

May 21, 2012

Mr. Gene Bonano
 U.S. Nuclear Regulatory Commission
 Region III
 2443 Warrenville Road
 Lisle, IL 60532-4351

SUBJECT: ORISE CONTRACT NO. DE-AC05-06OR23100
LETTER REPORT FOR ANALYTICAL RESULTS FOR FIVE SOIL AND TWO
SEDIMENT SAMPLES FROM THE MALLINCKRODT PLANT, ST. LOUIS,
MISSOURI
[INSPECTION NO. 04006563/2011003] (RFTA NO. 12-001)
DCN: 5166-LR-02-0

Dear Mr. Bonano:

The Oak Ridge Institute for Science and Education (ORISE) received five soil and two sediment samples on May 2, 2012 from the Mallinckrodt Plant in St. Louis, Missouri. The samples were analyzed according to the NRC Form 303 supplied with the samples. Uranium-234 (U-234) cannot be measured by gamma spectroscopy under normal conditions. Therefore, the U-234 is assumed to be in secular equilibrium with the measureable uranium-238 since the samples have naturally occurring isotopic ratios. The sample identification numbers are presented in Table 1 and the gamma spectroscopy results for the requested radionuclides are provided in Table 2. The formulas used to calculate total uranium and total thorium are shown as a footnote in Table 2. The pertinent procedure references are included with the data tables. A case narrative is included for clarification of the analysis of the two sediment samples.

ORISE's Quality Control (QC) requirements were met for these analyses. The QC files are available for your review upon request.

My contact information is listed below. You may also contact Dale Condra at 865.241.3242 with any questions or comments.

Sincerely,





 Wade Ivey, Manager
 Laboratory

WPI:RDC:km

Enclosures

c: T. Carter, NRC/FSME/DWMEP T-8F5
 S. Nesmith, NRC/FSME/PBPA/TWFN 8A23

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Distribution approval and concurrence:	Initials
Technical Review	
Quality Review	
Group Manager Review	

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CASE NARRATIVE

Two sediment samples were received in one liter plastic containers on May 2, 2012 from the Mallinckrodt site. The samples were classified as a water/soil mixture on NRC Form 303A. From an email dated May 3, 2012, Gene Bonano of the NRC instructed the lab to filter the samples to separate the liquid from the solid fraction and to report both fractions (as activity per unit dry mass for the solid fraction and activity per unit volume for the liquid fraction) for the requested gamma emitting radionuclides as described on NRC Form 303.

After filtration, it was determined that the quantity of liquid in both sediment samples was not large enough to fill the lab's smallest liquid counting geometry (250mL) for gamma spectroscopy. Sample M-12-1-06 had a volume of 185mL and sample M-12-1-07 had a volume of 155mL. This was communicated to the NRC and it was agreed upon (per an email dated May 7, 2012) that the liquid fraction would be counted twice by gamma spectroscopy. The first count used the original volume of sample and the data is qualified. The second count was performed on each sample after diluting to 250mL with deionized water to achieve the minimum sample quantity needed for a calibrated counting geometry. The quantified data from the second count is based on the original sample volume.

TABLE 1
SAMPLE IDENTIFICATIONS
AND COLLECTION INFORMATION
MALLINCKRODT PLANT
ST. LOUIS, MISSOURI

ORISE Sample ID	NRC Region III Sample ID	Collection Date	Collection Time
5166S0004	M-12-1-01	4/26/2012	10:36 AM
5166S0005	M-12-1-02	4/26/2012	10:40 AM
5166S0006	M-12-1-03	4/26/2012	10:46 AM
5166S0007	M-12-1-04	4/26/2012	11:06 AM
5166S0008	M-12-1-05	4/26/2012	11:11 AM
5166S0009	M-12-1-06 (solid)	4/26/2012	10:56 AM
5166S0010	M-12-1-07 (solid)	4/26/2012	10:59 AM
5166W0001	M-12-1-06 (water)	4/26/2012	10:56 AM
5166W0002	M-12-1-07 (water)	4/26/2012	10:59 AM

TABLE 2
CONCENTRATIONS OF SELECTED GAMMA EMITTERS
IN SOIL AND WATER SAMPLES
BY GAMMA SPECTROSCOPY CP1, REVISION 17
MALLINCKRODT PLANT
ST. LOUIS, MISSOURI

ORISE Sample ID	NRC Region III Sample ID	Radionuclide Concentrations, TPU ^a , and MDCs ^b (pCi/g) ^c					
		Th-228 by Pb-212	Th-232 by Ac-228	Th-230	Ra-226 by Pb-214	Pb-210	Total Th ^d
5166S0004	M-12-1-01	0.90 ± 0.09 , 0.08	0.95 ± 0.16 , 0.16	-0.3 ± 7.2 , 14.0	0.92 ± 0.09 , 0.09	1.21 ± 0.36 , 0.75	1.85 ± 0.18
5166S0005	M-12-1-02	3.60 ± 0.26 , 0.14	4.32 ± 0.44 , 0.23	8.0 ± 6.5 , 15.0	7.84 ± 0.43 , 0.13	12.7 ± 1.0 , 1.1	7.92 ± 0.51
5166S0006	M-12-1-03	2.99 ± 0.23 , 0.16	2.88 ± 0.35 , 0.32	14.8 ± 8.9 , 21.0	6.45 ± 0.38 , 0.18	6.38 ± 0.83 , 1.40	5.87 ± 0.42
5166S0007	M-12-1-04	0.94 ± 0.08 , 0.07	1.00 ± 0.14 , 0.13	0.4 ± 5.7 , 11.0	0.87 ± 0.07 , 0.06	1.13 ± 0.28 , 0.57	1.94 ± 0.16
5166S0008	M-12-1-05	1.00 ± 0.08 , 0.07	1.00 ± 0.14 , 0.13	-0.2 ± 5.7 , 11.0	1.18 ± 0.09 , 0.07	1.24 ± 0.31 , 0.64	2.00 ± 0.16
5166S0009	M-12-1-06 (solid)	2.48 ± 0.19 , 0.12	2.58 ± 0.31 , 0.30	13.1 ± 8.6 , 20.0	8.19 ± 0.46 , 0.15	6.57 ± 0.86 , 1.60	5.06 ± 0.36
5166S0010	M-12-1-07 (solid)	1.90 ± 0.15 , 0.11	2.19 ± 0.25 , 0.18	3.4 ± 6.0 , 14.0	4.48 ± 0.26 , 0.10	6.66 ± 0.66 , 0.94	4.09 ± 0.29
5166W0001 ^e	M-12-1-06 (water)	5 ± 12 , 28	-30 ± 30 , 76	700 ± 590 , 1,400	54 ± 16 , 34	-10 ± 86 , 210	-25 ± 32
5166W0001	M-12-1-06 (water)	10.5 ± 8.1 , 19.0	-26 ± 21 , 53	690 ± 430 , 980	11 ± 11 , 26	-10 ± 63 , 150	-16 ± 23
5166W0002 ^e	M-12-1-07 (water)	25.5 ± 9.4 , 21.0	42 ± 51 , 84	700 ± 820 , 1,900	23 ± 16 , 38	-48 ± 100 , 240	68 ± 52
5166W0002	M-12-1-07 (water)	15.7 ± 5.9 , 13.0	8 ± 32 , 51	480 ± 450 , 1,100	5 ± 10 , 23	5 ± 63 , 150	24 ± 33

ORISE Sample ID	NRC Region III Sample ID	Radionuclide Concentrations, TPU ^a , and MDCs ^b (pCi/g) ^c			
		K-40	U-238 by Th-234	U-235	Total U ^f
5166S0004	M-12-1-01	13.0 ± 1.2 , 0.8	2.07 ± 0.52 , 1.10	0.04 ± 0.10 , 0.25	4.2 ± 1.0
5166S0005	M-12-1-02	11.52 ± 0.94 , 0.74	10.4 ± 1.0 , 1.5	0.37 ± 0.18 , 0.40	21.2 ± 2.0
5166S0006	M-12-1-03	12.9 ± 1.2 , 1.0	8.1 ± 1.0 , 1.9	0.42 ± 0.20 , 0.47	16.6 ± 2.0
5166S0007	M-12-1-04	16.6 ± 1.2 , 0.5	1.22 ± 0.35 , 0.74	0.00 ^g ± 0.17 , 0.28	2.44 ± 0.72
5166S0008	M-12-1-05	16.2 ± 1.2 , 0.5	1.62 ± 0.36 , 0.74	0.07 ± 0.18 , 0.29	3.31 ± 0.74
5166S0009	M-12-1-06 (solid)	14.3 ± 1.2 , 1.0	23.5 ± 1.9 , 2.0	1.19 ± 0.19 , 0.36	48.2 ± 3.8
5166S0010	M-12-1-07 (solid)	15.4 ± 1.2 , 0.6	9.97 ± 0.91 , 1.20	0.46 ± 0.14 , 0.30	20.4 ± 1.8
5166W0001 ^e	M-12-1-06 (water)	90 ± 150 , 350	-200 ± 100 , 260	17 ± 31 , 73	-383 ± 202
5166W0001	M-12-1-06 (water)	-80 ± 110 , 260	-90 ± 80 , 200	-10 ± 23 , 56	-190 ± 162
5166W0002 ^e	M-12-1-07 (water)	210 ± 170 , 390	65 ± 97 , 230	-49 ± 54 , 92	81 ± 201
5166W0002	M-12-1-07 (water)	28 ± 100 , 240	10 ± 60 , 140	18 ± 16 , 37	38 ± 121

^aUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^bMDCs are after the commas

^cUnits are pCi/L for the two water fractions from samples M-12-1-06 and M-12-1-07.

^dTotal thorium is calculated using Th-228 + Th-232 for natural thorium.

^eData as sample was received and is qualified because sample quantity did not have a calibrated counting geometry.

^fTotal uranium is calculated using U-238*2 + U-235 for natural uranium.

^gZero value is due to rounding or sample and background count rates being equal.