DISPOSAL OF MIXED CERCLA WASTE AT THE OAK RIDGE RESERVATION IN AN ON-SITE DISPOSAL FACILITY

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ABSTRACT

After several false starts dating back to the 1980s, on-site disposal at the Department of Energy's Oak Ridge Reservation (ORR) became a reality when a Record of Decision was signed in November 1999 authorizing an on-site disposal facility. The facility will be an integral part of the cleanup of the ORR, which is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The cleanup may generate more than 1.5 million cubic meters of radioactive, hazardous, toxic, and mixed waste. Waste matrices will include soil, sediments, building debris, stabilized waste and solidified waste. The characterization of many of the waste streams will not be completed until the remedial action projects finish their remedial investigations, but it appears that over 80% of the waste to be generated will meet the waste acceptance criteria for the on-site disposal cell, called the Environmental Management Waste Management Facility (EMWMF).

The EMWMF project team consists of the Department of Energy, Bechtel Jacobs Company LLC (the ORR environmental restoration management and integration contractor), and a subcontractor team which includes Waste Management Federal Services (WMFS), CH2M Hill, Golder Associates, and American Technologies, Inc. This team's challenge is to design, construct, and operate a disposal facility which:

- Complies with stringent performance standards and requirements established in the CERCLA documentation;
- Accommodates a wet southeastern climate, seasonal shutdowns, and a blue-line stream bisecting the footprint;
- Incorporates a volume weighted sum-of-the-fractions waste acceptance criteria that will include at least 37 contaminants;
- Accommodates a waste stream with an undesirable soil to debris ratio and a cumulative volume that might vary by more than 0.5 million cubic meters;
- Incorporates an accelerated schedule requiring construction to continue through the winter; and,
- Accommodates existing contamination and future remedial action in the immediate vicinity.

INTRODUCTION

On November 2, 1999, a Record of Decision was signed by the Department of Energy (DOE), Region 4 of the Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC) that authorized on-site disposal of waste generated during the CERCLA cleanup of the ORR (1). There had been two major efforts to establish an on-site disposal facility for the ORR: one started in the early 1980s and ended in 1987; the second started in 1988 and ended in 1994. In both cases, strong opposition by the regulators was primarily responsible for the projects being halted.

The lessons learned from the unsuccessful attempts at on-site disposal were incorporated into the current effort, the first to be conducted under CERCLA, and a revised approach was implemented. A Remedial Investigation (2) was prepared to identify the types and volumes of waste expected to be generated during the CERCLA cleanup of the ORR. A conceptual design was prepared using an above grade facility to alleviate prior concerns over impacts to groundwater. The conceptual design was modeled to determine the impact of the encapsulated waste to a future hypothetical receptor to establish draft waste acceptance criteria (WAC) (3).

In the Feasibility Study (3), the conceptual design of an on-site disposal facility was evaluated at the final three candidate sites emanating from a screening study of the entire ORR. These locations were compared against each other and then against off-site disposal. The Feasibility Study confirmed that an on-site disposal cell could be sited on the ORR and that the draft WAC generated in the Remedial Investigation would allow a sufficient quantity of ORR remediation waste to be disposed of in the on-site facility to make on-site disposal economically viable. At the projected low-end waste generation estimate of 190,000 cubic meters, the cost difference between on-site and off-site disposal was slightly in favor of on-site disposal. Any growth in the actual waste generation quantities would only make on-site disposal more attractive. With current EMWMF-bound waste projections well in excess of 1,200,000 cubic meters, the EMWMF will yield a substantial cost savings for the ORR cleanup. The Feasibility Study also recommended East Bear Creek Valley as the site for the EMWMF (see Figure 1).

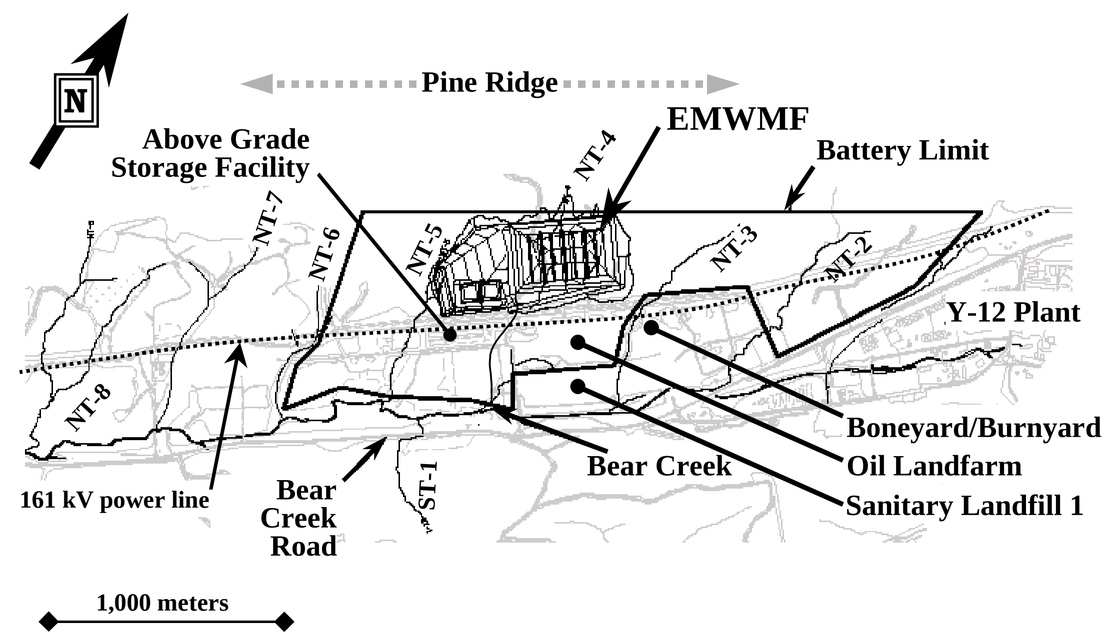


Figure 1: Oak Ridge Reservation, East Bear Creek Valley

The public participation aspect of CERCLA provided a considerable benefit to the project. DOE has been working for several years with public sector advisory groups on cleanup issues such as establishment of future use categories (e.g. industrial, restricted-recreational, unrestricted) for the ORR. Consequently, the results of the Remedial Investigation/Feasibility Study (RI/FS) and the recommendations of the Proposed Plan came as no surprise. In fact, the majority of the public realized that the responsible thing to do was for Oak Ridge to manage its own environmental problems, not ship them to another state. Further, they realized that the impasse regarding on-site waste disposal that had for many years prevented any cleanup of the ORR to begin in earnest was worsening the environmental insult versus the improvement that an appropriately engineered and well constructed disposal facility could provide. Finally, the public understood the local economic impacts of on-site vs. off-site disposal.

While the RI/FS was awaiting approval, the Environmental Restoration Management & Integration (M&I) contract kicked off. DOE had decided that the cleanup of the ORR was sufficiently different from the maintenance and operations (M&O) of the ORR production facilities and laboratories that a dedicated environmental contractor was needed. DOE removed the environmental scope from the existing M&O contract and created the M&I contract. Bechtel Jacobs Company LLC started its M&I contract in April 1998 with the still uncertain on-site disposal facility as the centerpiece of its strategy for ORR cleanup. To accelerate the schedule while the CERCLA documentation process was working, procurement of the subcontract for the on-site disposal facility commenced. The decision was made to pursue the subcontract in two steps--the first being multiple awards for a preliminary 30% design; the second being a single award (to one of the 30% design subcontractors) for the balance of scope to finish the design, then build and operate the facility.

The 30% design subcontract was awarded to three subcontractor teams in September 1998. They each provided a 30% design that met the project's technical requirements in January 1999. Only those three teams were permitted to compete for the second subcontract. The team led by Waste Management Federal Services, Inc. (including CH2M Hill, Golder Associates, and American Technologies, Inc.) was selected in September 1999. Award of the subcontract, however, could not be made until two prerequisites were satisfied:

- First, the CERCLA decision process had to be completed. At that point, the only uncompleted document was the Record of Decision.
- Second, a Report to Congress had to be sent to Congress for a 30-day review period. This report was required because the design and construction scope of the subcontract is being accomplished under a privatized funding scenario. The subcontractor is providing the financing to complete the design and construction. That investment will be repaid incrementally for each of the first 86,000 metric tons of waste disposed in the first six months of disposal operations.

The review period for the Report to Congress ended the day before the ROD was signed. Award of the subcontract was made a few weeks later and design work commenced immediately.

CONCEPTUAL DESIGN/PERFORMANCE REQUIREMENTS

To evaluate on-site disposal in the context of CERCLA, it was necessary to prepare a conceptual design. This design was intentionally conservative and "bland" to ensure that the comparison with the off-site disposal option was completely defensible and that the conceptual performance assumed could be replicated in practice. This also allowed plenty of opportunities for subcontract bidders to be innovative as they developed their bid/design to the 30% level and then beyond.

The conceptual design was an amalgamation of features and components required to satisfy the many applicable or relevant and appropriate requirements (ARARs) imposed by the variety of waste types targeted for disposal in the EMWMF:

- low-level radioactive waste (LLRW);
- hazardous waste as defined by the Resource Conservation and Recovery Act of 1976 (RCRA);
- toxic waste as defined by the Toxic Substances Control Act of 1976 (TSCA); and,
- mixed waste--mixtures of any of the above.

The conceptual design had a RCRA compliant liner that was 1.8 meters (m) thick with leachate collection and leachate detection layers, two 1.5 millimeter (mm) (or 60 mil) high density polyethylene (HDPE) membranes, and 0.9 m of natural clay with a permeability less than 1 x 10E-7 centimeters per second (cm/sec). The cover that was compliant with both RCRA requirements and LLRW disposal requirements with components that included: surface vegetative layer on the top and rip rap armoring on the side slopes; drainage layers; biointrusion barrier layer; 1.5 mm (60 mil) HDPE layer; geosythetic clay liner; and 0.9 meters of natural clay with a permeability less than 1 x 10E-7 cm/sec. Since the selected site has a shallow perched groundwater table, the TSCA requirement for a 15-meter vertical separation between the bottom of waste and the water table was waived in lieu of either one of the following: 1.5 m of soil having a permeability no greater than 1 x 10E-6 cm/sec between waste and groundwater or 3 m of soil having a permeability no greater than 1 x 10E-5 cm/sec.

The conceptual design was used in the risk model to determine the draft WAC. A hypothetical future receptor was assumed to be homesteading adjacent to and downgradient from the EMWMF. With a threshold risk limit of 1 x 10E-5 incidental lifetime cancer risk (ILCR) and a hazard index threshold of 1 for the first 1,000 years after closure, and a limit of 1 x 10E-4 ILCR and a hazard index threshold of 3 for any time period after 1,000 years, the model backcalculated the allowable quantities of the likely waste constituents. The model included several conservative assumptions to provide factors of safety: all synthetic components were assumed to fail when active post-closure maintenance and monitoring ceased 100 years after closure; perpetual institutional controls on land use adjacent to the EMWMF which would preclude a homesteader were disregarded; all contaminants were assumed to peak at the homesteader's well simultaneously, ignoring the distribution of migration times for the contaminants that spanned tens of thousands of years; and, the modeling period extended for 100,000 years, well beyond the norm of 1,000 years.

The key performance requirement was limiting infiltration through the cover to no more than 1 cm/year. The cover component that controlled this requirement for the conceptual design was the geosynthetic clay layer, which was positioned between the HDPE liner and the natural clay barrier. Waste disposal facility design requirements stipulate that the bottom liner system of the facility be at least as permeable as the cover, so over time a steady state condition would be reached with 1 cm of leachate exfiltrating across the footprint of the facility each year.

Other performance requirements included:

- Isolating the waste for up to 1,000 years, to the extent reasonably achievable, with a minimum performance life of 200 years
- Protection against plant and animal intrusion, and minimization of potential for inadvertent human intrusion; and
- Reduction of potential for incremental and total settlement, and slope failure under static and seismic conditions through proper design and waste placement techniques.

The conceptual design was the benchmark for design and performance. The subcontract bidders were required to furnish a design which met the ARARs, met DOE-specific requirements, and would perform at least as well as the conceptual design in the risk model. The conceptual design will also be used as a benchmark by the regulators in the form of a threshold which the final design and modeled performance must clear to gain approval.

The waste generation forecast at the time the RI/FS was issued indicated that eventual disposal cell capacity for the ORR cleanup would need to be in the range of 300,000 to 1,000,000 cubic meters. Thus, the bidders designs also had to show the facility at both of these extremes and had to be flexible enough to accommodate an actual volume anywhere in between. In the end, the WMFS-led team provided the design which met these requirements at the best value to the government. Many of the improvements and innovations to the conceptual design are described in subsequent sections.

DESIGN APPROACH

The EMWMF design was developed with the goal of aggressively moving forward with a permanent solution to the environmental challenges of the Oak Ridge Reservation (ORR). This solution is a disposal cell designed, constructed and operated in a fashion which offers ORR remedial action projects safe and cost effective disposal of their RCRA, TSCA, LLRW, and mixed remediation wastes. This facility will achieve the long-term goals for on-demand disposal at the ORR for many years into the future. WMFS and CH2M Hill brought experience from similar DOE facilities managing and operating these waste facility development projects. The experience base and the lessons learned from other similar projects were incorporated into the design and project implementation planning. This resulted in a comprehensive well-designed facility that anticipated the range of operational conditions that will be experienced at the EMWMF. The design ensures a compliant, safe, and operationally flexible facility that ultimately correlates to a cost-effective project.

Key features of the design include:

- Relocation of existing site infrastructure to clear the footprint and adjacent area (a 161 kV power line and a six unit Above Grade Storage Facility for containerized waste) prior to beginning cell construction;
- Optimization of the site Battery Limit to maximize use of site soils;
- Mining of on-ORR low permeability soils to create environmental barriers;
- Avoidance of wetlands and impingement onto existing contaminated sites within the Battery Limit;
- Application of value engineering in the decision/design process;
- Fully compliant cap, liners and leachate detection/collection system; and,
- A 3-meter thick geologic buffer underlying the facility to provide a stable foundation and to retard calculated transport of radionuclei from the facility

The design approach built upon the experience of the project team, particularly in CERCLA activities, on DOE sites and in Tennessee. WMFS also had existing designs to use as a proven design basis to the extent they were applicable and appropriate. Chief among these was the Environmental Remediation Disposal Facility (ERDF) that is currently operating on DOE’s Hanford Reservation in Washington. ERDF, which is operated by WMFS, is similar in many respects to the ORR facility. The design approach for the EMWMF also considered the overall project approach from a safety and regulatory compliance perspective as follows:

- Minimum Technical Requirements (MTRs) – WMFS used these as the basis of the 30% design submittal and each plan and report submitted with the 30% design addressed how the facility met the MTRs. To the extent possible and to assure a margin of safety beyond the requirements, the EMWMF design provides additional technical support for design elements to lessen uncertainty and reduce risk associated with taking the 30% design to fruition.
- Department of Energy Orders – form the basis of the design submittal. Each order is evaluated against each element of the design for applicability and compliance, then is “crosswalked” between the DOE order and the impacted design element(s).
- ARARs – used to ensure that the EMWMF design, construction, operation, and closure will meet applicable Federal and State regulations and guidelines, as defined in the ROD.
- Work Smart Standards (WSS) – The WSS ensure compliance with lower tier requirements like building codes and industry standards (e.g. ASME, NFPA, etc.) which are critical to the design, construction, and operation phases of a project. They have been integrated into the process through identification of hazards which are then correlated to the mitigating WSS. Where reasonable, a factor of safety is added to the WSS-compliant approach.

- Expandability – Provide a flexible design to allow for future expansion in the very likely event that the volume of waste resulting from ORR cleanup increases beyond the 300,000 cubic meter capacity for the initial construction of the EMWMF.
- Cost-Effective – Minimize cost for construction and operation by maximizing the waste disposal capacity for a given disposal footprint area.
- Accelerated Schedule – Design and construction need to be completed such that the facility can begin operations as soon as possible, but no later than the Fall of 2001.

The design approach for the EMWMF has optimized the RI/FS conceptual design in accordance with the latest site characterization information. The initial EMWMF disposal facility will have a capacity of 300,000 cubic meters (air space for daily cover and interim closure are considered inclusive) and will consist of two earthen, above-grade cells located immediately west of north tributary (NT)-3. This initial development will not significantly impact NT-4, so that if only the first phase is constructed, environmental disturbance will be minimized.

To achieve the full site disposal capacity, additional waste containment cells will be constructed by expanding the initial two cells to the west toward NT-5 to bring the EMWMF up to a capacity of 1,000,000 cubic meters. In accordance with the current site layout and EMWMF configuration, it appears that, if required, the EMWMF could be further expanded to the west toward NT-5. Waste generation volume projections have increased during each of the last two fiscal year baseline and life cycle baseline planning efforts. This operational flexibility to increase the EMWMF disposal volume provides a contingent approach to anticipate and resolve waste generation volumes up to 1,500,000 cubic meters.

Facility Layout

To avoid the requirement for a time-critical RCRA Part B permit modification that could potentially delay the project, the EMWMF will be oriented in a manner to avoid infringing on the boundaries of the Oil Landfarm (OLF)--a former waste treatment area that was closed under a RCRA cap in 1990, see Figure 1. The infringement would present a major potential risk to project schedule due to additional permitting activities and liner/cap construction. The conceptual design almost completely encompassed the OLF within the EMWMF footprint to provide a worst-case evaluation in the event the winning subcontractor's final design did infringe on the OLF in any manner. Such infringement would also pose an increased environmental and safety hazard due to potential release and exposure of personnel to polychlorinated biphenyls (PCBs) and other contaminants that had been landfarmed at the OLF. By avoiding the OLF, the project will save considerable time and cost while significantly reducing risk. This approach was evaluated and determined to provide the best overall value-added approach to the project from a total lifecycle perspective.

Another complicating factor is the shallow groundwater table within the Battery Limits that requires the facility to be constructed primarily as an above-grade facility. The elevation of the base of the EMWMF has been established so that the post-construction water table will be near the base of the geologic buffer. This will preclude the need for an expensive and time-consuming dewatering effort during construction, as well as ensure performance in accordance with the WAC model.

Liner System

The EMWMF liner system is intended to contain all leachate generated during the operational and institutional control phases of the project. The design meets or exceeds all ARARs, particularly the design guidance suggested by EPA for RCRA Subtitle C (hazardous waste) landfills and TDEC regulations for hazardous waste landfills.

A cross section of the liner system is shown in Figure 2. The liner system at the base of the landfill is somewhat different from the system on the sideslopes. For the floor liner system, each layer and its function are described below (from the top to the bottom):

- Protective Layer - 0.3 m-thick native soil layer capable of supporting truck and equipment traffic during initial waste placement operations;
- Geotextile - Used as separator between soil layers;
- Leachate Collection Drainage Layer - 0.3 meter-thick granular material, with permeability (K) = 1 x 10E-2 cm/sec or higher;
- Geotextile - Used as cushion over underlying geomembrane;
- Primary Geomembrane - 1.5 mm HDPE, textured;
- Geosynthetic Clay Liner - A GCL will be installed under the primary geomembrane only in the sump or lowest cell area to form a composite liner that will minimize leakage in areas of maximum hydraulic head (not shown in Figure 2);
- Geocomposite Leak Detection Layer - a geonet material thermally bonded to a layer of geotextile on each side to provide a transmissivity equal to or higher than 0.3 m of natural granular material with K = 1 x 10E-2 cm/sec
- Geotextile - Used as cushion over underlying geomembrane
- Secondary Geomembrane - 1.5 mm HDPE, textured.
- Low Permeability Soil - 0.9 m-thick soil, compacted to produce an in-place permeability of 1 x 10E-7 cm/sec or less
- Geologic Buffer – Compacted native or in situ fine-grained soil.

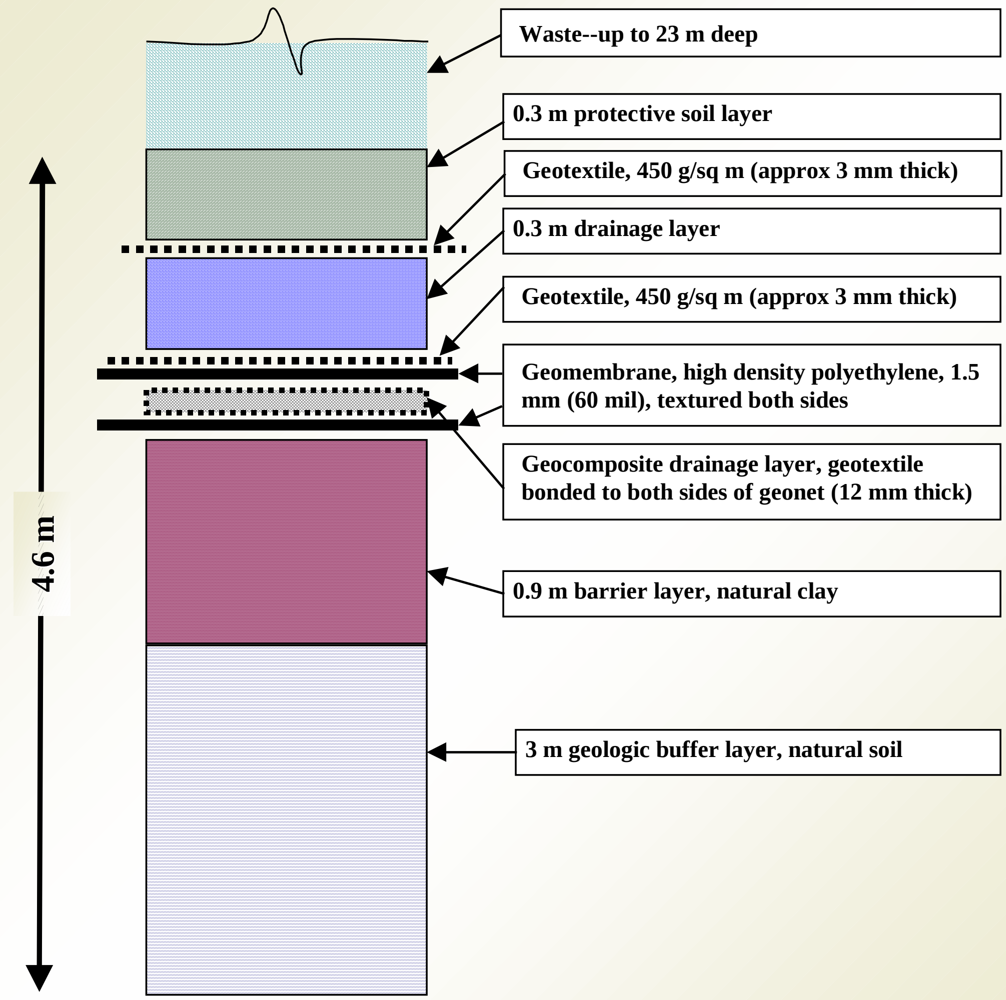


Figure 2: EMWMF Liner Cross Section

The liner system on the 3H:1V sideslopes of the cells will differ from the base liner because of the difficulty of placing granular materials on such slopes. The gravel drainage layer will be replaced with a geocomposite drainage layer.

Cover System

The cover is the key to the long-term performance of the EMWMF. The EMWMF will be closed and secured with a final cover that will accomplish the following objectives:

- Minimize infiltration of precipitation through the surface of the EMWMF to the amount assumed for the Performance Assessment (1 cm/yr) or less.
- Require minimal maintenance.
- Control migration of gas generated by decomposition of organic materials within the waste.
- Promote efficient drainage while preventing excessive erosion of the cover surface.
- Allow for settling and subsidence while maintaining the integrity of the final cover.

The final closure cover design is based on the conceptual design as presented in the RI/FS, modified to reduce cost and improve stability under seismic loading. The resulting design still meets or exceeds all ARARs, particularly the design guidance suggested by EPA for RCRA Subtitle C (hazardous waste) covers.

The final grade of the closed EMWMF will range from a maximum of 4H:1V to a minimum of 5 percent. The cover system is shown in Figure 3. Each layer and its function are described below (from the top to the bottom):

- Vegetative Cover - Will consist of a combination of quick-cover vegetation.
- Soil/Rock Matrix - Will consist of a mixture of crushed rock and native soil
- Filter Soil - 0.3 meter-thick granular soil placed under the soil/rock matrix in the final cover to prevent migration of fine soil into the underlying biointrusion layer.
- Geotextile - Used as separator between soil layers
- Biointrusion Layer - 0.9 meter -thick layer of clean rock material intended to provide a physical barrier to burrowing by large animals (i.e., mammals).
- Drainage Layer – 0.3 meter-thick granular material, K = 1 x 10E-2 cm/sec or higher to conform to assumptions in the infiltration analysis.
- Geotextile - Used as cushion over geomembrane
- Geomembrane - 1 mm (40-mil) linear low-density polyethylene (LLDPE) textured.
- Low Permeability Soil Layers - Designed to function as a barrier to infiltration and act in conjunction with the overlying geomembrane as a composite liner. This barrier will consist of two 0.3 meter-thick layers. Layer 1 will consist of a bentonite-amended soil with a permeability of 3 x 10E-8 cm/sec or less. It will be underlain by a 0.3 meter-thick Layer 2 of natural clay with a compacted permeability of 1 x 10E-7 cm/sec or less.

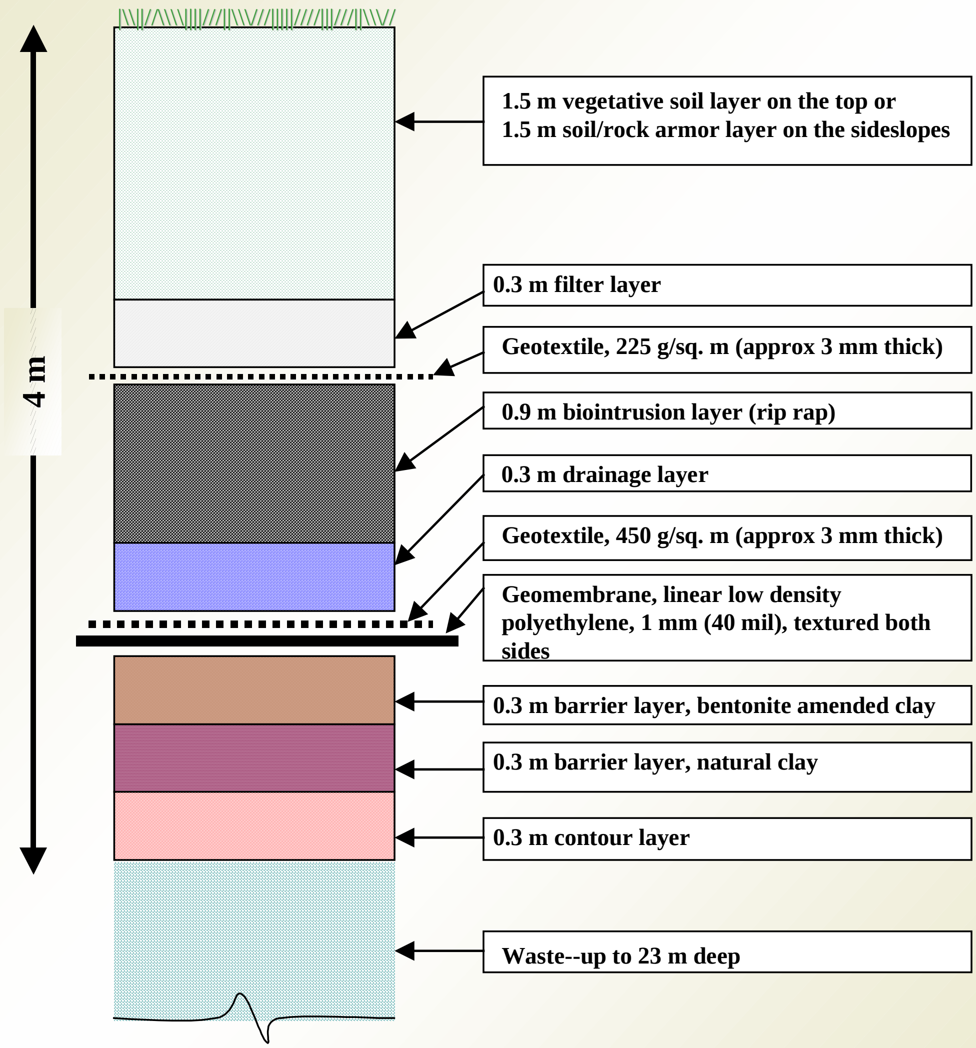


Figure 3: EMWMF Cover Cross Section

MEETING THE CHALLENGES

Evaluation and commitment to a design process and a construction plan entailed review and integration of the conceptual design detailed in the RI/FS. The challenges, due to the process being a design competition in the early stages of the project, was to optimize the overall containment system and cap and closure material while maintaining the performance standards imposed by state and federal guidance. The key to meeting this challenge was to apply operations experience learned at other DOE sites developed and operated by the WMFS team and use these to retrofit the design and construction plans with operations practices.

Challenges related to the site environs, challenges associated with state and federal regulatory frameworks, challenges associated with meeting ORR remediation goals and challenges working within established community and social commitments made to DOE and the local community were met by integrating their particular and often unique solutions into the design, the construction and operations plans.

The EMWMF site in East Bear Creek Valley is north of Bear Creek and sits on the south slope of Pine Ridge. Just over the crest of Pine Ridge (and downwind of the site with prevailing southwesterly winds) lies the Scarboro Community. Operations and construction of the EMWMF have to account for the proximity of these neighbors with diligence in controlling any kind of airborne release and monitoring to provide reassurance.

The Bear Creek Valley site is not pristine in its environmental conditions. Within Bear Creek Valley, the other site "neighbors" represent additional design/build/operate challenges: the Oil Landfarm (previously discussed), an existing closed sanitary landfill, a former disposal site called the Boneyard/Burnyard scheduled for remediation during the first year of EMWMF operations, rerouting and constructing over NT-4, and existing above grade LLRW/RCRA waste storage facilities (curbed, concrete slabs covered with internal frame RUBB® buildings). Geologically the site is underlain with 3 to 6 meters of unconsolidated detritus originating from weathering of the ridge and valley's limestone and shaley Paleozoic formations. The shallow groundwater at the site follows natural and erosional gradients down-slope and into the valley geohydrologic regimes.

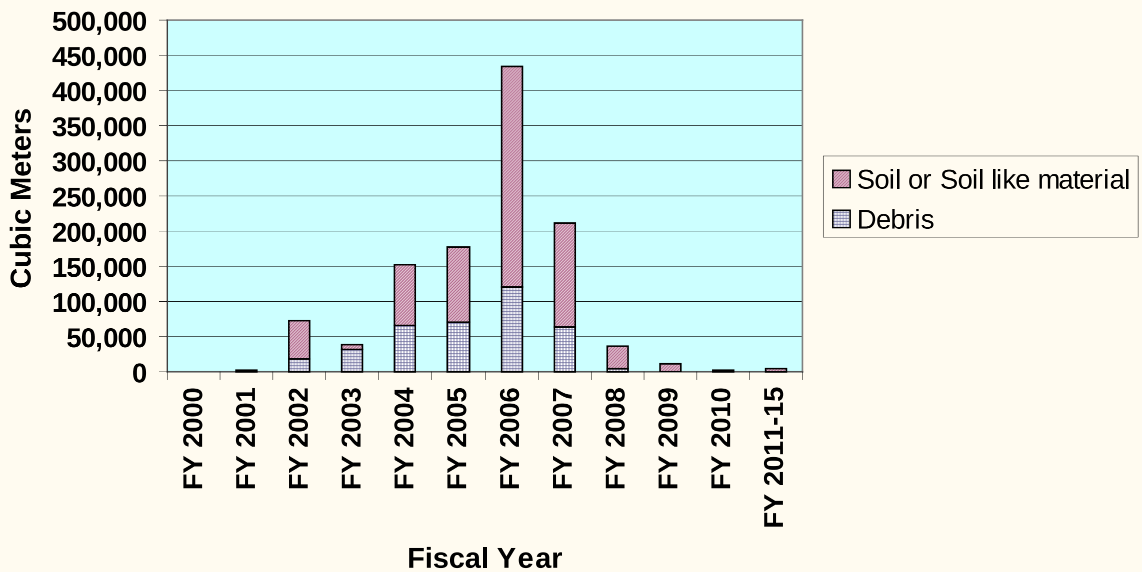
Value engineering, design innovation, experience and assembling a best-in-class team surmounted other challenges. Some examples of such challenges and their resolution are:

- Operating in a seasonal wet climate with greater than 130 cm of annual rainfall. This was addressed by designing a facility with internal clean rainfall collection and diversion and by using low permeability materials to retard infiltration to limit the potential human and environmental exposure pathway magnitudes addressed in the facility performance assessment. From an operational perspective, the challenge was to develop a facility capable of being shut down for several months at a time to avoid seasonal inundation and capable of being shut down periodically and suddenly from unpredicted thunderstorms. This was resolved by tapping WMFS's local commercial disposal facilities that are able to absorb low-period utilization employees and are also able to supply equipment and services at unplanned peak disposal periods.
- Volume weighted, sum of the fractions waste acceptance criteria. By utilizing this waste volume and contaminant accounting method, DOE will be able to maximize the amounts and concentrations of materials acceptable in the site. This represents a positive aspect to ORR remediation projects because it represents a maximization of the waste acceptance criteria for particular types and levels of contaminants. Procedures for implementing the volume weighted sum of fractions process during operations will be developed in a WAC Attainment Plan.
- Schedule flexibility to accomplish construction during less than optimum periods. Using value engineering and experienced local build subcontractors, the project will be able to meet a continuous construction schedule without delay or shutdown in winter months. Meeting this challenge will allow the site to open earlier and, consequently, allow remediation projects to accelerate their schedules for site cleanup and closure.
- Providing a groundwater monitoring system (shallow/deep) that can effectively monitor the EMWMF. Groundwater surrounding the EMWMF site is contaminated with hazardous and radioactive constituents from other waste disposal units. Hence it will be critical to effective EMWMF performance monitoring to be able to ascertain that groundwater contamination originated from ambient sources and not from the EMWMF.

Other significant challenges lie ahead:

- Securing regulatory acceptance of the design and construction in a timely manner. To this end, a working group has been established to allow the project team to work closely with the regulators. The group meets at least monthly and provides a convenient forum for advance discussion of potentially contentious issues, regular status updates, and general construction engagement.
- Integrating the remedial action projects to produce the best soil to debris ration possible. Current waste generation forecasts indicate the overall ratio is less that 3:1, soil to debris (see Figure 4); and considerably lower in several years. Industry experience indicates the lowest tolerable ratio is closer to 4:1.
- Integrating the overall waste generation rate to maintain a more level demand for disposal services over the life of the EMWMF. Current waste generation forecasts show annual waste quantities ranging from under 50,000 cubic meters up to over 400,000 cubic meters. The waste generation forecasts also indicate a "build it and they will come" effect. No doubt, remedial action project planners were not convinced that the EMWMF would ever become a reality, given the unsuccessful history of attempts at on-ORR disposal. The number and volume of waste streams destined for the EMWMF has increased in direct proportion to the increasing certainty of an on-ORR disposal option.
- Integrating the funding for waste disposal with that for remedial action in the face of the DOE budget process. Remedial action projects will not directly pay for disposal at the EMWMF. Instead, their waste generation forecasts will be used by the EMWMF project to estimate annual funding requirements. This presents an excellent opportunity for Bechtel Jacobs Company to apply the management and integration concept for DOE. In addition to ensuring that the budget for disposal is commensurate with that for remedial action, the overall budget must be managed with respect to allowable funding.

Figure 4:
Annual Waste Generation Forecast Rates



SCHEDULE AND COST

At this stage in the project, the ROD is signed, Congress has approved the project funding, the subcontract for design, construction, and up to 5 years of operation has been awarded, and the 60% design is being reviewed. The project is on a path to complete the 90%, 100%, and Issued For Construction designs on schedule to allow start of in October of this year as well. With a planned 10 month construction period, the site will begin accepting waste by October of 2001. The operating life of the EMWMF will be determined by the decisions made regarding the cleanup of the ORR. Expectations are that the site capacity could be expended within 10 years of operations under current long range funding projections.

The cost breakdown for the EMWMF shows two opposing trends. Unit costs for construction decrease as total EMWMF volume increases; unit costs for operations increase with volume. Since construction costs include regulatory documentation, design, procurement, construction, engineering, quality assurance / quality control, and oversight. Since many of these components are fixed costs, larger volumes provide better distribution of costs for calculating unit rates. Operations costs, on the other hand, include facility operation, air and groundwater monitoring, leachate management, and oversight. The larger the EMWMF becomes and the longer it operates, the more the impact of its southeastern U.S. location will be felt--130 cm of annual precipitation will complicate disposal operations and generate significant quantities of leachate and contact water.

In relation to the other sites within the DOE complex that have on-site disposal facilities--Fernald, Ohio; Hanford, Washington; Idaho National Engineering and Environmental Laboratory, Idaho; Monticello, Utah; and Weldon Spring, Missouri--the EMWMF's cost profile is "competitive" (4).

- The estimated range of construction costs for the EMWMF is $73 to $95 per cubic meter versus the range for the DOE complex of $22 to $112 per cubic meter.
- The estimated range of operations costs for the EMWMF is $57 to $63 per cubic meter compared to the entire DOE complex range of $12 to $63 per cubic meter.

The EMWMF has the most robust waste encapsulation systems (liner and cover) in the DOE complex. This is the most significant contributor to its position near the upper end of the construction cost range. The wet climate of Oak Ridge contributes to both construction and operations cost, though it is most apparent in the operations cost, making the EMWMF the upper bound. Of note is that actual costs of both construction and operations at sites with constructed or operating facilities have come in lower than the estimates.

PATH FORWARD/CONCLUSIONS

With the aforementioned waste generation forecasts consistently increasing, planning for procurement of additional EMWMF capacity is already underway. The goal is to issue only one more subcontract with scope to design, construct, operate, and close the EMWMF up to the maximum capacity that the East Bear Creek Valley site can accommodate. The lessons learned from the first 300,000 cubic meter procurement effort will help ensure success in achieving that goal and improve the chances of doing so in an optimal manner.

In spite of several noteworthy achievements and hard-fought victories in its wake, the journey for the EMWMF project is really just beginning. The concerted and conscientious efforts of scores of people are yet required to ensure the success of the project in providing cost-effective disposal for ORR CERCLA cleanup wastes. As the project continues to develop, we hope to provide continuing updates to the technical community.

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