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Remotely Controlled Large Container Disposal Methodology

S. J. Amir

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Solid Waste Disposal

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Solid Waste Disposal

Executive Summary

Remotely Handled Large Containers (RHLC), also called drag-off boxes, have been used at the Hanford Site since the 1940s to dispose of large pieces of radioactively contaminated equipment. These containers are typically large steel-reinforced concrete boxes, which weigh as much as 40 tons. Because large quantities of high-dose waste can produce radiation levels as high as 200 mrem/hour at 200 ft, the containers are remotely handled (either lifted off the railcar by crane or dragged off with a cable).

Many of the existing containers do not meet existing structural and safety design criteria and some of the transportation requirements. The drag-off method of pulling the box off the railcar using a cable and a tractor is also not considered a safe operation, especially in view of past mishaps.

As a result of these deficiencies, the *Hanford Site Solid Waste Acceptance Criteria* (WHC 1991b) placed a moratorium on the use of the drag-off method, effective January 1, 1992. Resumption will require a study of available alternatives and their relative degrees of risk. For the past six years many studies were conducted to redesign the drag-off boxes and develop an alternative method of transferring the box from the railcar into the trench.

This study re-evaluated some of the alternatives and recommends a preferred method of transporting and unloading RHLCs into a burial trench. The recommendations are as follows.

1. Container: The Modified Fuel Spacer Burial Box shall be used until a new RHLC is developed.
2. Transport: Railcar shall be used to transport the RHLC to the burial trench. In case the waste generator site does not have rail connection, the gantry could be used.
3. Transfer: The transfer of RHLC from the railcar into the trench shall be effected by a gantry. The gantry could also be used to remove a disposal container from the transportation cask and dispose of it in a trench. Multiple use transportation casks with heavy radiation shielding are sometimes used by the offsite generators in shipping remotely handled disposable waste containers. A 75-ton remotely controlled gantry with a suitable grapple costs about \$350,000.

A 75-ton gantry designed for nuclear application may be excessed by the U.S. Department of Energy (DOE) Savannah River Plant. This gantry could be transferred to the DOE Hanford Site at a cost of \$52,000. The cost includes training Hanford Site personnel. Yearly maintenance of the gantry by the manufacturer will cost \$2,000.

In certain applications, a crane may be used for the transfer. Because of ALARA (as low as reasonably achievable), the use of the crane will be

limited to low-dose waste (5 to 10 rem/hour), the weight of the container, and boom length of the crane. The walkdown of the crane along the 800-ft trench with a 40-ton container may raise some safety questions, especially if the method is used on a repeated basis. The crane must be fail-safe and the failure modes investigated.

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LIST OF TERMS

ALARA	as low as reasonably achievable
DOE	U.S. Department of Energy
LLW	low-level waste
PUREX	Plutonium-Uranium Extraction (Plant)
RHLC	Remotely Handled Large Containers
WHC	Westinghouse Hanford Company

REMOTELY CONTROLLED LARGE CONTAINER DISPOSAL METHODOLOGY

1.0 BACKGROUND

Remotely Handled Large Containers (RHLC) have been used at Hanford since the 1940s to dispose of large and miscellaneous waste components. The RHLCs (e.g., the Fuel Spacer Burial Box, K-3 Filter Burial Box, General Purpose Burial Box, Agitator Burial Box, Canyon (PUREX) Burial Box, or the Standard Burial Box with Yoke) are typically large steel-reinforced concrete boxes, which weigh as much as 40 tons. Wood containers have also been used in some applications. Because of the large bulk and high dose (up to and including Type B and Highway Route Controlled Quantities of nontransuranic solid low-level waste [LLW]), the waste containers produced radiation levels as high as 200 mrem/hour at 200 ft. To meet ALARA (as low as reasonably achievable) standards, the containers are remotely loaded in a canyon bay and transported to the burial site on a railcar. There the containers were dragged off with a cable and disposed of in a dedicated trench.

The drag-off approach, although practiced over a long time, presented many safety concerns. There were a few incidents and close calls. Concerned over the probability of a serious accident in an expanded program, a moratorium was imposed on the disposal of drag-off boxes, effective January 1, 1992 (WHC 1991b). Before a safer method is developed, the use of drag-off boxes of any configuration will require engineering studies that consider all available alternatives and their relative degrees of risk.

The work to find an alternative to the drag-off approach or improving it to address the safety concerns can be traced back to 1987 and 1988 when modifications in the existing containers were investigated so that they met the transportation requirements. Additional background information on the subject can be found in the reports listed in Section 8.

It is necessary now to investigate an alternate approach that meets the concerns of present safety standards.

2.0 PURPOSE/SCOPE

The purpose of this study is to determine the Preferred Alternative to the drag-off method of transporting the RHLC from the waste generator site to the burial trench and then transferring it from the railcar/truck trailer into the trench.

The scope of this study is to develop a method of transporting the existing Hanford Site containers, commercially available containers, and containers from other U.S. Department of Energy (DOE) sites in a manner consistent with the requirements as given in the *Hanford Site Solid Waste Acceptance Criteria* (WHC 1993).

3.0 TRANSPORTER OPTIONS

These are the options for a vehicle to transport the container from the generator site to the burial site. These options are as follows.

3.1 RAILCAR

Railcar is the primary method of transporting large equipment and waste containers from the facilities. The container is remotely loaded in a canyon area of the building onto a flatbed of a railroad car and carried to the disposal site.

Because most facilities are served by rail, there is an advantage to the railcar approach. Some shielding can be placed between the driver and the container, which provides some protection.

There are several disadvantages. They are as follows:

- ° Inability to operate on roads
- ° Inability to enter burial trenches (a separate transfer method is required)
- ° Inability to deliver to trenches not serviced by rail
- ° The railcar provides essentially no shielding, containment, or structural support to the RHLC in case of an accident.

3.2 TRUCK TRAILER

There are lowboy truck trailers available onsite that are capable of carrying a fully loaded container weighing 40 to 50 tons.

The advantage of a motor trailer is the ability to enter burial trenches, which could simplify the transfer process. There are several disadvantages. They are as follows:

- ° Inability to operate on rails
- ° Require a driver to remain in close proximity with the container (versus the railcar option, which allows the use of several spacer cars)
- ° The trailer provides essentially no shielding, containment, or structural integrity for the payload.

3.3 SPECIAL RAIL TRANSPORTER

This would involve making a railcar into a multipurpose transporter by designing it to include shielding, containment, and structural integrity. The special rail transporter could be considered to be an onsite packaging.

The advantage of the special rail transporter is its compatibility with most facilities (because most are served by rail). In addition, it provides shielding, containment, and structural integrity for the payload. The disadvantages are its inability to operate on roads, enter the burial trench (a separate transfer method is required), and to access the trenches not serviced by rail. This system will require considerable engineering and design work and, therefore, will no longer be considered as an option.

3.4 SPECIAL TRUCK TRANSPORTER

This would involve making a trailer (such as a lowboy) into a multipurpose transporter. The trailer, pulled by a truck or tractor, would include shielding, containment, and structural integrity to allow it to be considered as an onsite packaging.

The advantage of a special truck transporter is its ability to enter the burial trench (which could simplify the transfer process), and it provides shielding, containment, and structural integrity for the payload. The disadvantages are the inability to operate on rails, plus the requirement for a driver to remain in close proximity with the container (versus the railcar option, which allows the use of several spacer cars). This system will require considerable engineering and design work and, therefore, will no longer be considered as an option.

3.5 COMBINATION TRANSPORTER

This would involve making a multipurpose transporter that is designed to operate on the road, as well as on (or over) rail lines. It would include shielding, containment, and structural integrity to allow it to be considered as an onsite packaging.

There are several advantages with a combination transporter. They are as follows:

- ° Ability to operate on roads and on (or over) rails
- ° Ability to enter the burial trench (which could simplify the transfer process)
- ° Provides shielding, containment, and structural integrity for the payload.

The disadvantage is the requirement for a driver to remain in close proximity with the payload. This system will require considerable engineering and design work and, therefore, will no longer be considered as an option.

3.6 REMOTELY PILOTED/CAB-SHIELDED GANTRY TRANSPORTER

A remotely piloted or cab-shielded gantry crane can carry the containers from the generator facility directly into the burial trench. If the dose level is not very great, a cab driver can operate the gantry, and remote

piloting may not be necessary. The gantry operates on the road, in the trench, and over the rail lines.

There are several advantages with the shielded gantry transporter. They are as follows:

- ° Ability to operate on roads and over the rails, (thus eliminating separate transfer system)
- ° Shielding on the cab and the ability to operate remotely allow it to handle containers with high dose rates, as well as low dose rates
- ° It has a grapper that picks up and releases the container quickly and safely.

The disadvantage is that this transporter provides no second containment. Figure 1 shows some of the off-the-shelf gantrys and grappers available in the market.

4.0 TRANSFER OPTIONS

The term "Transfer" in this document refers to the method by which a burial container is moved off of the transporter and into the burial trench. The transfer options are as follows.

4.1 DRAG-OFF TRANSFER METHOD

This is the method that was used until 1991 to remotely handle burial boxes. Typically, the loaded box is delivered to the burial site on a railcar. A long cable is attached (before loading) to the burial box and is laid out over two spacer cars. This cable is used to drag the box off the railcar onto a concrete landing and then down into the burial trench where it is positioned for burial.

The advantages of this method are that a worst-case equipment failure would not result in dropping the container and the equipment operators can be located at a distance in a shielded environment. The disadvantage is that the control over the movement of the container is less than that with the crane lift-off method. It is also incompatible with Double-Liner Leachate Trenches in the present design configuration. Figures 2A through 2D show the drag-off transfer method.

4.2 CRANE LIFT-OFF TRANSFER METHOD

This method involves a crane lifting the burial container itself and lowering it into the burial trench.

The advantages of this method are greater control over the movement of the container than with the drag-off method and its compatibility with

Double-Liner Leachate Trenches. There are several disadvantages. They are as follows:

- ° A worst-case equipment failure can result in a dropped container
- ° Each burial container has to have structural strength to be lifted (strength that is not required after burial)
- ° Equipment operators have to be positioned fairly close to the container, depending on the weight and capacity of the crane
- ° Containers with a dose rate greater than 5 to 10 R/hour cannot be handled by this method.

4.3 CRANE LIFT-OFF USING A LIFTING PLATFORM

This would be a steel platform for carrying a burial container. It would have attachment points for the crane rigging and would allow crane lifting of burial containers that are not structurally capable of being lifted without additional support.

There are several advantages with this method. They are as follows:

- ° Greater control over the movement of the container compared to the drag-off method
- ° Compatibility with Double-Liner Leachate Trenches
- ° Method can be used for lifting burial containers that do not offer sufficient structural integrity to be lifted on their own.

The disadvantages include the following:

- ° A worst-case equipment failure can result in a dropped container
- ° Equipment operators have to be positioned fairly close to the container
- ° Containers with a dose rate greater than 5 to 10 R/hour cannot be handled by this method.

4.4 REMOTELY PILOTED/SHIELDED-CAB GANTRY CRANE

This method is the same as discussed in Section 3.6. The method is better suited to a transfer operation. It requires a remotely piloted gantry crane, which could position itself over the railcar where it could lift off the container. When the container was lifted, then the railcar would be pulled out from under the container, and then the gantry crane could carry the container down into the burial trench. This method is shown in Figure 3.

There are several advantages with this method. They are as follows.

- ° There is greater control of the payload than with either the drag-off or crane lift-off methods.
- ° In certain applications, the gantry could be used as a transporter, as well as a transfer mechanism.
- ° Remote control from up to 200 feet makes it possible to handle very high-dosage (500 to 1,000 rem/hour) waste that cannot be handled by other methods, even with heavy shielding.

The disadvantages are as follows.

- ° Although provided with a fail-safe option, the standard gantrys available in the market do not provide redundancy of key dynamic components.
- ° A worst-case equipment failure could lead to problems.
- ° The crane and drag-off methods do not provide redundancy and, in the case of a dynamic component failure, could create serious problems.

4.5 REMOTELY PILOTED PLATFORM

This method would require a remotely piloted motorized platform. When the platform is in place, the container would have to be moved onto the platform (dragged or lifted). The platform would then maneuver into the burial trench. Unloading could be by crane, or the platform could tilt until the container slides off.

There are several advantages with this method. They are as follows:

- ° A worst-case equipment failure could not lead to dropping the container
- ° Remotely located operators
- ° Greater control of the payload than either the drag-off or crane lift-off methods during most of the transfer.

The disadvantages are that the container is unloaded by tilting the platform and its incompatibility with Double-Liner Leachate Trenches. Certain types of design work are also required to develop this method.

5.0 CONTAINER OPTION

There are many container options, but only the two most applicable are discussed here.

5.1 COMBINED TRANSPORT AND BURIAL CONTAINER OPTIONS

For this option, a single container is used for both transportation and burial. Within this option, metal boxes, concrete boxes, composite boxes, and composite cylinders can be considered.

The advantage of a combined transport and burial container is that it creates an operation that is less complicated than using separate containers. The disadvantage is that a single container has to meet transportation and packaging criteria and burial criteria. Many of the transportation and packaging criteria are not necessary for a burial container. For example, a burial container does not require the strength to survive transportation accidents. Likewise, many of the burial criteria are not required for transportation of a container. For example, a transportation container does not have to maintain integrity after being buried for 300 years.

5.2 SEPARATE TRANSPORT AND BURIAL CONTAINER OPTIONS

For this option, the burial container is carried as a liner inside a separate transportation container. Within this option, different combinations of metal, concrete, and composite boxes and cylinders could be considered.

The advantage of the separate container option concern the difference between the burial criteria and the transportation and packaging criteria. Separating the transportation container from the burial container will allow each container to be made from a material best suited for that application (i.e., a strong material for transportation and a corrosion/radiation resistant material for burial). Also, this concept will allow reuse of the transportation container, versus the extra expense of building every burial container to meet transportation requirements. An additional advantage is that this concept is more flexible than the single-container concept because the transportation container can carry a standard liner, a redesigned or custom designed liner (if need be), or many other payloads.

The disadvantage of the separate container option is that it is operationally more complicated than the single container.

6.0 DISPOSAL SITE IMPROVEMENT OPTIONS

The modifications that could be done to the burial trench to accommodate certain options or to improve safety are discussed here. Figure 4 shows an existing drag-off trench.

6.1 CONCRETE LANDING PAD SIZE

Concrete landing pads will be used if the drag-off transfer method is used. The advantage is a decreased chance of a container tipping off of the pad. The disadvantage is the time and expense to increase the landing pad size.

6.2 SLOPE

The ramp into the trench shall have a more gradual (~4.0%) slope so as to accommodate the gantry cranes, which are designed for a 5% slope. The disadvantages are the possible rework of existing trenches and a longer ramp.

7.0 RECOMMENDED ALTERNATIVE

In Sections 3.0 through 6.0 various alternatives have been presented as transporter options, transfer options, container options, and site options. These options were evaluated based on the following criteria:

- ° Safety
- ° Economics
- ° Operations
- ° Versatility
- ° Long-Term Solution
- ° Practicality
- ° Off-the-Shelf Equipment.

Based on these criteria, the various alternatives are eliminated as discussed in the Mercado memo (WHC 1992a). The following recommendations are made for handling, transporting, and disposing of RHLCs.

7.1 TRANSPORTERS

Transportation using railcars and trailers is being included because all other transporter options were excluded and because this method is the most economically feasible.

7.2 TRANSFER METHOD

Two transfer methods are selected, based on the criteria established in Section 7.0: (a) Remotely Piloted/Shielded-Cab Gantry and (b) Crane Lift-Off. The use of a gantry crane will be the preferred method. When a gantry cannot be used, a standard crane may be selected with due safety analysis.

7.2.1 Remotely Piloted/Shielded-Cab Gantry Crane

The use of the gantry appears to be less complex and meets most of the criteria established in Section 7.0. The gantry could lift the container directly from the railcar and carry it into the burial trench safely and economically.

A 75-ton standard gantry crane is available in the market for approximately \$200,000. A conservative estimate for this crane after the addition of remote operating capability and special grapper is \$350,000.

A 75-ton gantry designed for nuclear application may be excessed by the DOE Savannah River Plant. This can be transferred to the DOE Hanford Site at a cost of \$52,000. The cost includes training the Hanford Site personnel.

The yearly maintenance by the manufacturer of the gantry will cost \$2,000. The Savannah River Plant gantry is shown in Figure 5.

7.2.2 Crane Lift-Off Method

The crane lift-off method is suitable to relatively low dose rate waste (5 to 10 rem/hour). It can also be used in trenches inaccessible to the gantry crane. A bottom frame strong enough to support the container load will be required for the existing eighteen Fuel Spacer Burial Boxes. The grapper mechanism needs also to be developed. Instead of the frame, a platform and grapper used in industry in similar applications can be purchased at a cost of about \$150,000.

Note that safety and accident analyses shall be done for this option. The walkdown of the crane along the 600- to 800-foot trench with the load hanging from a long rope is a cause of safety concern, especially when this operation is performed repeatedly.

7.3 BURIAL CONTAINERS

Because the future needs of the Hanford Site include a very high number of burial containers, their cost should be the primary consideration for determining the Preferred Alternative. There are three categories of materials being considered for a burial container (metal, concrete, and composite). Of these three categories, composites appear to offer the most promising solution, in terms of cost, light weight, and ability to meet the high integrity requirements. Consult the Mercado memo (WHC 1992a) and draft of *Low-Level Waste Design Criteria for Remote Handled Containers* (WHC 1992b) for additional information.

7.4 DISPOSAL SITE IMPROVEMENTS

It is recommended that the ramp in the trench will have a maximum slope of 4%. The surface of the trench and ramp will be compacted hard. The ramp, if possible, may be asphalted. The gantry is designed for a 5% grade.

8.0 REFERENCES

- WHC 1991a, Memo, J. G. Field to W. W. Bowen et al., 58100-91-JGF-066, "Drag-Off Burial Box Engineering Study," May 30, 1991, Westinghouse Hanford Company, Richland, Washington.
- WHC 1991b, *Hanford Site Solid Waste Acceptance Criteria*, WHC-EP-0063-3, N. P. Willis, G. C. Triner, Westinghouse Hanford Company, Richland, Washington.
- WHC 1992a, Memo, M. S. Mercado to S. J. Amir et al., 58200-92-MSM-001, "Burial Box Engineering Study - Determination of Facility Requirements," February 3, 1992, Westinghouse Hanford Company, Richland, Washington.

- WHC 1992b, DRAFT, *Low-Level Waste Design Criteria For Remote Handled Containers*, J. D Anderson and S. J. Amir, February 12, 1992, Westinghouse Hanford Company, Richland, Washington.
- WHC 1992c, Memo, J. W. Thornton to E. M. Benson et al., 58200-92-JWT-002, "Outyear Users of Remotely Handled Large Containers," January 23, 1992, Westinghouse Hanford Company, Richland, Washington.
- WHC 1993, *Hanford Site Solid Waste Acceptance Criteria*, WHC-EP-0063-4, N. P. Willis, Westinghouse Hanford Company, Richland, Washington.
- WHC 1994, DRAFT, *Problems/Solutions for Large Contaminated Equipment Transport/Burial Containers*, WHC-SD-WM-DIC-009, Rev. 0, R. J. Julian, Westinghouse Hanford Company, Richland, Washington.

Figure 1. Typical Gantrys and Grappers Used in Industry.

Figure 2A. Drag-Off Method of Container Disposal.

Figure 2B. Drag-Off Method of Container Disposal.

Figure 2C. Drag-Off Method of Container Disposal.

Figure 2D. Drag-Off Method of Container Disposal.

Figure 3. Container Disposal by Remotely Piloted/Shielded-Cab Gantry Crane.

Figure 4. Trench Dedicated to the Drag-Off Boxes.

Figure 5. Gantry Crane Used at Savannah River Plant.

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