

**CELL 4A LINING SYSTEM  
DESIGN REPORT**

**FOR THE**

**WHITE MESA MILL  
BLANDING, UTAH**

Prepared for:



**International Uranium (USA) Corporation**

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## 1. INTRODUCTION

This report presents the results of design analyses performed in support of the Cell 4A liner construction at the White Mesa Mill Facility in Blanding, Utah (site). The San Diego office of GeoSyntec Consultants, Inc. (GeoSyntec) prepared this report for International Uranium (USA) Corporation (IUSA). This report was prepared by Ms. Jane Soule of GeoSyntec. Mr. Gregory Corcoran, P.E. of GeoSyntec was in responsible charge and provided senior peer review of the work presented herein in accordance with the internal peer review policy of the firm.

### 1.1 Objective

The objective of this report is to present the components of the liner system and to demonstrate that the proposed Cell 4A liner system design complies with the applicable regulatory standards for the State of Utah, the U.S. Nuclear Regulatory Commission and the Federal Environmental Protection Agency (USEPA). In particular, the design is in accordance with the Utah Administrative Code (UAC) R317-6, and the Best Available Technology requirements mandated by Part I.D. of existing site Ground Water Discharge Permit No. UGW370004.

### 1.2 Background

Cell 4A was originally constructed in 1989 and first put into service in early 1990. The entire Cell was originally lined with a 40 mil high density polyethylene (HDPE) geomembrane which was underlain by one foot of clay on the bottom of the Cell. The Cell also had a leak detection system and a slimes drain system. The liner system experienced problems from the very early days of operation. All deposits, including silt and precipitated salts from process operations, on the top of the liner system, as well as the HDPE geomembrane, were removed in early 2005 and disposed in the Cell 3 area. The Cell 4A berms and base materials were not significantly altered during the removal of the 40-mil HDPE geomembrane.

Current site operations utilize Cells 1 and 3 for process liquids evaporation and disposal of tailings and by-products from the processing operations at the site. The capacity of these cells is diminishing and the re-construction of Cell 4A is needed to supplement evaporation/disposal capacity at the site.

The re-lined Cell 4A will be used as a tailings disposal cell for evaporation of process liquids and final storage of solids contained in the tailings and by-products from processing operations at the site.

### **1.3 Report Organization**

The remainder of this design report is organized into the following sections:

- Section 2, *Background Information*, presents general information on the site and background information on the existing conditions at Cell 4A.
- Section 3, *Lining System Design*, presents the liner system design for Cell 4A. The design drawings are presented in Appendix A.
- Section 4, *Summary and Conclusions*, presents the summary, conclusions, and limitations of this technical design report.

In addition to this report, Cell 4A permit documents include Design Drawings (Appendix A), a Construction Quality Assurance (CQA) Plan (Appendix B), Technical Specifications (Appendix C), Existing Berm and Clay Liner Construction Documentation (Appendix D), and engineering design calculations (Appendix E).

## **2. BACKGROUND AND SITE CONDITIONS**

### **2.1 Site Location**

The location of the site is shown on Sheet 1 of the Design Drawings (Appendix A). The site is located approximately 6 miles (9.5 kilometers) south of Blanding, Utah on Highway 191. Per the Universal Transverse Mercator (UTM) Coordinate System, the site is located at 4,159,100 meters Northing and 634,400 meters Easting.

The Mill is located on a parcel of fee land, State of Utah lease property and associated mill site claims, covering approximately 5,415 acres. The site mill operations are limited to approximately 50 acres located directly east of Cell 1. The existing tailings disposal cells (Cells 1 through 3) are approximately 370 acres. Cell 4A is located south of the eastern half of Cell 3. The site plan is shown on Sheet 2 of the Design Drawings.

### **2.2 Climatology**

The climate of southeastern Utah is classified as dry to arid continental. Although varying somewhat with elevation and terrain, the climate in the vicinity of the site can be considered as semi-arid with normal precipitation of about 13.4 in (34 cm) (WRCC, 2005). Most precipitation is in the form of rain with snowfall accounting for about 30 percent of the annual precipitation total. There are two separate rainfall seasons in the region, the first in late summer and early autumn (August to October) and the second during the winter months (December to March).

The average temperature in Blanding ranges from approximately 30 degrees Fahrenheit (°F) in January to approximately 76°F in July. Average minimum temperatures are approximately 18°F in January and maximum temperatures are approximately 91°F in July (<http://www.city-data.com/city/Blanding-Utah.html>).

The mean annual relative humidity is about 44 percent and is normally highest in January and lowest in July. The average annual Class I pan evaporation rate is 68 inches (173 cm) (NOAA, 1977), with the largest evaporation occurring in July. Values of pan coefficients range from 60% to 81%. The annual lake evaporation rate

for the site is 47.6 inches (120.9 cm) and the net evaporation rate is 34.2 inches per year (86.8 cm/yr).

### **2.3 Topography**

The regional topography is relatively flat, with drainage traveling from the north to south in the region. The existing Cell 4A has a surface area of approximately 40 acres and is approximately 40 feet deep at the lowest corner. The existing Cell 4A bottom slopes from the northeast to the southwest at approximately one (1) percent. Cell 4A was constructed in 1989 by building compacted fills on the south and west side of the Cell and excavating the interior to gain additional volume. The existing berms are inclined at approximately 3Horizontal:1Vertical (3H:1V), with the exception of the western berm which is inclined at approximately 2H:1V on the interior slope and 3H:1V on the exterior slope. A discussion of the berm construction is provided in Section 2.4.1 of this Section.

### **2.4 Existing Soil Conditions**

#### **2.4.1 Soil Berms**

Based on a review of the construction field reports, the existing soil berms are constructed of compacted sandy silt, and silty to clayey sand. Based on available records, compaction tests (with nuclear gauge and sand cone) were performed at a rate of approximately 1 test per 682 cubic yards (CY) of soil fill. Additional testing included Atterberg limits (1 per approximately 3,751 CY), soil gradation (1 per approximately 3,751 CY), and moisture density relations (standard Proctor, 1 per approximately 6,804 CY). Records indicate that the berm soil was compacted to meet the project specifications of 95 percent compaction of the maximum dry density per ASTM D698 (standard Proctor) at a moisture content of  $\pm 2\%$  of optimum. Copies of the field test data are provided in Appendix D.

Since the soil berms appear to have been constructed in general accordance with the standard industry practice, there is no need to reconstruct them.

#### **2.4.2 Clay Liner**

The liner system constructed in 1989 included a 12-inch thick layer of

compacted clay on the bottom of Cell 4A. Based on construction quality assurance/quality control testing, the soil used for the compacted clay liner is a sandy lean clay. Laboratory testing during construction included sieve analyses, Atterberg limits, and compaction tests. The test results for these analyses are presented in Appendix D. This clay liner is currently exposed in the bottom of the existing Cell 4A area.

## **2.5 Surface Water**

Surface water at the facility is diverted around all the Cells including Cell 4A. Surface water run-on into Cell 4A is limited to the perimeter access road surrounding the Cell and direct precipitation into Cell 4A.

The site has implemented a Storm Water Best Management Practices Plan in accordance with the facility permit. All site construction activities will be performed in accordance with the site Storm Water Best Management Practices Plan.

## **2.6 Groundwater**

Groundwater is located at a depth of approximately 50 to 80 feet at the site. No changes to the existing groundwater monitoring plan are proposed by this project.

## **2.7 Tailings**

Cell 4A will accept process liquids, tailings, and by-products associated with on-site processing operations. The liquids are typically highly acidic with a pH generally between 1 and 2. Tailings are generally comprised of ore that is ground to a maximum grain size of approximately 0.023 inches (0.6 mm).

### **3. LINER SYSTEM DESIGN**

The liner system is designed to provide a cell for disposal of by-products from the on-site processing operations while protecting the groundwater beneath the site. The liner system is designed to meet the Best Available Technology requirements of the Utah Administrative Code (UAC) R317-6, which require that the facility be designed to achieve 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. The liner system includes the following primary components, from top to bottom:

- Slimes drain system;
- Primary geomembrane liner;
- Leak detection system;
- Secondary geomembrane liner; and
- Geosynthetic clay liner.

These components, and related design considerations, are discussed below.

#### **3.1 Cell Capacity and Geometry**

The cell has been designed to accommodate storage of up to approximately 980 acre-feet (1.6 million cubic yards) of tailings with 3-feet of freeboard. The lowest elevation in Cell 4A is the sump located in the southwest corner at an elevation of approximately 5,556 feet above mean sea level (MSL).

Sideslopes will remain at the current inclinations, ranging from approximately 3H:1V to 2H:1V. Access to the bottom of Cell 4A for construction is provided at the northeast corner, which is inclined at approximately 6H:1V. The existing, approximately 15 feet wide, access road that surrounds the entire Cell 4A will be maintained as an unpaved road.

#### **3.2 Earthwork**

Limited earthwork for the project is expected within the bottom area of the cell and for anchor trenches at the top of the perimeter berms. As discussed in Section 1.2, the existing geomembrane liner and

overlying waste materials have been removed from Cell 4A. The clay liner constructed in 1989 has been exposed and will be used as the subgrade surface for the new liner system (see Section 3.3 below). Earthwork will be limited to excavation of a 4 foot deep emergency spillway from Cell 3 to Cell 4A, excavation of the sump area in the southwest corner of the cell, minor re-grading of the bottom area of the cell for the purposes of preparing subgrade for the geosynthetic liner system installation, excavation of leak detection system trenches, and excavation of anchor trenches on top of the perimeter berms. Fill soil will consist of anchor trench backfill, as discussed in Section 3.3.5.

### **3.3 Liner System**

A double liner system is proposed for Cell 4A, including a primary liner, leak detection system and composite secondary liner. The liner system, for both the bottom area and side slopes, consists of (from top to bottom):

- Slimes Drain System (Cell bottom only);
  - 60 mil smooth HDPE geomembrane (Primary Liner);
  - Geonet Drainage Layer (Leak Detection System);
  - 60 mil smooth HDPE geomembrane;
  - Geosynthetic Clay Liner (GCL); and
  - Prepared Subgrade.
- } (Composite Secondary Liner)

#### **3.3.1 Slimes Drain System**

A slimes drain system will be placed on top of the primary geomembrane liner to facilitate dewatering of the tailings prior to final reclamation of the Cell. The slimes drain system will consist of perforated 4-inch diameter schedule 40 polyvinyl chloride (PVC) pipe, drainage aggregate, cushion geotextile, and geosynthetic drainage materials that will provide a means to drain the tailings disposed within Cell 4A. The slimes drain system is shown on Sheets 4, 5, and 6 of the Drawings (Appendix A).

The perforated PVC pipe is designed to resist crushing and wall buckling due to the anticipated loading associated with the maximum height of overlying tailings. The design analyses for the pipe are presented in Appendix E, while Appendix C,

Section 02616 provides material specifications for the pipe and drainage aggregate.

The cushion geotextile is designed to protect the underlying primary HDPE geomembrane from puncture due to the drainage aggregate and the anticipated loading associated with the maximum height of overlying tailings. The design analyses for the cushion geotextile are presented in Appendix E, while Appendix C, Section 02771 provides material specifications.

The Slimes Drain sump will include a sideslope riser pipe to allow installation of a submersible pump for manual collection of liquids in the sump. The sump and riser pipes are shown on Sheet 6 of the Drawings (Appendix A).

### **3.3.2 Primary Liner**

The primary liner will consist of a smooth 60-mil HDPE geomembrane. The geomembrane will have a white surface that will limit geomembrane movement and the creation of wrinkles due to temperature variations. HDPE geomembrane was selected due to its high resistance to chemical degradation and ability to survive in an acidic environment. The limit of the liner system (both primary and secondary) and details are shown on Sheets 3, 5, and 6 of the Drawings (Appendix A).

The HDPE geomembrane will be constructed in accordance with the current standard of practice for geomembrane liner installation, as outlined in the site Technical Specifications (Appendix C, Section 02770) and the site Construction Quality Assurance (CQA) Plan (Appendix B). Seams will be welded to provide a continuous geomembrane liner. Testing during construction will include both non-destructive and destructive testing, as outlined in the Technical Specifications and CQA Plan. Upon completion of construction, the geomembrane manufacturer will provide a 20-year warranty for the geomembrane.

### **3.3.3 Leak Detection System**

The leak detection system (LDS) will underlie the primary liner and is designed to collect potential leakage through the primary liner and convey the liquid to the sump for manual detection through monitoring of sump levels. The LDS consists of a 200-mil thick geonet and a network of

gravel trenches throughout the bottom of the cell. The trenches will contain a 4-inch diameter perforated schedule 40 PVC pipe, drainage aggregate, and a cushion geotextile, which will drain to a sump located in the southwest corner of the cell. The trenches will aid in rapidly conveying any seepage to the drain sump. The LDS is shown on Sheets 4, 5 and 6 of the Drawings (Appendix A).

The perforated PVC pipe is designed to resist crushing and wall buckling due to the anticipated loading associated with the maximum height of overlying tailings. The design analyses for the pipe are presented in Appendix E, while Appendix C, Section 02616 provides material specifications for the pipe and drainage aggregate.

The cushion geotextile is designed to protect the underlying secondary HDPE geomembrane from puncture due to the drainage aggregate and the anticipated loading associated with the maximum height of overlying tailings. The design analyses for the cushion geotextile are presented in Appendix E, while Appendix C, Section 02771 provides material specifications.

The LDS sump will include a sideslope riser pipe and submersible pump to allow for manual collection of liquids in the LDS sump. The LDS sump and riser pipes are shown on Sheet 6 of the Drawings (Appendix A).

### **3.3.4 Secondary Composite Liner System**

The primary purpose of the secondary liner is to provide a flow barrier so that potential leakage through the primary liner will collect on top of the secondary liner then flow through the LDS to the LDS sump for manual collection. The secondary liner also provides an added hydraulic barrier against leakage to the subsurface soils and groundwater. The secondary liner consists of a composite liner that includes a 60-mil HDPE geomembrane overlying a GCL.

#### **3.3.4.1 Secondary Geomembrane Liner**

The geomembrane component of the secondary liner system will consist of a smooth 60-mil HDPE geomembrane and will meet the same criteria as the primary liner geomembrane (Section 3.3.2). The limit of the liner system (both primary and secondary) and details are shown on