INEEL LEAD RECYCLING IN A MORATORIUM ENVIRONMENT

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ABSTRACT

Since 1999, the Idaho National Engineering and Environmental Laboratory (INEEL) Lead Project successfully recycled over 700,000 pounds of excess INEEL lead to the private sector. On February 14, 2000, the Secretary of Energy, Bill Richardson, formalized the January 12, 2000, moratorium on recycling radioactive scrap metal that prevented the unrestricted release of recycled scrap metals to the private sector. This moratorium created significant problems for the INEEL lead recycling program and associated plans; however, through the cooperative efforts of the INEEL and Idaho State University as well as innovative planning and creative thinking the recycling issues were resolved. This collaboration has recycled over 160,000 pounds of excess lead to Idaho State University with a cost savings of over $.5M.

INTRODUCTION

The INEEL has tested over 50 nuclear reactors since 1954 and each needed lead for shielding, test equipment, and sampling. The INEEL has used lead casks of various sizes and configurations for transporting and housing radioactive materials. Many of these casks were no longer of use, had been decommissioned, and were to be dispositioned per the INEEL Site Treatment Plan. Since lead is regulated under RCRA and contaminated lead waste is a mixed waste, disposition requires care and vigilance. The INEEL Lead Project was commissioned and tasked with the safe and compliant disposition of excess INEEL lead.

In 1999, INEEL Lead Project successfully recycled nearly 200,000 pounds of excess INEEL lead to the private sector. The project identified, characterized, and shipped lead casks to GTS Duratek in Oak Ridge, TN for recycling and free release on the open market. The INEEL Lead Project was preparing to start a multi-year campaign to ship several million pounds of lead casks and excess lead to the private sector when the recycling project was brought to a halt.

On February 14, 2000, the Secretary of Energy, Bill Richardson, formalized the January 12, 2000, moratorium on recycling radioactive scrap metal that prevented the unrestricted release of recycled scrap metals to the private sector. On July 13, 2000, Secretary Richardson released another memorandum regarding the moratorium. This memorandum again continued the January 12, 2000, moratorium and "suspended unrestricted release for recycling of scrap metal from radiation areas within DOE facilities."

This moratorium created significant problems for the INEEL lead recycling program and associated plans; however, through cooperative efforts and innovative planning, the recycling issues were resolved. Although the moratorium restricted the release of recycled metals to the private sector, recycling and reuse were still encouraged within the Department of Energy (DOE) and commercial nuclear facilities.

IDENTIFIED NEED FOR RECYCLED LEAD

The INEEL Lead Project often receives formal and informal requests for lead to support various projects. These requests have come from both within and outside the INEEL. While the INEEL Lead Program was charting a course through the moratoriums and memorandums, one such request came from the Idaho State University (ISU) Idaho Accelerator Center (IAC). The ISU IAC had a need for lead bricks. The INEEL had excess lead. The solution was simple; the problem was how to get ISU the lead they needed and the INEEL needed to disposition within the restrictions presented by the DOE moratoriums.

On January 20, 2000, Dr. Frank Harmon, the Director of the Idaho State University (ISU) Idaho Accelerator Center (IAC), requested 100 tons of lead bricks from the INEEL. These lead bricks were needed to expand the capability of an existing auxiliary test cell at the IAC facility. Radiation shielding on two of the auxiliary test cell walls would allow separate and independent operation of additional electron accelerators. The most direct way to accomplish this upgrade in the shielding was to add a lead-brick layer against the existing concrete walls. The lead brick would be held in place with steel beams and completely covered with plywood sheathing. It is expected that the lead brick shielding will be in place for the life of the facility, estimated at 50 years. It is anticipated that the ISU need for lead bricks will not end with the above request. Additional brick may be requested for a number of specialty shielding configurations not yet specified. INEEL Lead Project Engineers met with the IAC and documented the shielding configuration required in Engineering Design File (EDF)-2824, "Idaho State University Accelerator Center Lead Shielding Requirements," (WROC-PROJ-237).

A Memorandum of Understanding, (MOU#DE-GM07-00ID11403), effective January 28, 2000, between the ISU IAC and the Department of Energy, Idaho Operation Office (DOE-ID), provides for significant collaboration opportunities for the INEEL and ISU. The purpose of this MOU is for DOE-ID to advance its technology transfer, technology sharing, and collaborative university research goals by furnishing particle acceleration devices and supporting equipment and materials from the INEEL to the IAC. The requested lead bricks fall within the scope of the MOU. As specified in the MOU, the ISU IAC will be responsible for the operation, inspection, maintenance, repair, and risk of loss of the Government Furnished Property (GFP). This provision in the MOU would include the lead bricks, however, DOE-ID will maintain ultimate control and responsibility over the lead materials.

REGULATORY ISSUES

The INEEL had excess lead in the form of casks. The ISU Accelerator Center needed lead in the form of bricks. Recycling the radioactive lead casks into bricks was a viable option that would be mutually beneficial to both the INEEL and ISU. However, in order to make this process plan a reality; a there were regulatory issues that needed to be addressed.

DOE MORATORIUM ON RELEASE OF MATERIALS FOR RE-USE AND RECYCLE

On February 14, 2000, Bill Richardson, the Secretary of Energy, released a memorandum regarding the release of materials for re-use and recycle. This memorandum notified the Department of Energy that the January 12, 2000, moratorium on the release of volumetrically contaminated metals will remain in effect until the Nuclear Regulatory Commission (NRC) makes a decision regarding whether to proceed with a rulemaking which would set national standards for the release of solid materials. This moratorium prevents the unrestricted release of scrap metals from radiation areas to the private sector. On July 13, 2000, Secretary of Energy, Bill Richardson, released another memorandum regarding the moratorium. This memorandum again continued the January 12, 2000 moratorium; however, it stated that, "All DOE programs and sites should expand their efforts to reuse and recycle materials within the department." In addition, Secretary Richardson indicated that DOE would be developing a set a proposed actions that

would provide incentives for internal reuse and recycling, when such activities are cost-effective and protective of workers, the public, and the environment.

In the case of the ISU need for lead, the lead would not be released to the public, but would remain under the DOE-ID realm of responsibility. The ISU Accelerator Center Program is a cooperative agreement between the DOE-ID and the University. All materials and equipment furnished by the DOE-ID to the ISU Accelerator Center are to be returned when the projects end or after the termination of the MOU, unless otherwise renegotiated.

FEDERAL REGISTER EXCLUSION OF PROCESSED SCRAP METAL FROM RCRA

In the Federal Register, Vol. 62, No. 91, Monday, May 12, 1997, Rules and Regulations, VIII, "Changes to Definition of Solid Waste to Exclude Processed Scrap Metal and Shredded Circuit Boards from RCRA Jurisdiction." The Environmental Protection Agency (EPA) amended the definition of solid waste to exclude processed scrap metal from RCRA jurisdiction. The EPA believes that processed scrap metal being recycled is distinct from other secondary materials defined as wastes when recycled. This is due to established markets for the material's utilization, inherent positive economic value of the material, the physical form of the material, and absence of damage incidents attributable to the material, and is therefore, sufficiently product-like that maintaining RCRA regulatory jurisdiction over this material is not necessary.

The EPA further clarifies that the exclusion for processed scrap metal being recycled applies to scrap metal that has undergone a processing step, regardless of who does the processing. In other words, a processing step may be performed by the generator, an intermediate scrap handler, or a scrap recycler. The EPA has added chopping, crushing, flattening, cutting, and sorting processes typically used in the processing of scrap metal for recycling to the definition of processed scrap metal in the final rule.

PROCESSING/RECYCLING OF LEAD CASKS

Once the regulatory issues were addressed, the proposed plan to process the INEEL lead casks into $2 \times 4 \times 8$ in. bricks was set into action. An already existing recycling contract between Bechtel BWXT Idaho, LLC, the INEEL prime contractor, and GTS-Duratek was modified. GTS-Duratek was capable of meeting the lead brick casting specifications and was licensed to handle radioactive materials as well. In FY-2001, approximately 218,000 lb of cask materials (lead and steel) were sent to GTS-Duratek from the INEEL. Table I below identifies the casks sent from the INEEL to GTS-Duratek in support of the recycling project. GTS-Duratek separates the steel from the lead. The steel is then cast into shield blocks for use at other DOE facilities. The extracted lead is cast into 2000-lb ingots. These ingots are then used in a separate process to cast lead bricks. Typically, the bricks are $2 \times 4 \times 8$ in. in size. Sampling and analysis of the lead brick lots prior to shipment to the INEEL or ISU will be conducted by GTS-Duratek to identify radioactive concentrations of the lead bricks. GTS-Duratek started casting lead bricks for ISU in April 2001.

Table I. Cask and cask materials sent to GTS-Duratek for recycling in FY-2001.

Date Shipped	Cask Description	wt (lbs.)	Volume
2/21/01	ATR-2	36,981	2.32 m^3
2/21/01	NR-1	23,400	1.47 m^3
2/22/01	Loft Downcomer	24,000	1.50 m^3
6/5/01	multicurie cell cask	600	1.2 ft^3
6/5/01	multicurie cell cask	4,500	7.39 ft^3
6/5/01	multicurie cell cask	4,500	7.39 ft^3
6/5/01	multicurie cell cask	4,500	7.39 ft^3
7/26/01	TFB Cask	18,500	0.6 m^3
7/31/01	Coffin Dolly	33,000	47 ft^3
7/31/01	Plug Beam & Misc.	26,800	35 ft^3
			0.83 ft^3
			20 gal
			10 ft^3
			10 ft^3
9/27/01	White Elephant	12,500	0.6 m^3
9/27/01	PBF-1	17,100	0.79 m^3
9/27/01	D&D Lead	9,420	16 ft^3
9/27/01	D&D Lead	2,860	16 ft^3
	Total:	**218,661**	

COST BENEFITS

Recycling of lead, especially contaminated lead is an expensive undertaking; however, when comparing recycling costs to treatment and disposal costs it becomes obvious that the pros out weigh the cons. The average treatment and disposal total cost for radioactively contaminated lead is approximately $5.00/lb. This $5.00/lb includes characterization, waste profiling, packaging, transportation, treatment, and disposal. The estimated treatment and disposal cost for the 218,661 lb of lead casks materials listed in Table I based on the $5.00/lb would be approximately $1,090,000.00

The recycling and recasting process costs between $1.00/lb and $5.00/lb. As the quantity of lead sent for recycling increases, the price per pound drops. The approximate total cost for recycling the 218,661 lb of cask materials is approximately $4.30/lb or $940,000.00. Again, this includes characterization, profiling, packaging, transportation, and recycling. As more lead is sent to GTS-Duratek, this overall cost will continue to drop.

The additional hidden cost savings in this process, however, is the fact that ISU won't have to purchase new bricks. The estimated cost to purchase 200,000 lb of new bricks is $349,000.00. This is based on 26 ¼ lb per 2 × 4 × 8 in. brick and $45.80 per brick (McMaster-Carr, Supply Company Catalog). Table II summarizes the estimated costs.

Table II. Cost comparison for the treatment and disposal versus recycling options.

Process	Estimated cost per process
Treatment and Disposal (218,661 lb casks) Purchase of new bricks (200,000 lb) Total:	$1,090,000.00 + $349,000.00 $1,439,000.00
Recycling and Recasting (218,661 lb casks)	$940,000.00

Recycling the INEEL lead cask materials into bricks for the ISU Accelerator Center resulted in an overall cost savings of approximately $500,000.00.

CONCLUSION

By the spring of 2002, over 700,000 pounds of excess lead had been shipped to Duratek, and 160,000 pounds of lead bricks had been delivered to ISU. The estimated cost savings exceed $1M over disposal of the lead in a landfill and procurement of new shielding materials. The INEEL Lead Project has charted a new course to compliantly recycle mixed waste into useful products and avoid unnecessary disposal costs.

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