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Mr. Steve Zappe
2905 Rodeo Park Drive
Building E
Santa Fe, NM 87505

Subject: TRANSMITTAL OF SUPPLEMENTAL REPORT

Dear Mr. Zappe:

The purpose of this letter is to provide you a hard copy of the supplemental report entitled "Characterization Parameters, Data Quality Objectives, and Methods for the Remote Handled TRU Waste Characterization Program 40 CFR 194 Compliance". This report is also available on the CD that was previously sent to you.

Sincerely,

W. A. Most, Sr. Environmental Scientist
Requirements Management Project

Attachment

010758

Characterization Parameters, Data Quality Objectives, and Methods For the Remote Handled TRU Waste Characterization Program 40 CFR 194 Compliance

Introduction

For compliance with 40 CFR 194, RH-TRU waste characterization parameters are defined in two sources, the Compliance Certification Application (CCA, 1996) and the WIPP Land Withdrawal Act (PL 102-579). The CCA parameters are technically based on the Performance Assessment performed to demonstrate compliance with 40 CFR 191 long term repository performance requirements. The LWA parameters are legal restrictions and legal definitions derived from the WIPP Final Environmental Impact Assessment (1980).

Both sets of parameters are addressed in this document in the same way in order to develop a full complement of RH-TRU waste characterization requirements that comply fully with all 40 CFR 194 requirements (which incorporate the LWA requirements) including the "Final Rule." Each individual parameter is analyzed to develop a corresponding characterization objective. Characterization objectives are considered to be Step 1 of the Data Quality Objective (DQO) process, and the remaining steps of this process are completed according to "Guidance for the Data Quality Objective Process" (EPA, 1994). Implementation of the DQO process is intended to establish a specific DQO for any characterization parameter that is not screened out by the process. That is, since tolerable uncertainties have not been specified by either the CCA or the LWA, it is anticipated that most, if not all, of the characterization parameters will not result in an associated DQO. Finally, after characterization objectives and DQOs have been established, methods of obtaining objectives and meeting DQOs are addressed.

CCA Characterization Parameters

The RH-TRU program must account for and control the limited waste components listed in the CCA. These components and associated limits are total inventory limits at repository closure for TRU waste including both RH-TRU and CH-TRU waste.

- Ferrous metals — minimum of 2×10^7 kilograms
- Nonferrous metals — minimum of 2×10^3 kilograms
- Free water in emplaced waste — maximum of 1684 cubic meters
- Cellulosics, plastics, and rubber — maximum of 2×10^7 kilograms

LWA Characterization Parameters

In addition to the general waste component limits that drive waste characterization requirements for both CH-TRU and RH-TRU, there are additional parameters, unique to RH-TRU, which must be quantified. 40 CFR 194.24(g) states, "The Department shall demonstrate in any compliance application that the total inventory of waste emplaced in the disposal system complies with the limitations on transuranic waste disposal described in the WIPP LWA." Other than the total disposed volume limit of 6.2 million cubic feet that applies to all TRU wastes, the referenced LWA limitations are for RH-TRU and are as follows:

- Each container must have a surface dose rate less than or equal to 1000 rems/h
- No more than 5% by volume of the final disposed RH-TRU waste inventory may have a surface dose rate greater than 100 rem/h
- No canister may have an activity level that exceeds 23 curies per liter
- The total disposed RH-TRU waste inventory is limited to 5.1×10^6 total curies

Characterization Objectives

Ferrous and non-ferrous metals

The CCA sets minimum limits for both ferrous and non-ferrous metals and shows that those limits will be met (and exceeded) by just the metal in the waste containers used for emplacement without consideration of metals within the waste matrix. It was proposed that compliance with these limits could be controlled simply by counting the number of containers emplaced in the WIPP. The CCA proposed this characterization approach and objective for both CH-TRU waste and RH-TRU waste. The EPA approved this characterization objective for metals in CARD #24, "*Therefore, EPA agrees with DOE's assertion that a method of quantification is not necessary, although EPA believes DOE must track the number of waste containers emplaced in the WIPP.*"

The RH-TRU waste characterization objective for metals is identical to the CH-TRU waste characterization objective of *accounting for metals in the disposed inventory.* Thus the characterization method of simply counting containers as they are emplaced in the WIPP and entering this data into the WWIS is also chosen for RH-TRU waste.

Free Water

Based on a transportation limit of 1% by volume of residual liquid for each waste container, the CCA arbitrarily set a free water limit of 1% of the total CH-TRU waste repository inventory (168,400 cubic meters). This limit of 1684 cubic meters consequently applies to the total TRU waste inventory, including RH-TRU. By agreement with the State of New Mexico, the WIPP RH-TRU inventory is limited to 7080 cubic meters, and 1% of this volume is slightly less than 71 cubic meters.

The "Free Water" characterization objective for RH-TRU waste is therefore *to limit the total residual liquid inventory emplaced with RH-TRU waste to less than 71 cubic meters.*

Cellulosics, Plastics, Rubber

The CCA set a total repository inventory maximum limit of 20 million kilograms of cellulosics, plastic, and rubber (CPR). This limit included both the RH-TRU waste and the CH-TRU waste. If the entire 7080 cubic meter RH-TRU waste inventory is assumed to be plastic at a density of 620 kilograms per cubic meter (SNL, 2001), then RH-TRU waste would contribute only 22% of the allowable CCA limit. The Transuranic Waste Baseline Inventory Report (TWBIR) projects an RH-TRU waste inventory total gross weight of 3.6 million kilograms and a combined CPR total of 250,000 kilograms. That is only slightly greater than 1% of the 20 million kilogram limit specified in the CCA.

It follows that the most conservative assumption of CPR content in RH-TRU waste will not in itself challenge the limit but 22% of the limit (4.4 million kilograms) might impact allowable emplacement inventories for CH-TRU waste. The TWBIR projected CPR inventory of 250,000 kilograms is not significant in terms of the repository limit or in terms of impacting CH-TRU waste operations.

Thus the characterization objective for CPR is to *control the total RH-TRU waste CPR mass such that CH-TRU waste emplacement is not severely impacted.* There is negligible CPR in Summary Category Group S3000 (homogeneous solids) and S4000 (soils and gravel) waste, and therefore this characterization objective is met by conservatively assuming that 50% of the mass of all Summary Category Group S5000 (debris) RH-TRU waste is attributable to CPR.

Surface Dose Rate

The LWA restricts the volume of RH-TRU waste with a surface dose exceeding 100rem/h that can be emplaced at the WIPP to 354 cubic meters (5% of 7080). It also limits the surface dose rate for any individual container to less than 1000 rem/h. The latest available RH-TRU waste inventory information (Attachment 1) indicates that there is no RH-TRU waste exceeding 1000 rem/h (in fact there is no DOE reported inventory that even approaches the limit), but that the amount exceeding 100 rem/h approximates the 5% limit.

The characterization objective for surface dose rate then becomes *to determine if the surface dose rate of a canister is less than 100 rem/h and more than 1000 rem/h.*

Activity

The LWA restricts the total emplaced RH-TRU waste activity to 5.1 million total curies and limits an individual canister to a maximum of 23 curies per liter.

Considering other restrictions (for example transportation limits, inventory totals, and surface dose rate restrictions) and the reported RH-TRU waste inventory, the 23Ci/l limit cannot realistically be approached. At 23 Ci/l, and a usable volume of 0.89 m^3, an RH canister would have to contain a total of 20,500 Ci to exceed the LWA limit.

For most radionuclides, there are not enough curies in the entire projected RH inventory to load even one RH canister to this level (Table 1, column 3). For the other high activity radionuclides, such as Cs^{137}, , Sr^{90}, Y^{90}, and Ba^{137} the loading would amount to only about 25 Ci per radionuclide per canister if an even distribution were assumed for all 7080 cubic meters. Just 50 canisters loaded to 20,500 Ci would consume the entire projected RH inventory. The high activity radionuclides, like Cs^{137} are also limited by the Hypothetical Accident Condition (HAC) of the RH-72B SARP (Table 1, column 2) to about 1200 Ci.

The conclusion is that, only by making unrealistic assumptions is it conceivable that an RH-72B cask could ever actually be loaded to 23 Ci/l, even if there is no specific waste characterization objective to prevent it. The remaining characterization objective is *to demonstrate, with sufficient confidence, that the total activity of emplaced RH-TRU waste is less than 5.1 million curies.*

Table 1 - Limiting Activity Values for RH TRU

Isotope	HAC Limit (Ci)	Expected Total RH Ci (TWBIR)	Isotope	HAC Limit (Ci)	Expected Total RH Ci (TWBIR)
			C-14		2.05E+00
Cs-137	1.2E+03	2.16E+05	Sb-125	4.1E+03	1.89E+00
Sr-90		2.09E+05	Cf-252	4.8E-03	1.29E+00
Y-90		2.09E+05	Nb-95	458	6.69E-01
Ba-137m	1.2E+03	2.04E+05	Zr-95	557	3.02E-01
Pu-241		1.42E+05	Pu-242	4.8E+01	1.50E-01
Co-60	3.6E+01	1.04E+04	U-236	466	9.68E-02
Pu-239	3.3E+04	1.03E+04	Th-232		9.25E-02
Am-241	2.6E+04	5.96E+03	Tc-99		5.85E-03
Pu-240	4.6E+03	5.07E+03	Am-243	1.5E+04	2.28E-04
Pu-238	2.2E+04	1.45E+03	Np-239		2.28E-04
Eu-152	1.2E+02	1.22E+03	Ag-110m	6.3E+01	1.31E-07
Eu-154	1.1E+02	5.91E+02	Pu-244	0.0679	2.21E-11
Cm-244	1.5E+02	3.15E+02	Au-198		#N/A
U-233	4.2E+04	1.58E+02	Cm-246		NR
Eu-155		1.18E+02	Cm-242	2.9E+03	NR
Cm-243	84825	4.95E+01	Np-237	4.2E+04	2.85E+00
U-234	4.3E+04	4.27E+01			
Cs-134	2.4E+02	1.84E+01			
Ru-106		1.09E+01			
U-238	6.5E+02	1.05E+01			
Ce-144		5.13E+00			
U-235	4.6E+04	4.63E+00			

The Data Quality Objective (DQO) Process

The EPA document SW-846 "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" defines DQOs as:

> *"Data quality objectives (DQOs) for the data collection activity describe the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data."*

The process for establishing DQOs is outlined in EPA QA/G-4, "Guidance for the Data Quality Objectives Process," and is summarized in Table 2.

Table 2 - THE DQO PROCESS

Step	Description
Step 1: State the Problem	Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.
Step 2: Identify the Decision	Identify what questions the study will attempt to resolve, and what actions may result.
Step 3: Identify the Inputs to the Decision	Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.
Step 4: Define the Study Boundaries	Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.
Step 5: Develop a Decision Rule	Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.
Step 6: Specify Tolerable Limits on Decision Errors	Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.
Step 7: Optimize the Design	Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

<u>Step 1: State the Problem</u>

The RH-TRU waste characterization objectives identified previously are the problem statements used in applying the DQO process.

- <u>Metals:</u> Account for metals in the disposed inventory.

- <u>Free Water:</u> Limit the total residual liquid inventory emplaced with RH-TRU waste to less than 71 cubic meters.

- <u>Cellulosics, Plastic, Rubber:</u> Control the total RH-TRU waste CPR mass such that CH-TRU waste emplacement is not severely impacted.

- <u>Surface Dose Rate:</u> Determine if the surface dose rate for a container is less than 100 rem/h and more than 1000 rem/h.

- Activity: Demonstrate, with sufficient confidence, that the total activity of emplaced RH-TRU waste is less than 5.1 million curies.

Step 2: Identify the Decision

All five "problems" consist of long-term data collection activities that will enable compliance decisions at repository closure. These are decisions to be made by WIPP operations and not by the RH-TRU waste characterization program. For the three CCA compliance driven problems (metals, free water, and CPR), the decisions at repository closure are based on total TRU waste inventory (both CH-TRU and RH-TRU), and the RH-TRU waste contribution to the decisions has been shown to be negligible (SNL, 2001). Steps 2 through 6 of the DQO process therefore do not apply to "metals, free water, CPR," and Step 7: Optimize the Design can be directly applied.

- Surface Dose Rate: There are two "questions the study will attempt to resolve" for surface dose rate. If surface dose rate exceeds 1000 rem/h the container cannot be received at the WIPP. If surface dose rate is less than 1000 rem/h but exceeds 100 rem/h there must be notification to enable WIPP operations to load manage to the 5% LWA volume restriction.

- Activity: The decision rule is to stop any further RH-TRU waste shipments once the 5.1 million total curie inventory limit is reached.

Step 3: Identify the Inputs to the Decision

- Surface Dose Rate: Measurements of surface dose rate for each container provide the inputs to enable the surface dose rate decisions.

- Activity: Cumulative total activity information of sufficient quality must be provided to assure, with some level of confidence, that the LWA limit of 5.1 million total curies is not exceeded.

Step 4: Define the Study Boundaries

Simply put, "data" for RH-TRU waste characterization must be collected as long as RH-TRU waste shipments continue up to the time of repository closure.

Step 5: Develop a Decision Rule

- Surface Dose Rate: Single surveys on individual containers are performed for a "go no-go" decision at the high range (1000 rem/h) and for a logical (yes/no) data input at the low range (100 rem/h). Thus there is no "statistical parameter of interest" for surface dose rate. Additionally, WIPP operations has a "stop further receipt of greater than 100 rem/h RH-TRU waste" decision rule if and when 354 cubic meters (5% of 7080 cubic meters) of RH-TRU waste with surface dose rate exceeding 100 rem/h is emplaced in the WIPP.

- Activity: Total activity is also a data collection process that continues, as stated in Step 4, until the repository is closed, or the shipping campaign concludes, or until the 5.1 million curie limit is reached. The "statistical parameter of interest" is each total activity data element (total waste stream activity or individual container total activity) as it is accumulated. However, since this is a data collection activity there is no associated "action level" until the cumulative 5.1 million total curie limit is reached. At that point the WIPP operations has a "stop further receipt of any RH-TRU waste" decision rule. This "action level" and associated statistics are developed in the following Step 6.

Step 6: Specify Tolerable Limits on Decision Errors

- Surface Dose Rate: has no "statistical parameter of interest" and involves a data collection process for which "limits on decision errors" do not apply.

- Activity: The 5.1 million curie LWA limit is a non-technical legal limit for which no decision error has been specified and for which one is not required in the normal technical sense. However the RH-TRU waste program must ensure that the WIPP can receive most of the projected RH-TRU waste in the DOE complex without either exceeding the legal limit or without incorrectly concluding that it has received the legal limit. To provide this assurance the program has established in Appendix 2 that total activity data elements (waste stream total activity or individual container total activity) must be collected with 95% confidence that the value is within a factor of five of the true value. That is:

$$\mathbf{0.2Value_{true} < Value_{data} < 5.0Value_{true}} \qquad \textbf{(95\% confidence level)}$$

Step 7: Optimize the Design

This final step in the DQO process is addressed for all five characterization objectives in the following section.

Characterization Methods

As required by Step 7 of the DQO process, the most effective and efficient method for accomplishing each of the five characterization objectives is presented below:

Metals (ferrous and non-ferrous)

The method for metals was developed and presented previously under "Characterization Objectives." The method of meeting the characterization objective is:

- **For all TRU waste, metals will be tracked and controlled to the minimum limits by counting the number of containers emplaced in the repository and entering this data into the WWIS.**

Free Water

- **Free water will be controlled to the maximum limit utilizing one of three accepted methods: 1) Using AK to show that a waste stream contains less than one percent residual liquids; 2) When AK is lacking, using non-destructive examination (NDE) on a sampling basis to show that a waste stream contains less than one percent residual liquids; 3) When AK and a sampling program are insufficient, using NDE and conservative assumptions to estimate the amount of residual liquid in each container in that waste stream.**

Cellulosics, Plastics, Rubber

The method for CPR was developed and presented previously under "Characterization Objectives." It is repeated here.

- **CPR will be tracked and controlled by determining the Summary Category Group of each waste stream. For every emplaced canister from a S5000 waste stream the WWIS will calculate 50% of the net weight and enter that value as CPR.**

Surface Dose Rate

The method for Surface Dose Rate was developed and presented previously under "Characterization Objectives." It is repeated here.

- **The surface dose rate of each container will be measured. If the dose rate exceeds 1000 rem/h the container is not eligible for receipt at the WIPP. If the dose rate exceeds 100 rem/h (and is less than 1000 rem/h) a notation in a logical field will be made in the WWIS.**

Activity

- **Total RH-TRU waste activity will be quantified to the accuracy specified in Step 6 of the DQO process ($0.2Value_{true} < Value_{data} < 5.0Value_{true}$ at a 95% confidence level) by utilizing one of three accepted methods: 1) Using AK on a waste stream basis; 2) When AK is lacking, using radiological measurements on a sampling basis to arrive at a waste stream total activity value; 3) When AK and a sampling program are insufficient, using radiological measurements to measure the total activity in each container in a waste stream. Total activity will be tracked and controlled using the WWIS.**

Appendix 1

RH TRU Waste Surface Dose Rate Estimates

SITE	SURFACE DOSE RATE ESTIMATES >200 to 1000 mrem/h Packaged%	>1 to 10 rem/h Packaged%	>10 to 100 rem/h Packaged%	>100 to 1000 rem/h Packaged%	>1000 rem/h Packaged%	Comments
HAN	5	40	50	5		Based on previous estimates communicated from the site of estimated packaged dose rates
INEEL	75	12	13			Estimated from site supplied data and original source of material (i.e., ANLE and RFETS)
INTEC		32	63	5		Estimated from site supplied data
LANL		80	20			No Data Available; Due to similarity of function (I.e., fuel examination), same distribution as KAPL assumed
ORNL	10	40	40	10		Based on previous estimates communicated from the site of estimated packaged dose rates
ANLE	50	50				Estimated from site supplied data
ANLW		80	20			Estimated from site supplied data
BCL	22	28	44	6		Estimated from site supplied data
BAPL		80	20			No Data Available; Due to similarity of function, same distribution as KAPL assumed
ETEC	100					Estimated from site supplied data
GE		80	20			No Data Available; Due to similarity of function, same distribution as KAPL assumed
KAPL		80	20			Estimated from site supplied data
Estimated Weighted Dose Rate Average for Package	15	38	43	4		Assumes As-Packaged for Assay with ORNL and new INTEC/INEEL inventories considered. (See Note.)
Estimated Weighted Dose Rate Average for Package	21	40	36	3		Assumes As-Packaged for Assay with only new INEEL inventories considered. INTEC and ORNL canisters will not require assay since they are homogeneous wastes that may be sampled before loading. (See Note.)

NOTE: As-Packaged for Assay assumes that the assay package size will be approximately 55-gallons in size, except for INTEC and ORNL where the assay package size (if assay of package is necessary) will be a RH TRU canister.

Appendix 2

DERIVATION OF ACCEPTABLE UNCERTAINTIES AND CONFIDENCE LEVELS

For the RH-TRU 5.1 Million Curie Total Activity Limit

The TWBIR projects an RH-TRU waste inventory of approximately one million total curies and the WIPP Land Withdrawal Act (LWA) limit on the total activity of RH-TRU waste is 5.1 million curies.

If every quantification of the projected RH-TRU waste total curie inventory is biased high by a factor of five, then the entire projected inventory would be accepted at the WIPP when the cumulative quantifications totaled the LWA limit.

If every quantification of the projected RH-TRU waste total curie inventory is biased low by a factor of five, then five times the projected inventory could be accepted at the WIPP when the cumulative quantifications totaled the LWA limit.

In practice, quantification methods (such as container assays, material disposition records, waste stream analysis) will have far less than a factor of five bias, and errors will tend to be normally distributed (random). Therefore total curies can be tracked as if they are, on average, unbiased. That is, the more quantification that takes place leading to a cumulative total, the more accurate the cumulative total is likely to be. The errors will tend to cancel out, and the WIPP could confidently receive five times the projected RH-TRU waste inventory without exceeding the LWA limit.

A tolerable decision error rate needs to be established to reflect the fact that quantification systems are subject to random errors. Since there is no specified decision error rate, the project has selected a 95% confidence level that a quantification is within a factor of five of the true value. The project has selected this level of confidence because it is consistent with the minimum standard typically set for demonstrating adequate confidence of compliance in other areas of the WIPP's environmental performance[1].

Assuming that systematic bias is minimized, the program *chooses* to limit the acceptable range of quantification error due to remaining random effects to the factors of five identified above and with a 95% confidence level.

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[1] Examples: 40CFR194.34(f), 40CFR194.55(f), 40CFR141.26(i).

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