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Supplement Analysis for the Packaging and Handling of Remote-Handled Transuranic Waste in Shielded Containers

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ACRONYMS AND ABBREVIATIONS

ANL	Argonne National Laboratory
BCL	Battelle Columbus Laboratories
CFR	Code of Federal Regulations
CH	contact-handled
CoC	Certificate of Compliance
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
HAC	Hypothetical Accident Condition
ICV	inner containment vessel
IDLH	immediately dangerous to life and health
INL	Idaho National Laboratory (formerly INEEL)
KA	Knolls Atomic Power Laboratory
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
NRC	Nuclear Regulatory Commission
OR	Oak Ridge National Laboratory
PA	performance assessment
PE	plutonium-equivalent
rem	roentgen equivalent man
RH	remote-handled
RL	DOE Hanford Site, Richland, WA
SA	Supplement Analysis
SAR	Safety Analysis Report
SCPA	Shielded Container Performance Assessment
SEIS-II	*Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environment Impact Statement*
SNL	Sandia National Laboratories
SRS	Savannah River Site
TA	transportation analysis
TRU	transuranic (waste)
TRUPACT-II	Transuranic Package Transporter Model II
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant

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1.0 INTRODUCTION

This supplement analysis (SA) addresses a proposed action to package at the generator sites, and to emplace at the Waste Isolation Pilot Plant (WIPP), a portion of the remote-handled (RH) transuranic (TRU) waste inventory using a new container design called the lead shielded container (hereinafter referred to as the shielded container).

TRU waste is waste that contains alpha particle-emitting radionuclides with atomic numbers greater than uranium (92) and half-lives greater than 20 years in concentrations greater than 100 nanocuries per gram of waste. TRU waste is categorized as either contact-handled (CH) or RH, based on the surface dose rate at the outside surface of the waste container. CH TRU waste, defined as exhibiting a dose rate of no more than 200 millirems per hour at the outside surface of the container, can be handled directly by trained workers. RH TRU waste, defined as exhibiting a dose rate of more than 200 millirems per hour at the outside surface of the container, requires special handling and shielding to protect workers. The WIPP, located near Carlsbad, New Mexico, is the only facility permitted to dispose of the Department of Energy's (DOE's) TRU waste generated by defense activities.

2.0 PURPOSE AND NEED FOR ACTION

In order to increase the efficiency of its operations at WIPP, DOE is proposing a change to the emplacement scheme for a portion of the RH TRU waste inventory. DOE proposes to package a subset of the RH TRU waste streams in shielded containers to be placed in the HalfPACT transport packaging for transport to and permanent disposal at WIPP.

3.0 PROPOSED ACTION

The shielded container is proposed as an alternative to disposal of RH TRU waste in canisters in the ribs (walls) of the disposal rooms in the WIPP repository. DOE proposes to use the shielded containers for packaging selected lower-activity RH TRU waste streams at the waste generator sites listed in Table 1. The shielded container, in a three-pack configuration, will be transported to WIPP in the HalfPACT transport package, unloaded, and emplaced underground in the disposal rooms for permanent disposal. Doses of radiation are typically calculated in units of rem (roentgen-equivalent man) or millirem (1 rem = 1,000 millirem) for individuals and in units of person-rem for collective populations. RH TRU waste streams that are candidates for placement in shielded containers must exhibit upon packaging a dose rate at the shielded container outer surface of less than 200 millirem/hour. These waste streams will remain designated as RH TRU waste in the Waste Data System (WDS), and will count against the limit of 5,100,000 curies for RH TRU waste defined by the WIPP Land Withdrawal Act and the limit of 250,000 cubic feet (7,080 cubic meters) for RH TRU waste defined by the Consultation and Cooperation Agreement between DOE and the State of New Mexico. There will be no increase in the total amount of waste disposed of at WIPP as a result of the use of the shielded container. Once packaged, the shielded containers will be placed in the HalfPACT shipping container for transport to WIPP for disposal. Upon receipt at WIPP, the shielded containers will be processed and placed in the disposal rooms in a manner similar to the emplacement scheme for CH TRU waste containers, resulting in minimal impact to WIPP waste handling procedures.

The shielded container, approximately the same size as a standard 55-gallon drum, consists of a twin-shelled, carbon steel cylindrical structure and a lid. Nominally, 1 inch of lead shielding is contained between the 7-gauge (0.179 inch) inner shell and 11-gauge (0.120 inch) outer shell. The shells are connected to an upper flange and a 3-inch thick solid steel bottom. The 3-inch thick solid steel lid integrates a silicone rubber gasket, fifteen 1/2-inch alloy steel closure bolts, two alignment pins to facilitate remote assembly, and a lead-

shielded filter port. The shielded container is designed to carry one 30-gallon steel payload drum. In addition to the 30-gallon payload drum, the shielded container may optionally contain a mesh "bag" to facilitate remote installation of the 30-gallon payload drum into the shielded container.

Based on field testing and evaluation and analysis of materials of construction and design, the shielded container has been shown to meet all applicable U.S. Department of Transportation (DOT) and Nuclear Regulatory Commission (NRC) transportation requirements.

Use of the shielded container as a stand-alone DOT 7A Type A packaging was demonstrated in the *Shielded Container Type A Evaluation Report* (TAER, Revision 0, Washington TRU Solutions). Type A confinement and shielding compliance were demonstrated by test through four potentially worst case drop orientations from 4 feet high onto an essentially unyielding surface. Type A stacking and penetration compliance were demonstrated through evaluation and analysis.

Use of the shielded container as an authorized payload container within the NRC-certified Type B(U) HalfPACT waste shipping package was demonstrated in the HalfPACT Safety Analysis Report (SAR), Revision 5. The SAR was submitted to the NRC in support of an amendment request to NRC Certificate of Compliance (CoC) 9279, "HalfPACT Waste Shipping Container," in July 2007. The NRC issued the new CoC incorporating the shielded container as an authorized payload container in May 2009. The HalfPACT package can accommodate one shielded container payload assembly consisting of three shielded containers, an optional plastic reinforcing plate above the three shielded containers, a radial dunnage assembly surrounding the three shielded containers, and an axial dunnage assembly below and above these components. To demonstrate confinement and shielding integrity of the shielded container, a full-scale test was conducted using one shielded container payload assembly (three shielded containers loaded with simulated waste) placed inside a HalfPACT inner containment vessel (ICV). The package was subjected to two 30-foot free drops onto a flat, essentially unyielding, horizontal surface: a vertical end drop and a horizontal side drop. These drops subject the Type B package (HalfPACT) and its contents (shielded container payload assembly) to collision forces similar to the defined Hypothetical Accident Conditions (HAC) required to be evaluated by the NRC. Post HAC test results showed that confinement integrity was maintained, and the shielding material did not reconfigure. As configured for shipment, the shielded container payload assembly remains within the previously established design and certification bases and limits of the HalfPACT package for weight (7,600 pounds) and decay heat (30 watts). Limits on shielded container activity and fissile content are also set consistent with previously implemented and accepted analytic approaches.

Ultimately, the results of the testing summarized above shows the shielded container is safe even after being subjected to severe handling or accident condition impacts as specified by DOT and NRC regulations.

Table 1 shows the estimated volumes that could be shipped to WIPP in shielded containers. A total of about 1,900 shipments would move directly to WIPP from these sites in shielded containers. The shielded containers will be configured as an assembly of three containers for transport in the HalfPACT and will remain in this "three-pack" configuration through unloading to final emplacement in the WIPP underground. Since the shipping configuration for shielded containers is such that each HalfPACT will contain a waste volume equivalent to that of the RH-72B, with three HalfPACTs per shipment as opposed to one RH-72B per shipment, the use of the shielded containers would result in an overall decrease in the number of RH TRU shipments to WIPP.

Table 1 – RH-TRU Waste to be Shipped to WIPP in Lead Shielded Containers[a]

Waste Generator Sites	RH-TRU Waste Volume (cubic meters)
Argonne National Laboratory (ANL)	58
Battelle Columbus Laboratories (BCL)	4
Hanford (RL)	1209
Idaho National Laboratory (INL)	85
Knolls Atomic Power Laboratory (KA)	8
Los Alamos National Laboratory (LANL)	73
Oak Ridge National Laboratory (OR)	468
Savannah River Site (SRS)	17
Total	1922

[a.] Only the portion of the inventory from each site that is expected to move to WIPP in the lead shielded container is included in this table, not the total site inventory.

The use of the shielded container would allow DOE to increase waste handling and emplacement efficiency by allowing for selected lower-activity RH TRU waste streams to be placed on the floor of the repository in a manner similar to that used for CH TRU waste disposal, instead of being emplaced in the walls. The use of the shielded containers will also enable DOE to expedite the cleanup of various TRU waste sites by significantly increasing the rate at which portions of the RH TRU waste inventory can be received and emplaced at the WIPP, while at the same time reducing the overall number of shipments of RH TRU waste to WIPP.

4.0 EXISTING ENVIRONMENTAL IMPACT STATEMENT ANALYSES

In the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2 (WIPP SEIS-II), DOE analyzed the potential environmental impacts associated with disposing of TRU waste at WIPP. DOE's proposed action in the WIPP SEIS-II was to open WIPP and dispose of up to 175,600 cubic meters of defense TRU waste. DOE announced its decision to implement the proposed action in the *Record of Decision for the Department of Energy's Waste Isolation Pilot Plant Disposal Phase*, 63 Fed. Reg. 3623 (1998). The WIPP SEIS-II analyzed the impacts associated with shipment, treatment and characterization of CH TRU and RH TRU wastes at various sites (including LANL, INL, and SRS) and shipping these wastes to the WIPP for disposal.

In the *Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations* (DOE/EIS-0026-SA-07), DOE examined the impacts of transportation activities utilizing the most recent inventory and an updated transportation analysis (TA) that was conducted using an updated version of the RADTRAN code used for the SEIS-II analysis (SNL 2008). The updated TA incorporated updated census data and the most recent TRU waste inventory numbers available at the time of the analysis (DOE 2008a), and used the WebTRAGIS code (the updated version of the HIGHWAY code) to determine the routes, instead of the HIGHWAY code used previously in the SEIS-II. In addition, the SEIS-II estimated latent cancer fatalities (LCFs) for members of the public at 5×10^{-4} per person-rem and for workers at 4×10^{-4} person-rem in accordance with the guidance in effect at the time it was prepared; updated DOE guidance suggesting the use of 6×10^{-4} LCFs per person-rem for both the public and workers was used in estimating LCF impacts in the updated TA. The updated TA also included changes due to the proposed use of the shielded container. A determination was made, based on this Supplement Analysis, that the updated information evaluated did not substantially change the risks estimated in the WIPP SEIS-II in terms of human health, safety, and the environment.

In this analysis, DOE considered whether the current proposed action presents substantial changes or presents significant new circumstances or information relevant to environmental concerns that has bearing on the actions or impacts previously analyzed in the WIPP SEIS-II. None of the activities involved in this current proposed action for the generator sites or for WIPP would require any new excavation or facility construction. Therefore, DOE's previous estimates of potential impacts to geological and hydrological resources, land use, biological resources, cultural resources, socioeconomics, and noise at those sites would remain substantially unchanged.

To determine whether the human health impacts (worker and public) of the current proposed action are consistent with the impacts reported in the WIPP SEIS-II, DOE examined the impacts that could be associated with the current proposed action during transportation, routine operations, and facility accidents.

5.0 ENVIRONMENTAL IMPACTS

5.1 Transportation Impacts

The SEIS-II examined three categories of impacts from transporting TRU waste:

- The overall number of traffic accidents and pollution-related health effects from truck transportation and the number of resulting fatalities and injuries were calculated. These impacts are directly proportional to the number of additional truck shipments that transport TRU waste would place on the nation's highways and not on the radioactive or hazardous materials being transported.
- Routine, incident-free radiological impacts were calculated. These impacts are associated with the external radiation present around a shipping cask as it is being transported.
- The impacts from specific accident scenarios in which a TRU waste package is breached and releases radioactive or hazardous materials were calculated. These impacts are "radiological and non-radiological impacts from transportation accidents".

Accidents, Fatalities, and Pollution-Related Health Effects

There are no additional accidents, fatalities, or pollution-related health effects associated with using the shielded containers. Use of shielded containers will decrease the overall number of RH shipments to WIPP and thus is expected to reduce these impacts as compared to the SEIS-II.

Routine Incident-Free Radiological Impacts

There are no additional incident-free radiological impacts associated with using lead shielded containers. The shielded container will have the same limits on surface dose rates as a direct loaded CH TRU drum, and thus the external radiation present around a shielded container will be no greater than that around CH TRU waste containers. Again, the reduced number of shipments that will result from the use of the shielded containers would reduce these impacts as compared to the impacts analyzed in the SEIS-II.

Radiological and Non-Radiological Impacts from Transportation Accidents

There are no additional radiological and non-radiological impacts from transportation accidents associated with using the shielded containers. The SEIS-II used estimates of the potential waste activity (by isotope) that could be shipped to WIPP to calculate the impacts of "worst case" accidents involving both TRUPACT-II shipping containers for CH TRU waste and RH-72B shipping containers for RH TRU waste. The isotopic mixtures in these "worst case" accidents were estimated from inventory data developed very early in DOE's National TRU Program.

The updated TA evaluated the impacts associated with severe transportation accident scenarios using updated estimates of the quantities and characteristics of the TRU waste inventory, and also incorporated changes due to the proposed use of the shielded container as part of the available packaging configurations for RH TRU wastes. The maximum radionuclide inventory that can be transported in a shipment of HalfPACTs loaded

with shielded containers is less than the maximum radionuclide inventory that can be transported in an RH-72B. Therefore, impacts due to a radiological release from a shipment of shielded containers in a transportation accident would be less than those of an RH-72B shipment, since less radioactivity would potentially be released in an accident. Non-radiological releases for severe accident scenarios were also evaluated as part of the updated TA. For all chemicals analyzed, the concentration to which the maximally exposed individual would be exposed for RH shipments would be no more than about .006% of the immediately dangerous to life and health (IDLH) value. Therefore, since the inventory of chemicals that would be transported in the HalfPACT with shielded containers would not exceed that analyzed in the severe accident scenario involving a RH-72B shipment, no human health effects would be expected from non-radiological releases from a severe transportation accident involving shielded containers.

5.2 Generator Site Impacts

Activities at the generator or storage sites will be essentially the same, whether the waste is loaded and shipped in shielded containers in HalfPACTs or in the RH-72B. The proposed action would not result in additional generator/storage site accident scenarios or increase the impacts resulting from those scenarios. Generator sites will be required to package RH TRU waste into 30-gallon drums to utilize the shielded container, whereas they would have the option to use 30- or 55-gallon drums when loading into a RH removable lid canister for shipment in the RH-72B. This may result in a few more cycles of handling and loading, but is not a significant increase in handling cycles. Potential positive impacts may occur at generator sites utilizing shielded containers. Sites will be able to store some RH TRU waste in shielded containers and manage the containers as CH TRU, reducing exposure risks to workers.

5.3 WIPP Site Impacts

There would be no increase in the total amount of waste disposed of at WIPP as a result of the current proposed action. The use of shielded containers for emplacement of RH-TRU waste at WIPP will not increase the probability of occurrence of an accident at the WIPP site over that previously considered because they will be handled and emplaced in the disposal rooms in the same manner as currently used for CH waste. No new equipment will be required because the existing waste handling equipment will be used for handling and disposal.

The impacts due to handling and disposal of the shielded containers were examined to determine whether those impacts would differ from the impacts calculated in the WIPP SEIS-II. A safety impact analysis was conducted on the shielded container to identify any potential changes to the total effective dose to on-site workers and the maximally exposed offsite individual from previous analyses performed to support the WIPP Documented Safety Analysis. A postulated accident involving a container drop of a maximally loaded HalfPACT payload of shielded containers inside the CH Bay of the WIPP waste handling building was examined. DOE estimates that the risk of a LCF from this accident would be 2.9×10^{-3} for the maximally exposed worker, and 5.2×10^{-6} for the population around WIPP. Comparable impacts from a single hypothetical bounding drum drop in the WIPP SEIS-II analysis are .03 risk of a LCF to the maximally exposed worker and 9×10^{-3} to the population around WIPP (see SEIS-II, Table 5-19).

6.0 PERFORMANCE ASSESSMENT

Previous performance assessments (PAs) have used the assumption that all RH TRU waste would be emplaced in canisters in the walls of the repository. RH TRU waste contained in the shielded container would be placed on the floor of the repository in a manner similar to that used for CH TRU waste disposal, instead of being emplaced in the walls. DOE tasked SNL to assess the impact of emplacing RH TRU waste using shielded containers on the long-term performance of the repository by conducting a performance analysis using the current baseline PA system, making only those changes necessary to represent shielded containers in the WIPP (*Analysis Report for the Shielded Container Performance Assessment*, Dunagan et al., 2007) (SCPA).

Given the uncertainty in the exact amount of RH TRU waste that can be emplaced in shielded containers, the SCPA used a bounding approach that considered several extreme cases, including a case with all the RH TRU waste in RH canister containers in the walls (the current baseline) and a case with all the RH TRU waste in shielded containers in the rooms. The SCPA analysis concluded that the WIPP would continue to comply with the containment requirements specified in 40 Code of Federal Regulations (CFR) 191.13 when representing the disposal of RH TRU waste in shielded containers. SCPA results using the shielded containers emplacement configuration were not discernibly different than the PA results for the current RH TRU emplacement configuration. Moreover, the SCPA concluded that the packaging and emplacement of RH TRU waste in shielded containers has no discernable impact on releases. This statement applies to all release pathways: cuttings and cavings, spallings, direct brine releases, groundwater releases, and total releases. The existing PA suite of modeling tools does not consider the effects of lead on actinide solubility. If such effects were modeled, the presence of additional lead in the repository would augment the already extreme reducing conditions, thereby limiting the solubility of actinides even further, and resulting in even smaller predicted releases than the SCPA would imply. The results of the SCPA analysis are expected because the volume and radioactivity of all RH TRU waste streams comprises only a few percent of the total volume and total radioactivity for the inventory used in the PA analysis. Therefore, RH TRU waste has negligible effect on long-term performance in any emplacement configuration.

7.0 INTENTIONAL DESTRUCTIVE ACTS

DOE also considered the potential impacts of intentional destructive acts (i.e., acts of sabotage or terrorism) and estimated that the impacts would be no greater than the impacts of an accident as analyzed in this SA. The initiating forces resulting from an intentional destructive act and the resulting quantities of radioactive or hazardous material potentially released by such an act would be similar to those for severe accident scenarios as discussed previously in this SA.

8.0 DETERMINATION

Based on the analyses discussed in this supplement analysis, DOE concludes that its proposed action as discussed in this SA does not substantially change the risks estimated in the WIPP SEIS-II in terms of human health, safety, and the environment. Accordingly, DOE has concluded that the changes in the emplacement scheme and use of shielded containers are not substantial changes in the proposed action that are relevant to environmental concerns. Further, there are no significant new circumstances or information relevant to environmental concerns and bearing on the proposals analyzed in the WIPP SEIS-II or the impacts of those proposals. Therefore, a supplement to the WIPP SEIS-II is not needed. As a minor modification to the project, an amendment to the existing WIPP ROD is not warranted.

Approved September 28, 2010

/signature on file/
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9.0 REFERENCES

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