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ABSTRACT

The United States Department of Energy (DOE) is expected to issue a policy early this year articulating DOE's position on the recycle of DOE radioactive scrap metal. In anticipation of this "Recycle 2000" initiative, the nuclear industry has formed a new trade association called the Association of Radioactive Metal Recyclers (ARMR). This article describes the Recycle 2000 initiative, provides some background on ARMR and its membership, and identifies industry views on the actions to be taken and issues to be resolved if Recycle 2000 is to become a reality.

RECYCLE 2000

The U.S. Department of Energy (DOE) has a huge volume of radioactive scrap metal (RSM) in inventory at sites across the DOE complex. In March 1995, an inventory report prepared for the Office of Technology Development documented the existence of 157,501 tons of contaminated carbon steel at thirteen (13) sites (1). Others have estimated that, when metal generated during the future dismantlement of contaminated DOE facilities is included, the total volume of DOE RSM could reach 3 million tons!

In December 1994, the "Recycle 2000" concept was articulated by DOE at a meeting in Denver in conjunction with a diverse group of stakeholders including citizens groups, environmental organizations, unions, industry and various government organizations. The overall objective was to determine stakeholder support for DOE to remove RSM from the waste disposal stream and "beneficially reuse" the DOE metal in applications where its small radioactivity content would not be a detriment. Specifically, DOE proposed that, by the year 2000, at least 50 percent of the low-level waste disposal containers (B-25 boxes) used by DOE would be fabricated from DOE-generated radiologically contaminated carbon steel defined as RSM. Such a proposal would recycle natural resources (metal) and vastly reduce the DOE disposal volume that would otherwise be required if the radioactive scrap metal was buried.

Since this successful Recycle 2000 concept introduction, other meetings have been conducted by DOE in Salt Lake City and Knoxville with considerable emphasis placed on, 1) developing a cost model comparing the cost of recycling RSM into waste containers to the cost of burial, and 2) evaluating the dose received (risk) by industry workers and the general public if the Recycle 2000 concept was implemented.

There appears to be considerable support for recycling not only in industry but throughout DOE and EPA. Consider the following:

- USDOE Assistant Secretary for Environmental Management, Thomas P. Grumbly, has stated that, "It is our policy to reuse or recycle these scrap metals to the maximum practical extent" (2).

- USDOE Director of Environmental Restoration, James Owendoff, expressed in a Weapons Complex Monitor interview a preference to use waste disposal containers fabricated from recycled DOE metal as opposed to containers made from virgin steel, even at a large cost premium (3).
- USDOE Director of the Office of Eastern Area Programs, Jim Fiore, has stated, "Pollution prevention and waste minimization activities such as scrap metal recycling are supported and encouraged by Headquarters" (4).
- USDOE Director of the Waste Minimization Division, J. Kent Hancock, estimated that between \$28 to \$43 billion could be saved within the complex over the next 75 years by implementing pollution prevention programs including recycling (5).
- The USEPA has established pollution prevention as a "national objective" requiring that pollution be prevented or eliminated at the source wherever feasible, recycled when prevention is not feasible, and disposed of only as a last resort.
- Presidential Executive Order #12780 requires that DOE "promote cost-effective waste reduction and recycling of usable materials from waste generated by Federal Government activities," and that DOE "integrate these programs to assist in addressing the nation's solid waste disposal problems."

Because of the strong support for recycling both within industry and government, the industry consensus is that the Recycle 2000 Policy will be adopted by DOE and promulgated in early 1996.

ASSOCIATION OF RADIOACTIVE METAL RECYCLERS (ARMR)

In 1995, strong industry interest in the beneficial reuse concept and in DOE's Recycle 2000 initiative spawned the formation of a new trade association called the Association of Radioactive Metal Recyclers (ARMR), headquartered at the University of Tennessee in Knoxville.

ARMR is a trade organization of the holders, decontamination processors, metal fabricators and end users of recycled radioactive scrap metal. Through the activities of the Association, the Members seek to stimulate and support the movement of radioactive scrap metal to useful products with the following specific objectives:

- Coordinate the exchange of information among the Members regarding Radioactive Scrap Metal (RSM).
- Foster the identification of reuse products, including the free release of decontaminated metals.
- Support the development of the industry infrastructure to permit the beneficial reuse of RSM.
- Encourage research into cost-effective recycle of RSM.
- Advocate regulatory practices and national standards supportive of RSM recycle.
- Promote the recycle of RSM as an environmentally favorable and cost effective alternative to disposal.
- Hold or participate in industrial society meetings to promote the recycle of RSM.
- Provide information to the interested public and speak with the single voice of a trade association.
- Advance other activities supportive of the purpose of the Association.

Since its formation, ARMR has worked closely with DOE in refining the Recycle 2000 policy. In an October 13, 1995 letter to ARMR, Tom Grumbly, DOE Assistant Secretary for Environmental Management, stated that "We welcome your (ARMR) thoughts on how to implement that decision (Recycle 2000) efficiently and quickly. We also encourage you to share your ideas on how the National Recycle Program might be expanded in the future." Although ARMR has a strong focus on DOE, the organization will also address material generated by the commercial nuclear power industry and the fabrication of many different products in addition to low-level waste containers.

A current list of ARMR organizational members include:

- Advanced Recovery Systems
- Alaron
- Allied Erecting and Dismantling
- American Technologies, Inc.
- Brandenburg Industrial Service Co.
- CDM Federal Programs
- Carolina Metals
- Corpex Technologies
- Fernald Environmental Restoration Management Corporation (FERMCO)
- Hake Associates
- Lockheed Martin Energy Systems, Inc.
- MSE Western Environmental Technology Offices
- M4 Environmental Management, Inc.
- Manufacturing Sciences Corporation
- Molten Metal Technology
- Princeton Plasma Physics Lab
- Scientific Ecology Group
- University of Tennessee
- U.S. Ecology
- Westinghouse Savannah River Company

The formation of ARMR and the list of organizational members should leave no doubt in anyone's mind that **industry is ready to support the DOE Recycle 2000 effort!**

INDUSTRY IS READY!

Recycling options available today for radioactive scrap metal include both decontamination/free release of metal and metal melting/beneficial reuse.

Decontamination/Free Release Capability

The nuclear services industry not only strongly supports the Recycle 2000 concept but has already made considerable capital investment in preparing to respond to DOE for policy implementation. In fact, nuclear industry emphasis on waste volume reduction beginning in 1980 has spawned a number of companies that specialize in removing contaminated material, including contaminated metal, from the waste disposal stream. These companies are typically licensed by agreement states, states authorized by the Nuclear Regulatory Commission to issue radioactive material licenses, and permitted to receive radiologically contaminated metal for subsequent decontamination, survey, and free release in accordance with NRC Regulatory Guide 1.86 and DOE Order 5400.5.

A list of companies currently operating commercial facilities offering decontamination and free-release service is as follows:

ALARON	Pittsburgh, PA
ATG	Richland, Washington
Hake Associates	Memphis, TN
Manufacturing Sciences Corporation	Oak Ridge, TN
SEG	Oak Ridge, TN
US Ecology	Oak Ridge, TN

The metal most suitable for cost-effective decontamination and free-release normally has a high mass to surface area ratio with easily accessible surfaces for decontamination and survey. Following metal decontamination and free release, the metal is typically sold to commercial scrap metal dealers.

Metal Melting/Beneficial Reuse Capability

In direct support of the Recycle 2000 initiative, industry has recently expanded its metal recycling capability going beyond simple decontamination/free release. Specifically, a number of companies now offer metal melting services for that metal that cannot be easily decontaminated -- a capability required to support Recycle 2000. In fact, a true niche marketplace has developed with considerable competition.

SEG

In 1990, SEG was the first company to offer commercial metal melting services to process metal not suitable for economic decontamination, that is, metal with low mass to surface areas, inaccessible surfaces or otherwise difficult or impossible to decontaminate.

The melting process reduces the bulked volume of radiologically contaminated scrap metal by a factor of approximately 15. The process also concentrates most of the RSM's radioactivity in the "slag" which is removed for burial. Since the resulting metal product still retains a small amount of volumetric radioactivity, the product cannot be "free released" under current regulations in the United States. SEG has contracted with Los Alamos to provide shield blocks fabricated from this metal - an application where the slight volumetric contamination of the metal was not a detriment to the products intended use - shielding (6). SEG currently has the capacity to melt and process more than 15,000 tons per year.

In addition to its metal melt facilities in Oak Ridge, SEG has acquired and now operates a container fabrication facility in Carlsbad, New Mexico.

SEG's effort has been followed up and expanded by other companies in an attempt to anticipate the commercial opportunities growing out of the Recycle 2000 concept.

MANUFACTURING SCIENCES CORPORATION (MSC)

MSC, in a joint venture with British Nuclear Fuels Limited (BNFL), recently completed construction of a new, 115,000 square foot metal recycling facility in Oak Ridge. The facility features automated indoor storage of all incoming contaminated scrap metal, remotely operated material handling, semi-automated mechanical and chemical decontamination processes and vacuum induction melting. The new plant will operate in conjunction with MSC's existing metal rolling and fabrication facility. Estimated plant capacity for complete metal recycle is 10,000 tons per year.

MSC is ideally positioned to respond to Recycle 2000 in the short-term since the company possesses not only the capability to melt RSM into ingots but also to roll the ingots into metal sheet and fabricate waste containers.

MSC also has a contract with DOE to convert four buildings at Rocky Flats to commercial use for RSM recycling. These buildings collectively contain nine vacuum induction melting furnaces and two rolling mills. This so-called National Conversion Pilot Project, when completed in 1997, will be offered by DOE to commercial enterprises and be available to support DOE Recycle 2000 efforts.

CAROLINA METALS

Carolina Metals operates a metals processing facility in Barnwell, SC which is licensed to handle radioactive materials. In 1995, the company worked with MSC in a demonstration to fabricate stainless steel containers for Westinghouse Savannah River Company using 20 tons of volumetrically contaminated heat exchangers, cooling water piping, and slug buckets from activities at SRS. The company has an estimated capacity to melt 1,000 tons of RSM annually.

Carolina Metals currently does not provide any decontamination services but has teamed with Alaron to melt materials which they have generated in their decontamination activities.

RECOMMENDED ACTION

With industry infrastructure in place, it's now time for DOE to consider the privatization of DOE recycling efforts. Privatization would enable commercial companies to recycle DOE metal operations under NRC or Agreement State rules - and not be bound by DOE Orders which frequently increase cost. The concept has many advantages:

Speed - DOE recycling efforts can move forward quickly if DOE will fund large recycling projects by commercial companies, essentially privatizing the function in support of Recycle 2000 objectives.

Cost Reduction - A large-scale privatization effort will provide significant manufacturing "economies-of-scale" resulting in reduced DOE costs. In addition, DOE contractor labor costs now incurred in fragmented recycling efforts and in the custodianship of existing RSM piles would be reduced.

Backlog Reduction/Contaminant Migration Mitigation - The huge DOE scrap metal backlog could be eliminated quickly, reducing storage costs and the continued migration of contaminants into the environment from numerous DOE scrap metal piles.

Visible Cleanup Progress - Real cleanup progress will be visible at a time when visible progress is very important.

The strongest argument for action is very pragmatic. Many of DOE's scrap metal piles have been in existence for well over a decade. For example, the Oak Ridge Scrap Metal Program was established in 1986, but the scrap metal piles are still there, in outdoor uncovered storage, with the metal corroding and with small amounts of radionuclides escaping into the environment. DOE has the ability to recycle this material now! The RFP issued in November

1995 by Lockheed-Martin Energy Systems in Oak Ridge for the recycling of approximately 710 tons of RSM is a small first step supporting DOE recycling efforts. A national procurement contract should be considered so that all sites can participate in the achievement of Recycle 2000 objectives. Features of a national procurement contract could include: 1) standardization of terms and conditions. 2) specification of the new family of standard DOE waste disposal containers, and 3) definition of secondary waste disposition responsibility.

KEY ISSUES

Despite broad support within government and industry for the Recycle 2000 effort and industry readiness to support DOE, there are a number of issues that appear to be impeding DOE recycling efforts.

- **Funding**
Current federal budget realities in general and DOE budget cuts in particular put recycling efforts in competition with other cleanup activities for limited dollars. With funding limited, the decision is frequently made to let RSM piles grow in size and deal with them later. If funding for recycling is not provided, it will be difficult or impossible for the Recycle 2000 policy to succeed.
- **Recycle Cost Premiums**
Budget constraints are related to the "recycle cost premium". In many cases, it costs more to recycle metal than to simply bury it. The problem is particularly acute for those DOE sites planning on-site disposal cells where the recycle cost premium can be especially significant. Sometimes the issue is whether to recycle or take what appears to be fiscally expedient action, at least in the short-term.
- **Life Cycle Costs**
The size of the "recycle cost premium" depends heavily on the true life cycle cost of waste disposal. A recent study performed by the Oak Ridge National Laboratory's Center for Risk Management for the DOE's EM Waste Management organization stated that the total annual cost of waste disposal at DOE sites is, in most cases, considerably higher than the burial charge used in most recycle vs. disposal cost comparisons. For example, the full-cost of disposal at the Nevada Test Site in FY-95 was determined to be \$24 per cubic foot, double the published disposal price (7). In fact, the weighted average DOE disposal price in FY95 was calculated to be \$38.50 per cubic foot. By understating real disposal costs, economic analyses comparing recycle to disposal will almost always favor disposal.
- **Decentralization of DOE Recycling Efforts**
DOE recycling efforts are underway at a number of sites across the complex including Oak Ridge, Savannah River, Rocky Flats, INEL and Fernald. Due to the nature of DOE management and operation (M&O) contracts, these positive M&O efforts are often uncoordinated, overlapping and thus unable to take advantage of the substantial "economies of scale" that would result from large-scale DOE procurements to rid the complex of unwanted RSM inventories. It is recommended that DOE centralize recycling activities, utilizing a National Procurement Contract to assure Recycle 2000 policy implementation.

CONCLUSION

The DOE Recycle 2000 Policy has wide support, both in industry and government. Industry has invested millions of dollars in the infrastructure required to support DOE recycling efforts. Now is the time for DOE to move ahead to eliminate the Department's huge backlog of radioactive scrap metal.

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