DEVELOPMENT OF A WASTE MINIMIZATION PLAN FOR A DEPARTMENT OF ENERGY REMEDIAL ACTION PROGRAM: IDEAS FOR MINIMIZING WASTE IN REMEDIATION SCENARIOS

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ABSTRACT

Waste minimization has become an important consideration in the management of hazardous waste because of regulatory as well as cost considerations. Waste minimization techniques are often process specific or industry specific and generally are not applicable to site remediation activities. This paper will examine ways in which waste can be minimized in a remediation setting such as the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program, where the bulk of the waste produced results from remediating existing contamination, not from generating new waste.

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has a preferred strategy for hazardous waste management that lists waste minimization as the first two elements. The reduction of waste at the source through process modification is most preferable. The reuse and recycling of wastes for materials or energy recovery is the next preferred approach (1). EPA encourages the application of waste minimization to reduce the amount requiring treatment and, ultimately, land disposal. In the broadest sense, the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA) define waste minimization as any action taken to reduce waste volume or toxicity.

Potential waste minimization techniques are often process specific or industry specific and generally are not directly applicable to remediation activities. The bulk of wastes produced at a remedial action site results from remediating existing contamination, not from generating new wastes (2,3). The challenge project managers face is to generate less waste when large volumes of contaminated material are remediated, managed, and eventually disposed of. This paper will outline several opportunities for minimizing waste under these circumstances.

BACKGROUND

The Formerly Utilized Sites Remedial Action Program (FUSRAP) is a U.S. Department of Energy (DOE) program that evaluates and remedies radiological and hazardous chemical conditions at a number of sites that are privately, institutionally, and DOE owned. In general, FUSRAP sites became radioactively contaminated during the early period of the U.S. nuclear program and have since been converted to other uses. At the time of decommissioning, these sites were decontaminated in accordance with the standards and survey methods then in existence. However, guidelines for releasing sites for use without radiological restrictions and regulatory requirements for hazardous substances have since become more stringent. As a result, FUSRAP was initiated in 1974 to identify these sites, reevaluate their radiological and hazardous substance status, carry out remedial actions, and certify the sites for future use.

FUSRAP seeks to decontaminate selected sites and release them for use without radiological or hazardous substance restrictions or to stabilize or otherwise control contamination to meet current guidelines for the protection of public health and safety. To date, 33 sites in 13 states have been identified, and DOE has required that some form of remedial action be taken.

DESCRIPTION OF FUSRAP WASTES

Many of the FUSRAP sites supported early Manhattan Engineering District and Atomic Energy Commission nuclear work for national defense and security. The activities at the sites primarily involved research; processing; and storage of uranium and thorium ores, concentrates, or residues. Radioactive contamination and, in some cases, hazardous and radioactive mixed wastes are present at all the sites.

The FUSRAP sites that still require remedial action and the waste types present at each are shown in Table I. These wastes include soil; building debris; solidified material and other solids; liquids and other liquid-containing waste; personal protective equipment; site sampling, remediation, and maintenance equipment; and solid waste not directly associated with remedial action activities. Predominantly low-level, residual radioactive contamination remains at the FUSRAP sites. Remediation of the sites usually involves the excavation of soil and the decontamination or removal of building material, equipment, and hazardous substances (3).

DEVELOPMENT OF A WASTE MINIMIZATION PLAN

A waste minimization plan was developed for FUSRAP as required by DOE Order 5400.1, "General Environmental Protection Program"(4). Although DOE Order 5400.1 was developed for DOE operating and production facilities, it also applies to remedial action projects. The plan recognizes that FUSRAP sites are primarily undergoing remedial activities and incorporates requirements for waste minimization found in DOE Orders 5400.1 and 5820.2A, "Radioactive Waste Management," and EPA legislation including RCRA; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, Cleanup Standards; and the Pollution Prevention Act. Guidance documents used to support the development of the plan include EPA's *Waste Minimization Opportunity Assessment Manual* (1) and the *U.S. Department of Energy Model Process Waste Assessment Plan* (5).

A plan for waste minimization ordinarily provides goals in numerical terms. However, the available guidance does not address methods for developing baseline data and numerical goals for a remedial action program such as FUSRAP. The 1990 annual waste reduction report, the first published for

TABLE I

Waste Types at FUSRAP Sites

Site name	Radioactive	Mixed	Hazardous	Nonhazardous
	Missouri Sites			
Latty Avenue Properties, Hazelwood	1, 2	No	No	7
St. Louis Airport Site, St. Louis	1, 2, 5	No	No	7
St. Louis Airport Vicinity Prop., St. Louis	1	No	No	7
St. Louis Downtown Site, St. Louis	1, 2	No	No	7
	New Jersey Sites			
Maywood Interim Storage Site, Maywood	1, 2, 4, 5	No	No	7
Wayne Interim Storage Site, Wayne/Pequannock	1, 2, 4, 5	No	No	7
Middlesex Sampling Plant, Middlesex	1, 2, 5	1	No	7
New Brunswick Laboratory Site, New Brunswick	1	Unknown	Unknown	7
Du Pont & Company, Deepwater	1	Unknown	No	7
	New York Sites			
Niagara Falls Storage Site, Lewiston	1, 2, 5	No	No	7
Colonie Interim Storage Site, Colonie	1, 2, 3, 4, 5, 6	2, 3, 4	3, 4	7
Ashland 1, Tonawanda	1	No	No	7
Ashland 2, Tonawanda	1, 5	No	No	7
Linde Center, Tonawanda	1, 2, 5	No	No	7
Seaway Industrial Park, Tonawanda	1	Unknown	Unknown	7
Baker and Williams Warehouses, New York City	2, 5	No	No	7
	Additional Sites			
Albany Research Center, Albany, OR	1, 2, 5	1, 2, 5	1	7
Aliquippa Forge, Aliquippa, PA	1, 2	Unknown	Unknown	7
Elza Gate Site, Oak Ridge, TN	1, 2, 5	No	No	7
General Motors, Adrian, MI	1, 2	Unknown	Unknown	7
Seymour Specialty Wire, Seymour, CT	2, 3	Unknown	No	7
Shpack Landfill, Norton, MA	1	Unknown	No	7
Ventron Corporation, Beverly, MA	1, 2	Unknown	No	7
W. R. Grace & Company, Curtis Bay, MD	1	Unknown	Unknown	7

1 = Soil
2 = Building material
3 = Solidified material, other solids
4 = Liquids and other liquid-containing wastes
5 = Personal protective equipment
6 = Site equipment (sampling, remediation, maintenance)
7 = Solid waste not directly associated with remedial activities (such as glass, paper, and aluminum cans)

FUSRAP, established a baseline of information about the waste minimization techniques implemented at FUSRAP sites (2). Waste minimization goals could be formed by evaluating trends and changes from one annual report to another.

WASTE MINIMIZATION TECHNIQUES APPLICABLE TO FUSRAP

FUSRAP is an environmental restoration program, and its activities are associated with either field characterization of contamination or design and implementation of remedial actions. Because FUSRAP facilities are not active, only a limited number of waste minimization techniques are appropriate. Waste minimization, by strict definition, includes (1) minimizing or eliminating waste generation and (2) recycling to use, reuse, or reclaim a material from a waste stream. However, the bulk of the waste produced at the sites results from removing contaminated materials rather than generating new waste. For this reason, reducing the volume or toxicity of contaminated material before disposal is a legitimate technique for minimizing waste generation at FUSRAP sites. Table II shows which waste minimization technique is applicable for a particular waste type that may be present at a FUSRAP site. As shown in Table I, the types of wastes vary, so the applicability of waste minimization techniques varies from site to site.

The annual waste reduction report describes how waste reduction techniques have been applied to a number of waste management activities. These activities include field characterization, soil excavation, removal of building material, decontamination of equipment, management of bulk waste,

TABLE II

Waste Minimization Methods Applicable to FUSRAP Sites

Waste type	Material substitution	Segregation	Consolidation	Loss Prevention & Supply Control	Recycling
Radioactive					
Soils		X	X	X	
Building material & equipment		X	X		
Personal protective clothing, Rags, etc.		X	X		
Radioactive mixed	X	X			
Hazardous					
Excess chemicals	X			X	X
Excess paint	X			X	
Laboratory samples		X			
RCRA metal contamination		X			
Solvent rags	X	X			
Solvents	X			X	X
Solid, nonhazardous					
Aluminum beverage cans					X
Cardboard					X
Glass					X
Metal					X
Office paper					X
Old fuel					X
Package material					X
Used oil					X

Waste Type	Housekeeping	Size Reduction	Decontamination	Treatment	Reclamation
Radioactive					
Soils					
Building material & equipment	X	X	X		
Personal protective clothing, Rags, etc.		X			
Radioactive Mixed	X		X	X	
Hazardous					
Excess chemicals	X			X	X
Excess paint	X				
Laboratory samples	X	X			X
RCRA metal contamination	X		X		X
Solvent rags	X	X	X		
Solvents	X				

general site housekeeping, and support activities. The remainder of the paper will give examples of how waste minimization was accomplished at FUSRAP sites.

WASTE GENERATION REDUCTION

The quantity of new waste generated at FUSRAP sites is small relative to the existing volume of waste because activities involve site remediation and not production. New waste consists of materials such as used personal protective equipment, support equipment, and by-product waste from decontamination procedures. Strategies applicable to FUSRAP to minimize the amount of newly generated wastes are shown in Table II. During 1990, these strategies included material substitution, segregation, consolidation, contamination control, loss prevention, supply control, recycling, and housekeeping.

Material substitution involves the replacement, reduction, or elimination of hazardous materials in maintenance, cleaning, and decontamination processes. In 1990, procedures for decontaminating field equipment were changed by substituting isopropyl alcohol for methanol as the solvent rinse. Used methanol is a listed RCRA hazardous waste; removing this listed substance from the decontamination procedure subsequently eliminated new hazardous waste generation.

Remediation plans include waste stream segregation, which was formally implemented during remediation of the Albany Research Center (ARC) site in Oregon. Detailed surveys were performed to determine the extent of contamination. Waste was then categorized and segregated to minimize the total amount of generated waste and mixed waste in particular; the amount of waste that would require specialized management controls was thus reduced and, subsequently, costs were minimized. The waste streams were inventoried using chemical and radiological characterization data, federal and state regulations, and the acceptance criteria of the planned disposal facility. The different categories of wastes were then managed separately: uncontaminated solid waste, radioactive solid waste, radioactive asbestos, radioactive waste contaminated with polychlorinated biphenyls (PCBs), radioactive mixed waste, and aqueous waste.

Health and safety officers have been implementing waste segregation at all FUSRAP sites. Personal protective clothing (PPC) articles worn during field activities are screened for radioactivity. Uncontaminated PPC is disposed of as solid waste. Contaminated PPC is further surveyed for "hot spots" of contamination (most frequently on the knees), which are then cut out and disposed of as radioactive solid waste; thus, the amount of radioactive solid waste is reduced from a full-size article of PPC to two napkin-size pieces.

Waste was consolidated at the Colonie Interim Storage Site (CISS) in New York. Drummed electroplating waste was consolidated to reduce the amount of void space in the drums and, thus, the amount of drums managed at the site.

Contamination control involves preventing the spread of contamination and protecting equipment from excessive contact with hazardous or radioactive materials. For example, decontamination activities are conducted in bermed areas, and excavated material is containerized on designated, plastic-lined areas. These measures control and minimize the spread of contamination to other areas.

Loss prevention is practiced at FUSRAP sites owned or leased by DOE because access to these sites is restricted. The number of visitors is limited, and visitors are accompanied by FUSRAP personnel. At all sites, chemicals are stored in locked cabinets, and field personnel are issued only the amount of chemicals needed for that day.

Supply control is facilitated through the use of a central warehouse. Any unused chemicals and decontaminated equipment remaining after all site activities have been completed are returned to the warehouse and made available to support activities at other sites. Using the warehouse ensures that needed chemicals and equipment are readily available, increases the reuse of equipment, and reduces the amount of unused chemicals requiring disposal. Chemicals that are not commonly used on the sites and are left over are returned to the manufacturer.

Office products, such as aluminum cans, white paper, and green-bar computer paper, are being recycled by FUSRAP at DOE and DOE contractor offices.

Housekeeping efforts involve keeping work areas clean and orderly to support loss prevention and contamination control efforts. Keeping areas free of debris and clear of obstructions reduces the chance of a needless spread of contamination.

VOLUME REDUCTION

Because activities at FUSRAP sites involve remediation, volume reduction refers to the reduction of the quantity of waste materials already onsite by techniques such as size reduction, decontamination, and resource recovery.

Size reduction methods include grinding, melting, and compacting. At the St. Louis Airport Site in Missouri, PPC was compacted to reduce the number of drums needed to contain it. Since that time, FUSRAP has segregated waste to reduce the quantity (and, consequently, the volume) of PPC disposed of as hazardous waste, as described earlier. There are plans to use a shredder to reduce the volume of used machinery and lighting fixtures to be remediated at CISS.

Decontamination using physical methods is the primary technique used to reduce waste volume. Physical methods used include abrasive blasting, dewatering and drying, and washing and scrubbing. At the Elza Gate site in Tennessee, a steel shot blaster was used to remove the top layer of contamination from a concrete pad; when contamination is confined to the surface, the abrasive blasting pulverizes the concrete as it is removed and thus minimizes the volume of waste produced and the total volume of waste requiring disposal. Washing and scrubbing is frequently used to remove radioactive contamination from surfaces. At all sites, field equipment is routinely decontaminated by rinsing and scrubbing to allow its continued use.

Additional decontamination techniques include scabbling and scarifying processes to remove the top layer of contaminated material. Surfaces are scanned for contamination to determine the amount of material that needs to be removed. These processes help minimize the amount of waste generated because the amount of material removed can be easily controlled and limited, thereby reducing the total waste requiring disposal. A scarifying process was applied at the Baker and Williams Warehouses site in New York to remediate asphalt and resulted in 12 drums of waste. FUSRAP engineers estimated that 96 drums would have been generated without the application of this waste minimization technique.

Resource recovery can occur through reuse and reclamation of materials. During remedial action activities at ARC, contaminated brass fixtures were removed. Because brass is a hazardous waste in the state, the contaminated fixtures constituted a radioactive mixed waste that is prohibited from disposal. The radioactive contamination was removed by wiping the fixtures with a damp cloth; the process eliminated the mixed waste, allowed the fixtures to be reused, and reduced the volume of radiological waste to a few pieces of cloth.

WASTE TREATMENT

Treatment can reduce the volume, toxicity, or mobility of existing wastes. The national capacity for disposing of radioactively contaminated hazardous waste is very small; thus, mixed waste is evaluated for treatment of the hazardous component before disposal. Treatment could result in the destruction of the hazardous component. If the hazardous component of mixed wastes cannot be treated because radioactivity is present, the waste is stabilized or the contaminant mobility reduced. Minimizing waste by reducing generation and volume is the preferred approach, and treatment should be considered only as the final option before disposal.

CONCLUSION

It is difficult to systematically plan for and measure the success of a waste minimization program at a remediation project like FUSRAP. The amount and type of contamination requiring remediation can vary widely from site to site. The application of waste minimization techniques must be planned on a site-specific basis, considering the type of waste, the media in which it is found, and its association with other forms of contamination. Although traditional methods (such as materials balancing and measurement of waste mass flows and composition) of measuring the success of a waste minimization program do not apply to remedial action scenarios, the success of the program is measured by observing the increase in the use of waste minimization techniques and by comparing estimates of the amount of waste produced with and without the application of those techniques.

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