

Waste Generator Instructions: Key to Successful Implementation of the US DOE's 435.1 for Transuranic Waste Packaging Instructions (LA-UR-12-24155) – 13218

David M. French, J.D. *, Timothy A. Hayes, Ph.D. **, Howard L. Pope ***,
Alejandro E. Enriquez, Ph.D. ****, Peter H. Carson *****

* LANL EES-12, Carlsbad, NM, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, dmfrench@lanl.gov, ** LANL EES-12, Carlsbad, NM, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, thayes@lanl.gov, *** Aspen Resources Ltd., Inc., P.O. Box 3038, Boulder, CO 80307, hpope@aspenresources.com, **** LANL NCO-4, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, enriquez@lanl.gov, *****LANL NPI-7, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, pcarson@lanl.gov

ABSTRACT

In times of continuing fiscal constraints, a management and operation tool that is straightforward to implement, works as advertised, and virtually ensures compliant waste packaging should be carefully considered and employed wherever practicable. In the near future, the Department of Energy (DOE) will issue the first major update to DOE Order 435.1, *Radioactive Waste Management*. This update will contain a requirement for sites that do not have a Waste Isolation Pilot Plant (WIPP) waste certification program to use two newly developed technical standards: *Contact-Handled Defense Transuranic Waste Packaging Instructions* and *Remote-Handled Defense Transuranic Waste Packaging Instructions*. The technical standards are being developed from the DOE O 435.1 Notice, *Contact-Handled and Remote-Handled Transuranic Waste Packaging*, approved August 2011. The packaging instructions will provide detailed information and instruction for packaging almost every conceivable type of transuranic (TRU) waste for disposal at WIPP. While providing specificity, the packaging instructions leave to each site's own discretion the actual mechanics of how those Instructions will be functionally implemented at the floor level.

While the *Technical Standards* are designed to provide precise information for compliant packaging, the density of the information in the packaging instructions necessitates a type of Rosetta Stone that translates the requirements into concise, clear, easy to use and operationally practical recipes that are waste stream and facility specific for use by both first line management and hands-on operations personnel. The Waste Generator Instructions provide the operator with step-by-step instructions that will integrate the sites' various operational requirements (e.g., health and safety limits, radiological limits or dose limits) and result in a WIPP certifiable waste and package that can be transported to and emplaced at WIPP.

These little known but widely productive Waste Generator Instructions (WGIs) have been used occasionally in the past at large sites for treatment and packaging of TRU waste. The WGIs have resulted in highly efficient waste treatment, packaging and certification for disposal of TRU waste at WIPP. For example, a single WGI at LANL, combined with an increase in gram loading, resulted in a mind boggling 6,400% increase in waste loading for ^{238}Pu heat source waste. In fact, the WGI combined with a new Contact Handled (CH) TRU Waste Content (TRUCON) Code provided a massive increase in shippable wattage per Transuranic Package Transporter-II (TRUPACT-II) over the previously used and more restrictive TRUCON Code that have been used previously for the heat source waste. In fact, the use of the WGI process at LANL's TA-55 facility reduced non-compliant drums for WIPP certification and disposal from a 13% failure rate down to a 0.5% failure rate and is expected to further reduce the failure rate to zero drums per year. The inherent value of the WGI is that it can be implemented in a site's current procedure issuance process and it provides documented proof of what actions were taken for each waste stream packaged. The WGI protocol provides a key floor-level operational component to achieve goal alignment between actual site operations, the WIPP TRU waste packaging instructions, and DOE O 435.1.

INTRODUCTION

Waste generating instructions, or something very similar, have been in place for years in one form or another. Some sites have formalized their packaging instructions ranging from submitting them to Document Control for formal issuance and document retention, to developing a formalized protocol for WGI requests. Other sites developed packaging procedures/instructions that do not include all the components of the herein discussed WGI.

The Rocky Flats site realized that the volume and multitude of TRU waste streams, along with the extent of processing, packaging and certifying TRU waste for shipment and disposal at WIPP, necessitated a formal process for controlling how the various TRU wastes would be treated and packaged. This formalized control system provided actual defense-in-depth to ensure the final TRU waste was fully compliant with WIPP's packaging and transportation requirements. The ability to bring under one roof the control of waste processing and packaging at each of the various buildings and facilities at Rocky Flats eliminated the high potential of a facility missing a key WIPP packaging or transportation requirement. This system also eliminated the need for each facility at Rocky Flats to have WIPP packaging experts, which allowed a comprehensive, site-wide, WGI database to be created.

The formalizations of WGI's at various DOE complex sites have included some or all of the following aspects:

- controlled document generation and issuance,
- various levels of approvals,

- required usage,
- formalized updates, and
- formalization of the WGI structure and layout.

While the WGI is not new, its importance in helping generate WIPP and other disposal sites' acceptable waste has significantly increased recently and most likely will continue well into the future as available disposal space decreases and becomes increasingly costly.

DOE ORDER 435.1

The Department of Energy (DOE) is planning to issue an update to DOE Order 435.1, *Radioactive Waste Management and associated Guide*. The Order provides requirements for the treatment, storage and disposal of high-level, low-level (including mixed low-level), and transuranic waste. The Guide provides information to waste management personnel on implementing the requirements delineated in the Order. The Order also directs personnel to three Technical Standards that contain more detailed requirements: *Radioactive Waste Management Disposal Authorization Statements Technical Basis Documentation*; *Contact-Handled Defense Transuranic Waste Packaging Instructions*; and *Remote-Handled Defense Transuranic Waste Packaging Instructions*.

If a waste is not treated, generated or packaged in strict accordance with the DOE Order requirements and the applicable WAC for the receiving facility, it is highly likely that such “non-compliant” waste packages will not be acceptable at the disposal facility. Sites will then be required to reprocess and/or repackage the waste. Unfortunately, re-processing of already treated and/or packaged waste will, in most instances, be at a significant cost – in schedule, processing time, personnel costs, and worker dose, along with the possibility of generating new waste from the reprocessing of the non-compliant waste stream.

A graphic example would be the hypothetical case of a homogenous (S3000) waste stream that is solidified, while a small amount of debris waste from the original waste stream remains in the waste that is being solidified. If a piece of that debris can be seen in the final waste form, what is the significance of that piece of debris? There are two different answers, depending on whether the site has a formal WIPP certification program under CCP or if the site is processing and packaging its waste under DOE O 435.1 packaging instructions.

The site under a formal WIPP certification program that has a S3000 homogeneous waste that also contains, for example, with 20 percent debris may be able to certify that waste if the site is able to show in its Acceptable Knowledge (AK) that only 20 percent of the waste stream is debris, and it is verified by Non-Destructive Assay (NDA), then the waste may be considered a S3000 homogenous waste and may be acceptable under the site's qualified WIPP waste

certification program. However, a very different result will occur under the DOE TRU packaging instructions for sites that do not have a certified program.

In the case where a CCP waste certification program is *not* in place at a site, if the site solidifies the same waste and it is then found after solidification that a piece of debris is visible and the debris item cannot be removed – then the question becomes whether the waste can now be certified for WIPP disposal or must the item be removed, and even if the debris item is removed can the rest of the waste stream be certified for WIPP disposal? The generator must look to the CH packaging instructions for direction. The answer, while clear, is somewhat counterintuitive at first – at least to someone who has worked under a WIPP certified program previously. Here at this juncture, is where the impact of the WGI's efficacy is clearly recognized. If a WGI was being used in the above case where the site did not have a certified program the error in allowing debris waste in the homogenous waste processing could have been stopped. Unfortunately, for our thought experiment site, it is too late and reprocessing and repackaging of the waste stream will be required.

The CH-packaging instructions do not provide for the ability to verify vis-à-vis NDA that only 20 percent of the solidified waste form is actually debris waste and the remaining portion of the waste form is homogenous waste. Instead, the packaging instructions require the removal of all debris – not just the visible debris pieces. As a result, that drum and all the other drums in that waste stream, which are a mixture of S5000 and S3000, must have their contents segregated into a debris only (S5000 waste) quantities and a homogenous only (S3000 waste) quantities (this includes drummed waste that has already been solidified). This rework or reprocessing of solidified waste drums will, most likely, be difficult to accomplish, costly and adverse to schedule. To avoid such a situation, it is highly encouraged that a WGI system be employed to prevent such a potential loss of schedule and funds. Such losses may be difficult to reconcile in lean budget times.

WASTE GENERATOR INSTRUCTIONS

A primary benefit of the WGI system is not only its relative ease of implementation but that it inherently provides a multifaceted cross-checking of the site's waste generating procedures with the DOE O 435.1 waste generating instructions and WIPP. The WGI allows and provides a documentation interface between the site and WIPP. In particular, the WGI provides the ability to have functional internal site reviews and assessments, which allows various cognizant site organizations or functions to have upfront participation in how the waste will be generated and packaged (for example, available funding and personnel, schedules, and needed commodities).

As an example, the WGI, once developed for a site's particular waste form, can be socialized with WIPP for their assessment, review, analysis or comment. However, it is suggested that even before submittal of the WGI to WIPP, prior assistance by CCP may be very helpful. This very interaction between CCP and the site will provide an extremely useful interchange of information both for the site but also for WIPP. It is the goal of both WIPP and a site to have the site treat, package and ship its waste most efficiently. Additionally, WIPP has the goal and direction to use its available disposal space as wisely as possible. Further, unnecessary waste re-work benefits neither WIPP nor the waste generating site; hence, we find that goal alignment between each site and WIPP is a key function of the WGI.

The WGI used by LANL at TA55 for Heat-Source Plutonium Solid TRU Waste is broken down into six primary sections with several subsections as illustrated below:

1. Introduction
 - 1.1. Purpose
 - 1.2. Scope
 - 1.3. Application
2. Precautions and Limitations
 - 2.1. General
 - 2.2. Technical Safety Requirements (TSRs)
3. TRUCON Code Packaging Descriptions
 - 3.1. LA122A/222A : Nonhydrogenous debris packaged in metal cans
 - 3.2. LA122I/222I : Nonhydrogenous debris packaged into LANL-BAG-014 (metal can optional)
 - 3.3. LA125A/225A : Hydrogenous debris packaged into LANL-BAG-014 (metal can optional)
4. Acronyms and Definitions
 - 4.1. Acronyms
 - 4.2. Definitions
5. Responsibilities
6. References

Only the first three sections are discussed below, along with excerpts from the TA55 Heat-Source Plutonium Solid Waste WGI (PMT5-WGI-001) to provide context for the section. The introduction may be as brief or as long as needed to convey pertinent information to the waste processing and/or packaging personnel on the floor. For the Plutonium Heat Source (HS) WGI, the *Introduction* is brief and to-the-point as seen below.

Section 3, TRUCON Code Packaging Descriptions, will only be applicable to sites that have a WIPP Certified TRU waste program and use the TRUCON Code Packaging Descriptions. However, Section 3 would be replaced by packaging steps and requirements that meet the applicable DOE O 435.1 Packaging Instructions and the facility's additional waste packaging requirements.

1. INTRODUCTION

1.1 Purpose

This waste generator instruction (WGI) describes how Heat-Source Plutonium (HS-Pu) contaminated transuranic (TRU) waste payload containers (e.g. 55 gallon drums, pipe overpack containers (POCs), and standard waste boxes (SWBs)) are packaged at TA-55. The goal is to produce a loaded payload container which is compliant with DOE/WIPP-02-3122 *Transuranic Waste Acceptance Criteria (WAC) for the Waste Isolation Pilot Plant (WIPP)* and the *Contact Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC) Document* requirements at the point of generation.

1.2 Scope

This procedure implements the WGI requirement of P930-1 *LANL Waste Acceptance Criteria* for the HS-Pu solid TRU waste stream generated at TA-55. Packaging configurations for payload containers that meet the analytical decay heat limits and radiological limits for Transuranic Waste Content (TRUCON) Codes LA 122A/222A, LA 122I/222I, and LA 125A/225A are described herein. The analytical decay heat limits are based on a 20 day close-proximity shipping category designation for LA 122A/222A and 10-day controlled shipping category designations for both LA122I/222I and LA125A/225A.

HS-Pu handled at TA-55 is on average enriched 85% in ^{238}Pu . The ^{238}Pu isotope has a specific activity of 17.1 Ci/g and a Specific Power of 0.5676 W/g. The WIPP-WAC and CH-TRAMPAC establish limits based on plutonium-239 equivalent activity (PECi) and analytical decay heat limits (expressed in Watts). At TA-55 it is more convenient to express these limits in grams of HS-Pu. The following conversions are useful to determine limits in grams of HS-Pu.

$$1\text{g HS-Pu} = 13.2\text{ PECi} = 0.482\text{ W}$$

The Heat-Source WGI provides the line manager and line operations personnel sufficient information in the *Purpose* and *Scope* subsections to let an operator know which waste the WGI applies to – in this case, Heat-Sources Plutonium (^{238}Pu). Additionally, the scope section provides basic information that the primary interest in ^{238}Pu waste is not fissile grams equivalents but the wattage generated by the waste, where 1 g HS ^{238}Pu is equal to approximately 0.482 watts. This is particularly important because the TRUPACT-II limit is 40 watts.

The *Applicability* subsection provides three items, which must be completed first prior to commencement of waste packaging operations. See an excerpt of this subsection below:

1.3 Applicability

This WGI describes the packaging configuration of items deposited into a payload container to undergo the discard evaluation process. Items undergoing discard evaluation are considered waste only after:

- 1) the payload container contents meet the packaging criteria of this WGI
- 2) the material being evaluated is determined to have no further programmatic value by the PMT5 group leader
- 3) the loaded payload container is transferred to WES-FFS for staging in approved waste storage areas

While the *Applicability* section in this particular WGI is quite brief, the section may be expanded to include more details regarding the waste to be processed or packaged. For example, if more than one specific waste operation is occurring in the area, or the packaging area is a funnel point for several different waste types or forms then additional information may be needed for the packaging operators to fully understand and be able to differentiate the different wastes types from each other and which WGI applies.

The *Precautions and Limitations* section is particularly important for HS plutonium waste because there are few, if any, facilities available to conduct ^{238}Pu repackaging operations once outside the TA55 facility, as experienced plutonium HS personnel know very well. Thus, it is critical that HS waste packaging operation be done correctly the first time to help ensure operator dose is maintained as-low-as-reasonable-achievable (ALARA).

Of significant interest in the *Precautions and Limitations* section below, is the language on “how and why” the “test category” for hydrogen generation limits is more effective for packaging HS waste than the analytical decay heat limit. While the HS WGI references the analytical decay heat limit in the TRUCON code and WIPP shipping category, the WGI limit is actually bound by test category certification process and the calibration limits on the NDA equipment. For additional details see an excerpt of this subsection below:

2. PRECAUTIONS AND LIMITATIONS

HS-Pu contaminated items undergoing discard evaluation will undergo visual examination (VE) by Central Characterization Project (CCP) certified personnel. The CCP-certified VE will confirm the selected TRUCON code packaging description and the absence of WIPP prohibited items. Limitations of Real-Time-Radiography (RTR) used in the CCP waste certification process at TA-54, the lack of facilities to remediate RTR identified anomalies, payload-package degradation during the time elapsed between shipment to TA-54 and RTR scanning, the high specific activity of HS-Pu, and fundamental ALARA principles require the use of VE at TA-55 in lieu of RTR at TA-54 for certification of HS-Pu contaminated solid TRU waste.

Adherence to analytical decay heat limits may expedite the certification of waste to WIPP. However, the CCP certification process relies heavily on the “test category” methodology which does not require compliance to analytical decay heat limits. Although this WGI delineates the shipping category and corresponding analytical decay heat limit for each packaging configuration, the true working limit is bound by harnessing the flexibility of the “test category” certification process and considering limitations in the calibration range of WIPP-certified nondestructive analysis (NDA) equipment.

A working limit of ≤ 15 g HS-Pu per loaded 55 gallon drum is established by this WGI and is independent of which TRUCON code packaging configuration is used. The 55 gallon drums which exceed analytical decay heat limit for a TRUCON code will be certified through the “test category” method. Drums that exceed the radiological limit of 80 PECi (6 g HSPu)¹ will be shipped from TA-55 for overpack at TA-54. The ≤ 15 g HS-Pu working limit may be revised as appropriate when the calibration range of CCP instruments is extended.

Section 3, TRUCON Code Packaging Descriptions, is a primary section that provides the detailed information necessary for packaging the waste in a compliant manner by sites that have a WIPP certified waste program. Sites that come under DOE O 435.1 waste packaging instructions do not employ TRUCON codes; instead, such sites strictly rely on the packaging instructions.

For HS waste the packaging details include for example:

- The type of waste to be packaged (debris or homogenous)
- The waste form – ash, rags, calcined hydroxide cakes, metal, glass, etc.
- What the waste is packaged in – drum-out bags, metal cans (and their size)
- In specific instances each waste form is packaged into specific cans with specific filters
- Hydrogenous waste is segregated from non-hydrogenous waste and homogenous waste is segregated from debris waste
- Use of filtered bags and whether the bag is folded over or horsetailed
- Volume of metal cans

The HS WGI subsection 5, Packaging Requirements, contains step-by-step operations that meet both WIPP’s requirements as well as the site’s operational requirements – the Packaging

Instructions under DOE O 435.1 do not include institutional requirements or rules, as these requirements must be provided by the site; therefore, the WGI is an excellent document that allows the integration of all applicable requirements. For example, each site, and most operations, have both personnel exposure limits as well as external dose limits which must be adhered to, as well as the dose limits set on packages in the Packaging Instructions.

CONCLUSIONS

The WGI concept has been time-tested and has shown to be an excellent process by which sites are able to formalize both site requirements and packaging requirement (in this case, the DOE Technical Standard for TRU packaging instructions) into a cohesive document. The WGI can be used effectively by line personnel to generate WIPP compliant packaging as well as other disposal site compliant packaging such as low-level, low-level mixed, or RH wastes.

Additionally, the WGI can be used as an interface and discussion document with WIPP, allowing sites to gain a better understanding of the requirements and how to implement such requirements before actual processing and packaging operations are developed and implemented. The cost to a site for non-compliant waste packages can be significant and usually avoided by the implementation of the WGI process into the site's current waste generating procedures.

Fundamentally, the WGI process provides a key operational component to achieve goal alignment between actual site operations, WIPP requirements, DOE O 435.1 waste packaging instructions, and the floor level manager and operator.