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# SUCCESSFUL OPENING AND DISPOSAL TO-DATE OF MIXED CERCLA WASTE AT THE ORR-EMWMF

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## ABSTRACT

On May 28, 2002, the Environmental Management Waste Management Facility (EMWMF) opened for operations on the Department of Energy's Oak Ridge Reservation (ORR). The EMWMF is the centerpiece in the DOE's strategy for ORR environmental cleanup. The 8+ year planned project is an on-site engineered landfill, which is accepting for disposal radioactive, hazardous, toxic and mixed wastes generated by remedial action subcontractors. The opening of the EMWMF on May 28, 2002 marked the culmination of a long development process that began in mid-1980. In late 1999 the Record of Decision was signed and a full year of design for the initial 400, 000-yd3 disposal cell began. In early 2000 Duratek Federal Services, Inc. (Federal Services) began construction. Since then, Federal Services and Bechtel Jacobs Company, LLC (BJC) have worked cooperatively to complete a required DOE readiness evaluation, develop all the Safety Authorization Basis Documentation (ASA's, SER, and UCD's) and prepare procedures and work controlling documents required to safely accept waste.

This paper explains the intricacies and economics of designing and constructing the facility and offers four significant presentations within the paper on the following topics:

- Design, Construction and Readiness

  For other DOE or commercial entities interested in defining the feasibility of creating such a facility at their location, they can use the early section of the paper, which discusses the successful path utilized by Federal Services and BJC through design, construction and readiness. Reviewing and understanding these processes will allow site development parties to cut development time and cost and garner stakeholder buy-in from a process that has proven successful at the ORR.

- Successful Waste Acceptance
  For those with an interest in waste acceptance/waste certification, this paper contains "secrets of success" needed by remedial action contractors to get similar waste into a disposal cell----safely and efficiently.

- First 6 Months of Operations
  For those just interested in learning and evaluating how the EMWMF has operated over its first 6 months, this paper presents site waste volumes and inventory of contaminants over that period and discusses lessons learned through start-up of operation.

- Future Operations
  Finally, this paper defines the path forward to expand the EMWMF site to its ultimate capacity. Currently the EMWMF is constructed to accept 400,000 cubic yards of remedial action waste. Federal Services studies during the design phase indicate that the site can accommodate a larger facility, if needed. Expansion design, construction time, when will it be available for operations, and how long will it operate are discussed in this paper.

## INTRODUCTION

In November 1999, a Record of Decision (ROD) was signed by the U.S. Department of Energy (DOE), Region 4 of the Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC). The ROD authorized on-site (on ORR) disposal of waste generated during the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup of the ORR and associated sites of the ORR (1). Wastes to be disposed include low-level radioactive waste, waste regulated under the Resource Conservation and Recovery Act and Toxic Substance Control Act and mixtures of these. Examples include contaminated soils, contaminated building debris, classified waste and man-made mineral fibers such as asbestos.
Prior to signature of the ROD, a remedial investigation/feasibility study (RI/FS) (2) had been prepared to identify types and volume of waste expected to be generated during the CERCLA cleanup of the ORR and develop and evaluate disposal alternatives. One such alternative, called the onsite disposal alternative, consists of an above grade facility designed to alleviate concerns over long-term groundwater impacts (3). Included in the RI/FS was a no action alternative, as well as an offsite disposal alternative. Based on the conceptual facility described in the RI/FS, DOE's Management and Integration (M&I) contractor, Bechtel Jacobs Company, procured three subcontracts for a 30% design. This process accelerated the subsequent detailed design stage, since the successful subcontractor was able to build on their 30% design.

Following the ROD signature, Federal Services was selected by BJC to complete the final design, construct and operate the 400,000 $yd^3$ EMWMF. After an approximate one year design effort which included DOE, EPA, TDEC and BJC reviews at the 30%, 60%, 90%, 100% and issued for construction (IFC) stages, construction of the initial phase of the

disposal cell and ancillary facilities began. The construction included performing confirmatory site investigations, clearing, grubbing, and grading approximately 60 acres of timbered land, relocating a 161kV power line and relocating an above grade storage facility. Construction was complete in April of 2002 and after an extensive readiness review by the DOE, the site opened for waste placement on May 28, 2002. By the end of 2002, some 85,000 cubic yards of contaminated soils and debris had been received and placed in the EMWMF. Along with the 400, 000-yd3 design, Federal Services also prepared a modular expansion design for a total disposal capacity of 1.3 million $yd^3$. After the initial phase of the EMWMF is filled to capacity, the DOE has the option to close the facility or initiate the expansion in order to accommodate expanded disposal needs.

## Design, Construction and Readiness

The design of the EMWMF was developed in an incremental format, with EPA, TDEC and DOE reviews at each stage. The primary objective of the design was to document compliance with minimum technical requirements (MTR's) and applicable or relevant and appropriate requirements (ARAR's) defined the in the ROD. A performance assessment demonstrated long-term protection of human health and the environment and served as the basis for the waste acceptance criteria (WAC). The risk model utilized for the performance assessment included conservative assumptions to assure the facility had a factor of safety margin that reduced potential for human health and environmental upsets after closure. For example, while synthetic components were used in construction, no credit was assumed during the post closure period. Additionally, while the site is in an industrial use area, the risk model assumed a homesteader scenario with a home site and water well immediately adjacent to the EMWMF and the site performance period from 1,000 years to 100,000 years. .

The key to meeting performance requirements was to design the facility to limit infiltration into the cover to no more than 1cm/yr and to design the bottom liner system to be at least as permeable as the cover. This assured that eventually, after post closure monitoring and maintenance ceased, the site would reach a steady state of 1 cm of leachate exfiltrating across the cell footprint each year.

The design capacity of the EMWMF design was to range from 400,000 $yd^3$ to 1,300,000 $yd^3$ over a five year to thirty-year operating life. Waste generation forecasts varies as greatly as did the design capacity. Estimates ranged from the upper limit of 1,300,000 $yd^3$ to 2,500,000 $yd^3$. As this was the case and because of the conservatism in the risk model and the sensitivity of the cell's performance to infiltration being greater than exfiltration, the design's major components were:

1. A three-sided perimeter structural berm constructed above grade with future disposal expansions occurring on the open (fourth) side.
2. A ten-foot thick layer of geologic buffer underlying the disposal cell with a minimum permeability of $1X10^{-5}$ cm/sec.

3. A five-foot thick multi-layer liner incorporating leachate collection/detection overlying geosynthetics and compacted clay materials.
4. A contact water transfer and holding pond system that allowed water falling inside the cell with a potential to contact waste to be quickly removed and held until analysis confirmed that constituents in the contact water were below release criteria.

Duratek Federal Services design team, American Technologies, CH2M Hill, Avisco, Inc. and Golder Associates completed the progressive stages of the design, responded to all public, regulatory and DOE comments and developed evidence files to support startup of construction ahead of required milestones. The construction, due to conditions at the EMWMF site, required Federal Services to perform infrastructure construction activities as a precedent to cell construction.

The EMWMF site is located in an East Tennessee ridge and valley physiographic province. The site is located on the north flank of the east/west trending Pine Ridge. The valley floor (East Bear Creek Valley) is formed from some 10-15 feet of unconsolidated materials overlying 45 degree dipping interbedded limestones and shales. The limestones form the ridges and the less competent shales form the valley floors in this physiographic province. At the nearly flat valley floor potentiometric surfaces are at or near the ground surface. On the valley slopes, moving upgradient to the ridge crest, potentiometric surfaces may be as deep as 20 to 30 feet. Except for legacy disposal sites, East Bear Creek Valley is void of other government and all development.

Heavily wooded north/south erosional rills and small interbasin valleys also dissect East Bear Creek Valley. To prepare for cell construction several preparatory activities had to proceed, each requiring its own readiness review. For example:

1. Existing groundwater wells had to be evaluated against the EMWMF footprint to see if some wells required plugging and abandonment. Where necessary, wells were relocated and additional wells installed.
2. Marketable hardwood and pine trees were removed by DOE prior to the remaining vegetation being removed and roots grubbed out. On site trench burners were brought in to burn the fallen trees and roots.
3. An existing 161 kV powerline had to be relocated.
4. 50,000 $ft^2$ of concrete had to be formed and poured to accommodate relocating an Above Grade Storage Facility.
5. Some 40,000 cubic yards of unsuitable soil had to be removed and replaced with structural materials and underdrain systems. Soils were so saturated and unstable they had to be track-hoe excavated and top-loaded into scrapers to remove them from the site.

Readiness evaluations for these several preconstruction tasks were completed as required in BJC procedures and in Federal Services' subcontract with BJC. Each readiness evaluation included preparation of evidence files which included procedures, activity hazard analyses for each task and subtask, training requirements, conduct of operations information and roles and responsibilities. The readiness evaluation evidence files were

prepared by Federal Services and formally presented to BJC in compliance with agreed upon criteria. Each readiness evaluation was then presented to DOE with BJC as presenter of evidence and Federal Services in a technical support role. In all cases, the readiness reviews were successful and full and on-time construction was commenced shortly thereafter.

After this period of preconstruction and infrastructure construction the site was ready for cell construction. Again, Federal Services prepared evidence according to criteria requirements for each of several construction tasks. As had been successfully evidenced in preconstruction readiness reviews, a more thorough readiness performance could be realized by "modularizing" the work into work packages and conducting readiness for each of these discrete work packages. For example, the initial construction readiness covered general activities relating to equipment, general construction activities, badging, training, etc. As more specific tasks were scheduled in construction, they had separate "sub readiness reviews". This approach allowed for more efficient and thorough coordination with DOE, TDEC and subject matter experts. Construction readiness work packages were developed for general earthworks, test pads and liners, tanks and piping and electrical.

The construction of the EMWMF took over a year and as such extended through all of East Tennessee's seasons. While this had little schedule impact it does mean the construction planning had to account for temperature extremes, rainy seasons and statistical possibilities for severe weather events. Construction began in January of 2001 and ended in May of 2002. During this period :

- Federal Services and its contractors and BJC worked a combined 350,000 hours.
- 65 acres of hardwood and pine was cleared, root plowed and the debris burned
- Over 550,000 $yd^3$ of topsoil, cut and fill for berms and structural soils were moved
- Imported and placed 206,000 $yd^3$ of geobuffer, clay liner and liner protective layer material
- Routinely worked 12 hour days over 6 day weeks
- Installed five 30,000 gallon leachate tanks with associated pumps and piping and a leachate transfer load-out feature
- Constructed four 545,000 gallon double-lined ponds
- Constructed two 200,000 capacity double lined disposal cells covering 23 acres
- Installed 37 miles of wire, 19,000 feet of pipe and 1,000 feet of utility poles

**Successful Waste Acceptance**

The success of DOE's overall plan for comprehensive management of waste generated from environmental cleanup is centered on having cost-effective on-site disposal capabilities. To mitigate impacts to the general public and the environment from waste disposed in the EMWMF cells, DOE designed waste acceptance criteria (WAC) as

controls. These criteria are administrative based, analytical based, auditable safety analysis based and physical operations constraints based. Adding the risk reducing effects of these WAC to the risk reducing effects of the design of the EMWMF resulted in a high level of confidence in the regulatory and public arenas that the EMWMF could operate and be closed and not represent an unmanageable risk to the future of either group.

To assure an orderly and planned waste acceptance process, the DOE developed a WAC Attainment Plan (3) to define the overall process to assure all regulatory agreements and waste derived risk and hazard-based performance criteria are attained before and during waste placement. Implementation of the WAC Attainment Plan requires integrated efforts by Remedial Action (RA) Contractors, BJC(WAC Attainment team), and Federal Services. Each has a distinct and separate role and each entity role encompasses specific responsibilities as follows.

**RA Contractors** – manage remedial action operations and are responsible for certifying all waste meet the WAC. They also must certify that the analytical WAC parameters and the ASA derived WAC concentrations are correct.

**BJC** – manages RA Contractors and EMWMF Waste Operations and are responsible for implementation of the WAC Attainment Plan. BJC also facilitates approval of waste lots, delivery, scheduling of deliveries and tracking of generated waste destined for the EMWMF.

**Federal Services** – operates the EMWMF to accept preapproved waste lots, verify compliance of waste deliveries with the physical WAC and place the waste in designated location in the cell.

Federal Services staffed the EMWMF project to assure safe and efficient receipt and disposal of waste and equipped the facility with scales and a waste tracking software package (WasteSoft). The waste acceptance process is managed by a Waste Acceptance Manager who integrates the waste acceptance, waste tracking and oversees compliance with the WAC Attainment plan and the ASA. This position also interfaces with the RA Contractors for scheduling waste deliveries, EMWMF operations hours and compliance with the physical waste acceptance criteria.

## First 6 Months of Operations

The EMWMF opened for acceptance of approved waste lots and placement in the cell on May 28, 2002. Waste deliveries to the EMWMF has predominately been in dump type vehicles. Waste vehicles from the RA Contractors are tare weighted in advance and each vehicle is equipped with a radio frequency indicator (RFI) that is read by the WasteSoft® software and used in calculating net weight after the truck and its contents are weighed. Upon arrival at the EMWMF the RA Contractor vehicle pulls onto the scale and the driver is issued a receipt ticket. The driver exits the scale and proceeds (depending on the truck contents) to a location inside the cell fence where a BJC subcontractor performs an inbound radiation survey. After receiving approval from this subcontractor the truck

proceeds to the EMWMF dump ramp. At this location the waste lot and weight are verified by Federal Services employee and the driver is given verbal and hand motions to position the truck on the dump ramp. After the contents of the disposal vehicle is unloaded (98% were dumped directly onto the work face, while the remaining waste is offloaded from flatbed trucks and placed directly in the waste face) the truck exterior is surveyed to assure it is not leaving with removable contamination. RA Projects with approved waste lots and their delivery methods to date includes:

Table I. Remedial Action Contractor Projects, Oak Ridge Reservation

| | | |
|---|---|---|
| Bone Yard/Burn Yard | Articulated Cat Dump Vehicles | Contaminated Soils |
| Intermediate Holding Pond | Rolloff on Dump Vehicle | Contaminated Soils |
| K-1070A | Rolloff on Dump Vehicle | Contaminated Soils |
| K-25/27 | Flat Bed Trailers | Transite Panels |
| K-25/27 | Rolloff Dump Vehicles | Bagged Mineral Fiber |
| BNFL | Flat Bed Trailers | Concrete Blocks |

Between May 28 and December 31, 2002, Federal Services placed 147,136 tons of waste delivered in 7,535 trucks from the projects listed above. Received waste consisted of over 98% loose contaminated soil and debris and 2% mineral fiber and transite and large concrete structures. Federal Services normal shift waste receipt hours are 07:15 am to 2:45 PM daily. Waste receipt and placement occurred on 129 of the days between May 28 and December 31. There were a total of 19 rain out days or days when the incoming waste was too wet to safely place and on several occasions work was scheduled for a sixth day during the week. In place density measurements, waste receipts and fill elevations indicate a current ratio of approximately 1.6 tons per cubic yard.

Figure 1. Waste Placement at the Lower Dump Ramp in the EMWMF Disposal Cell

## Future Operations

Phase 1 of the EMWMF project included project development and site characterization. Phase 2 of the EMWMF included the design, construction and operation of the 400,000-yd3 capacity disposal cells. Based on waste generation projections developed by BJC, the life of the EMWMF 400,000 yd3 cells is approximately 3 to 5 years. Since the waste generation projections also indicate remedial action at the ORR extending through FY-15, planning included expansion of the EMWMF and its disposal cells to accommodate this future need.

The future expansion of the EMWMF to accommodate the waste is currently being evaluated The evaluation to date indicates the volumes of waste consistently increasing over time. BJC is well underway with planning for expanding future disposal capacity. Currently, BJC is creating a request for proposal to solicit interest from qualified bidders to complete the design and construct phase 3 of the EMWMF with an additional capacity for 800,000$yd^3$. Operations of the second phase of the EMWMF will proceed under a separate solicitation. Projections are that the expansion is required to be ready for operations in early FY-05 to meet generation forecast.

## Path Forward and Conclusions

The opening of the EMMWF marked the end of a 4-year site evaluation, design and construction process managed by the DOE and BJC. Waste accepted for disposal at the EMWMF is generated during remediation at CERCLA sites at various locations on the ORR and associated offsite locations. Since the site opened for operations, over 100,000 $yd^3$ of ORR remedial action waste have been safely placed into the cells. Waste generation projections indicate the current cells can operate through FY-04. After this point, additional capacity needs to be available to complete DOE's planned site remediation work.

References:


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3. Department of Energy, “Attainment Plan for Risk/Toxicity-Based Waste Acceptance Criteria at the Oak Ridge Reservation, Oak Ridge, Tennessee,” DOE/OR/01-1909&D3 (2001).