Mallinckrodt LLC

March 25, 2013

U.S. Nuclear Regulatory Commission
Document Control Desk
Two White Flint North Building
11545 Rockville Pike
Washington, DC 20555
Attn: John Buckley

RE: Mallinckrodt C-T Demolition & Decommissioning (D&D), License Number STB-401
Authorization to Dispose Unimportant Quantity of Material

Dear Mr Buckley:

Mallinckrodt LLC (MI) is requesting NRC approval for the disposal of the resin and activated carbon tanks and media at the Wayne Disposal Inc. (WDI) landfill in Belleville an Unimportant Quantity material. The Material was used to in the water filtering system to process storm water and groundwater collected from the open excavations during the C-T Phase II D&D project at the Mallinckrodt facility located at 3600 N Second Street in St. Louis, Missouri. A total of 6 tanks containing approximately 370 cubic feet of media will be shipped for disposal at WDI pending approval from both the NRC and the State of Michigan in accordance with Section 12.1.6 of the Decommissioning Plan (DP).

A waste assessment has been performed to ensure the material meets the waste acceptance criteria for WDI as well as the requirements of the DP for disposal of unimportant quantities of material associated with the decommissioning project. A copy of this assessment is provided as an attachment to this request. As demonstrated in the assessment, this media meets the requirement for disposal at WDI provided both the NRC and the State of Michigan approve the transfer. Once approved, Mallinckrodt with the assistance of Energy*Solutions* will ship the material for disposal pending acceptance by WDI.

If you have any questions or require additional information, you may contact me at 314-654-5838 or Mr. Michael Carr (Energy*Solutions*) at 865-425-4587 (office), 865-250-2149 (cell) or via email at mcarr@energysolutions.com.

Respectfully,

Karen Burke

Karen Burke, RSO

Cc: Mark Cambra, PE, PM (Energy*Solutions*)
Michael Carr, CHP, RSO (Energy*Solutions*)
Wayne Disposal Inc.
Enc: Waste Assessment Memo

Memorandum

To: Mark Cambra

From: Michael Carr, CHP 3-14-2013

Date: March 14, 2013

Subject: Waste Assessment – Mallinckrodt Resin and Activated Carbon

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This waste assessment supports the disposal of the activated carbon and resin media from the Mallinckrodt Decommissioning Project in St. Louis, MO at the Wayne Disposal, Inc (WDI) landfill in Belleville, MI. The State of Michigan's Department of Natural Resources and Environment (MDNRE) has approved WDI to accept soils and other debris containing very low concentrations of radioactive materials in accordance with the MDNRE letter to the Director of Operations for Michigan Disposal Inc and WDI dated August 4, 2010.

As specified in the referenced letter, WDI may accept low level radioactive materials such that the average concentration in a shipment does not exceed the levels as specified in Table 1 as attached. Individual pockets of material may exceed the concentration limits up to a factor of 3 provided the concentration of all radionuclides in the shipment does not exceed the limits as specified in the Table.

Section 12.1.6 of the Mallinckrodt Decommissioning Plan (DP), *Waste Disposition*, as approved by the USNRC, states that soil, debris and other materials generated during Phase II of the decommissioning containing more than an unrestricted concentration and less than an "unimportant quantity" of source material as defined in 10CFR40.13 will be disposed in accordance with an NRC-authorized transfer to a disposal facility, subject to the approval from the cognizant State regulatory agency(ies) in which the disposal facility is located. If waste materials contain greater than an unimportant quantity of source material, it will be disposed at an NRC-regulated disposal facility.

As defined by 10CFR40.13(a), an "unimportant quantity" of material is source material in any chemical mixture, compound, solution or alloy in which the source material is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution or alloy. This exemption does not include byproduct materials. Source material consists of Uranium and Thorium or any combination thereof and their associated progeny.

During the Phase II decommissioning at the Mallinckrodt facility, water from within the active excavations were controlled, processed through filter media, sampled and released to the St. Louis Municipality Sewer District. As a result of the water filtering, source materials were concentrated on the filter media including activated carbon and anion/cation resins. Upon completion of water processing, these tanks were dewatered and sampled to assess the radionuclide concentrations on the filter media. A total of 8 samples were collected from the 6 filter tanks (2 activated carbon and 4 resin tanks). A summary of the sample results is provided in Table 2 including the average activities over the 6 tanks assuming the media volume and density is consistent across all 6 tanks. As demonstrated by the sample analyses, the average activities across the shipment are less than the WDI's Waste Acceptance Criteria (WAC) with no individual samples exceeding 3 times the limits.

Although the material meets the WDI WAC as defined, it must also be demonstrated that the waste stream is considered and unimportant quantity of source materials by the US NRC. The sample activities from the filter tanks were multiplied by the specific activity for each radionuclide of concern and summed on a per gram waste basis. The maximum concentration of source material over the samples collected was 0.031 percent. As defined in 10CFR40.13(a), this material is considered an unimportant quantity as it is less than 0.05 percent. As a result, the filter media would be considered an unimportant quantity. A summary of this calculation is provided as Table 3.

Energy*Solutions* will ensure the filter tanks are fully dewatered and adsorbent added to the tanks to absorb any residual water that may separate during transit. The 6 tanks will be loaded on a single conveyance constituting a single shipment to WDI for disposal pending approval by both the US NRC and the MDNRE.

Attachments:

1) August 4, 2010 MDNRE letter to Michigan Disposal Inc and WDI
2) Filter media sample analyses

Table 1
WDI Waste Acceptance Criteria - Radionuclides

Radionuclide	Concentration Limit (pCi/gram)
^{238}U	**75**
^{234}U	75
^{230}Th	75
^{226}Ra	**50**
^{210}Pb	50
^{210}Po	50
^{235}U	4
^{231}Pa	4
^{227}Ac	4
^{232}Th	**13**
^{228}Ra	13
^{228}Th	13

Table 2
On-Site Sample Analyses - Comparison to WDI Waste Acceptance Criteria

Tank	Media	Sample Location	^{232}Th pCi/gram	^{238}U pCi/gram	^{226}Ra pCi/gram
1	Activate Carbon	Top (Inlet)	1.14	3.02	4.92
2	Activate Carbon	Top (Inlet)	1.78	4.21	8.68
3	Uranium Tank - Resin	Top (Inlet)	1.01	100.54 [b]	20.19
3	Uranium Tank - Resin	Middle	0.39 [a]	102.68 [a, b]	20.29 [a]
3	Uranium Tank - Resin	Top (Inlet)	0.10 [a]	93.35 [a, b]	19.20 [a]
4	Uranium Tank - Resin	Top (Inlet)	0.42	18.77	4.23
5	Radium/Thorium Tank -Resin	Top (Inlet)	1.72	3.97	8.92
6	Radium/Thorium Tank -Resin	Top (Inlet)	2.33	1.73	9.97
Average [c, d]			**1.40**	**22.04**	**9.49**

a Not included in the average. Both samples from Tank 3 are consistent. Sample excluded to eliminate skewing the data average.

b Less than 3x the WDI WAC limit specified in Table 1.

c Average values assume the same volume and density of material across all 6 tanks. The 4 resin tanks are of the same model and size while the activated carbon tanks are slightly larger.

d Average values across the waste stream are below the WDI WAC limits as specified in Table 1.

Table 3
Unimportant Quantity Assessment

Tank	Activity		Specific Activity		Source weight per gram of material		Unimportant Quantity [a]	
	^{232}Th pCi/g	^{238}U pCi/g	^{232}Th Ci/g	^{238}U Ci/g	^{232}Th g/g	^{238}U g/g	Total g/g	Percent %
1	1.14	3.02	1.10E-07	3.40E-07	1.03E-05	8.88E-06	1.92E-05	0.0019%
2	1.78	4.21	1.10E-07	3.40E-07	1.62E-05	1.24E-05	2.86E-05	0.0029%
3	1.01	100.54	1.10E-07	3.40E-07	9.18E-06	2.96E-04	3.05E-04	0.0305%
3	0.39	102.68	1.10E-07	3.40E-07	3.54E-06	3.02E-04	3.06E-04	0.0306%
3	0.10	93.35	1.10E-07	3.40E-07	8.79E-07	2.75E-04	2.75E-04	0.0275%
4	0.42	18.77	1.10E-07	3.40E-07	3.80E-06	5.52E-05	5.90E-05	0.0059%
5	1.72	3.97	1.10E-07	3.40E-07	1.56E-05	1.17E-05	2.73E-05	0.0027%
6	2.33	1.73	1.10E-07	3.40E-07	2.11E-05	5.10E-06	2.62E-05	0.0026%

a Unimportant quantity upper limit is 0.05% per 10CFR40.13(a). All sample results are less than the limit and are considered to be unimportant quantities per the US NRC.

Waste Assessment Memo
Attachment 1

August 4, 2012 Letter to Michigan Disposal Inc and WDI

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

REBECCA A. HUMPHRIES
DIRECTOR

August 4, 2010

Mr. Kerry M. Durnen, P.E.
Director of Operations
Michigan Disposal, Inc. and Wayne Disposal, Inc.
49350 North I-94 Service Drive
Belleville, Michigan 48111-1854

Dear Mr. Durnen:

SUBJECT: Disposal of Certain Radioactive Material at Wayne Disposal, Inc.; MID 048 090 633

Wayne Disposal, Inc. (WDI) has proposed accepting, for disposal at their facility, soils and other debris containing very low concentrations of radioactive material not meeting other criteria in their Waste Analysis Plan.

In support of this proposal, WDI has submitted two documents:

1. "Revised Dose Assessment for Occupational Workers at the Wayne Disposal Landfill," dated June 27, 2010; and
2. "Dose Assessment for the Wayne Disposal Inc. Landfill," dated July 2, 2010, with the following items dated June 13, 2010: Figures 6.1 to 6.4; Appendices 7.1 to 7.5 and 7.7; and the Appendix 7.8 MicroShield computer model.

The State of Michigan regulates radioactive material pursuant to Part 135, Radiation Control, of Michigan's Public Health Code, 1978 PA 368, as amended (Act 368), being Sections 333.1101 to 333.25211 of the Michigan Compiled Laws, and the radiation control administrative rules promulgated thereunder, being R 325.5001 *et seq.* of the Michigan Administrative Code. In Michigan, the U.S. Nuclear Regulatory Commission (NRC) regulates source, byproduct, and special nuclear materials under the Atomic Energy Act of 1954, as amended, and the regulations in Title 10 of the Code of Federal Regulations (10 CFR).

WDI has been issued a Hazardous Waste Management Facility Operating License (License) pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, being Sections 324.11101 to 324.11153 of the Michigan Compiled Laws, and the hazardous waste management administrative rules promulgated thereunder, being R 299.9101 *et seq.* of the Michigan Administrative Code, by the Department of Natural Resources and Environment (DNRE).

The DNRE, Environmental Resource Management Division (ERMD), Radiological Protection Program (RPP), has reviewed the proposal. Based on the dose assessments, the requirements of the Part 111 License and associated administrative rules, and the requirements of Act 368 and associated administrative rules, the DNRE has determined that the disposal is authorized by law and will not result in undue hazard to public health and safety or property, under the following conditions:

1. WDI may not accept any high-level or low-level radioactive waste or any radioactive material generally licensed under 10 CFR, Sections 31.7, 31.10, 31.12, or 40.22. WDI may not accept any material that would require WDI to have a specific or a general radioactive material license from the NRC.

2. Before the first shipment of material to WDI, WDI shall submit information to the RPP describing the physical and radiological properties of the material, the site history, the expected volume, a certification from the generator that the material meets the conditions in this letter, and other information sufficient to allow the RPP to determine if the material can be accepted at WDI. WDI shall submit this information to the RPP for approval for each site from which WDI wants to accept material.

3. Pursuant to its authority over all radioactive materials at WDI, the RPP may, in the approval letter or at any time, impose additional requirements or conditions, or both, on the receipt, processing, analysis, storage, or disposal of these materials as may be necessary to ensure the health and safety of workers, protection of the environment, and compliance with any applicable rules, regulations, and statutes.

4. If WDI becomes aware of radioactive materials not identified in any materials' characterization or manifest that are present in materials received or buried at the site, WDI shall maintain a record of these and shall, within the next business day, notify the RPP of the materials not specifically approved. The RPP will determine appropriate corrective actions to be taken at the facility, up to and including removal of the material.

5. The average radioactivity concentration in a shipment may not exceed the following:

Table 1

Nuclide	Concentration (pCi/gm)
U-238	75
U-234	75
Th-230	75
Ra-226	50
Pb-210	50
Po-210	50
U-235	4
Pa-231	4
Ac-227	4
Th-232	13
Ra-228	13
Th-228	13

6. In a shipment, individual pockets of material may exceed the concentration limits in Table 1 for the radionuclides present by a factor of three if the average concentration of all radionuclides in the shipment does not exceed the limits in Table 1.

7. WDI shall maintain on file a record of the maximum radiation portal monitoring reading for each vehicle entering WDI transporting the material.

8. WDI shall collect a random sample from 1 shipment out of every 20 shipments from each waste stream from each generator authorized by the RPP. Specific locations will be sampled by taking surface and subsurface grab samples from the shipment. At least one grab sample per ten cubic yards of material is required. The grab samples will be composited to provide a representative sample of the shipment. WDI shall have the samples analyzed using gamma spectroscopy including uranium-238, uranium-235, thorium-232, radium-226, and radium-228. WDI shall compare the results of this analysis to Table 1. If the results exceed Table 1, WDI shall contact the generator and try to resolve the discrepancy. If the results cannot be reconciled, WDI shall cease accepting the waste stream until the discrepancy can be resolved. WDI shall keep all records from the random sampling program for review by the RPP.

9. During emplacement of the waste, WDI shall have ambient air monitoring filters analyzed for radionuclides in accordance with a plan approved by the RPP.

10. During and after emplacement of the waste, WDI shall have leachate samples analyzed for radionuclides in accordance with a plan approved by the RPP.

11. Samples must be analyzed by a radiochemistry laboratory that is appropriately licensed or certified for the analysis being performed.

12. WDI shall provide the RPP with an annual report by April 1 of each calendar year for activities conducted the previous calendar year. The report must contain the following items:
    - A summary of waste stream quantities disposed.
    - Any instances in which the concentrations of radioactive material exceeded those in Table 1.
    - A summary of the results of the RPP-approved environmental monitoring programs.

13. WDI shall maintain records pertinent to the disposal of this material.

If you have any questions, please contact Mr. Ken Yale, Acting Chief, Radiological Protection Section, ERMD, at 517-241-1278; yalek@michigan.gov; or DNRE, P.O. Box 30241, Lansing, Michigan 48909-7741.

Sincerely,

Liane J. Shekter Smith, P.E., Chief
Environmental Resource Management Division
517-373-9523

cc: Mr. Scott Maris, The Environmental Quality Company
Mr. Michael Takacs, The Environmental Quality Company
Mr. Dan Swallow, Van Buren Township
Ms. De Montgomery, DNRE
Mr. Steve Buda, DNRE/Operating License File
Mr. Lawrence AuBuchon/Mr. Mike Busse, DNRE
Mr. Ken Yale, DNRE
Mr. Robert Skowronek, DNRE

Waste Assessment Memo
Attachment 2

Filter Media Sample Results

Top Tank No. 1
Activated Carbon

RESI - Mallinckrodt STL Spectrum name: 1E001315.An1

Sample description
Carbon 201035

Spectrum Filename: C:\User\1E001315.An1

Acquisition information
Start time:	31-Jan-2013 11:18:32
Live time:	897
Real time:	900
Dead time:	0.32 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration
Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration
Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files
Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters
Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	5.5400E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 5.5400E+02) = 1.8051E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001315.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.2151

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
46.81	264.	24.09	1.01	5.166E-02	46.52	4.250	6.557E+00	PB210
53.81	330.	17.61	0.90	5.508E-02				
63.50	160.	46.45	1.31	7.099E-02	63.29	4.800	2.572E+00	TH234
74.75	1248.	4.11	0.97	7.881E-02				
77.15	2205.	2.73	0.97	7.798E-02				
79.29	184.	27.22	0.97	7.705E-02				
83.79	109.	25.43	0.98	7.487E-02				
87.17	664.	6.13	0.99	7.325E-02				
89.82	335.	10.90	0.99	7.208E-02				
92.91	247.	12.83	1.00	7.083E-02	92.59	5.570	3.406E+00	TH234
111.01	79.	28.15	1.02	6.606E-02				
113.35	59.	40.20	1.03	6.567E-02				
150.91	126.	37.95	1.87	6.142E-02				
160.88	111.	42.36	0.81	6.031E-02				
163.35	77.	38.91	1.10	6.003E-02	163.35	5.080	1.377E+00	U235
185.92	267.	12.44	1.14	5.718E-02	185.50	57.200	4.432E-01	U235
					186.20	3.600	7.054E+00	RA226
238.47	266.	11.06	1.22	4.978E-02	238.63	43.300	6.708E-01	PB212
241.86	1003.	4.10	1.22	4.930E-02	241.92	7.470	1.482E+01	PB214
258.85	69.	40.71	0.57	4.697E-02				
274.57	80.	27.77	1.27	4.491E-02				
295.04	2060.	2.87	1.32	4.237E-02	295.22	19.200	1.378E+01	PB214
337.83	72.	36.96	1.62	3.770E-02	338.32	11.270	9.228E-01	AC228
351.87	3381.	1.86	1.38	3.634E-02	351.99	37.600	1.346E+01	PB214
455.03	38.	36.71	1.15	2.852E-02				
511.06	69.	23.70	1.59	2.551E-02				
546.64	29.	40.45	0.78	2.390E-02				
582.55	97.	25.30	1.32	2.248E-02	583.19	84.500	2.771E-01	TL208
609.26	2479.	2.34	1.68	2.153E-02	609.32	46.090	1.358E+01	BI214
665.21	80.	20.19	1.75	1.981E-02				
726.72	27.	42.57	2.03	1.821E-02	727.33	6.580	1.210E+00	BI212
768.10	257.	10.98	1.42	1.730E-02	768.36	4.940	1.635E+01	BI214
782.99	19.	48.20	1.90	1.701E-02				
786.05	44.	29.94	1.90	1.695E-02	785.37	1.100	1.292E+01	BI212

806.05	45.	30.51	1.92	1.655E-02				
811.43	27.	40.46	1.92	1.645E-02				
838.48	52.	32.18	0.98	1.595E-02				
861.48	34.	32.75	0.62	1.558E-02	860.56	12.420	9.557E-01	Tl208
874.23	25.	44.87	1.05	1.535E-02				
911.02	79.	28.01	2.35	1.478E-02	911.20	25.800	1.126E+00	AC228
934.08	133.	17.69	1.36	1.445E-02	934.06	3.030	1.656E+01	BI214
969.17	53.	26.21	0.50	1.398E-02	968.97	15.800	1.305E+00	AC228
1000.46	31.	39.29	0.63	1.357E-02	1001.03	0.842	1.475E+01	Pa234m
1023.50	16.	48.20	0.83	1.330E-02				
1104.79	12.	49.73	0.86	1.242E-02				
1119.94	525.	5.86	2.34	1.227E-02	1120.28	15.100	1.543E+01	BI214
1237.36	203.	10.04	2.36	1.121E-02	1238.11	5.790	1.698E+01	BI214
1377.03	131.	14.30	0.67	1.019E-02	1377.67	4.000	1.749E+01	BI214
1459.94	42.	34.23	0.55	9.654E-03	1460.80	11.000	2.134E+00	K40
1509.87	70.	20.64	1.18	9.368E-03				
1521.60	38.	25.94	0.63	9.302E-03				
1539.29	50.	33.94	0.83	9.204E-03				
1587.31	18.	41.26	0.79	8.948E-03				
1619.96	11.	37.48	1.14	8.779E-03	1620.50	1.490	4.573E+00	BI212
1763.76	388.	6.25	3.60	8.113E-03	1764.51	15.400	1.689E+01	BI214
2203.09	118.	11.89	0.89	6.534E-03				

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
136.68	53.61	490.	264.	0.294	42.88	0.827	LU-177	sD
190.91	74.76	690.	1248.	1.391	8.22	0.967	PB-214	D
197.06	77.16	708.	2206.	2.459	5.46	0.971	PB-214	D
202.54	79.30	1168.	184.	0.206	54.44	0.975	TH-227	D
214.16	83.76	327.	111.	0.123	49.96	0.982	TA-182	D
222.84	87.14	498.	663.	0.740	12.28	0.987	PB-214	D
229.62	89.79	499.	334.	0.372	21.88	0.991	PB-214	D
283.90	111.09	207.	79.	0.088	56.29	1.024	PA-234	D
289.88	113.42	254.	59.	0.066	80.41	1.028	TA-182	D
386.23	150.91	360.	126.	0.140	75.89	1.867	KR-85M	s
411.80	160.88	323.	96.	0.107	56.99	1.101	BA-140	D
663.08	258.85	240.	69.	0.077	81.42	0.572	XE-138	s
703.67	274.52	205.	80.	0.090	55.02	1.269	SR-91	D
1166.34	455.03	64.	38.	0.043	73.42	1.151	-	s
1310.07	510.80	101.	69.	0.077	47.39	1.585	TL-208	D
1401.36	546.64	45.	29.	0.032	80.90	0.784	J-135	s
1705.61	665.21	52.	80.	0.090	40.39	1.751	BI-214	s
2007.88	782.32	32.	19.	0.021	96.40	1.895	PA-234	D
2067.07	805.87	70.	45.	0.050	61.01	1.919	BI-214	D
2080.88	811.26	46.	27.	0.030	80.92	1.924	CO-58	D
2150.31	838.48	57.	52.	0.058	64.36	0.977	J-135	s
2242.06	874.23	37.	25.	0.028	89.74	1.052	EU-154	s
2625.23	1023.50	16.	16.	0.018	96.40	0.833	SR-91	s
2833.92	1104.79	12.	12.	0.014	99.45	0.857	-	s
3874.14	1509.87	26.	70.	0.078	41.27	1.176	BI-214	s
3904.27	1521.60	13.	38.	0.042	51.87	0.630	-	s
3949.70	1539.29	42.	50.	0.056	67.88	0.825	RB-89	s
4073.07	1587.31	12.	18.	0.020	82.52	0.787	AC-228	s
5655.39	2203.09	12.	118.	0.132	23.79	0.888	BI-214	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
PB-210	119.24	46.81	540.	264.	0.294	48.18	1.014s
TH-234	162.06	63.50	825.	160.	0.178	92.89	1.313s
TH-234	236.65	92.59	414.	247.	0.276	26.51	0.996D
U-235	418.13	163.35	413.	77.	0.086	77.82	1.105D
U-235	474.94	185.50	569.	114.	0.127	62.18	1.138D
RA-226	476.73	186.20	489.	186.	0.207	36.66	1.139D
PB-212	611.21	238.63	300.	265.	0.295	22.19	1.217D
PB-214	619.65	241.92	346.	1003.	1.119	8.20	1.222D
PB-214	756.36	295.22	291.	1981.	2.209	5.11	1.298D
AC-228	865.67	337.83	212.	72.	0.080	73.91	1.625
PB-214	901.99	351.99	305.	3381.	3.769	3.74	1.377D
Tl-208	1493.51	582.55	120.	97.	0.108	50.60	1.315s
BI-214	1562.06	609.26	189.	2479.	2.763	4.68	1.677
BI-212	1863.47	726.72	38	27.	0.030	85.15	2.035
BI-214	1969.66	768.10	104.	257.	0.286	21.96	1.425s
BI-212	2013.99	785.37	66.	44.	0.049	59.87	1.898D
Tl-208	2209.34	861.48	30.	34.	0.038	65.50	0.624s
AC-228	2336.49	911.02	88.	79.	0.088	56.02	2.354s
BI-214	2395.68	934.08	75.	133.	0.149	35.38	1.362s
AC-228	2485.77	969.17	42.	53.	0.059	52.42	0.499s
Pa-234m	2566.07	1000.46	32.	31.	0.035	78.58	0.631s
BI-214	2872.83	1119.94	75.	525.	0.586	11.72	2.340s
BI-214	3174.31	1237.36	37.	203.	0.226	20.08	2.358s
BI-214	3532.97	1377.03	44.	131.	0.146	28.60	0.670s
K-40	3745.90	1459.94	30.	42.	0.046	68.46	0.550s
BI-212	4156.92	1619.96	2.	11.	0.012	74.97	1.135s
BI-214	4526.37	1763.76	29.	388.	0.432	12.50	3.602s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Peak Code	Peak MDA Value pCi/g	COMMENTS
AC-228		1.1364E+00					
			911.20	1.126E+00	*(	3.116E-01	28.01 G
			968.97	1.305E+00	(	3.718E-01	26.21 G
			338.32	9.228E-01	(	4.348E-01	36.96 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
BI-212		3.1610E+00					
			727.33	1.210E+00	(	6.548E-01	42.57 G
			1620.50	4.573E+00	?(	1.370E+00	37.48 G
			785.37	1.292E+01	(	5.509E+00	29.94 G
BI-214		1.3583E+01					
			609.32	1.358E+01	(	1.756E-01	2.34 G
			1764.51	1.689E+01	+	5.479E-01	6.25 G
			1120.28	1.543E+01	+	5.913E-01	5.86 G
			1238.11	1.698E+01	+	1.193E+00	10.04 G
			768.36	1.635E+01	+	1.513E+00	10.98 G
			934.06	1.656E+01	+	2.500E+00	17.69 G
			1377.67	1.749E+01	+	2.064E+00	14.30 G
K-40		2.1337E+00					
			1460.80	2.134E+00	(	6.571E-01	34.23 G
Pa-234m		1.4751E+01					
			1001.03	1.475E+01	?(	6.272E+00	39.29 G
PB-210		6.5571E+00					
			46.52	6.557E+00	*(	1.345E+00	24.09 G
PB-212		6.6920E-01					
			238.63	6.692E-01	(	1.019E-01	11.10 G
			300.09	9.361E-01	+	1.236E+00	82.72 G
PB-214		1.3558E+01					
			351.99	1.346E+01	(	1.619E-01	1.87 G
			295.22	1.325E+01	(	2.656E-01	2.55 G
			241.92	1.482E+01	(	6.397E-01	4.10 G
RA-226		4.9208E+00					
			186.20	4.921E+00	(	1.362E+00	18.33 G
TH-234		3.0184E+00					
			63.29	2.572E+00	*(	1.076E+00	46.45 G
			92.59	3.403E+00	(	6.522E-01	13.26 G
Tl-208	N	9.5569E-01					
			860.56	9.557E-01	(	3.587E-01	32.75 G
			583.19	2.771E-01	-	7.325E-02	25.30 G
			277.35	5.732E-01	-	6.722E-01	73.50 G
U-235		1.8909E-01					
			185.50	1.891E-01	(	9.235E-02	31.09 G
			143.76	6.066E-01	+	4.023E-01	76.18 G

Nuclide	Ave activity	Energy	Activity	Code	Peak MDA	Comments
		163.35	1.377E+00 +		8.442E-01	38.91 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228	1.1364E+00	4.0354E-01	4.0606E-01	0.312E+00
BI-212	3.1610E+00	1.3516E+00	1.3574E+00	0.655E+00
BI-214	1.3583E+01	6.3545E-01	8.3382E-01	0.176E+00
K-40 #	2.1337E+00	1.4608E+00	1.4633E+00	0.657E+00
Pa-234m#	1.4751E+01	1.1591E+01	1.1606E+01	0.627E+01
PB-210 #	6.5571E+00	3.1589E+00	3.1697E+00	0.134E+01
PB-212	6.6920E-01	1.4850E-01	1.5086E-01	0.102E+00
PB-214	1.3558E+01	4.6831E-01	7.1392E-01	0.162E+00
RA-226	4.9208E+00	1.8040E+00	1.8145E+00	0.136E+01
TH-234	3.0184E+00	8.0031E-01	8.0925E-01	0.108E+01
Tl-208	9.5569E-01	6.2600E-01	6.2716E-01	0.359E+00
U-235	1.8909E-01	1.1757E-01	1.1781E-01	0.923E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

Total Activity (39.3 to 3170.7 keV) 6.4634033E+01 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Top Tank No. 2
Activated Carbon

RESI - Mallinckrodt STL Spectrum name: 1E001321.An1

Sample description
Carbon 201064

Spectrum Filename: C:\User\1E001321.An1

Acquisition information
Start time:	31-Jan-2013 13:05:53
Live time:	898
Real time:	900
Dead time:	0.28 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration
Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration
Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files
Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters
Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	5.6200E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 5.6200E+02) = 1.7794E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001321.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1193

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
40.72	53.	41.75	0.91	4.872E-02				
46.57	253.	15.34	0.99	5.154E-02	46.52	4.250	6.200E+00	PB210
53.26	170.	23.20	0.80	5.481E-02				
63.37	258.	18.74	1.07	7.068E-02	63.29	4.800	4.086E+00	TH234
74.77	1015.	4.66	0.97	7.880E-02				
77.17	1780.	3.05	0.97	7.797E-02				
79.44	112.	30.23	0.97	7.697E-02				
84.11	121.	26.08	0.98	7.469E-02				
87.12	532.	7.19	0.99	7.326E-02				
89.84	270.	12.50	0.99	7.205E-02				
92.77	322.	10.37	1.00	7.087E-02	92.59	5.570	4.361E+00	TH234
128.83	110.	38.78	1.37	6.371E-02				
144.03	102.	42.07	1.46	6.214E-02	143.76	10.960	8.060E-01	U235
164.37	119.	34.74	1.11	5.991E-02	163.35	5.080	2.091E+00	U235
177.52	52.	44.08	0.67	5.828E-02				
185.94	463.	8.32	1.35	5.717E-02	185.50	57.200	7.573E-01	U235
					186.20	3.600	1.205E+01	RA226
238.46	442.	6.76	1.22	4.977E-02	238.63	43.300	1.101E+00	PB212
241.91	716.	4.89	1.22	4.929E-02	241.92	7.470	1.041E+01	PB214
258.83	56.	34.84	0.65	4.697E-02				
295.15	1563.	2.83	1.30	4.237E-02	295.22	19.200	1.030E+01	PB214
300.08	37.	47.13	1.30	4.179E-02	300.09	3.270	1.435E+00	PB212
338.19	160.	17.76	1.21	3.766E-02	338.32	11.270	2.021E+00	AC228
351.83	2609.	2.37	1.39	3.634E-02	351.99	37.600	1.023E+01	PB214
462.82	36.	43.20	1.52	2.806E-02				
510.98	89.	22.62	0.76	2.550E-02				
583.51	122.	15.48	1.43	2.244E-02	583.19	84.500	3.445E-01	Tl208
609.26	1940.	2.56	1.60	2.153E-02	609.32	46.090	1.048E+01	BI214
665.21	76.	26.25	1.26	1.981E-02				
688.35	29.	44.75	0.72	1.918E-02				
726.97	44.	42.22	0.53	1.821E-02	727.33	6.580	1.975E+00	BI212
748.44	22.	39.60	1.10	1.773E-02				
768.22	182.	11.62	1.21	1.730E-02	768.36	4.940	1.139E+01	BI214
785.66	99.	19.66	0.91	1.695E-02	785.37	1.100	2.845E+01	BI212

806.98	36.	34.97	1.27	1.653E-02				
857.70	48.	39.20	0.45	1.558E-02	860.56	12.420	1.320E+00	Tl208
871.29	45.	37.18	0.57	1.540E-02				
911.29	120.	15.84	1.47	1.478E-02	911.20	25.800	1.681E+00	AC228
934.41	111.	20.17	2.43	1.445E-02	934.06	3.030	1.362E+01	BI214
968.78	105.	18.00	1.18	1.398E-02	968.97	15.800	2.555E+00	AC228
1000.84	21.	48.46	0.76	1.357E-02	1001.03	0.842	1.000E+01	Pa234m
1120.18	424.	6.16	2.19	1.226E-02	1120.28	15.100	1.227E+01	BI214
1145.72	21.	39.17	0.79	1.202E-02				
1239.22	124.	12.10	2.29	1.120E-02	1238.11	5.790	1.025E+01	BI214
1258.12	25.	34.18	0.38	1.105E-02				
1354.60	15.	40.59	0.60	1.034E-02				
1377.75	106.	16.86	1.98	1.018E-02	1377.67	4.000	1.390E+01	BI214
1423.63	10.	39.38	0.82	9.883E-03				
1459.73	43.	20.55	2.05	9.654E-03	1460.80	11.000	2.153E+00	K40
1481.03	30.	30.06	0.67	9.534E-03				
1621.20	12.	28.87	0.78	8.779E-03	1620.50	1.490	4.915E+00	BI212

pk energy	area	uncert	fwhm	corr	nuclide	brnch.	act.	nuc
1764.20	297.	6.70	2.90	8.111E-03	1764.51	15.400	1.274E+01	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
103.64	40.78	217.	53.	0.059	83.50	0.913	CE-144	D
135.78	53.26	308.	170.	0.189	46.41	0.799	LU-177	
190.96	74.79	611.	1013.	1.128	9.34	0.968	PB-214	D
197.13	77.19	588.	1774.	1.976	6.13	0.971	PB-214	D
202.94	79.45	525.	102.	0.114	66.54	0.975	TH-227	D
214.92	84.13	448.	112.	0.124	56.81	0.982	TA-182	D
222.64	87.14	474.	522.	0.582	14.68	0.987	PB-214	D
229.61	89.86	448.	259.	0.289	26.24	0.991	PB-214	D
329.60	128.83	285.	110.	0.123	77.57	1.366	AC-228	s
454.47	177.52	132.	52.	0.057	88.15	0.668	CS-136	s
663.01	258.83	137.	56.	0.062	69.68	0.647	XE-138	s
1186.32	462.76	102.	36.	0.040	86.40	1.524	CS-138	D
1309.87	510.98	82.	89.	0.099	45.24	0.762	TL-208	s
1705.63	665.21	70.	76.	0.085	52.50	1.260	BI-214	s
1765.01	688.35	37.	29.	0.032	89.50	0.720	AG-110M	s
1919.22	748.44	18.	22.	0.024	79.20	1.102	RH-106M	s
2069.46	806.98	35.	36.	0.040	69.94	1.266	BI-214	s
2234.51	871.29	53.	45.	0.050	74.36	0.573	NB-94	s
2938.99	1145.72	14.	21.	0.023	78.34	0.791	TE-131	s
3227.61	1258.12	12.	25.	0.028	68.35	0.381	TA-182	s
3475.36	1354.60	7.	15.	0.016	81.18	0.603	-	s
3652.65	1423.63	3.	10.	0.012	78.75	0.822	-	s
3800.07	1481.03	11.	30.	0.033	60.12	0.669	-	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
PB-210	118.77	46.62	375.	275.	0.306	36.55	1.006s
TH-234	161.72	63.37	462.	258.	0.287	37.47	1.070
TH-234	236.65	92.59	447.	319.	0.355	21.84	0.996D
U-235	368.59	144.03	320.	102.	0.114	84.15	1.459s
U-235	420.75	164.37	265.	119.	0.133	69.48	1.109s

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
U-235	474.94	185.50	566.	195.	0.218	37.30	1.138D
RA-226	476.73	186.20	422.	333.	0.371	20.59	1.139D
PB-212	611.21	238.63	225.	443.	0.494	13.49	1.217D
PB-214	619.65	241.92	255.	716.	0.797	9.79	1.222D
PB-214	756.36	295.22	184.	1563.	1.741	5.63	1.298D
PB-212	768.85	300.09	130.	37.	0.041	93.19	1.305D
AC-228	866.59	338.19	185.	160.	0.178	35.52	1.207
PB-214	901.57	351.83	283.	2609.	2.907	4.75	1.393
Tl-208	1495.97	583.51	64.	122.	0.136	30.96	1.429s
BI-214	1562.05	609.26	116.	1940.	2.162	5.11	1.600s
BI-212	1864.12	726.97	73.	44.	0.049	84.43	0.534s
BI-214	1969.98	768.22	63.	182.	0.202	23.24	1.210s
BI-212	2014.75	785.66	56.	99.	0.110	39.33	0.909s
Tl-208	2199.62	857.70	58.	48.	0.053	78.39	0.448s
AC-228	2337.18	911.29	51.	120.	0.133	31.68	1.472s
BI-214	2396.53	934.41	74.	111.	0.124	40.34	2.430s
AC-228	2484.77	968.78	48.	105.	0.117	36.00	1.181s
Pa-234m	2567.06	1000.84	26.	21.	0.024	96.93	0.758s
BI-214	2873.44	1120.18	50.	424.	0.472	12.32	2.188s
BI-214	3176.23	1238.11	45.	143.	0.159	21.33	2.286D
BI-214	3534.83	1377.75	37.	106.	0.118	33.71	1.979
K-40	3745.37	1459.73	7.	43.	0.048	41.10	2.047
BI-212	4160.11	1621.20	0.	12.	0.013	57.74	0.779s
BI-214	4527.48	1764.20	18.	297.	0.331	13.40	2.896s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g	COMMENTS
AC-228		1.7843E+00					
			911.20	1.681E+00	(	2.345E-01	15.84 G
			968.97	2.555E+00	+	3.902E-01	18.00 G
			338.32	2.021E+00	(	4.002E-01	17.76 G
BI-212		2.5181E+00					
			727.33	1.975E+00	(	8.893E-01	42.22 G
			1620.50	4.915E+00	?(	9.544E-01	28.87 G
			785.37	2.845E+01	+	5.011E+00	19.66 G
BI-214		1.0693E+01					
			609.32	1.048E+01	@(	1.352E-01	2.56 G
			1764.51	1.274E+01	+	4.241E-01	6.70 G
			1120.28	1.227E+01	+	4.767E-01	6.16 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
			1238.11	1.181E+01	(	1.289E+00	10.67 G
			768.36	1.139E+01	(	1.163E+00	11.62 G
			934.06	1.362E+01	+	2.447E+00	20.17 G
			1377.67	1.390E+01	+	1.873E+00	16.86 G
K-40		2.1527E+00					
			1460.80	2.153E+00	(	3.183E-01	20.55 G
Pa-234m		1.0002E+01					
			1001.03	1.000E+01	?(	5.534E+00	48.46 G
PB-210		6.7298E+00					
			46.52	6.730E+00	*(	1.104E+00	18.27 G
PB-212		1.1019E+00					
			238.63	1.102E+00	(	8.694E-02	6.75 G
			300.09	1.451E+00	+	1.042E+00	46.59 G
PB-214		1.0274E+01					
			351.99	1.023E+01	(	1.539E-01	2.37 G
			295.22	1.030E+01	(	2.085E-01	2.81 G
			241.92	1.042E+01	(	5.419E-01	4.89 G
RA-226		8.6805E+00					
			186.20	8.680E+00	(	1.247E+00	10.29 G
TH-234		4.2147E+00					
			63.29	4.086E+00	(	7.932E-01	18.74 G
			92.59	4.325E+00	(	6.680E-01	10.92 G
Tl-208	N	1.3201E+00					
			860.56	1.320E+00	&(	4.928E-01	39.20 G
			583.19	3.445E-01	-	5.264E-02	15.48 G
			277.35	6.481E-01	-	5.653E-01	61.62 G
U-235		3.1970E-01					
			185.50	3.197E-01	(	9.071E-02	18.65 G
			143.76	8.060E-01	+	3.275E-01	42.07 G
			163.35	2.091E+00	&	6.665E-01	34.74 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.

$ - Peak identified, but first peak of this nuclide
failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the
library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity
to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

- -

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228	1.7843E+00	4.2461E-01	4.3049E-01	0.235E+00
BI-212	2.5181E+00	1.2878E+00	1.2917E+00	0.889E+00
BI-214	1.0693E+01	5.4663E-01	6.9239E-01	0.135E+00
K-40	2.1527E+00	8.8483E-01	8.8895E-01	0.318E+00
Pa-234m#	1.0002E+01	9.6945E+00	9.7027E+00	0.553E+01
PB-210 #	6.7298E+00	2.4594E+00	2.4739E+00	0.110E+01
PB-212	1.1019E+00	1.4867E-01	1.5498E-01	0.869E-01
PB-214	1.0274E+01	4.1938E-01	5.8532E-01	0.154E+00
RA-226	8.6805E+00	1.7872E+00	1.8202E+00	0.125E+01
TH-234	4.2147E+00	9.1402E-01	9.2924E-01	0.793E+00
Tl-208 #	1.3201E+00	1.0348E+00	1.0362E+00	0.493E+00
U-235	3.1970E-01	1.1924E-01	1.1991E-01	0.907E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

RESI - Mallinckrodt STL Spectrum name: 1E001321.An1

---------- S U M M A R Y ----------

Total Activity (39.3 to 3170.7 keV) 5.9790176E+01 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Top Tank No. 3
Ur Resin

RESI - Mallinckrodt STL Spectrum name: 1E001316.An1

Sample description
U1

Spectrum Filename: C:\User\1E001316.An1

Acquisition information

Start time:	31-Jan-2013 11:45:08
Live time:	897
Real time:	900
Dead time:	0.29 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration

Filename:	DE3F09-1.CLB

Detector #1 47-TN41706A Calibration_20130129

Energy Calibration

Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration

Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files

Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters

Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	4.8500E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 4.8500E+02) =
	2.0619E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001316.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1112

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
40.18	83.	46.40	0.77	4.843E-02				
49.17	133.	40.44	0.99	5.281E-02				
53.35	511.	18.43	1.04	5.485E-02				
63.36	5367.	1.62	0.95	7.062E-02	63.29	4.800	9.851E+01	TH234
67.22	135.	24.28	0.96	7.703E-02				
69.85	198.	20.68	0.96	7.880E-02				
72.48	191.	22.42	0.96	7.920E-02				
74.89	134.	33.32	0.97	7.878E-02				
76.71	132.	34.71	0.97	7.817E-02				
81.09	145.	27.84	0.98	7.617E-02				
84.09	650.	7.64	0.98	7.469E-02				
89.81	354.	13.76	0.99	7.205E-02				
92.59	7603.	1.35	1.00	7.093E-02	92.59	5.570	1.195E+02	TH234
98.57	509.	8.69	1.15	6.891E-02				
105.54	144.	20.53	1.02	6.717E-02				
109.07	179.	18.49	1.02	6.645E-02				
112.66	340.	11.23	1.03	6.582E-02				
121.11	75.	36.06	1.04	6.459E-02				
125.15	49.	49.47	1.05	6.411E-02				
131.30	117.	32.59	0.79	6.345E-02				
143.71	856.	4.96	1.09	6.217E-02	143.76	10.960	7.804E+00	U235
163.23	388.	8.39	1.07	6.004E-02	163.35	5.080	7.891E+00	U235
185.59	4325.	1.70	1.25	5.722E-02	185.50	57.200	8.205E+00	U235
186.23	669.	13.56	1.14	5.714E-02	186.20	3.600	2.019E+01	RA226
194.95	49.	30.70	0.74	5.594E-02				
201.98	50.	33.20	1.16	5.495E-02				
205.26	332.	6.99	1.17	5.449E-02				
226.65	39.	41.12	0.79	5.144E-02				
238.56	96.	17.05	1.22	4.977E-02	238.63	43.300	2.759E-01	PB212
241.73	61.	25.20	1.22	4.932E-02	241.92	7.470	1.030E+00	PB214
258.10	73.	21.00	1.51	4.707E-02				
270.43	46.	38.62	0.71	4.544E-02				
294.90	120.	15.78	1.48	4.239E-02	295.22	19.200	9.126E-01	PB214
337.74	40.	34.74	1.04	3.765E-02	338.32	11.270	5.781E-01	AC228

RESI - Mallinckrodt STL Spectrum name: 1E001316.An1

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
171.60	67.16	466.	135.	0.150	48.56	0.956	TA-182	D
178.32	69.78	739.	198.	0.221	41.37	0.960	GD-153	D
185.07	72.41	822.	191.	0.213	44.83	0.964	BI-207	D
191.39	74.88	855.	205.	0.229	42.67	0.968	PB-214	D
196.07	76.70	950.	166.	0.186	54.59	0.971	PB-212	D
207.26	81.13	744.	148.	0.165	54.78	0.978	SB-125	D
214.98	84.14	901.	656.	0.731	15.11	0.982	TA-182	D
229.62	89.85	1007.	359.	0.400	27.14	0.991	PB-214	D
251.99	98.57	482.	509.	0.567	17.37	1.155	PA-234	
269.86	105.37	367.	144.	0.161	41.06	1.016	EU-155	D
278.92	108.90	460.	179.	0.200	36.98	1.021	U-235	D
288.12	112.49	557.	340.	0.378	22.46	1.027	LU-177	D
309.79	121.15	331.	75.	0.084	72.11	1.040	SE-75	D
320.16	125.20	265.	49.	0.054	98.94	1.046	PA-234	D
335.91	131.30	243.	117.	0.130	65.17	0.788	PA-234	s
499.16	194.95	76.	49.	0.055	61.41	0.737	RH-106M	s
517.20	202.03	111.	50.	0.055	66.39	1.163	U-235	D
525.61	205.31	103.	332.	0.370	13.99	1.168	U-235	D
580.48	226.65	77.	39.	0.043	82.24	0.793	PA-234	s
661.14	258.10	54.	73.	0.081	42.00	1.512	XE-138	s
692.78	270.43	75.	46.	0.052	77.23	0.713	AC-228	s
973.33	379.80	33.	34.	0.038	75.79	1.057	SB-125	s
1837.90	716.76	6.	14.	0.016	81.70	0.595	RH-106M	s
1965.44	766.36	46.	117.	0.130	24.80	1.878	J-134	D

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
TH-234	161.65	63.35	1310.	5477.	6.103	3.54	0.987
TH-234	236.65	92.59	1496.	7603.	8.473	2.71	0.996D
U-235	367.77	143.71	334.	856.	0.954	9.91	1.095
U-235	417.82	163.23	236.	388.	0.432	16.78	1.065
U-235	474.94	185.50	721.	3770.	4.201	3.83	1.138D
RA-226	476.73	186.20	3778.	669.	0.745	27.12	1.139D
PB-212	611.21	238.63	85.	96.	0.107	34.11	1.217D
PB-214	619.65	241.92	88.	61.	0.068	50.80	1.222D
PB-214	756.36	295.22	51.	111.	0.124	26.28	1.298D
AC-228	865.44	337.74	42.	40.	0.044	69.47	1.044s
PB-214	901.04	351.62	42.	192.	0.215	19.59	1.718s

351.62	192.	9.79	1.72	3.636E-02	351.99	37.600	8.753E-01	PB214
379.80	34.	37.89	1.06	3.386E-02				
582.98	46.	32.51	1.61	2.246E-02	583.19	84.500	1.489E-01	Tl208
609.18	127.	11.76	1.56	2.154E-02	609.32	46.090	7.947E-01	BI214
716.76	14.	40.85	0.60	1.846E-02				
766.36	136.	12.97	1.96	1.734E-02				
911.04	62.	12.70	1.12	1.479E-02	911.20	25.800	1.009E+00	AC228
932.25	18.	34.53	0.38	1.445E-02	934.06	3.030	2.505E+00	BI214
1000.73	242.	7.14	1.92	1.358E-02	1001.03	0.842	1.312E+02	Pa234m
1120.53	33.	20.66	0.82	1.226E-02	1120.28	15.100	1.101E+00	BI214
1238.26	18.	31.63	0.46	1.121E-02	1238.11	5.790	1.770E+00	BI214
1764.15	14.	47.02	0.55	8.110E-03	1764.51	15.400	6.961E-01	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Centroid Channel	Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
102.25	40.18	280.	83.	0.092	92.79	0.774	EU-152	s
126.01	49.17	624.	85.	0.095	85.68	0.927	EU-155	D
136.03	53.35	1194.	511.	0.569	36.86	1.044	LU-177	s

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
Tl-208	1494.61	582.98	38.	46.	0.051	65.01	1.612
BI-214	1561.83	609.18	24.	127.	0.142	23.52	1.559
AC-228	2336.54	911.04	0.	62.	0.069	25.40	1.117s
BI-214	2390.98	932.25	5.	18.	0.020	69.07	0.381s
Pa-234m	2566.78	1000.73	12.	242.	0.269	14.27	1.923
BI-214	2874.32	1120.53	3.	33.	0.037	41.33	0.823s
BI-214	3176.61	1238.26	4.	18.	0.021	63.27	0.461s
BI-214	4527.37	1764.15	8.	14.	0.016	94.04	0.546s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g	COMMENTS
AC-228		1.0095E+00					
			911.20	1.009E+00	(	3.794E-02	12.70 G
			968.97	2.812E-02	-	2.451E-01	655.74 G
			338.32	5.781E-01	-	2.223E-01	34.74 G
BI-212		7.8155E-01					
			727.33	8.380E-01	&(	7.128E-01	78.56 G
			1620.50	1.582E-01	-	1.106E+00	120.19 G
			785.37	4.441E-01	%(	2.535E+00	327.87 G
BI-214		7.7002E-01					
			609.32	7.947E-01	(	7.143E-02	11.76 G
			1764.51	6.961E-01	?(	3.277E-01	47.02 G
			1120.28	1.101E+00	+	1.390E-01	20.66 G
			1238.11	1.770E+00	+	4.171E-01	31.63 G
			768.36	4.264E-01	-	1.924E+00	276.99 G
			934.06	2.505E+00	&	7.630E-01	34.53 G
			1377.67	5.083E-02	-	3.553E-01	120.19 G
K-40		1.2670E-01					
			1460.80	1.267E-01	%(	1.362E-01	88.71 G
Pa-234m		1.3123E+02					
			1001.03	1.312E+02	(	4.293E+00	7.14 G
PB-210		1.1172E+00					
			46.52	1.117E+00	%(	1.644E+00	90.71 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
PB-212		2.7584E-01					
			238.63	2.758E-01	(	6.204E-02	17.06 G
			300.09	6.985E-01	+	7.828E-01	72.65 G
PB-214		8.8431E-01					
			351.99	8.753E-01	@(	6.906E-02	9.79 G
			295.22	8.481E-01	(	1.270E-01	13.14 G
			241.92	1.023E+00	(	3.694E-01	25.40 G
RA-226		2.0194E+01					
			186.20	2.019E+01	(	4.324E+00	13.56 G
TH-234		1.0054E+02					
			63.29	1.005E+02	(	1.548E+00	1.77 G
			92.59	1.195E+02	+	1.416E+00	1.35 G
Tl-208	N	1.7095E-01					
			860.56	1.926E-01	%(	1.295E-01	61.24 G
			583.19	1.489E-01	?(	4.732E-02	32.51 G
			277.35	4.234E-01	%(	3.880E-01	70.04 G
U-235		7.3000E+00					
			185.50	7.151E+00	(	1.187E-01	1.92 G
			143.76	7.804E+00	(	3.879E-01	4.96 G
			163.35	7.891E+00	(	7.297E-01	8.39 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:
T - Thermal Neutron Activation
F - Fast Neutron Activation

Peak Codes:
G - Gamma Ray
X - X-Ray

RESI - Mallinckrodt STL Spectrum name: 1E001316.An1

I - Fission Product
N - Naturally Occurring Isotope
P - Photon Reaction
C - Charged Particle Reaction
M - No MDA Calculation
R - Coincidence Corrected
H - Halflife limit exceeded
P - Positron Decay
S - Single-Escape
D - Double-Escape
K - Key Line
A - Not in Average
C - Coincidence Peak

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228	1.0095E+00	2.5640E-01	2.5952E-01	0.379E-01
BI-212 #	7.8155E-01	1.2280E+00	1.2284E+00	0.713E+00
BI-214	7.7002E-01	1.8108E-01	1.8365E-01	0.714E-01
K-40 #A	1.2670E-01	2.2479E-01	2.2484E-01	0.136E+00
Pa-234m	1.3123E+02	1.8731E+01	1.9444E+01	0.429E+01
PB-210 A	1.1172E+00	2.0267E+00	2.0272E+00	0.164E+01
PB-212	2.7584E-01	9.4093E-02	9.4730E-02	0.620E-01
PB-214	8.8431E-01	1.7321E-01	1.7674E-01	0.691E-01
RA-226	2.0194E+01	5.4762E+00	5.5347E+00	0.432E+01
TH-234	1.0054E+02	3.5607E+00	5.3521E+00	0.155E+01
Tl-208	1.7095E-01	1.1113E-01	1.1134E-01	0.130E+00
U-235	7.3000E+00	2.7963E-01	4.0295E-01	0.119E+00

\# - All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

S U M M A R Y

Total Activity (39.3 to 3170.7 keV) 2.6236636E+02 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Top Tank No. 3
Ur Resin
Resample

RESI - Mallinckrodt STL Spectrum name: 1E001319.An1

Sample description
U1 Top #2

Spectrum Filename: C:\User\1E001319.An1

Acquisition information
Start time: 31-Jan-2013 12:33:55
Live time: 898
Real time: 900
Dead time: 0.24 %
Detector ID: 1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration
Created: 29-Jan-2013 09:27:39
Zero offset: 0.307 keV
Gain: 0.390 keV/channel
Quadratic: -8.307E-08 keV/channel^2

Efficiency Calibration
Created: 29-Jan-2013 09:24:23
Type: Polynomial
Uncertainty: 1.264 %
Coefficients: -0.311421 -4.696349 0.833724
-0.134056 0.009610 -0.000249

Library Files
Main analysis library: Mallinckrodt.Lib
Library Match Width: 0.500
Peak stripping: Library based

Analysis parameters
Analysis engine: npp32 G53W3.05
Start channel: 100 (39.30keV)
Stop channel: 8144 (3170.73keV)
Peak rejection level: 50.000%
Peak search sensitivity: 1
Sample Size: 4.1500E+02
Activity scaling factor: 1.0000E+06/(1.0000E+00* 4.1500E+02) =
2.4096E+03
Detection limit method: Critical level - ORTEC method
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001319.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1325

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
53.24	340.	22.49	1.27	5.480E-02				
63.36	4354.	1.94	0.97	7.065E-02	63.29	4.800	9.335E+01	TH234
80.96	102.	38.14	0.98	7.626E-02				
84.17	533.	8.26	0.98	7.468E-02				
89.89	353.	11.80	0.99	7.201E-02				
92.62	5988.	1.50	1.00	7.091E-02	92.59	5.570	1.099E+02	TH234
98.51	336.	10.92	1.07	6.893E-02				
105.58	95.	28.00	1.02	6.717E-02				
109.14	166.	18.15	1.02	6.645E-02				
112.80	283.	11.95	1.03	6.581E-02				
121.07	69.	46.49	1.05	6.460E-02				
137.28	50.	40.23	0.57	6.283E-02				
143.69	752.	5.03	1.15	6.218E-02	143.76	10.960	8.005E+00	U235
163.29	397.	7.99	1.14	6.003E-02	163.35	5.080	9.448E+00	U235
185.62	3710.	1.77	1.16	5.721E-02	185.50	57.200	8.222E+00	U235
186.24	544.	15.48	1.14	5.714E-02	186.20	3.600	1.920E+01	RA226
202.00	85.	17.17	1.16	5.496E-02				
205.25	329.	6.41	1.17	5.450E-02				
238.77	39.	34.19	1.22	4.973E-02	238.63	43.300	1.302E-01	PB212
241.38	30.	40.16	1.22	4.937E-02	241.92	7.470	5.869E-01	PB214
257.86	68.	23.48	1.35	4.710E-02				
270.11	16.	49.01	0.60	4.548E-02				
277.02	46.	31.88	0.82	4.455E-02	277.35	6.310	1.178E+00	Tl208
294.98	67.	20.60	1.20	4.238E-02	295.22	19.200	5.976E-01	PB214
332.20	10.	46.90	0.66	3.826E-02				
351.87	76.	20.14	0.85	3.634E-02	351.99	37.600	4.036E-01	PB214
394.45	26.	42.48	0.54	3.268E-02				
540.71	14.	32.41	1.01	2.415E-02				
609.21	65.	15.38	1.32	2.154E-02	609.32	46.090	4.751E-01	BI214
717.42	18.	29.28	0.90	1.844E-02				
728.11	29.	24.14	0.51	1.821E-02	727.33	6.580	1.756E+00	BI212
766.59	117.	12.39	2.17	1.734E-02				
1000.96	225.	7.12	2.20	1.357E-02	1001.03	0.842	1.428E+02	Pa234m
1120.64	12.	33.96	0.74	1.226E-02	1120.28	15.100	4.505E-01	BI214

1238.64	6.	40.82	0.49	1.121E-02	1238.11	5.790	6.706E-01	BI214
1764.45	14.	26.73	1.17	8.110E-03	1764.51	15.400	8.131E-01	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	2 Sigma %	FWHM keV	Suspected Nuclide	
135.74	53.24	847.	340.	0.379	44.97	1.272	LU-177	s
206.83	80.95	709.	102.	0.114	76.28	0.977	I-131	D
215.07	84.16	700.	533.	0.593	16.51	0.982	TA-182	D
229.95	89.95	684.	362.	0.403	22.98	0.992	PB-214	D
251.83	98.51	378.	336.	0.374	21.85	1.067	PA-234	

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
269.96	105.35	310.	95.	0.106	55.99	1.016	EU-155	D
279.09	108.91	372.	166.	0.185	36.31	1.022	U-235	D
288.47	112.57	428.	283.	0.315	23.89	1.027	LU-177	D
309.69	121.07	320.	69.	0.077	92.98	1.046	SE-75	s
351.27	137.28	80.	50.	0.056	80.46	0.575	HF-181	s
517.27	201.98	65.	85.	0.095	34.35	1.163	U-235	D
525.58	205.22	58.	329.	0.366	12.83	1.168	U-235	D
660.54	257.86	52.	68.	0.075	46.97	1.348	XE-138	
691.95	270.11	21.	16.	0.018	98.03	0.596	AC-228	s
851.23	332.20	6.	10.	0.011	93.81	0.660	U-237	s
1010.92	394.45	24.	26.	0.029	84.96	0.541	-	s
1386.17	540.71	4.	14.	0.016	64.82	1.013	J-134	s
1839.60	717.42	2.	18.	0.019	58.55	0.898	RH-106M	s
1965.94	766.59	33.	92.	0.102	27.38	1.878	J-134	D

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
TH-234	161.69	63.36	930.	4354.	4.849	3.88	0.974
TH-234	236.65	92.59	1181.	5988.	6.669	3.05	0.996D
U-235	367.70	143.69	255.	752.	0.838	10.06	1.146
U-235	417.97	163.29	193.	397.	0.442	15.99	1.142
U-235	474.94	185.50	542.	3320.	3.698	4.00	1.138D
RA-226	476.73	186.20	3282.	544.	0.606	30.97	1.139D
PB-212	611.21	238.63	62.	40.	0.044	64.28	1.217D
PB-214	619.65	241.92	59.	28.	0.032	85.26	1.222D
Tl-208	709.69	277.02	45.	46.	0.051	63.75	0.822s
PB-214	756.36	295.22	29.	70.	0.078	32.33	1.298D
PB-214	901.68	351.87	38.	76.	0.085	40.28	0.846s
BI-214	1561.92	609.21	10.	65.	0.072	30.77	1.323
BI-212	1867.03	728.11	4.	29.	0.032	48.28	0.505s
BI-212	2014.00	785.37	4.	0.	0.000	0.00	0.000s
Pa-234m	2566.90	1000.78	4.	236.	0.262	13.65	2.212s
BI-214	2874.61	1120.64	2.	12.	0.013	67.92	0.739s
BI-214	3177.60	1238.64	0.	6.	0.007	81.65	0.487s
K-40	0.00	1460.80	0.	0.	0.000	0.00	0.000
BI-212	4157.00	1619.99	0.	0.	0.000	0.00	0.000s
BI-214	4528.12	1764.45	0.	14.	0.016	53.45	1.168s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Activity pCi/g	Code	MDA Value pCi/g	COMMENTS
AC-228		9.6731E-02					
			911.20	6.656E-02	&(	1.436E-01	155.84 G
			968.97	9.305E-02	%(	8.265E-02	81.72 G
			338.32	1.710E-01	%(	2.108E-01	86.79 G
BI-212		1.7558E+00					
			727.33	1.756E+00	(	2.821E-01	24.14 G
			1620.50	0.000E+00	-	1.292E+00	0.00 G
			785.37	0.000E+00	-	1.813E+00	0.00 G
BI-214		4.9922E-01					
			609.32	4.751E-01	(	5.385E-02	15.38 G
			1764.51	8.131E-01	+	1.353E-01	26.73 G
			1120.28	4.505E-01	?(	1.118E-01	33.96 G
			1238.11	6.706E-01	?(	2.604E-01	40.82 G
			768.36	6.440E-01	%(	2.021E+00	193.89 G
			934.06	5.521E-02	-	3.859E-01	120.19 G
			1377.67	5.343E-01	%(	4.150E-01	57.74 G
K-40		0.0000E+00					
			1460.80	0.000E+00	(	1.591E-01	0.00 G
Pa-234m		1.4958E+02					
			1001.03	1.496E+02	@(	3.078E+00	6.83 G
PB-210		1.2379E+00					
			46.52	1.238E+00	%(	1.608E+00	80.50 G
PB-212		1.4965E-01					
			238.63	1.342E-01	(	6.185E-02	32.14 G
			300.09	3.537E-01	%(	5.715E-01	105.45 G
PB-214		4.8774E-01					
			351.99	4.036E-01	*(	7.628E-02	20.14 G
			295.22	6.244E-01	(	1.119E-01	16.16 G
			241.92	5.600E-01	(	3.532E-01	42.63 G
RA-226		1.9199E+01					
			186.20	1.920E+01	(	4.707E+00	15.48 G

RESI - Mallinckrodt STL Spectrum name: 1E001319.An1

Nuclide		Ave activity	Energy	Activity	Code	Peak	MDA	Comments
TH-234		9.3353E+01						
			63.29	9.335E+01	(	1.523E+00		1.94 G
			92.59	1.099E+02	+	1.470E+00		1.53 G
Tl-208	N	1.1096E-01						
			860.56	3.749E-02	%(	1.235E-01		208.17 G
			583.19	4.205E-02	%(	3.450E-02		63.31 G
			277.35	1.178E+00	*(	4.048E-01		31.88 G
U-235		7.4612E+00						
			185.50	7.357E+00	(	1.202E-01		2.00 G
			143.76	8.005E+00	(	3.961E-01		5.03 G
			163.35	9.448E+00	+	7.697E-01		7.99 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
\+ - Peak activity higher than counting uncertainty range.
\- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

RESI - Mallinckrodt STL Spectrum name: 1E001319.An1

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228 #A	9.6731E-02	1.2653E-01	1.2659E-01	0.144E+00
BI-212 #	1.7558E+00	8.4761E-01	8.5047E-01	0.282E+00
BI-214	4.9922E-01	1.5361E-01	1.5488E-01	0.539E-01
K-40 #A	0.0000E+00	0.0000E+00	0.0000E+00	0.159E+00
Pa-234m#	1.4958E+02	2.0420E+01	2.1268E+01	0.308E+01
PB-210 A	1.2379E+00	1.9931E+00	1.9937E+00	0.161E+01
PB-212	1.4965E-01	9.6189E-02	9.6372E-02	0.618E-01
PB-214	4.8774E-01	1.5767E-01	1.5886E-01	0.763E-01
RA-226	1.9199E+01	5.9460E+00	5.9948E+00	0.471E+01
TH-234	9.3353E+01	3.6245E+00	5.1868E+00	0.152E+01
Tl-208 A	1.1096E-01	7.0738E-02	7.0875E-02	0.124E+00
U-235	7.4612E+00	2.9825E-01	4.2058E-01	0.120E+00

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

Total Activity (39.3 to 3170.7 keV) 2.7248248E+02 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Middle Tank No. 3
Ur Resin

RESI - Mallinckrodt STL Spectrum name: 1E001318.An1

Sample description
U1 (1'-3')

Spectrum Filename: C:\User\1E001318.An1

Acquisition information
Start time: 31-Jan-2013 12:17:34
Live time: 898
Real time: 900
Dead time: 0.28 %
Detector ID: 1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration
Created: 29-Jan-2013 09:27:39
Zero offset: 0.307 keV
Gain: 0.390 keV/channel
Quadratic: -8.307E-08 keV/channel^2

Efficiency Calibration
Created: 29-Jan-2013 09:24:23
Type: Polynomial
Uncertainty: 1.264 %
Coefficients: -0.311421 -4.696349 0.833724
-0.134056 0.009610 -0.000249

Library Files
Main analysis library: Mallinckrodt.Lib
Library Match Width: 0.500
Peak stripping: Library based

Analysis parameters
Analysis engine: npp32 G53W3.05
Start channel: 100 (39.30keV)
Stop channel: 8144 (3170.73keV)
Peak rejection level: 50.000%
Peak search sensitivity: 1
Sample Size: 4.7600E+02
Activity scaling factor: 1.0000E+06/(1.0000E+00* 4.7600E+02) =
2.1008E+03
Detection limit method: Critical level - ORTEC method
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum)

RESI - Mallinckrodt STL Spectrum name: 1E001318.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1165

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
38.65	54.	38.49	0.58	4.768E-02				
49.96	73.	49.87	0.93	5.310E-02				
53.34	299.	15.35	0.93	5.475E-02				
58.80	157.	39.97	1.59	5.751E-02				
63.35	5172.	1.76	0.94	7.062E-02	63.29	4.800	9.671E+01	TH234
74.32	96.	48.16	0.97	7.894E-02				
77.25	165.	26.01	0.97	7.798E-02				
84.08	480.	10.18	0.98	7.469E-02				
89.75	264.	17.73	0.99	7.207E-02				
92.62	6735.	1.45	1.00	7.091E-02	92.59	5.570	1.078E+02	TH234
98.62	384.	9.00	1.01	6.892E-02				
105.67	70.	43.56	1.02	6.712E-02				
108.94	130.	24.17	1.02	6.646E-02				
112.60	347.	10.47	1.03	6.582E-02				
120.50	112.	46.89	1.08	6.467E-02				
130.82	100.	30.66	1.29	6.350E-02				
143.74	819.	5.32	1.09	6.217E-02	143.76	10.960	7.603E+00	U235
153.61	72.	34.36	1.06	6.113E-02				
163.20	389.	9.90	1.00	6.004E-02	163.35	5.080	8.077E+00	U235
185.63	3882.	1.80	1.18	5.721E-02	185.50	57.200	7.502E+00	U235
186.24	660.	13.07	1.14	5.714E-02	186.20	3.600	2.029E+01	RA226
194.54	44.	37.39	1.54	5.600E-02				
202.06	49.	30.92	1.16	5.495E-02				
205.23	292.	7.59	1.17	5.450E-02				
238.19	72.	24.98	0.77	4.981E-02	238.63	43.300	2.105E-01	PB212
241.83	34.	44.18	1.22	4.929E-02	241.92	7.470	5.871E-01	PB214
258.20	94.	19.42	1.00	4.705E-02				
295.12	114.	14.29	1.08	4.236E-02	295.22	19.200	8.856E-01	PB214
336.58	40.	33.54	0.54	3.765E-02	338.32	11.270	5.964E-01	AC228
351.67	235.	8.24	1.33	3.635E-02	351.99	37.600	1.089E+00	PB214
577.12	21.	27.13	1.67	2.268E-02				
582.93	54.	17.77	1.67	2.246E-02	583.19	84.500	1.815E-01	Tl208
609.46	186.	10.19	1.14	2.153E-02	609.32	46.090	1.186E+00	BI214
623.53	16.	44.78	1.72	2.105E-02				

743.04	48.	27.80	1.33	1.785E-02				
766.58	151.	12.05	1.08	1.734E-02				
785.88	16.	46.66	1.90	1.695E-02	785.37	1.100	5.525E+00	BI212
809.88	9.	42.74	0.73	1.647E-02				
825.42	14.	31.94	0.69	1.619E-02				
859.73	22.	34.50	2.23	1.558E-02	860.56	12.420	7.085E-01	Tl208
911.57	18.	38.22	0.68	1.478E-02	911.20	25.800	2.986E-01	AC228
931.33	21.	28.00	0.47	1.445E-02	934.06	3.030	3.010E+00	BI214
1000.96	255.	6.84	2.34	1.357E-02	1001.03	0.842	1.412E+02	Pa234m
1120.30	40.	17.78	1.15	1.226E-02	1120.28	15.100	1.372E+00	BI214
1377.05	12.	35.36	0.95	1.018E-02	1377.67	4.000	1.864E+00	BI214
1460.37	21.	21.82	0.58	9.654E-03	1460.80	11.000	1.251E+00	K40
1764.31	18.	23.57	0.88	8.110E-03	1764.51	15.400	9.118E-01	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
98.33	38.65	126.	54.	0.060	76.98	0.585	CE-139	s
127.32	49.77	620.	73.	0.081	99.75	0.928	EU-155	lD
136.04	53.15	902.	299.	0.333	30.69	0.933	LU-177	D
150.01	58.80	756.	157.	0.175	79.93	1.587	TA-182	s
189.80	74.24	1029.	96.	0.107	96.31	0.967	BI-207	D
197.31	77.16	838.	165.	0.184	52.03	0.971	PB-214	D
215.03	84.13	952.	491.	0.547	19.95	0.982	TA-182	D
229.57	89.80	950.	273.	0.304	34.19	0.991	PB-214	D
252.13	98.55	406.	384.	0.428	18.00	1.005	PA-234	D
270.20	105.60	429.	70.	0.078	87.13	1.016	EU-155	D
278.59	108.87	426.	130.	0.144	48.34	1.021	U-235	D
287.97	112.52	487.	347.	0.387	20.93	1.027	LU-177	D
308.22	120.50	378.	112.	0.125	93.78	1.081	NP-239	s
334.69	130.82	168.	100.	0.111	61.32	1.293	PA-234	s
393.15	153.61	108.	72.	0.080	68.72	1.063	XE-138	
498.13	194.54	85.	44.	0.049	74.78	1.536	RH-106M	s
517.41	202.06	89.	49.	0.054	61.84	1.163	U-235	D
525.54	205.23	100.	292.	0.326	15.18	1.168	U-235	D
661.41	258.20	68.	94.	0.104	38.84	1.004	XE-138	
1479.36	577.28	6.	21.	0.023	55.85	1.666	KR-89	D
1598.66	623.91	17.	16.	0.018	89.56	1.721	PA-234	D
1905.34	743.04	30.	48.	0.053	55.59	1.328	PA-234	s
1965.98	766.58	46.	126.	0.140	23.53	1.878	J-134	D
2076.90	809.88	2.	9.	0.010	85.49	0.732	J-132	s
2116.77	825.42	2.	14.	0.016	63.89	0.689	PA-234	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
TH-234	161.66	63.35	1087.	5172.	5.762	3.51	0.941
TH-234	236.65	92.59	1417.	6735.	7.504	2.90	0.996D
U-235	367.83	143.74	340.	819.	0.912	10.64	1.095
U-235	417.74	163.20	299.	389.	0.434	19.79	1.000
U-235	474.94	185.50	677.	3414.	3.804	4.04	1.138D

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
RA-226	476.73	186.20	3386.	660.	0.735	26.14	1.139D
PB-212	611.21	238.63	79.	97.	0.108	32.82	1.217D
PB-214	619.65	241.92	97.	34.	0.038	88.36	1.222D
Tl-208	712.00	277.93	13.	0.	0.000	0.00	0.000s
PB-214	756.36	295.22	52.	117.	0.130	25.45	1.298D
AC-228	862.45	336.58	42.	40.	0.045	67.08	0.540s
PB-214	901.17	351.67	42.	235.	0.262	16.48	1.332s
Tl-208	1495.15	583.19	20.	54.	0.061	35.56	1.673D
BI-214	1562.55	609.46	40.	186.	0.207	20.38	1.142s
BI-212	2013.99	785.37	21.	16.	0.018	93.32	1.898D
Tl-208	2204.84	859.73	7.	22.	0.024	69.01	2.229s
AC-228	2337.91	911.57	8.	18.	0.020	76.44	0.676s
BI-214	2388.63	931.33	3.	21.	0.023	56.00	0.470s
AC-228	2485.00	968.87	3.	0.	0.000	0.00	0.000s
Pa-234m	2567.35	1000.96	9.	255.	0.284	13.69	2.344s
BI-214	2873.74	1120.30	3.	40.	0.045	35.57	1.150s
BI-214	3533.03	1377.05	2.	12.	0.013	70.71	0.947s
K-40	3747.00	1460.37	0.	21.	0.023	43.64	0.584s
BI-212	4157.00	1619.99	0.	0.	0.000	0.00	0.000s
BI-214	4527.78	1764.31	0.	18.	0.020	47.14	0.876s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g		COMMENTS
AC-228		3.8912E-01						
			911.20	2.986E-01	?(	1.093E-01	38.22	G
			968.97	0.000E+00	-	1.156E-01	0.00	G
			338.32	5.964E-01	&(	2.252E-01	33.54	G
BI-212		1.5302E+00						
			727.33	8.625E-01	%(	4.379E-01	50.90	G
			1620.50	0.000E+00	-	1.127E+00	0.00	G
			785.37	5.525E+00	(	3.599E+00	46.66	G
BI-214		1.2318E+00						
			609.32	1.186E+00	(	9.394E-02	10.19	G
			1764.51	9.118E-01	-	1.180E-01	23.57	G
			1120.28	1.372E+00	(	1.340E-01	17.78	G
			1238.11	1.300E-01	-	5.864E-01	327.87	G
			768.36	9.900E-01	-	1.987E+00	124.83	G
			934.06	3.010E+00	&	5.990E-01	28.00	G
			1377.67	1.864E+00	+	5.119E-01	35.36	G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
K-40		1.2510E+00					
			1460.80	1.251E+00	(	1.388E-01	21.82 G
Pa-234m		1.4116E+02					
			1001.03	1.412E+02	@(	3.869E+00	6.84 G
PB-210		1.5699E+00					
			46.52	1.570E+00	%(	1.619E+00	64.04 G
PB-212		2.8568E-01					
			238.63	2.857E-01	(	6.072E-02	16.41 G
			300.09	6.955E-01	+	6.561E-01	62.81 G
PB-214		1.0885E+00					
			351.99	1.089E+00	@(	6.994E-02	8.24 G
			295.22	9.085E-01	-	1.307E-01	12.72 G
			241.92	5.871E-01	-	3.940E-01	44.18 G
RA-226		2.0290E+01					
			186.20	2.029E+01	(	4.170E+00	13.07 G
TH-234		1.0268E+02					
			63.29	9.671E+01	(	1.437E+00	1.76 G
			92.59	1.078E+02	(	1.404E+00	1.45 G
Tl-208	N	7.0848E-01					
			860.56	7.085E-01	*(	2.063E-01	34.50 G
			583.19	1.814E-01	-	3.439E-02	17.78 G
			277.35	0.000E+00	-	1.891E-01	0.00 G
U-235		6.5981E+00					
			185.50	6.598E+00	(	1.171E-01	2.02 G
			143.76	7.603E+00	+	3.990E-01	5.32 G
			163.35	8.077E+00	+	8.354E-01	9.90 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
\+ - Peak activity higher than counting uncertainty range.
\- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228 #	3.8912E-01	1.9788E-01	1.9848E-01	0.109E+00
BI-212	1.5302E+00	1.0566E+00	1.0584E+00	0.438E+00
BI-214	1.2318E+00	2.5107E-01	2.5580E-01	0.939E-01
K-40	1.2510E+00	5.4598E-01	5.4824E-01	0.139E+00
Pa-234m#	1.4116E+02	1.9319E+01	2.0117E+01	0.387E+01
PB-210 A	1.5699E+00	2.0107E+00	2.0117E+00	0.162E+01
PB-212	2.8568E-01	9.3748E-02	9.4433E-02	0.607E-01
PB-214	1.0885E+00	1.7940E-01	1.8454E-01	0.699E-01
RA-226	2.0290E+01	5.3032E+00	5.3641E+00	0.417E+01
TH-234	1.0268E+02	2.3403E+00	4.7045E+00	0.144E+01
Tl-208	7.0848E-01	4.8891E-01	4.8972E-01	0.206E+00
U-235	6.5981E+00	2.6689E-01	3.7416E-01	0.117E+00

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

S U M M A R Y

Total Activity (39.3 to 3170.7 keV) 2.7721484E+02 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Top Tank No. 4
Ur Resin

RESI - Mallinckrodt STL Spectrum name: 1E001320.An1

Sample description
Tank 3 Top

Spectrum Filename: C:\User\1E001320.An1

Acquisition information

Start time:	31-Jan-2013 12:50:02
Live time:	899
Real time:	900
Dead time:	0.10 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration

Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration

Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files

Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters

Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	4.2800E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 4.2800E+02) =
	2.3364E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001320.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1339

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
40.33	33.	45.15	0.61	4.850E-02				
46.83	76.	33.22	1.08	5.167E-02	46.52	4.250	2.454E+00	PB210
53.14	121.	29.28	1.13	5.475E-02				
63.34	882.	4.38	0.99	7.061E-02	63.29	4.800	1.830E+01	TH234
69.05	54.	39.87	0.52	7.847E-02				
74.80	81.	24.42	0.97	7.879E-02				
77.28	145.	15.25	0.97	7.792E-02				
83.70	51.	43.00	0.98	7.488E-02				
89.71	59.	38.09	0.99	7.210E-02				
92.58	1078.	3.79	1.00	7.094E-02	92.59	5.570	1.917E+01	TH234
98.59	94.	21.32	1.18	6.891E-02				
105.41	29.	49.85	1.09	6.716E-02				
112.69	76.	28.95	0.79	6.579E-02				
143.70	135.	15.83	1.10	6.218E-02	143.76	10.960	1.393E+00	U235
163.19	80.	27.64	0.67	6.004E-02	163.35	5.080	1.850E+00	U235
185.68	673.	4.38	1.22	5.721E-02	185.50	57.200	1.443E+00	U235
					186.20	3.600	2.297E+01	RA226
205.22	54.	23.47	1.20	5.450E-02				
238.47	90.	14.28	1.22	4.977E-02	238.63	43.300	2.941E-01	PB212
241.81	57.	20.71	1.22	4.930E-02	241.92	7.470	1.080E+00	PB214
295.14	103.	13.40	1.62	4.236E-02	295.22	19.200	8.896E-01	PB214
339.79	30.	39.20	0.63	3.765E-02	338.32	11.270	4.911E-01	AC228
351.73	136.	11.12	1.25	3.635E-02	351.99	37.600	6.985E-01	PB214
449.82	12.	32.02	0.55	2.884E-02				
510.52	43.	22.59	1.16	2.553E-02				
583.10	37.	25.92	0.79	2.246E-02	583.19	84.500	1.363E-01	TI208
609.34	109.	10.69	1.98	2.153E-02	609.32	46.090	7.691E-01	BI214
727.81	16.	31.29	0.57	1.821E-02	727.33	6.580	9.575E-01	BI212
767.30	30.	22.71	0.63	1.730E-02	768.36	4.940	2.493E+00	BI214
785.43	11.	38.83	0.37	1.695E-02	785.37	1.100	4.081E+00	BI212
860.79	10.	31.62	1.36	1.558E-02	860.56	12.420	3.630E-01	TI208
911.23	21.	24.74	1.34	1.478E-02	911.20	25.800	3.867E-01	AC228
934.40	11.	30.15	0.39	1.445E-02	934.06	3.030	1.764E+00	BI214
1001.43	62.	14.30	1.30	1.357E-02	1001.03	0.842	3.831E+01	Pa234m

1120.88	29.	18.57	0.65	1.226E-02	1120.28	15.100	1.100E+00	BI214
1239.11	11.	30.15	1.36	1.121E-02	1238.11	5.790	1.190E+00	BI214
1378.21	7.	37.80	0.39	1.018E-02	1377.67	4.000	1.207E+00	BI214
1460.05	12.	28.87	0.58	9.654E-03	1460.80	11.000	7.936E-01	K40
1764.50	16.	25.00	0.78	8.110E-03	1764.51	15.400	8.998E-01	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
102.63	40.33	42.	33.	0.037	90.30	0.614	EU-152	
135.48	53.14	162.	121.	0.135	58.56	1.132	LU-177	s
176.29	69.05	91.	54.	0.060	79.74	0.522	TA-182	s
191.02	74.84	157.	81.	0.090	48.84	0.968	PB-214	D
197.38	77.33	171.	145.	0.161	30.49	0.971	PB-214	D
213.90	83.73	210.	52.	0.058	83.25	0.982	TA-182	D
229.33	89.75	223.	59.	0.066	75.83	0.991	PB-214	D
252.04	98.59	108.	94.	0.104	42.65	1.182	PA-234	s
269.52	105.41	72.	29.	0.032	99.70	1.088	EU-155	s
288.20	112.69	136.	76.	0.085	57.89	0.788	LU-177	
525.52	205.22	38.	54.	0.061	46.94	1.199	U-235	
1152.96	449.82	1.	12.	0.013	64.05	0.546	RH-106M	s
1308.71	510.52	11.	43.	0.048	45.17	1.160	J-133	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
PB-210	119.30	46.83	104.	76.	0.085	66.44	1.078
TH-234	161.65	63.34	214.	882.	0.980	8.76	0.989
TH-234	236.65	92.59	297.	1078.	1.199	7.58	0.996D
U-235	367.72	143.70	102.	135.	0.150	31.65	1.098
U-235	417.72	163.19	108.	80.	0.089	55.28	0.671s
U-235	474.94	185.50	142.	571.	0.635	10.25	1.138D
RA-226	476.73	186.20	585.	124.	0.138	58.04	1.139D
PB-212	611.21	238.63	38.	90.	0.100	28.54	1.217D
PB-214	619.65	241.92	40.	57.	0.063	41.14	1.221D
PB-214	756.36	295.22	30.	91.	0.101	27.00	1.298D
AC-228	870.69	339.79	25.	30.	0.033	78.39	0.632s
PB-214	901.32	351.73	22.	136.	0.151	22.24	1.255
Tl-208	1494.93	583.10	14.	37.	0.041	51.84	0.793s
BI-214	1562.25	609.34	6.	109.	0.121	21.39	1.979s
BI-212	1866.27	727.81	3.	16.	0.018	62.57	0.575s
BI-214	1967.62	767.30	4.	30.	0.034	45.42	0.628s
BI-212	2014.14	785.43	2.	11.	0.012	77.66	0.372s

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
Tl-208	2207.56	860.79	0.	10.	0.011	63.25	1.364s
AC-228	2337.03	911.23	2.	21.	0.023	49.49	1.339s
BI-214	2396.50	934.40	0.	11.	0.012	60.30	0.390s
AC-228	2484.50	968.68	2.	0.	0.000	0.00	0.454s
Pa-234m	2568.58	1001.43	4.	62.	0.069	28.60	1.299s
BI-214	2875.24	1120.88	0.	29.	0.032	37.14	0.649s
BI-214	3178.80	1239.11	0.	11.	0.012	60.30	1.363s
BI-214	3536.00	1378.21	0.	7.	0.008	75.59	0.389s
K-40	3746.20	1460.05	0.	12.	0.013	57.74	0.584s
BI-214	4528.27	1764.50	0.	16.	0.018	50.00	0.778s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g	COMMENTS
AC-228		4.1844E-01					
			911.20	3.867E-01	(	6.068E-02	24.74 G
			968.97	0.000E+00	-	1.048E-01	0.00 G
			338.32	4.911E-01	&(	1.941E-01	39.20 G
BI-212		9.7897E-01					
			727.33	9.575E-01	?(	2.230E-01	31.29 G
			1620.50	1.074E+00	%(	1.251E+00	70.71 G
			785.37	4.081E+00	+	1.292E+00	38.83 G
BI-214		8.0179E-01					
			609.32	7.691E-01	@(	4.150E-02	10.69 G
			1764.51	8.998E-01	?(	1.310E-01	25.00 G
			1120.28	1.100E+00	+	8.837E-02	18.57 G
			1238.11	1.190E+00	+	2.521E-01	30.15 G
			768.36	2.493E+00	&	3.667E-01	22.71 G
			934.06	1.764E+00	+	3.737E-01	30.15 G
			1377.67	1.207E+00	+	4.018E-01	37.80 G
K-40		7.9361E-01					
			1460.80	7.936E-01	?(	1.541E-01	28.87 G
Pa-234m		3.8307E+01					
			1001.03	3.831E+01	(	2.742E+00	14.30 G
PB-210		2.4539E+00					
			46.52	2.454E+00	(	7.604E-01	33.22 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
PB-212		2.9747E-01					
			238.63	2.943E-01	(	4.673E-02	14.27 G
			300.09	3.391E-01	%(	5.357E-01	103.49 G
PB-214		7.2809E-01					
			351.99	6.985E-01	(	5.641E-02	11.12 G
			295.22	7.861E-01	(	1.102E-01	13.50 G
			241.92	1.086E+00	+	2.814E-01	20.57 G
RA-226		4.2326E+00					
			186.20	4.233E+00	(	1.924E+00	29.02 G
TH-234		1.8766E+01					
			63.29	1.830E+01	(	7.084E-01	4.38 G
			92.59	1.917E+01	(	7.131E-01	3.79 G
Tl-208	N	3.6302E-01					
			860.56	3.630E-01	?(	8.458E-02	31.62 G
			583.19	1.363E-01	-	3.246E-02	25.92 G
			277.35	1.083E-01	&	2.515E-01	159.70 G
U-235		1.2512E+00					
			185.50	1.224E+00	(	5.967E-02	5.13 G
			143.76	1.393E+00	(	2.424E-01	15.83 G
			163.35	1.850E+00	+	5.569E-01	27.64 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
\+ - Peak activity higher than counting uncertainty range.
\- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:
T - Thermal Neutron Activation
F - Fast Neutron Activation

Peak Codes:
G - Gamma Ray
X - X-Ray

RESI - Mallinckrodt STL Spectrum name: 1E001320.An1

I - Fission Product
N - Naturally Occurring Isotope
P - Photon Reaction
C - Charged Particle Reaction
M - No MDA Calculation
R - Coincidence Corrected
H - Halflife limit exceeded
P - Positron Decay
S - Single-Escape
D - Double-Escape
K - Key Line
A - Not in Average
C - Coincidence Peak

- -

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g	MDA pCi/g
AC-228	4.1844E-01	1.9396E-01	1.9467E-01	0.607E-01
BI-212 #	9.7897E-01	6.1254E-01	6.1378E-01	0.223E+00
BI-214	8.0179E-01	1.7150E-01	1.7443E-01	0.415E-01
K-40 #	7.9361E-01	4.5819E-01	4.5928E-01	0.154E+00
Pa-234m	3.8307E+01	1.0955E+01	1.1061E+01	0.274E+01
PB-210	2.4539E+00	1.6303E+00	1.6332E+00	0.760E+00
PB-212	2.9747E-01	8.4898E-02	8.5718E-02	0.467E-01
PB-214	7.2809E-01	1.2736E-01	1.3060E-01	0.564E-01
RA-226	4.2326E+00	2.4566E+00	2.4624E+00	0.192E+01
TH-234	1.8766E+01	1.0868E+00	1.3181E+00	0.708E+00
Tl-208	3.6302E-01	2.2959E-01	2.3004E-01	0.846E-01
U-235	1.2512E+00	1.2830E-01	1.3760E-01	0.597E-01

\# - All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

Total Activity (39.3 to 3170.7 keV) 6.9392601E+01 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Top Tank No. 5
Ra-Th Resin

RESI - Mallinckrodt STL Spectrum name: 1E001314.An1

Sample description
Tank 2 RA Top

Spectrum Filename: C:\User\1E001314.An1

Acquisition information

Start time:	31-Jan-2013 11:00:32
Live time:	899
Real time:	900
Dead time:	0.09 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration

Filename:	DE3F09~1.CLB

Detector #1 47-TN41706A Calibration_20130129

Energy Calibration

Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration

Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files

Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters

Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	4.9000E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 4.9000E+02) =
	2.0408E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001314.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.0990

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
46.68	88.	22.38	2.42	5.152E-02	46.52	4.250	2.465E+00	PB210
52.96	57.	43.93	1.04	5.466E-02				
63.34	201.	11.11	0.95	7.024E-02	63.29	4.800	3.652E+00	TH234
74.81	179.	12.22	0.97	7.880E-02				
77.16	265.	9.15	0.97	7.799E-02				
87.09	124.	15.30	0.99	7.324E-02				
90.00	71.	25.12	0.99	7.195E-02				
92.67	273.	8.69	1.00	7.088E-02	92.59	5.570	4.243E+00	TH234
98.83	60.	36.55	0.48	6.884E-02				
120.80	25.	43.81	1.09	6.464E-02				
129.23	32.	43.74	1.05	6.367E-02				
186.14	298.	7.70	1.04	5.714E-02	186.20	3.600	8.887E+00	RA226
209.16	70.	22.61	1.15	5.394E-02				
238.53	248.	7.40	1.22	4.977E-02	238.63	43.300	7.070E-01	PB212
241.78	88.	16.52	1.22	4.931E-02	241.92	7.470	1.468E+00	PB214
259.21	20.	47.95	1.25	4.689E-02				
270.12	50.	32.25	1.29	4.548E-02				
277.55	31.	40.10	0.58	4.455E-02	277.35	6.310	6.765E-01	Tl208
295.11	159.	12.81	1.12	4.237E-02	295.22	19.200	1.197E+00	PB214
338.30	133.	15.91	1.46	3.765E-02	338.32	11.270	1.923E+00	AC228
351.68	326.	6.39	1.41	3.635E-02	351.99	37.600	1.464E+00	PB214
583.17	74.	23.17	0.58	2.246E-02	583.19	84.500	2.392E-01	Tl208
609.23	299.	6.63	1.56	2.154E-02	609.32	46.090	1.848E+00	BI214
675.92	9.	47.25	1.03	1.951E-02				
727.35	48.	20.12	1.47	1.821E-02	727.33	6.580	2.475E+00	BI212
768.98	44.	24.85	0.81	1.730E-02	768.36	4.940	3.135E+00	BI214
786.35	20.	37.42	1.15	1.695E-02	785.37	1.100	6.580E+00	BI212
904.55	15.	32.12	2.02	1.488E-02				
911.22	102.	11.08	2.02	1.478E-02	911.20	25.800	1.633E+00	AC228
918.60	9.	43.43	2.03	1.467E-02				
934.46	26.	29.16	1.36	1.445E-02	934.06	3.030	3.642E+00	BI214
969.06	45.	24.04	0.77	1.398E-02	968.97	15.800	1.250E+00	AC228
1119.87	81.	11.91	1.20	1.227E-02	1120.28	15.100	2.683E+00	BI214
1460.33	25.	20.00	0.78	9.654E-03	1460.80	11.000	1.444E+00	K40

1764.77	33.	19.70	0.52	8.110E-03	1764.51	15.400	1.637E+00	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide
135.02	52.96	95.	57.	0.063	87.86	1.036	LU-177 s

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
191.06	74.80	150.	179.	0.199	24.43	0.968	PB-214	D
197.09	77.15	160.	265.	0.294	18.29	0.971	PB-214	D
222.84	87.17	117.	126.	0.140	30.25	0.987	PB-214	D
230.31	90.08	126.	67.	0.075	52.93	0.992	PB-214	D
252.64	98.83	132.	60.	0.067	73.11	0.485	PA-234	s
309.00	120.80	43.	25.	0.028	87.62	1.094	NP-239	
330.62	129.22	81.	32.	0.035	87.47	1.053	AC-228	D
535.62	209.16	56.	70.	0.077	45.21	1.147	AC-228	
664.00	259.40	35.	20.	0.022	95.89	1.247	XE-138	D
691.98	270.12	63.	50.	0.056	64.50	1.291	AC-228	s
1733.10	675.92	5.	9.	0.010	94.49	1.032	AU-198	s
2319.99	904.57	5.	15.	0.017	64.72	2.016	KR-89	D
2356.05	918.62	3.	9.	0.010	87.39	2.029	LA-140	D

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
PB-210	118.92	46.68	50.	88.	0.098	44.77	2.422s
TH-234	161.51	63.29	169.	201.	0.224	23.05	0.949D
TH-234	236.65	92.59	156.	273.	0.304	17.70	0.996D
RA-226	476.73	186.20	65.	299.	0.333	13.84	1.139D
PB-212	611.21	238.63	45.	248.	0.276	14.81	1.217D
PB-214	619.65	241.92	68.	88.	0.098	33.94	1.221D
Tl-208	711.04	277.55	39.	31.	0.034	80.19	0.576s
PB-214	756.36	295.22	54.	149.	0.166	21.55	1.298D
AC-228	866.88	338.30	70.	133.	0.148	31.83	1.465s
PB-214	901.21	351.68	27.	326.	0.363	12.78	1.405s
Tl-208	1495.11	583.17	44.	74.	0.082	46.34	0.585s
BI-214	1561.96	609.23	21.	299.	0.333	13.27	1.555s
BI-212	1865.08	727.35	9.	48.	0.054	40.24	1.472
BI-214	1971.92	768.98	15.	44.	0.049	49.71	0.812s
BI-212	2016.50	786.35	9.	20.	0.022	74.83	1.152s
AC-228	2336.95	911.20	12.	102.	0.113	22.16	2.021D
BI-214	2396.65	934.46	7.	26.	0.029	58.33	1.359s
AC-228	2485.47	969.06	18.	45.	0.050	48.07	0.773s
BI-214	2872.64	1119.87	3.	81.	0.090	23.81	1.204s
K-40	3746.92	1460.33	0.	25.	0.028	40.00	0.779s
BI-212	4157.00	1619.99	0.	0.	0.000	0.00	0.000s
BI-214	4528.95	1764.77	3.	33.	0.037	39.40	0.520s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g	COMMENTS
AC-228		1.7209E+00					
			911.20	1.633E+00	(	1.324E-01	11.08 G
			968.97	1.250E+00	-	2.745E-01	24.04 G
			338.32	1.923E+00	*(	2.818E-01	15.91 G
BI-212		2.4747E+00					
			727.33	2.475E+00	(	3.512E-01	20.12 G
			1620.50	0.000E+00	-	1.093E+00	0.00 G
			785.37	6.580E+00	&	2.300E+00	37.42 G
BI-214		1.7954E+00					
			609.32	1.848E+00	(	6.600E-02	6.63 G
			1764.51	1.637E+00	?(	1.869E-01	19.70 G
			1120.28	2.683E+00	+	1.337E-01	11.91 G
			1238.11	4.096E-01	-	8.991E-01	161.17 G
			768.36	3.135E+00	+	6.550E-01	24.85 G
			934.06	3.642E+00	+	8.635E-01	29.16 G
			1377.67	-1.757E-01	-	1.367E+00	601.19 G
K-40		1.4441E+00					
			1460.80	1.444E+00	?(	1.346E-01	20.00 G
Pa-234m		2.8627E+00					
			1001.03	2.863E+00	%(	1.615E+00	58.63 G
PB-210		2.4655E+00					
			46.52	2.465E+00	*(	4.616E-01	22.38 G
PB-212		7.0699E-01					
			238.63	7.070E-01	(	4.438E-02	7.40 G
			300.09	5.051E-01	-	6.840E-01	87.44 G
PB-214		1.4650E+00					
			351.99	1.464E+00	*(	5.438E-02	6.39 G
			295.22	1.123E+00	-	1.294E-01	10.77 G
			241.92	1.469E+00	(	3.197E-01	16.97 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
RA-226		8.9248E+00					
			186.20	8.925E+00	(	5.591E-01	6.92 G
TH-234		3.9685E+00					
			63.29	3.652E+00	(	5.486E-01	11.52 G
			92.59	4.241E+00	(	4.514E-01	8.85 G
Tl-208	N	2.6134E-01					
			860.56	2.008E-01	&(	2.523E-01	106.18 G
			583.19	2.392E-01	(	4.997E-02	23.17 G
			277.35	6.765E-01	*(	3.175E-01	40.10 G
U-235		5.5129E-02					
			185.50	2.568E-02	%(	8.113E-02	193.68 G
			143.76	2.251E-01	&(	1.841E-01	62.38 G
			163.35	2.012E-02	%(	2.199E-01	583.10 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
\+ - Peak activity higher than counting uncertainty range.
\- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

RESI - Mallinckrodt STL Spectrum name: 1E001314.An1

***** S U M M A R Y C F N U C L I D E S I N S A M P L E *****

Nuclide		Time of Count Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g	MDA pCi/g
AC-228		1.7209E+00	3.3370E-01	3.4064E-01	0.132E+00
BI-212		2.4747E+00	9.9576E-01	1.0006E+00	0.351E+00
BI-214		1.7954E+00	2.3822E-01	2.4868E-01	0.660E-01
K-40	#	1.4441E+00	5.7762E-01	5.8047E-01	0.135E+00
Pa-234m	#	2.8627E+00	3.3568E+00	3.3587E+00	0.161E+01
PB-210	#	2.4655E+00	1.1037E+00	1.1081E+00	0.462E+00
PB-212		7.0699E-01	1.0467E-01	1.0838E-01	0.444E-01
PB-214		1.4650E+00	1.8723E-01	1.9608E-01	0.544E-01
RA-226		8.9248E+00	1.2350E+00	1.2850E+00	0.559E+00
TH-234		3.9685E+00	5.7663E-01	5.9781E-01	0.549E+00
Tl-208	C	2.6134E-01	1.2111E-01	1.2155E-01	0.252E+00
U-235	A	5.5129E-02	6.8774E-02	6.8809E-02	0.811E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

Total Activity (39.3 to 3170.7 keV) 2.4965755E+01 pCi/g

Analyzed by: _____
Chris Bryson

Reviewed by: _____ 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL

Top Tank No. 6
Ra-Th Resin

RESI - Mallinckrodt STL Spectrum name: 1E001317.An1

Sample description
Tank 4 RA Top STDC

Spectrum Filename: C:\User\1E001317.An1

Acquisition information
Start time:	31-Jan-2013 12:01:33
Live time:	899
Real time:	900
Dead time:	0.09 %
Detector ID:	1

Detector system
Detector #1 47-TN41706A

Calibration
Filename: DE3F09~1.CLB
Detector #1 47-TN41706A Calibration_20130129

Energy Calibration
Created:	29-Jan-2013 09:27:39
Zero offset:	0.307 keV
Gain:	0.390 keV/channel
Quadratic:	-8.307E-08 keV/channel^2

Efficiency Calibration
Created:	29-Jan-2013 09:24:23
Type:	Polynomial
Uncertainty:	1.264 %
Coefficients:	-0.311421 -4.696349 0.833724
	-0.134056 0.009610 -0.000249

Library Files
Main analysis library:	Mallinckrodt.Lib
Library Match Width:	0.500
Peak stripping:	Library based

Analysis parameters
Analysis engine:	npp32 G53W3.05
Start channel:	100 (39.30keV)
Stop channel:	8144 (3170.73keV)
Peak rejection level:	50.000%
Peak search sensitivity:	1
Sample Size:	4.8200E+02
Activity scaling factor:	1.0000E+06/(1.0000E+00* 4.8200E+02)=
	2.0747E+03
Detection limit method:	Critical level - ORTEC method
Random error:	1.0000000E+00
Systematic error:	1.0000000E+00
Fraction Limit:	0.000%
Background width:	best method (based on spectrum).

RESI - Mallinckrodt STL Spectrum name: 1E001317.An1

Half lives decay limit: 12.000
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	NO	
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

Energy Calibration
Normalized diff: 0.1662

***** S U M M A R Y O F P E A K S I N R A N G E *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. pCi/g	Nuc
63.78	94.	24.12	1.08	7.164E-02	63.29	4.800	1.733E+00	TH234
74.79	161.	12.97	0.97	7.880E-02				
77.20	225.	10.28	0.97	7.797E-02				
84.08	41.	38.02	0.98	7.471E-02				
86.99	45.	37.94	0.99	7.333E-02				
89.80	88.	19.96	0.99	7.207E-02				
92.65	45.	46.72	1.00	7.094E-02	92.59	5.570	7.124E-01	TH234
93.16	123.	15.59	1.00	7.073E-02				
105.68	35.	34.64	1.36	6.710E-02				
128.97	51.	32.38	1.80	6.370E-02				
143.20	42.	40.51	1.63	6.217E-02	143.76	10.960	3.844E-01	U235
186.10	308.	7.55	0.98	5.715E-02	186.20	3.600	9.353E+00	RA226
209.34	66.	17.97	0.98	5.392E-02				
238.49	157.	10.84	1.22	4.978E-02	238.63	43.300	4.553E-01	PB212
242.04	75.	19.43	1.22	4.928E-02	241.92	7.470	1.277E+00	PB214
295.04	177.	11.68	1.49	4.237E-02	295.22	19.200	1.356E+00	PB214
327.76	50.	23.01	0.78	3.872E-02				
338.22	161.	11.89	1.58	3.766E-02	338.32	11.270	2.366E+00	AC228
351.86	306.	7.32	1.45	3.634E-02	351.99	37.600	1.397E+00	PB214
409.42	24.	41.31	0.87	3.155E-02				
463.18	61.	22.59	1.63	2.804E-02				
510.26	50.	23.93	0.69	2.554E-02				
583.29	66.	19.20	1.53	2.245E-02	583.19	84.500	2.169E-01	Tl208
609.34	268.	7.09	1.31	2.153E-02	609.32	46.090	1.683E+00	BI214
716.17	12.	47.83	0.70	1.847E-02				
767.15	31.	31.62	0.37	1.730E-02	768.36	4.940	2.274E+00	BI214
911.12	142.	9.71	1.76	1.478E-02	911.20	25.800	2.313E+00	AC228
935.63	32.	29.13	0.75	1.445E-02	934.06	3.030	4.604E+00	BI214
968.08	82.	20.77	2.79	1.398E-02	968.97	15.800	2.315E+00	AC228
1001.17	19.	22.94	0.78	1.357E-02	1001.03	0.842	1.037E+01	Pa234m
1119.68	62.	14.77	1.31	1.226E-02	1120.28	15.100	2.082E+00	BI214
1237.64	22.	25.37	0.98	1.121E-02	1238.11	5.790	2.146E+00	BI214
1377.87	17.	24.25	0.65	1.018E-02	1377.67	4.000	2.603E+00	BI214
1458.63	29.	27.66	1.09	9.654E-03	1460.80	11.000	1.683E+00	K40

1729.76	15.	25.82	1.17	8.263E-03				
1763.92	37.	16.44	0.97	8.110E-03	1764.51	15.400	1.847E+00	BI214

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide	
191.00	74.78	139.	161.	0.180	25.95	0.968	PB-214	D

RESI - Mallinckrodt STL Spectrum name: 1E001317.An1

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
197.17	77.19	155.	225.	0.250	20.55	0.971	PB-214	D
214.96	84.08	101.	40.	0.044	78.43	0.982	TA-182	D
222.42	86.99	125.	46.	0.052	74.04	0.987	TB-160	D
229.63	89.80	111.	89.	0.099	39.78	0.991	PB-214	D
238.26	93.16	152.	93.	0.104	42.75	0.997	U-235	D
270.23	105.68	48.	35.	0.039	69.28	1.364	EU-155	s
329.96	128.97	79.	51.	0.057	64.76	1.801	AC-228	s
536.08	209.34	32.	66.	0.073	35.94	0.982	AC-228	
839.84	327.76	26.	50.	0.056	46.01	0.776	AC-228	s
1049.31	409.42	28.	24.	0.027	82.61	0.872	AC-228	s
1187.24	463.18	27.	61.	0.068	45.17	1.634	AC-228	
1308.03	510.26	22.	50.	0.055	47.86	0.694	J-133	s
1836.39	716.17	8.	12.	0.013	95.65	0.705	RH-106M	s
4439.00	1729.76	0.	15.	0.017	51.64	1.168	BI-214	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.

This section based on library: Mallinckrodt.Lib

********** I D E N T I F I E D P E A K S U M M A R Y **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV
TH-234	162.78	63.78	84.	94.	0.105	48.24	1.076s
TH-234	236.65	92.59	200.	45.	0.050	93.44	0.996D
U-235	366.45	143.20	45.	42.	0.047	81.02	1.633s
U-235	418.13	163.35	46.	0.	0.000	0.00	1.105D
RA-226	476.73	186.20	55.	329.	0.366	12.74	1.139D
PB-212	611.21	238.63	67.	157.	0.175	21.67	1.217D
PB-214	619.65	241.92	79.	76.	0.084	40.32	1.222D
PB-214	756.36	295.22	53.	161.	0.179	20.35	1.298D
AC-228	866.66	338.22	56.	161.	0.179	23.78	1.577s
PB-214	901.65	351.86	51.	306.	0.340	14.64	1.453
Tl-208	1495.41	583.29	21.	66.	0.073	38.39	1.530s
BI-214	1562.26	609.34	22.	268.	0.298	14.17	1.312
BI-214	1967.23	767.15	16.	31.	0.035	63.25	0.369s
BI-212	2013.00	784.98	3.	0.	0.000	0.00	0.000s
AC-228	2336.75	911.12	10.	142.	0.157	19.42	1.760s
BI-214	2399.66	935.63	10.	32.	0.036	58.26	0.747s
AC-228	2482.95	968.08	39.	82.	0.091	41.54	2.787s
Pa-234m	2567.90	1001.17	0.	19.	0.021	45.88	0.779s
BI-214	2872.14	1119.68	4.	62.	0.069	29.53	1.309s
BI-214	3175.03	1237.64	3.	22.	0.025	50.75	0.984s
BI-214	3535.12	1377.87	0.	17.	0.019	48.51	0.649s

RESI - Mallinckrodt STL Spectrum name: 1E001317.An1

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
K-40	3742.55	1458.63	7.	29.	0.032	55.33	1.090s
BI-214	4526.76	1763.92	0.	37.	0.041	32.88	0.973s

s - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

- Nuclide - Name	Code	Average Activity pCi/g	Peak Energy keV	Peak Activity pCi/g	Code	Peak MDA Value pCi/g	COMMENTS
AC-228		2.3252E+00					
			911.20	2.313E+00	@(	1.234E-01	9.71 G
			968.97	2.315E+00	(	4.108E-01	20.77 G
			338.32	2.366E+00	(	2.563E-01	11.89 G
BI-212		6.4193E-01					
			727.33	6.419E-01	&(	4.142E-01	58.03 G
			1620.50	2.383E-01	-	1.111E+00	111.80 G
			785.37	0.000E+00	-	1.350E+00	0.00 G
BI-214		1.8194E+00					
			609.32	1.683E+00	(	6.893E-02	7.09 G
			1764.51	1.847E+00	?(	1.163E-01	16.44 G
			1120.28	2.082E+00	(	1.602E-01	14.77 G
			1238.11	2.146E+00	?(	3.656E-01	25.37 G
			768.36	2.274E+00	&	6.766E-01	31.62 G
			934.06	4.604E+00	&	1.032E+00	29.13 G
			1377.67	2.603E+00	+	3.568E-01	24.25 G
K-40		1.6833E+00					
			1460.80	1.683E+00	&(	3.705E-01	27.66 G
Pa-234m		1.0367E+01					
			1001.03	1.037E+01	?(	1.271E+00	22.94 G
PB-210		7.9745E-01					
			46.52	7.974E-01	%(	4.452E-01	51.51 G
PB-212		4.5544E-01					
			238.63	4.554E-01	(	5.508E-02	10.84 G
			300.09	6.758E-01	+	6.573E-01	64.50 G
PB-214		1.3349E+00					
			351.99	1.397E+00	(	7.597E-02	7.32 G
			295.22	1.232E+00	(	1.304E-01	10.17 G
			241.92	1.285E+00	(	3.510E-01	20.16 G

Nuclide		Ave activity	Energy	Activity	Code	Peak MDA	Comments
RA-226		9.9671E+00					
			186.20	9.967E+00	(	5.239E-01	6.37 G
TH-234		1.7327E+00					
			63.29	1.733E+00	*(	3.936E-01	24.12 G
			92.59	7.124E-01	-	5.198E-01	46.72 G
Tl-208	N	2.4228E-01					
			860.56	2.901E-01	%(	1.502E-01	50.92 G
			583.19	2.169E-01	@(	3.509E-02	19.20 G
			277.35	4.880E-01	&(	3.058E-01	54.64 G
U-235		6.5992E-02					
			185.50	4.987E-03	%(	8.530E-02	1040.01 G
			143.76	3.844E-01	&(	1.430E-01	40.51 G
			163.35	0.000E+00	-	3.232E-01	0.00 G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
\+ - Peak activity higher than counting uncertainty range.
\- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

RESI - Mallinckrodt STL Spectrum name: 1E001317.An1

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide	Time of Count Activity pCi/g	Uncertainty 2 Sigma Counting pCi/g	Total pCi/g	MDA pCi/g
AC-228	2.3252E+00	4.0031E-01	4.1084E-01	0.123E+00
BI-212 #	6.4193E-01	7.4502E-01	7.4546E-01	0.414E+00
BI-214	1.8194E+00	2.5785E-01	2.6780E-01	0.689E-01
K-40 #	1.6833E+00	9.3130E-01	9.3370E-01	0.370E+00
Pa-234m#	1.0367E+01	4.7568E+00	4.7746E+00	0.127E+01
PB-210	7.9745E-01	8.2150E-01	8.2211E-01	0.445E+00
PB-212	4.5544E-01	9.8711E-02	1.0036E-01	0.551E-01
PB-214	1.3349E+00	1.9539E-01	2.0247E-01	0.760E-01
RA-226	9.9671E+00	1.2701E+00	1.3304E+00	0.524E+00
TH-234	1.7327E+00	8.3579E-01	8.3862E-01	0.394E+00
Tl-208 #	2.4228E-01	9.3013E-02	9.3510E-02	0.150E+00
U-235 A	6.5992E-02	5.3468E-02	5.3532E-02	0.853E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

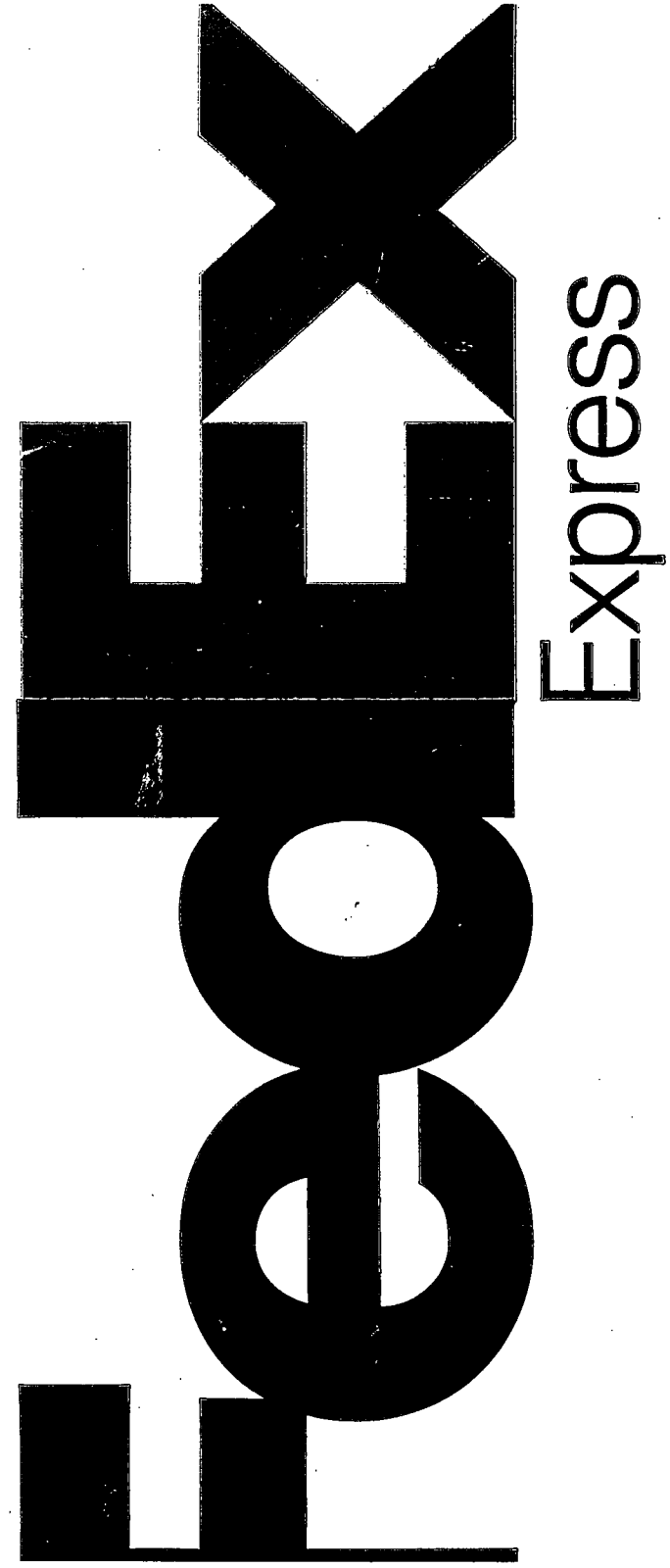
S U M M A R Y

Total Activity (39.3 to 3170.7 keV) 2.9927547E+01 pCi/g

Analyzed by: Chris Bryson

Reviewed by: 3-4-2013
Supervisor

Laboratory: RESI - Mallinckrodt STL



From: (314) 654-3462
BARBARA L JOHNSON
Tyco Mallinckrodt
675 McDonnell Blvd

Hazelwood, MO 63042

Origin ID: ALNA

FedEx Express

J1311302120326

Ship Date: 26MAR13
ActWgt: 1.0 LB
CAD: 3742267/INET3370

Delivery Address Bar Code

SHIP TO: (301) 415-7000 BILL SENDER

John Buckley
US Nuclear Regulatory Commission
Two White Flint North Building
11545 Rockville Pike
WASHINGTON, DC 20555

T- 8K5

Ref # 008011420677-6656
Invoice #
PO #
Dept #

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TRK# 0201 7993 7188 9080

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