



Department of Energy

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2990

MAY 24 2000

Mr. Phillip C. Harris
Ohio Environmental Protection Agency
Division of Hazardous Waste Management
401 East 5th Street
Dayton, OH 45202-2911

DOE-0682-00

Dear Mr. Harris:

DOCUMENTATION SUPPORTING A REVISED RESOURCE CONSERVATION AND RECOVERY ACT HAZARDOUS WASTE DETERMINATION FOR THORIUM HYDROXIDE WASTE

The purpose of this letter is to notify the Ohio Environmental Protection Agency (OEPA) of a revised determination for thorium hydroxide waste and provide documentation supporting this determination. This information was requested in a January 25, 2000, meeting between representatives of the OEPA, Department of Energy, Fernald Environmental Management Project (DOE-FEMP), Fluor Fernald, Inc., and a subsequent phone conversation in February 2000.

The thorium hydroxide waste in question was previously managed as Resource Conservation and Recovery Act (RCRA) hazardous. As the enclosed Process Knowledge Narrative, Sampling and Analysis Narrative, and statistical calculations outline, this waste was reevaluated. The results of this reevaluation determine the thorium hydroxide waste is not RCRA hazardous. Consequently, it is now managed in Material Evaluation File (MEF) 40208 as a RCRA nonhazardous waste.

If you have any questions, or require additional information, please contact Robert Danner at (513) 648-3167.

Sincerely,

Jack R. Craig
Director

Enclosures

Mr. Phillip C. Harris

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MAY 24 2000

cc w/o enclosures:

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March 13, 2000

MEF 40208, rev. 3
MTC: 105 SRC: 364
Ref: Sample Plan Nos.: 95-994, 97-1378, and 97-1408

Sampling and Analysis Narrative

To characterize this waste, three sampling events were conducted: 95-994, 97-1378, and 97-1408.

95-994: thorium hydroxide from overpacked drums in one white metal box (WMB), inventory #W043105, was sampled under this plan in June 1995. The material was analyzed for TC metals, isotopic uranium, free liquids, and percent moisture. Unfortunately, the drums that were sampled did not have complete lot code numbers at that time and analytical results cannot be traced back to individual drums, although the results can be traced to the WMB. Nonetheless, the analytical results indicated the presence of barium above the regulatory threshold (100 ppm TCLP) and consequently the need for further sampling.

97-1378: the purpose of this SAP was to demonstrate the homogeneity within lots of material. Toward this end, thirty-one grab samples were collected for analysis from three randomly chosen lots in April 1997. The material was analyzed for TC metals, Th^{228} , Th^{230} , Th^{232} , Pu^{238} , $\text{Pu}^{239/240}$, gross alpha/beta, and gamma. The 90% upper confidence limit (UCL) for all TC metals was less than the respective regulatory threshold.

97-1408: in June 1997 thirty samples and one duplicate were collected. Each of these thirty samples represented a composite of four initial samples taken of the thorium hydroxide waste (MTC 105). Each of the initial samples was taken from one of the individual lots of the 105 material. In this manner, every lot of 105 material was represented in this sampling event. SAP 97-1408 specified a four-part composite sample strategy. Consequently, where a 90% UCL equals or exceeds one-fourth of the relevant regulatory threshold for a chemical constituent, the lots represented by the composite data point were characterized as RCRA hazardous for that constituent. This is based on a worst case scenario that one of the drums represented in the composite sample could have a concentration of a hazardous constituent that equals or exceeds its respective regulatory threshold and then be diluted by the three other parts of the composite sample. With the exception of barium, all analytes were reported, as a function of the 90% UCL, at a concentration that is at least one order of magnitude below one quarter of their respective regulatory thresholds.

Regulatory Determination

At the time SAP 97-1408 was written, NTS did not accept statistical inference (per USEPA SW-846) for a RCRA determination. As a result, disposal at NTS required individual containers within a population that exceeded a regulatory threshold for a toxicity

characteristic to be declared RCRA hazardous irrespective of the average concentration of the constituent of concern in the whole population. On the basis of this fact and the compositing rationale for SAP 97-1408, the lots represented by a data point for barium exceeding 25mg/L (TCLP) were determined to be hazardous waste under RCRA.

As a result of SAP 97-1408, the original population of 1276 drums was divided into two sub-populations. The inventory determined to be RCRA non-hazardous and characterized by MEF 40208 consists of 934 drums overpacked into WMBs. The inventory determined to be RCRA hazardous and characterized by MEF 40216 consists of 342 drums overpacked into WMBs.

Reevaluation of the RCRA Hazardous Determination (MEF 40216)

In August of 1999, Waste Management (WM) asked Waste Characterization (WC) to review the RCRA hazardous waste determination for the part of the thorium hydroxide waste inventory characterized by MEF 40216. WM felt that the RCRA hazardous determination was based on an overly conservative rationale and that if the thorium hydroxide characterized in MEFs 40208 and 40216 was viewed as one population of waste, there was a reasonable expectation that the population as a whole was RCRA non-hazardous based on existing analytical data.

In conjunction with this request, NTS waste acceptance criteria (WAC) had changed since the original determination. Formerly, as outlined in Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, NVO-325, Revision 1, Section 4.2.3.1, those containers within a waste population exceeding a regulatory threshold for a toxicity characteristic were required to be declared RCRA hazardous for the purpose of disposal at NTS irrespective of the fact the 90 percent upper confidence limit for the average concentration of the constituent of concern in the whole population was below the regulatory threshold. In March 1997 to be consistent USEPA guidance (SW-846), NTS revised its WAC and removed the disposal prohibition for individual containers exceeding the RCRA threshold for a specific analyte as long as the 90 percent upper confidence limit for the average concentration of the analyte in a waste population was below its respective regulatory threshold. As a result a new statistical analysis was performed on the existing analytical data.

Weighted Average Barium Concentration

In order to meet the requirements for a RCRA non-hazardous determination, indicating that the average TCLP limit for barium was not more than 100 ppm, data from the three sampling episodes, described above, were utilized. The following table summarizes the sampling episodes.

Sampling Event	Lots	Sampling Method	Type of Results
95-994 ¹	72, 74	4 samples from 2 lots. Can not trace samples back to specific lot.	4 individual results. ²
97-1378	8, 23, 83	Grab samples from 10 of the 11 drums in the lot.	31 results. ³
97-1408 ⁴	All lots, except 8, 23, 83	1 sample from a drum from 4 different lots. ⁵	4 samples composited and analyzed as 1 sample.

Assumptions

1) The barium concentrations within a lot are homogeneous. Therefore, a sample result is an unbiased estimate of the measure of central tendency (mean or median concentration).

2) With little or no data to the contrary, it is assumed that the composite samples are 'representative' of the average barium concentration of all 4 (or 2) lots. Any differences in the concentrations between lots included in a composite will have been accommodated by the averaging nature of compositing. (i.e. A high or low value will have equal weight in the composite concentration value.

Analysis

The 1997 sampling episodes, 97-1378 and 97-1408, contain data of one form or another from all 117 lots. Additionally, lots 72 and 74 are also represented in the 1995, 95-994, sampling episode. Four samples (and one duplicate) were drawn and analyzed for the 95-994 sampling episode. The samples were taken from lots 72 and 74. Unfortunately, tracking information is insufficient to identify the specific lot the individual samples came from, just that they came from lot 72 or 74.

Since there is data from all 117 lots it can be reasoned that the data represents a 'census' of the population. And since each lot contains approximately the same volume it can further be reasoned that the arithmetic weighted average of sample results, giving each lot equal weight, is an unbiased estimate of the average concentration of all 117 lots.

Based on this reasoning the method of determining the weighted average is as follows:

¹ 95-994-3(D) and 95-994-4(D) were duplicates and were averaged together before any statistical calculations were performed.

² Four results were reported, but one was not used because it was a result of totals analysis and not a TCLP result.

³ Ten results each in lots 8 and 23 – eleven results in lot 83.

⁴ 97-1408-5(D) and 97-1408-6(D) were duplicates and were averaged together before any statistical calculations were performed.

⁵ Exception: sample number 97-1408-30 was a composite of only two samples.

1. For results reported as not detected one half of the detection limit was used in all statistical calculations.
2. Duplicate analytical results were averaged together prior to statistical calculations.
3. Lots 8, 23, and 83 are represented by the average of the ten drum grab samples.
4. All other lots, except lots 72 and 74, are represented by the composite result which included the respective sample. (E.g. Samples from lots 102, 104, 105 and 106 were composited into sample 97-1408-1. Each of the lots (102, 104, 105 and 106) are therefore represented by the result for composite sample 97-1408-1.)
5. Lots 72 and 74 are represented as part of a composite sample (97-1408-12 and 97-1408-13, respectively) from the 1997 data. The 1995 data for lots 72 and 74 include four sample results. In order to weight each sampling episode equally the 1997 data and the 1995 data were given equal weight, one half each. Since the specific lot from which the 1995 samples were taken can not be identified each of the four samples was given a one eighth weight in both lot 72 and 74. Four times one eighth equals one half, therefore, each of the sampling episodes gets equal weight in both lots.
6. A weighted average is simply the sum of each result multiplied by its respective weight and then divided by the sum of the weights. Since each lot is given a total weight of one, this is equivalent to dividing the sum of the results multiplied by their respective weights by the number of lots, 117 (see Attachment A).

The weighted average of the barium concentration in the 117 lots equals 30.86 ppm, well below the TCLP limit of 100 ppm for barium. Unfortunately, the derivation of a confidence interval on the average concentration is not straightforward. The derivation of a confidence interval requires that the data come from a known distribution such as the Normal distribution or the Lognormal distribution, the two most commonly seen distributions with environmental data. Distribution testing using the Shapiro-Wilk procedure indicate that neither the Normal nor the Lognormal distribution can be assumed to be the underlying distribution. Therefore, parametric estimates of confidence intervals are inappropriate and per the "Waste Characterization Requirements Manual" (RM-0053, 4.8.2.3 (d)), a nonparametric approach may be used.

The nonparametric approach deemed most appropriate was the use of the Sign Test (see Attachment B). Through its use, a nonparametric confidence interval that is a distribution-free statistic based on a normal approximation on the ranks of the sample data was developed. The nonparametric 90 percent upper confidence limit (UCL) of the median is 5.4 ppm. Again, well below the 100 ppm threshold.

Based on this analysis, WC concludes that the overall average barium concentration within the 117 lots is well below the TCLP threshold of 100 ppm.

Finally, although no analytical results for arsenic, cadmium, chromium, silver, lead, or mercury were reported at a concentration above the respective regulatory threshold (all results for selenium were reported as non-detects), a weighted average concentration and 90 percent UCL was developed for each these TC metals. The 90 percent UCL for each of these constituents was at least one order of magnitude below the respective regulatory threshold.

Sample ID	FACTS ID	Lot Sequence	Lot Item No.	Weight Factor	Barium	Qual	Arsenic	Qual	Cadmium	Qual	Chromium	Qual	Silver	Qual	QualLead	Qual	Mercury	Qual	Selenium	Qual	Selenium Wt. Factor
97-1408-30	200297682	0001	11	1	0.221	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0018	U	0.22	UJ	1
97-1408-28	200297680	0002	11	1	0.112	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-27	200297679	0003	11	1	0.495	UJ	0.12	UJ	0.014	U	0.03	-	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-25	200297677	0004	11	1	0.297	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.002	U	0.22	UJ	1
97-1408-28	200297680	0005	11	1	0.112	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-25	200297677	0006	11	1	0.297	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.002	U	0.22	UJ	1
97-1408-28	200297680	0007	11	1	0.112	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1378-1	200292874	0008	1	0.1	0.0175	U	1.2	U	0.035	U	0.67	-	0.0575	UJ	0.805	UJ	0.00114	U	0.11	UJ	0.1
97-1378-2	200292875	0008	2	0.1	0.23	U	1.2	U	0.035	U	0.395	-	0.0575	UJ	0.54	UJ	0.00212	U	0.11	UJ	0.1
97-1378-3	200292876	0008	3	0.1	0.655	U	1.2	UJ	0.035	U	0.122	-	0.225	J	0.54	UJ	0.00094	U	0.11	UJ	0.1
97-1378-4	200292877	0008	4	0.1	0.545	U	1.2	UJ	0.035	U	0.525	-	0.0575	UJ	0.54	UJ	0.0024	U	0.11	UJ	0.1
97-1378-5	200292878	0008	5	0.1	0.0175	U	1.2	UJ	0.035	U	0.262	-	0.0575	UJ	0.725	UJ	0.00098	U	0.11	UJ	0.1
97-1378-6	200292879	0008	6	0.1	0.0175	U	1.2	UJ	0.035	U	0.105	-	0.0575	UJ	0.685	UJ	0.00248	U	0.11	UJ	0.1
97-1378-7	200292880	0008	7	0.1	0.0175	U	1.2	UJ	0.035	U	0.428	-	0.0575	UJ	0.54	UJ	0.00122	U	0.11	UJ	0.1
97-1378-8	200292881	0008	8	0.1	0.0175	U	1.2	UJ	0.035	U	0.752	-	0.263	J	0.54	UJ	0.00704	-	0.11	UJ	0.1
97-1378-9	200292882	0008	9	0.1	0.308	U	1.2	UJ	0.035	U	0.31	-	0.0575	UJ	0.54	UJ	0.00302	U	0.11	UJ	0.1
97-1378-10	200292883	0008	10	0.1	0.412	U	1.2	UJ	0.035	U	0.265	-	0.0575	UJ	0.54	UJ	0.0001	U	0.11	UJ	0.1
		0008	avg	1																	1
97-1408-27	200297679	0009	11	1	0.495	UJ	0.12	UJ	0.014	U	0.03	-	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-28	200297680	0010	11	1	0.112	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-29	200297681	0011	11	1	0.164	UJ	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00051	U	0.22	UJ	1
97-1408-29	200297681	0012	11	1	0.164	UJ	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00051	U	0.22	UJ	1
97-1408-29	200297681	0013	11	1	0.164	UJ	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00051	U	0.22	UJ	1
97-1408-29	200297681	0014	11	1	0.164	UJ	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00051	U	0.22	UJ	1
97-1408-25	200297677	0015	11	1	0.297	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.002	U	0.22	UJ	1
97-1408-26	200297678	0016	11	1	0.864	J	0.843	J	0.014	U	0.024	U	0.023	U	0.216	U	0.00074	U	0.22	UJ	1
97-1408-30	200297682	0017	6	1	0.221	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.0018	U	0.22	UJ	1
97-1408-25	200297677	0018	11	1	0.297	UJ	0.12	UJ	0.014	U	0.024	U	0.023	U	0.216	U	0.002	U	0.22	UJ	1
97-1408-26	200297678	0019	11	1	0.864	J	0.843	J	0.014	U	0.024	U	0.023	U	0.216	U	0.00074	U	0.22	UJ	1
97-1408-26	200297678	0020	11	1	0.864	J	0.843	J	0.014	U	0.024	U	0.023	U	0.216	U	0.00074	U	0.22	UJ	1
97-1408-27	200297679	0021	11	1	0.495	UJ	0.12	UJ	0.014	U	0.03	-	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-26	200297678	0022	11	1	0.864	J	0.843	J	0.014	U	0.024	U	0.023	U	0.216	U	0.00074	U	0.22	UJ	1
97-1378-12	200292884	0023	1	0.1	0.282	U	1.2	J	0.035	U	0.2	-	0.0575	UJ	0.54	UJ	0.00206	U	0.11	UJ	0.14285714
97-1378-13	200292885	0023	2	0.1	0.31	U	1.2	J	0.035	U	0.272	-	0.0575	UJ	0.54	UJ	0.0037	U	0.11	UJ	0.14285714
97-1378-14	200292886	0023	3	0.1	0.185	U	1.2	UJ	0.035	U	0.148	-	0.0575	UJ	1.06	UJ	0.00138	U	0.11	UJ	0.14285714
97-1378-15	200292887	0023	4	0.1	0.55	U	1.24	J	0.035	U	0.292	-	0.0575	UJ	0.585	UJ	0.00148	U	0.11	UJ	0.14285714
97-1378-16	200292888	0023	5	0.1	0.0175	U	1.2	UJ	0.035	U	0.06	U	0.0575	UJ	0.54	UJ	0.00052	U	0.11	UJ	0.14285714
97-1378-17	200292889	0023	6	0.1	1.26	U	1.2	UJ	0.035	U	0.06	U	0.0575	UJ	0.54	UJ	0.00462	U	0.11	UJ	0.14285714
97-1378-18	200292890	0023	7	0.1	0.045	U	1.6	J	0.035	U	0.24	-	0.0575	UJ	0.54	UJ	0.0024	U	0.11	UJ	0.14285714
97-1378-19	200292891	0023	8	0.1	0.0175	U	2.3	U	0.035	U	0.08	U	0.288	U	0.54	U	0.0023	U	0.11	R	0
97-1378-20	200292892	0023	9	0.1	0.818	U	2.3	U	0.035	U	0.06	U	0.0575	U	0.54	U	0.00094	U	0.11	R	0
97-1378-21	200292893	0023	10	0.1	0.925	U	2.3	U	0.035	U	0.198	U	0.0575	U	0.595	UJ	0.0044	U	0.11	R	0
		0023	avg	1																	1
97-1408-27	200297679	0024	11	1	0.495	UJ	0.12	UJ	0.014	U	0.03	-	0.023	U	0.216	U	0.0021	U	0.22	UJ	1
97-1408-20	200297672	0025	11	1	1.629	J	0.12	U	0.014	U	0.025	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-19	200297671	0026	11	1	4.41	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00068	U	0.22	UJ	1
97-1408-20	200297672	0027	11	1	1.629	J	0.12	U	0.014	U	0.025	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1

U denotes non-detect result
J denotes estimated result
R denotes unusable result

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Sample ID	FACTS ID	Lot Sequence	Lot Item No.	Weight Factor	Barium	Qual	Arsenic	Qual	Cadmium	Qual	Chromium	Qual	Silver	Qual	QualLead	Qual	Mercury	Qual	Selenium	Qual	Selenium Wt. Factor
97-1408-20	200297672	0028	11	1	1.629	J	0.12	U	0.014	U	0.025	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-20	200297672	0029	11	1	1.629	J	0.12	U	0.014	U	0.025	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-21	200297673	0030	11	1	1.52	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-21	200297673	0031	11	1	1.52	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-21	200297673	0032	11	1	1.52	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-21	200297673	0033	11	1	1.52	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-22	200297674	0034	11	1	0.608	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00023	U	0.22	UJ	1
97-1408-18	200297670	0035	11	1	16	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-19	200297671	0036	11	1	4.41	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00068	U	0.22	UJ	1
97-1408-22	200297674	0037	1	1	0.608	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00023	U	0.22	UJ	1
97-1408-17	200297669	0038	11	1	162.3	-	0.12	UJ	0.014	U	0.024	U	0.033	J	0.216	U	0.0002	U	0.27	UJ	1
97-1408-18	200297670	0039	11	1	16	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-17	200297669	0040	11	1	162.3	-	0.12	UJ	0.014	U	0.024	U	0.033	J	0.216	U	0.0002	U	0.27	UJ	1
97-1408-19	200297671	0041	11	1	4.41	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00068	U	0.22	UJ	1
97-1408-24	200297676	0042	11	1	5.4	J	0.12	UJ	0.014	U	0.084	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-23	200297675	0043	11	1	0.727	J	0.12	U	0.014	U	0.11	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-23	200297675	0044	11	1	0.727	J	0.12	U	0.014	U	0.11	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-22	200297674	0045	11	1	0.608	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00023	U	0.22	UJ	1
97-1408-16	200297668	0046	11	1	12.1	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.224	UJ	1
97-1408-24	200297676	0047	11	1	5.4	J	0.12	UJ	0.014	U	0.084	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-23	200297675	0048	11	1	0.727	J	0.12	U	0.014	U	0.11	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-24	200297676	0049	11	1	5.4	J	0.12	UJ	0.014	U	0.084	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-18	200297670	0050	11	1	16	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-17	200297669	0051	11	1	162.3	-	0.12	UJ	0.014	U	0.024	U	0.033	J	0.216	U	0.0002	U	0.27	UJ	1
97-1408-18	200297670	0052	11	1	16	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-17	200297669	0053	11	1	162.3	-	0.12	UJ	0.014	U	0.024	U	0.033	J	0.216	U	0.0002	U	0.27	UJ	1
97-1408-24	200297676	0054	11	1	5.4	J	0.12	UJ	0.014	U	0.084	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-23	200297675	0055	11	1	0.727	J	0.12	U	0.014	U	0.11	-	0.023	U	0.216	U	0.0002	U	0.22	UJ	1
97-1408-15	200297667	0056	11	1	2.127	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-15	200297667	0057	11	1	2.127	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-13	200297665	0058	11	1	54.33	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-22	200297674	0059	11	1	0.608	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00023	U	0.22	UJ	1
97-1408-19	200297671	0060	11	1	4.41	J	0.12	U	0.014	U	0.024	U	0.023	U	0.216	U	0.00068	U	0.22	UJ	1
97-1408-10	200297662	0061	1	1	114.4	-	0.12	UJ	0.014	U	0.024	U	0.029	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-10	200297662	0062	11	1	114.4	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-14	200297666	0063	11	1	13.58	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-14	200297666	0064	11	1	13.58	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-14	200297666	0065	11	1	13.58	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-14	200297666	0066	11	1	13.58	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-13	200297665	0067	11	1	54.33	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-13	200297665	0068	1	1	54.33	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-11	200297663	0069	11	1	45.79	-	0.12	UJ	0.014	U	0.024	U	0.026	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-11	200297663	0070	11	1	45.79	-	0.12	UJ	0.014	U	0.024	U	0.026	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-11	200297663	0071	11	1	45.79	-	0.12	UJ	0.014	U	0.024	U	0.026	J	0.216	U	0.0002	U	0.22	UJ	1
95-994-3&4(D)	200145883&4	0072	3	0.125	1435.5	J	0.1925	U	0.0675	-	2.3625	-	0.425	J	1.51625	-	0.00011	-	0.0625	U	0.125
95-994-5	200145885/92**	0072	5	0.125	4.205	-	0.175	U	0.07	U	1.385	-	0.21	U	0.415	U	0.00025	-	0.13	U	0.125
95-994-6	200145886/93**	0072	7	0.125	4.68	-	0.16	U	0.07	U	1.78	-	0.21	UJ	2.46	-	0.00026	-	0.07	U	0.125
95-994-7	200145887/94**	0072	8	0.125	0.625	-	0.175	U	0.075	U	1.51	-	0.225	UJ	0.43	U	0.00005	U	0.055	U	0.125
97-1408-12	200297664	0072	11	0.5	272	-	0.12	UJ	0.014	U	0.024	U	0.087	J	0.216	U	0.00071	U	0.22	UJ	0.5
		0072	avg	1																	1

9 U denotes non-detect result
 J denotes estimated result
 R denotes unusable result

Sample ID	FACIS ID	Lot Sequence	Lot Item No.	Weight Factor	Barium	Qual	Arsenic	Qual	Cadmium	Qual	Chromium	Qual	Silver	Qual	Lead	Qual	Mercury	Qual	Selenium	Qual	Factor	
97-1408-12	200297664	0073		11	1	272	-	0.12	UJ	0.014	U	0.024	U	0.087	J	0.216	U	0.00071	U	0.22	UJ	1
95-994-3&4(D)	200145883&4	0074		3	0.125	1435.5	J	0.1925	U	0.0675	-	2.3625	-	0.425	J	1.51625	-	0.00011	-	0.0625	U	0.125
95-994-5	200145885/92**	0074		5	0.125	4.205	-	0.175	U	0.07	U	1.385	-	0.21	U	0.415	U	0.00025	-	0.13	U	0.125
95-994-6	200145886/93**	0074		7	0.125	4.68	-	0.16	U	0.07	U	1.78	-	0.21	UJ	2.46	-	0.00026	-	0.07	U	0.125
95-994-7	200145887/94**	0074		8	0.125	0.625	-	0.175	U	0.075	U	1.51	-	0.225	UJ	0.43	U	0.00005	U	0.055	U	0.125
97-1408-13	200297665	0074		11	0.5	54.33	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	0.5
		0074	avg		1																	1
97-1408-12	200297664	0075		11	1	272	-	0.12	UJ	0.014	U	0.024	U	0.087	J	0.216	U	0.00071	U	0.22	UJ	1
97-1408-12	200297664	0076		11	1	272	-	0.12	UJ	0.014	U	0.024	U	0.087	J	0.216	U	0.00071	U	0.22	UJ	1
97-1408-11	200297663	0077		11	1	45.79	-	0.12	UJ	0.014	U	0.024	U	0.026	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-5&6(D)	200297657	0078		4	1	36.24	J	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-15	200297667	0079		11	1	2.127	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-16	200297668	0080		11	1	12.1	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.224	UJ	1
97-1408-16	200297668	0081		11	1	12.1	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.224	UJ	1
97-1408-15	200297667	0082		11	1	2.127	-	0.12	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1378-23	200292894	0083		1	0.090909091	0.07	U	2.3	UJ	0.06	U	0.06	U	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-24	200292895	0083		2	0.090909091	0.0175	U	2.3	UJ	0.035	U	0.06	U	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-25	200292896	0083		3	0.090909091	1.32	U	2.3	UJ	0.035	U	0.06	U	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-26	200292897	0083		4	0.090909091	0.0175	U	2.3	UJ	0.035	U	0.06	U	0.0575	U	0.542	UJ	0.0002	U	0.11	R	0
97-1378-27	200292898	0083		5	0.090909091	0.0175	U	2.3	UJ	0.035	U	0.988	-	0.11	U	0.54	U	0.0002	U	0.11	R	0
97-1378-28	200292899	0083		6	0.090909091	0.085	U	43	J	0.035	U	0.22	U	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-29	200292900	0083		7	0.090909091	1.04	U	2.3	U	0.035	U	0.215	U	0.0575	U	0.565	U	0.0002	U	0.11	R	0
97-1378-30	200292901	0083		8	0.090909091	0.0175	U	2.3	U	0.035	U	0.965	-	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-31	200292902	0083		9	0.090909091	0.698	U	2.3	U	0.04	U	0.13	U	0.0575	U	0.54	U	0.0002	U	0.11	R	0
97-1378-32	200292903	0083		10	0.090909091	2.27	U	2.3	U	0.035	U	0.102	U	0.095	U	0.628	U	0.0002	U	0.11	R	0
97-1378-33	200292904	0083		11	0.090909091	1.14	U	2.3	U	0.035	U	0.158	U	0.065	U	0.54	U	0.0002	U	0.11	R	0
		0083	avg		1																	0
97-1408-16	200297668	0084		11	1	12.1	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.224	UJ	1
97-1408-9	200297661	0085		11	1	12.55	-	0.128	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.00043	U	0.282	UJ	1
97-1408-10	200297662	0086		11	1	114.4	-	0.12	UJ	0.014	U	0.024	U	0.029	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-5&6(D)	200297657	0087		11	1	36.24	J	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-10	200297662	0088		11	1	114.4	-	0.12	UJ	0.014	U	0.024	U	0.029	J	0.216	U	0.0002	U	0.22	UJ	1
97-1408-2	200297654	0089		11	1	2.569	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-5&6(D)	200297657	0090		11	1	36.24	J	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-4	200297656	0091		11	1	55.17	-	0.12	UJ	0.014	U	0.031	-	0.023	UJ	0.216	U	0.0002	U	0.606	UJ	1
97-1408-4	200297656	0092		11	1	55.17	-	0.12	UJ	0.014	U	0.031	-	0.023	UJ	0.216	U	0.0002	U	0.606	UJ	1
97-1408-3	200297655	0093		11	1	3.739	-	0.12	UJ	0.014	U	0.032	-	0.023	UJ	0.216	U	0.0002	U	0.43	UJ	1
97-1408-3	200297655	0094		11	1	3.739	-	0.12	UJ	0.014	U	0.032	-	0.023	UJ	0.216	U	0.0002	U	0.43	UJ	1
97-1408-2	200297654	0095		5	1	2.569	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-2	200297654	0096		11	1	2.569	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-3	200297655	0097		11	1	3.739	-	0.12	UJ	0.014	U	0.032	-	0.023	UJ	0.216	U	0.0002	U	0.43	UJ	1
97-1408-4	200297656	0098		11	1	55.17	-	0.12	UJ	0.014	U	0.031	-	0.023	UJ	0.216	U	0.0002	U	0.606	UJ	1
97-1408-5&6(D)	200297657	0099		11	1	36.24	J	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-3	200297655	0100		11	1	3.739	-	0.12	UJ	0.014	U	0.032	-	0.023	UJ	0.216	U	0.0002	U	0.43	UJ	1
97-1408-2	200297654	0101		11	1	2.569	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-1	200297653	0102		11	1	0.873	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-7	200297659	0103		11	1	32.65	-	0.12	U	0.014	U	0.024	U	0.034	J	0.216	U	0.00033	U	0.22	UJ	1
97-1408-1	200297653	0104		11	1	0.873	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-1	200297653	0105		1	1	0.873	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-1	200297653	0106		11	1	0.873	-	0.12	U	0.014	U	0.024	U	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1

U denotes non-detect result
J denotes estimated result
R denotes unusable result

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Sample ID	FACTS ID	Lot Sequence	Lot Item No.	Weight Factor	Barium	Qual	Arsenic	Qual	Cadmium	Qual	Chromium	Qual	Silver	Qual	QualLead	Qual	Mercury	Qual	Selenium	Qual	Selenium Wt. Factor
97-1408-7	200297659	0107	11	1	32.65	-	0.12	U	0.014	U	0.024	U	0.034	J	0.216	U	0.00033	U	0.22	UJ	1
97-1408-9	200297661	0108	11	1	12.55	-	0.128	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.00043	U	0.282	UJ	1
97-1408-8	200297660	0109	11	1	0.88	-	0.12	U	0.014	U	0.042	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-8	200297660	0110	11	1	0.88	-	0.12	U	0.014	U	0.042	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-8	200297660	0111	11	1	0.88	-	0.12	U	0.014	U	0.042	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-4	200297656	0112	11	1	55.17	-	0.12	UJ	0.014	U	0.031	-	0.023	UJ	0.216	U	0.0002	U	0.606	UJ	1
97-1408-8	200297660	0113	11	1	0.88	-	0.12	U	0.014	U	0.042	-	0.023	UJ	0.216	U	0.0002	U	0.22	UJ	1
97-1408-9	200297661	0114	11	1	12.55	-	0.128	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.00043	U	0.282	UJ	1
97-1408-7	200297659	0115	11	1	32.65	-	0.12	U	0.014	U	0.024	U	0.034	J	0.216	U	0.00033	U	0.22	UJ	1
97-1408-9	200297661	0116	11	1	12.55	-	0.128	UJ	0.014	U	0.024	U	0.023	UJ	0.216	U	0.00043	U	0.282	UJ	1
97-1408-7	200297659	0117	6	1	32.65	-	0.12	U	0.014	U	0.024	U	0.034	J	0.216	U	0.00033	U	0.22	UJ	1

U denotes non-detect result
J denotes estimated result
R denotes unusable result

Attachment B

Sign Test

This procedure tests the hypothesis that at least 50 percent of the lots have average concentrations greater than the TCLP Limit with a 90% level of confidence. In other words, determine whether the median (a nonparametric estimate of the midpoint of the data) concentration for all 117 lots is greater than the TCLP Limit with a 90% level of confidence. If 50 percent or more of the lots had average contaminant levels greater than the TCLP Limit it would be likely that the overall average level would be greater than the TCLP Limit indicating a failure to meet the TCLP requirement. Conversely, if fewer than 50 percent of the lots had contaminant levels greater than the TCLP Limit it would be likely that the overall average level would be less than the TCLP Limit, thus meeting the TCLP Limit requirement. The Sign Test is a specific variant of the Binomial Test and exact probabilities have been developed to assess the confidence level on test of the hypothesis for smaller data sets. For larger data sets, a normal approximation formula is used to determine approximate probabilities.

The Sign Test method is used in three situations: 1) when there are fewer than approximately 15% non-detects and the t-Test cannot be used reliably (i.e., the data distribution significantly diverge from the normal or lognormal distribution) and there is significant evidence of a lack of symmetry in the distribution of the data, 2) when the percentage of non-detects range from 15% to 50% and there is significant evidence of a lack of symmetry in the distribution of the data, or, 3) when greater than 50 percent of the data are reported as non-detects. Traditional methods (e.g., t-Test) require data results above the detection limit to calculate the test statistic, where as the Sign Test only requires that the result be discernible from the TCLP Limit. If the detection limit is below the TCLP Limit, the Sign Test can be used to determine whether the midpoint of the data (a nonparametric surrogate for the mean) is above the TCLP Limit with a specified level of confidence. The test method is robust to wide data variations and large percentages of non-detects (assuming the detection level is below the TCLP Limit). The method does not require any prior knowledge of the underlying distribution or that the data be symmetrically distributed.

Under the hypothesis that the percentage of lot average concentration exceeds the TCLP Limit is greater than 50 percent, the one sample Sign Test is applied as follows. The test statistic, $S+$, is the number of lot average measurements (n) reported as greater than the TCLP Limit (i.e., positive differences). The magnitude of the positive (or negative) differences are not considered; only the signs. Any result equal to the TCLP Limit is dropped from the data set and n is reduced by one. The number of results greater than the TCLP Limit ($S+$) are counted and compared to a table of percentiles for the binomial distribution at $p = 0.5$ (the median is the 50th percentile), which can be found in many basic statistics texts (for exact probabilities) or against a critical values table for simple pass or fail determination. It must be noted that most sign test tables show two-tailed percentage points. Since the determination of meeting the TCLP Limit is a one-sided test (i.e. is the median greater than the TCLP Limit), the reference probability point should be double that of the pre-specified confidence level. For example, if the pre-specified

confidence level is 5 percent, the reference probability point should be 10 percent (5 percent above and 5 percent below). When using a binomial table no adjustment is required. The given probabilities are given as cumulative probabilities which are one-sided probabilities.

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