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Energy Systems Environmental Restoration Program
Y-12 Environmental Restoration Program

**RCRA Closure Plan for the Bear Creek
Burial Grounds B Area and Walk-In Pits
at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee**

Date Issued—January 1993

Prepared for
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

Prepared by the
OAK RIDGE Y-12 PLANT
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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FOREWORD

In June 1987, the RCRA Closure/Postclosure Plan for the Bear Creek Burial Grounds (BCBG) was submitted to the Tennessee Department of Environment and Conservation (TDEC) (then known as the Tennessee Department of Health and Environment) for review and approval. TDEC modified and issued the plan approved on September 30, 1987. Subsequently, this plan was modified again and approved as Y/TS-395, *Revised RCRA Closure Plan for the Bear Creek Burial Grounds* (February 29, 1988).

Y/TS-395 was initially intended to apply to A Area, C-West, B Area, and the Walk-In Pits of BCBG. However, a concept was developed to include the B Area (non-RCRA regulated) in the Walk-In Pits so that both areas would be closed under one cap. This approach included a tremendous amount of site preparation with an underlying stabilization base of 16 ft of sand for blast protection. The plan was presented to the state of Tennessee on March 8, 1990, and the Department of Energy was requested to review other unique alternatives to close the site. Therefore, the closure plan for B Area and the Walk-In Pits was prepared separately from that of the other burial grounds and was presented in DOE/OR/01-1100&D1.

This amended closure plan (DOE/OR/01-1100&D2) goes further to include inspection and maintenance criteria along with other details.

INTRODUCTION

The Bear Creek Burial Grounds (BCBG) are located on the southwest flank of Pine Ridge ~1.5 miles west of the Oak Ridge Y-12 Plant in Bear Creek Valley. This facility consists of several contiguous disposal sites identified as Burial Grounds A, B, C, and D (see Figs. 1 and 2). Each burial site consists of a series of trenches used for disposal of solid wastes and, in some cases, liquid wastes. Trench bottoms are reported to be a maximum of 20 ft below the original grade.

The first disposal trench in BCBG was excavated in August 1955 for the disposal of solid wastes. In July 1959, the Y-12 Plant was authorized by the Atomic Energy Commission to begin using this facility for the disposal of certain types of liquid wastes. Since that time, several types of wastes have been disposed of in the various burial ground areas, including the following (not listed in order of generated volume):

- ferrous metals and uranium,
- oils and coolants,
- salts,
- debris,
- solvents,
- ethylenediamine tetraacetic acid (EDTA),
- asbestos,
- material contaminated with radioisotopes, and
- mop water.

The actual quantity and identity of materials is uncertain, and other materials may have been disposed of that are not listed in any inventory. The largest volume of material disposed in BCBG consists of uranium-contaminated industrial trash (paper, wood, steel, glass, and rubble).

When RCRA Part A permit applications were submitted, trenches and disposal areas in BCBG that received hazardous waste after November 19, 1980, were designated and given interim status. These RCRA trenches are identified in Fig. 2.

The B Area and the Walk-In Pits are located adjacent to each other in BCBG. The B Area consists of a series of trenches located on the crest of a hill in the center the BCBG. The Walk-In Pits are located on the side of this hill on the north and south sides of B Area (there are "north" and "south" Walk-In Pits).

The B Area was first used in 1962 for the disposal of depleted uranium chips, metals, and oxides. Because the chips were pyrophoric, chip fires were common. For a period of time in 1968, chips were deliberately burned upon delivery in order to prevent unpredicted and unattended fires later. This practice was stopped soon after it was initiated, and unoxidized chips may remain in the covered trenches at present.

Fig. 1. Bear Creek Valley Waste Disposal Area.

Fig. 2. Map of BCBG area showing B Area and Walk-In Pits. Hatched areas are RCRA; other areas are CERCLA only.

The Walk-In Pits were first used in 1966 for the disposal of uranium and thorium saw fines and other shock-sensitive metals. From 1968 until 1980, the area was also used for the above-grade burial of acids, bases, and organics. Packaging of these wastes included drums, cardboard boxes, and buckets. The explosion hazard of the waste buried in the Walk-In Pits limits the types of closure activities which may be safely undertaken and is the main cause for changes in closure activities from those at the other parts of BCBG (such as A Area and C-West).

CLOSURE PERFORMANCE STANDARDS

At closure, the BCBG B Area and Walk-In Pits will be covered with an engineered cap designed and constructed to minimize migration of liquids, promote drainage around the capped areas, and minimize erosion, subsidence, and maintenance. They will be closed in place in a manner that will reduce the need for postclosure maintenance. As a result of this closure, the potential for additional releases to the receiving stream and the groundwater will be reduced and controlled. Detailed descriptions of closure procedures are provided in the following sections.

WASTE INVENTORY

The waste inventory in the B Area and the Walk-In Pits includes solid waste (such as wood, metal, paper, glass, and debris) contaminated with depleted uranium chips, metals, and oxides; uranium and thorium saw fines and other shock-sensitive metals; and acids, bases, and organics. These materials will remain in place because attempts to remove these materials would pose potential harm to health and environment.

EQUIPMENT DECONTAMINATION

Because of the manner in which the B Area and the Walk-In Pits will be closed, equipment decontamination will not be required as part of closure. Wastes were covered with soil after disposal. When a trench was filled, an additional 2- to 3-ft layer of clean soil was added to cover the trench. Equipment should not come into contact with wastes or contaminated material. During construction, recontouring fill will be pushed in front of the equipment over the site such that the equipment will be in contact only with clean soil. If, however, the equipment is contaminated, it will be decontaminated by first scraping off soil remaining on the equipment. Soil residues will be placed beneath the cap. The equipment will then be triple steam cleaned. Personnel will wear protective clothing. Wash and rinse water will be collected. Verification sampling is not proposed for the equipment. However, it will be visually inspected to ensure that no visible residue from the excavation remains. If the equipment is contaminated, radiation monitoring will be performed before the equipment exits the controlled/exclusion area.

DESIGN ELEMENTS OF CLOSURE

The site (a hilltop and steep side slopes) will be cleared (i.e., trees/brush cut close to the surface in order not to disturb the wastes) and backfilled with clean clay to form a continuous relatively smooth contour (Fig. 3). Because of site topography, the thickness of this clay layer will vary. The Walk-In Pits (a north and south area) contain explosive hazards and will have clay fill placed and compacted in accordance with safety restrictions. A gas-collection vent system will be installed by placing slotted pipes across the hilltop and side slopes. A geotextile fabric and geonet will overlay the site to act as a gas-collection system and to connect to the gas vents. A flexible, synthetic geomembrane liner will be placed on top of the geotextile fabric and geogrid. This geomembrane will be secured by concrete, soil, and rip-rap anchor along its edges and by a mortar-filled fabric envelope over the entire surface. Gas vents will be constructed through the geomembrane layer.

INSTALLATION PROCEDURES

The construction of the engineered multilayered cap is described below.

COVER PLACEMENT

1. *Recontouring Fill*

A minimum of 2 ft of soil will be placed over the Walk-In Pits as blast shielding for construction personnel. The explosion potential of the waste materials is very small, and the 2-ft layer is being placed as a precautionary measure. Extensive safety analysis and documentation have been conducted on this project. B Area will also be covered with a minimum of 2 ft of soil.

The site will receive additional soil fill to recontour the uneven terrain. The existing site has areas of very steep slopes, benches, depressions, and other topographic features that would preclude the placement of a flexible geomembrane liner. The site recontouring will produce a smooth, continuous topography without depressions or humps. The fill will be graded smooth prior to placement of the geosynthetic layers.

2. *Geotextile Fabric and Geonet*

A geotextile fabric will be placed over the recontouring fill. The fabric will serve as a cushion to protect the geomembrane above it from puncture. It will serve as a separator to prevent the intrusion of soil into the geonet. The geonet is the gas-collection layer. Any gasses that form in the waste and migrate upward through the cover soil would collect under the geomembrane liner if a gas-venting layer was not provided. The geonet will allow gasses to migrate to a header that is connected to a series of vents. The geotextile and geonet will also serve as a pathway for condensate to migrate to the bottom of the hill.

Bear Creek Burial Ground

Fig. 3. Cross-section of B Area and Walk-In Pits.

3. *Geomembrane*

A flexible geomembrane liner will be placed over the geonet to prevent water from infiltrating into the waste. The geomembrane chosen for this cap is one of reinforced polypropylene.

4. *Cover System*

A "fabriform" revetment mat will be placed over the geomembrane. It will provide protection for the geomembrane from wind damage, ultraviolet light (which degrades plastic), and animals (which may perforate the geomembrane with their hooves or burrows). The revetment mat consists of a double-layer fabric into which a highly fluid sand/cement mortar is pumped. The mortar will harden into a concrete layer ~4 in. thick. Reinforcing tendons will run in each direction within the mat. This type of revetment system is used extensively along shorelines to prevent erosion. In this application it will provide excellent protection for the geomembrane.

Storm-water runoff will be directed to ditches along the perimeter of the site and at the foot of the hill. The fabriform cover will be placed in the ditches to serve as a paved channel for runoff. This will contain storm water, dissipate energy, and prevent erosion.

DRAINAGE AND EROSION

The fabriform cover and the geomembrane are intended to prevent infiltration of rainfall and to control the flow of storm water across the site. Storm runoff will sheet flow over the fabriform cover to swales outside the waste perimeter. The swales will be lined with fabriform and will be continuous with the cap cover. Where the drainage swales exit the site, energy dissipators will be provided to control erosion.

ADDITIONAL CLOSURE ACTIVITIES

CONSTRUCTION QUALITY ASSURANCE

The landfill shall be designed, constructed, and operated to protect human health and the environment. To ensure that the completed landfill meets or exceeds all projected design criteria, plans, and specifications, a construction quality assurance (CQA) program is necessary.

1. The owner/operator shall prepare a written CQA plan to be used during construction of the cap. The plan will be used in monitoring and documenting the quality of the materials used and the conditions and manner of their placement. The plan will be developed, administered, and documented by a registered professional civil or geotechnical engineer with experience in landfill construction and construction site inspections. In addition, the CQA plan will be provided during site inspection to any officer, employee, or representative of the Division who is duly designated by the Commissioner of the Tennessee Department of Environment and Conservation (TDEC).

Although the specific content of the CQA plan will depend on site-specific factors, the following specific components will be included, at a minimum:

- areas of responsibility and lines of authority in executing the CQA plan;
- qualifications of CQA personnel;
- frequency and scale of such observations and tests; and
- **documentation of CQA.** This will include daily record keeping (observation and test data sheets, problem reporting and corrective measures data sheets); design engineer acceptance reports (for errors, inconsistencies, and other problems); and final documentation. After completion of construction, a final documentation report(s) will be prepared. This report(s) will include summaries of all construction activities, observations, test data sheets, deviations from design and material specifications, and as-built drawings.

2. The documentation for the CQA program will be kept in the facility operating record.

CONSTRUCTION DRAWINGS

Construction drawings shall be prepared and submitted to the Commissioner before construction is initiated. These drawings shall depict the proposed final contours after cap placement; cross-sections showing each layer of the cap, including slopes; and run-on/runoff control structures, including calculations supporting the design.

TRAFFIC CONTROL

When cap construction is completed, the access roads in the vicinity of this site will be routed such that no road crosses any portion of the Walk-In Pits and B Area. Traffic will be restricted from leaving the roadways by an existing 6-ft-high chain-link and gates fence between the roadways and the burial ground disposal areas.

CLOSURE SCHEDULE

A closure schedule for BCBG B Area and the Walk-In Pits is presented in Table 1.

**Table 1. Schedule for closure of Bear Creek Burial Grounds
B Area and Walk-In Pits**

Activity	Closure Plan completion date
Closure Plan submitted	11/08/92
Closure Plan approved	01/30/93
CFC ^a drawings submitted	12/30/92
Start construction	05/01/93
Complete construction	01/01/94
Submit closure certification to TDEC	03/02/94

^aCertified for construction.

NOTICE TO LOCAL LAND AUTHORITY

Within 90 days after final closure is completed, a survey plat indicating the location and dimensions of landfill pits, trenches, and disposal areas with respect to permanently surveyed benchmarks will be submitted to the local land authority and to the Commissioner of TDEC. The plat will be prepared and certified by a professional land surveyor. The survey plat will contain the following prominently displayed note or a similarly worded note to comply with Tennessee Rule 1200-1-11-.05(7)(i):

The owner or operator of the property containing the Bear Creek Burial Grounds as shown on this plat is obligated to restrict disturbance of the site in accordance with *Rules Governing Hazardous Waste Management in Tennessee*. Postclosure use of the property on or in which hazardous wastes remain must never be allowed to disturb the integrity of the final cover, liner(s), or any other components of any containment system or the function of the facility's monitoring systems unless the owner or operator receives approval from the Commissioner of the Tennessee Department of Environment and Conservation under the previously referenced rules.

To comply with Tennessee Rule 1200-1-11-.05(7)(i), a record and identification of the type, location, and quantity of hazardous wastes disposed of within the pits, trenches, and disposal areas of the facility shall be submitted to the Commissioner and local land authority. The record and identification of the type, location, and quantity of waste shall be based upon best available knowledge and records.

NOTICE IN DEED TO PROPERTY

The note presented in the previous section, Notice to Local Land Authority, or a similarly worded note complying with Tennessee Rule 1200-1-11-.05(7)(j) will be recorded on the facility property deed or on some instrument normally examined during title search.

CLOSURE CERTIFICATION

The Department of Energy (DOE) will submit closure certifications from both DOE and an independent registered professional engineer that closure has been completed in accordance with the approved closure plan. The certifications shall be submitted to the Commissioner within 60 days after closure is completed.

OTHER ACTIVITIES

Further investigation or remediation will not be included in RCRA closure activities. Any future monitoring (e.g., groundwater), assessments, or remediation will be conducted as part of the ongoing Comprehensive Environmental Response, Compensation, and Liability Act activities at the Y-12 Plant. These activities will be conducted in compliance with the Federal Facility Agreement.

INSPECTION AND MAINTENANCE PLAN

INTRODUCTION

This Inspection and Maintenance Plan describes potential problems that could affect the performance of the cap, inspection criteria, inspection frequency, and other monitoring and maintenance requirements.

POTENTIAL POSTCLOSURE PROBLEMS

Settlement/Subsidence

For the purposes of this plan, *settlement* is defined as elevation change as a result of consolidation of near surface soils under applied load. *Subsidence* is the loss of near surface materials into existing void space. Uniform settlement of materials under a cap is generally not a problem, because the cap moves as a unit and is not distressed. If severe, differential settlement or subsidence could result in distress to the geomembrane layer of the cap. On the BCBG B Area and Walk-In Pits cap, it is considered quite unlikely that differential settlement or subsidence would distress the cap for the following reasons:

1. The type of construction proposed is quite tolerant of settlement. Large uniform settlements are of no consequence to the proposed geomembrane cap. If moderate differential settlement (less than 6 in.) does occur, the geomembrane and anchorage system can conform to the terrain with no loss of integrity.
2. The chance of differential settlement or subsidence is very small because the probability of large voids or soft areas on the site is low. The waste and some cover soil have been in place for years. Many voids have been filled, and the soil has consolidated over time. The additional cover soil will be placed in such a way that new voids will not be created.

3. If voids that could cause large differential settlements exist, they would probably show up when the initial lifts of soil are placed over the site and the heavy equipment compacts it. The voids will be filled at that time and would present no long-term problems to the cap.
4. Once the cap is in place and rain water infiltration is controlled, the primary motive force for displacement of soils on site is eliminated. The probability of a subsidence incident after the cap is in place should diminish even further.

Geomembrane Distress

The primary forces that degrade a geomembrane are ultraviolet light, animal/human intrusion, and wind uplift. The design includes a grout-filled revetment mat layer which mitigates the effects of all of these degrading forces. The mat shields the geomembrane liner from ultraviolet light (sunlight), protects it from hooved animals and inadvertent human intrusion, and provides an anchorage system to prevent wind uplift.

Uncontrolled Storm Runoff

The site currently has locations where storm runoff is concentrating and causing erosion. When cap construction is complete, the entire area will be covered such that there will no longer be any exposed soil. The design addresses runoff by providing paved ditches as required to convey storm water off the site. Energy dissipators are included in the design to slow down the flow. Because of its textured surface, the revetment mat over the geomembrane also limits the velocity of storm runoff.

POSTCLOSURE INSPECTION

Although the design has incorporated features that address most of the potential postconstruction problems, a postclosure inspection program will be implemented. The postclosure inspection program will focus on two areas of concern: settlement/subsidence monitoring and growth of undesirable vegetation. Inspection will be performed by a combination of visual, analytical, and measurement techniques.

Visual Inspection

Periodic visual inspections of the BCBG B Area and Walk-In Pits cap will be made. Following the completion of construction activities, inspections will be performed monthly for the first 6 months and then quarterly thereafter. The following cap components will be included in the periodic visual inspection:

1. The perimeter of the cap and the perimeter drainage ditches will be inspected for any damage, especially that due to animals burrowing under the edge of the cap.
2. The inspector will walk the cap (except for access-limited areas) and visually inspect for damage or degradation. The inspector will evaluate the general condition of the protective cover mat. Special emphasis will be given to visually inspecting for signs of differential settlement and subsidence and the presence of unwanted vegetation.

3. Areas of the site in which access restrictions apply because of safety concerns will be visually inspected from the perimeter of those areas. The longest distance from the edge of any limited access area to the center of that area is ~ 100 ft.

Inspections will be documented by completion of a Postclosure Inspection Checklist (see Fig. 4).

Subsidence Monitoring

Site topographic surveys coupled with photogrammetric methods will be employed to monitor the site for subsidence. A baseline survey of the site will be performed at the completion of cap construction. Monitoring surveys of cap elevations will be performed annually. The accessible areas will have benchmarks that will be surveyed by conventional methods. The access-limited areas will be surveyed remotely or mapped by aerial or land-based photogrammetric methods. The results of the annual monitoring survey will be a topographical map that can be compared with the baseline to determine if subsidence has occurred and the extent of subsidence. If an area of subsidence is found, and if the cover is 6 in. lower than the baseline topographic elevation at that location, a formal investigation of the subsidence incident will be initiated.

Unwanted Vegetation

The presence of limited vegetation on the cap has no adverse effect on cap performance or cap integrity. However, unlimited growth of vegetation over a long period of time could pose a problem for the cap. The scenario under which vegetation would damage the cap is as follows. If trees were allowed to grow on the cap, the roots could not penetrate the geomembrane. Therefore, they would grow around the revetment mat and be very shallow. If trees grew large enough, high winds could upend the trees, damaging the revetment mat and possibly the liner.

To control the growth of unwanted vegetation, the area will be treated with a suitable herbicide such as Round-up. The herbicide would be sprayed over the site on an as-needed basis. The decision to spray would be based on visual inspections. The criterion for herbicide application would be to make application when vegetation growth exceeds a height of 6 in. above the revetment mat.

Inspector's Name and Title _____

Date of Inspection _____ Time of Inspection _____

Date Next Topo Survey Is Due _____

Inspector's Signature _____

Supervisor's Signature _____

INSPECTION ITEM	TYPE OF PROBLEM	ACCEPT/ REJECT	OBSERVATIONS	CORRECTIVE ACTION	DATE ACTION REQUEST
Erosion of Cap Perimeter	Gullies, rills, bare soil around perimeter or in drainage ditches			Restore areas to design grade and re-seed	
Protective Cover Mat	Damage or degradation, vegetation over 6 inches			Repair damaged or degraded mat sections, treat with herbicide	
Subsidence or Settlement	Any areas where visual observations detect subsidence or settlement of the cover			Report condition to management for investigation	
Run-on and Run-off Control System	Ponding, blockage, erosion			Regrade and seed/rip-rap low or eroded areas, remove blockage	
Rodent Damage	Burrowing and other damage from rodents			Repair damage and implement animal control measures	
Bench Marks	Damaged, dislocated, or missing survey benchmarks			Replace or repair monuments, resurvey	
Signage	Damaged, deteriorated, or missing signs			Repair or replace signs	
Unauthorized Materials	Unauthorized materials placed in area			Obtain management instructions for removal of materials	

(Photograph and/or sketch deteriorated areas)

Fig. 4. Example Postclosure Inspection Checklist.

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