INVENTORY, CLASSIFICATION, SEGREGATION, BULKING AND DISPOSAL OF MIXED CONTAINERIZED WASTE AT THE FORMER WELDON SPRING URANIUM FEED MATERIALS PLANT

Robert H. Miller and Roger A. Nelson
Jacobs Engineering Group, Inc.
Route 2, Highway 94 South
St. Charles, Missouri 63303

ABSTRACT

This paper presents the planning, regulatory agency interface and operational experience associated with the inventory, sampling, handling, segregation and disposal of containerized chemicals and other materials at a former Uranium Feed Materials Plant now being decommissioned as the Weldon Spring Site Remedial Action Project (WSSRAP). A preliminary inventory performed without documentation of the nature of materials stored throughout the entire 166 acre Weldon Spring Chemical Plant identified approximately 310 major groups of containers. These groups represented about 4,000 individual containers. It was estimated that about 20,000 liters of unknown liquids and about 28,000 liters of unknown solids which could contain elevated levels of natural series isotopes (primarily uranium) due to their use in the uranium production activities during plan operations.

The inventory indicated that 55 percent of the materials were likely to be listed hazardous wastes under RCRA. Based primarily upon the container integrity, it was also estimated that about five percent of the containerized waste was contaminated with uranium at levels detectable using hand-held field instruments. A plan to sample and segregate radiologically and non-radiologically contaminated materials was developed. This plan also included the consolidation of wastes in each category by compatible chemical classes and the disposal of the non-radiologically contaminated chemical waste at off-site licensed facilities.

Chemical sampling and laboratory methods were performed consistent with EPA methods (SW-846). By means of in-situ radiation measurements using hand-held detection instruments, the wastes were segregated and subsequently consolidated. Additional sampling was then performed to establish actual radiological levels in the various groups. After discussion of the resultant radiological levels with the state RCRA agency and the EPA of the resultant radiological levels, all wastes containing levels below those agreed upon will be disposed of off site. Materials containing levels above the negotiated release criteria will be retained on-site to await disposition along with the remainder of the other wastes at the Weldon Spring Site according to the CERCLA process.

INTRODUCTION

The advent of the Superfund Amendments and Reauthorization Act (1986) resulted in the Department of Energy (DOE) and other Federal agencies introducing different ways of handling (and even considering) wastes with mixed chemical and radiological substances. However, without specific (and quantitative) release criteria for various radionculides, the disposal of Toxic Substances Control Act (TSCA) or Resource Conservation and Recovery Act (RCRA) wastes containing even small amounts of radioactive substances became limited to disposal facilities such as those at Beatty, NV or Barnwell, SC at costs much higher than formerly incurred. Dismantlement and decommissioning projects, such as the WSSRAP were forced to develop a somewhat unique method of disposing of potentially radiologically contaminated chemicals.

The Weldon Spring Site Remedial Action Project (WSSRAP) is a decommissioning project being conducted by DOE of the former Weldon Spring Uranium Feed Materials Plant (WSUFMP). During operation of the former WSUFMP, the primary radioactive species was uranium in several different chemical forms. After the plant shutdown in 1966, all process lines were drained and all process chemical vessels emptied. However, the majority of other containerized chemicals in use on site were untouched.

The chemicals present today as the Remedial Action Project begins are in the form of containers of all shapes and sizes. These containers include both labeled and unmarked varieties of glass, metal, fiber and paper bag construction. The containers range from small 50 cc glass vials to 55 gallon metal drums and plastic lead-acid batteries to fire extinguishers and bags of asbestos cement.

Before the disposition of the materials could be decided, it was necessary to determine the radiological (uranium) content of both the surfaces of the containers as well as the chemical material within. The answer to this question was complicated by the fact that both open and closed containers were exposed to various elevated airborne levels of uranium metal and oxide dust during the ten years of plant operation and to lesser levels during the subsequent 20 years while the facility was maintained in a caretaker status. Thus, all containers could exhibit elevated levels (especially on rusted metal surfaces).

Open containers in areas with high loose alpha contamination levels generally would be expected to contain levels detectable with hand-held instrumentation (such as beta-gamma probes or low energy gamma scintillometers). Examples include open barrels of oil, grease, or paint. Closed containers, which had been previously opened, may or may not contain mixed waste depending upon whether the material was placed back in the container after being used.

There are six categories of containers with various probabilities of containing mixed waste or exhibiting levels of surface uranium above fixed or removable alpha release criteria (see Table I). These categories are based on whether the container had been previously opened and the degree of loose contamination present in the general area in which the container was stored. For example, unopened containers with seals intact are presumed to not contain radiologically contaminated materials.

radiological screening of containers and containerized wastes.

This radiological screening activity occurred either prior to or in conjunction with the Subcontractor's activities or both. Project personnel then assumed responsibility for segregating mixed waste from non-radiologically contaminated waste and for minimizing the creation of mixed waste during future bulking or consolidation activities.

TABLE I
Probability of Contents of Containers Being Mixed Waste

No loose Alpha Present			Loose Alpha Present in Area			
Open Containers	Closed Reclosed	Containers Intact	Open Containers	Closed Reclosed	Containers Intact	
Moderate	Low	None	High	Moderate	None	(1)
Moderate	Moderate	Low	High	High	High	(2)

(1) Probability of material in container being mixed waste.

(2) Probability of container surface indicating levels above surface release criteria for uranium (5000/1000 total/removable dpm/100 cm2).

SCOPE

Selected containerized chemicals and materials which include liquids, solids, gases, sediments and sludges contained in surface storage tanks, process vessels, drums, fuel tanks, laboratory hoods and containers, gas cylinders, fire extinguishers, batteries, bags, boxes, bottles, cans, jars, and other miscellaneous containers were identified for removal from the site as part of the WSSRAP. The inventory indicated that 55 percent by volume of the waste was hazardous waste, 45 percent by volume of the waste was non-hazardous, and five percent of the total volume to be radiologically contaminated. Table II gives a breakdown of the major waste types encountered.

The subcontractor for this work package (Metcalf and Associates of St. Charles, Missouri) was responsible for the handling of these materials while on site and their transfer and consolidation to an on-site interim storage facility. The interim storage facility was fabricated within an existing structure at the site to meet the requirements of 40 CFR 264.175, Containment. On-site project personnel assumed responsibility for other relevant regulatory requirements such as posting, spill response, etc.

Due to the degree of interaction between radiological segregation and chemical classification, a detailed logic flow was developed for delineating between on-site project personnel and subcontractor responsibilities. This logic is present as a flow diagram in Fig. 1. Each step shown in the logic is associated with specific responsibility assigned to either the "Contractor" (abbreviated Cont. and representing on-site project personnel) or to the "Subcontractor" (abbreviated S/C).

In order to accomplish radiological segregation of the containerized wastes, the project personnel provided in-situ

As part of the work package the subcontractor was required to submit a detailed work plan prior to the start of on-site activities. The work plan included discussion of:

- Subcontractor mobilization
- Containment system construction
- Container inspection, relocation, and staging procedures
- Container opening procedures and methodology
- Container sampling procedures, methodology, and strategy
- Sample analysis procedures and methodology for known and unknown materials
- Compatibility testing procedures and methodology
- Bulking, overpacking, and/or recontainerization procedures

The subcontractor also submitted a quality assurance plan, a health and safety plan, a respiratory protection program, and an emergency response plan (primarily spill prevention and response). Each of the above plans was developed to satisfy the applicable requirements of the Hazardous Waste Regulations defined by 40 CFR 260-268, the Hazardous Substance Regulations defined by 40 CFR 300.6, 29 CFR 1910 Subpart H General Industry Standards, and 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response.

SCREENING/REPACKAGING/SAMPLING, AND CONTAINMENT

It should be noted that in nearly all instances, for the activites discussed below, the work was conducted in Level C Personal Protective Equipment (PPE). Generally the

TABLE II
Waste Category Vs. Volume for Containerized Wastes t the Weldon Spring Chemical Plant

CATEGORY	VOLUME (liters)
Organic liquids, solvents, lubricants	17,000
Tar and asphalt liquids	950
Tar and asphalt solids	1,400
Aqueous acids (pH < 2.0)	380
Aqueous alkalines (pH > 12.0)	570
Metals (magnesium scrap, metal powders, etc.)	17,000
PCB contaminated liquids (> 50-500 ppm)	450
PCB materials (> 500 ppm)	470
Laboratory pack liquids	760
Laboratory pack solids	2,000
Strong oxidizers	8,500
Strong reducing agents	6,400
Fire extinguishers (CO_2 and metal)	525 units
Automotive and industrial batteries	258 units
Unknown solids	28,000

PPE requirements were driven by non-radiological hazards and compliance with 29 CFR 1910.120 (j) "Handling drums and containers". In some instances, either the radiation survey or prior monitoring for airborne radioactive particulates indicated the necessity of Level C worker protection.

Screening

Field screening activities included in-situ radiation measurements using hand-held detection instruments and onsite laboratory analysis for non-radiological characteristics of the waste. The radiological screening was conducted by project personnel. The instrument used was a hand-held beta-gamma probe connected to an analog ratemeter. The instrument exhibited a background count rate approximating 30 counts per minute. The areal sensitivity of the instrument was about 500 disintegrations per minute per 100 square centimeters.

The surface contamination guidelines for uranium apply to alpha radiation. Experience on the WSSRAP, however, has shown that measurements of alpha radiation are biased low. The uranium and associated decay products (which emit alpha particles that travel only a few microns in solids) have been driven into or have migrated into the subsurface of materials such as container walls or are volumetrically dispersed in solids or liquids and cannot be effectively detected with alpha radiation detectors. The uranium decay products also emit one or more beta particle or gamma ray per decay. These daughter products have been shown to always be present with the parent radionuclide. For this reason Geiger-Mueller detectors, which respond to the more penetrating beta and gamma radiation as well as alpha radiation, were be used for the measurements instead of standard type alpha radiation detectors.

In most cases on-site personnel performed a radiation survey of the containers, and if possible contents, before the Subcontractor handled the waste. Project personnel did not physically handle any containers. In the cases where the container and/or contents could not be surveyed in place (due to access restriction or nearby radiation fields see Activity 2 and 3 in Fig. 1) the Subcontractor provided access immediately prior to his handling of the material. In either case the Contractor communicated the survey result to the Subcontractor prior to the containerized waste being repackaged or mixed with other similar or compatible waste. This portion of the screening activities generally made up activities 1 through 5 of Fig. 1. At completion of Activity 5, the Subcontractor potentially had four waste classifications to handle; non-radiologically contaminated waste, non-radiologically contaminated containers, radiologically contaminated waste, and radiologically contaminated containers.

Subsequent to the radiological screening and prior to any waste consolidation, the materials were sampled. The samples were subjected to compatibility testing which included analysis for pH, flash point, oxidizer/reducer, total cyanide, total sulfide, and water reactive. These tests were performed on-site in a mobile laboratory. Table III indicates the test method used in most cases for each parameter. If more extensive testing was required it was conducted at the parent laboratory. These test results coupled with visual inspection of the sample and volatile organic vapor levels at the container provided the necessary information for future waste bulking based on physical/chemical compatibility and

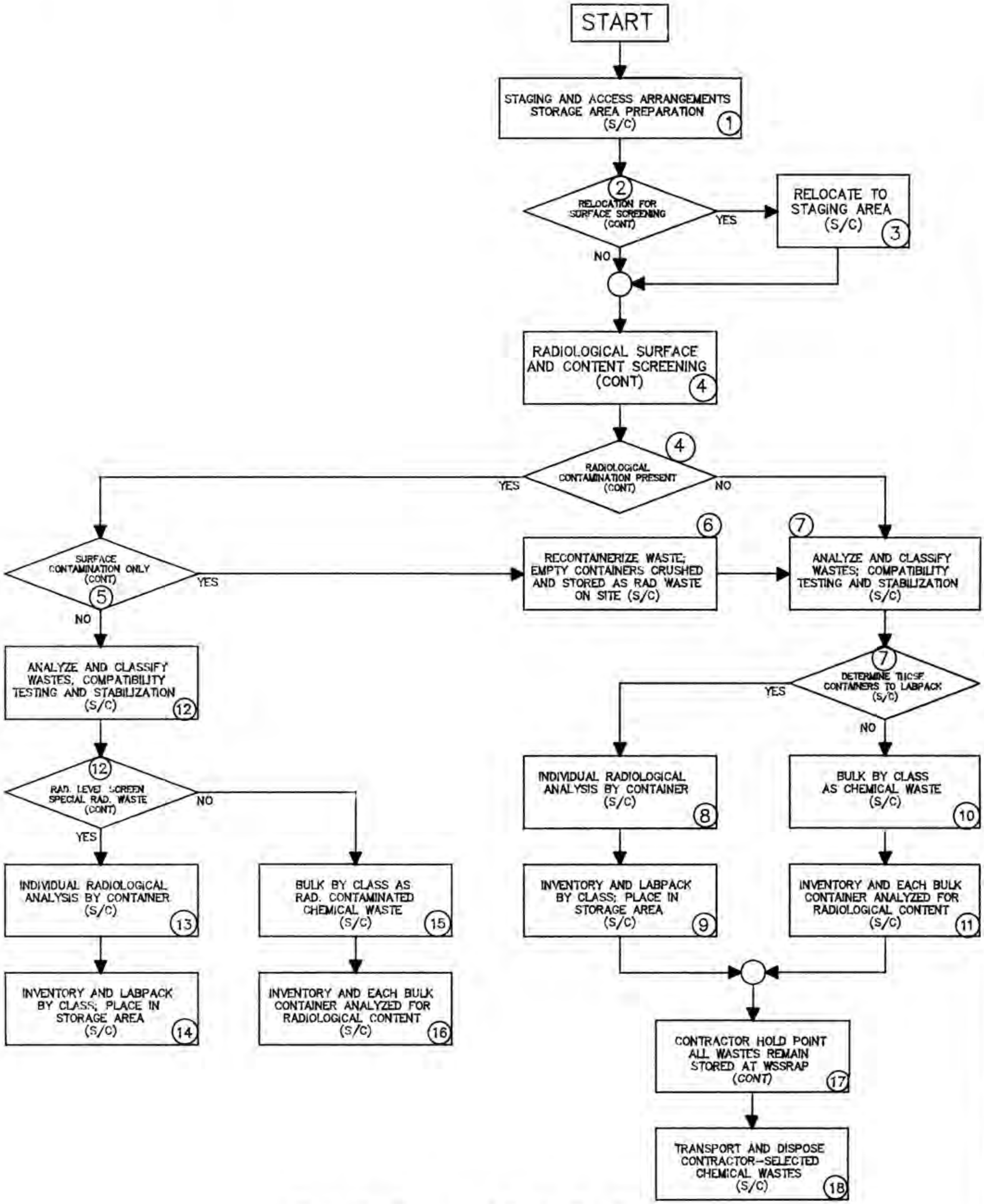

Fig. 1. Handling and Stabilization Flow Diagram.

worker safety during container handling and repackaging. These efforts comprised Activities 7 and 12 of Fig. 1.

Repackaging

Repackaging activities included waste segregation and consolidation as a function of radiation screening, hazard class, compatibility, and planned disposal method. It was necessary during the course of the project to perform recontainerization, consolidation, overpacking and lab packing of various containers and their contents. In general final containers consisted of 210 liter (55 gallon) drums and one cubic yard sacks which meet Department of Transportation (DOT) packaging requirements specified in 40 CFR 171-178. Use of the one cubic yard sacks was confined to repackaging of dry, previously bagged items such as diatomaceous earth and soda ash.Contents in containers which were in good condition, that is, show no signs of rust, deterioration, or stress points where leakage could occur, or the presence of radioactive surface contamination were maintained in their original containers; this occurred in only one instance and involved an unopened 210 liter drum of hydraulic oil. Contents from different containers were consolidated into 210 liter drums based upon radiation screening and compatibility testing.

Overpacking as a means of recontainerization was used only in one instance. In one location ten empty and, heavily reinforced 210 liter stainless steel drums were discovered with high interior surface contamination. These drums did not lend themselves structurally compatible with the Subcontractors drum crushing unit. Consideration was also given to the high potential of contaminating the drum crushing unit. It was decided then to overpack these drums in 320 liter (85-gallon) drums.

Labpacking was required in only two instances. The first involved eight small stainless steel keg-type vessels (about 76 liters (20 gallons) each) containing a highly radioactive liquid. On-site qualitative tests indicated the predominant radionuclides to be uranium-238 and thorium-230. These vessels were individually labpacked into 210 liter drums. The second instance involved a half-full quart jar of sodium cyanide. This item was individually labpacked in a 19 liter (5-gallon) steel container.

In all other cases containerized wastes were repackaged by conventional means. Liquids were poured or pumped into 210 liter closed head or open head drums. Solids, sludges, sediments, solidified paint and roofing tar, metal scrap, rock salt, etc. were scraped, chiseled, beat, shoveled, spooned , and/or poured into 210 liter open head drums. Only cylinders containing breathing air, nitrogen, or oxygen were found on-site with contents. These were discharged to ambient air sometimes by remote handling depending on a visual inspection of cylinder integrity. Carbon dioxide fire extinguishers were also discharged to ambient air. Fire extinguishers for fighting metals fires were discharged into a 210 liter closed head drum. After discharge the fire extinguishers and cylinders were cut in half to facilitate volume reduction and land disposal options. The non-radiologically contaminated units will be released as scrap. The radiologically contaminated units will be packed in a strong tight container and disposed of as low-level radioactive waste.

All containers were emptied to meet the definition of RCRA empty (40 CFR 261.7). Containers were verified empty by visual inspection and/or use of a stick or rod.

After all repackaging was complete, empty containers were crushed using a portable drum crushing unit. The crushing was completed in two phases. The first phase involved crushing of non-radiologically contaminated empty containers. These were crushed first to negate the possibility of using contaminated equipment to crush non-contaminated empty containers. The crushed containers were set aside for later disposal as scrap metal.

Phase two of the container crushing dealt with the radiologically contaminated empty containers. These containers were crushed and packaged into 320 liter salvage drums for disposal as low-level radioactive waste. As suspected, the crushing unit was grossly contaminated with

TABLE III
Summary of Compatibility Test Procedures

Parameter	Name of Test	Reference*
pH	pH	Paper test
Flash Point	Flash Point	Tag Closed Tester, PenskyMartens Closed Tester
Oxidizer	Iodidestarch	Paper test
Reducer	Methylene blue	Paper test
Cyanides	Ferrous sulfate, ferric chloride	Spot test
Sulfide	Lead acetate	Paper test
Water reactive	Water spot test	Spot test

* These tests in addition to a number of additional compatibility testing procedures are documented in the EPA publication entitled Design and Development of a Hazardous Waste Reactivity Testing Protocol, by C.D. Wolback, R.R. Whitney, and U.B. Spannagel, Energy and Environmental Division, Acurex Corporation, Mountain View, California 94039 (Publication No. EPA-600/2-84-057).

loose material (predominantly rust) but was easily decontaminated with a broom and portable water pressure washer.

Sampling

After repackaging was completed all final containers were staged in a single, central location. At this point samples were collected from each container for radiological analysis and for representative analysis of each container and representative analysis for each waste type for assessment of the best final disposal disposition. The sampling and laboratory analyses were performed consistent with the Environmental Protection Agency (EPA) document SW-846 "Test Methods for Evaluating Solid Waste".

Containment

A containment system was fabricated by the Subcontractor from an existing structure at the site. The containment system was constructed to meet the requirements of 40 CFR 264.175. The structure has a smooth concrete floor, masonry walls, three large bay doors, two personnel entryways, and a roof of built-up tar and gravel. Four of the doorways were blocked with concrete block cemented to the floor and walls on either side of the door. The third bay doorway was blocked with a piece of neoprene backed angle iron bolted to the floor; this piece is removable to allow fork truck access in and out of the containment area. All floor/wall interfaces, expansion joints, and floor cracks were sealed with a polyurethane seal. Drums were stacked two high on wood pallets. Secondary containment was provided for PCB containing water, acids, or caustics by placing these containers in a bermed, plastic lined area within the primary containment system.

Each final container was marked and labeled. Specific marking and labeling included: a) unique container number, b) segregation/compatibility description, c) appropriate DOT shipping label, d) appropriate RCRA hazardous waste or non-hazardous waste label, e) packing list indicating container contents including which specific containers were repacked into the subject final container.

TRANSPORTATION AND DISPOSAL

As optional work the Subcontractor will be responsible for the transport and disposal of the non-radiologically contaminated wastes. Hazardous wastes shall be disposed of at EPA approved hazardous waste disposal facilities. Non-hazardous wastes will be disposed of in accordance with applicable federal, state, and local laws and regulations.

The radiologically contaminated wastes will be retained in the interim storage facility described earlier until a final disposition is decided. At this time it is planned that most materials be transported to and disposed of at the DOE-operated TSCA incinerator in Oak Ridge. Other material will likely be landfilled at a low-level waste facility or incorporated into the disposition of all other waste materials at the Weldon Spring Site.