State of Utah

Department of Environmental Quality

Dianne R. Nielson, Ph.D.
Executive Director

DIVISION OF RADIATION CONTROL
Dane L. Finerfrock
Director

JON M. HUNTSMAN, JR.
Governor

GARY HERBERT
Lieutenant Governor

July 20, 2006

Mr. Harold Roberts
Vice President – Corporate Development
International Uranium (USA) Corporation
1050 Seventeenth Street, Suite 950
Denver, CO 80265

Re: June 22 and 30, 2006 IUC Submittals Regarding June 14, 2006 DRC Round 2 Interrogatory for the Cell 4A Lining System Design Report: **DRC Review Findings and Request for Information - Round 4 Interrogatory.**

Dear Mr. Roberts,

We have reviewed your June 22 and June 30, 2006 submittals in response to the June 14, 2006 DRC Round 2 Interrogatory for the Cell 4A Lining System Design Report. We also acknowledge an on-site meeting held with DRC staff on July 11, 2006 wherein some of these issues were discussed. A Round 3 DRC Interrogatory was also provided to you under separate cover that focused on the cleanup of contaminated sub-grade soils beneath the former Cell 4A embankment.

The purpose of this Round 4 Interrogatory is to identify those issues and concerns related to cell design and re-lining that continue to be unresolved from the Round 2 Interrogatory. Similar to previous work, URS staff performed this review and prepared the Round 4 Interrogatory, which is attached for your consideration and resolution.

Five major issues continue unresolved from the Round 2 Interrogatory, including:

1. Cell 4A Soil Cleanup Report – which has yet to be submitted, and was the focus of the Round 3 Interrogatory.
2. GCL Freeze / Thaw Damage – including several engineering design options or measures that need to be taken to prevent or mitigate the impact of this damage on the long-term performance of the tailings embankment.
3. Revised Seismic Hazard Analysis – including more recent ground acceleration data and evaluation methods for Cell 4A.
4. Dike Stability Documentation – to demonstrate stability of the existing earthen dikes at Cell 4A.

5. Demonstration of Adequate Slimes Drain Performance and Leak Detection System Maximum Allowable Leakage Rate – including a quantitative evaluation of the ability of the slimes drain design to effectively remove fluids from the tailings cell in a timely and efficiently manner at closure. Also, additional information is required to justify the leak detection system maximum allowable leakage rate (ALR) and definition of pre-determined actions to control and mitigate a leak should the ALR be exceeded.

Certain other open issues have been identified which are new to the project, including:

6. GCL Field Hydration – including construction practices, procedures, methods, and Construction Quality Assurance/Quality Control (CQA/QC) testing to ensure that the GCL properly hydrates after emplacement.

7. Revised CQA/QC Plan – that includes pre-determined, clear, and discrete provisions to identify and rectify any design and construction deficiencies.

8. Backfill Compaction Requirements – including design and CQA/QC specifications for compacting soil and stone backfill materials that may be used.

9. Prevention of ATV Damage – including procedures and equipment needed to ensure that All Terrain Vehicles used to emplace the liner system will not damage it.

10. Clarification of Dike Stability – including resolution of certain inconsistencies in dike slopes.

11. Missing ALR Data and Calculations – including supporting data and calculations to justify ALR conclusions provided.

12. Adjustment or Justification of Certain Geonet Safety Factors – that account for certain phenomenon expected during and after construction

13. Calculation Corrections – regarding pipe strength and spillway designs.

After resolution of these open issues, it will be possible to move forward with issuance of a Construction Permit.

With regards to the agreed upon review schedule and budget, it is clear that a fourth round interrogatory was not contemplated during negotiation of our Memorandum of Agreement. Consequently, we suggest that a new schedule and budget be negotiated.

Also, it would appear that a conference call or meeting is in order to discuss the unresolved issues and chart a path forward. Please call me to arrange for such a meeting.

Sincerely,

Loren B. Morton

LBM:lm

cc: Britt Quinby, URS
Dave Frydenlund, IUC

F:/.../Rnd4TransLtr.doc
File: IUC Cell 4A Relining Project

URS

UTAH DIVISION OF RADIATION CONTROL
CELL 4A LINING SYSTEM
INTERNATIONAL URANIUM (USA) CORPORATION
WHITE MESA MILL
BLANDING, UTAH

INTERROGATORIES – FOURTH ROUND

URS

TABLE OF CONTENTS

Section Page

URS

Acronyms and Abbreviations

ALARA	As Low As Reasonably Achievable
BAT	Best Available Technology
CFR	Code of Federal Regulations
CQAP	Construction Quality Assurance Plan
DR	Design Report
DRC	Division of Radiation Control (Utah)
FML	Flexible Membrane Liner
GCL	Geosynthetic Clay Liner
HDPE	High Density Polyethylene
LCRS	Leachate Collection and Removal System
SDR	Standard Dimension Ratios
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TMP	Tailings Management Plan
TRDP	Tailings Reclamation and Decommissioning Plan
URCR	Utah Radiation Control Rules

URS

Summary of Requested Items

Please refer to the interrogatories for the context of the item requests.

The following items are ones that continue to be unresolved:

1. A Radiation Survey Report to demonstrate that the existing subgrade for Cell 4A has radiation and contamination levels that are acceptable.
2. Additional data and/or information that the GCL will be able to resist damage/degradation due to exposure to the leachate and freeze/thaw action. The response to Round 1 and 2 was incomplete. Included must be data on the potential impact of freeze/thaw on the GCL in the exposed portion of the liner system (i.e., the portion of the liner above the cell fluid level during operations with no confining pressure). Several options to address and resolve this issue are provided in the Interrogatory R313-24-4-03/04.
3. An up to date seismic hazardous analysis that includes recent data and evaluation methods.
4. Recent documentation that the cell dikes have maintained their integrity with time due to environmental factors such as erosion, subsidence, biointrusion, etc.
5. A Leachate Monitoring, Operations, Maintenance, and Reporting Plan that includes anticipated flow rates and maximum flow rates in the leachate collection layer (slimes collection layer). This is to include a demonstration that the tailings sands will settle out and function properly as a slimes drain layer without clogging and that the collection pipes are properly located and have the ability to remove the tailings solution in a reasonable time and manner. This plan shall also include the demonstration of the Action Leakage Rate and proposed response actions should the Action Leakage Rate be exceeded. Information provided to date is insufficient to adequately respond to this request.

The following items are ones where responses were provided by IUC that addressed the concern, but questions remain:

6. Included must be means and methods used prior to operation of Cell 4A that determine if the hydration of the GCL is adequate. The level must be comparable to the level of hydration of the GCL used in the acid resistance testing.
7. A revised Construction Quality Assurance Plan that includes a clear and concise description of the protocols for identifying and rectifying deficiencies in an upfront section.
8. Clarifications in either the CQAP, Technical Specifications, or on the Project Drawings regarding soil and stone backfill compaction requirements and the use of stone base for the concrete spillway.
9. Assurance and/or a demonstration that the use of the proposed ATVs will not adversely impact the integrity of the exposed liner.

10. Additional clarification on the evaluation of the stability of the cell dikes. There appears to be an inconsistency as to the steepness of the outside of the cell dike.
11. Data and calculations used to generate the plot of liquid levels that are anticipated in the cell during operation to the ALR.
12. Include an appropriate factor of safety, to account for uncertainties associated with the manner of installation of the geonet in the cell, or justification as to why it is not needed.
13. Correct minor inconsistencies identified in the pipe strength and spillway calculations.

URS

INTERROGATORY IUC R313-24-4-01/04: RADIATION SURVEY AND RELATED DEMONSTRATIONS

PRELIMINARY FINDING:

Refer to R313-24-1(3), R313-24-4, R313-15-501, R313-15-406, and 10 CFR 40 Appendix A, Criterion 5A(1); DRC rules require that a radiation survey be performed to demonstrate that the requirements of R313-15 are met, including the magnitude and extent of radiation levels and concentrations or quantities of radioactive material (see R313-15-501). DRC rules also require IUC to describe "... how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment,..." (see R313-15-406). R313-24-4 and 10 CFR 40 Appendix A, Criterion 5A(1) require that for uranium tailings impoundments where wastes have migrated into the liner during the active life of the facility, that closure of said impoundment must include "...removal or decontamination of all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate."

Refer to R317-6-6.3(Q); "Unless otherwise determined by the Executive Secretary, the application for a permit to discharge wastes or pollutants to ground water shall include the following complete information:... Q. Other information required by the Executive Secretary."

Also refer to R317-6-6.4(A); IUC must provide information that allows the Executive Secretary to determine:..."3. the applicant is using best available technology to minimize the discharge of any pollutant;...".

INTERROGATORY STATEMENT:

Per Round 3 Interrogatory please provide a revised report/plan that includes:

1. *Site characterization data that defines the nature and extent of the U nat, Th-230, and Ra-226 contamination in Cell 4A. This is to include survey and sample results, their respective locations (marked on a drawing), the sample depths, and operational information that supports the identification of areas as potentially contaminated (or not impacted).*
2. *In place of the modeling effort to derive the clean up levels for uranium and thorium, the use of 30 pCi/g levels as the clean up criteria for natural uranium. This criteria would be combined with 5 pCi/g for Ra-226 averaged over in the upper 15 cm (6-inches) of soil, and 15 pCi/g averaged over a 15 cm thick layer of soils more than 15 cm below the surface. This is consistent with the approach recommended in the USNRC Branch Technical Position Paper "Guidelines for Residual Concentrations of Thorium and Uranium Waste in Soil" (USNRC 1981). In addition, the uranium can be used as an indicator for other metals that may have an impact on groundwater, which is consistent with item number 43 on page 48 of the Draft December 1, 2004 Statement of Basis for the Ground Water Quality Discharge Permit for the site.*

3. *Complete set of background data results, analytical methods used, sample locations shown on a map, sample depths, and an evaluation that justifies, demonstrates, and establishes the background levels to be used.*

4. *A revised methodology to identify elevated levels of contamination (above the clean up criteria) and confirm that it has been removed to the respective clean up levels. This includes means for justifying that sufficient samples have been collected at appropriate locations and they are representative of the area to be evaluated (i.e., released). This would include radiation measurement surveys of the soil surface and soil sampling at discrete depths and locations to define the vertical profile of the contamination (i.e., soil samples from 0 to 15 cm and from 15-cm and below) by location. These results would be used to support the basis for identifying areas as contaminated (impacted), or not impacted and in support of a sampling and survey strategy to be implemented during remediation and for the final confirmation survey and sampling to demonstrate that the contamination has been removed to levels consistent with the clean up criteria. Typically, the amount of sampling required for the areas not impacted is less than needed for the contaminated areas. Also, the sample analysis performed needs to be defined. For the characterization portion there is flexibility in the methods to be used. However, the laboratory used for the final status survey/sampling will be approved by the State of Utah for the respective analytical methods. In addition, the DRC must be notified at least 30 days in advance of performing the final status survey so as to allow for a representative to be onsite and collect split samples if so desired. The MARSSIM guide referenced in the "Basis for Interrogatory" provides one means for designing characterization, remedial, and final status survey/sampling.*

BASIS FOR INTERROGATORY:

It is clear that the former liner system in Cell 4A did not meet the requirements of 10 CFR 40 Appendix A, Criterion 5A(1); in that it did not "...prevent wastes from migrating into the liner during the active life of the facility." It is also clear that both waste residues in Cell 4A, the liner, contaminated subsoils, and structures and equipment contaminated with waste and leachate need to be removed (ibid.). Prior to the installation of the new liner system, IUC needs to demonstrate that the existing subgrade has radiation levels that are acceptable. IUC had previously submitted the results of a preliminary radiation survey, and on June 6, 2006, provided a (Draft) "Cell 4A Contaminate Removal Work Plan Schedule" for informal DRC review. This plan presented the proposed clean up criteria in soil for Ra-226, U-238, and Th-230, and the methodology to be used to confirm that the respective clean up criteria are met in the cell subgrade prior to the initiation of Cell 4A liner construction.

The DRC provided IUC with comments on the proposed clean up plan in Round 3 Interrogatories and requested a revised plan/report that includes the information and data discussed in the Interrogatory Statement above.

This request was followed by a teleconference on this topic on June 19, 2006 between the DRC, URS and IUC. Further, IUC's June 30, 2006 (Part 2) response to Round 2 Interrogatories stated that a justification for sampling frequency based on categories of low, medium and high possibilities for the presence of residual contamination in the Cell 4A area will be submitted under a separate cover. However, please note that the submittal provided is to be a complete clean up plan/report that addresses and includes all the information in items 1 through 4 of the Interrogatory Statement above. Other than the informal draft, nothing on this plan (or report) has been received.

REFERENCES:

Letter from IUC to UDRC dated May 8, 2006; Re: Cell 4A Lining System Design Report, Response to URS Completeness Review,

October 18, 2005 DRC letter to IUC (request for additional information).

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.

INTERROGATORY IUC R313-24-4-02/04: DOUBLE LINER SYSTEM

PRELIMINARY FINDING:

Refer to R313-24-4, 10 CFR 40 Appendix A, Criterion 5A(1): Surface impoundments must have a liner that is designed, constructed, and installed to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil, ground water, or surface water at any time during the active life (including the closure period) of the impoundment. The liner may be constructed of materials that may allow wastes to migrate into the liner (but not into the adjacent subsurface soil, ground water, or surface water) during the active life of the facility, provided that impoundment closure includes removal or decontamination of all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate. For impoundments that will be closed with the liner material left in place, the liner must be constructed of materials that can prevent wastes from migrating into the liner during the active life of the facility.

Refer to R317-3-1(1.7). 1.7. Construction Supervision. The applicant must demonstrate that adequate and competent inspection will be provided during construction. It is the responsibility of the applicant to provide frequent and comprehensive inspection of the project.

Refer to R317-3-10(4)(E). E. Construction Quality Control and Assurance. A construction quality control and assurance plan showing frequency and type of testing for materials used in construction shall be submitted with the design for review and approval. Results of such testing, gradation, compaction, field permeability, etc., shall be submitted to the executive secretary.

INTERROGATORY STATEMENT:

Please include in an upfront section of the QACP protocols for identifying and rectifying any deficiencies.

In review of the technical specifications and drawings for quality control requirements, the following concerns were identified that need to be included or addressed in either the CQAP, drawings, or the specifications:

1. *Section 1.04 of Specification section 03400 (Submittals) requires that the 28-day compressive strength test results be submitted 7 days prior to construction of the spillway. The 28-day compression tests should be derived from samples of the concrete actually provided, and collected from the source (e.g., the truck chute during placement). The frequency should be a minimum of one sample per 150 cubic yards of concrete used.*
2. *Part 2 (Products) of Specification Section 03400 includes requirements for mix design, concrete, and steel. However, no product requirements for the aggregate to be used are provided. Please provide aggregate product requirements.*

3. *Please include in Section 3.02 of Specification Section 03400 (Subgrade Preparation) subgrade compaction requirements. Also, please confirm and demonstrate that the subgrade materials be suitable as a base for the concrete? Concrete pavement and slabs are typically placed on a compacted stone base. Since the berm perimeter access road will traverse this spillway, it will need to function as road pavement and have a stable base/subase.*

4. *Correct the reference to Table 1A in the text of section 7.2.1. It is currently referenced as Table 1.*

5. *Please include in either the CQAP, Technical Specifications, or on the drawings compaction requirements for the soil and stone backfill materials to be placed. This includes the drainage aggregate, anchor trench backfill, and any subgrade material that are placed to make the proposed grade as needed. The compaction requirements must include the method of compaction per soil type, lift thickness, frequency of testing, and test methods.*

BASIS FOR INTERROGATORY:

The applicant proposes to use a double liner with leak detection in order to prevent migration of wastes out of the impoundment (Cell 4A Lining System Design Report). The liners will be constructed of 60 mil High-Density Polyethylene (HDPE). The applicant has provided a Design Report (Cell 4A Lining System) that contains an introduction (summary), design drawings, Construction Quality Assurance Plan, Technical Specifications, existing berm (dike) and clay liner construction documentation, and design calculations. The applicant indicates that the double liner with the leak detection system design is the Best Available Technology (BAT).

Construction Quality Assurance Plan (CQAP)

The initial review of the CQAP resulted in a request for clarification in Round 1 Interrogatories on specific issues relating to the lines of communication and protocols for identifying and rectifying deficiencies. Also, that the engineer of record be an independent party. IUC's response to this interrogatory provided clarification on certain responsibilities between the Construction Manager and the Geosynthetic Installer as they relate to acceptance of the geomembrane installation for the cell. However, no mention was made in the response of the respective lines of communication and protocols for other aspects of the liner system installation (i.e., GCL, earthwork, geonet, etc).

IUC included with their June 22, 2006 response to Round 2 Interrogatories (Part 1) a revised CQAP that includes Section 2.11 that addresses the project lines of communication. However protocols for identifying and rectifying deficiencies are not included in this new section.

The revised CQAP also includes the following corrections or clarifications requested in the Round 2 Interrogatories:

- *Correct section listing contained in Section 1.4.*
- *Section 2.8 is corrected to state that the CQA Officer is independent from the Owner.*
- *Section 14.1, Survey Control (previously Section 13.1), was corrected to state "by the Land Surveyor as needed", in place of "by the Construction Manager as needed."*

Project Technical Specifications

A section on the concrete spillway was also included in the revised plan (Section 13.0). However, this section refers back to the technical specifications and drawings for quality control requirements. In review of the technical specifications and drawings for quality control requirements, the following concerns were identified that need to be included or addressed in either the CQAP or the specifications:

1. *Section 1.04 of Specification section 03400 (Submittals) requires that the 28-day compressive strength test results be submitted 7 days prior to construction of the spillway. The 28-day compression tests must be derived from samples of the concrete actually provided, and collected from the source (e.g., the truck chute during placement). The frequency should be a minimum of one sample per 150 cubic yards of concrete used.*
2. *Part 2 (Products) of Specification section 03400 includes requirements for mix design, concrete, and steel. However, no product requirements for the aggregate to be used are provided.*
3. *Section 3.02 of Specification section 03400 (Subgrade Preparation) needs to include subgrade compaction requirements. Also, will the subgrade materials be suitable as a base for the concrete? Concrete pavement and slabs are typically placed on a compacted stone base. Since the berm perimeter access road will traverse this spillway, it will need to function as road pavement and have a stable base/subase.*

In addition, it was noted that Table 1A is referenced in the text of section 7.2.1 as Table 1. This inconsistency should be corrected. Also, in review of the revised drawings, CQAP, and Technical Specifications, it was noted that there are no compaction requirements for the soil and stone backfill materials to be placed. This includes the drainage aggregate, anchor trench backfill, and any subgrade material that are placed to make the proposed grade as needed. The compaction requirements must include the method of compaction per soil type; lift thickness, frequency of testing, and test methods.

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.

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.

INTERROGATORY IUC R313-24-4-03/04: LINER STRENGTH & COMPATIBILITY

PRELIMINARY FINDING:

Refer to R313-24-4, 10 CFR 40 Appendix A, Criterion 5A(2)(a): The liner must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;

INTERROGATORY STATEMENT:

As requested in Round 2 Interrogatories, please provide methods to be used to ensure that the GCL will hydrate to the desired level prior to the start of cell operations. This must include assurance through testing that the subgrade soils have sufficient moisture and will facilitate the migration of water from the soil to the GCL in a timely manner.

As stated in Round 2 Interrogatories, the levels of expected GCL hydration must be compared with the levels of hydration of the GCL specimens used by Ruhl and Daniel as well as GCL specimens that were tested by Kolstad et a.l 2004 for conventional non-prehydrated GCLs tested against acidic liquids (the latter reference source was previously cited in the Round 1 Interrogatories). Are the levels of expected GCL hydration comparable to the levels of GCL hydration of the samples used in the acid resistance testing? The results and conclusions must be presented in a framework that demonstrates that the reported test data (i.e., GCL degree of hydration) are applicable to the range of the expected GCL hydration based on site conditions.

*As previously requested in Round 1 and Round 2 Interrogatories, Please provide an evaluation of the GCL and its ability to perform under all anticipated conditions (**Particularly where it is exposed to freeze/thaw without cover or confining pressure**). All evaluations provided to date in support of the GCL's resistance to freeze/thaw have the GCL under a soil or liquid cover. Alternatives to providing this evaluation are presented in the Basis for Interrogatory below.*

Please provide assurance and/or a demonstration that the proposed use of All Terrain Vehicles (ATVs) on the liner system will not adversely impact the integrity of the liner. The respective limitation of equipment use on the liner system must be included as part of the project specifications (that are included with the current application).

BASIS FOR INTERROGATORY:

As stated in Round 1 Interrogatories, to meet the regulatory requirements referenced for the cell liner system, the liner system materials (HDPE, GCL, clay, geonet, fabric, granular material, piping, extraction and monitoring equipment, etc.) need to be compatible with leachate so as not to compromise the integrity if the system.

In IUC's May 8, 2006 response to the completeness review IUC provided supporting technical information on the compatibility of the liner system materials with the cell leachate (or tailing cell solution). In response to this submittal, the DRC included in Round 1 Interrogatories a request for current site-specific information, test data, and/or studies on the current and anticipated chemical and physical characteristics of the leachate. This was done so that a comparison could be performed of the constituents in (including the organic ones), and characteristics of, the cell solution to the respective technical data.

IUC responded to the Round 1 Interrogatory by providing inorganic test results of the tailing cell solution from September 4, 2003. Current results from 2005 and/or 2006 were not provided, nor were any results on organic constituents. Also, no discussion was included on the results being representative of anticipated chemical and physical characteristics of the tailings cell solution.

Round 2 Interrogatories expressed concern that organic compounds in the cell solution could have an adverse impact on the liner system (refer to Round 2 Interrogatories for the listing). To address this concern, the DRC requested in Round 2 Interrogatories that IUC provide either a quantitative evaluation that addresses the long-term resistance of all the liner system components to the tailings cell solution, or perform liner compatibility studies to demonstrate this long-term resistance. The primary liner components of concern are the HDPE flexible membrane liner and the GCL.

Compatibility of Flexible Membrane Liner with Tailings Solution

In IUC's June 30, 2006 response to this request, IUC provided a general explanation and references to support HDPE resistance to acidic solutions and organic solvents (similar to what had already been provided). Also included in this response was a general statement that only trace amounts of synthetic organic chemicals are found in the tailings solution at the White Mesa Mill. However, no supporting data on the organic chemical content and/or relative concentrations of the tailing solutions was provided. Chemical analysis of the tailings solution that includes the concentration of the organic chemicals referenced above could be used to compare against the respective material resistance information provided in the literature referenced, and therefore support a quantitative evaluation. However, historic data available on the concentrations of organic constituents in tailings solution indicate that when present, they are at concentrations much lower than would impact the HDPE. This combined with the consideration of the robust nature of HDPE as a liner material satisfies this concern.

Hydration of GCL

Due to the significance of hydration on the ability of the GCL to sustain a low hydraulic conductivity, Round 2 Interrogatories requested that IUC must provide data (e.g., a plot) indicating approximate predicted levels of hydration of the GCL expected to occur over time based on the GCL being in direct contact with the subgrade materials present 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 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) when placed in direct contact with sand having various moisture contents ranging from 1% to 17%. The data indicate that the bentonite moisture content would increase to about 140% after 15 days and would increase further to the range of 150% to 200% after about 45 days if the bentonite side of the GCL were placed in contact with sand at 10% or greater moisture content. On-site dike soil and compacted clay liner soil moisture contents are reported to be in the range of 13% to about 18.6 %.

Although data furnished for the bentonite component of a GCL are for a GCL (Gundseal®-type) that is not the same type of GCL that is specified for use in Cell 4A, analogous data (Daniel 1994) are available for the same general type of GCL (two Claymax® GCLs, having thin and thick geotextile backings) that would be used in Cell 4A. Those data indicate lower moisture contents for bentonite in the GCL (in the range of 50% to 80%) after 15 days of contact with sands in the same moisture content range as that addressed by the IUC data (about 10% to 15%), but moisture contents in same range to slightly higher than those reported above for the Gundseal-type GCL after about 42 days for contact with the same sand materials. This information suggests that if at least 42 to 45 days are allowed to transpire between GCL placement in the Cell 4A liner system and placement of the cell into active service, the GCL should hydrate to about 150 % to 200 % or more if the subgrade materials in contact with the GCL exhibit in-situ moisture contents of at about 10% or greater.

Based on the above information, IUC must be able to demonstrate the GCL will hydrate to the desired amount prior to operation. Since the hydration is dependent on the moisture content of the underlying subgrade soils, this includes assurance that there is sufficient moisture available in the soil prior to GCL placement, and that the soil type will facilitate the transfer of the moisture to the GCL (i.e., clay, silts, or silty-sands; not gravel) prior to the operation of the cell. Note that the operation of the cell will be dependent on establishing the integrity of the liner system, which includes the proper hydration of the GCL so it will be resistant to acidic solutions.

Round 2 Interrogatory also requested the following:

> *"...The(se) levels of expected [field] GCL hydration should be compared with the levels of hydration of the GCL specimens used by Ruhl and Daniel as well as compared to the levels of hydration (moistening) of the GCL specimens that were tested by Kolstad et al. 2004 for conventional non-prehydrated GCLs tested against acidic liquids (the latter reference source was previously cited in the Round 1 Interrogatories). The results and conclusions should then be presented in a framework that demonstrates that the reported test data are applicable to the range of the expected site conditions."*

This request is repeated here; IUC must specifically compare the ranges of expected GCL hydration levels (that are described above) to the level(s) of GCL (pre-) hydration that were established for those GCL specimens that were tested in laboratory to assess the effects of aggressive acidic leachates on GCL hydraulic conductivity (for which the GCLs were not significantly adversely affected), relative to laboratory tests that were

performed that exposed these aggressive chemicals to non- pre-hydrated GCL specimens (for which the GCL specimens were significantly negatively affected). This comparison is important for assessing the comparability of the expected GCL field hydration levels to those tested that applied to those GCL specimens tested in the laboratory that were not adversely affected by the acidic leachate. This comparative information needs to be provided.

Freeze/Thaw Action on GCLs

Included in round 1 interrogatory was a discussion on the concern of freeze/thaw action on the GCL under little to no confining pressure:

> *"Other potential impacts to the GCL could result from exposure to multiple freeze/thaw cycles and from inadvertent and undetected damage during installation. Portions of the liner system will be exposed above the liquid/tailings level in the cell for an extended period of time. During this time the liner system will be not be covered (have very little to no confining pressure) and be exposed to multiple freeze/thaw cycles. As indicated in the literature cited above, GCLs subjected to freeze/thaw cycles under little to no confining pressures (no cover) could heave such that the hydraulic conductivity will increase. Assurance is needed that this action will not result in an unacceptable increase in the performance of the GCL (i.e., in a hydraulic conductivity greater than 1.0x 10^{-7} cm/sec). Inadvertent damage of a GCL during installation could result in a breach of this layer that is more detrimental to the performance of the liner system than inadvertent damage to a 12-inch thick layer of clay. Therefore, the evaluation of the GCL and its ability to perform under the all anticipated conditions an important aspect of ensuring liner system performance."*

This provided the basis for a request for more information on the GCL's ability to resist freeze/thaw. In response to Round 1 Interrogatories IUC included reference to a recent article (Podgornery, 2006) on the long-term impact of freeze/thaw on the GCL. However, the referenced article provides an evaluation for the condition where the GCL has a confining pressure such as with a liner or cover that has 5 to 15 feet of liquid over it. As stated above, the concern is over the portion of the liner that is exposed, and not covered by the solution/tailings during operation. Therefore, the same request for an evaluation of the GCL and its ability to perform under all anticipated conditions (including where it is exposed to freeze/thaw ***without cover or confining pressure****).*

IUC reiterated in their June 30, 2006 response to Round 2 Interrogatories the same claims that GCL is more resistant than compacted clay to freeze/thaw and cited a reference previously supplied (Nelson 1993). However, as with "Podgornery, 2006" the testing performed by Nelson involved the GCL under a confining pressure. The confining pressures used by Nelson were less than those used by Podgornery, and simulated a soil cover from 4-inches to 6-feet in thickness.

Since IUCs responses provided to date have not yet been sufficient to completely address this issue, an evaluation of the GCL and its ability to perform under all anticipated

conditions (including where it is exposed without confining pressure) must be provided. Potential alternatives that could address this concern include:

1. *The portion of the cell liner that may be exposed during operation could be covered with no less than 1-foot of compacted soil. This would function to protect the exposed liner as well as to provide confining pressure.*
2. *The portion of the cell liner above the average water level (portion that is exposed) could incorporate 1-foot of clay in place of the GCL.*
3. *Limit the disposal of tailings to the portion of the cell where the liner was not exposed.*
4. *Modeling may be able to demonstrate that damage to the portion of the GCL in question (on the upper side slope) will not impair the effectiveness of the cell to contain the tailings and any solution/leachate present.*
5. *Include an FML in the final cover system of the closed tailings cell. This would function to decrease the permeability of the cover and the potential for moisture to enter the cell.*

Stresses Imposed on the Liner System

Also included in Round 1 and Round 2 Interrogatories was the following request:

> *"Please provide detailed procedures that IUC will follow during installation of the cell liner system and operation of the cell during tailings placement that will limit the stress applied to the liner system to acceptable levels. For liner installation these procedures shall include provisions that no construction loads be placed on the side slope liner system, and during operation they are to include tailings placement procedures that will also limit stress to the side slope liner. The respective detailed procedures for liner installation shall be included as part of the project construction specifications. The respective detailed procedures covering the operation of the cell shall be included in the Cell 4A Operations and Maintenance Procedures and Plan, and Best Available Technology Monitoring Plan.*
>
> *As an alternative to providing the detailed procedures requested (in the paragraph) above, a justification for the liner system design that accounts for typical construction loads and potential loads due to tailings placement on the side slopes can be provided."*

In the June 30, 2006 response to Round 2 Interrogatories IUC stated;

> "...traffic into the cell will be restricted to foot traffic or low ground pressure vehicles, such as a one-person ATV. After competition, at no time will construction or earthmoving equipment or pickup trucks be allowed on the cell liner."

In IUC's May 8, 2006 response to Round 1 Interrogatories it was stated that no construction loads would be placed on the side slope liner system components. If ATV's are to be used on the liner system, please provide assurance and/or a demonstration that

they will not adversely impact the integrity of the liner. This is particularly critical on the cell side slopes.

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.

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

IUC May 1999, Groundwater Information Report for White Mesa Uranium Mill.

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.

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.

U.S. Nuclear Regulatory Commission, Standard Review Plan for Review of DOE Plans for Achieving Regulatory Compliance at Sites With Contaminated Ground Water Under Title I of the Uranium Mill Tailings Radiation Control Act, Draft Report for Comment, NUREG-1724, June 2000.

INTERROGATORY IUC R313-24-4-04/04: LINER SETTLEMENT

PRELIMINARY FINDING:

Refer to R313-24-4, 10 CFR 40 Appendix A, Criterion 5 A(2)(b): The liner must be placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift.

INTERROGATORY STATEMENT:

This request has been satisfied.

BASIS FOR INTERROGATORY:

Both Round 1 and Round 2 Interrogatories stated that the license application has not provided for review a complete evaluation of potential differential settlement on the bottom verses side slopes of the liner due to anticipated loads during operations and after final closure.

IUC's June 30, 2006 response to Round 2 Interrogatories included a settlement evaluation that estimated the differential settlement between a point under the berms and a second point under the tailings within the cell (120-feet from the berm). It appears that the evaluation estimates the settlement due to the load of the tailings (and berm) at discrete depths up to 400 feet. However, it is our understanding that soil overburden under Cell 4A is limited to less than 5-feet, under which there is bedrock (Dakota Sandstone). In consideration of this, the estimated settlement would be limited to the upper layer of overburden, and due to the nature of this overburden soil, it is anticipated that the resultant settlement would be insignificant. Therefore, since the evaluation provide is conservative, and the results are well within a range of acceptable differential settlement, this request has been satisfied.

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.

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.

INTERROGATORY IUC R313-24-4-05/04: DIKE INTEGRITY

PRELIMINARY FINDING:

Refer to R313-24-4, 10 CFR 40 Appendix A, Criterion 5A(5): When dikes are used to form the surface impoundment, the dikes must be designed, constructed, and maintained with sufficient structural integrity to prevent massive failure of the dikes. In ensuring structural integrity, it must not be presumed that the liner system will function without leakage during the active life of the impoundment.

INTERROGATORY STATEMENT:

Please address the following concerns on the stability of Cell 4A dikes:

1. *This slope stability evaluation models the exterior slope as 3H:1V. However, the calculation entitled "Settlement Evaluation of Berms" dated June 6, 2006 and provided with IUC's response to Round 2 Interrogatories indicates that there are exterior berm slopes of 2H:1V. Please clarify this inconsistency, and if there are exterior slopes of 2H:1V, then they need to be considered in the slope stability evaluation.*
2. *As previously stated in Round 2 Interrogatory, the seismic loading used (0.10g) is based on an evaluation of seismic activity and impacts from the 1970s and 1980s and is based on a dated evaluation. A more recent evaluation based on current data and methods needs to be performed.*
3. *Please provide evidence that the current extent of erosion, subsidence, biointrusion or other forces have not altered the dike, originally constructed in 1989, so that long-term structural integrity maybe ensured. State the extent to which erosion, subsidence, biointrusion, or other forces have altered the dike since it was originally constructed. State inspections, maintenance and/or repairs conducted to date including documentation developed, such as logs, data, and inspection reports.*

BASIS FOR INTERROGATORY:

Appendix D of the design report presents documents from the original construction of the dike on the west and south sides of Cell 4A. However, this information is inadequate to conduct a detailed review of the license and to meet the regulatory requirements. Information is needed as to how the dike has been maintained or will be re-constructed to meet the requirements for structural integrity during the active life of the impoundment.

IUC's May 8, 2006 response to URS Completeness Review did provide an evaluation of the stability of the original Cell 4A dikes. This evaluation considered two slopes and used a seismic loading of 0.10g. The indication was that the slopes evaluated were 3H:1V, and they are the highest. However, the design report does indicate the presence of a 2H:1V slope on the west side of Cell 4A. Due to the presence of the 2H:1V slope, it is uncertain if the slopes evaluated are the most critical.

In response to this request a revised dike stability analysis was received from IUC (June 9, 2006), and the basis for the 0.10g seismic loading was also provided. The slope stability analysis evaluated the southern Cell 4A berm, and defined it with a 2H:1V interior slope and a 3H:1V exterior (outside) slope. It identified the critical slope as the interior 2H:1V slope under both static and dynamic conditions. It also evaluated the lined and unlined conditions, and due to the installation of a double liner and drain system discounted the unlined condition. However, the following concerns have been identified:

1. *This slope stability evaluation models the exterior slope as 3H:1V. However, the calculation entitled "Settlement Evaluation of Berms" dated June 6, 2006 and provided with IUC's response to Round 2 Interrogatories indicates that there are exterior berm slopes of 2H:1V. This needs to be clarified, and if there are exterior slopes of 2H:1V, then they need to be considered in the slope stability evaluation.*

2. *The evaluation takes credit for the double liner and drain system within the cell. Therefore, it is important to note that as long as the liner and leak detection system function as designed (i.e. effective leachate barrier and collection system), and the dikes do not become impacted with solution/leachate, this is valid. However, if the integrity of the liner system is in question (i.e., the ALR is exceeded) the Executive Secretary may require the installation of piezometers in the dikes to monitor groundwater elevations to ensure there is not seepage of tailings solution (release) into the dikes that may impact the integrity of the berms.*

3. *The seismic loading used (0.10g) is based on an evaluation of seismic activity and impacts from the 1970s and 1980s and is dated. A more recent evaluation based on current data need to be performed. This was discussed during a teleconference with IUC and as a result, URS and the DRC provided in a June 23, 2006 email a scope of what an updated seismic hazardous analysis would include. Sample papers (Wong 1996 and Wong 1997) were also provided to illustrate what a typical analysis of this type includes.*

   IUC's provided in their June 30, 2006 response to Round 2 Interrogatories a discussion of how the 1996 seismic hazardous analyses (Wong 1996) supported the use of 0.10g and the outdated analysis. Please note that the results of an revised updated analysis my result in a seismic loading consistent with the 0.10g value. However, the concern is that there is new more recent data that needs to be reviewed and evaluated as it relates to the White Mesa site, and from this evolution the appropriate seismic loading value determined.

No recent evidence that the current extent of erosion, subsidence, biointrusion or other forces have not altered the dike, originally constructed in 1989, that documents long-term structural integrity is ensured have been provided as requested in both Round 1 and Round 2 Interrogatories. State the extent to which erosion, subsidence, biointrusion, or other forces have altered the dike since it was originally constructed. State inspections, maintenance and/or repairs conducted to date including documentation developed, such as logs, data, and inspection reports.

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.

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.

Wong, Ivan G., Olig, Susan S., and Bott, Jacqueline D.J. 1996. Earthquake Potential and Seismic Hazards in the Paradox Basin, Southeastern Utah. 1996 Utah Geological Association Guidebook, pages 241 to 250.

Wong Ivan G., Olig, Susan S., Hassinger, Bruce W., Blubaugh, Richard E. 1997. Earthquake Hazards in the Intermountain US: Issues relevant to uranium mill tailings disposal. Tailings and Mine Waste 1997, pages 203 to 212.

INTERROGATORY IUC R313-24-4-06/04: BEST AVAILABLE TECHNOLOGY

PRELIMINARY FINDING:

Refer to R313-24-4, R317-6-1.13: ***Best Available Technology*** *means the application of design, equipment, work practice, operation standard or combination thereof at a facility to effect the maximum reduction of a pollutant achievable by available processes and methods taking into account energy, public health, environmental and economic impacts and other costs.*

Refer to R313-24-4, R317-6-6.4(A)(3/112): The Executive Secretary may issue a ground water discharge permit for a new facility if the Executive Secretary determines, after reviewing the information provided under R317-6-6.3, that: 1.the applicant demonstrates that the applicable class TDS limits, ground water quality standards protection levels, and permit limits established under R317-6-6.4E will be met; 2. the monitoring plan, sampling and reporting requirements are adequate to determine compliance with applicable requirements;3. the applicant is using ***best available technology*** *to minimize the discharge of any pollutant; and 4. there is no impairment of present and future beneficial uses of the ground water.*

INTERROGATORY STATEMENT:

As requested in Round 1 and Round 2 Interrogatories, Please provide a Leachate Monitoring, Operations, Maintenance, and Reporting Plan that includes an estimate of the anticipated flow rates and maximum capacity in the leachate collection system (slimes collection layer). This estimate must include a calculation that:

- *Estimates the flow rate of the tailings cell solution through the tailings and into the collection pipes.*
- *A demonstration that the sand fraction will settle out and provide an adequate slimes drainage layer or the inclusion of a drainage layer over the primary liner that is properly designed and will function to effectively remove the tailings solution in a timely manner. Also, this sand drainage layer needs to be properly designed so that tailings fines will not filter into it and result in the clogging of the sand layer (restricting flow in this drainage layer), and that the proposed collection pipe layout is adequate to collect and remove the leachate solution.*

The Leachate Monitoring, Operations, Maintenance, and Reporting Plan shall also include proposed response actions to take if the Action Leakage Rate is exceeded.

Please provide the following information to support the determination of an appropriate Action Leakage Rate for the Cell 4A lining system. This information must be included as part of the Leachate Monitoring, Operations, Maintenance, and Reporting Plan.

1. *The corresponding calculations and listing of data generated and used as the basis of the plot of the ALR verses the head of liquid above the primary liner.*

2. *A revised Action Leakage Rate (ALR) Calculation to account for uncertainties associated with the manner of geonet installation and other factors (listed in the Basis of Interrogatory) within Cell 4A, or a justification as to why the respective factors need not be considered.*

As requested in Round 2 Interrogatory, further review of the design calculations revealed some inconsistencies that should be addressed. Please provide the following revisions or additional information so that the design calculations are consistent:

1. *A revised Pipe Strength Calculation that provides a consistent value for the PVC pipe ring deflection (page 5 of 6, contains a different value than that calculated on page 3 of 6). It appears that the calculation was revised and the ring deflection indicated in the narrative on page 5 of 6 was not updated*
2. *A revised Emergency Spillway Concrete Pavement Calculation that provides a consistent value for the slab bending moment due to the applied wheel load (page 3 of 5 contains two inconsistent values for this parameter compared with Attachment C). What about consideration of a significantly heavier piece of equipment traveling over the spillway such as may occur during construction or future cell development? All of the information contained on the final page of this calculation (drawing sheet 7 of 7) is not visible due to the fact that the original measured 11" x 17" and was copied as letter size; please provide a legible reproduction. Also, the date on this drawing (November 2005) is not consistent with the date of the latest revision to the Size D drawings (dated January 2006).*
3. *A revised Spillway Capacity Calculation that provides a formal list of references utilized in the document. The calculation should also include additional documentation of assumptions in regard to the size and flows off/from Cells 2 and 3, or the respective reference (e.g., if included in the Annual Technical Evaluation Reports).*

BASIS FOR INTERROGATORY:

For waste cell liner systems as proposed for Cell 4A, the State of Utah considers BAT to be a double liner with leachate collection/detection systems. For Cell 4A, this was defined in Round 1 Interrogatory. Round 1 and 2 Interrogatories expressed concerns about different aspects of the liner system. Specifically ones concerning the GCL, the ability of the slimes drain to remove tailing solution in a timely manner, the ALR, and some miscellaneous design calculations.

GCL

The Round 1 Interrogatory included the following request:

> *"Please provide additional information to demonstrate, for the anticipated site conditions, that the proposed width of longitudinal GCL panel overlap (12 inches) is adequate to prevent the possibility of separation gaps occurring between individual GCL panels after field placement of the GCL panels."*

IUC's provided the following in their May 26, 2006 response:

"Current industry standard of practice is to install adjacent geosynthetic clay liner (GCL) panels on side slopes with a minimum 6-inch overlap. When the liner system is to remain exposed, the industry is moving towards a 12-inch overlap, as recommended by Thiel, et. al., 2005. In addition, for the following reasons, the amount of GCL separation is not expected to be greater than 12 inches:

- The GCL to be used in the Cell 4A project will have a woven geotextile component that will minimize the potential for tension developed necking in the GCL.
- A white surfaced geomembrane will be installed to limit temperature changes within the exposed liner system components.
- Two geomembrane layers and one geonet layer installed overlying the GCL will provide some temperature insulation for the underlying GCL.
- The side slopes are not considered steep (greater than 2H:1V) and will therefore have less tension developed necking in the GCL."

The first bulleted item in the response states that the GCL will incorporate a woven geotextile component that will minimize the potential for tension-developed necking in the GC, and Round 2 Interrogatories requested that Section 02772, Geosynthetic Clay Liner, of the Project Specifications include specific requirements regarding the type(s) of geotextile backing required for the GCL.

IUC's June 22, 2006 response to Round 2 Interrogatories include a revised Technical Specifications that includes a requirement in Section 02772 (GCL), Part 2.01 (Material Properties) that the GCL used shall have a woven geotextile backing component on one side and a non-woven geotextile backing component on the other side. Part 3.03 of that Specification Section has also been revised to include a requirement that the GCL be installed with the woven geotextile side facing upward (facing the overlying geomembrane). Based on these changes, IUC's response to this item is acceptable.

Slimes Drain Layer

Also included in Round 1 Interrogatory was the following request:

> *"Please provide a Leachate Monitoring, Operations, Maintenance, and Reporting Plan that includes an estimation of anticipated flow rates and maximum capacity in both the leachate collection and detection systems."*

IUC's response to Round 1 Interrogatories did not include a Leachate Monitoring, Operations, Maintenance, and Reporting Plan and indicates that the respective flow rate information is included in the evaluation of the Action Leakage Rate (reference IUC's May 24, 2006 submittal). However, only the flow in the leak detection system is included as part of this evaluation. Also, IUC's included the following in response to a request for clarification on the slime drain layout included in the drawings:

"The slimes drain system is installed in a manner that provides drainage of the low point of the cell and is design to aid in dewatering of the slimes fraction of the tailings solids. The tailings will be placed into the Cell along the north, northwest and

northeast sides of the Cell. The sand fraction will settle out first near the point of discharge and the finer grained material will eventually settle in the pool area of the Cell. The sand fraction of the tailings solids will drain faster than the slimes fraction, therefore extending the drain in to those areas will provide little or no additional benefit. The slimes drain layout proposed for Cell 4A is approximately three (3) times larger than the systems installed in the other cells."

In response, Round 2 Interrogatories included the following clarification of this request:

"Please provide a Leachate Monitoring, Operations, Maintenance, and Reporting Plan that includes an estimate of the anticipated flow rates and maximum capacity in the leachate collection system (slimes collection layer). This estimate must include a calculation that:

- *Estimates the flow rate of the tailings cell solution through the tailings and into the collection pipes.*
- *A demonstration that the sand fraction will settle out and provide an adequate slimes drainage layer, this sand drainage layer is properly designed so that tailings fines will not filter into it and result in the clogging of the sand layer (restricting flow in this drainage layer), and that the proposed collection pipe layout is adequate to collect and remove the leachate solution."*

IUC included in their June 30, 2006 response to Round 2 Interrogatories with a general explanation that stated the sand will settle out to the bottom of the cell prior to the fines settling, thereby resulting in a drainage layer (as was previously communicated in the May 24, 2006 response), the strip drain will be wrapped in geotextile to keep out fines, and the PVC pipe will have gravel bedding wrapped in geotextile that will also keep the fines out of the pipe. However, no demonstration or design basis calculation was provided that supports the effective development of a drainage layer via the settling of sand verses the slimes, or that support the effective and continued drainage through these sands and geotextile (without clogging). Nor is there any estimate of the flow rates through the drainage layer that demonstrates that the slimes drain will function to remove the tailings solution in a timely manner, and limit the potential for solution migration through the liner and into the surrounding environment.

The estimate of the anticipated flow rates and maximum capacity in the slimes collection layer needs to be provided. IUC's response must include a calculation that estimates the flow rate of the tailings cell solution through the tailings and into the collection pipes, and an assurance that the sand fraction will settle out and provide an adequate drainage layer, or include a granular drainage layer design to effectively remove the tailings solution. This is of specific concern since drainage media such as sand used for drainage layers need to be designed (sized or a filter applied) so that the overlying fines (slimes) do not infiltrate and clog the sand. The design of the collection pipe also needs to be justified and a basis provided.

ALR

The Action Leakage Rate, which is defined as the maximum design flow rate that the leak detection system can rapidly remove without the fluid head on the liner exceeding one (1)

foot, needs to be determined. IUC provided the calculation of the Action Leakage Rate in their May 24, 2006 response. However, the review of this calculation revealed the following concerns:

1. *There is an inconsistency in the thickness of the geonet (leak detection layer) assumed for the Action Leakage Rate determination (300 mils) and the specified thickness of the geonet as indicated in Table 02773-1 of the Project Specification (Appendix C of the Cell 4A Lining System Design Report). This discrepancy needs to be resolved by either revising the ALR calculation to include a 200-mil geonet thickness or by revising the Project Specifications to specify a 300-mil geonet thickness.*

   IUC's June 22, 2006 response to Round 2 Interrogatories include revised Technical Specifications that contain the requirement in Section 02773 (Geonet), Table 02773-1 (Required Geonet Property Values) that the geonet used shall have a minimum thickness of 300 mils. This revision now makes the thickness of the geonet the same as the geonet thickness that was assumed in design calculations done to determine the ALR.

2. *It is our understanding that during some periods of cell operation, the volume of process liquids stored in Cell 4A will be less than 37 feet in height. During such time periods, the flow (leakage) rates to the leak detection system will be less than when the full 37 feet of liquid head would be present. In other words, the calculated action leakage rate is a function of fluid head, and a fluid head less than 37 feet will have a lower action leakage rate. Therefore, since the action leakage rate is a function of the fluid head, and the head on the liner in the cell will vary with time and facilities operations, a correlation of fluid head to action leakage rate needs to be developed and used so that the appropriate action leakage rate is used and the function of the liner properly monitored.*

   IUC's June 30, 2006 response to Round 2 Interrogatories included a plot of the ALR verses the head above the primary geomembrane. However, the corresponding calculations and listing of the data generated/used as the basis of the plot must be provided.

3. *Round 2 Interrogatory requested that the Specifications and Construction Quality Assurance Plan must be revised as needed to reflect appropriate procedures for installing and adjoining geonet panels and geonet pieces based on the final selected geonet type to ensure constancy with design assumptions. However, these changes were not indicated in IUC's response, and remain to be addressed.*

   In addition, the inclusion of an appropriate specific factor of safety in the ALR calculation to account for uncertainties relating to the final manner (e.g., direction) of installation of portions of the geonet in selected areas of Cell 4A was also requested. IUC addressed this in the June 30, 2006 response by providing a graphical representation of the varying factor of safety values and Action Leakage Rates (ALRs) associated with different head conditions in Cell 4A and additional supporting information. In their response, IUC indicated that: (1) the

ALR calculation is based on the worst case condition (i.e. longest drainage path within the leak detection system layer), which represents less than 5% of the lined area; and (2) within the ALR calculation, partial factor of safety values are applied to account for chemical and creep issues; that is, the overall factor of safety, 1.3 minimum, does not account for these partial factor of safety values, and accounting for the partial factor of safety values, the global factor of safety would be approximately 3.64.

Based on the above information, IUC's response that the ALR calculation is based on the worst-case, longest drainage path (estimated 5% occurrence) within the leak detection layer is acceptable in that it incorporates a level of conservatism into the calculation with respect to assessing the capability of the geonet to handle anticipated leak detection system flows.

The response provided that "...the overall factor of safety, 1.3 minimum, does not account for these partial factor of safety values, and accounting for the partial factor of safety values, the global factor of safety would be approximately 3.64", is not relevant to the question posed in the interrogatory since, by definition, all partial factors of safety are intended to be included in the overall safety factor calculation when evaluating adequacy of the geonet for the expected site conditions. Therefore, this information provides no basis for granting any additional allowance to account for possible uncertainties in the actual thickness characteristics of the geonet leak detection layer or possible uncertainties in geonet placement in the field and associated possible variations in geonet flow capacities, when evaluating the geonet leak detection layer's capability of handling anticipated leak detection system flows.

In addition, IUC indicated in their response that "the geonet thickness, a key factor in the ALR calculation, is specified to be a minimum value. Therefore, the actual geonet installed in Cell 4A will likely have a thickness that is greater than the minimum requirement of 300 mils." This is not a strictly correct statement, since most suppliers would likely interpret the requirement of a minimum thickness of 300 mil for the geonet as determined by ASTM Method D 5199 to require that each roll of geonet must have a ***minimum average roll value*** *(nominal thickness) of 300 mils based on 10 randomly spaced test location across the roll and with the lowest value of any of the 10 random test locations having a thickness of no less than 90% of the determined nominal thickness value. This response therefore provides no basis for assuming that the geonet would likely have a thickness that is greater than the minimum requirement of 300 mils. This information offers no basis for any additional allowance to account for possible uncertainties in the actual thickness characteristics of the geonet leak detection layer or possible uncertainties in geonet placement direction uncertainties and related possible variations in geonet flow capacities when evaluating the geonet leak detection layer's capability of handling anticipated leak detection system flows.*

The total (aggregate) factor safety determined in the ALR calculation and applied to calculation of the geonet hydraulic conductivity is 2.8 (product of service reduction factors = 1.0 x 1.4 x 2.0 x 1.0) – see page 3 of 6 of "Calculation of Action Leakage Rate Through the Leak Detection System Underlying a Geomembrane Liner", Geosyntec Consultants, May 23, 2006. The calculation of the aggregate factor of safety must either justify why the following design considerations and installation uncertainties do not need to be of concern for the lining system in Cell 4A, or include an additional service reduction factor that takes them into to account.

1. *Uncertainties associated with the direction of placement of the geonet in some areas of the cell, which could result in reduced flow capacities within the geonet in some areas of the cell.*
2. *Possible damage of some geonet material occurring during installation (e.g., due to abrasion occurring during placement, etc...) or due to temperature effects or other factors (e.g., see Koerner 1997, p. 403).*
3. *Possibility of partial intrusion of geomembrane into the geonet due to: (a) intrusion of geomembrane into the geonet in some areas following potential eventual breakdown of the ribbed structure of the geonet in at least some part(s) of the geonet as a result of prolonged exposure to acidic leachate; (b) any wrinkles that may be present in geomembrane material in contact with the geonet.*
4. *Uncertainty with respect to adequacy and appropriateness of intrusion assumptions, taken together with the relatively flat slope of cell floor (1%) – Richardson et al. 1999, p. 23, indicate that (for geocomposites), intrusion reduction factors are significantly larger at low gradient than at a higher gradient, and therefore recommend use of a larger service reduction factor on flatter slopes than on steeper slopes (e.g. sideslopes). Although these recommendations were made for the case of geocomposites, for geotextile intrusion into the geonet, a similar argument might be made for the case of geomembranes in contact with the geonet, albeit that the impact would be of smaller magnitude.*

Inconsistencies in Project Calculations

Further review revealed some inconsistencies in the project calculations. These were requested in Round 2 Interrogatories but not included in IUC's. They must be addressed and revised final calculations produced. They include inconsistencies in the Pipe Strength and Spillway calculations.

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.

GSE. Technical Note: "Installation of Geosynthetic Drainage Products". Undated. Available at:

http://www.gseworld.com/Literature/TechnicalNotes/PDF/TN025installationgeo.pdf

Koerner, R.M. 1997. Designing with Geosynthetics, Fourth Edition.

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.

Richardson, G.N., and Zhao, A. 1999. Design Manual for Lateral Drainage Systems for Landfills

Thiel, R., Criley, K., and Bryk 2005. "Practical Guidelines for Specifying GCL Overlaps", Geotechnical Fabrics Report, October/November 2005. St. Paul, MN.

40 CFR 264.301.