USE OF ACCEPTABLE KNOWLEDGE TO DEMONSTRATE TRAMPAC COMPLIANCE

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ABSTRACT

Recently, Los Alamos National Laboratory-Carlsbad Operations (LANL-CO) has supported the Central Characterization Project (CCP) managed by the U.S. Department of Energy (DOE) in the shipment of transuranic (TRU) waste from various small-quantity TRU waste generators to hub sites or other DOE sites in TRUPACT-II shipping containers. This support has involved using acceptable knowledge (AK) to demonstrate compliance with various requirements of Revision 19 of the TRUPACT-II Authorized Methods of Payload Compliance (TRAMPAC).

LANL-CO has worked to facilitate TRUPACT-II shipments from the University of Missouri Research Reactor (MURR) and Lovelace Respiratory Research Institute (LRRI) to Argonne National Laboratory-East (ANL-E) and Los Alamos National Laboratory (LANL), respectively. The latter two sites have TRU waste certification programs approved to ship waste to the Waste Isolation Pilot Plant (WIPP) for disposal. In each case, AK was used to satisfy the necessary information to ship the waste to other DOE facilities. For the purposes of intersite shipment, AK provided data to WIPP Waste Information System (WWIS) transportation modules to ensure that required information was obtained prior to TRUPACT-II shipments. The WWIS modules were used for the intersite shipments, not to enter certification data into WWIS, but rather to take advantage of a validated system to ensure that the containers to be shipped were compliant with TRAMPAC requirements, particularly in the evaluation of quantitative criteria. LANL-CO also assisted with a TRAMPAC compliance demonstration for homogeneous waste containers shipped in TRUPACT-II containers from ANL-E to Idaho National Engineering and Environmental Laboratory (INEEL) for the purpose of core sampling. The basis for the TRAMPAC compliance determinations was AK regarding radiological composition, chemical composition, TRU waste container packaging, and absence of prohibited items. Also, even in the case where AK is not used to fully demonstrate TRAMPAC compliance, it may be used to identify problem areas for shippability of different waste streams. An example is the case of Pu-238-contaminated waste from the Savannah River Site that had a low probability of meeting decay heat limits and aspiration times due to several factors including large numbers of confinement layers. This paper will outline 17 TRAMPAC compliance criteria assessed and the types of information used to show compliance with all criteria other than dose rate and container weight, which are normally easily measured at load preparation.

INTRODUCTION

Acceptable knowledge (AK) is a term used by the U.S. Environmental Protection Agency (EPA) and in the WIPP RCRA Part B permit to describe process knowledge, specifically that used to characterize the contents of TRU waste containers. In this context, AK is used to meet RCRA-related program requirements defined in the WIPP Waste Analysis Plan. AK was most recently addressed in the WIPP Waste Acceptance Criteria (WAC) Appendix A, which provides requirements related to characterization of radiological constituents in TRU waste containers. However, the term AK has not traditionally been used in the context of transportation requirements for TRU waste containers. The TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), Revision 19, allowed the use of information from existing site records and/or databases or knowledge of process, existing records of visual inspection or

examination, radiography (whether or not performed under a WIPP-certified program), and evidence of site-specific administrative and procurement controls as compliance methods for meeting various transportation requirements [1]. These requirements are defined in the areas of container/physical, nuclear, chemical, and gas generation properties, with additional requirements defined related to quality assurance and payload assembly. All of the types of information listed above are typically sought during AK investigations as AK source documents, including VE and RTR records from activities not performed under WIPP-certified programs, as at small quantity sites or during the 1980s prior to formalization of some existing WIPP requirements. In the work described herein, LANL personnel used AK information not to support certification of TRU waste for disposal at WIPP, but strictly to meet TRAMPAC requirements for intersite shipment of waste in a TRUPACT-II container.


WIPP's first waste shipment
March 26, 1999

The TRAMPAC requires that shippers show compliance with its requirements by either 1.) a programmatic TRAMPAC defining how payload compliance will be demonstrated, which will be submitted by the shipper and audited and approved by the U.S. Department of Energy (DOE) Carlsbad Field Office (CBFO), as well as any implementing procedures; or 2.) for small quantity shipments, preparation of a waste-specific data TRAMPAC that must also be approved by the DOE-CBFO and defines how compliance with the transportation requirements will be demonstrated. Such a shipment may be made by any waste generator with no approved programmatic TRAMPAC or a waste generator with a limited number of containers not addressed within a site-specific programmatic TRAMPAC. The case studies described in this paper were performed for the CCP managed by DOE-CBFO, which essentially functioned as a site at the locations described and has its own audited, approved programmatic TRAMPAC document. However, small quantity sites needing to ship TRU waste drums to another site for purposes such as sampling could potentially do so based largely on AK information, provided that they have an approved waste-specific data TRAMPAC.

ASSESSMENT OF TRAMPAC REQUIREMENTS

AK information such as RTR and VE records and database and procurement information may be used to assess compliance of TRU waste containers in 17 different areas described below.

- Container Description – Only four types of payload containers are allowed for TRU waste in the TRUPACT-II. AK including the following can be used to demonstrate compliance: visual inspection to DOT Type A packaging or equivalent requirements, or those specified in TRAMPAC Appendix 2.1; or administrative or procurement controls showing that only the allowable types of containers were used.

- Container Weight – Limits are stated for various types of payload containers. AK in the form of measurement records may be used to demonstrate compliance. The records must show that a calibrated scale was used and the weight measurement error must also be reported.

- Markings – "Each payload container shall be labeled with a unique container identification number." AK in the form of records of payload container visual inspection may be used.

- Venting – All payload containers, including any overpacked drums, must have at least one filter vent that meets the specifications of Appendix 2.5 of the TRAMPAC. AK in the form of visual inspection records or evidence of administrative and procurement controls can be used to demonstrate that filter vents meet or were procured to the specifications of Appendix 2.5.

Additionally, all containers (typically 55-gallon drums) with high-density rigid polyethylene liners must have a minimum 0.3-inch diameter puncture in the lid of the rigid liner.

- Liquids – Liquids are prohibited in payload containers, except for residual liquids comprising <1% of the payload container volume. AK may be used to demonstrate compliance, including records and database information, process knowledge, or records of RTR, VE, or from a sampling program demonstrating that no liquids are present.

- Sharp/Heavy Objects – These items must be blocked, braced, or otherwise packaged to prevent puncture of payload containers. AK may be used as described for liquids, with the difference that records should show no sharp or heavy objects present or that such objects are packaged to prevent damage to payload containers.

- Sealed Containers – Except for containers of Waste Material Type II.2 (solid inorganic materials packaged in metal containers), sealed containers with > 4-liter volumes are prohibited inside of payload containers. AK may be used as described for liquids, with the difference that records should show that no sealed containers are present, or that such internal containers are vented.

- Nuclear Criticality (FGE Analysis) – The Pu-239 fissile gram equivalent (FGE) must be within specified limits for each container type, such as 200 g for a 55-gallon drum. To demonstrate this requirement, waste generators must determine the isotopic composition (i.e., which isotopes are present) and quantity of each isotope, as well as calculate the actual FGE for each payload container. The actual FGE must then be compared with the limit for that payload container type. AK records of past isotopic analyses by mass spectroscopy or gamma "pulse height analysis" may be used for each payload container to determine a measured FGE for comparison with the TRAMPAC limit. These records must also include some estimate of the measurement error. Such records are not required to have been generated under a certified NDA program such as that mandated in the WIPP WAC Appendix A [2].

- Radiological Dose Rate – External dose rates of payload containers must be <= 200 mrem/hr on contact and <= 10 mrem/hr at a distance of two meters. AK records of dose rate measurements that were traceable to a national standard may be used to demonstrate compliance.

- Pyrophoric Materials – Pyrophorics may only be present in payload containers at < 1 weight percent (wt%) unless reacted. AK in the form of records and database information (including knowledge of process) or administrative/procurement controls prohibiting pyrophorics in TRU waste-generating areas may be used to demonstrate compliance.

- Explosives, Corrosives, Compressed Gases – These items are prohibited from payload containers. Any of the following types of AK may be used to meet this requirement: records of VE, RTR, or other sampling of payload containers showing that no such materials were present; administrative and procurement controls prohibiting use of such materials in TRU waste-generating areas; or process knowledge based on records or database information.

- Chemical Composition – All chemical constituents in a payload container must be on a list of allowable materials, with the exception that non-allowed materials may be present at < 5-wt%. If AK exists that a TRUCON code has been approved for the waste, then this requirement is satisfied.

- Chemical Compatibility – Chemicals present in waste must be compatible with each other and

other materials present in other drums and the TRUPACT-II inner containment vessel and O-ring seals. As with the chemical composition requirement, AK documenting that a TRUCON code has been approved for the waste shows compliance.

- Shipping Category/TRUCON code – Each payload container must have a designated shipping category for purposes of evaluating compliance with gas generation requirements. This requires knowledge of the waste type (chemical composition), its gas generation potential, and the gas release resistance, which depends on the type of payload container and type and maximum number of confinement layers). Confinement layers and rigid liners must also meet specified requirements. As with chemical requirements, a documented approved TRUCON shows compliance. The maximum number of layers of confinement may be determined based on AK regarding waste management practices used when the waste was packaged, as well as records and database information.

- Decay Heat – Payload containers may demonstrate compliance with flammable gas/volatile organic compound (VOC) concentration limits using the decay heat limits contained in or calculated in accordance with Section 5.0 of the TRAMPAC if the container has <= 500 ppm total flammable VOCs. AK records of isotopic composition and quantity can then be used to calculate the wattage for each payload container that can be compared to the decay heat limit for compliance assessment purposes.

- Flammable VOCs – Containers may demonstrate compliance with flammable (gas/VOC) concentration limits analytically (by showing that container decay heat < the decay heat limit) if the total concentration of flammable VOCs in the container headspace is <= 500 ppm. AK for such a demonstration may include records from a sampling program or other records from the waste generation process that show that no flammable VOCs were used. Containers with a total concentration of flammable VOCs > 500 ppm must undergo further analysis through the test category methods described in Chapter 5 of the TRAMPAC.

- Aspiration – This requirement applies only to containers that have been stored in an unvented condition. Previously unvented containers must be aspirated (vented) for a defined length of time prior to transportation in a TRUPACT-II.

CASE STUDY: SHIPMENT OF DRUMS TO BE CORE SAMPLED FROM ANL-E

At ANL-E, CCP was required to send ten homogeneous solid waste drums to the Idaho National Engineering and Environmental Laboratory (INEEL), which is one of the few sites in the DOE complex with an audited, approved homogeneous TRU waste core sampling program. Because ANL-E was a small quantity site without a certified program and the first site for CCP that had a homogeneous waste stream ready for characterization, neither the site nor CCP had an audited, approved solid waste sampling program meeting the requirements of the WIPP WAP. Therefore, CCP needed to show compliance with TRAMPAC requirements for the ten-drum population of interest so that the drums could be shipped in a TRUPACT-II to INEEL.

While some audited, approved CCP confirmation equipment was in use on-site and was used to supply some information for TRAMPAC compliance, the following AK information was used to show compliance for this shipment [4]:

- AK procurement records were used to confirm allowable container types and rigid liners
- Database information on radiological composition of individual drums was used to meet nuclear criticality and decay heat requirements. AK records on packaging were also used to determine the maximum possible number of confinement layers for use in the decay heat assessment.
- AK records of an approved TRUCON code were used to meet shipping category, chemical composition, and chemical compatibility requirements
- AK database, procurement, and container-specific generator waste requisition records were used to show the absence of liquids, sealed containers > four liters other than heat-sealed bags, sharp/heavy objects, pyrophoric materials, and explosives, corrosives, and compressed gases. The ANL-E Waste Management System (WMS) provided some of the necessary database records.
- Several different AK records were used to confirm compliance with filter vent requirements. Filter vent models were indicated on one or more TRU Waste Package Venting Data Sheets completed by generators for each container (AE-I-196). Procurement records showed that filter vents were procured from Nuclear Filter Technology (NFT), Inc. in accordance with an approved ANL-E procurement program. The TRU Waste Package Venting Data Sheet indicates the purchase order (PO) number for each drum vent filter specified [4].

CASE STUDY: SHIPMENT OF TRU WASTE FROM A SMALL QUANTITY SITE TO A "HUB" SITE

At the University of Missouri Research Reactor (MURR), CCP was tasked with shipping MURR's TRU waste inventory in TRUPACT-II containers to ANL-E, where CCP was deployed with audited, approved AK, confirmation, and certification programs. In this case, ANL-E acted as a hub site for MURR. No CCP measurement equipment was deployed to MURR because of its very small inventory of only seven 55-gallon containers. As a result, the demonstration of TRAMPAC compliance had to be made based solely on existing AK records and visual inspections of payload containers.

For the TRAMPAC compliance demonstration, a MURR TRAMPAC compliance document was prepared. This document outlined the following AK records that were used to demonstrate TRAMPAC compliance [5]:

- Container Description and Markings – AK records such as packaging procedures showed that all payload containers are approved 55-gallon drums and that drums are marked with bar codes.
- Filter Vent – Based on procurement information and procedures, the filter vents used on drums and liner bags were compliant with requirements.
- Liquids were demonstrated not to be present in the TRU waste in excess of TRAMPAC limits based on 1.) procedures showing that liquid residues were pH adjusted and treated via either evaporation or solidification and that all wastes bagged out of gloveboxes was dry and 2.) visual

inspection of each waste bag prior to emplacement in a 55-gallon drum to verify that any liquid resulting from condensation over time was below TRAMPAC limits.

- Sharp/Heavy Objects and Sealed Containers Greater than Four Liters were described in AK information as being either packaged to provide puncture protection or absent from waste containers

- Nuclear Criticality – AK information listed the actinide inventory for each waste bag in each drum, allowing assessment against the 200 g FGE limit for 55-gallon drums.

- Pyrophoric Materials, Explosives, Corrosives, and Compressed Gases were demonstrated not to be present in the waste based on AK such as procedures used at the time of packaging.

- Chemical Content, Chemical Compatibility, and Shipping Category/TRUCON code - According to AK documentation, waste bags were placed in filtered liner bags with a retractable safety knife that was then used to slash through the outer layers of each waste bag, resulting in only one uncut layer. The filtered liner bag was then sealed with twist and tape and placed directly in a drum. An approved TRUCON code for small quantity sites was found to be applicable to this packaging configuration.

- Decay Heat – AK information listed the actinide inventory for each waste bag in each drum, allowing assessment against the limits of the applicable shipping category described in Section 5.0 of the TRAMPAC.

- Aspiration – Because the drums were not stored in an unvented condition, no special assessment of aspiration time was required.

CASE STUDY: ASSESSING GAS GENERATION COMPLIANCE AT SRS

AK can also be used to assess compliance with individual TRAMPAC requirements for inventory workoff, facility, and other planning purposes.

At the Savannah River Site, a substantial inventory of Pu-238-contaminated TRU waste containers numbering 4,900 was evaluated due to concerns about gas generation potential. LANL-CO personnel used existing AK records, TRU waste package data forms completed by generators at the time of packaging, in combination with information from SRS' COBRA database, to assess what percentage of the waste could meet existing decay heat limits and whether decay heat limits with dose-dependent G values (gas generation potential) that could be calculated under Revision 19 of the TRAMPAC could improve the shippability of the waste stream. The waste in question was generated at SRS' HB-Line facility, which purified Pu-238 materials (among others) for use in production of radioisotope thermoelectric or thermal generators at other DOE facilities [6]. A similar analysis could be conducted for SRS' other Pu-238 waste streams, including waste from the 235-F facility.

Although all personnel involved recognized the limitations inherent in using some gamma spectroscopy data up to 30 years old at the time of the analysis, the results elucidated the size of the problem for the waste stream in question. The results showed that the waste stream was only approximately 10% shippable using decay heat limits allowed under Revision 18 of the TRAMPAC, improving to approximately 30% shippable using limits calculated under Rev. 19 assuming matrix depletion, i.e., using dose-dependent G values. However, this means that a substantial portion of the inventory remains unshippable under existing requirements; SRS continues to investigate alternatives for this inventory.

The analysis also revealed containers that did not comply with the aspiration requirement as of late 2002, as some older containers had many layers of confinement and were not vented until the year 2000. Due to the long time these containers were/are sealed and the many layers of confinement, aspiration proved prohibitive in attaining compliance for shippability. Further analysis of hydrogen gas sampling data collected by CCP at the time of venting was conducted to determine whether more containers could be made shippable based on actual hydrogen data under Option 2 of TRAMPAC Appendix 5.9.

CONCLUSION

AK information such as old analytical records, database information, and procurement information may be used to assess compliance of TRU waste containers with TRAMPAC requirements in 17 different areas. LANL has successfully used AK information at MURR and ANL-E to meet TRAMPAC requirements for intersite shipment of waste in a TRUPACT-II container. AK was also used at SRS to assess compliance with individual TRAMPAC requirements for inventory workoff planning purposes. AK may similarly be used by sites needing to make intersite shipments in TRUPACT-II containers for sampling or other purposes.

REFERENCES

1 "TRUPACT-II Authorized Methods for Payload Control (TRAMPAC)," Rev.19c, Washington TRU Solutions, LLC, April 2003.

2 "Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant" (WAC), Rev. 0.1, DOE/WIPP-02-3122, Department of Energy-Carlsbad Field Office, July 2002.

3 "Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Attachment B, Waste Analysis Plan," NM4890139077-TSDF, State of New Mexico (2003).

4 "Acceptable Knowledge Summary Report for Argonne National Laboratory – East Contact-Handled TRU Waste Facility Maintenance and Laboratory Operations," Rev. 7, CCP-AK-ANLE-001, February 27, 2003.

5 "Acceptable Knowledge Summary Report for Missouri University Research Reactor TRUMP-S Project," Rev. 0, CCP-AK-MURR-001, 2003.

6 "Acceptable Knowledge Summary Report for Savannah River Site Waste Streams: SR-W027-221H-HET, SR-W026-221H-HET-A, SR-W026-221H-HET-B, SR-W027-221H-HEPA, SR-T001-221H-HEPA, SR-W027-HBL-Box," CCP-AK-SRS-4, March 21, 2003.