LARGE COMPONENT PACKAGING AND DISPOSITION AT WEST VALLEY DEMONSTRATION PROJECT

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ABSTRACT

Decommissioning and decontamination (D&D) of US Department of Energy (DOE) facilities continues to present unique challenges for packaging and disposal of radioactive material. West Valley Nuclear Services Company (WVNSCO) has been handed its fair share of such unique challenges at the West Valley Demonstration Project (WVDP). WVNSCO, a subsidiary of Washington Group International, has been operating and managing the WVDP facility since 1982 and is the first company in this country to design, construct, operate, and complete a high-level radioactive waste vitrification program for the U.S. Department of Energy. Two hundred seventy-five canisters were produced and staged for eventual shipment. In 2002 the high-level waste vitrification process was shutdown in preparation for D&D of the Vitrification Facility. Three of the major components of concern within the Vitrification Facility were the Melter, the Concentrate Feed Makeup Tank (CFMT), and the Melter Feed Holdup Tank (MFHT). The removal, packaging, and disposition of these three components presented significant radiological and handling challenges for the project.

This paper presents the approach taken in the planning, implementation, and preparation for the disposition of the CFMT, MFHT, and Melter. It addresses the major regulatory and design requirements for packaging, transportation, and disposition of these components. The specific topics that are covered include radiological characterization, shielding, packaging design, on-site handling and movement, off-site transportation options, and a brief discussion on disposition.

INTRODUCTION / BACKGROUND

The WVDP Vitrification Facility operated from 1996 to 2001, processing radioactive waste. It was shutdown in 2002 in preparation for D&D of the facility. The D&D work began at the end of July 2003 and the major work was completed late in December 2004.

The vitrification process was conducted within a shielded concrete cell inside the Vitrification Facility. All the major components were housed inside this Vitrification Cell, including the Melter, which was used to encapsulate and solidify high-level radioactive waste into a more stable borosilicate glass waste form. The Vit Cell is a reinforced concrete structure with outside dimensions of approximately 12.8 meters (42 feet) wide and 21.34 meters (70 feet) long. It rises approximately 12.80 meters (42 feet) above grade and most of its interior wall and floor surface is lined with stainless steel plate. Most walls are four feet thick and there are six lead glass windows that provide views into the Vit Cell from the operating aisles. Three of the largest and most radioactive components housed within the Vit Cell were the Melter, CFMT, and MFHT. These three components were the primary items of equipment used in the process of solidifying the radioactive waste; consequently, they were the three components that needed to be removed from the Vit Cell in order to eliminate the majority of radioactive source term material and clear the way for eventual demolition of the Facility.

The challenges associated with removing these three large components on a relatively short schedule were significant. The major challenges included the following:

(1) Establishment of the best removal path – the large size and weight of these components made the task of removal very difficult;
(2) Waste characterization – accurate determination of the waste classification was critical to the ability to package, transport, and dispose of these components as low-level radioactive waste;
(3) Package design – the packages had to be designed in accordance with the applicable U.S. Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), and disposition facility regulations. They also had to be designed such that they would be compatible with the different on-site and off-site handling and transportation limitations;
(4) Disposition facility determination – disposition facilities had to be evaluated to determine if they could accept these components;
(5) Transportation mode determination – truck, rail, and barge modes of transport had to be evaluated to determine the most feasible means for transporting these components to their respective disposition facilities; and
(6) Inaccessibility - the high dose rates and contamination levels inside the Cell prohibited personnel entry, forcing the handling to be done remotely.

Work began to clear the pathway out of the Vit Cell, while cost and risk evaluations were conducted to confirm that off-site disposition of these components was possible. Nearly 200 jumpers that carried fluids between the components and walls of the Vit Cell were all cut off and removed from service prior to the actual removal of the CFMT, MFHT, and Melter. The jumpers were removed via an electrically powered impact wrench hung from the Vit Cell cranes. A special electrically powered abrasive saw was deployed from the Brokk, an electrically powered mobile manipulator, to cut larger items including the Melter electrodes. Those jumpers that were welded to the components were cut off via special hydraulic shears deployed from the Vit Cell cranes.

Once the project team completed its evaluations and confirmed that off-site disposition was an achievable goal, a "kick-off" meeting was held to begin planning in earnest for the removal of the major vessels. This meeting occurred the first week of February 2004 and the most challenging phase of the project was officially begun. Due to the required project completion deadline of the end of 2004 members of the project team conducted numerous activities in parallel. The project was broken into numerous sub-projects, which included component characterization, package design, component rigging and handling, on-site travel path evaluation, disposition facility evaluation, and component transportation.

CHARACTERIZATION

Characterization of the Melter, CFMT, and MFHT was performed by WMG, Inc. from its Peekskill, New York headquarters. WMG, Inc. is a small business that has developed expertise in radiological characterization over the past 25 years. Characterization is the process which is utilized to determine both the waste classification for disposal in accordance with 10CFR61 (Reference 1) and the transportation classification in accordance with 49CFR173 (Reference 2). The primary nuclide distribution for the waste is determined based upon smear sample analysis (i.e., "Part 61 analysis"). Dose-to-curie conversion factors are established via detailed three-dimensional models and calculations then these conversion factors are applied to survey data to establish the amount of curies of each of the radionuclides.

The 49CFR173 transportation classification was established by comparing the surface activity of the components to the LSA and SCO limits, and by comparing the nuclide activities to the corresponding A_2 values in 49CFR173.

Accurate and current radiological data was required to be gathered for each of the components. It was extremely important for accurate characterization. The radiological data that was collected included the complete operational history of the vitrification process (including spills and relevant process problems), the most recent radiological surveys of the components, and all applicable smear samples from each of the components. WVNSCO supplied radiological dose rate and contamination surveys of the three components, which served as the input data for the characterization.

Physical data (i.e., dimensions and weights) was also necessary for the development of accurate models for each of the three components. The best source for this information was the manufacturer's drawings for each of the associated components. The manufacturer's drawings were also used to determine the materials of construction, geometric information for the establishment of computer models, and to calculate surface areas and volumes. This information was especially important for modeling the Melter, which had a rather complex geometry and was comprised of various materials, such as steels, glass and different types of refractory. WMG developed detailed, three-dimensional shielding models of each component using this information.

Additional requirements were evaluated to confirm that each component shipping/disposal package design would meet all of the 49CFR173 transportation criteria. These criteria included: the conveyance limits, the 3-meter unshielded dose rate limit, the exclusive use shipment criteria, the reportable quantities (RQ) limits, and the "strong tight" or "Industrial Package" requirements. All of the component packages were designed such that they met all 49CFR173 transportation criteria.

The component packages also had to be designed such that they would satisfy the waste acceptance criteria (WAC) for the disposition facility (i.e., disposal or processing facility) to which they would be shipped. The waste acceptance criterion ensures that the packaged radioactive material conforms to the licensing agreements established between the disposition facility and the particular state in which the facility is located. WMG designed the packages to meet the WAC for several potential disposition facilities because the final destination had not been selected for disposition of each of the components.

Characterization Method

Characterization is a two-step process, which is required to document that DOT and disposition facility requirements for transport and disposition, respectively, are met. First, a detailed three-dimensional shielding model of the component is prepared from the manufacturer's drawings. This model is used as input to QAD-CGGP-A. The nuclide distribution is established from the Part 61 analyzed smears obtained from the inside surfaces of the component. The nuclide distribution is used in conjunction with the shielding model results to determine dose-to-curie factors for the survey measurement locations. Finally, the total activity of the interior surfaces of the component is calculated using the measured dose rates and the dose-to-curie factors.

The resultant total contamination activity is assumed to be homogeneously distributed on the interior surface area to obtain a surface contamination level (i.e., in Bq/cm^2 or μCi/cm^2). The activity is decayed to the anticipated shipping date to obtain the approximate total activity and the total surface contamination level.

This methodology was utilized to characterize the CFMT, MFHT, and Melter. The characterization results yielded the following:

CFMT	<Type A Quantity of LSA-II, Radioactive Material	Class C Waste
MFHT	<Type A Quantity of LSA-II, Radioactive Material	Class C Waste
Melter	<Type A Quantity of LSA-II, Radioactive Material	Class C Waste

DOT Regulations for Package Design

The general transport (packaging) requirements for radioactive components are specified in 49CFR173.427, "Transport requirements for low specific activity (LSA) Class 7 (radioactive) materials and surface contaminated objects (SCO)". The general requirements specified in this section of the CFR include:

(1) The external dose rate must not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 m from the unshielded material;
(2) The quantity of LSA and SCO material in any single conveyance must not exceed 100 times the A_2 limits;
(3) Packages must meet the contamination control limits specified in 49CFR173.443;
(4) External radiation levels must comply with 49CFR173.441; and

(5) For LSA material and SCO the shipments must be "exclusive use"

Evaluations of each of the components and their associated packaging were performed, based upon these regulations, to determine whether they could be shipped in "strong tight" or Industrial Packages (IP). Strong tight containers have less stringent requirements (per 49CFR173.427(b)(3)). The requirements that had to be satisfied for the packages to qualify as "strong tight" include:

(1) The package must prevent leakage of the radioactive content under normal conditions of transport
(2) The shipment must be exclusive use
(3) The quantity of radioactive material in the Component package must be less than a Type A quantity of material ($<1A_2$)
(4) The inside of the component will be made inaccessible, and the contamination levels on the inaccessible surfaces are less than 8.0E+05Bq/cm^2 (20 μCi/cm^2) beta gamma (and LTA), and less than 8.0E+04Bq/cm^2 (2 μCi/cm^2) alpha

The CFMT, MFHT, and Melter all exceeded the criteria for shipment in "strong tight" containers because they were all greater than a Type A quantities of material. Therefore the packages for all three of these components were designed by WMG to meet the IP-II requirements.

Shielding Evaluation

Component package shielding must be designed in accordance with 49CFR173.441, which provides the external radiation dose rate limitations for packages used for the transport of radioactive materials, as mentioned previously. Per 49CFR173.441, "…each package of Class 7 (radioactive) materials offered for transportation must be designed and prepared for shipment, so that under conditions normally incident to transportation…" the following criteria are met:

(1) 2 mSv/h (200 mrem/h) on the external surface of the package (49CFR173.441(b)(1))
(2) 2 mSv/h (200 mrem/h) at any point on the outer surfaces of the transport vehicle, including the top and underside of the vehicle (49CFR173.441(b)(2))
(3) 0.1 mSv/h (10 mrem/h) at any point 2 meters (6.6 feet) from, in the case of an open vehicle, the vertical planes projected from the outer edges of the conveyance (49CFR173.441(b)(3))
(4) 0.02 mSv/h (2 mrem/h) in any normally occupied space (49CFR173.441(b)(4))

Each of the three component packages was designed by WMG to meet these shielding requirements.

PACKAGING

Package Design

All three of the component packages were designed by WMG, Inc. The packages were designed in accordance with the requirements of 49CFR173 (Reference 2). The general package design requirements are contained in 49CFR173.410 and .411. As mentioned previously, each of the three component packages were designed with shielding such that the packages would meet the dose rate requirements established in 49CFR173.441. The component packages were designed and fabricated in accordance with the requirements of the American Institute for Steel Construction (Reference 3) and ANSI/AWS D1.1 (Reference 4).

Package Descriptions

There were two basic package designs utilized by WMG for the CFMT, MFHT, and Melter. The CFMT and MFHT packages were truncated cylinders (i.e., right circular cylinders with flat sides). The Melter package was an approximately square box. The package configurations are shown in Figures 1 and 2. As mentioned previously, these packages were designed to provide containment comparable to that of an Industrial Package Type 2 (IP-2) package.

The standard shipping/disposal package consists of the component, including all of its contents, the basic container (i.e., either a cylinder or box), and a cover. The total weights for the loaded shipping/disposal packages ranged from approximately 111,972 kg (300,000 lbs) to 145,564 kg (390,000 lbs).

The components ranged in weight from approximately 7,092 kg (19,000) to 40,310 kg (108,000 lbs).

Fig. 1. CFMT and MFHT Shipping/Disposal Package Configuration.

Fig. 2. Melter Shipping/Disposal Package Configuration.

General Package Design Requirements

The specific package design attributes which are addressed by 49CFR173.410 include handling, lifting attachments, exterior protrusions, water collection pockets, feature safety impacts, normal transport vibrations, chemical compatibility, and valves. The following is a list of each of the attribute requirements:

(1) The package must be designed so that it can be easily handled and properly secured on a conveyance during transport (173.410(a)).
(2) The package must be designed so that each lifting attachment has a minimum safety factor of three against yielding when used to lift the package in the intended manner. It must be designed so that failure of any lifting attachment under excessive load will not impair the ability of the package to meet other requirements (173.410(b)).
(3) The package must be designed such that the external surface, as far as practicable, will be free from protruding features and will be easily decontaminated (173.410(c)).
(4) The outer layer of the package must be designed to avoid, as far as practicable, pockets or crevices where water might collect (173.410(d)).
(5) Any added features must not reduce the safety of the package (173.410(e)).
(6) The package must be designed so that it is capable of withstanding the effects any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (173.410(f)).

(7) The package must be designed such that the materials of construction, including any components or structures, are both physically and chemically compatible with each other and the package contents (173.410(g)).
(8) The package must be designed so that all valves through which the package contents could escape will be protected against unauthorized operation (173.410(h)).

All of these attributes were incorporated into the WMG packaging designs for the CFMT, MFHT, and Melter containers.

Package Fabrication and Mock-Up Testing

American Tank & Fabricators (AT&F), a fabrication shop from Cleveland, Ohio, fabricated all three of the component containers and a transfer shield box. They were contracted by WMG for the containers and by Matrix for the shield box. AT&F was selected as the fabricator because of their previously successful experience fabricating large containers for WMG. AT&F maintains an excellent quality control program and safety record. They are an ASME shop and have the capability to machine large pieces of steel (i.e., large sizes and thicknesses) with a high degree of accuracy. All of the containers were successfully fabricated by AT&F in accordance with the WMG design drawings. The transfer shield was successfully fabricated in accordance with the Matrix design drawings.

Integrated mock up testing was performed at the AT&F facility to ensure mobility on the rail system and fit-up within the respective containers and transfer shield. This was a large project, in and of itself, due to the size of the containers and transfer shield. The CFMT, MFHT, and Melter containers weighed 62,866 kg (168,433 lbs), 53,353 kg (142,946 lbs), and 77,545 kg (207,763 lbs), respectively. The transfer shield weighed in excess of 41,056 kg (110,000 lbs). Special handling equipment was required for these containers and the transfer shield.

The first mock up test was performed to check the CFMT container design and fabrication. A template was fabricated to simulate the profile of the CFMT. This template was inserted into the container to verify that there was sufficient clearance for the component. The mock up test was successful. It pointed out the need for several small modifications, which could have resulted in major problems had this test not been performed.

The second mock up test was performed to check the MFHT container design and fabrication. As with the CFMT mock up, a template was fabricated to simulate the profile of the MFHT (see Figure 3). This mock up identified that several of the existing component protuberances would have to be cut closer to the MFHT to allow for the component to fit into the container.

A third mock up test was performed on the Melter container. WVNSCO shipped the FACTS Melter, a prototype of the actual Melter, to AT&F for this test. The rail system was connected to the transfer shield and the transfer shield was connected via rails, to the Melter container. The Melter container was designed and fabricated with integral rails for rolling the Melter into place in the container. The mock up test was performed by rolling the FACTS Melter up an inclined rail section, into the transfer shield, out of the transfer shield, and into the container. This mock up test was successful in identifying several minor rail problems, which were fixed, prior to shipment of the rail system to the site.

Fig. 3. MFHT Mock-Up Test.

ON-SITE HANDLING AND MOVEMENT

The Matrix Service group, a heavy rigging and transport specialty group from Eddystone, Pennsylvania performed rigging and handling of all three components. Matrix Service group, formerly the F.W. Hake Group, has been in business for over 80 years as a heavy rigging and transport company.

The component rigging and handling had to be coordinated with the package design and removal path evaluation. The decision was made in May 2004 (approximately 3 months after the project team "kick-off" meeting) to remove the components through the existing doorways into the EDR building rather than out through a hatch in the roof of the Vit Cell. This decision focused Matrix Service design of the lift plans on a single removal path. It also allowed WMG to focus the package design for end-loaded containers and eliminate the option for a top loaded design, which would have been required if the components were removed via the roof.

The component removal path traversed three adjacent, but separate rooms before ending at the waste container: the Vit Cell, the Equipment Decontamination Room (EDR) and the Load Out Facility. Matrix Service designed similar component handling systems for each of the three components. They designed a rail and cart handling system that could be used in conjunction with the existing transfer cart for transport of components. Each of the components were moved out of the Vit Cell, through the Transfer Tunnel, into the EDR where they were rotated 90 degrees, then pulled through doorway and into the respective shipping containers. WVNSCO designed and built a special tent enclosure that sealed the opening between the doorway and the shipping containers. The containers for each of the components were positioned in the EDR–to–Load Out building doorway with their open end facing into the EDR. The containers were designed and fabricated with integral rails that mated up to, and interlocked with, Matrix Service EDR transfer rails. Once a shipping container was in place at the Load Out building doorway, and the tent enclosure was sealed to the shipping container, Matrix Service aligned the EDR rails and connected them to the container rail sections. A cable was strung through a "pulling hold" in the end the shipping container. This cable was connected to a winch supplied by Matrix Service, which was used to pull each of the components into their respective containers.

The CFMT and MFHT were light enough that the EDR bridge cranes could jointly lift them off the rail section in the EDR then rotate and position them onto the rails that extended into the associated containers. The Melter handling system was similar to that used for the CFMT and MFHT but required the use of a transfer shield due to the higher dose rates and greater weight of the Melter. The transfer shield was a multi-purpose housing that provided shielding and allowed for hands-on maneuverability with the Melter inside of it. It consisted of four sides and a bottom. The lower portions of the sides were 12.7 mm (5 inches) thick. The upper portions were 5 mm (2 inches) thick.

The CFMT was the first component to be removed from the Vit Cell and loaded into its container. The CFMT was 4.67 meters (15'-4") tall x 3.81 meters (12'-6") in diameter and weighed 7,021 kg (18,810 lbs). It was successfully lifted, down-ended, transported via the rail and cart system, and loaded into the 62,866 kg (168,433 lb) shipping container. The tent enclosure was then opened and the cover was installed on the shipping container. Following the loading effort the CFMT was grouted into place within the shipping container with low-density cellular concrete (LDCC). The grout was specially mixed to achieve 1121 kg/ cu meter (70 lb/sq ft) density then placed within the shipping container via grout ports. The total weight of the packaged CFMT (i.e., the CFMT, the shipping container, and the LDCC) was 124,625 kg (333,900 lbs). Following the grouting effort it was loaded onto a heavy hauler and transported to a rail siding at the WVDP site, where it was off-loaded with a special gantry crane, which was erected by Matrix Service. It will remain in temporary storage on the rail siding until it is shipped to the disposal facility.

The MFHT was the second component to be removed from the Vit Cell. The MFHT was 3.68 meters (12'-1") tall x 3.76 meters (12'-4") in diameter and weighed 8,850 kg (23,710 lbs). A special tipping fixture, which was designed and fabricated by Matrix Service, was attached to the base of the MFHT to allow it to be rolled down onto its side. This component was successfully lifted, down-ended, and transported via the rail and cart system, and loaded into the 53,353 kg (142,946 lb) shipping container using the same method and equipment as was used for the CFMT. The MFHT shipping container however, had to be rotated 45-degrees to allow for installation of the MFHT, due to external support ears that would otherwise prevent the component from fitting out through the shield doorways and into the shipping container. Special lift lugs were positioned on the outside of the container to allow for it to be rotated and handled both before and after loading. Following the loading effort the MFHT was grouted into place within the shipping container with LDCC, just as the CFMT had been grouted. The total weight of the packaged MFHT was 111,375 kg (298,400 lbs). Following the grouting effort it was loaded onto a heavy hauler and transported to the rail siding and placed next to the CFMT for temporary storage.

The Melter was the last of the three components to be removed from the Vit Cell. It was the most difficult of all the components due to its size, weight, and external dose rates. It was 3.60 meters (11'-10) long x 3.30 meters (10'-9-3/4") wide x 3.20 meters (10'-6") tall and weighed 40,123 kg (107,500 lbs). It also had three (3) large electrodes attached to it that had to be removed. The electrodes were approximately 2 meters (6'-7") long and weighed about 560 kg (1500 lbs). After the Melter was pulled onto the apron, all three electrodes were partially cut off using the mobile demolition machine saw. The cuts were made thru the 30.48 cm (12") diameter portion of the electrode. A grapple-shear was then attached to the demolition machine and the electrodes were bent off. All of this work was done remotely via a coordinated operational effort with manipulator arms, the Cell cranes, and the demolition machine working together. The operators worked from outside the Vit Cell in the viewing aisles.

The Melter had integral flanged rollers built into its' base. These rollers were used for installing the Melter in place. They were also used to remove the Melter from the Cell. Matrix Service designed and fabricated a special rail system specifically for the Melter. The dose rates from the Melter, which were as high as 1000 Sv/hr (100 rem/hr), coupled with the weight of 40,123 kg (107,500 lbs), resulted in the need for a transfer shield in order to allow access for workers manipulating the Melter inside the EDR. The EDR cranes did not have enough capacity to lift the Melter so a jacking and rolling system was designed to accommodate this need. With the Melter inside the transfer shield the Matrix Service rigging crew could access the outside of the transfer shield to maneuver it into position for loading it into the shipping container. The Melter had to be rotated 90-degrees, after it was relocated into the EDR, to align it with the shipping container. Matrix Service devised a block and tackle set up and slide set up in the EDR for the final move of the Melter and transfer shield together, to the EDR doorway next to the shipping container.

A special tow hitch was designed and fabricated by WVNSCO for pulling the Melter. WVNSCO operators installed this hitch to the Melter remotely via manipulator arms in the Vit Cell. The tow hitch was outfitted with braided steel cable that was attached to a winch, which was located in the EDR. The winch was used to pull the Melter out of the Vit Cell, through the tunnel, up a ramp, and into the transfer shield.

Unfortunately, concerns about the challenges of moving the Melter proved to be well founded. The rear Melter rollers slipped off the temporary rails installed in the doorway between the Transfer Tunnel and the Equipment Decontamination Room. Rail sweeps on the Melter apparently became caught in the rail and damaged it as it was being moved up the inclined ramp section. The Melter became stuck in the Transfer Tunnel with its trailing edge around 4.57 meters (15 feet) from the face of the Transfer Shield. Recovery cost 12 days on the critical path and involved jacking the Melter up and pulling it back onto the rails using a grip-hoist. The equipment for the recovery was threaded through a narrow space above the Melter from the Equipment Decontamination Room into the Transfer Tunnel. The recovery equipment was placed in position using the grapple-shear mounted on the mobile demolition machine. The entire operation was accomplished remotely. Once the Melter was back on the track, winching was resumed and the Melter was pulled into the Transfer Shield.

After the Melter was in the transfer shield the Matrix Service crew entered the EDR and configured the cable and slide plates, then rotated the transfer shield and Melter 90-degrees. The transfer shield then had to be lowered down onto the "jack and slide" rails via hydraulic jacks. The towing cable was reconnected to a truck winch outside the Load Out building by stringing it through the end of the shipping container. With the towing cable in place, and the doorway sealed to the shipping container, the Melter was remotely pulled out of the transfer shield and into the shipping container. The transfer shield and shipping container had integral rails that were coupled together prior to this move. The 77,545 kg (207,763 lb) shipping container was also designed and fabricated such that the Melter would be positioned correctly inside when the pull terminated. After the Melter was inside the container the doorway to container seal was separated and the shipping container cover was moved into place and bolted to the container. The cover for the Melter was the largest of the covers, weighing 13,168 kg (35,280 lbs). An "engineered lift" was required for installation of this cover because it's weight exceeded the Load Out building crane capacity. After the cover was bolted onto the container special jackscrews were installed to fix the Melter in position inside the shipping container. The total weight of the packaged Melter was 132,517 kg (355,044 lbs). Following the installation of the jackscrews it was loaded onto a heavy hauler and transported to the rail siding and placed next to the CFMT and MFHT for temporary storage.

The component loading efforts began the first week of September with the CFMT being the first component to be removed from the Vit Cell. As mentioned previously, the planning for this major effort started back in February 2004 with the initial "kick-off" meeting. Matrix Service started mobilizing their equipment and crew in late July to begin the rigging and handling efforts. The component moves were completed, with the setting of the Melter package onto the rail siding on November 17th.

TRANSPORTATION

Transportation Mode Selection

There were only two viable modes of transportation available for transport of the components to a disposition facility (i.e., a processor or disposal site). These modes included truck and rail. Barge and air transport were options, however the expense and risk associated with these modes of transport was determined to be cost prohibitive, therefore these options were not considered to be viable.

The evaluation process for determining the mode of transport had to consider numerous factors. The main factors included in this evaluation were shipment destination, package size, schedule constraints, and public visibility.

WVNSCO had to first determine which disposal/storage sites could accept these radioactive components, then work with these prospective sites to determine which of them would accept the components. WMG worked with WVNSCO to evaluate the Waste Acceptance Criteria (WAC) for each of the sites. The component characterizations were used to determine whether the components would meet the specific WAC for each site.

The size and weight of the packaged components was a significant factor as well. Ground loading and weight distribution had to be evaluated for all movements of the packaged components and for all modes of transport. A site evaluation had to be performed to determine which of the two modes of transport were viable for the WVDP site. This evaluation began with site walk downs to assess the site roadways, from the point at which the component exited the Vit Cell to the conveyance loading facility (i.e., truck or rail loading area). The site roads were evaluated to determine if repairs were necessary and to determine if underground or aboveground utilities needed to be relocated or protected. The access road(s) to the conveyance loading facilities (i.e., the WVDP rail siding) were also evaluated. The condition of the roadway into, and out of, the site was evaluated for the truck transport option. The condition of the loading facilities for each of the modes was assessed as well. The costs associated with the required repairs and modifications were factored into the decision. Quotes were obtained from reputable vendors for both rail and truck transportation. The costs of repairs and modifications were added to the associated costs for each of the modes of transportation to tally the total cost for each mode.

Schedule constraints also had to be factored into the transport mode decision. Any constraints associated with the modes of transport could impact the decision. Schedule constraints typically include windows of opportunity when trucking routes are available, waterways are navigable, or rail lines are available.

The truck transport mode evaluation had to consider the availability of qualified truck companies and equipment. There are a limited number of companies that are certified to haul hazardous waste and have trucks large enough to haul these “super loads”. Truck route availability also needs to be considered. It is generally a function of “time of day” transport requirements for each state, road conditions, bridge capacities, and bridge clearances. It can take 6 months per state to obtain the transport permits for loads of this size and type.

The rail transport mode evaluation also had to consider the availability of equipment. For rail shipments of this size however, the railcar availability is not the problem. Rail clearance along the transport path from the shipping point of origination to transport destination is the biggest problem with rail shipment. Rail lines are most restrictive east of the Mississippi River, where the bridges are generally older and more restrictive from both a load capacity and clearance standpoint. Another significant problem with using rail as the mode of transport is rail line availability. There are a limited number of rail lines, which can be utilized for these large component shipments, particularly from the west coast power plants. As a result of this there are stringent schedule constraints that are invoked by the railroad companies, which limit the feasibility of rail as a mode of transport. The rail companies have to constrain these shipments because of the impact upon their “bread and butter” shipments.

IWRI/Cavanagh Services Group (the transportation contractor) worked with WVNSCO, WMG and the rail companies to establish the rail transport option for these components. Rail clearance was the biggest issue that had to be overcome. Initial rail clearance requests were rejected by the railroad companies due to size limitations along the rail routes. WVNSCO and WMG were able to achieve workable solutions to aid with these initial clearance problems. WVNSCO agreed to minimize the overall component size envelopes by cutting off protuberances and appurtenances from the exterior of the components. With these reduced size envelopes WMG was able to reduce the shipping container sizes accordingly. WMG also designed the CFMT and MFHT containers with flat sides to reduce the container width even further. This innovative design eliminated the remaining outstanding issues with the rail clearance.

Perhaps the greatest consideration as to which mode of transport would be used was public visibility. The packages were designed in accordance with the DOT regulations, such that they can be shipped via truck, rail, or barge, however public perception plays a major part in determining which mode to select. The greatest visibility to the public occurs when transport is performed via truck since the component packages would be traveling down public roads and highways on 61-meter (200-foot) long special beam trailers pulled by extremely heavy-duty tractors. WVNSCO chose to use rail as the preferred mode of transport primarily because of impacts to the public as these unusually long and heavy vehicles traveled down the road.

DISPOSITION

Disposition means off-site storage, processing, or direct disposal (i.e., burial) of the component, as applicable. The present disposition options being considered by the WVDP for the CFMT, MFHT, and Melter include off-site storage and/or disposal. The plan is for the CFMT and MFHT to be disposed of and the Melter to be stored off-site.

Disposal

Disposal is simply burial of the component in a qualified disposal facility. The process of disposal involves development of a waste profile, which is based on the characterization results. This waste profile is submitted to the waste disposal facility for approval of the package. A package configuration sketch is included with the waste profile to show the locations of all package components. Once the component is packaged and delivered to the disposal facility, it is off-loaded and buried in an approved cell, according to its waste classification.

The decision has not been finalized on when the CFMT, MFHT, or Melter will be shipped off-site for disposal and storage, respectively. That could possibly be the topic of another paper in the future.

REFERENCES

1. 10CFR61, Licensing Requirements for Land Disposal of Radioactive Waste
2. 49CFR173, Subpart I, Class 7 (Radioactive) Materials, Revised October 1, 1998
3. American Institute for Steel Construction, Manual of Steel Construction Allowable Stress Design, Ninth Edition
4. ANSI/AWS D1.1, Structural Welding Code – Steel, 1998
5. ANSI N14.2, American National Standard "Tiedown for Truck Transport of Radioactive Waste"
6. 10CFR71, Packaging and Transportation of Radioactive Material