Studsvik Processing Facility - A Proven Solution for the Conservation of a National Asset

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ABSTRACT

Studsvik has completed over 7½ years of operation at its Erwin, TN facility. During this time period Studsvik processed over 13.3 million pounds *(4.96 million kg)* of radioactive ion exchange bead resin, powdered filter media, granular activated carbon (GAC), and filter cartridges which comprised a cumulative total activity of 87,396 Curies *(3.23E+09 MBq)*, with the highest radiation level for any incoming resin container being 400 R/hr (*4.0 Sv/hr*).

The Studsvik Processing Facility (SPF-Erwin) has the capability to safely and efficiently receive and process a wide variety of solid and liquid Low Level Radioactive Waste (LLRW) streams including: Spent Filter Cartridges (Metal or Poly), Ion Exchange Resins (IER), powered filter medias, GAC, organic solids, graphite, oils, solvents, and cleaning solutions. In 2005 Studsvik added advanced robotic technology to the SPF greatly increasing its capabilities to safely handle waste streams with radiation levels in excess of 400 R/hr (*4.0 Sv/h*), saving personnel exposure and maximizing ALARA. The most recent addition to Studsvik's capabilities is the cost and volume efficient processing of filter cartridges (both metal and poly).

The SPF-Erwin employs the **Th**ermal **O**rganic **R**eduction (THOR^{sm}) process, developed and patented by Studsvik, which utilizes pyrolysis/steam reforming technology. THOR^{sm} reliably and safely processes these wide varieties of LLRWs in a unique, moderate temperature, pyrolysis/steam reforming, fluidized bed treatment system. The THOR^{sm} technology is also suitable for processing hazardous, mixed, and dry active LLRW with appropriate licensing and waste feed modifications.

Studsvik has proven to be an experienced and reliable source for the cost efficient disposition of LLRW for the nuclear industry. These processing concepts and capabilities have helped generators maximize the utilization of the limited available burial space - extending the Class-A, Class-B, and Class-C burial capabilities. This paper will provide an overview of this proven approach for both organic and inorganic LLRWs. A perfect example of the processors and generators working together to conserve a National Asset we have all come to know as the LLRW burial sites.

INTRODUCTION

The commercial nuclear industry generates a variety of LLRW streams that require disposal. A large percentage of these wastes streams come from the liquid radwaste systems (e.g., spent ion exchange resins, powdered filter medias, GAC, and metal and poly filter cartridges, etc.). Since the summer of 1999 Studsvik's THOR^{sm} technology has been successfully providing generators processing, volume reduction, and disposal services for the disposition of their pump-able water treatment medias (resin/powdered media/GAC). Until recently there has been no true volume reduction disposition option for spent filter cartridges. For years it has been the industry standard for generators to dispose of dewatered spent filter cartridges by placing them in a High Integrity Container (HIC) and then burying the entire HIC. This is inefficient due to the fact that the actual filter waste volume would be almost 2.5 times less then the actual burial volume, resulting in the burying of void space (a.k.a., air). For example: Utilizing a typical HIC with a burial envelope volume of ~120 ft^3 *(~3.4 m^3)* the generator would place as many spent dewatered filter cartridges inside until it was internally filled to capacity. Due to the size and geometric shape of the filters the generator can only fit 30 to 50 ft^3 *(0.85 to 1.42 m^3)* of actual filter waste inside the burial container. Sadly, this was wasting precious LLRW burial space.

Table 1 below is a sampling of actual Filter HICs that were received depicting burial volume to filter waste volume packaging efficiencies. Out of the 40 filter HICs the average percentage of **lost burial space was 79%**.

Table 1

Burial Volume - Incoming		**Waste Volume - Incoming**		**Burial Container**	
ft3	***m3***	**ft3**	***m3***	**% Utilized**	**% Lost**
122.5 ft3	*(3.47 m3)*	30.0 ft3	*(0.85 m3)*	24%	76%
122.5 ft3	*(3.47 m3)*	15.2 ft3	*(0.43 m3)*	12%	88%
122.5 ft3	*(3.47 m3)*	19.6 ft3	*(0.56 m3)*	16%	84%
122.5 ft3	*(3.47 m3)*	30.0 ft3	*(0.85 m3)*	24%	76%
120.3 ft3	*(3.41 m3)*	33.9 ft3	*(0.96 m3)*	28%	72%
132.4 ft3	*(3.75 m3)*	33.8 ft3	*(0.96 m3)*	26%	74%
132.4 ft3	*(3.75 m3)*	41.5 ft3	*(1.17 m3)*	31%	69%
120.3 ft3	*(3.41 m3)*	21.0 ft3	*(0.59 m3)*	17%	83%
132.4 ft3	*(3.75 m3)*	32.9 ft3	*(0.93 m3)*	25%	75%
120.3 ft3	*(3.41 m3)*	33.1 ft3	*(0.94 m3)*	28%	72%
120.3 ft3	*(3.41 m3)*	23.8 ft3	*(0.67 m3)*	20%	80%
132.4 ft3	*(3.75 m3)*	28.7 ft3	*(0.81 m3)*	22%	78%
120.3 ft3	*(3.41 m3)*	16.9 ft3	*(0.48 m3)*	14%	86%
205.8 ft3	*(5.83 m3)*	29.7 ft3	*(0.84 m3)*	14%	86%
120.3 ft3	*(3.41 m3)*	21.0 ft3	*(0.60 m3)*	17%	83%
120.3 ft3	*(3.41 m3)*	32.8 ft3	*(0.93 m3)*	27%	73%
122.5 ft3	*(3.47 m3)*	30.9 ft3	*(0.88 m3)*	25%	75%
120.3 ft3	*(3.41 m3)*	20.6 ft3	*(0.58 m3)*	17%	83%
51.2 ft3	*(1.45 m3)*	2.0 ft3	*(0.06 m3)*	4%	96%
132.4 ft3	*(3.75 m3)*	36.8 ft3	*(1.04 m3)*	28%	72%
120.3 ft3	*(3.41 m3)*	21.0 ft3	*(0.59 m3)*	17%	83%
120.3 ft3	*(3.41 m3)*	19.3 ft3	*(0.55 m3)*	16%	84%
132.4 ft3	*(3.75 m3)*	25.4 ft3	*(0.72 m3)*	19%	81%
122.5 ft3	*(3.47 m3)*	30.0 ft3	*(0.85 m3)*	24%	76%
120.3 ft3	*(3.41 m3)*	23.9 ft3	*(0.68 m3)*	20%	80%
122.5 ft3	*(3.47 m3)*	14.7 ft3	*(0.42 m3)*	12%	88%
120.3 ft3	*(3.41 m3)*	23.2 ft3	*(0.66 m3)*	19%	81%
120.3 ft3	*(3.41 m3)*	20.7 ft3	*(0.59 m3)*	17%	83%
120.3 ft3	*(3.41 m3)*	15.8 ft3	*(0.45 m3)*	13%	87%
120.3 ft3	*(3.41 m3)*	36.6 ft3	*(1.04 m3)*	30%	70%
122.5 ft3	*(3.47 m3)*	32.0 ft3	*(0.91 m3)*	26%	74%
205.8 ft3	*(5.83 m3)*	50.4 ft3	*(1.43 m3)*	24%	76%
120.3 ft3	*(3.41 m3)*	20.8 ft3	*(0.59 m3)*	17%	83%
120.3 ft3	*(3.41 m3)*	33.0 ft3	*(0.94 m3)*	27%	73%
120.3 ft3	*(3.41 m3)*	21.3 ft3	*(0.60 m3)*	18%	82%
120.3 ft3	*(3.41 m3)*	15.6 ft3	*(0.44 m3)*	13%	87%
120.3 ft3	*(3.41 m3)*	13.2 ft3	*(0.37 m3)*	11%	89%
205.8 ft3	*(5.83 m3)*	50.6 ft3	*(1.43 m3)*	25%	75%
120.3 ft3	*(3.41 m3)*	27.6 ft3	*(0.78 m3)*	23%	77%
120.3 ft3	*(3.41 m3)*	35.9 ft3	*(1.02 m3)*	30%	70%
Averages of above 40 Filter HICs					
127.2 ft3	***3.6 m3***	**26.6 ft3**	***0.8 m3***	**21%**	**79%**

DISPOSITION OPTIONS FOR LLRW

In the past there have been limited disposition options for LLRW generated from the liquid radwaste systems that could maximize the burial space being utilized. Advances in dewatering systems and rapid drying technologies made preparing wet pump-able slurries easier and more suitable for LLRW disposal but did little for volume/mass reduction (no real burial space savings). Spent filter cartridge cutting/shearing systems were developed to help mitigate wasted space in the filter HICs but have proven to be cumbersome, time consuming, and high maintenance. Most systems were abandoned even though slight packaging efficiency increases were experienced proving that filter cutting/shearing is not a true long-term viable option for filter disposition.

No one has been able to develop and implement a disposition option that would encompass the broad waste streams and radiation levels of the LLRW generated from the liquid radwaste systems, while at the same time saving precious burial space. Table 2 below identifies the largest LLRW generated from the liquid radwaste systems.

Table 2

ORGANIC		INORGANIC	
Pump-able Slurries	**Solid Components**	**Pump-able Slurries**	**Solid Components**
• IER • Powdered Medias • Tank/Sump Sludges • GAC	• Poly Filters • DAW/General Waste • Discrete Material	• Diatomaceous Earth • Zeolites • Sludges/Dirts	• Metal Filters • DAW/General Waste • Discrete Material

DISPOSITION INGENUITY (THOR^{SM} ALONG WITH VOID SPACE UTILIZATION)

Studsvik has successfully implemented a proven disposition option that saves precious LLRW burial space by utilizing its thermal volume/weight reduction technology (THOR^{sm}) combined with its ingenuity with void space utilization in filter HICs. This solution incorporates the advantages of Studsvik's heavily shielded facility, advanced robotic technology, and numerous years of experience handling low to high radiation level LLRW materials.

When processing organic material (such as those as identified in Table 2) through the THOR^{sm} pyrolysis/steam reforming process a final end product is produced that is a dry, flowable, granular, waste stream called Reformed Residue (or RR). The RR can be added to *filter HICs, filling the void spaces around the inorganic materials, making use of the remaining space available in the disposal container.

**NOTE: Not only spent filter cartridges are candidates for RR overfill. Other discrete LLRW material, such as velocity limiters from control rod blades, core exit thermal couples, valves, etc., are also suitable RR overfill*

CONCLUSION

Studsvik's proven approach of processing organic material for volume reduction and then using this material to fill otherwise wasted void space within the disposal container has been utilized with superb success. This technique has enhanced disposal efficiency and economics for the broad range and radiation levels of the LLRW generated from liquid radwaste systems. Figures 1 and 2 below confirm that this disposition ingenuity has conserved over **231,575 ft3** ***(6,557 m3)*** of LLRW burial space since 1999. A perfect example of the processors and generators working together to conserve a National Asset we have all come to know as the LLRW burial sites.

ADDITIONAL REFERENCES

EPRI Technical Report: 1003436 (Advanced Volume Reduction & Waste Segregation Strategies for LLRW Disposal)

EPRI Technical Report: 1009566 (Non-Metal Filter Study)

US Units:

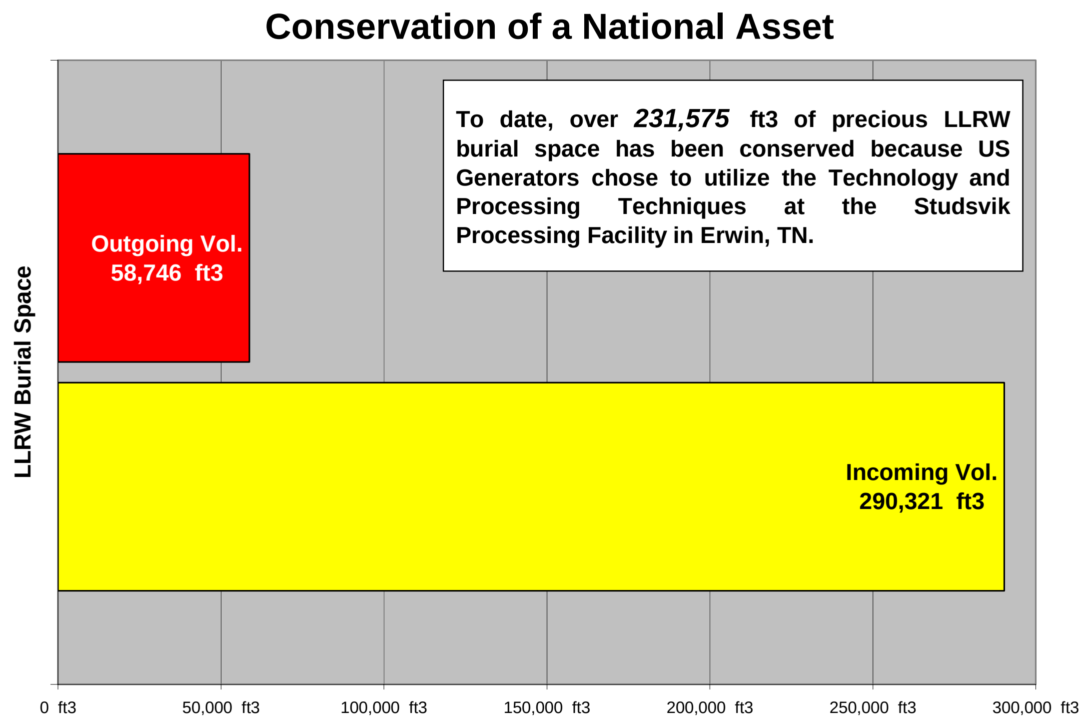

Figure 1

SI Units:

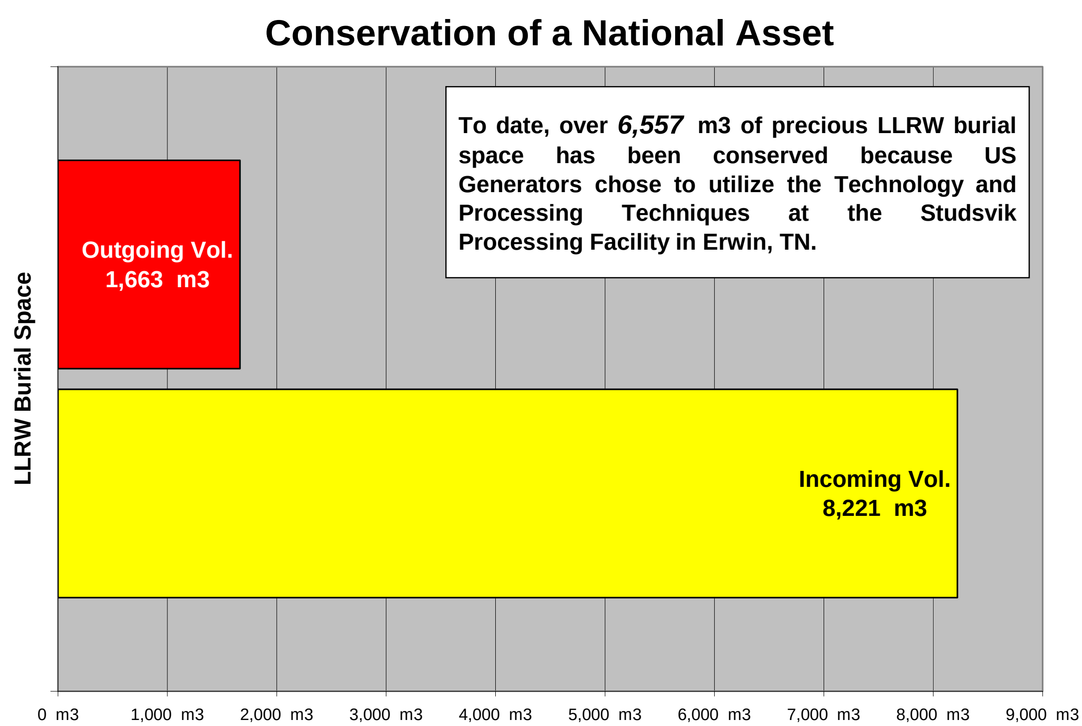

Figure 2