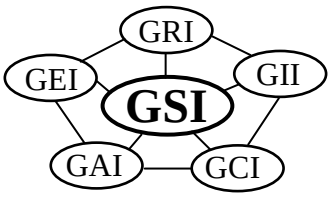
Geosynthetic Institute
475 Kedron Avenue
Folsom, PA 19033-1208 USA
TEL (610) 522-8440
FAX (610) 522-8441



GRI White Paper #18

Geosynthetic Lining Opportunities at Uranium Mill Tailings (UMT) and Low Level Radioactive Waste (LLRW) Facilities in the USA

by

Jamie R. Koerner
Special Projects Coordinator
Geosynthetic Institute
Phone 610-522-8441
Fax 610-522-8442
jrkoerner@verizon.net

Robert M. Koerner, PhD, PE, NAE
Director - Geosynthetic Institute
Emeritus Professor – Drexel University
Phone 610-522-8440
Fax 610-522-8442
robert.koerner@coe.drexel.edu

George R. Koerner, Ph.D., P.E., CQA
Director Designate
Geosynthetic Institute
Phone 610-522-8440
Fax 610-522-8441
gkoerner@dca.net

November 5, 2010

GRI White Paper #18

Geosynthetic Lining Opportunities at Uranium Mill Tailings (UMT) and Low Level Radioactive Waste (LLRW) Facilities in the USA

Background

The nuclear age, beginning during World War II, brought with it two unforeseen consequences insofar as waste disposal was concerned. The first was the disposal of uranium mill tailings (UMT) resulting largely from the production of uranium for the nation's weapons program.

"Uranium mill tailings contain the radioactive element radium, which decays to produce radon, a radioactive gas. The radium in these tailings will not decay entirely for thousands of years. The mill tailings pose a potential hazard to public health and safety.

To provide for the disposal, long-term stabilization, and control of these mill tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public, Congress enacted the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). This Act established two programs to protect the public and the environment from uranium mill tailings.

The UMTRCA Title I program established a joint Federal/State-funded program for remedial action at abandoned mill tailings sites where tailings resulted largely from production of uranium or the weapons program. Now there is Federal ownership of the tailings disposal sites under general license from the Nuclear Regulatory Commission (NRC). Under Title I, the Department of Energy (DOE) is responsible for cleanup and remediation of these abandoned sites. The NRC is required to evaluate DOE's design and implementation and, after remediation, concur that the sites meet standards set by the Environmental Protection Agency (EPA).

The UMTRCA Title II program is directed toward uranium mill sites licensed by the NRC or Agreement States in or after 1978. Title II of the Act provides the following:

- NRC authority to control radiological and non-radiological hazards.
- EPA authority to set generally applicable standards for both radiological and non-radiological hazards.
- Eventual State or Federal ownership of the disposal sites, under general license from NRC.

There are five Agreement States – Colorado, Illinois, Texas, Utah and Washington – that license Atomic Energy Act section 11e.(2); material (i.e., certain mill tailings and related waste

containing thorium or uranium). NRC is required to make a determination that all applicable standards and requirements have been met by uranium mills before termination of their Agreement State license."[*]

The second waste disposal material which was initially not contemplated is so-called low-level radioactive waste ("LLRW"). This infers any radioactive waste that is not considered high-level. Thus, LLRW is anything that is not irradiated reactor fuel or waste from reprocessing the irradiated fuel.

"In 1980, the Low-Level Radioactive Waste Policy Act (LLRWPA and its 1985 Amendments Act P.L. 99-240) was passed by Congress, placing the responsibility for so-called low-level radioactive waste disposal in the hands of the states. Through this act, states could form disposal compacts, within which they could create a single disposal site for use by multiple states. In some compacts the plan was to rotate disposal sites, potentially creating more than one in each compact over time.

Actually implementing disposal sites, however, has been extremely difficult due to the fact that all classes of so-called low-level radioactive waste can have very long-lasting components (some literally millions of years being hazardous) while the federal regulations only require 100 years of institutional control (see 10 CFR 61.59). The NRC attributes the difficulty in opening new sites to the controversial nature of nuclear waste disposal and public opposition to the siting of new LLW disposal facilities.

Only seven commercial low-level radioactive waste disposal facilities have operated in the U.S., three of which are still open today. As of March 2009, two new sites have been licensed, but one was cancelled (in Ward Valley, California) and one (in Andrews County, TX) has been licensed with dozens of conditions and other challenges as yet unmet."[**]

With the above as a brief introduction to the topic, this GSI White Paper addresses UMT and LLRW disposal insofar as the *size of disposal areas* of the various sites in the United States. Details and idiosyncrasies of the applicable cover and/or liner systems that can be used at these facilities are well known to the readers of this White Paper and need not be repeated here.

---

[*]Taken verbatim from: U. S. NRC "Fact Sheet on Uranium Mill Tailings," <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/mill-tailings.html>.

[**] Taken verbatim from: U. S. NRC. *History and Framework of Commercial Low-Level Radioactive Waste Management in the United States (NUREG-1853).* Washington: Advisory Committee on Nuclear Waste, 2007. ML070600684. Accessed 13 Apr. 2009 <http://www.nrc.gov/reading-rm/adams.html>

Stimulus for this White Paper

In light of the hazardous nature of both UMT and LLRW materials, along with the associated sensitive social, political and environmental concerns, disposal strategies and impoundment technologies have been discussed intensively and regularly by many governmental and private groups. Perhaps the most recent in this regard is the August 3-5, 2010, Workshop on Engineered Barrier Performance Related to Low Level Radioactive Waste, Decommissioning, and Uranium Mill Tailings Facilities, hosted by the U. S. Nuclear Regulatory Commission at their headquarters in Rockville, Maryland. These proceedings coupled with 2008 report by S. Cohen and Associates[***] prompted the authors of this GSI White Paper to investigate the size and scale of the UMT and LLRW disposal situation with obvious focus on the existing and potential use of geosynthetic materials to (i) cover closed sites, and to (ii) line and cover operating sites and those being remediated and/or planned. Such quantitative information has not been available to date on a unified basis for all UMT and LLRW sites in the United States. *Thus, this White Paper is generated in order to assess the size and scale of such disposal operations in the United States.*

The data to be presented was obtained stemming from an initial inquiry to all UMT and LLRW site owners and/or operators as follows:

[***] S. Cohen and Associates, "Review of Existing and Proposed Tailings Impoundment Techniques," for U. S. Environmental Protection Agency, Sept. 25, 2008

"Dear _____

We were recent participants in a U. S. NRC Workshop on Engineered Barriers for LLRW materials including uranium mill tailings. Throughout the three-day event, no one presented data as to the size or scale of the present situation. It appears to us that the absence of such data could easily shift strategies from one alternative solution to another.

Thus the purpose of our inquiry is to ask if you, or someone in your department, could supply us with information on the approximate size of uranium mill tailings (or low level radioactive waste) sites in your state. If such data or even a rough estimate is available, please advise how we can access this information.

Thank you in advance."

The response from this inquiry was excellent and was provided either directly or via data from designated internet sites. Obviously, all of the information is "sunshined", but accumulation and compiling required considerable effort.

Survey Results and Geosynthetic Implications

The response to our survey questionnaire and subsequent internet search resulted in Table 1 following.

Table 1 – Result of GSI Survey of Uranium Mill Tailings (UMT) and Low Level Radioactive Waste (LLRW) Sites in the USA

Site Name	Location	Type of Facility	Status of Facility	Size of Disposal Area (acres)
Ambrosia Lake Mill	NM	UMT	remediation	91
Belfield Ashing Facility	ND	UMT	remediation	21
Bowman Ashing Facility	ND	UMT	remediation	59
Burrell Disposal Cell	PA	UMT	remediation	4
Canonsburg Mill	PA	UMT	remediation	6
Durango Mill	CO	UMT	remediation	120
Edgemont Mill	SD	UMT	remediation	125
Falls City Mill	TX	UMT	remediation	607
Grand Junction Mill	CO	UMT	remediation	98
Green River Concentrator	UT	UMT	remediation	31
Gunnison Mill	CO	UMT	remediation	29
Lakeview Mill	OR	UMT	remediation	40
Lowman Mill	ID	UMT	remediation	8
Maybell Mill	CO	UMT	remediation	66
Mexican Hat Mill	UT	UMT	remediation	72
Monument Valley Upgrader	AZ	UMT	remediation	30
Monument Valley	AZ	UMT	remediation	68
Naturita Mill	CO	UMT	remediation	10
Rifle Mills	CO	UMT	remediation	71
Riverton Mill	WY	UMT	remediation	72
Salt Lake City Mill	UT	UMT	remediation	120
Shiprock Mill	NM	UMT	remediation	77
Slick Rock Mill	CO	UMT	remediation	12
Spook Leaching Facility	WY	UMT	remediation	6
Tuba City Mill	AZ	UMT	remediation	50
			Subtotal	**= 1893 acres**
Richland	WA	LLRW	operating	100
Barnwell	SC	LLRW	operating	235
Beatty	NV	LLRW	closed	80
West Valley	NY	LLRW	closed	15
Maxey Flats	KY	LLRW	remediation	252
Sheffield	IL	LLRW	closed	20
Clive	UT	LLRW	operating	540
			Subtotal	**= 1242 acres**
		TOTAL		**= 3134 acres**

Included in the table are twenty-five UMT sites that are identified consisting of 1893 total acres; thus each site averages about 76 acres in size. Since these are presently existing, or under remediation, the geosynthetic opportunities are for geomembranes (GM), geosynthetic clay liners (GCL), or GM/GCL composite covers. Accompanying these barrier materials could well be drainage composites and possibly geosynthetic reinforcement (geogrids and geotextiles) for improved slope stability on a site-specific basis. Furthermore, a double layer strategy is not out-of-the-question.

The table also identifies seven LLRW sites consisting of 1242 total acres; thus each site averages about 177 acres in size. These sites consist of closed, under remediation, and operating sites; the latter requiring both liner systems beneath the waste and cover systems above the waste. Such liners and covers are well known for municipal solid waste and hazardous solid waste and are regularly provided by the geosynthetics industry. They need not be elaborated upon in this document. The closed and under remediation sites will require cover systems as mentioned for the UMT sites just mentioned.

In summary, the information in this White Paper provides a regulator, designer, manufacturer, or installer of geosynthetic materials insight into the size and scale of both UMT and LLRW disposal operations in the USA. It should be mentioned, however, that nuclear waste disposal (both UMT and LLRW) is indeed a worldwide issue and concern. Investigation is underway to collect global information and report accordingly.