

OAK RIDGE RESERVATION SOLID LOW-LEVEL AND RADIOACTIVE MIXED WASTE PLANNING AND DISPOSAL ACTIVITIES

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ABSTRACT

Management of low-level waste (LLW) and radioactive mixed wastes (RMW) on the Oak Ridge Reservation (ORR) is driven by the Department of Energy (DOE) performance requirements and existing Federal and State compliance agreements. DOE operations on the ORR generate approximately 4,500 cubic meters of LLW and 6,000,000 kgs of RMW each year. LLW generated at the Y-12 Plant and the K-25 Site is currently stored at those locations pending the development of new LLW disposal facilities. Most LLW generated at the Oak Ridge National Laboratory is currently placed on the Interim Waste Management Facility (IWMF) in Solid Waste Storage Area 6. All RMW are either treated for destruction or stored pending the development and/or implementation of treatment.

The IWMF represents a transition step between smaller scale demonstrations of tumulus disposal technology (i.e., Tumulus I and Tumulus II) and the currently planned Class L-II Disposal Facility. Wastes are placed in metal boxes which are grouted into concrete vaults. The vaults are then placed on a concrete pad. All releases from the pad drain into a central collection gallery and are monitored prior to release or treatment. The IWMF incorporates several design modifications from the original design reflecting experiences and lessons learned from the limited operations on Tumulus I and II and will provide information on the performance on the technology to be utilized in the new facility. A performance based approach utilizing performance objectives specified in DOE orders and pathways assessment methodology to establish waste concentration limits to ensure performance objectives are met is being used in project planning for new disposal facilities. The planned new facility, which will also utilize tumulus disposal technology, is currently planned to begin operation in the 1998 timeframe. Uranium-contaminated wastes from the Y-12 Plant and the K-25 Site will be stored pending development of either on-site or off-site disposal capability. The Class L-I Disposal Facility utilizing Resource Conversation Recovery Act-type disposal design features (i.e., liners and leachate collection) is planned to begin operation after the year 2000 for the management of these wastes. In the interim, these wastes will continue to be stored and off-site disposal alternatives will be evaluated. In order to optimize the use of available storage space and to minimize the requirements for additional new storage facilities, wastes will be treated by supercompaction and incineration to reduce the volume requiring storage.

Management of RMW is driven by the requirements of the existing Land Disposal restrictions (LDR) Federal Facility Compliance Agreement. That Agreement mandates that plans be developed that provide schedules for treating wastes in existing facilities, if appropriate, or that provide for the identification, selection, development and demonstration, and deployment of technologies to treat the remaining wastes. Required new facilities must be identified, schedules for their construction provided, and schedules for the treatment of stored wastes specified. Capability currently exists on the ORR to treat wastes requiring stabilization, neutralization, deactivation, and incineration. Consistent with DOE national program plans, wastes are grouped into treatability groups which are then matched to required or candidate technologies for treatment. Plans for facilities or necessary development to support implementation of treatment will be developed. A development program which specifies activities to identify, select, develop and demonstrate technologies for the remaining wastes and schedules for the implementation of these activities is being planned. Under the requirements of the Agreement, these activities must be completed by March 1995. At that time, a plan identifying technologies to treat the waste, facilities that will treat the waste using the identified technologies, schedules for the construction of such facilities, and schedules for the treatment of the waste must be prepared. In addition to activities aimed at treating wastes to meet LDR requirements, mixed waste disposal alternatives both on and off the ORR are being evaluated. A preliminary screening study of the feasibility of siting a RMW disposal facility on the ORR was completed in FY 1993. An engineering feasibility study is currently planned for FY-1993 and 1994. Off-site disposal options are also being evaluated.

INTRODUCTION

The U. S. Department of Energy (DOE) operates three facilities on the Oak Ridge Reservation (ORR): the Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and the K-25 Site. ORNL is a multi-program research facility while

the mission at the other two sites is in a state of flux. Previously, the Y-12 Plant had been a weapons component fabrication facility; however, recent events have focused activities on weapons tear-downs and advanced manufacturing concepts. The K-25 Site was operated as a gaseous diffusion plant to

produce enriched uranium until 1985. At that time, enrichment operations were formally discontinued and the site mission evolved to waste management operations. These activities will be discussed in more detail later in the paper.

Management of low-level waste (LLW) and radioactive mixed waste on the ORR is driven by requirements to comply with DOE Orders, federal and state requirements, and existing Federal Facility Compliance Agreements (FFCA). As a result, waste management activities are currently in a state of transition: current operations are either under revision or phasing out. At the same time, plans are under development for new facilities for the management of these wastes.

Routine program activities and environmental restoration activities including research and development, weapons teardown, facility decontamination and decommissioning, and remedial actions associated with the clean-up of contaminated sites generate approximately 4,500 cubic meters of LLW annually. These wastes consist of typical LLW trash (e.g., gloves, wipes, booties, and other personal protective equipment), ion exchange media, sludges, soils, and contaminated debris. Similarly, these activities generate approximately 6,000,000 kgs of mixed waste each year. The bulk of these wastes consist of sludges from the treatment of waste waters, soils from clean-up of remedial action sites, debris from remedial action and decontamination and decommissioning activities, and ash and sludges from the Toxic Substance Control Act (TSCA) Incinerator.

PROGRAM ELEMENTS

Major elements of the waste management program on the ORR are 1) waste minimization; 2) waste storage; 3) waste treatment to meet regulatory requirements, to provide more cost effective utilization of facilities, or to meet performance objectives; 4) technology development and demonstration to support treatment and disposal technology selection and deployment; and 5) disposal on-site utilizing enhanced technologies or off-site at other approved sites. Waste minimization activities have been implemented on the ORR since the early 1980's in accordance with the requirements of the Resource Conservation and Recovery Act but did not receive full attention until waste disposal options for LLW and mixed wastes became limited in the mid-1980's. Since 1988,

LLW generation on the ORR has decreased annually from approximately 20,000 cubic meters in 1988 to the current 1993 estimate of approximately 4,500 cubic feet. During the same period, mixed waste generation was reduced from approximately 13,000,000 kgs in 1987 to the current estimate of approximately 6,000,000 kgs. The estimates for 1993 include anticipated remedial action and decontamination and decommissioning wastes expected to be generated. Historically, these wastes have not been included in waste generation forecasts because they are not considered routine (i.e., constant, on-going programmatic wastes). Even considering these wastes, there is a significant reduction in waste volumes, reflecting both the implementation of an aggressive waste minimization program as well as the change in mission of the ORR facilities. However, it is anticipated that environmental restoration (including both remedial actions and decontamination and decommissioning) annual generation rates will rise significantly in the future.

As indicated previously, currently operating LLW disposal facilities are either being modified and upgraded or phased out of operation. Wastes that were previously dis-

posed of in on-site disposal facilities are currently placed in storage. In support of these changes, Bear Creek Burial Ground (BCBG) disposal operations ceased in 1991; LLW generated at the Y-12 Plant and the K-25 Site are currently stored at those two locations pending treatment, as appropriate, and the selection and implementation of disposal either on the ORR or off-site. All mixed wastes generated on the ORR are currently stored pending treatment and disposal of the residuals. However, in order to minimize storage space requirements, some of these wastes are being volume reduced through supercompaction and incineration using commercial treatment facilities. In addition, a number of treatability studies and supporting development activities are planned for both LLW and mixed wastes. LLW activities will be aimed at improved waste form performance to ensure radiological performance objectives are met. Treatment of mixed wastes will be aimed at identification and selection of treatment technologies to meet Land Disposal Restriction (LDR) requirements. Further development efforts will be required to support actual facility design.

Although LLW disposal in BCBG was discontinued in 1991, LLW disposal operations at ORNL have been continuously upgraded since 1985. As part of the planning and development efforts to support new disposal facilities for the ORR, Tumulus I and II were operated as limited scale demonstrations to gain experience on design and construction of the concept. In addition, some limited information on actual facility performance was obtained. Tumulus disposal technology, adapted from the basis French tumulus design, consists of the placement of waste in metal containers which are then placed inside concrete containers, vaults in the case of the ORR. These vaults are then stacked on a concrete pad. All releases from the facility are collected through a central leachate collection system, monitored, and then either released through an National Pollutant Discharge Elimination System (NPDES) discharge point or transported for treatment. In 1991, the Interim Waste Management Facility (IWMF) went operational incorporating lessons learned from Tumulus I and II and will provide additional information on design and construction and more information on facility performance. As indicated previously, all mixed wastes generated on the ORR are currently stored in permitted facilities; no mixed waste disposal is occurring at this time. The TSCA Incinerator currently provides treatment for mixed waste liquids.

CURRENT REGULATORY ENVIRONMENT

LLW management is driven by DOE orders, principally DOE Order 5820.2A "Radioactive Waste Management." That order requires that performance assessments be completed for all currently operating and planned LLW disposal facilities. The objective of such a performance assessment is to ensure that releases from the facility *do not* result in violation of the performance objectives of the order. The order also provides requirements related to waste minimization, waste characterization and certification, waste acceptance, disposal facility siting, etc.

Management of mixed wastes is driven by the LDR as implemented through the LDR FFCA with the Environmental Protection Agency (EPA) Region IV and the FFCA as well as the relevant DOE Orders governing both hazardous, mixed, and radioactive wastes. The ORR LDR FFCA spells out specific milestones leading to the treatment of all LDR

mixed wastes as generated and all stored inventories of such wastes.

SOLID LOW-LEVEL WASTE DISPOSAL ACTIVITIES AND PLANS

As indicated previously, solid LLW generated at the Y-12 Plant and the K-25 Site is currently stored pending decisions regarding the final disposition of the waste. These wastes are stored outdoors in B-25 boxes because of a shortage of space available inside buildings. At the present time, the Y-12 Plant and the K-25 Site are storing wastes outdoors. Approximately 68,000 cubic feet of LLW are being stored outside at the Y-12 Plant and approximately 24,000 cubic feet of LLW is stored outside at the K-25 Site. In addition, some Y-12 and K-25 wastes are currently stored inside the K-25 and K-27 Buildings but these wastes may be moved outdoors if and when this space is needed for mixed waste storage. ORNL wastes placed on Tumulus I and II are currently covered by Fabric Membrane Structures which provide temporary covers for the waste until final closure of solid waste storage area (SWSA) 6 is implemented.

As indicated previously, Tumulus I and II were operated at ORNL as technology demonstrations of improved disposal technology. Tumulus I began construction in 1986 and was operated from 1987 through 1989. Tumulus II, designed as a bridge between the technology demonstration and the limited operational phase (the IWWMF), was constructed during 1989 and operated during 1990 and 1991. Tumulus II incorporated design modifications resulting from lessons learned from the construction and operation of Tumulus I. As a result of the limited scale demonstrations, the IWWMF was constructed as limited operational implementation of the technology. It is considered limited operation scale because 1) the facility is located in SWSA 6 and did not require a new site selection process; 2) the space available for the facility in SWSA 6 limits the operational life of the facility to five to ten years; and 3) waste acceptance criteria that will be used for the new disposal operations are not yet in place. Construction began in 1990 and continued into 1991 when the facility went operational.

The IWWMF incorporated a number of design changes as a result of lessons learned from Tumulus I and II. These are briefly described in the following sections.

Pad Size

The size of the pads has been reduced from 65 feet by 110 feet to 60 feet by 90 feet in order to eliminate difficulties associated with the integral pour approach. Also, the 30 mil plastic liner used on Tumulus I was eliminated on Tumulus II and the IWWMF because of construction difficulties and significant in-leakage of groundwater from the underpad drainage system. Finally, the pad thickness was increased to 1.5 inches to allow for three high stacking of the vaults, if appropriate.

Drain Line Gallery

Because of problems with the integrity of the below-grade drain pad on both Tumulus I and II, the piping has been replaced by a drainage gallery. The gallery will also provide access for inspections and monitoring.

Disposal Vaults

Vaults were loaded using fork lifts in Tumulus I. Changes to provide for choker cable lift rings were incorporated to eliminate damage to vault edges.

Operational Monitoring

Monitoring of releases from the pad (i.e., release resulting from rainfall and subsequent runoff from the pad), indicated elevated pH levels, in the range of eight to ten, resulting from the leaching of the concrete making up the vaults and pad. Tumulus I and II were subsequently covered with Fabric Membrane Structures to prevent contact of the rain water with the large volume of concrete making up the vaults and pad.

Current plans call for the development of new LLW disposal capacity on the ORR for both mixed fission products and uranium-contaminated wastes. Wastes on the ORR have been grouped into three basic categories: Class L-I (i.e., LLW containing low concentrations of uranium and other long-lived radionuclides that will meet all performance objectives at the time of disposal), Class L-II (LLW containing mixed fission products and low concentrations of long half life radionuclides in concentrations such that all performance objectives will be met after the institutional control period), and Class L-IV (i.e., LLW that are not acceptable for disposal on the ORR using planned disposal technologies as a result of the performance assessment). Class L-IV wastes will be treated to separate the waste into Class L-I or Class L-II wastes for disposal on-site and a smaller fraction of Class L-IV wastes, to reduce the volume of Class L-IV wastes, or to improve the chemical and/or physical stability of the waste. Class L-III wastes were proposed for treatment in a land based treatment system. This concept was rejected by the State of Tennessee and Class L-III wastes are now included in Class L-IV. A preliminary assessment was conducted to identify target concentration limits for the various waste classes in order to determine the feasibility of the project. Concentration limits will be further defined as part of the Environmental Impact Statement (EIS) process and will be finalized when the final facility performance assessment is completed.

Class L-I Disposal Facility (Class L-I DF) is planned to utilize landfill disposal technology as defined by State of Tennessee solid waste regulations. The facility will have liners (i.e., a synthetic liner underlain by clay) and a leachate collection system. Any leachate collected will be monitored and either released through an NPDES permitted discharge or transported to ORNL for treatment. The Class L-I DF is considered as Phase II of the current FY-1996 Line Item Project and would not be completed until after the year 2000.

The Class L-II Disposal Facility (Class L-II DF), as planned, will utilize tumulus disposal technology as demonstrated in Tumulus I and II and the IWWMF. Wastes are placed in B-25 boxes which are then placed in concrete vaults. The space between the vault and the box will be filled with grout and the vault lid will then be secured to the vault. Vaults are then placed on the concrete pad using an overhead crane to provide more efficient stacking, more efficient stacking operations, and to reduce worker occupational exposures. A central drainage gallery, as is employed in the IWWMF, will collect any releases from the pad and transport them to a central monitoring area. If acceptable, these releases will be discharged through and NPDES permitted discharge. If these waters require treatment, they will be transported to ORNL for treatment in the Process Waste Treatment Plant.

The EIS for these projects is currently in preparation and is scheduled to be issued in draft for public comment in

December 1993. The Final EIS is scheduled for September 1994 and the Record of Decision is scheduled for October 1994.

Near-term, options for the management of Class L-IV focus on continued safe storage of the waste. Additional storage capacity is currently being developed for these wastes at ORNL. Long-term management options to be evaluated include waste form performance improvements to allow on-site management of the waste, off-site disposal (at both DOE sites and commercial sites), alternative on-site disposal technologies and long-term storage on-site.

During the period prior to operation, alternative disposal options for both Class L-I and L-II wastes will be investigated. In addition, treatment options to reduce the waste volume requiring disposal and options to increase the chemical and physical stability of the waste will be evaluated.

SOLID RADIOACTIVE MIXED WASTE DISPOSAL ACTIVITIES AND PLANS

Because of the lack of adequate and/or available mixed waste treatment and disposal capacity, mixed waste is all stored on-site in permitted storage facilities. As of December 31, 1991; approximately 59,000,000 kgs of mixed waste are currently in storage on the ORR. The LDR FFCRA requires that the following plans, reports, and documents be prepared: 1) Waste Minimization Plan, 2) Waste Storage Plan, 3) Plan for the Treatment of Wastes With Existing Identified Treatment Capacities (i.e. Table "A" wastes), 4) Strategy Plan for the Treatment of Wastes Without Existing Identified Treatment Capacities (i.e., Table "B" wastes), 5) Waste Treatment Methods Plan, and 6) an Annual Waste Minimization Status Report. The Waste Minimization Plan identifies activities that will be undertaken to reduce the volume of LDR mixed waste generated on the ORR. The status report will report both progress versus the plan and the overall effectiveness of the plan in reducing the volume of waste generated.

The Waste Storage Plan evaluates current and planned storage capacities versus storage requirements for LDR mixed wastes in order to provide assurance that the wastes will be stored safely and compliantly until such time as they are treated. The plan outlines a strategy that relies on the utilization of existing storage facilities and upgrading other available existing facilities prior to the construction of new facilities.

The Plan for the Treatment of Wastes With Existing Identified Treatment Capacity provides preliminary workoff plans for stored waste inventories and for the treatment of newly generated wastes. Wastes were matched to four existing treatment capabilities as follows: 1) neutralization, 2) stabilization, 3) deactivation, and 4) incineration. Neutralization wastes are essentially stored for treatment or treated as generated. No stored inventory exists beyond the current year. Stabilization wastes are currently limited to the Melton Valley Storage Tank supernatant which are planned for solidification during FY-1993. Plans call for transferring this waste to Table "B" at that time. No deactivation wastes are generated at this time and there is no stored inventory. It is anticipated that a small volume of these wastes will be generated as part of the

decontamination and decommissioning of facilities at the Y-12 Plant in the immediate future. Plans call for the continuation of current treatment methods for this waste.

The Strategy Plan for the Treatment of Wastes Without Existing Treatment Capacities is due to EPA Region IV in March 1993. The plan groups Table "B" wastes according to the waste treatability groups established by the DOE Mixed Waste Treatment Project as follows: 1) aqueous liquids and slurries, 2) organic liquids, 3) solid process residues, 4) soils, 5) debris wastes, 6) special wastes, and 7) inherently hazardous wastes. Technologies were then matched to the various waste groups. Current treatment capabilities were compared to the identified technologies in order to identify potential modifications to existing facilities, to identify new facility needs, and to identify areas requiring treatability studies and development activities to support technology selection. Based on this preliminary evaluation, activities leading to the identification and selection of treatment technologies, facility identification, and scheduling wastes for treatment were prioritized. Because of the limited available mixed waste treatment capacity, current plans call for the development of a new Mixed Waste Treatment Facility (MUTF) that will provide treatment for Table "B" wastes with known treatment technologies. As currently envisioned, the MUTF will provide for the treatment of solid process residues, soils, debris waste, and mercury contaminated wastes. Treatability studies and other development activities supporting technology selection for the remaining Table "B" wastes will be coordinated with national DOE program activities.

Options for the management of treated mixed waste residues will include mixed waste disposal on the ORR, off-site disposal (both other DOE sites and commercial sites), long-term storage on the ORR as mixed waste, delisting of the mixed waste to create a LLW, and treating to reduce radioactivity levels to a level "Below Regulatory Concern" (BRC) and management off-site as hazardous waste, and a combination of delisting and "BRC" resulting in management of the waste as industrial waste.

CONCLUSIONS/SUMMARY

Near-term activities in the areas of LLW and mixed waste management will focus on waste minimization, interim storage, and waste treatment to meet regulatory requirements, to reduce the volume of waste, or to improve waste form performance. While disposal options for LLW will continue to be pursued in the near-term, mixed waste disposal options will require more time for evaluation, selection, and implementation. Major issues and uncertainties that will affect plans for the management of both LLW and mixed wastes include: 1) the acceptability of the transfer of DOE waste from one state to another for the purposes of treatment and/or disposal, 2) the absence of a "BRC" standard for distinguishing radioactive from non-radioactive wastes, 3) the viability of delisting mixed wastes, 4) the availability of funding for construction of required treatment and disposal facilities, 5) the acceptability of LLW disposal on the ORR, and 6) the acceptability of mixed waste disposal on the ORR.