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FERNALD SCRAP METAL RECYCLING AND BENEFICIAL REUSE

BY

Gerald P. Motl
Daniel D. Burns

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FERMCO*
Fernald Environmental Management Project
P.O. Box 398704
Cincinnati, Ohio 45239-8704

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Gerald P. Motl and Daniel D. Burns
Fernald Environmental Restoration Management Corp.

INTRODUCTION

The Fernald site, formerly known as the Feed Materials Production Facility, is located on a 1,050 acre site 17 miles northwest of downtown Cincinnati, Ohio. From 1953 to 1989, Fernald produced uranium metal products to meet defense production requirements of the Department of Energy. In October 1990, the DOE transferred management responsibility for the site from its Defense Programs organization to the Office of Environmental Restoration and Waste Management. In August 1991, the site was renamed the Fernald Environmental Management Project (FEMP) to reflect the site's new cleanup mission. The Fernald Environmental Restoration Management Corporation (FERMCO) assumed cleanup responsibilities from Westinghouse Environmental Management Company of Ohio (WEMCO) in December 1992, as the DOE's first environmental restoration management contractor (ERMC).

SCRAP METAL PILE HISTORY

During the 36-year production history at Fernald, scrap metal components were routinely accumulated in a scrap metal "boneyard" located in the northeast corner of the Fernald site. The scrap metal pile soon grew to contain over 5,000 tons of scrap metal including structural steel, process equipment, crushed drums, tanks, pipes, vehicles, and other heavy equipment. Much of this material had been contaminated during metal production with uranium levels in excess of 200,000 disintegrations per minute (dpm) alpha.

In 1987, the scrap metal pile was included as part of the Oak Ridge metals management program. This program was set up to decontaminate the enormous quantity of metal in inventory at the three DOE gaseous diffusion plants (K-25, Paducah and Piketon), Oak Ridge National Lab, Y-12 and Fernald. In support of this program, Quadrex Corporation was retained to segregate the Fernald scrap into three categories. The categories included: 1) ferrous material, 2) non-ferrous material such as aluminum and copper and 3) refuse material with no recoverable metal value. The ferrous and non-ferrous materials were further segregated into two piles based on surface contamination levels. Material with contamination levels greater than 200,000 dpm alpha was then weather protected to control contaminated material runoff.

During a six week plant shutdown in the summer of 1989, site management directed the workforce to gather additional scrap metal from throughout the site to improve overall site housekeeping. As a result of "Project Cleansweep," the scrap metal piles became even larger, more unsightly and more dispersed.

See Photo #1

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Fernald Scrap Yard - April, 1990 Following Project "Clean Sweep"

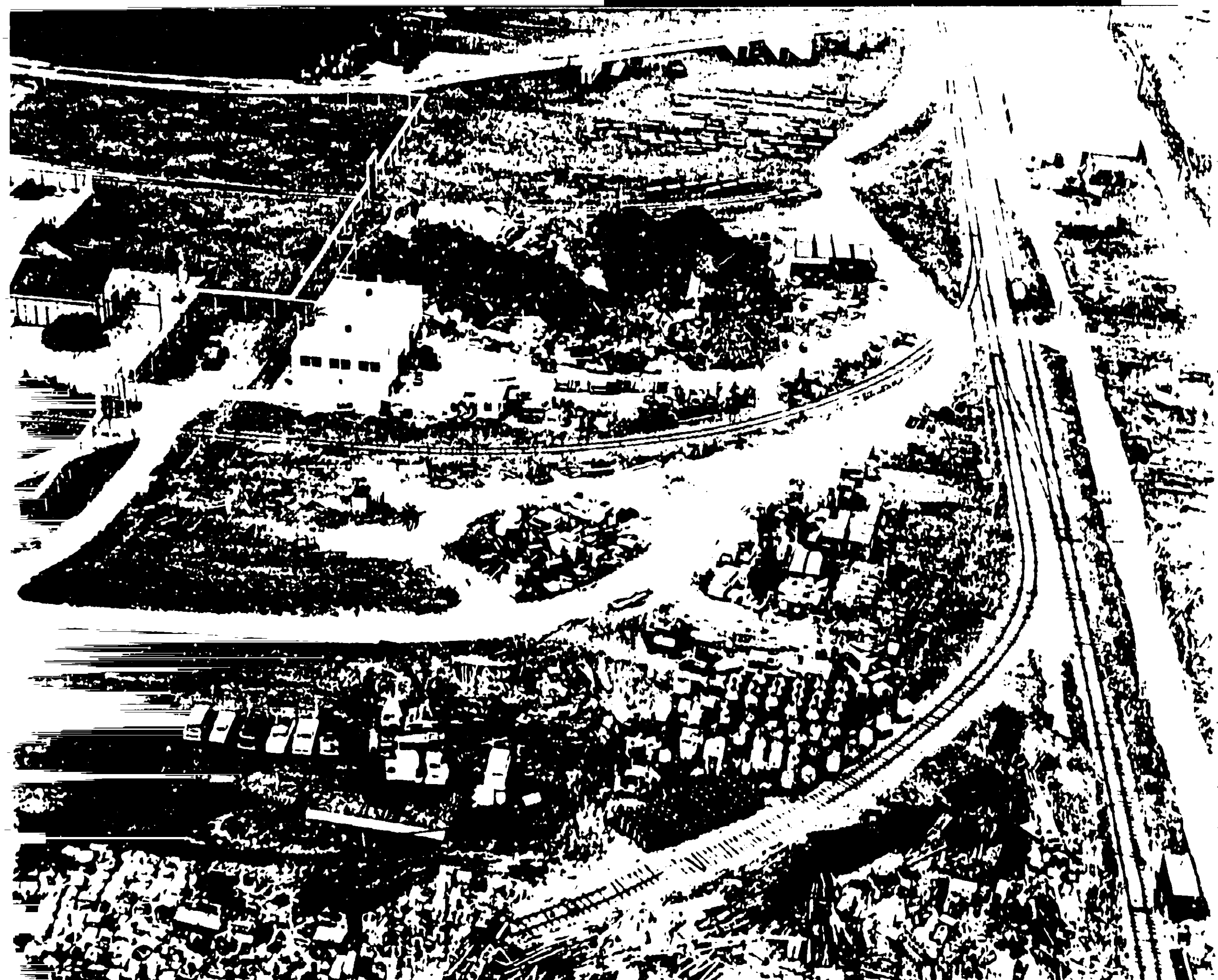

Table 1. SCRAP METAL PILE HISTORY	
DATE	ACTIVITY
1951-87	Metal Accumulation
1987	Metal Segregation
1989	Project "Clean Sweep"
1991	"Refuse" Material Disposal
1992	Scrap Metal Pile Removal Action Approved Recycle/Beneficial Reuse Contract Awarded
1993	Contract Completed

Between June 1991 and November 1992, approximately 3,000 tons of refuse metal was loaded into sealand containers and white metal boxes and shipped to the Nevada Test Site. In fiscal year (FY) 1992, Fernald accounted for 89% of the total DOE waste disposed of at the Nevada Test Site.

See Photo #2

In April 1992, recognizing the need to "reduce the potential for contaminant migration to previously uncontaminated areas and minimize the potential for exposures," the United States Environmental Protection Agency (USEPA) approved Removal Action 15 under the Amended Consent Agreement executed between the EPA and DOE. Removal Action 15 set in motion the plan to recycle and beneficially reuse the ferrous and non-ferrous metals contained in the metal scrap piles. Following an extended procurement process, a contract was awarded to the Scientific Ecology Group (SEG) in December, 1992.

THE PROCUREMENT STRATEGY

The Fernald procurement strategy was to recycle the contents of the scrap metal piles using a subcontractor on a "turn-key" basis. This strategy was conceived by WEMCO and ratified by DOE in order to accelerate increasingly aggressive waste disposition goals.

The strategy envisioned literally "roping off" the pad containing the remaining 2,200 tons of ferrous and non-ferrous scrap metal. The contractor selected would perform all on-site work under a series of project-specific plans, including a Health & Safety plan, a Transportation Plan and a Quality Assurance Plan. Actual metal processing would be performed under a work plan containing procedures that would be submitted to Fernald for review. The responsibility of the subcontractor was to include metal sorting, segregation, size reduction, packaging, transportation, processing and final disposition of the recycled end product. In addition, the subcontractor would be responsible for the characterization, processing, packaging and final disposition of any secondary waste generated during the recycling process. Great emphasis was placed on giving potential bidders flexibility to utilize their commercial expertise to provide the most cost effective and timely recycle options.

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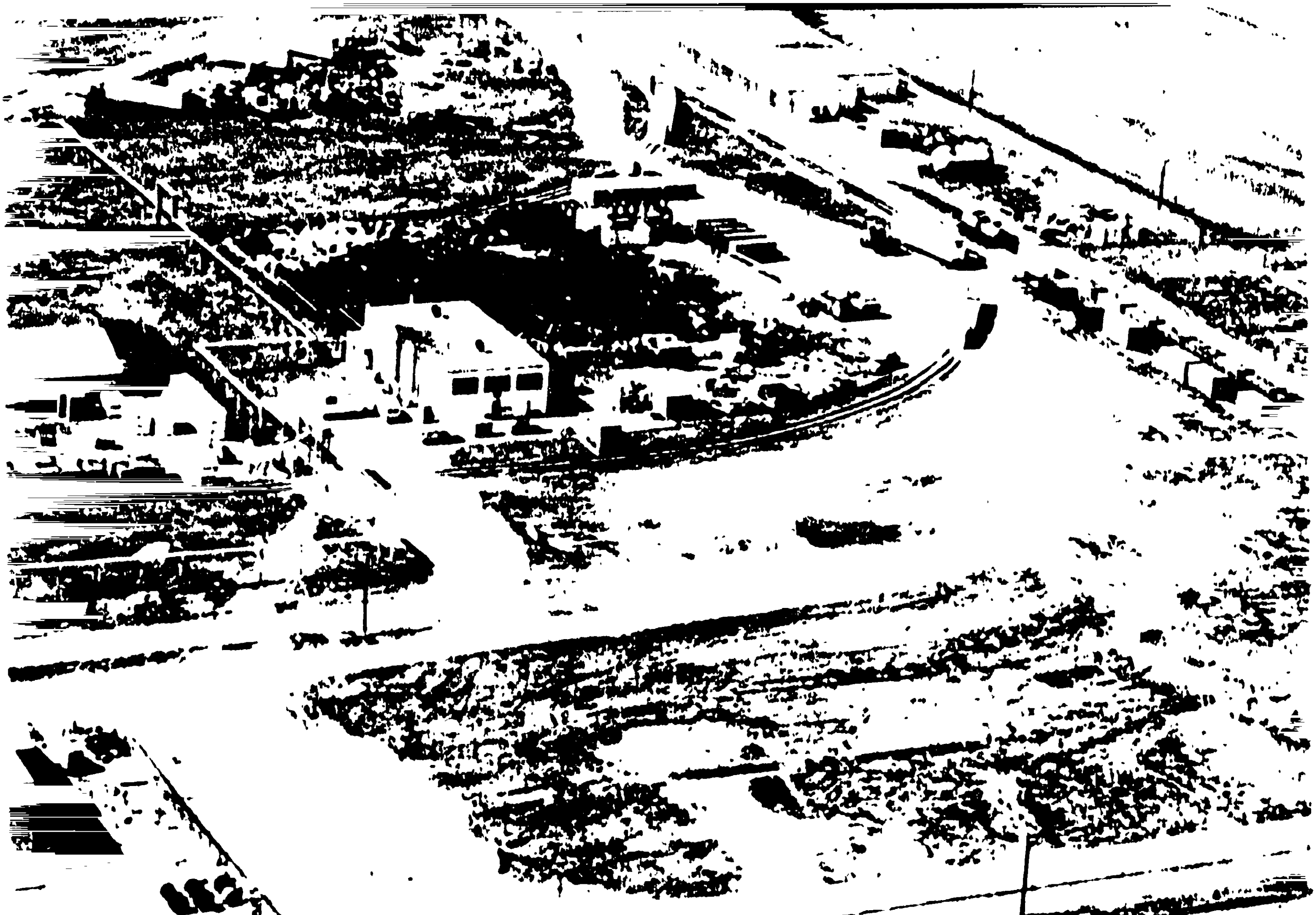
Fernald Scrap Yard - March, 199?
Following Refuse Remova



Proposal evaluation was to be conducted by a Source Evaluation Board using both technical and cost criteria. Since the scrap metal was being recycled as part of a CERCLA Removal Action, the technical evaluation criteria selected were those identified in the National Contingency Plan. These evaluation criteria included:

1. Overall protection of human health and the environment - this criterion measured the effect of residuals remaining after the completion of the activity. An assessment was made of the amount of waste generated by the process and potential exposures resulting from subsequent land burial of waste generated.

2. Compliance with applicable or relevant and appropriate requirements (ARAR's) - a review was conducted to determine applicable regulations as well as applicable DOE orders. Evaluation was made of the bidder's actions and programs to assure compliance with all regulations and DOE orders that were determined to be applicable.

3. Long-term effectiveness - an evaluation was conducted to determine the permanence of the action.

4. Short-term effectiveness - the primary consideration under short-term effectiveness was an assessment of worker safety during the removal action. This consisted of a review of occupational safety and health considerations associated with material movement, an analysis of the hazard identification processes within the bidder's proposals, and an assessment of the mitigating and control mechanisms utilized by the bidder to control hazards.

5. Reduction of toxicity, mobility, and volume - an assessment was completed on the amount of recycling and volume reduction obtained by the action proposed. Additionally, for any secondary waste generated, the mobility and toxicity of the waste was assessed and an evaluation was conducted of the bidder's ability to meet the waste acceptance criteria for ultimate waste disposal.

6. Implementation feasibility - an evaluation was conducted to look at the feasibility of the proposed technologies, the experience that the bidder had with the proposed technologies, and an engineering estimate of the applicability of those technologies for the selected recycling processes.

Cost was evaluated and accounted for 30 percent of the score.

Four proposals were received in response to the Request for Proposal (RFP). Three companies, including the Scientific Ecology Group, Inc. (SEG), Alaron and Allied Technology Group (ATG), proposed to perform the work off-site. IT Corporation proposed to establish a decontamination facility on-site. SEG, using Quadrex as a subcontractor, received the highest evaluation score and was awarded the scrap metal recycling contract. The approach proposed by the SEG/Quadrex team was to melt and "beneficially reuse" the ferrous metal and decontaminate and "free release" the non-ferrous metal.

SCRAP METAL PROCESSING

SEG mobilized resources immediately to prepare and secure approval of required project-specific plans and the overall project workplan. This effort, which required approvals from DOE and EPA, took three months. Equipment was mobilized on site within six weeks of SEG's receipt of authorization to proceed.

The pad containing the scrap metal piles was roped off to isolate the SEG activities from other Fernald activities. SEG's first action was to further segregate and sort the metal in the scrap metal pile. Segregation included yet another screen to identify any additional refuse metal not suitable for recycling. This refuse material was then sent directly to the Nevada Test Site (NTS) by FERMCO personnel. Recyclable material was again sorted into ferrous and non-ferrous streams.

Ferrous Metal Processing

The ferrous streams were reduced in size prior to packaging by a large mechanical sheer mounted on a track hoe. The shear selected was a Labounty shear with a shear strength of 2,000 tons capable of size reducing solid metal components up to 6" in diameter. The shear was able to cut through 12" I-beams and remotely size reduce heavy equipment such as contaminated cranes and bulldozers. Following size reduction, the material was loaded by SEG into containers and transported to the SEG metal processing facility in Oak Ridge, Tennessee.

See Photo #3

At SEG, the ferrous metal was further size reduced and loaded into large storage bins. Prior to melting, the metal was preheated to 1,100 degrees (F) to improve furnace throughput and reduce thermal shock. Batches of approximately 40,000 pounds of metal were then charged into the metal melt furnace. Furnace temperature was gradually brought up to about 2,800 degrees (F) over a period of several hours. After verifying metal chemistry and removing "slag" material, each batch of melted scrap metal was cast into shield blocks ranging from 4,000 to 20,000 pounds in weight.

See Photo #4

The shield blocks were fabricated by SEG for delivery to DOE for use in medium energy physics experiments. SEG had contracted earlier to provide 35,000 tons of shield blocks to the Los Alamos National Lab at no cost to the government. This arrangement was not only of great benefit to DOE but it also resulted in the avoidance of disposal charges that would have been incurred by SEG if the cast material had simply been buried. Los Alamos valued the shield blocks at $800 per ton.

The recycling of contaminated scrap metal into shield blocks in an example of "beneficial reuse" - a concept where material that could not otherwise be free-released is utilized in an application where contamination is not a detriment. The melting process is a valid metal decontamination process since approximately 90% of the scrap metal contamination is concentrated in the slag material which is removed for waste disposal. The contamination that is not removed with the slag, however, becomes homogeneously distributed throughout the cast material. Since there is no current "de minimis" release criteria for this so-called ronmental

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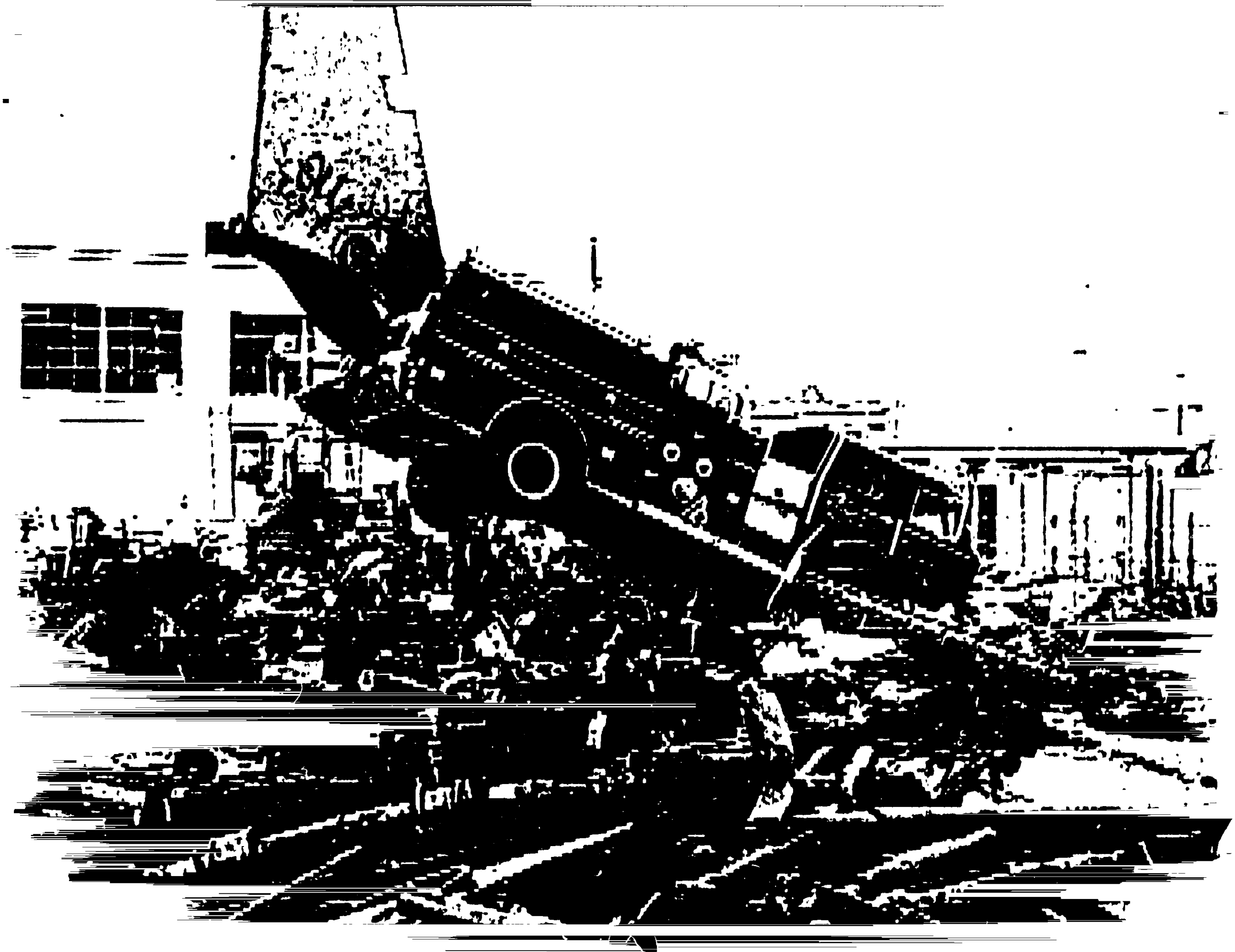
Fire Truck Size Reduction



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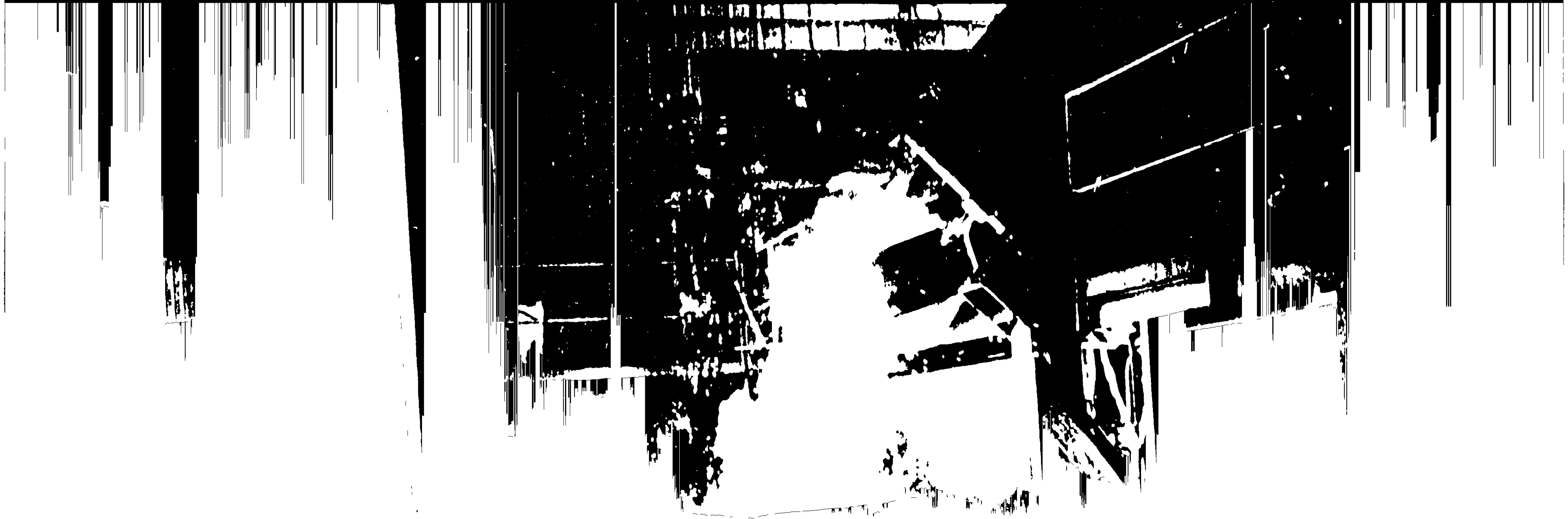
Cast Pour



"volumetric" contamination, the cast material cannot be released to the public. By casting the metal into shield blocks for use by DOE, "control" of the material is retained by the Department of Energy. More importantly, the application selected is one where the shield blocks provided will eventually become activated while fulfilling their intended purpose. Independent of whether the shield blocks are fabricated from virgin metal or "beneficially-reused" scrap metal, the shield blocks will eventually require disposition as radioactive waste. In short, to use a term coined by Ollie North, beneficial reuse is a "neat idea."

Following casting, quality assurance (QA) inspection and painting, the first shield blocks fabricated from Fernald scrap metal were shipped from SEG to Los Alamos in August, 1993.

See Photo #5

Non-ferrous metal

Non-ferrous metals were also size reduced at Fernald, packaged and transported to the Quadrex Recycle Center in Oak Ridge, Tennessee.

See Quadrex Photo (being sent Fed X)

Quadrex decontaminated the non-ferrous materials previously, stainless steel and aluminum, in a series of chemical baths using proprietary Quadrex formulations. Following decontamination, the metal was surveyed, "free-released" under the Quadrex Tennessee radioactive material license, and sold to scrap metal dealers in the local area.

See Photo #6

LESSONS LEARNED

The Fernald scrap metal project marked the first large-scale recycling of DOE contaminated scrap metal. A number of lessons were learned that should be of value to those contemplating similar projects in the future.

EPA Involvement

Since the scrap metal recycling was conducted under a CERCLA removal action, the level of detail to which the EPA would retain approval authority had to be established. As the procurement progressed, it became apparent that the EPA request for information associated with the removal action was inconsistent with implementation of the federal acquisition regulations. The EPA desired a level of detail in the removal action work plan that could be provided only by the contractor selected to perform the work. Since the procurement could not be initiated until the removal action work plan was approved, an impasse was quickly identified.

Resolution was obtained after the EPA agreed to approve the initial removal action work plan containing only a description of the desired results and the applicable regulations for the project. It was agreed, however, that DOE would review the detailed contractor project plans following contract award and then provide the plans to the EPA for informational purposes. As a result, USEPA remained cognizant of the details of the Removal Action without impeding the procurement process. The lesson is that, with proper coordination, even CERCLA

FERMCO Shield Blocks

projects heavily regulated by both DOE and EPA can proceed smoothly.

Industrial Relations

The scrap metal project augmented an existing low level waste disposition program at Fernald. Fernald waste disposition activities, including waste segregation, size reduction, packaging and shipment to the Nevada Test site had historically been performed by Fernald employees represented by a labor union. As SEG was mobilizing on-site, the union informed the Industrial Relations department that a grievance would be filed since the union believed that the subcontracted work fell under union jurisdiction.

Following a series of four meetings with union representatives, it was demonstrated that the terms of a "memorandum of understanding" contained in the then current bargaining agreement were being complied with. The memorandum stated:

"Many factors are considered prior to subcontracting a particular job or project. Some of the factors include but are not limited to the following:

- availability of special skills
- availability of equipment and supplies
- expediency mandating immediate action when our people are being fully utilized in other priorities; and
- the application of the Davis-Bacon Act

After identifying the special skills and equipment that SEG would be utilizing on the project and pointing out that the union work force was actually expanding at the time, the union agreed to withhold the threatened grievance. The lesson learned is that, as the role of a DOE facility changes from operation to cleanup, additional union jurisdictional issues are likely to arise.

Secondary Waste Disposition

The final disposition of secondary waste resulting from metal recycling required resolution after contract award. The two major secondary waste streams generated were slag from the metal melt process at SEG and solidified sludge resulting from decontamination processes at Quadrex. The waste was managed by applying the standard industry practice of attributing waste which can be reasonably identified to a single generator to that generator. When segregation is not practical, the secondary waste is deemed to be generated by the waste processing facility treating the material.

For the ferrous material processing operations at SEG, several secondary waste streams were generated. The largest waste stream was the slag waste from oxidation products. Since the slag was generated during melting campaigns and could therefore be reasonably segregated and attributed to the Fernald scrap metal, DOE retained ownership of the waste. In accordance with DOE Order 5820.2A, entitled, "Radioactive Waste Management", the slag was characterized for radiological and RCRA aspects, compacted, packaged and shipped by SEG to the Nevada Test Site for disposal. On the other hand, dry active waste and the dust collector waste generated during melting operations could not reasonably be attributed solely to the Fernald metal and was thus considered SEG waste under SEG's Tennessee radioactive material license. This waste was stabilized by SEG and shipped to the Barnwell burial site for disposal.

See Photo #7

Secondary waste from the decontamination process at Quadrex was generated in the form of solidified sludges resulting from treatment of decontamination solutions. The waste created during decontamination could not reasonably be attributed solely to the Fernald scrap metal and was thus considered to be Quadrex waste. Quadrex stabilized this material with cement in 55 gallon drums prior to disposal at the Barnwell burial site.

Safety and Equipment Hazards

Fernald encountered a series of potentially serious safety hazards during the course of the project. These hazards included the discovery of a uranium hexafluoride (UF-6) cylinder, size reduction of a vehicle containing fuel and melting of lead metal that was not properly screened out of the ferrous metal pile. Each of these hazards was remedied immediately and policies and procedures implemented to prevent recurrence.

The first incident was the discovery of a small cylinder containing UF-6 that had not been screened from the contents of the scrap metal pile. A cylinder measuring 18" in length and 5" in diameter was breached during metal loading, resulting in the emission of a "puff" of UF-6 gas. UF-6 is hazardous when inhaled due to its radioactive and corrosive characteristics. In accordance with contingency plans in place, operations were immediately terminated until properly equipped emergency response personnel retrieved the cylinder and placed it in compatible packaging for subsequent disposition. Health and safety procedures were subsequently modified to require that personal emergency air supplied respirators be available at all times while sorting or segregating. The incident was investigated and it was determined that no reportable releases occurred and that no personnel exposures resulted from the incident.

The second incident was the release of about 15 gallons of gasoline during the size reduction of a contaminated fire truck. Fortunately, there was no fire and the spill was contained and cleaned up without further problems. Many vehicles were included in this project and detailed procedures were in place to assure that all liquids were properly drained and managed before vehicle size reduction. This particular occurrence resulted from a breakdown in procedural compliance.

The last occurrence was the accidental addition of approximately 6,000 pounds of lead in to the SEG furnace. Lead is a non-ferrous material which is incompatible with the design of the furnace. The lead diffused through the furnace refractory, grounding out the furnace heating coils which in turn caused an automatic furnace shutdown. The furnace was out of operation for seven days for repair and refractory replacement. Approximately 50,000 pounds of waste, including a 27,000 pound partially melted metal charge and 16,000 pounds of damaged furnace refractory, was generated. The subsequent investigation concluded that the lead had been contained in a counterweight used on a piece of heavy equipment. During the incident investigation, lead was discovered in counterweights that had apparently been fabricated and used without documentation during Fernald's operating lifetime. As a result of this incident, changes have been implemented in SEG's sorting and segregation procedures.

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Slag Removal

The major lesson learned is that processing scrap metal needs to be carefully planned and monitored. Extraordinary precautions must be taken to screen out foreign material and avoid the resulting hazards for personnel and equipment.

Cost Factors

Table 2 compares the cost of recycling the Fernald scrap metal to the cost of disposal. If the 2,200 tons of Fernald scrap metal had not been recycled, the only alternative would have been disposal at the DOE Nevada Test Site. The recycling option incurred a Fernald cost premium of 18% over the cost of waste disposal. However, when the value of shield blocks provided to LANL is reflected in the calculation, the scrap metal project shows a net benefit to DOE of $1 Million.

Table 2. Fernald Scrap Metal Recycling Project (2,210 Tons)

	DISPOSAL	RECYCLE
Labor Packaging (11328 hrs. @ $30/hr.) Shipping (7080 hrs. @ $40/hr.)	 $ 339,840 $ 283,200	
Containers (177 Sealands @ $2,700/container)	$ 477,900	
Transportation (177 Shipments @ $3,000/shipment)	$ 531,000	
Disposal (238,950 cu. ft. @ $10/cu. ft.)	$2,389,500	
SEG (2210 tons @ $2152/ton)		$4,755,920
TOTAL COST	$4,021,440	$4,755,920
RECYCLE VALUE (2200/1.02 tons @ $800/ton)		($1,725,490)
NET TOTAL COST	$4,021,440	$3,030,430

The lesson is that, at current DOE disposal site burial costs, it will frequently cost more to recycle scrap metal than to simply ship it to DOE disposal sites for burial. For the scrap metal pile project, the recycle premium was outweighed by the value of shield blocks provided to DOE for use elsewhere in the DOE complex. Without the benefit of "beneficial reuse", recycling within DOE may have to be justified by factors such as resource conservation, energy consumption, and avoidance of land burial. In the commercial nuclear world, where waste disposal prices are much higher, recycling can be much more easily cost justified.

CONCLUSION

The Fernald scrap metal project demonstrated that contractor capabilities can be used successfully to recycle large quantities of DOE scrap metal. More importantly, the project proved that the "beneficial reuse" concept makes excellent economic sense when a "market" for recycled products (such as shield blocks) can be identified. Since much of the scrap metal remaining within the DOE complex cannot be economically decontaminated, continuing emphasis must be placed on the identification of other end products that can be fabricated from volumetrically contaminated metal. Additional initiatives are now underway within DOE to recycle metal in this category into products such as waste containers and vitrification canisters.

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