OAK RIDGE RESERVATION DEPARTMENT OF ENERGY FACILITIES WASTE DISPOSITION CHALLENGES AND SUCCESS STORIES

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ABSTRACT

Waste disposition is a challenge for most environmental restoration and infrastructure reduction projects. Over the past three years Safety and Ecology Corporation (SEC) working with the management contractors for the U.S. Department of Energy (DOE) Oak Ridge facilities have been able to minimize the volume of waste (mixed, hazardous, asbestos, and radiological) that is disposed of and increased the volume for release, reuse, and recycle. This paper will focus on the success and challenges of several projects at the three Oak Ridge, Tennessee DOE facilities - Oak Ridge National Laboratory, East Tennessee Technology Park, and the Y-12 National Security Complex. Projects implemented by SEC will be used to illustrate the waste disposition decision process and the challenges/successes to completion. All these projects were "fixed price" with defined milestones keyed into award fee for management contractors and regulatory milestones for DOE.

From the first project completed over three years ago to the most recent, the waste disposition approach has been refined and a decision process developed. This decision process will be discussed in the paper and illustrated graphically to indicate the critical elements to selecting the most appropriate waste disposition option. This paper will discuss the following items with a focus on waste minimization efforts at the Oak Ridge Reservation DOE facilities.

- Waste disposition decision process.
- Waste disposition options – recycle, reuse, salvage, and disposal.
- Elements of integration required for successful pre-planning – design and implementation.
- Waste disposition challenges and solutions.

- Decontamination to reduce mixed waste volumes.
- Release surveys required to disposition waste for reuse/recycle.
- Lessons learned for future projects.

INTRODUCTION

Due to the changing mission and past operations of the U.S. Department of Energy (DOE) facilities located in Oak Ridge, Tennessee, surplus facilities required upgrades or replacement while other area contaminated from operations of these facilities required cleanup. Bechtel Jacobs Company LLC (BJC) was awarded the cleanup contract for all three facilities in 1998 and later transitioned this contract to an accelerated closure contract in 2002 with DOE. BWX Technologies Y-12 LLC (BWXT Y-12) was awarded the management and operations (M&O) contract for the Y-12 National Security Complex in 2000. University of Tennessee-Battelle (UT-Battelle) was awarded the Oak Ridge National Laboratory (ORNL) M&O contract by DOE.

Weapons research and production facilities were established at the Oak Ridge National Laboratory (ORNL), East Tennessee Technology Park (ETTP), formerly known as the Oak Ridge Gaseous Diffusion Plant, and the Y-12 National Security Complex (formerly the Y-12 Plant) in 1943 as part of the World War II Manhattan Project. The original mission was to produce and chemically separate the first gram quantities of plutonium as part of the national effort to produce the atomic bomb. As their role in the development of nuclear weapons decreased over time, the scope of work expanded to include the production of isotopes, fundamental research in a variety of sciences, research involving hazardous and radioactive materials, environmental research, and radioactive waste disposal.

ORNL's mission today is to maintain its role as an international leader in a range of scientific areas that support the DOE mission; therefore, cleanup goals support controlled industrial use within the main plant area and unrestricted industrial use in surrounding areas. The vision of ETTP is to cleanup the legacy waste and surplus facilities to facilitate reindustrialization of the site for future use. The Y-12 National Security Complex is a unique national asset in the manufacture, processing and storage of special materials that are vital to our national security and is contributing to the prevention of the spread of weapons of mass destruction. Thus, Y-12 is pursuing an aggressive program of infrastructure reduction, modernization and investment in technology to make the plant as safe and efficient as possible and to improve production capabilities.

Facilities across the DOE complex are transitioning from a production phase to a remediation, decontamination and decommissioning (D&D), and redevelopment phase increasing the volumes of hazardous, radioactive, and mixed wastes generated during these cleanup efforts. Waste management activities, including generation, characterization and disposition, are a challenge all face in the environmental restoration and remediation business. As transportation, processing, and disposal rates for wastes continue to increase, exponentially in some areas, more cost-effective waste management options must be sought out.

The following sections will present the waste management concepts developed over a three-year period for several remediation/D&D projects at the Oak Ridge DOE facilities that resulted in a more streamlined waste disposition design with a focus on waste minimization. The paper will first define waste minimization and then how these concepts were integrated in the waste disposition process for various completed projects with success.

WASTE MINIMIZATION

Waste minimization includes source reduction, recycling, reuse, and recovery of material. Waste minimization activities reduce the demand for treatment and disposal capacity resulting in less regulatory involvement and reduced costs. Waste management principles must be incorporated into environmental restoration/D&D activities to ensure the greatest environmental and financial benefits. Reasons to minimize waste include:

- To reduce treatment and/or disposal costs;
- To reduce the impacts of other hazardous, radioactive, and mixed waste requirements;
- To improve human health and the environment;
- To promote better environmental stewardship and leadership; and
- To build better community relations for the client.

Waste minimization programs must include qualitative and quantitative (where possible) reduction goals and ensure that adequate resources are available to meet these goals. Qualitative goals include the intent to identify and implement activities that eliminate or reduce the generation of waste in all phases of the project. While often more difficult to implement, quantitative goals include commitments to measurable reductions in waste volumes generated and disposed. Project teams develop waste minimization objectives, such as seeking alternative non-hazardous chemicals as substitutes for traditional cleaners and degreasers, or developing aggressive waste management strategies that decrease the volume of hazardous or mixed wastes generated and disposed by as much as 70%.

TECHNICAL APPROACH TO WASTE MINIMIZATION

To meet waste minimization goals and objectives stated in project-specific Waste Management Plans, SEC designated a Waste Management Specialist that is responsible for developing the waste minimization program, providing leadership and training for project personnel on identifying opportunities to eliminate or reduce waste generation, and for initiating a pollution prevention opportunity assessment (PPOA) during the planning stages of a project. Pollution Prevention (P2) goals are included as routine aspects of environmental restoration projects and generally focus on emphasizing recycling/reuse and segregation for primary waste streams and source reduction for secondary wastes. The following are waste minimization concepts utilized on projects to achieve these goals.

Housekeeping

By keeping work areas clean and equipment properly maintained, the chance of breakage or leaking is greatly reduced. Equipment receives daily inspection and regular preventative maintenance to ensure efficient operation. Spill response plans are developed that considers cleanup methods that reduce the generation of cleanup waste. In addition, designating equipment for use (and reuse where applicable) in radiological areas reduces the volume of radiological waste to be disposed.

Material Segregation
All materials are handled and stored to prevent commingling or cross-contamination. Great care is taken to prevent contamination spread to non-contaminated items or areas.

- D&D material/waste stream segregation is integrated into demolition design to ensure that clean material does not become contaminated during machine demolition of the structure.

- Storage bins for contaminated tools and equipment to be reused in contaminated areas are maintained so new tools do not repeatedly become contaminated.

- Boundaries are established between contamination areas, buffer or reduction areas, and support areas to prevent the spread of contamination to clean areas.

- Personnel are trained on PPE donning and doffing procedures and on minimizing the spread of contamination to clean areas

Administrative Controls
Administrative controls or criteria (such as relocating radiological boundary lines to result in less material being classified as radiological) are reviewed to determine if changes would result in reducing or eliminating the generation of wastes.

Process Changes
Changes to equipment or materials used in the process may result in less use of resources or less generation of wastes.

- Modification of remediation/D&D design to accommodate the various waste streams that are present.

- Substituting non-hazardous materials for hazardous inputs will result in the reduction or elimination of hazardous waste and in the reduction of potential for worker exposure.

- Utilizing innovative in-situ sampling technologies whenever possible. Equipment such as the XRF detector and ISOCS detector reduce the generation of sampling and analysis waste such as containers, residues, PPE, sampling tools, and decontamination equipment and effluent. Whenever possible, SEC utilizes these innovative technologies as alternates to traditional characterization methodologies

- Utilizing innovative decontamination methodologies such as CO_2 blasting, eliminating the disposal of the blast media. All decontamination efforts are reviewed to determine the most effective and least waste-producing methodology. During decontamination, environmentally benign cleaners such as Simple Green are substituted for hazardous organic solvents whenever possible.

- Maintaining a Hazardous Material Inventory System (HMIS) to track the possession and use of hazardous materials at each site. The HMIS includes a system of suggesting alternates to traditional hazardous materials.

- Integrating process knowledge with on-site radiological surveys minimizes the number of required samples for off-site laboratory analysis.

Recovery/Recycling/Reuse

Recycling and reuse is the best method for achieving minimization of the primary waste streams. Materials such as scrap metal, timber, and concrete can be sent to waste disposition outlets that recycle this material which results in significant waste reduction and cost savings. Whenever feasible, these materials are decontaminated, allowing the material to be recycled or reused.

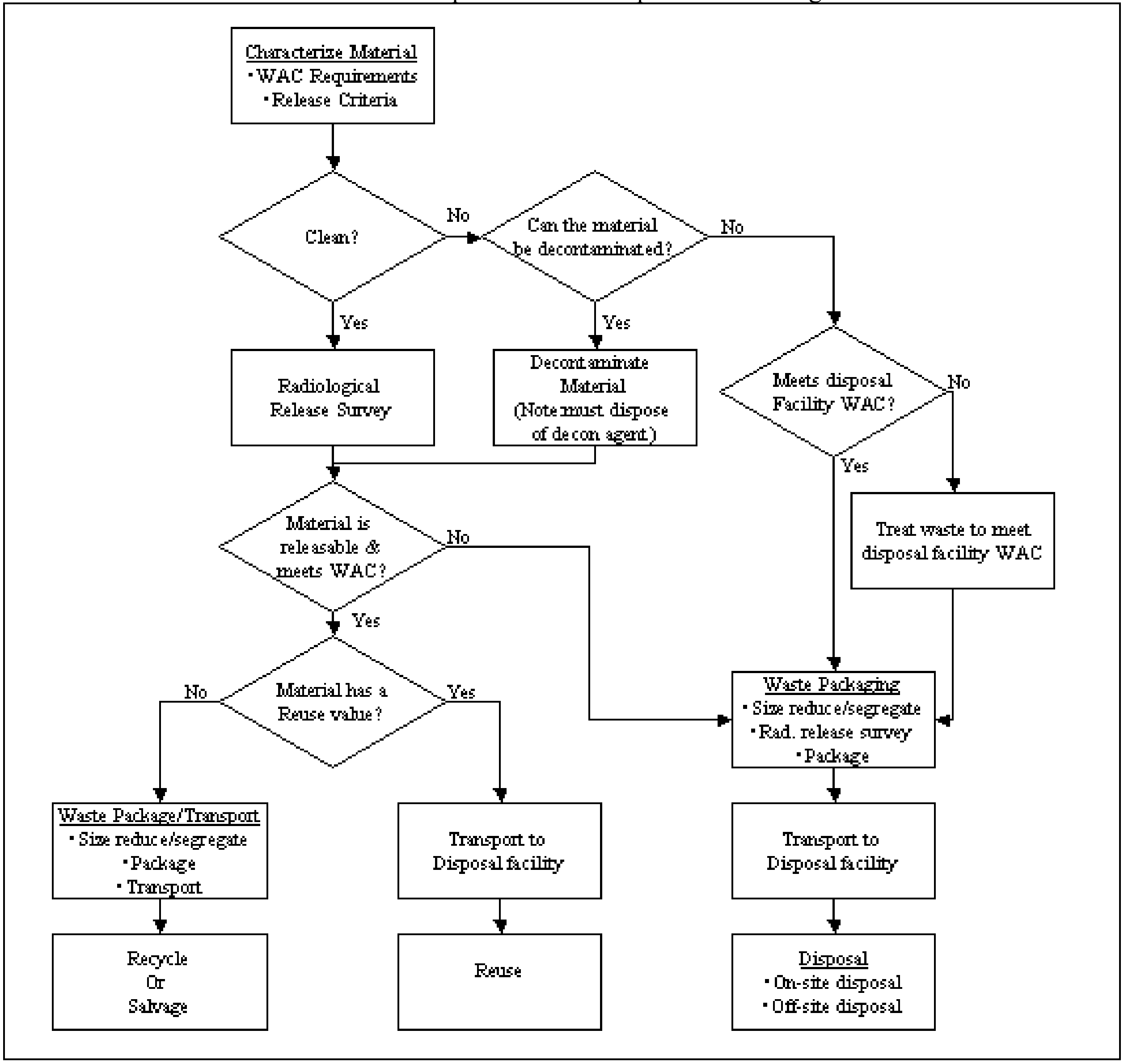
Volume Reduction

Size reduction through compacting, baling and melting greatly reduces the volume of materials requiring disposal. Several waste disposition outlets are capable of super-compacting or baling compactable wastes, achieving volume reductions of 200% or more**.**

WASTE DISPOSITION DECISION PROCESS

During the planning and evaluation stages of a project, the potential waste streams are assessed to identify cost-effective disposition options. It is at this stage of project planning, that the greatest opportunity for waste minimization can be realized. The disposition decision process is depicted below in Table I. While seemingly straightforward, the decision-making process is applied to each potential waste stream. The process allows planners to evaluate the disposition options, including recycle, salvage, reuse, or disposal prior to field mobilization to perform remediation/D&D. In addition, the remediation/D&D design can be altered at this point to maximize waste segregation and minimize cost. Thus, the field implementation is focused on waste disposition at the beginning versus midway or even the end of field activities when multiple containers of waste have already been generated.

Table I Waste disposition decision process flow diagram



It is essential that waste disposition be incorporated in the initial design of the remediation/D&D and integrated into every controlled document that supports field implementation. The following items must be considered for selecting the waste disposition option that is the most cost effective and environmentally sound for the various waste streams that may be encountered on a project.

- Availability of on-site disposal facilities and understanding the waste acceptance criteria (WAC). If on-site disposal is readily available and the waste stream meets the WAC then this will reduce the need for off-site transport, disposal fees, and release surveys.

- Availability of off-site disposal facility and understanding the WAC. If there is no on-site disposal facility then an acceptable off-site disposal facility must be sought with an understanding of profiling, transportation/packaging options, WAC, and certificate of disposal.

- Availability of various transportation alternatives including truck and rail in close proximity to the site. Evaluate all options as waste that must be packaged and shipped long distances may be best transported by rail that can most cost effectively be accomplished using different container than truck. Avoid repackaging by determining transport up front.

- Release criteria for the DOE facility the work is being performed at must be understood, as it could be more aggressive than the receiving disposition facility.

Evaluate the option of segregation versus availability of on-site disposal that can accepted the commingled waste streams with submission of a Special Case Waste Application to local regulators. Segregation is preferred unless in the case of Oak Ridge DOE facilities that have a construction debris landfill adjacent to an asbestos landfill that may allow for commingled waste to be disposed when segregation is difficult and costly (e.g., asbestos insulation on piping, asbestos floor tile on debris).

DESIGN AND IMPLEMENTATION

Once each potential waste stream has been evaluated through the decision process shown in Table 1, the intended path for that waste stream should be identified. As shown in this figure, potential paths include treatment/disposal, recycle, reuse, and salvage. For example, once salvage has been determined as the path forward for a particular material, several salvage options may be available. During the demolition of Building K-1001, SEC chose to salvage the existing furniture and fixtures in the facility. The salvaged items were donated to local churches and schools as this option provided a valuable reuse while eliminating need for waste disposal. Over 150 m^3 (200 CY) of material was kept out of an industrial landfill by donating the materials to local schools and churches. The choosing of a receiving facility is often the result of an evaluation of numerous and complex factors, and is often specific to a particular waste stream.

Once the options have been evaluated and an outlet has been identified, smooth integration and arrangement with the outlet during the planning stages is essential for seamless waste management during remediation and D&D activities. Comprehensive understanding of the receiving facility WAC and release criteria for DOE facility must be incorporated into the design of project plans and activities. Client approval of the outlet during the pre-mobilization stages ensures that waste management activities progress smoothly.

Similar integration and planning is necessary for other waste minimization outlets as well. Recycle facilities must go through the extensive approval and qualification process, which, if not started early in the life of a project, can delay disposition activities. Additionally, characterization of the waste material should focus on both the client's release criteria (to move material from the site) and on the waste disposition facility WAC (to receive the material for recycle or other disposition). Release criteria may range widely depending on the final disposition of the material and the DOE facility. By identifying disposition outlets early in the project, one can design characterization strategies to meet the acceptance and release criteria needed to get the material to the facility.

RELEASE SURVEYS REQUIRED FOR REUSE/RECYCLE

Although reuse and recycle of waste material is often a financially attractive disposition option, material slated for recycle/reuse must be sufficiently characterized to meet several important criteria, including:

- WAC of the receiving facility;
- Release criteria for the DOE facility;
- Compliance with transportation regulations while material is in transit; and
- Environmental health and safety criteria for workers handling the material.

A number of survey and characterization strategies can be employed to meet the above criteria. In some cases, process knowledge is sufficient to adequately characterize the material. For radiologically contaminated material, guidance provided in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) is the basis for release surveys. The MARSSIM process was developed collaboratively by the Nuclear Regulatory Commission, U. S. Environmental Protection Agency, DOE, and U.S. Department of Defense for use in designing, implementing, and evaluating radiological surveys. The primary focus of MARSSIM is to demonstrate compliance of a site or facility with criteria established for future use without radiological restrictions. Other sites have additional release criteria that may be more stringent than a MARSSIMS approach. Potentially Resource, Conservation and Recovery Act (RCRA) contaminated material should be analyzed for corrosivity, flammability, reactivity and toxicity as specified in 40 Code of Federal Regulation (CFR) 261 to meet acceptance criteria of recycling facilities.

Decontamination of material has become complicated by the recent DOE moratorium on recycling of radioactively contaminated metal from DOE facilities. RCRA contaminated metals that can be decontaminated and proven clean can be readily recycled, saving thousands of dollars in disposition costs. Radioactively contaminated metals can often be "re-used" at another DOE facility, saving disposal costs. "Re-use" provides a good alternative to recycle while the moratorium is in place.

WASTE DISPOSITION CHALLENGES AND SOLUTIONS

While waste minimization offers an array of important financial and other advantages, significant challenges can face a subcontractor dedicated to recycle, reuse, salvage, and other waste minimization activities. Projects completed by SEC will be used to illustrate the waste disposition decision process and provide lessons learned regarding waste minimization challenges as presented below.

Challenge/Lessons Learned #1
Ensure that the release criteria are clearly defined and measurable before attempting to free-release material.

Description: During performance of the Building 7934 RCRA Closure and Silvery Recovery Unit Removal, SEC dismantled a photographic solution processing unit, contaminated with a variety of RCRA metals, volatiles and semi-volatile constituents (Fig. 1). SEC's P2 Goals identified decontamination of the unit and reuse of the metal as the most advantageous option. SEC planned an aggressive decontamination of the metals using high pressure heated washes and mild detergents and abrasive scrubbing to remove RCRA contaminants from the metal. The metal would then be triple rinsed and the final rinseate would be sampled for RCRA

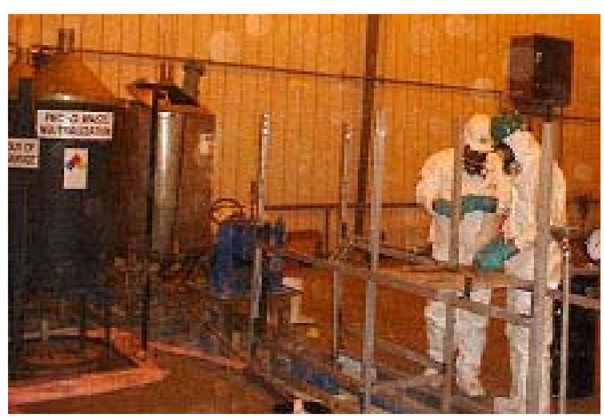


Fig. 1 Workers decontaminating a silver recovery unit.

contaminants. If the final rinseate tested clean, the material could be sent to a local metal recycle facility at ETTP for eventual reuse. Although the unit never processed any radioactive material, SEC planned to perform surface scans of 100% of the metal to meet the WAC of the receiving facility.

During decontamination of the material, SEC found that the planned surface scans of the metal would not be sufficient to meet the ORNL release criteria and move the material from the site. Instead, because the material was located within a radiologically controlled area, SEC would have to prove that the metal had “no added radioactivity”. There are no numerical criteria for “no added radioactivity”; rather, the general approach is to demonstrate by Best Available Technology (BAT) that the liquid rinseate contains no increase in radioactivity, above that in the liquid, prior to its use. Using the BAT, it was determined that if the level of radionuclides in the liquid waste was less than the minimum detectable activity (MDA) above the levels in the unused liquid, it is reasonable to conclude that the liquid waste contains no added radioactivity. The greatest difficulty arose because the laboratory was unable to achieve the MDA for the material because of the viscous nature of the rinseate. The material could not be free released, because SEC was unable to prove that the material contained no added radioactivity.

Solution: SEC was able to resample the material and obtain a sample with which the laboratory could meet the required MDAs. The re-sampling and reanalysis activities, however, added considerable cost and time to a regulatory-driven schedule for closure of the unit. While the project was able to meet its regulatory milestones, the additional release criteria caused SEC to incur further cost.

Lessons Learned: When evaluating waste minimization as a viable option, it is important to take into account not only the acceptance criteria of the receiving facility, but also the release criteria of the client/DOE facility and/or site. While characterization may be sufficient to meet acceptance criteria, more stringent release criteria may drive the characterization approach, introducing hidden costs and delays into waste management activities. A comprehensive characterization approach must take into account acceptance criteria and release criteria.

Challenge/Lessons Learned #2

When wastes slated for one disposal facility are sent to another facility, because waste minimization activities are employed, it is important that differences in the acceptance criteria of the facilities are understood early in the planning stages.

Description: During performance of the Building 7503 Recovery Project, SEC was tasked with removing and disposing of over 101,600 kg (100 tons) of high density block shielding. Historical information indicated that the shield blocks were radioactively contaminated. Based on this information, SEC managed the material as radioactive and issued a contract with a radioactive waste disposal facility. Blocks were packaged for transport to the radioactive waste disposal facility. As SEC was removing the shield blocks (Fig. 2), it was noted that the vast majority of the blocks were non-contaminated based on field radiological surveys. Based on these observations, SEC was able to perform a MARSSIM-based survey of the material and release the blocks as “clean”. Releasing the blocks as clean and disposing of them in a local industrial 1 andfill saved the client hundreds of thousands of dollars in radiological waste transportation and disposal costs.

Fig. 2 Segregation of barite shield blocks

As SEC instituted a contract with the industrial landfill, it became apparent that the packaging and physical properties of the blocks, including their size, density, and weight would make disposition at the landfill difficult. Rather than repackaging the blocks, SEC chose to pursue a special case waste permit with the landfill to allow acceptance of the material "as is". SEC expected the special case waste permitting process to take several weeks; however the process took over three months and caused considerable delays in the waste disposition portion of the project. Although the special waste permit was granted and the material was disposed at a local industrial landfill, the permitting process caused considerable delays.

Lessons Learned: Waste minimization activities performed in the field can prove to be extremely cost-effective. However, when those activities change the anticipated disposal outlets for a particular waste stream, the subtle differences in acceptance criteria can dramatically affect packaging, size-reduction and handling requirements. Waste that was sized and packaged for a particular disposal outlet may not be acceptable to a different outlet. Ideally, characterization of waste streams should be performed before wastes are generated, so packaging and handling requirements can be specified based on characterization results. Again, proper planning at the earliest stages of a project is essential to meet aggressive schedules and budgets.

Challenge/Lessons Learned #3

Integrating the release criteria and WAC prior to field implementation resulted in streamlined waste disposition and waste minimization goals.

Description: During performance of the Transportable Vitrification System (TVS) RCRA Closure, SEC dismantled a large-scale modular vitrification system for the treatment of mixed wastes. The wastes contained both hazardous and radioactive materials in the form of sludge, soil, and ash. Dismantlement activities were accomplished utilizing conventional air or hand tools then a plasma arc torch was used to cut difficult connection. Once these upper units and associated components were disconnected, a large crane was mobilized to the site to move the units to the ground (Fig. 3).

Fig. 3 TVS dismantlement activities

As modules/equipment was dismantled, they were surveyed and segregated based on process knowledge into contaminated and non-contaminated waste streams and staged on site. Surface radiological scans of the material were performed to initially determine whether the material is radiologically contaminated. Representative samples from the staged material were collected and sent off for laboratory analysis during the initial weeks of field operations, ensuring sufficient time for waste characterization and profiling. Composite rinseate samples were collected and analyzed for the selected radiological and RCRA contaminants of concern to verify the segregated materials meet the WAC of the receiving facility.

In some cases the dismantled equipment had to be size reduced further to fit into transport container or to meet WAC requirements. The "gutted" Batch Feed Module was used as a size reduction area to contain any material from the hot cutting technique using the plasma arc on over-sized material. This module was also used as a decontamination area for slightly contaminated equipment. The decontamination method was simply a 210 kg/cm^3 (3,000 psi) steam cleaner with cleaning additive in rinse water.

This waste disposition strategy resulted in over 430 m^3 (560 CY) of material being reused/recycled minimizing the mixed low-level radioactive waste (LLW) volume to 60 m^3 (75 CY) and construction debris to 15 m^3 (20 CY).

Solution: SEC was able to implement lessons learned from the Building 7934 RCRA Closure and utilize the waste disposition process illustrated in Figure 1 to achieve a streamlined waste disposition.

Lessons Learned: Designing a waste disposition strategy during the planning stages instead of the field implementation stage resulted in cost savings over $100,000 in waste disposal cost and cost avoidance to the government of over $500,000 due to not having to dispose of waste as mixed LLW.

Challenge/Lessons Learned #4

Integrating the facility characterization and structural integrity assessment with the demolition approach resulted in streamlined waste disposition and obtainable P2 goals.

Description: During Fall 2003, SEC was awarded three Task Order contracts by BWXT Y-12 LLC to perform hazardous (RCRA, TSCA, and asbestos) abatement, facility demolition, waste disposition for approximately 34structures as part of the Y-12 Infrastructure Reduction Program. The Building 9723-19 demolition will be used to illustrate the integration of waste disposition into the development of the demolition approach. This building was originally constructed in the 1940's as a perimeter security facility and in later years had been utilized as a change house for radiological workers until the time demolition was scheduled to commence. The facility was contaminated with hazardous material primarily from the original construction materials and paint. Radiological contamination was also present as a result of its use as a change house for work involving uranium.

The 1765 m^2 (19,000-ft^2) 9723-19 Building presented a very challenging problem due to its size, the large amount of contaminated material inside, and the roof condition. The asbestos containing and uranium-contaminated roof had deteriorated over the years to the point it was deemed inaccessible for access. It was critical that the roofing material be segregated from the general building debris to avoid generating an enormous amount of additional asbestos-radiological waste due to brining the contaminated roof down onto the clean building debris using traditional demolition approaches.

The interior of the facility contained hundreds of personal metal lockers that had been used by the workforce. These lockers were contaminated both internally and externally with uranium from several decades of use. The levels of contamination were very high in the lower sections and underneath the bases. Additional areas of the facility interior were also highly contaminated including wall sections, floors, and HVAC components.

Solution: The facility was fully characterized and the waste streams identified. The demolition of the facility was planned to incorporate each waste stream by its unique disposal requirements. This involved selective internal demolition for the RCRA (Mercury switches), TSCA (PCB ballast), and asbestos containing material (transite siding and pipe insulation). The PCB and mercury items were first removed, decontaminated as necessary and transferred to BWXT Y-12 LLC on-site recycling programs. Then the asbestos siding (non-friable) and pipe insulation (friable) were removed, packaged accordingly, and disposed at the appropriately licensed on-site landfill. The lockers were disassembled, sprayed with a fixative to contain removable contamination, and packaged in intermodal containers. The lockers were then sent to the BNFL super compactor locally for size reduction. Selective radiological decontamination and demolition was then performed on the remaining internal structures and this material packaged for disposal as required.

The final challenge was to demolish the building with the roof intact without contaminating the entire building debris. An engineering analysis was performed on the structure to determine a safe method of demolition. This was accomplished by involving a structural engineer who evaluated existing building drawings and the facility itself to identify a "controlled collapse" sequence that would allow the roof to remain intact. This sequence is illustrated in the structural engineering drawing (Fig. 4). The structure was internally weakened in critical areas using conventional hand tools and temporary supports were installed. The structure was then divided into seven demo zones. These zones were then sequentially laid down by securing an appropriately sized cable to the interior support beams then pulling this cable with a tracked excavator. This method provided a means to kept the roof intact and resulted in a stable flat surface at ground level. The roof was then abated of the contaminated asbestos material allowing the vast majority of the debris to be disposed of at the onsite sanitary landfill. This approach saved several thousand yards of material from having to be dispositioned as mixed waste.

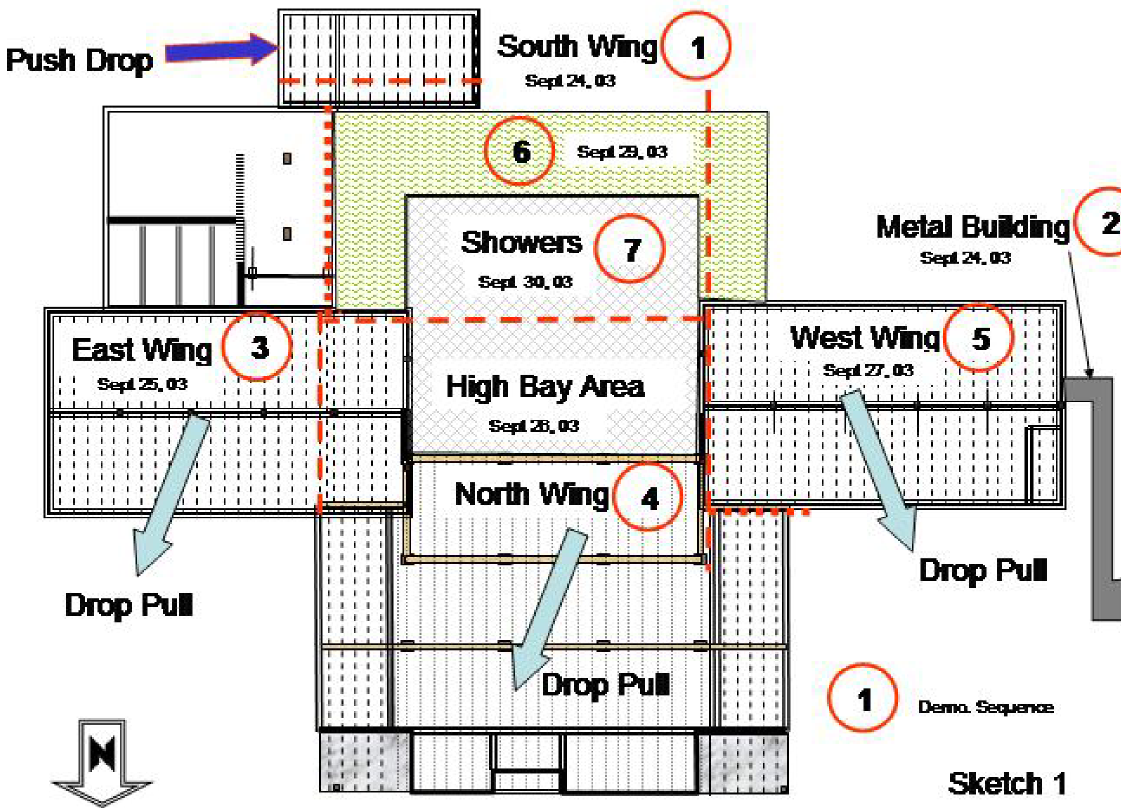


Fig. 4 Building 9723-19 controlled collapse sequence

Lessons Learned: Incorporating the waste disposition strategy into the demolition approach and refining during field implementation stage to accommodate new findings, resulted in cost savings over $100,000 in waste disposal cost and cost avoidance to the government of over $100,000 due to not having to dispose of waste as mixed LLW.

WASTE MINIMIZATION SUCCESSES

Despite occasional waste minimization challenges that are common to all field projects, SEC has been able to save hundreds of thousands of dollars by implementing waste minimization strategies during RADD activities. By implementing minimization strategies such as source reduction, recycling, reuse, or salvage, SEC has reduced the volume of radioactive, hazardous and/or mixed waste disposed by over 1530 m^3 (2,000 CY) within the last 3 years. Specific examples of waste minimization successes on RADD projects are detailed below in Table II.

Each of the projects showed a marked decrease in total volume of waste disposed as well as volume of radioactive and/or hazardous waste disposed. Waste minimization is an integral part of any remediation and D&D strategy that SEC develops. Effective environmental restoration depends on the reduction of the quantity and toxicity of hazardous and radioactive waste. SEC has assisted BJC and proven the effectiveness of the team at taking waste minimization strategies from the planning table into the field, resulting in significant reductions in waste volumes and toxicity saving time and money.

TABLE II. Projects Waste Minimization Successes

PROJECT	WASTE MINIMIZATION STRATEGY	RESULT
Building 3019B LOG Duct Characterization	Use of the ISOCS system to perform radiological characterization of the laboratory off-gas duct system. The ISOCS greatly reduced the need for intrusive sampling and eliminated wastes associated with intrusive sampling.	• The generation of radioactive secondary waste was reduced by > 7 m^3 (10 CY) • Contaminating tools and equipment was eliminated by not performing intrusive sampling.
Building 7503 Recovery	Over 75 m^3 (100 CY) of material in the building was labeled as radioactive, slated for disposal. SEC performed MARSIMS-type characterization to maximize recycle and reuse as alternatives to disposal.	• Only 20 m^3 (27 CY) of waste was disposed as radioactive. • Approximately 75 m^3 (100 CY) of waste was released and disposed of as clean. • SEC saved 60 m^3 (80 CY) of material from disposal by recycling and reusing resulting in a 150% volume reduction.
Building 7934 RCRA Equipment Removal and RCRA Closure	SEC performed extensive decontamination of an abandoned silver recovery unit, contaminated with RCRA metals. The recovery unit was slated for disposal as hazardous waste	• Hazardous waste stream volume was reduced by over 200% • Over 7 m^3 (10CY) of clean scrap metal .was recycled
Building K-1001 Demolition	Prior to demolition of the facility, all salvageable and recyclable materials from the building were removed instead of disposed of hazardous material or construction debris..	• Salvage of over 150 m^3 (200 CY) of office furniture and materials • Recycle of over 200 lead batteries and mercury thermometers • Recycle of over 3800 mercury bulbs
Building 7602 Recovery	Radioactive waste material removed during the decommissioning was compacted, baled or melted for reuse.	• Waste processing resulted in a volume reduction of over 98%
Joyner Scrap Yard	Radioactive waste material removed during the remediation was compacted, baled or melted for reuse.	• Waste processing resulted in a volume reduction of over 40%
GAAT Stabilization	As the 567,800 L (150,000 gallon) below ground tanks were stabilized with grout, above-ground support and process piping, and risers, were grouted in place within the tanks, providing a cost, effective, stable form of disposition.	• Waste volume requiring disposition was reduced by over 400% • Cost avoidance was > $200,000
TVS RCRA Closure	Radiologically contaminated metal was decontaminated and clean metal was surveyed and released to meet release criteria for reuse/recycle.	• Over 430 m^3 (560 CY) of metal was reused/recycled. • Radioactive waste volume was reduced by 70%. • Construction debris volume was reduced by 95%
BWXT Y-12 Building Demolition Projects	Building demolition approaches incorporated waste minimization in design phase to increase the amount of salvage/recycle material and reduce disposal cost	• Over 900 metric tons of material was recycled/reused versus disposed in landfills • Cost avoidance of $180,000

FOOTNOTES

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