WIPP WASTE GENERATOR ACCEPTABLE KNOWLEDGE ACCURACY

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) Hazardous Waste Facility Permit (HWFP) requires that acceptable knowledge (AK) accuracy be quantified and reported annually. Four different metrics for determining the accuracy of acceptable knowledge information used to characterize waste have been developed based on the requirements in the HWFP. These principally include container waste stream assignment (one metric) and assignment of Environmental Protection Agency (EPA) hazardous waste numbers (HWNs) (three metrics). Acceptable knowledge accuracy is determined as the result of waste confirmatory activities, including headspace gas sampling and analysis, radiography or visual examination, and solids sampling. The first two confirmatory activities are performed on nearly every container of waste. The last is performed on a representative subset of containers.

Statistics have been compiled based on over 70,000 containers of defense-related transuranic waste that have been characterized and shipped to WIPP through August 2004. These data generally show that acceptable knowledge accuracy is extremely good.

Cumulatively, generator sites have radiographed or visually inspected over 70,000 containers of waste. The waste examination has shown that the acceptable knowledge information is very accurate, with a composite accuracy of over 98 percent with regard to waste matrix code or waste stream reassignments. More than 51,000 containers have been subjected to sampling and analysis to confirm the assignment of HWNs by AK. Accuracy for HWN assignment ranges from 96 percent to over 99 percent. When hazardous waste number reassignment did occur, the change did not result in any actions other than documentary. That is, all such waste still met the WIPP waste acceptance criteria without treatment.

INTRODUCTION

The WIPP HWFP (Ref. 1) requires that AK information be used extensively for waste characterization. Specifically, AK information is used for the following:

- To delineate TRU mixed waste streams
- To assess whether TRU mixed heterogeneous debris wastes exhibit a toxicity characteristic (20.4.1.200 NMAC, incorporating 40 CFR §261.24)
- To assess whether TRU mixed wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR §261.31)

Furthermore, there are numerous places in the HWFP that require confirmation of waste characterization information generated through the AK process. Using these confirmation data,

generator sites are required to determine their AK accuracy as a measure of the effectiveness of their AK program. The HWFP defines accuracy for AK as follows (Ref. 1):

- **Accuracy** - Accuracy is the degree of agreement between an observed sample result and the true value. The percentage of waste containers which require reassignment to a new waste matrix code and/or designation of different hazardous waste codes based on the reevaluation of acceptable knowledge or on obtaining sampling and analysis data will be reported as a measure of acceptable knowledge accuracy.

This requirement is implemented at each generator site through a CBFO-approved TRU waste characterization program. Table I includes a list of generator sites included in this evaluation. The determination of AK accuracy involves the confirmation of AK information using two methods: waste examination through radiography or visual examination (VE) and sampling and analysis using headspace gas sampling and analysis or solids sampling and analysis.

Requirements in the HWFP for confirming AK information can be expressed in terms of AK Accuracy metrics. These are defined below:

Metric 1: Waste Matrix Code (WMC) and waste stream assignment are confirmed using radiography or VE. Each time a container is assigned a new WMC or moved to another waste stream, the reassignment is recorded against AK accuracy.

Metric 2: Toxicity Characteristic Assignment is confirmed by determining a base material that may contain a toxicity characteristic hazardous waste (such as lead) in a waste container through radiography or VE. The presence of the material in a container where it is not expected is counted against AK accuracy.

Metric 3: F-listed solvent assignment is confirmed using headspace gas sampling and analysis. If the ninety percent upper confidence limit (UCL_{90}) concentration of an F-listed solvent exceeds the regulatory threshold established by the HWFP and the solvent has not been identified in the AK record, the HWN is added. The addition is counted against AK accuracy unless the presence of the solvent can be explained as a result of packaging or radiolysis.

Metric 4: If a toxicity characteristic metal, volatile organic compound (VOC), or semi volatile organic compound (SVOC) is detected in the solids portion and the toxicity characteristic HWN was not previously assigned, the HWN will be assigned and counted against AK accuracy.

DATA FOR EVALUATING ACCEPTABLE KNOWLEDGE ACCURACY

Generator sites have procedures for determining AK accuracy. The sites are required to apply the procedures on at least an annual basis. Accuracy reports are collected during annual recertification audits as part of the objective evidence that AK accuracy is routinely evaluated. Because of the timing of the recertification audits throughout the calendar year, AK accuracy reports may be fairly recent, or may be up to a year old. Table I lists the AK accuracy reports that were available for this evaluation and the number of containers that are covered by the reports.

Table I. Acceptable Knowledge Accuracy Reports for Each Site

Generator Site		Date of Most Recent AK Accuracy Report	Number of Containers Included in the Report	
			Sampling & Analysis	Radiography or Visual Examination
Advanced Mixed Waste Treatment Project (AMWTP) (Ref. 2)		August 16, 2004	1,343	9,037
Central Characterization Project/Argonne National Laboratory-East (CCP/ANL-E) (Ref. 3)		October 6, 2003	396	396
Central Characterization Project/Los Alamos National Laboratory (CCP/LANL) (Ref. 4, 5)		April 27, 2004	8	8
Central Characterization Project/Lawrence Livermore National Laboratory (CCP/LLNL) (Ref. 6)		May 5, 2004	5	5
Central Characterization Project/Nevada Test Site (CCP/NTS) (Ref. 7)		September 17, 2003	275	275
Central Characterization Project/Savannah River Site (CCP-SRS) (Ref. 8, 9)		October 13, 2003	5,452	5,452
Hanford (Ref. 10-15)		June 10, 2004 June 16, 2004	960	960
Los Alamos National Laboratory (LANL) (Ref. 16)		September 22, 2003	1,399	1,399
Rocky Flats Environmental Technology site (RFETS) (Ref. 17)	Retrievably Stored (RS)	October 21, 2003	25,252	23,057
	Newly Generated (NG)	October 21, 2003	1,279	3,901
3,100 m^3 Project (Ref. 18)		January 14, 2003	16,351	25,531

		Number of Containers Included in the Report	
Total		51,441	70,021

WASTE MATRIX CODE OR WASTE STREAM REASSIGNMENT

Generator sites report AK accuracy using radiography or VE. The number of containers assigned a new WMC or moved to a new waste stream is reported as a percentage of the total number of containers examined (Metric 1). Table II summarizes the number of containers assigned a different WMC or waste stream. The RFETS has reported VE information for both retrievable stored and newly generated waste. These are broken out as separate entries in Table II.

Table II. Waste Matrix Code Assignments Using Radiography or Visual Examination (Metric 1)

Site		Number Of Containers Examined	Number Of Containers Reassigned	AK Accuracy
AMWTP		9,037	44	99.5%
CCP/ANL-E		396	61	84.6%
CCP/LANL		8	0	100.0%
CCP/LLNL		5	0	100.0%
CCP/NTS		275	0	100.0%
CCP/SRS		5,452	252	95.4%
Hanford		960	0	100.0%
LANL		1,399	9	99.4%
RFETS	RS	18,075 (RTR)	521	97.1%
		4,982 (VE)	13	99.7%
	NG	3,901 (VE)	157	96.0%
3,100 m^3 Project		25,531	159	99.4%
TOTAL		70,021	1216	98.3%

HAZARDOUS WASTE NUMBER REASSIGNMENT

Metrics 2 through 4 reflect changes made to the AK-derived assignment of HWNs to a waste stream. The HWFP requires that AK information be used to apply HWNs to the waste stream during initial characterization and waste stream profile preparation. These are then confirmed by the results of headspace gas sampling and analysis, solids sampling and analysis, and observation of base materials using radiography or VE. Table III summarizes the number of times a generator site changed the toxicity characteristic HWN assignment associated with a container, based on results of radiography or VE (Metric 2). In some cases, the generator noted the base material that may have a toxicity characteristic HWN assigned to it (e.g., a leaded apron). In such instances, the HWN assignment is counted against AK accuracy as required by Metric 2. At RFETS, when radiography resulted in the assignment of a container to a new WMC, the HWN assignment may also have changed to be consistent with the new WMC. In such cases, the assignment of the new WMC is counted against AK accuracy (and is included in Table II

above) however, the change in HWN is not counted against AK accuracy since the new HWNs are changed to be consistent with the new WMC and its associated HWN suite.

Table III. Hazardous Waste Number Changes Made as the Result of Radiography or Visual Examination (Metric 2)

Site		Number Of Containers Examined	Number Of Containers With Changed HWNs	AK Accuracy
AMWTP		9,037	0	100.0%
CCP/ANL-E		396	11	97.2%
CCP/LANL		8	0	100.0%
CCP/LLNL		5	0	100.0%
CCP/NTS		275	0	100.0%
CCP/SRS		5,452	17	99.7%
Hanford		960	0	100.0%
LANL		1,399	0	100.0%
RFETS	RS	23,057	101	99.6%
	NG	3,901	0	100.0%
3,100 m^3 Project		25,531	0	100.0%
TOTAL		70,021	129	99.8%

Table IV is a summary of the number of containers subjected to headspace gas sampling and analysis as reported in the generator sites AK accuracy reports, the number of F-listed HWNs added as a result of this sampling and analysis and the number of containers affected by the assignment (Metric 3).

Table IV. Summary of F-listed Hazardous Waste Number Reassignments as the Result of Headspace Gas Sampling and Analysis (Metric 3)

Generator Site		Number of Containers Evaluated	Number of New Codes Assigned	Number of Containers Reassigned	AK Accuracy
AMWTP		1,343	0	0	100.0%
CCP/ANL-E		396	0	0	100.0%
CCP/LANL		8	0	0	100.0%
CCP/LLNL		5	0	0	100.0%
CCP/NTS		275	0	0	100.0%
CCP/SRS		5,452	0	0	100.0%
Hanford		960	0	0	100.0%
LANL		1,399	0	0	100.0%
RFETS	RS	25,252	3	695	97.2%
	NG	1,279	3	29	97.7%
3,100 m^3 Project		16,351	5	772	95.3%
TOTAL		51,441		1,496	97.1%

Table V summarizes the homogeneous solids waste streams that were characterized and provides instances when a hazardous waste code was added as the result of the sampling and analysis (Accuracy Metric 4).

Table V. Summary of Toxicity Characteristic Hazardous Waste Number Reassignments as the Result of Solids Sampling and Analysis (Metric 4)

Generator Site		Number of Containers in AK Report	Number of New Codes Assigned	Number of Containers Reassigned	AK Accuracy
AMWTP		1,343 (Note 1)	0	0	100.0%
CCP/ANL-E		0	0	0	100.0%
CCP/LANL		4	0	0	100.0%
CCP/LLNL		0	0	0	100.0%
CCP/NTS		0	0	0	100.0%
CCP/SRS		0	0	0	100.0%
Hanford		291	1	291 (Note 2)	0.0%
LANL		0	0	0	100.0%
RFETS	RS	15,058	2	949	93.7%
	NG	3,901	3	29	99.3%
3,100 m^3 Project		11,010	0 (Note 3)	0	100.0%
TOTAL		31,607		1,269	96.0%

Note 1: AMWTP did not perform additional solids sampling.
Note 3: Based on discussion of solids sampling results in a Waste Stream Profile Form submitted after the annual AK Accuracy report was prepared.
Note 2: The 3,100 m^3 Project noted a discrepancy with regard to toxicity characteristic compound (D022) during headspace gas sampling in three solids waste streams. They assigned the HWN although solids sampling did not support the assignment.

There are other items that generator sites report as part of their AK accuracy reports. For example, the 3,100 m^3 Project assigned toxicity characteristic HWNs to debris waste based on the results of headspace gas sampling and analysis or for unspecified reasons as summarized in Table VI. Finding chemicals such as chloroform (D022) in the headspace in concentrations above the established regulatory threshold limits when the AK information does not indicate such presence represents a discrepancy. However, there is little evidence that the discrepancy is associated with the assignment of HWNs. This observation is reinforced by the fact that when D022 was identified in the headspace of homogeneous solids, it was not also detected by the solids sampling.

The permit addresses this situation only for confirmation of F-listed HWN assignments using headspace gas sampling and analysis (Ref. 1). With regard to the "concentration of applicable toxicity characteristic solvents," the HWFP allows removal of such HWNs based on headspace gas sampling and analysis if the concentration in the headspace gas renders the waste non-toxic. The HWFP does <u>not</u> specifically require the addition of toxicity characteristic HWNs based on headspace gas sampling and analysis. This is supported by the discussion in the HWFP regarding the use of solids sampling and analysis and headspace gas sampling and analysis together. The permit states in a parenthetical statement in Section B4-3d, "i.e., a VOC is detected

in the solidified waste but not in the headspace". The use of "i.e." instead of "e.g." in the statement defines a discrepancy as the situation where the compound appears in the solids sample and not in the headspace gas sample. This text also reinforces that toxicity characteristic codes need not be assigned based solely on headspace gas sampling and analysis.

There are other instances where the 3,100 m^3 Project assigned toxicity HWNs as noted in Table VI. This is a conservative application of HWNs by the generator site. The discrepancy is reported in this paper because it affects a large number of containers. However, it is not counted against the AK accuracy because the assignment of codes in this manner is not required by the WIPP HWFP and is not consistent with RCRA HWN assignment practice.

Table VI. Instances Where the 3,100 m^3 Project Assigned a Toxicity Characteristic HWNs to a Waste Stream

Waste Stream Identifier	Summary Category Group	Number Of Containers	HWNs Assigned	Comments
INW169.001	S5000	83	D009	HWN assigned to WSPF. Note that the 3,100 m^3 Project AK Accuracy report is not specific regarding the method by which the D009 code was identified.
INW198.001	S5000	239	D009	HWN assigned to WSPF. Note that the 3,100 m^3 Project AK Accuracy report is not specific regarding the method by which the D009 code was identified.
INW211.001	S5000	1,453	D009	HWN assigned to WSPF. Note that the 3,100 m^3 Project AK Accuracy report is not specific regarding the method by which the D009 code was identified.
INW216.001	S3000	6,018	D022	HWN assigned to WSPF. Note that the WSPF indicates that D022 was assigned based on headspace gas sampling and analysis and Solids Sampling did not detect D022.
INW218.001	S3000	4,650	D032	HWN assigned to WSPF. Solids Sampling did not support the addition of this code.
INW222.001	S3000	342	D022	HWN assigned to WSPF.

Waste Stream Identifier	Summary Category Group	Number Of Containers	HWNs Assigned	Comments
				Note that the WSPF indicates that D022 was assigned based on headspace gas sampling and analysis and Solids Sampling did not detect D022.
INW252.001	S5000	13	D022	HWN assigned to WSPF.
INW276.004	S5000	285	D008, D029, D040	HWN assigned to WSPF.
TOTAL		13,083		All containers counted against AK accuracy by 3,100 m^3 Project.

DISCUSSION

Since the beginning of the WIPP waste characterization program, both the EPA and the New Mexico Environment Department (NMED) have expressed an interest in the reliability of information used by DOE to meet the waste characterization requirements. This interest led both regulatory agencies to require that waste characterization information be confirmed as a means of assuring that information collected was adequate. The data required by the HWFP to be reported by generator sites indicate that the concerns regarding waste characterization accuracy generally and AK accuracy specifically are unfounded.

Clearly, AK information is not perfect; there are a finite number of errors detected in the course of waste characterization. Specifically, over 51,000 containers have been fully characterized resulting in a reassignment of hazardous waste numbers only 4 percent of the time. Likewise, out of over 70,000 containers subjected to radiography or VE, the WMC or waste stream assignment was changed 1.5 percent of the time.

With more than 70,000 containers disposed at WIPP as of the end of calendar year 2004, the use of AK has proven to be effective for characterizing waste. Verification of information collected through the AK process has resulted in generally high AK accuracies as shown in Table VIII.

Table VIII. Overall Results of Waste Characterization Accuracy

Metric	Number Of Containers	AK Accuracy
1. Waste Matrix Code or Waste Stream Reassignment	70,021	98.3%
2. Base Material Toxicity Characteristic Assignment	70,021	99.8%

3. F-listed Solvent Assignment (headspace gas sampling and analysis)	51,441	97.2%
4. Toxicity Characteristic Assignment (solids sampling and analysis)	31,607	96%

Based on these observations, the following can be stated with regard to AK accuracy:

- AK records have been extremely reliable throughout the DOE complex, with regard to the segregation into waste streams.
- AK records have been extremely reliable throughout the DOE complex, with regard to the assignment of waste matrix codes.
- In only a few instances were new HWNs added due to observation of base materials that could exhibit the toxicity characteristic.
- Changes in HWN assignment have not resulted in the identification of HWNs that are not already in the HWFP, thereby rendering a container ineligible to come to WIPP pending a permit modification to add the HWN.
- Only six containers were identified through radiography as ineligible for shipment to WIPP because of a new HWN assignment. All are at RFETS and are associated with identification of free liquids in the waste. The liquids were characterized as prohibited using AK.

CONCLUSION

This paper has shown that the confirmation requirements of the WIPP HWFP using intrusive sampling and analyses have not led to safer management of TRU mixed waste as anticipated by the HWFP. The incidental incremental (additional) knowledge of the waste obtained by these intrusive sampling and analysis methods has not enhanced the protection of human health and environment beyond that already achieved by the combination of AK and the robust waste management practices already inherent in the other RCRA provisions.

This conclusion was recognized more than a year ago, when Congress introduced a specific clause into the 2004 Energy and Water Appropriations Act (Section 311) [19] that called for the elimination of the intrusive sampling and analysis activities that are used to confirm waste characterization. That legislation stipulates:

> (a) The Secretary of Energy is directed to file a permit modification to the Waste Analysis Plan (WAP) and associated provisions contained in the Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant (WIPP). For purposes of determining compliance of the modifications to the WAP with the hazardous waste

> analysis requirements of the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.), or other applicable laws waste confirmation for all waste received for storage and disposal shall be limited to: (1) confirmation that the waste contains no ignitable, corrosive, or reactive waste through the use of either radiography or visual examination of a statistically representative subpopulation of the waste; and (2) review of the Waste Stream Profile Form to verify that the waste contains no ignitable, corrosive, or reactive waste and that assigned Environmental Protection Agency hazardous waste numbers are allowed for storage and disposal by the WIPP Hazardous Waste Facility Permit.
>
> (b) Compliance with the disposal room performance standards of the WAP shall be demonstrated exclusively by monitoring airborne volatile organic compounds in underground disposal rooms in which waste has been emplaced until panel closure.

The accuracy of AK, as demonstrated in this paper, confirms the soundness of the legislated change. As directed by Section 311, DOE submitted the legislatively required permit modification request to the NMED in January 2004. The NMED provided initial feedback on the DOE application on December 30, 2004.

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