ASSET RECOVERY OF HAZARDOUS MATERIALS BENEFICIAL REUSE OF RADIOLOGICALLY ENCUMBERED LEAD STOCKS

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ABSTRACT

Underutilized and surplus lead stocks and leaded components are a common legacy environmental problem across much of the Department of Energy (DOE) Complex. While seeking to dispose of these items through its Environmental Management Program, DOE operational programs continue to pursue contemporary mission requirements such as managing and/or storing radioactive isotopes that require lead materials for shielding. This paradox was identified in late 1999 when DOE’s policies for managing scrap metal were assessed. In January 2000, the Secretary of Energy directed the National Center of Excellence for Materials Recycle (NMR) to develop and implement a comprehensive lead reuse program for all of DOE.

Fluor Hanford, contractor for DOE Richland Operations, subsequently contacted NMR to pilot lead reclamation and reuse at the Hanford Site. This relationship resulted in the development of a beneficial reuse pathway for lead reclaimed from spent fuel transport railcars being stored at Hanford. The 1.3 million pounds of lead in the railcars is considered radiologically encumbered due to its prior use. Further, the material was considered a mixed Resource Conservation and Recovery Act (RCRA) low-level radioactive waste that would require expensive storage or macro encapsulation to meet land disposal restrictions prior to burial.

Working closely with Flour Hanford and the Office of Air, Water, and Radiation (EH-412), NMR developed a directed reuse pathway for this and other radiologically encumbered lead. When derived supplemental release limits were used, the lead recovered from these railcars became eligible for reuse in shielding products to support DOE and commercial nuclear industry operations. Using this disposition pathway has saved Hanford one third of the cost of disposing of the lead and the cost of acquiring additional lead for nuclear shielding applications. Furthermore, the environmental costs associated with mining and producing new lead for shielding products and stewardship of the waste was eliminated. Methods and processes developed in cooperation with Fluor Hanford are applicable to, and have been successfully applied to, lead stocks at DOE sites such as Savannah River, Mound, Los Alamos, and Idaho.
INTRODUCTION

With the unrestricted use of metal recovered from radiologically controlled areas prohibited, options for disposing of lead are quite limited. Essentially, the only viable outlet has been compliant disposal. For lead, compliant disposal requires macro encapsulation with several inches of plastic followed by burial. The cost for lead disposal has therefore been quite high, in excess of $3.00 per pound.

Further examination of DOE procurements revealed that the DOE was purchasing new lead at the same time program elements were offering used lead for disposal. After considerable study, it was determined that old lead could be “reallocated” to new uses to support nuclear shielding requirements at much less cost than disposal. By adopting this approach, DOE could save money while practicing model environmental stewardship.

The pilot effort for recovering and recycling lead was done as a partnership between Flour Hanford and the DOE National Center for Materials Recycle (NMR) in Oak Ridge. The effort took lead recovered from Hanford decontamination and decommissioning projects and re-fabricated it into casks for storing isotopes. For this project, the lead was processed and verified to be compliant with release requirements and standards expressed in DOE Order 5400.5 Radiation Protection of the Public.

Since this successful pilot project, NMR has developed, according to DOE Order 5400.5 requirements, supplemental release limits for the directed reuse of lead in nuclear shielding applications. These limits are contained in Supplemental Release Limits for Directed Reuse of Lead in Shielded Products by the Department of Energy, October 2001, (ORNL TM-2001/36). This document specifies limits for radionuclide concentrations throughout the volume of lead to be offered for directed reuse. Applying supplemental limits has expanded the amount of lead eligible for recovery and reuse.

Since its establishment in early 2001, the Lead Reuse Program has secured the reuse of more than one million pounds of lead coming from throughout the DOE complex - 400,000 pounds came from Hanford.

FACTS AND BENEFITS

On July 13, 2000 the DOE’s Secretary of Energy established a policy that suspended releasing DOE’s scrap metal from radiological areas into open commerce. This policy covered all metals even if they were free of radioactive contamination or as established by DOE Order 5400.5, they were stored in a radiological area as defined by 10CFR835 on or after that date. With this restriction of release into general commerce, these metals should be viewed as “administratively encumbered.”

With shrinking budgets, increasing regulatory scrutiny, and the high cost of compliant disposal, the directed reuse of lead provides a viable, cost-effective option that can expedite dispositioning unwanted lead stocks. Recycling however, is not free. Generators of the lead are expected to pay up to $3.00 per pound to place their lead into the recycle pathway. To date, the highest cost for lead recycle into directed use products has been less than $2.50 per pound with the mean price firmly established at $1.75 per pound.
Recycling is also beneficial from a regulatory perspective. If the lead is programmed for recycling rather than waste disposal, some relief from RCRA storage requirements can be expected. Lead is considered an “intermediate” in an industrial process and is exempt, for the most part, from RCRA regulations. This exemption, however, does not absolve the generator from proper and prudent handling, but does offer relief in the type and location of storage space used to manage the lead prior to it being shipped for recycling.

In addition, the United States Environmental Protection Agency’s charter firmly establishes recycle and reuse as the preferred disposition pathways for unwanted materials – especially those with inherent toxicity such as lead. Cooperation with local and federal regulators can be expected for *bona fide* recycle projects such as the DOE Lead Recycle Program.

**TYPICAL LEAD PRODUCTS**

To date, the Lead Recycle Program has secured the manufacture of storage casks for Fluor Hanford, isotope storage casks for the Pacific Northwest National Laboratory, a spent fuel transfer cask for Southern California Edison, shielded 55 gallon drum overpacks, shielded boxes, lead bricks, and some one-of-a-kind items. In this last category of items, efforts are now underway to fabricate shields for ion-exchange columns to support the Spallation Neutron Source (SNS) project.

Virtually any product requiring lead for shielding applications can be fabricated, or in the case of lead bricks and some sheet, be directly reused. To date manufacturing costs for these products has ranged from $0.50 to $2.50 per pound burdened entirely on the lead content of the item. With compliant disposal costs running $3.00 and up, many generators find it financially advantageous to recycle rather than dispose.

**VALUE OF LEAD PRODUCTS**

A market study was conducted across potential government and commercial consumers of their need and pricing thresholds for shielded products. The products would be made from lead recovered from DOE decontamination and decommissioning projects that could be determined to meet the authorized release criteria contained in DOE Order 5400.5 or Supplemental Release Limits for Directed Reuse of Lead in Shielded Products by the Department of Energy (ORNL TM-2001/36). This study showed consumers were willing to pay for specific types of shielded containers, as given in Table 1 below:

<table>
<thead>
<tr>
<th>Container Type</th>
<th>Price Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 Gallon Drum, Lead Lined</td>
<td>$1,000 - $1,999</td>
</tr>
<tr>
<td>55 Gallon Drum Overpack</td>
<td>&lt;$4,999</td>
</tr>
<tr>
<td>4’x6’x4’ Lead-Lined Box</td>
<td>$7,499-$15,000</td>
</tr>
<tr>
<td>4’x6’x4’ Lead-Lined Box Overpack</td>
<td>$19,999-$29,999</td>
</tr>
</tbody>
</table>

Assuming “willingness to pay” is an accurate estimate of value, the value of lead shielded products appears to be significant.
DEMAND FOR LEAD PRODUCTS

During the market survey, respondents were asked how much of each candidate lead product they would purchase at different prices and if the price were for the cost of freight only. Little change in demand was noted for all but one of the products listed in Table 1. With the exception of the 4’x4’x6’ lead-lined box, demand for each of the products remained constant across the price ranges quoted in Table 1. For the box, however, reducing the price to “freight cost only” resulted in a 40 percent increase in demand over the minimum cost of $7,499 per unit. This is likely due to the specialized nature of these products. When a project demands a lead-lined container, little else will suffice.

Since these are custom-built items, there is little price competition in the market place. The significant increase in demand for the shielded box may also be due to project reconfiguring to take advantage of a cost-free container (except for freight costs). In any event, the market study clearly demonstrates that a market exists for recycled lead products in both the commercial and government sectors.

LEAD RECYCLE BUSINESS PRACTICES

Currently, the generator of the lead is burdened with the cost of dispositioning through recycling and reuse – currently up to $2.50 per pound, depending on the amount and character of the lead offered. This is contrasted with the costs for disposal ranging from $3.00 - $6.00 per pound for macro-encapsulation followed by disposal as low-level radioactive mixed RCRA waste. In all lead disposition cases presented to NMR to date, costs to recycle has ranged from approximately $0.70 to $2.50 per pound. Recycling has proven to be the least cost dispositioning option for lead in all cases offered to date.

These funds are used to pay for shell fabrication and lead processing (including remelting) to cycle the lead into a reuse pathway. Typically, NMR secures an outlet for lead before accepting it into the program. When lead is transferred, funds are also transferred through internal DOE financial mechanisms. NMR uses up to the amount authorized and returns any residual funding to the generator.

Processing services for lead requiring decontamination is secured through NMR’s Asset Recovery Basic Ordering Agreement (BOA). This is a competitive vehicle currently held by four pre-qualified vendors. Each vendor has a radioactive materials license that permits possession, handling, processing, and release of materials from radiological control. The license is granted either by the Nuclear Regulatory Commission (NRC) or an NRC Agreement state. No processing is done at DOE facilities.

CURRENT DOE LEAD REUSE POLICY

On January 19, 2001, the Secretary of Energy established the current DOE policy regarding lead reuse. This policy requires programs to seek to reuse lead rather than purchase additional lead from commercial suppliers.
It also requires generators of unwanted lead to preferentially seek disposition of this material through recycle and reuse pathways that involve placing lead in nuclear shielding applications. This policy is not only consistent with previous policy directives regarding release of metals from radiological areas into general commerce, but also with a host of Executive Orders mandating “green” procurement and management practices for federal agencies.

In fact, DOE’s policy states that the reuse of lead metal and lead products will take precedence over the purchase of new lead metal and lead products. DOE is required to give first consideration to reusing existing lead inventories before procuring any new lead metal or lead products. If you do have an inventory of lead, or need lead products, the policy is that you will coordinate your lead reuse efforts with the DOE National Center of Excellence for Metals Recycle (NMR).

NMR continues to work with its DOE headquarter counterparts to gain more flexibility under the DOE Metals Recycling Moratorium.

The program we have established is the result of considerable effort and arm wrestling to gain more latitude. Although, we here would like to see a “lifting” of the moratorium, NMR’s crystal ball does not see this happening any time in the near future.

LEAD RECYCLING WORKS

This recently developed process for reusing and recycling lead is a sound business practice. The system was built with careful consideration for not only the costs and benefits of lead recycle and the attendant products produced, but also for the costs of compliant disposal. Qualitative externalities such as the environmental benefits of mining less lead ore were intentionally not considered to simplify the economic decision between recycling and disposal.

Key to the success of this new business center has been our ability to make use of commercial resources. Duratek; Bull Run Metals; Nuclear Lead, Inc.; and Toxco have been extremely active in the competitive procurements issued by NMR and Fluor Hanford to secure the processing and reuse of over 1,000,000 pounds of lead over the last year and one half. Through the use of our Asset Recovery BOA, we are also attracting other firms to compete for lead recycling projects. Through the BOA, DOE is able to reduce the administrative burden on qualified firms by consolidating qualification audits on these facilities.

As this program becomes more visible and successful, it will generate its own market and demand. With increased demand for the lead products, prices will be kept in check as the throughput of lead increases.

NMR is diligently working to expand the markets and products for this lead. One key area NMR is working is to expand who can recycle this lead into compliant products. The other area is to broaden the types of products that can be manufactured for nuclear applications.
KEYS TO CONTINUED SUCCESS

The directed reuse of impacted lead is gaining momentum and becoming a real success. Among The Center of Excellence for Materials Recycle, DOE contractors, and the private sector, a strong, viable industry has evolved around the concept of directed reuse of impacted lead. The concept and practice have created a great opportunity that is helping make generators, end users, and regulators winners.

A synergy is developing that is perpetuating the conventional recycle loop. Generators now have options for dispositioning lead; and users, a source for cost-effective lead products. Regulators at all levels appear comfortable with the direction this new industry is headed. As the industry matures, we should see an increase in the value for all parties.

One area NMR is working to increase the value to all parties is the development of standard type products. This eliminates repeated engineering costs and increases production efficiencies that ultimately lead to increased value. Based on industry requests, NMR recently undertook a project to drop test a lead lined box to gain “7A” Department of Transportation shipping certifications. These boxes are all ready in production.

Standard sampling and analysis protocols are also being enhanced. The enhancements will reduce characterization efforts of lead that has the potential for volumetric contamination. Recent analysis of the Fluor Hanford lead provided much needed information, experience, and confidence that will streamline future analysis efforts.

CONCLUSION

Lead recycle and reuse is a viable disposition alternative to disposal. In most cases it has proven to be more cost effective even when the value of the resulting product is not taken into account. With compliant disposal costs of $3.00 per pound and above, recycling of lead has been found to always be more financially advantageous than disposal. The value of the products made from this material represents an additional bonus to DOE.

Lead recycling, as presented in this paper, is not only compliant with current DOE policy regarding the release of scrap metals from radiological areas, but represents the preferred dispositioning pathway for DOE lead stocks. Recycling offers advantages to generators in the form of exemption from RCRA storage requirements because lead earmarked for recycle is not considered a waste. Generators must take care to insure their lead is programmed for recycle to assure themselves of environmental compliance.

From a stakeholder standpoint, members of the general public have applauded this directed reuse program. Interest groups and individual citizens alike have commented that more should be done to secure directed reuse outlets for other materials such as nickel and steel.

If you have questions or need more information, the best contacts for information are:

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