**********
*****  G A M M A  S P E C T R U M  A N A L Y S I S  *****
**********

Filename: C:\GENIE2K\CAMFILES\UNC 2017\IMC Samples\IMC-0226\UNC-IMC-022

Report Generated On : 5/9/2017 10:34:26 AM

Sample Title : UNC-IMC-0226-S-P-6
Sample Description :
Sample Identification : IMC-0226-S-P-6
Sample Type :
Sample Geometry : cylinder

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 40 - 8192
Peak Area Range (in channels) : 40 - 8192
Identification Energy Tolerance : 1.000 keV

Sample Size : 3.537E+002 grams

Sample Taken On : 4/18/2017 12:00:00 AM
Acquisition Started : 5/1/2017 12:09:37 PM

Live Time : 1800.0 seconds
Real Time : 1800.4 seconds

Dead Time : 0.02 %

Energy Calibration Used Done On : 4/13/2017
Efficiency Calibration Used Done On : 5/9/2017
Efficiency ID : H-IMC-0226-S-P-6

**********
***** P E A K A N A L Y S I S R E P O R T *****
**********

Detector Name: 8566
Sample Title: UNC-IMC-0226-S-P-6
Peak Analysis Performed on: 5/9/2017 10:34:13 AM
Peak Analysis From Channel: 40
Peak Analysis To Channel: 8192

| | Peak No. | ROI start | ROI end | Peak centroid | Energy (keV) | FWHM (keV) | Net Peak Area | Net Area Uncert. | Continuum Counts |
|---|---|---|---|---|---|---|---|---|---|
| F | 1 | 180- | 193 | 186.29 | 46.73 | 0.68 | 5.66E+001 | 10.63 | 5.83E+001 |
| M | 2 | 295- | 315 | 299.80 | 75.13 | 0.57 | 7.85E+001 | 21.58 | 1.08E+002 |
| m | 3 | 295- | 315 | 308.81 | 77.39 | 0.57 | 5.28E+001 | 17.23 | 8.68E+001 |
| | 4 | 356- | 364 | 360.45 | 90.31 | 0.49 | 2.00E+001 | 23.80 | 5.10E+001 |
| F | 5 | 733- | 748 | 741.99 | 185.79 | 0.87 | 1.91E+002 | 74.63 | 6.60E+001 |
| F | 6 | 949- | 959 | 952.98 | 238.59 | 0.70 | 7.43E+001 | 20.11 | 5.36E+001 |
| F | 7 | 1175- | 1183 | 1178.68 | 295.07 | 0.77 | 2.75E+001 | 13.81 | 2.70E+001 |
| F | 8 | 1397- | 1412 | 1405.19 | 351.75 | 1.21 | 7.09E+001 | 17.64 | 2.24E+001 |
| F | 9 | 1901- | 1912 | 1907.26 | 477.39 | 1.01 | 3.13E+001 | 15.32 | 3.40E+001 |
| F | 10 | 2031- | 2046 | 2039.21 | 510.41 | 1.49 | 4.55E+001 | 16.36 | 3.07E+001 |
| F | 11 | 2425- | 2438 | 2432.24 | 608.77 | 1.07 | 3.09E+001 | 41.96 | 1.75E+001 |
| F | 12 | 5823- | 5849 | 5835.34 | 1460.37 | 2.64 | 1.59E+002 | 25.20 | 3.00E+000 |

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.960 sigma

**********
*****  N U C L I D E  I D E N T I F I C A T I O N  R E P O R T  *****
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Sample Title: UNC-IMC-0226-S-P-6
Nuclide Library Used: C:\GENIE2K\CAMFILES\UNC 2017 NLB 0328201

..... IDENTIFIED NUCLIDES .....

| Nuclide Name | Id Confidence | Energy (keV) | Yield (%) | Activity (pCi/gram) | Activity Uncertainty |
|---|---|---|---|---|---|
| K-40 | 0.968 | 1460.82* | 10.66 | 7.65554E+000 | 1.37770E+000 |
| Pb-210 | 0.994 | 46.54* | 4.25 | 2.19125E+000 | 7.44846E-001 |
| Pb-212 | 0.994 | 74.82* | 10.28 | 5.68820E-001 | 1.94020E-001 |
| | | 77.11* | 17.10 | 2.24159E-001 | 8.59384E-002 |
| | | 86.83 | 2.07 | | |
| | | 87.35 | 3.97 | | |
| | | 89.78* | 1.46 | 8.97803E-001 | 1.08357E+000 |
| | | 115.18 | 0.60 | | |
| | | 238.63* | 43.60 | 1.58361E-001 | 4.96433E-002 |
| | | 300.09 | 3.30 | | |
| PB-214 | 0.846 | 74.82* | 5.80 | 1.00819E+000 | 3.55519E-001 |
| | | 77.11* | 9.70 | 3.95167E-001 | 1.55621E-001 |
| | | 86.83 | 1.70 | | |
| | | 87.35 | 2.24 | | |
| | | 89.78* | 0.82 | 1.59853E+000 | 1.93425E+000 |
| | | 241.99 | 7.25 | | |
| | | 258.76 | 0.53 | | |
| | | 295.22* | 18.42 | 1.69817E-001 | 8.94174E-002 |
| | | 351.93* | 35.60 | 2.71237E-001 | 7.83087E-002 |
| | | 785.96 | 1.06 | | |
| | | 839.07 | 0.58 | | |
| Ra-226 | 0.975 | 81.07 | 0.20 | | |
| | | 83.79 | 0.32 | | |
| | | 186.21* | 3.64 | 3.96635E+000 | 1.69254E+000 |

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.10
Errors quoted at 1.960 sigma

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*****  I N T E R F E R E N C E  C O R R E C T E D  R E P O R T  *****
**********

| | Nuclide Name | Nuclide Id Confidence | Wt mean Activity (pCi/gram) | Wt mean Activity Uncertainty |
|---|---|---|---|---|
| | K-40 | 0.968 | 7.655542E+000 | 1.377697E+000 |
| | Pb-210 | 0.994 | 2.191253E+000 | 7.448458E-001 |
| | Pb-212 | 0.994 | 1.576068E-001 | 4.273897E-002 |
| X | BI-214 | 0.304 | | |
| | PB-214 | 0.846 | 2.265212E-001 | 5.538814E-002 |
| | Ra-226 | 0.975 | 3.966347E+000 | 1.692535E+000 |
| X | U-235 | 0.500 | | |

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at  1.960 sigma

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

Peak Locate Performed on:  5/9/2017  10:34:13 AM
Peak Locate From Channel:  40
Peak Locate To Channel:  8192

| | Peak No. | Energy (keV) | Peak Size in Counts per Second | Peak CPS % Uncertainty | Peak Type | Tol. Nuclide |
|---|---|---|---|---|---|---|
| F | 9 | 477.39 | 1.7408E-002 | 48.90 | Sum | |
| F | 10 | 510.41 | 2.5279E-002 | 35.94 | | |
| F | 11 | 608.77 | 1.7187E-002 | 135.63 | | |

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at  1.960 sigma

**********
***** N U C L I D E M D A R E P O R T *****
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Detector Name: 8566
Sample Geometry: cylinder
Sample Title: UNC-IMC-0226-S-P-6
Nuclide Library Used: C:\GENIE2K\CAMFILES\UNC 2017 NLB 0328201

| | Nuclide Name | Energy (keV) | Yield (%) | Line MDA (pCi/gram) | Nuclide MDA (pCi/gram) | Activity (pCi/gram) | Dec. Leve (pCi/gram |
|---|---|---|---|---|---|---|---|
| + | K-40 | 1460.82* | 10.66 | 5.644E-001 | 5.64E-001 | 7.656E+000 | 2.170E-00 |
| + | Pb-210 | 46.54* | 4.25 | 1.881E+000 | 1.88E+000 | 2.191E+000 | 8.880E-00 |
| | BI-212 | 727.33 | 6.67 | 1.598E+000 | 1.60E+000 | 4.225E-002 | 7.420E-00 |
| | | 785.37 | 1.10 | 9.946E+000 | | -7.250E-001 | 4.602E+00 |
| | | 1078.62 | 0.56 | 2.243E+001 | | -5.163E+000 | 1.026E+00 |
| | | 1620.50 | 1.47 | 5.742E+000 | | 1.319E+000 | 2.354E+00 |
| + | Pb-212 | 74.82* | 10.28 | 3.706E-001 | 8.49E-002 | 5.688E-001 | 1.755E-00 |
| | | 77.11* | 17.10 | 1.955E-001 | | 2.242E-001 | 9.201E-00 |
| | | 86.83 | 2.07 | 2.187E+000 | | 1.696E+000 | 1.050E+00 |
| | | 87.35 | 3.97 | 1.040E+000 | | -8.732E-001 | 4.972E-00 |
| | | 89.78* | 1.46 | 1.789E+000 | | 8.978E-001 | 8.338E-00 |
| | | 115.18 | 0.60 | 5.173E+000 | | 4.148E+000 | 2.445E+00 |
| | | 238.63* | 43.60 | 8.488E-002 | | 1.584E-001 | 3.956E-00 |
| | | 300.09 | 3.30 | 1.727E+000 | | -1.115E+000 | 8.160E-00 |
| | BI-214 | 76.86* | 0.55 | 6.134E+000 | 1.20E-001 | 7.033E+000 | 2.887E+00 |
| | | 79.29 | 0.91 | 5.040E+000 | | 6.536E-001 | 2.414E+00 |
| | | 609.32* | 45.49 | 1.202E-001 | | 1.619E-001 | 5.300E-00 |
| | | 665.45 | 1.53 | 7.190E+000 | | 3.266E+000 | 3.366E+00 |
| | | 768.36 | 4.89 | 2.176E+000 | | -8.823E-001 | 1.006E+00 |
| | | 806.18 | 1.26 | 8.305E+000 | | -4.145E+000 | 3.821E+00 |
| | | 934.06 | 3.11 | 4.325E+000 | | 1.120E+000 | 2.009E+00 |
| | | 1120.29 | 14.92 | 1.084E+000 | | 8.680E-001 | 5.047E-00 |
| | | 1155.21 | 1.63 | 9.025E+000 | | -5.327E+000 | 4.163E+00 |
| | | 1238.11 | 5.83 | 2.898E+000 | | 1.049E+000 | 1.346E+00 |
| | | 1280.98 | 1.43 | 1.042E+001 | | -3.207E-001 | 4.777E+00 |
| | | 1377.67 | 3.99 | 3.239E+000 | | 1.362E+000 | 1.454E+00 |
| | | 1385.31 | 0.79 | 1.579E+001 | | -3.578E+000 | 7.058E+00 |
| | | 1401.52 | 1.33 | 1.051E+001 | | 5.634E+000 | 4.751E+00 |
| | | 1407.99 | 2.39 | 5.683E+000 | | -1.144E+000 | 2.560E+00 |
| | | 1509.21 | 2.13 | 5.140E+000 | | 8.681E-001 | 2.235E+00 |
| | | 1583.20 | 0.70 | 2.100E+001 | | -4.774E-001 | 9.443E+00 |
| | | 1661.27 | 1.05 | 1.033E+001 | | 5.764E-001 | 4.424E+00 |
| | | 1729.59 | 2.88 | 4.977E+000 | | 5.696E-001 | 2.208E+00 |
| | | 1764.49 | 15.30 | 1.031E+000 | | 8.473E-001 | 4.616E-00 |
| | | 1847.43 | 2.03 | 6.297E+000 | | 7.670E-001 | 2.725E+00 |
| > | | 2118.51 | 1.16 | 0.000E+000 | | 0.000E+000 | 0.000E+00 |
| > | | 2204.06 | 4.92 | 0.000E+000 | | 0.000E+000 | 0.000E+00 |
| > | | 2447.70 | 1.55 | 0.000E+000 | | 0.000E+000 | 0.000E+00 |
| + | PB-214 | 74.82* | 5.80 | 6.569E-001 | 1.06E-001 | 1.008E+000 | 3.111E-00 |
| | | 77.11* | 9.70 | 3.446E-001 | | 3.952E-001 | 1.622E-00 |
| | | 86.83 | 1.70 | 2.663E+000 | | 2.066E+000 | 1.278E+00 |
| | | 87.35 | 2.24 | 1.843E+000 | | -1.548E+000 | 8.813E-00 |

| | Nuclide Name | Energy (keV) | Yield (%) | Line MDA (pCi/gram) | Nuclide MDA (pCi/gram) | Activity (pCi/gram) | Dec. Leve (pCi/gram |
|---|---|---|---|---|---|---|---|
| + | PB-214 | 89.78* | 0.82 | 3.185E+000 | 1.06E-001 | 1.599E+000 | 1.485E+00 |
| | | 241.99 | 7.25 | 8.869E-001 | | 1.038E-001 | 4.259E-00 |
| | | 258.76 | 0.53 | 8.310E+000 | | 2.829E-001 | 3.900E+00 |
| | | 295.22* | 18.42 | 1.623E-001 | | 1.698E-001 | 7.280E-00 |
| | | 351.93* | 35.60 | 1.063E-001 | | 2.712E-001 | 4.800E-00 |
| | | 785.96 | 1.06 | 1.044E+001 | | -4.688E-001 | 4.833E+00 |
| | | 839.07 | 0.58 | 2.181E+001 | | 5.895E-001 | 1.016E+00 |
| + | Ra-226 | 81.07 | 0.20 | 1.885E+001 | 1.02E+000 | -1.189E+000 | 8.941E+00 |
| | | 83.79 | 0.32 | 1.418E+001 | | 1.160E+001 | 6.804E+00 |
| | | 186.21* | 3.64 | 1.020E+000 | | 3.966E+000 | 4.819E-00 |
| | AC-228 | 89.96 | 1.90 | 1.686E+016 | 4.38E+015 | -2.813E+016 | 8.075E+01 |
| | | 93.35 | 3.10 | 1.057E+016 | | 1.578E+016 | 5.073E+01 |
| | | 99.51 | 1.26 | 1.950E+016 | | 1.084E+016 | 9.236E+01 |
| | | 105.60 | 0.74 | 3.076E+016 | | -1.280E+016 | 1.452E+01 |
| | | 129.07 | 2.42 | 1.072E+016 | | 5.374E+015 | 5.091E+01 |
| | | 153.98 | 0.72 | 3.539E+016 | | 2.127E+015 | 1.674E+01 |
| | | 209.25 | 3.89 | 8.495E+015 | | 1.009E+015 | 4.029E+01 |
| | | 214.85 | 0.76 | 4.039E+016 | | -6.336E+015 | 1.905E+01 |
| | | 270.24 | 3.46 | 1.053E+016 | | -1.371E+015 | 4.957E+01 |
| | | 328.00 | 2.95 | 1.482E+016 | | -3.088E+015 | 6.973E+01 |
| | | 338.32 | 11.27 | 4.524E+015 | | 2.284E+015 | 2.143E+01 |
| | | 409.46 | 1.92 | 2.768E+016 | | -9.173E+015 | 1.299E+01 |
| | | 463.00 | 4.40 | 1.347E+016 | | 1.323E+015 | 6.313E+01 |
| | | 562.50 | 0.87 | 7.071E+016 | | -4.025E+016 | 3.276E+01 |
| | | 674.75 | 2.10 | 3.641E+016 | | 8.186E+015 | 1.692E+01 |
| | | 726.86 | 0.62 | 1.301E+017 | | 3.439E+015 | 6.040E+01 |
| | | 755.32 | 1.00 | 8.492E+016 | | -4.670E+016 | 3.947E+01 |
| | | 772.29 | 1.49 | 5.235E+016 | | -6.051E+015 | 2.413E+01 |
| | | 794.95 | 4.25 | 2.060E+016 | | 1.318E+016 | 9.562E+01 |
| | | 830.49 | 0.54 | 1.686E+017 | | 5.920E+016 | 7.827E+01 |
| | | 835.71 | 1.61 | 5.732E+016 | | -2.233E+016 | 2.663E+01 |
| | | 840.38 | 0.91 | 1.027E+017 | | -1.756E+016 | 4.775E+01 |
| | | 904.20 | 0.77 | 1.355E+017 | | -3.248E+016 | 6.317E+01 |
| | | 911.20 | 25.80 | 4.378E+015 | | 4.113E+015 | 2.052E+01 |
| | | 964.77 | 4.99 | 2.146E+016 | | 8.073E+015 | 9.987E+01 |
| | | 968.97 | 15.80 | 7.585E+015 | | 5.968E+015 | 3.557E+01 |
| | | 1247.08 | 0.50 | 2.237E+017 | | -1.698E+017 | 1.026E+01 |
| | | 1459.14 | 0.83 | 3.041E+017 | | 6.986E+017 | 1.457E+01 |
| | | 1495.91 | 0.86 | 9.284E+016 | | 1.308E+016 | 4.018E+01 |
| | | 1588.20 | 3.22 | 3.822E+016 | | 1.724E+016 | 1.735E+01 |
| | | 1630.63 | 1.51 | 5.874E+016 | | -7.794E+015 | 2.554E+01 |
| | TH-230 | 67.67 | 0.38 | 1.151E+001 | 1.15E+001 | 2.783E+000 | 5.457E+00 |
| | PA-234 | 742.81 | 0.11 | 1.099E+002 | 1.51E+001 | 4.312E+001 | 5.132E+00 |
| | | 766.42 | 0.32 | 3.471E+001 | | -3.064E+000 | 1.609E+00 |
| | | 1001.03 | 0.84 | 1.506E+001 | | -8.492E+000 | 6.929E+00 |
| | TH-234 | 63.29 | 3.70 | 1.386E+000 | 1.39E+000 | -2.591E-001 | 6.595E-00 |
| | | 92.38 | 2.13 | 2.175E+000 | | 2.437E+000 | 1.046E+00 |
| | | 92.80 | 2.10 | 2.187E+000 | | 2.847E+000 | 1.052E+00 |
| | | 112.81 | 0.21 | 1.501E+001 | | -1.533E+000 | 7.106E+00 |
| | U-234 | 53.20 | 0.12 | 4.757E+001 | 4.76E+001 | 2.500E+001 | 2.243E+00 |
| | | 120.90 | 0.04 | 9.088E+001 | | -4.023E+000 | 4.302E+00 |

| Nuclide Name | Energy (keV) | Yield (%) | Line MDA (pCi/gram) | Nuclide MDA (pCi/gram) | Activity (pCi/gram) | Dec. Leve (pCi/gram |
|---|---|---|---|---|---|---|
| U-235 | 89.96* | 3.43 | 7.615E-001 | 3.70E-001 | 3.821E-001 | 3.549E-00 |
| | 93.35 | 5.54 | 7.814E-001 | | 1.166E+000 | 3.749E-00 |
| | 104.82 | 0.69 | 4.416E+000 | | 7.162E-001 | 2.084E+00 |
| | 105.60 | 1.31 | 2.295E+000 | | -9.552E-001 | 1.083E+00 |
| | 108.58 | 0.50 | 6.590E+000 | | 2.038E+000 | 3.126E+00 |
| | 109.19 | 1.66 | 1.960E+000 | | -2.192E-001 | 9.291E-00 |
| | 143.76 | 10.96 | 3.704E-001 | | 3.147E-001 | 1.771E-00 |
| | 163.36 | 5.08 | 7.224E-001 | | 3.348E-001 | 3.426E-00 |
| | 194.94 | 0.63 | 6.869E+000 | | -4.360E-001 | 3.266E+00 |
| | 202.12 | 1.08 | 4.418E+000 | | 2.046E+000 | 2.108E+00 |
| | 205.32 | 5.02 | 8.597E-001 | | -1.003E+000 | 4.078E-00 |

+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

**********
**** L I N E A C T I V I T Y C O N S I S T E N C Y E V A L U A T O R ***
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==========
Analysis using Key Line Activities
==========

Filename: C:\GENIE2K\CAMFILES\UNC 2017\IMC Samples\IMC-0226\UNC-IMC-022

Equation used to calculate plot: ln(Ratio) = A + B*ln(Energy)
where: Ratio = Activity/KL Activity

Notes:
'^' Denotes Key Line energy
* All uncertainties quoted at 1.96 sigma

| Nuclide | Energy (keV) | | Activity (pCi/gram) | Activity %Uncert* | Ratio[%Uncert] | A | B [uncert] |
|---|---|---|---|---|---|---|---|
| K-40 | 1460.8 | ^ | 7.66E+000 | 17.996 | | | |
| Pb-210 | 46.5 | ^ | 2.19E+000 | 33.992 | | | |
| Pb-212 | 74.8 | | 5.69E-001 | 34.109 | 3.592[46.327] | 4.32 | -0.788 |
| | 77.1 | | 2.24E-001 | 38.338 | 1.415[49.523] | | [ 0.484] |
| | 89.8 | | 8.98E-001 | 120.69 | 5.669[124.69] | | |
| | 238.6 | ^ | 1.58E-001 | 31.348 | 1.000[44.333] | | |
| PB-214 | 74.8 | | 1.01E+000 | 35.263 | 3.717[45.574] | 4.02 | -0.715 |
| | 77.1 | | 3.95E-001 | 39.381 | 1.457[48.830] | | [ 0.317] |
| | 89.8 | | 1.60E+000 | 121.00 | 5.893[124.39] | | |
| | 295.2 | | 1.70E-001 | 52.655 | 0.626[60.051] | | |
| | 351.9 | ^ | 2.71E-001 | 28.871 | 1.000[40.830] | | |
| Ra-226 | 186.2 | ^ | 3.97E+000 | 42.672 | | | |