Demonstration of Capability

Method: EPA 900.0 SOPs: GAB-Prep01, GAB-AN01

Prep Analyst: John Doe Analyst Signature: John Doe

Inst. Analyst: John Doe Analyst Signature: John Doe

Matrix: Drinking Water Units: pCi/L Reviewed by: Jane Roe

Date of Study: 6/25/2019 QA Dept. Approval: Alma Joe

Instrument ID: GFPC

Parameter	PQL	DOC Spike	MB1 Result	MB2 Result	MB3 Result	MB4 Result	LCS1	LCS2	LCS3	LCS4	%REC #1	%REC #2	%REC #3	%REC #4	Avg. %REC	Std. Dev.	%Recovery Limits		Std. Dev. Limit
Gross Alpha	3.0	14.79	0.363	-0.047	0.278	-0.061	14.395	14.518	14.160	13.059	97.34	98.17	95.75	88.30	94.89	4.50	80	120	20.00
Gross Beta	4.0	17.86	0.630	0.072	0.053	0.084	16.013	16.869	15.223	16.276	89.68	94.47	85.25	91.15	90.14	3.82	80	120	20.00

Comments: ***Gross alpha MCL = 15 pCi/L. LCS spike levels between the DL and MCL*** ✓
Gross beta MCL is dose-dependent. Screening level is typically 50 pCi/L

Calculate SDWA DL for LCS1 and confirm it is ≤ gross alpha DL (3.0 pCi/L). LCS1 parameters for calculation (see pp 4-5):
t_S = sample count time = 300 min
t_B = background count time = 1000 min
B = background count rate = 0.0240 cpm
ε = efficiency (for detector #67) = 19.16%
V = sample aliquot volume = 0.20018 L

$$DL = \frac{\frac{1.96^2}{2t_s} \times \left[1 + \sqrt{1 + \frac{4t_s^2}{1.96^2} \times B \times \left(\frac{1}{t_s} + \frac{1}{t_B}\right)}\right]}{\varepsilon \times V \times 2.22} = \frac{\frac{3.8416}{600} \times \left[1 + \sqrt{1 + \frac{360000}{3.8416} \times 0.0240 \times \left(\frac{1}{300} + \frac{1}{1000}\right)}\right]}{0.1916 \times 0.20018 \times 2.22}$$

DL = 0.321 pCi/L, below the gross alpha regulatory DL of 3.0 pCi/L ✓

Gross Alpha and Gross Beta Preparation Logbook

Batch: *GAB-JD-DOC* Matrix: *Drinking Water* Spike Analyst: *John Doe* Prep Date/Time: *6/19/19 @ 12:30 pm*
QC ID: alpha: *19-027* beta: *19-004* LCS QC Volume: *0.1 mL* MS/MSD QC Volume: *NA*
Balance ID: *B-614922* Pipette ID: *MV-1*

Bottle ID	Sample No.	Solid Test Tare Mass (g)	Solid Test Mass Gross (g)	mL Ck	Spot Ck Target mL	Sample Aliquot (g)	Analysis Tare Mass (g)	Analysis Gross Mass (g)	Comments
N/A	MB1	N/A	N/A	N/A	N/A	203.70	9.31798	9.31802	
N/A	MB2	N/A	N/A	N/A	N/A	206.56	9.34764	9.34766	
N/A	MB3	N/A	N/A	N/A	N/A	201.76	9.38336	9.38340	
N/A	MB4	N/A	N/A	N/A	N/A	203.70	9.31626	9.31629	
N/A	LCS1	N/A	N/A	N/A	N/A	200.18	9.24946	9.24953	
N/A	LCS2	N/A	N/A	N/A	N/A	202.18	9.28643	9.28646	
N/A	LCS3	N/A	N/A	N/A	N/A	201.50	9.34939	9.34940	
N/A	LCS4	N/A	N/A	N/A	N/A	203.96	9.34520	9.24529	

Reagents:

Conc. HNO_3: *RF19-10475* Date Placed in Oven: *6/19/19@1700* Date Removed from Oven: *6/20/19@1450*
Oven ID: *14* Temp. In: *107 °C* Temp. Out: *107 °C*

Often, sample 'aliquots' are weighed. For LCS1, the aliquot is 200.18 g. Assuming a density of 1.00 g/mL, this equates to 200.18 mL volume. Residue masses after sample evaporation are very low (< 0.1 mg) due to preparation of method blanks and LCSs in reagent water. EPA Method 900.0, Rev. 1.0 incorporates a salt matrix so QC elements are more representative of real samples.

Gross Alpha and Gross Beta Analysis

Sample ID	Detector #	Begin Analysis Date/Time	Batch ID	Alpha cpm	Beta cpm	Sample Count time (min)
MB1	63	6/25/2019 0813	GAB-JD-DOC	0.06	0.42	300
MB2	64	6/25/2019 0813	GAB-JD-DOC	0.026666667	0.27	300
MB3	65	6/25/2019 0912	GAB-JD-DOC	0.05	0.316666667	300
MB4	66	6/25/2019 0813	GAB-JD-DOC	0.033333333	0.356666667	300
LCS1	67	6/25/2019 0813	GAB-JD-DOC	1.25	4.313333333	300
LCS2	68	6/25/2019 0814	GAB-JD-DOC	1.283333333	4.356666667	300
LCS3	69	6/25/2019 0814	GAB-JD-DOC	1.26	4.056666667	300
LCS4	70	6/25/2019 0814	GAB-JD-DOC	1.173333333	4.233333333	300

Sample count data. LCS1 is counted on Detector #67. Each detector has its own calibration efficiency and crosstalk determination. "cpm" is the count rate in counts per minute. See pp 8-9 for examples of an efficiency calibration curve and fit equations.

Also note: Time of preparation on pg. 2 was 6/19/19 at 12:30 pm. On this page, analysis was performed on 6/25/19 at 8:13 am. That's almost six full days (~140 hrs.). For the LCS/LFBs spiked with standard Th-230, it makes no difference. EPA Method 900.0 says to hold samples 'at least 72 hours' after preparation before counting. That specification can cause problems depending on which alpha emitters may be present in real samples. If drinking water data packages show MCL exceedances, recommend that the lab stick to the 72-hour limit and not hold prepared samples for longer periods of time.

Gross Alpha and Gross Beta Analysis
(Report Summary)

Test Code: Alpha_Beta
Prep Start Date/Time: 6/19/2019@12:30
Prep Finish: 6/19/2019
Reporting Units: pCi

Analyst: JD
Prep SOP: GAB-Prep01
Analysis SOP: GAB-AN01
Sigma: 1.96

LCS Spike ID: alpha – 19-027; LCS Vol: 0.1 mL
beta – 19-004; LCS Vol: 0.1 mL
Zero Factor: 2.71

Sample ID	Aliquot	Units	Tare (g)	Gross (g)	Residue (mg)	Det. ID	Count Date	Alpha Gross cpm	Beta Gross cpm	Count Time (min)	Alpha Bkgd cpm	Beta Bkgd cpm	Bkgd Count Time (min)	Activity Units	Bkgd Count Date
MB1	0.20370	L	9.31798	9.31802	0.04	63	6/25/2019 08:13	0.0600	0.4200	300	0.0270	0.2780	1000	pCi	6/21/2019 17:54
MB2	0.20656	L	9.34764	9.34766	0.02	64	6/25/2019 08:13	0.0267	0.2700	300	0.0310	0.2570	1000	pCi	6/21/2019 18:30
MB3	0.20176	L	9.38336	9.38340	0.04	65	6/25/2019 09:12	0.0500	0.3167	300	0.0250	0.2950	1000	pCi	6/21/2019 18:30
MB4	0.20370	L	9.31626	9.31629	0.03	66	6/25/2019 08:13	0.0333	0.3567	300	0.0390	0.3420	1000	pCi	6/21/2019 18:30
LCS1	0.20018	L	9.24946	9.24953	0.07	67	6/25/2019 08:13	1.2500	4.3133	300	0.0240	0.3980	1000	pCi	6/21/2019 18:30
LCS2	0.20218	L	9.28643	9.28646	0.03	68	6/25/2019 08:14	1.2833	4.3567	300	0.0140	0.3180	1000	pCi	6/21/2019 18:31
LCS3	0.20150	L	9.34939	9.34940	0.01	69	6/25/2019 08:14	1.2600	4.0567	300	0.0120	0.3780	1000	pCi	6/21/2019 18:31
LCS4	0.20396	L	9.34520	9.24529	0.09	70	6/25/2019 08:14	1.1733	4.2333	300	0.0300	0.3820	1000	pCi	6/21/2019 18:31

Net alpha cpm = gross alpha cpm – alpha bkgd
= 1.25 cpm – 0.0240 cpm
= 1.226 cpm (as shown on next page)

Gross Alpha and Gross Beta Analysis
(Report Summary)

Test Code: Alpha_Beta
Prep Start Date/Time: 6/19/2019@12:30
Prep Finish: 6/19/2019

Analyst: JD
Prep SOP: GAB-Prep01
Analysis SOP: GAB-AN01

Gross Alpha Results

Sample ID	Alpha Activity	Two-Sigma Count Uncertainty	Two-Sigma CSU	MDC	Critical Value	Units	Net Alpha cpm	Residue (mg)	Beta-to Alpha Xtalk cpm	Xtalk-corrected Net Alpha cpm	Alpha efficiency	Activity conversion (cpm to pCi)
MB1	0.363	0.325	0.331	0.585	0.196	pCi/L	0.033	0.04	0.000000	0.033	20.10%	2.22
MB2	-0.047	0.231	0.231	0.606	0.206	pCi/L	-0.004	0.02	0.000000	-0.004	20.26%	2.22
MB3	0.278	0.302	0.306	0.573	0.191	pCi/L	0.025	0.04	0.000000	0.025	20.07%	2.22
MB4	-0.061	0.261	0.261	0.673	0.233	pCi/L	-0.006	0.03	0.000000	-0.006	20.38%	2.22
LCS1	14.395	1.490	2.975	0.594	0.198	pCi/L	1.226	0.07	0.000000	1.226	19.16%	2.22
LCS2	14.518	1.469	2.983	0.467	0.147	pCi/L	1.269	0.03	0.000000	1.269	19.48%	2.22
LCS3	14.160	1.443	2.915	0.436	0.135	pCi/L	1.248	0.01	0.000000	1.248	19.70%	2.22
LCS4	13.059	1.405	2.726	0.634	0.215	pCi/L	1.143	0.09	0.000000	1.143	19.34%	2.22

Using the data for LCS1, calculate the efficiency from the calibration equation, activity, the counting uncertainty and the MDC.

LCS1 has a solid residue of 0.07 mg after evaporation. It was counted on detector #67.
(1) Calculate the alpha efficiency. The alpha efficiency equation is shown on page 9: $y = ax^4 + bx^3 + cx^2 + dx + e$. The parameters for detector #67 are: a = 0, b = 0, c = 7.1418 E-06, d = -2.1877 E-03, e = 0.1918.
Detector #67 Alpha Efficiency, $y = 0 + 0 + (7.418\text{ E-}06)(0.07)^2 + (-2.1877\text{ E-}03)(0.07) + 0.1918 =$ **0.1916 (19.16%)** ✓

(2) Calculate alpha activity. There is no beta-to-alpha crosstalk, therefore,

$$Alpha\ Activity = \frac{Net\ Alpha\ cpm}{Alpha\ Eff \times Volume \times 2.22} = \frac{1.226\ cpm}{0.1916 \times 0.20018L \times 2.22 cpm/pCi}$$

Alpha Activity = 14.397 pCi/L ✓

(3) Calculate the counting uncertainty.

$$u_c = \frac{\sqrt{\frac{Alpha\ Gross\ cpm}{t_S} + \frac{Alpha\ Bkgd\ cpm}{t_B}}}{Alpha\ Eff \times Volume \times 2.22} = \frac{\sqrt{\frac{1.25\ cpm}{300\ min} + \frac{0.0240\ cpm}{1000\ min}}}{0.1916 \times 0.20018L \times 2.22 cpm/pCi}$$

One-sigma counting uncertainty = 0.760278

"Two-sigma" expanded counting uncertainty (95% confidence) = 1.96 X u_c = 1.96 X 0.760278 = 1.490 ✓

(4) Calculate the MDC (equivalent to MDA). MDC is referred to as the minimum detectable concentration. MDA is referred to as the minimum detectable activity. They are not the same as the drinking water DL and should not be used in place of the DL. But one or the other is commonly reported because the instrument software calculates it in the report.

$$MDC\ (MDA) = \frac{\frac{2.71}{t_S} + \left(4.65 \times \sqrt{\frac{Alpha\ Bkgd\ cpm}{t_S}}\right)}{Alpha\ Eff \times Volume \times 2.22} = \frac{\frac{2.71}{300\ min} + \left(4.65 \times \sqrt{\frac{0.0240\ cpm}{300\ min}}\right)}{0.1916 \times 0.20018L \times 2.22\ cpm/pCi}$$

MDC = 0.594 pCi/L ✓

SDWA DL (0.321) < MDC (0.594) < Gross Alpha Regulatory DL (3.0)

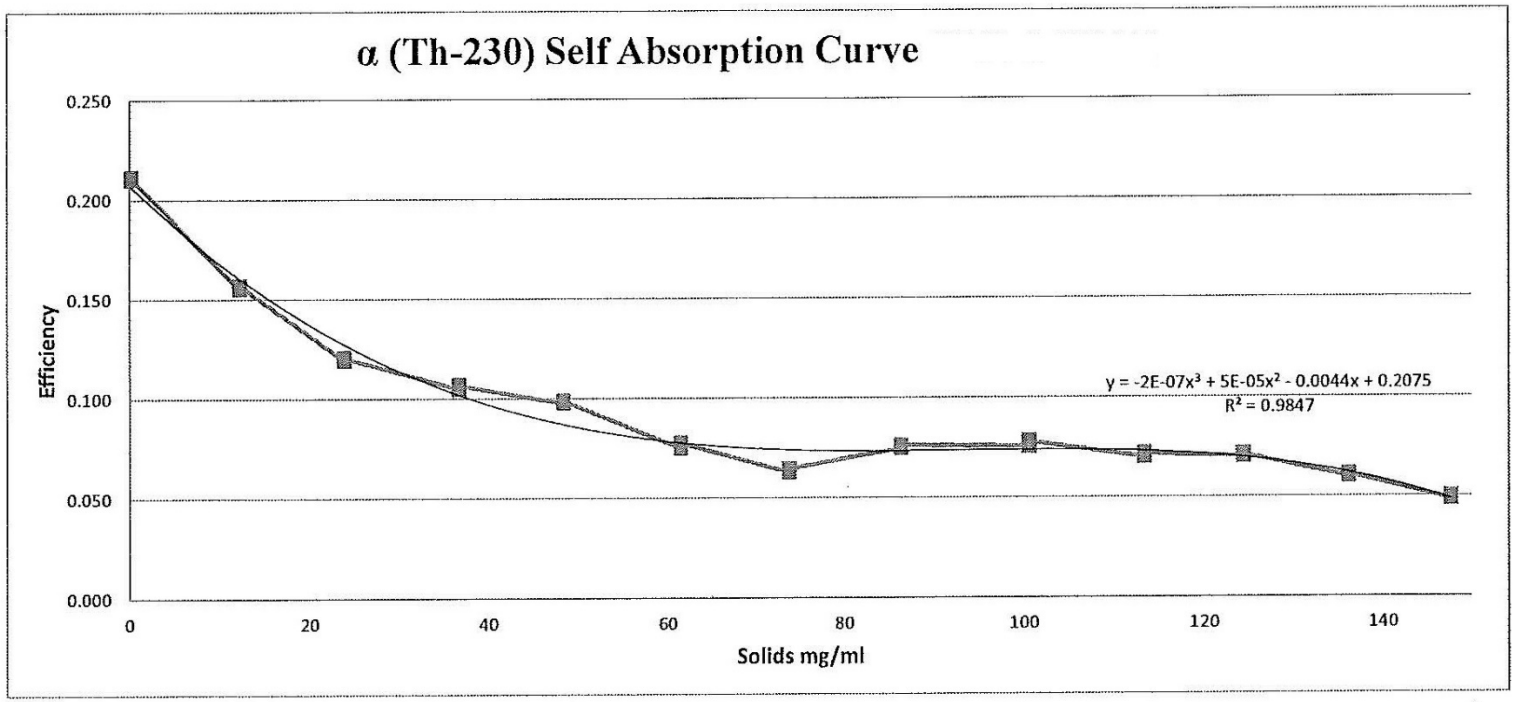
Quality Control Sample Performance

Test: Gross Alpha and Gross Beta
Analyst: John Doe
Date Prepared: 6/19/2019
Batch ID: GAB-JD-DOC

	LCS1 Alpha	LCS1 Beta	LCS2 Alpha	LCS2 Beta	LCS3 Alpha	LCS3 Beta	LCS4 Alpha	LCS4 Beta
Count Date	06/25/2019	06/25/2019	06/25/2019	06/25/2019	06/25/2019	06/25/2019	06/25/2019	06/25/2019
Spike ID	19-027	19-004	19-027	19-004	19-027	19-004	19-027	19-004
Stock Conc. (pCi/mL)	29.865	36.061	29.865	36.061	29.865	36.061	29.865	36.061
Volume Used (mL)	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Sample Aliquot (L)	0.20018	0.20018	0.20218	0.20218	0.20150	0.20150	0.20396	0.20396
Target Conc. (pCi/L)	14.919	18.014	14.772	17.836	14.822	17.896	14.643	17.680
Measured Activity (pCi/L)	14.395	16.013	14.518	16.869	14.160	15.223	13.059	16.276
Percent Recovery	96.49%	88.89%	98.28%	94.58%	95.54%	85.06%	89.19%	92.06%

All LCS recoveries are within ± 20%.
Verify:
LCS1 – 0.1 mL of Stock 19-027 (29.865 pCi/mL) diluted in 0.20018 L of water. Theoretical activity = 14.919 pCi/L. Actual measured alpha activity (pg 5) was 14.395 pCi/L. ✓

Gross Alpha and Gross Beta
Example Calibration Efficiency (Self-Absorption) Curve



This is an example alpha calibration curve from a separate data package, but it demonstrates what you should see. The lab prepares a series of water samples, each containing successively higher levels of dissolved solids. They can use either their own tap water or, if the tap water doesn't have sufficient dissolved solids content, a synthetic salt matrix. They spike each sample with a constant activity (in disintegrations/minute, dpm) of a NIST-traceable standard. For gross alpha, the regulations mandate either Th-230 or natural uranium. The lab determines efficiency as the measured counts per minute (cpm) divided by the known dpm of the standard. Plot efficiency vs. solids (either in mg/mL or just mg) to generate the curve. When analyzing real samples, once you know the solids residue level, you can use the curve to determine the detector efficiency which is a parameter needed to calculate activity, uncertainty and detection limit.

Gross Alpha and Gross Beta Analysis
Calibration Summary

Det	Alpha Efficiency: ax^4 + bx^3 + cx^2 + dx + e					Alpha-to-beta Crosstalk: ax^4 + bx^3 + cx^2 + dx + e					Beta Efficiency: ax + b		Beta-to-alpha Crosstalk: ax + b			Alpha	Alpha to beta	Beta
No.	a	b	c	d	e	a	b	c	d	e	a	b	a	b	expire	ε	Xtalk	ε
1	0	0	0.000012980	-0.0029512	0.23286	0	-3.71E-07	6.2263E-05	-1.951E-03	0.36002	-1.9486E-004	0.4364	0	0	0	12/14/17	12/14/17	8/25/17
2	0	0	1.2991E-05	-0.0030454	0.24366	0	-1.37E-07	9.424E-05	1.8469E-03	0.32667	-1.307E-04	0.43207	0	0	0	12/14/17	12/14/17	8/25/17
3	0	0	1.3277E-05	-0.002994	0.23714	0	-4.31E-07	1.271E-05	-1.5035E-03	0.33919	-1.4021E-04	0.43041	0	0	0	12/14/17	12/14/17	8/25/17
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63	0	0	6.6295E-06	-2.1818E-03	2.0110E-01	0	-1.4193E-07	3.2966E-05	1.6576E-03	4.2240E-01	-1.5603E-04	4.4936E-01	0	0	0	8/23/17	8/23/17	8/29/17
64	0	0	7.0767E-06	-2.2327E-03	2.0260E-01	0	-1.1102E-07	1.7931E-05	2.6816E-03	4.1807E-01	-9.9145E-05	4.4691E-01	0	0	0	8/23/17	8/23/17	8/29/17
65	0	0	6.9777E-06	-2.2044E-03	2.0074E-01	0	3.1873E-07	-2.2759E-05	3.2263E-03	4.3733E-01	-1.2435E-04	4.5374E-01	0	0	0	8/23/17	8/23/17	8/29/17
66	0	0	8.2262E-06	-2.3250E-03	2.0384E-01	0	3.5475E-07	-3.1006E-05	3.2037E-03	4.3318E-01	-8.8398E-05	4.4899E-01	0	0	0	8/23/17	8/23/17	8/29/17
67	0	0	7.1418E-06	-2.1877E-03	1.9180E-01	0	-1.6737E-07	3.8153E-05	2.6895E-03	5.0812E-01	-2.4455E-04	4.6266E-01	0	0	0	8/28/17	8/28/17	8/23/17
68	0	0	7.3606E-06	-2.2234E-03	1.98486E-01	0	4.6140E-07	-5.1452E-05	5.7471E-03	4.6338E-01	-1.3244E-04	4.5570E-01	0	0	0	8/28/17	8/28/17	8/23/17
69	0	0	8.6298E-06	-2.3407E-03	1.9705E-01	0	3.1433E-07	-3.7875E-05	5.2352E-03	4.5653E-01	-1.8696E-04	4.5654E-01	0	0	0	8/28/17	8/28/17	8/23/17
70	0	0	7.1699E-06	-2.1692E-03	1.9355E-01	0	3.4176E-07	-3.1986E-05	4.3609E-03	4.6364E-01	-1.4327E-04	4.5062E-01	0	0	0	8/28/17	8/28/17	8/23/17
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73	0	0	6.1778E-06	-2.1387E-03	2.0421E-01	0	-1.1615E-07	2.5360E-05	1.2611E-03	3.8678E-01	-7.7339E-05	4.4377E-01	0	0	0	8/28/17	8/28/17	8/23/17
74	0	0	7.9074E-06	-2.3101E-03	2.0581E-01	0	-6.6996E-09	4.6141E-06	2.7593E-03	3.9796E-01	-9.3797E-05	4.5582E-01	0	0	0	8/28/17	8/28/17	8/23/17

**The data package submitted by the laboratory contained the calibration data for all 74 detectors. Only a representative group, including those used in the DOC, is shown here. The efficiency (self-absorption) curve is generated when the detector is calibrated. Calibration is checked annually, but re-calibration is only needed if re-check fails or major instrumental changes occur. The parameters (a – e) come from the curve-fit and x represents the residue mass.

Just for fun!

What about gross beta? More tolerant of higher dissolved solids levels, but subject to alpha-into-beta crosstalk. We have all the data we need to calculate gross beta for LCS1. Below is the gross beta summary report:

Gross Alpha and Gross Beta Analysis
(Report Summary)

Test Code: Alpha_Beta
Prep Start Date/Time: 6/19/2019@12:30
Prep Finish: 6/19/2019

Analyst: JD
Prep SOP: GAB-Prep01
Analysis SOP: GAB-AN01

Gross Beta Results

Sample ID	Beta Activity	Two-Sigma Count Uncertainty	Two-Sigma CSU	MDC	Critical Value	Units	Net Beta cpm	Residue (mg)	Alpha-to Beta Xtalk cpm	Xtalk-corrected Net Beta cpm	Beta efficiency	Activity conversion (cpm to pCi)
MB1	0.630	0.395	0.411	0.741	0.282	pCi/L	0.142	0.04	0.013941	0.128	44.94%	2.22
MB2	0.072	0.325	0.326	0.708	0.269	pCi/L	0.013	0.02	-0.001812	0.015	44.69%	2.22
MB3	0.053	0.354	0.355	0.762	0.290	pCi/L	0.022	0.04	0.010936	0.011	45.37%	2.22
MB4	0.084	0.378	0.378	0.818	0.313	pCi/L	0.015	0.03	-0.002455	0.017	44.90%	2.22
LCS1	16.013	1.159	3.090	0.868	0.333	pCi/L	3.915	0.07	0.623186	3.292	46.26%	2.22
LCS2	16.869	1.167	3.235	0.784	0.299	pCi/L	4.039	0.03	0.588402	3.450	45.57%	2.22
LCS3	15.223	1.132	2.949	0.852	0.327	pCi/L	3.679	0.01	0.569815	3.109	45.65%	2.22
LCS4	16.276	1.156	3.133	0.858	0.329	pCi/L	3.851	0.09	0.530544	3.321	45.06%	2.22

Net beta cpm = gross beta cpm – beta bkgd
= 4.3133 cpm – 0.3980 cpm
= 3.9153 cpm ✓

Same process as for the gross alpha calculations, except we have to take the alpha-to-beta crosstalk contribution into consideration. Again, confirm the calculations for LCS1 counted on Detector #67 with a solid residue of 0.07 mg.

(1) Calculate the beta efficiency. As shown on pg. 9, the beta efficiency calibration curve equation is y = ax + b with parameters for detector #67: a = -2.4455E-04 and b = 0.46266.
Beta Efficiency for Detector #67 = (-2.4455E-04)(0.07) + (0.46266) = 0.4626 or 46.26% ✓

(2) In order to calculate the gross beta activity, you have to subtract the alpha-to-beta crosstalk. As shown on pg. 9, the equation for alpha-to-beta crosstalk is $y = ax^4 + bx^3 + cx^2 + dx + e$. The parameters for detector #67 are: a = 0, b = -1.6737E-07, c = 3.8153E-05, d = 2.6895E-03, e = 0.50812. Using the residue mass of 0.07 mg,
Alpha-to-Beta Crosstalk Factor for Detector #67 = $(-1.6736E-07)(0.07)^3 + (3.8153E-05)(0.07)^2 + (2.6895E-03)(0.07) + 0.50812$ = 0.5083. Now, take the crosstalk factor and multiply by the Net Alpha cpm (on page 5) to determine the alpha-to-beta crosstalk contribution:
(1.226 net alpha cpm) X (0.5083 crosstalk factor) = 0.62318 ✓

Calculate the beta activity:

$$Beta\ Activity = \frac{Net\ Beta\ cpm - (alpha - to - beta\ crosstalk)}{Beta\ Eff\ \times Volume \times 2.22} = \frac{[(3.9153\ cpm - 0.62318\ cpm)]}{0.4626 \times 0.20018L \times 2.22\ cpm/pCi}$$

Beta Activity = 16.012 pCi/L ✓

(3) Calculate the counting uncertainty (Beta Gross cpm and Beta Bkgd cpm data on page 4):

$$u_c = \frac{\sqrt{\frac{Beta\ Gross\ cpm}{t_S} + \frac{Beta\ Bkgd\ cpm}{t_B}}}{Beta\ Eff \times Volume \times 2.22} = \frac{\sqrt{\frac{4.3133\ cpm}{300\ min} + \frac{0.3980\ cpm}{1000\ min}}}{0.4626 \times 0.20018\ L \times 2.22\ cpm/pCi}$$

One-sigma counting uncertainty = 0.591
'Two-sigma" expanded counting uncertainty (95% confidence) = 1.96 X u_c = 1.96 X 0.591 = 1.159 ✓

(4) Calculate the SDWA DL and the MDC.

SDWA DL:

$$DL = \frac{\frac{1.96^2}{2t_s} \times \left[1 + \sqrt{1 + \frac{4t_s^2}{1.96^2} \times Beta\ Bkgd\ cpm \times \left(\frac{1}{t_s} + \frac{1}{t_B}\right)}\right]}{Beta\ Eff \times V \times 2.22} = \frac{\frac{3.8416}{600\ min} \times \left[1 + \sqrt{1 + \frac{360000\ \text{min ^2}}{3.8416} \times 0.3980\ cpm \times \left(\frac{1}{300} + \frac{1}{1000}\right)}\right]}{0.4626 \times 0.20018\ L \times 2.22\ cpm/pCi}$$

The SDWA beta DL = 0.428 pCi/L

MDC:

$$MDC = \frac{\frac{2.71}{t_S} + \left(4.65 \times \sqrt{\frac{Beta\ Bkgd\ cpm}{t_S}}\right)}{Beta\ Eff \times Volume \times 2.22} = \frac{\frac{2.71}{300\ min} + \left(4.65 \times \sqrt{\frac{0.3980\ cpm}{300\ min}}\right)}{0.4626 \times 0.20018L \times 2.22\ cpm/pCi}$$

MDC = 0.868 pCi/L ✓

SDWA DL (0.428) < MDC (0.868) < Gross Beta Regulatory DL (4.0 pCi/L)