1. This report consists of the analytical results and supporting documentation for six soil samples received by Paragon on 04/23/04.

2. These samples were prepared according to Paragon Analytics procedures PA SOP721R10, PA SOP773R8, and PA SOP778R9. Modifications were made to the method as described on QASS 268110.

3. The samples were analyzed for the presence of isotopic uranium according to Paragon Analytics procedure PA SOP714R8. The analyses were completed on 05/19/04.

4. The isotopic analysis results for these samples are reported on a dry weight basis in units of pCi/gram.

5. This analytical method quantifies U-235 alpha activity in a specific region of interest corresponding to emission energies between those of U-234 and U-238. A potential limitation of this method is that measurable amounts of U-234 in the sample may cause a small amount of characteristic activity in the U-235 region of interest due to poorly resolved alpha activity at the boundary between the two regions. To minimize the potential for a high bias in the U-235 analytical results, the U-235 region of interest has been narrowed and limited to a lower energy region. An 85.1% abundance correction has been made to the final U-235 results.

6. Paragon Analytics follows the convention outlined in ANSI N42.23 for reporting significant digits in the TPU and MDC results. ANSI N42.23 states that the TPU result should be rounded to two significant digits and that the MDC result should be rounded to the same decimal place as the TPU result. In practice, this could result in an MDC result with a reported value of 0 for samples with significant activity, including the batch laboratory control sample.

7. These samples were initially prepared in batch AS040428-5 on 04/28/04. Samples H07 and BB04 (PA IDs 0404241-9 and -12) had chemical recoveries below the 30% lower control limit. This was likely caused by elevated levels of native uranium.
present in the samples. Spectral quality was inadequate for accurate quantification of the data in these two samples, as well as in sample H07S (PA ID 0404241-11). These three samples as well as the method blank and laboratory control sample (LCS) were submitted to the preparation lab for a clean-up procedure described on QASS 268168. The samples were then reanalyzed as the same batch ID on 05/16/04. The cleanup procedure provided adequate spectral quality for accurate quantification of the data. However, the chemical recovery of samples 0404241-9 and -11 is below the 30% lower control limit at 26.76% and 28.68% respectively. After the cleanup procedure, the chemical recovery for sample 0404241-12 is within control limits. The method blank and LCS were analyzed and meet all quality control criteria, but due to a reporting limitation, the results are not able to be included in this report. The cleanup results of samples 0404241-9, -11, and -12 are submitted in this report. Please refer to NCR 5663 for further details.

8. U-234 activity is reported in the associated method blank above the minimum detectable concentration value. The measured blank activity is below the requested MDC (0.1 pCi/g). Results are acceptable according to PAI SOP 715, and are submitted without further qualification.

9. No anomalous situations were encountered during the preparation or analysis of these samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Skye Dobberstein
Radiochemistry Instrumentation

Date 5/21/01

Radiochemistry Final Data Review

Date 5/21/04
PARAGON ANALYTICS
Radiochemistry Data Package

Section 1

SAMPLE RESULTS
SUMMARY
## Isotopic Uranium By Alpha Spectroscopy Sample Results Summary

**Client Name:** New Horizons  
**Client Project Name:** CSMRI  
**Client Project Number:** 2135  
**Laboratory Name:** Paragon Analytics  
**PAI Work Order:** 0404241  
**Reported on:** Friday, May 21, 2004  
**Date:** 9:51:19 AM

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<th>Sample Type</th>
<th>Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Units</th>
<th>Matrix</th>
<th>Prep Batch</th>
<th>Date Analyzed</th>
<th>Flags</th>
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</thead>
<tbody>
<tr>
<td>0404241-3</td>
<td>B17</td>
<td>Sample</td>
<td>U-234</td>
<td>1.88 +/- 0.36</td>
<td>0.05</td>
<td>pCi/g</td>
<td>SOIL</td>
<td>AS040428-5</td>
<td>5/10/2004</td>
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<tr>
<td>0404241-3</td>
<td>B17</td>
<td>Sample</td>
<td>U-235</td>
<td>0.082 +/- 0.044</td>
<td>0.015</td>
<td>pCi/g</td>
<td>SOIL</td>
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<td>0404241-3</td>
<td>B17</td>
<td>Sample</td>
<td>U-238</td>
<td>2.00 +/- 0.38</td>
<td>0.04</td>
<td>pCi/g</td>
<td>SOIL</td>
<td>AS040428-5</td>
<td>5/10/2004</td>
<td></td>
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<td>0404241-7</td>
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**Comments:**

**Data Package ID:** U0404241-1

**Qualifiers/Flags:**
- U: Result is less than the sample specific MDC.
- LT: Result is less than Requested MDC, greater than sample specific MDC.
- Y1: Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2: Chemical Yield outside default limits.
- M: The requested MDC was not met.
- M3: The requested MDC was not met, but the reported activity is greater than the reported MDC.

**Abbreviations:**
- TPU: Total Propagated Uncertainty (see PAI SOP 743)
- MDC: Minimum Detectable Concentration (see PAI SOP 709)
- BDL: Below Detection Limit

**Date Printed:** Friday, May 21, 2004  
**Paragon Analytics**  
**LIMS Version:** 5.018A
## Isotopic Uranium By Alpha Spectroscopy Sample Results Summary

**Client Name:** New Horizons  
**Client Project Name:** CSMRI  
**Client Project Number:** 2135  
**Laboratory Name:** Paragon Analytics  
**PAI Work Order:** 0404241  
**Reported on:** Friday, May 21, 2004  
**Date Printed:** Friday, May 21, 2004  
**LIMS Version:** 5.018A

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<th>Lab Sample ID</th>
<th>Client Sample ID</th>
<th>Sample Type</th>
<th>Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Units</th>
<th>Matrix</th>
<th>Prep Batch</th>
<th>Date Analyzed</th>
<th>Flags</th>
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<td>U-234</td>
<td>58 +/- 10</td>
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<td>5/19/2004</td>
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<td>H07</td>
<td>Sample</td>
<td>U-235</td>
<td>3.49 +/- 0.71</td>
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<td>5/19/2004</td>
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<td>H07</td>
<td>Sample</td>
<td>U-238</td>
<td>59 +/- 10</td>
<td>0</td>
<td>pCi/g</td>
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<td>0404241-12</td>
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**Comments:**

**Data Package ID:** U0404241-1

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| U                 | Result is less than the sample specific MDC.  
| LT                | Result is less than Requested MDC, greater than sample specific MDC.  
| Y1                | Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.  
| Y2                | Chemical Yield outside default limits.  
| M                 | The requested MDC was not met.  
| M3                | The requested MDC was not met, but the reported activity is greater than the reported MDC.  

**Abbreviations:**

TPU - Total Propagated Uncertainty (see PAI SOP 743)  
MDC - Minimum Detectable Concentration (see PAI SOP 709)  
BDL - Below Detection Limit

---

**Date Printed:** Friday, May 21, 2004  
**Page 2 of 2**
PARAGON ANALYTICS
Radiochemistry Data Package

Section 2

QC RESULTS
SUMMARY
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Method Blank Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
ClientProject ID: CSMRI 2135

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
QCBatchID: 5-1
Run ID: 040428-5A
Final Allquot: 2.00 g
Result Units: pCi/g
File Name: U4285B

Prep Batch: AS040428-5
Date Collected: 28-Apr-04
Date Prepared: 28-Apr-04
Date Analyzed: 10-May-04
Count Time: 300 minutes

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<tr>
<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
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<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>0.046 +/- 0.029</td>
<td>0.027</td>
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<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>0.011 +/- 0.016</td>
<td>0.028</td>
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<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>0.005 +/- 0.014</td>
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Chemical Yield Summary

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<th>Flag</th>
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<tbody>
<tr>
<td>U-232</td>
<td>4.272</td>
<td>2.97</td>
<td>pCi/g</td>
<td>69.6</td>
<td>30 - 110 %</td>
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Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

M - Requested MDC not met.
B - Analyte concentration greater than MDC.
B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: U0404241-1

Date Printed: Friday, May 21, 2004
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Laboratory Control Sample(s)

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client/Project ID: CSMRI 2135

Lab ID: AS040428-5LCS
Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 28-Apr-04
Prep Batch: AS040428-5
Date Prepared: 28-Apr-04
QC Batch ID: AS040428-5-1
Date Analyzed: 10-May-04
Run ID: AS040428-5A
Count Time: 300 minutes
Final Allquot: 2.00 g
Result Units: pCi/g
File Name: U4285L

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<th>Target Nuclide</th>
<th>Results +/- 2s TPU</th>
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<th>Lab Qualifier</th>
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<td>13866-29-5</td>
<td>U-234</td>
<td>4.45 +/- 0.73</td>
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<td>103</td>
<td>82 - 122</td>
<td>P</td>
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<tr>
<td>7440-81-1</td>
<td>U-238</td>
<td>4.51 +/- 0.74</td>
<td>0.01</td>
<td>4.50</td>
<td>100</td>
<td>82 - 122</td>
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Chemical Yield Summary

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<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
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<tr>
<td>U-232</td>
<td>4.272</td>
<td>3.26</td>
<td>pCi/g</td>
<td>78.4</td>
<td>30 - 110 %</td>
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Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: U0404241-1
## Isotopic Uranium By Alpha Spectroscopy

**PAI 714 Rev 8**  
**Duplicate Sample Results (DER)**

**Lab Name:** Paragon Analytics  
**Work Order Number:** 0404241  
**Client Name:** New Horizons  
**ClientProject ID:** CSMRI 2135

<table>
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<tr>
<th>CASNO</th>
<th>Analyte</th>
<th>Sample Result +/- 2 s TPU</th>
<th>Duplicate Result +/- 2 s TPU</th>
<th>DER</th>
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<tbody>
<tr>
<td>13986-29-5</td>
<td>U-234</td>
<td>1.02 +/- 0.21</td>
<td>0.89 +/- 0.19</td>
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<td>2.13</td>
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<td>15117-66-1</td>
<td>U-235</td>
<td>0.040 +/- 0.029</td>
<td>0.057 +/- 0.036</td>
<td>0.35</td>
<td>2.13</td>
<td>LT</td>
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<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>0.98 +/- 0.20</td>
<td>1.00 +/- 0.20</td>
<td>0.06</td>
<td>2.13</td>
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### Comments:

**Duplicate Qualifiers/Flags:**
- **U** - Result is less than the sample specific MDC.
- **Y1** - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- **Y2** - Chemical Yield outside default limits.
- **W** - DER is greater than Warning Limit of 1.42
- **D** - DER is greater than Control Limit of 2.13
- **LT** - Result is less than Request MDC, greater than sample specific MDC
- **M** - Requested MDC not met.
- **M3** - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- **L** - LCS Recovery below lower control limit.
- **H** - LCS Recovery above upper control limit.
- **P** - LCS, Matrix Spike Recovery within control limits.
- **N** - Matrix Spike Recovery outside control limits

**Abbreviations:**
- **TPU** - Total Propagated Uncertainty (see PAI SOP 743)
- **DER** - Duplicate Error Ratio
- **BDL** - Below Detection Limit
- **NR** - Not Reported

**Data Package ID:** U0404241-1

---

**Date Printed:** Friday, May 21, 2004  
**Paragon Analytics**  
**LIMS Version:** 5.018A
PARAGON ANALYTICS
Radiochemistry Data Package

Section 3

INDIVIDUAL SAMPLE RESULTS
Isotopic Uranium By Alpha Spectroscopy

PAI 714 Rev 8
Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
ClientProject ID: CSMRI 2135

Field ID: B17
Lab ID: 0404241-3

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 19-Apr-04
Prep Batch: AS040428-5
Date Prepared: 28-Apr-04
QCBatchID: AS040428-5-1
Date Analyzed: 10-May-04
Run ID: AS040428-5A
Count Time: 300 minutes
Report Basis: Dry Weight
Final Alilquot: 2.13 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: U42413

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<td>13996-29-5</td>
<td>U-234</td>
<td>1.88 +/- 0.36</td>
<td>0.05</td>
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<tr>
<td>15117-95-1</td>
<td>U-235</td>
<td>0.082 +/- 0.044</td>
<td>0.015</td>
<td>LT</td>
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<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>2.00 +/- 0.38</td>
<td>0.04</td>
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Chemical Yield Summary

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<tr>
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<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
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<td>U-232</td>
<td>4.014</td>
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<td>pCi/g</td>
<td>50.9</td>
<td>30 - 110 %</td>
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Comments:

Qualifiers/Flags:
- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M - The requested MDC was not met.

Abbreviations:
- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Data Package ID: U0404241-1

Date Printed: Friday, May 21, 2004
Paragon Analytics
LIMS Version: 5.018A
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
ClientProject ID: CSMRI 2135

Field ID: BI37
Lab ID: 0404241-5

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 19-Apr-04
Date Prepared: 28-Apr-04
Date Analyzed: 10-May-04

Prep Batch: AS040428-5
QCBatchID: AS040428-5-1
Run ID: AS040428-5A
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 2.03 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: U42415

<table>
<thead>
<tr>
<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>2.85 +/- 0.50</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>0.212 +/- 0.073</td>
<td>0.034</td>
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</tr>
<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>2.82 +/- 0.50</td>
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Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-232</td>
<td>4.200</td>
<td>2.61</td>
<td>pCi/g</td>
<td>62.1</td>
<td>30 - 110 %</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Qualifier/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404241-1

Date Printed: Friday, May 21, 2004
Paragon Analytics
LIMS Version: 5.018A
Isotopic Uranium By Alpha Spectroscopy

PAI 714 Rev 8

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client Project ID: CSMSR 2135

Field ID: BI42
Lab ID: 0404241-7

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 19-Apr-04
Date Prepared: 28-Apr-04
Date Analyzed: 10-May-04

Prep Batch: AS040426-5
 QC Batch ID: AS040426-5-1
 Run ID: AS040426-5A
 Count Time: 300 minutes
 Report Basis: Dry Weight

Final Allquot: 2.06 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: U42417

<table>
<thead>
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<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>1.02 +/- 0.21</td>
<td>0.04</td>
<td></td>
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<tr>
<td>15117-95-1</td>
<td>U-235</td>
<td>0.040 +/- 0.029</td>
<td>0.014</td>
<td>LT</td>
</tr>
<tr>
<td>7440-81-1</td>
<td>U-238</td>
<td>0.98 +/- 0.20</td>
<td>0.03</td>
<td></td>
</tr>
</tbody>
</table>

Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-232</td>
<td>4.148</td>
<td>2.35</td>
<td>pCi/g</td>
<td>56.6</td>
<td>30 - 110 %</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404241-1
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Sample Duplicate Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client Project ID: CSMRI 2135

<table>
<thead>
<tr>
<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>0.89 +/- 0.19</td>
<td>0.03</td>
<td></td>
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<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>0.057 +/- 0.036</td>
<td>0.037</td>
<td>LT</td>
</tr>
<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>1.00 +/- 0.20</td>
<td>0.03</td>
<td></td>
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</table>

Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-232</td>
<td>4.129</td>
<td>2.49</td>
<td>pCi/g</td>
<td>60.3</td>
<td>30 - 110 %</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404244-1

Date Printed: Friday, May 21, 2004
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client Project ID: CSMRI 2135

Field ID: H07
Lab ID: 0404241-9

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 22-Apr-04
Date Prepared: 28-Apr-04
Date Analyzed: 19-May-04

Prep Batch: AS040428-5
QC Batch ID: AS040428-5-1
Run ID: AS040428-5A
Count Time: 300 minutes
Report Basis: Dry Weight
Final Aliquot: 2.06 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: UZ42419

<table>
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<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>58 +/- 10</td>
<td>0</td>
<td>Y2</td>
</tr>
<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>3.49 +/- 0.71</td>
<td>0.07</td>
<td>Y2</td>
</tr>
<tr>
<td>7440-81-1</td>
<td>U-238</td>
<td>59 +/- 10</td>
<td>0</td>
<td>Y2</td>
</tr>
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</table>

Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
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<tbody>
<tr>
<td>U-232</td>
<td>4.155</td>
<td>1.11</td>
<td>pCi/g</td>
<td>26.8</td>
<td>30 - 110%</td>
<td>Y2</td>
</tr>
</tbody>
</table>

Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404241-1

Date Printed: Friday, May 21, 2004
LIMS Version: 5.018A
Isotopic Uranium By Alpha Spectroscopy

PAI 714 Rev 8

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client Project ID: CSMRI 2135

Field ID: H075
Lab ID: 0404241-11

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Date Collected: 22-Apr-04
Date Prepared: 28-Apr-04
Date Analyzed: 16-May-04
Prep Batch: AS040428-5
GC Batch ID: AS040428-5-1
Run ID: AS040428-5A
Count Time: 300 minutes
Report Basis: Dry Weight
Final Allquot: 2.02 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: UC424111

<table>
<thead>
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<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13968-29-5</td>
<td>U-234</td>
<td>54.2 +/- 9.6</td>
<td>0.1</td>
<td>Y2</td>
</tr>
<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>2.44 +/- 0.55</td>
<td>0.03</td>
<td>Y2</td>
</tr>
<tr>
<td>7440-61-1</td>
<td>U-238</td>
<td>58 +/- 10</td>
<td>0</td>
<td>Y2</td>
</tr>
</tbody>
</table>

Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
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<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-232</td>
<td>4.238</td>
<td>1.22</td>
<td>pCi/g</td>
<td>28.7</td>
<td>30 - 110 %</td>
<td>Y2</td>
</tr>
</tbody>
</table>

Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404241-1
Isotopic Uranium By Alpha Spectroscopy
PAI 714 Rev 8
Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0404241
Client Name: New Horizons
Client Project ID: CSMRI 2135

Field ID: BB04
Lab ID: 0404241-12

Sample Matrix: SOIL
Prep SOP: PAI 778 Rev 9
Prep Batch: AS040428-5
QC Batch ID: AS040428-5-1
Run ID: AS040428-5A
Count Time: 300 minutes
Report Basis: Dry Weight
Final Aliquot: 2.05 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCl/g
File Name: UZ424112

<table>
<thead>
<tr>
<th>CASNO</th>
<th>Target Nuclide</th>
<th>Result +/- 2 s TPU</th>
<th>MDC</th>
<th>Lab Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>13966-29-5</td>
<td>U-234</td>
<td>11.1 +/- 1.9</td>
<td>0</td>
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</tr>
<tr>
<td>15117-96-1</td>
<td>U-235</td>
<td>0.51 +/- 0.15</td>
<td>0.05</td>
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</tr>
<tr>
<td>7440-81-1</td>
<td>U-238</td>
<td>11.6 +/- 2.0</td>
<td>0</td>
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</table>

Chemical Yield Summary

<table>
<thead>
<tr>
<th>Carrier/Tracer</th>
<th>Amount Added</th>
<th>Result</th>
<th>Units</th>
<th>Yield</th>
<th>Control Limits</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-232</td>
<td>4.165</td>
<td>1.59</td>
<td>pCl/g</td>
<td>38.1</td>
<td>30 - 110 %</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
LT - Result is less than Requested MDC, greater than sample specific MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:
TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)
BDL - Below Detection Limit

Data Package ID: U0404241-1

Date Printed: Friday, May 21, 2004
Paragon Analytics
LIMS Version: 5.018A
PARAGON ANALYTICS
Radiochemistry Data Package

Section 4

RAW DATA
## Isotopic Uranium By Alpha Spectroscopy Raw Data Report

**Laboratory Name:** Paragon Analytics  
**Prep SOP:** PAI 778  
**Analytical SOP:** PAI 714  
**Reported on:** Friday, May 21, 2004  
**Page 1 of 4**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Nuclide Type</th>
<th>Sample Date/Time</th>
<th>Prep Batch Code</th>
<th>Ingrowth Date/Time</th>
<th>Decay Date/Time</th>
<th>Matrix</th>
<th>Sample Alq Analy Aq</th>
<th>Inst ID Det ID</th>
<th>Analyte Aq File Name</th>
<th>Count Date/Time</th>
<th>Net Cnts</th>
<th>Base Efficiency</th>
<th>Activity +/- 2 s TPU</th>
<th>MDC Declay</th>
<th>Report Unit Status</th>
<th>DER RPQ</th>
<th>%Spk Recov Flags</th>
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<tr>
<td>0404241-1</td>
<td>U-232</td>
<td>4/19/2004</td>
<td>AS040424-5</td>
<td>NA</td>
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<td>SOIL</td>
<td>2.13 x 10^-3</td>
<td>Alpha Spec</td>
<td>AS040428-SA</td>
<td>5/10/2004</td>
<td>868,000</td>
<td>29.9%</td>
<td>0.0301</td>
<td>NA</td>
<td>Dry Weight</td>
<td>NA</td>
<td>LT</td>
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<tr>
<td>0404241-3</td>
<td>U-234</td>
<td>11:00 AM</td>
<td>AS040424-9-1</td>
<td>NA</td>
<td>NA</td>
<td>SOIL</td>
<td>2.13 x 10^-3</td>
<td>Alpha Spec</td>
<td>AS040428-SA</td>
<td>5/10/2004</td>
<td>465,600</td>
<td>29.9%</td>
<td>0.0381</td>
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<td>Dry Weight</td>
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<tr>
<td>0404241-3</td>
<td>U-235</td>
<td>11:00 AM</td>
<td>AS040424-9-1</td>
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<td>2.13 x 10^-3</td>
<td>Alpha Spec</td>
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<td>0404241-3</td>
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<td>11:00 AM</td>
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<td>Alpha Spec</td>
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<tr>
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<td>U-232</td>
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<td>SOIL</td>
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<td>5/10/2004</td>
<td>1,028,400</td>
<td>29.0%</td>
<td>0.0301</td>
<td>NA</td>
<td>Dry Weight</td>
<td>NA</td>
<td>LT</td>
</tr>
<tr>
<td>0404241-5</td>
<td>U-235</td>
<td>2:15:00 PM</td>
<td>AS040424-9-1</td>
<td>NA</td>
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<td>SOIL</td>
<td>2.03 x 10^-3</td>
<td>Alpha Spec</td>
<td>AS040428-SA</td>
<td>5/10/2004</td>
<td>697,500</td>
<td>29.0%</td>
<td>0.0301</td>
<td>NA</td>
<td>Dry Weight</td>
<td>NA</td>
<td>LT</td>
</tr>
<tr>
<td>0404241-5</td>
<td>U-238</td>
<td>2:15:00 PM</td>
<td>AS040424-9-1</td>
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<td>SOIL</td>
<td>2.03 x 10^-3</td>
<td>Alpha Spec</td>
<td>AS040428-SA</td>
<td>5/10/2004</td>
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<td>NA</td>
<td>Dry Weight</td>
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<td>LT</td>
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<tr>
<td>0404241-5</td>
<td>U-238</td>
<td>2:15:00 PM</td>
<td>AS040424-9-1</td>
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<td>0404241-7</td>
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<td>3:15:00 PM</td>
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<td>0404241-7</td>
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<td>AS040424-9-1</td>
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<td>NA</td>
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<td>2,346,500</td>
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<tr>
<td>0404241-7</td>
<td>U-235</td>
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<td>0.0301</td>
<td>NA</td>
<td>Dry Weight</td>
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</tbody>
</table>

**Comments:**

**Data Package ID:** U0404241-1

**Qualifiers/Flags:**
- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- D - DER is greater than Control Limit of 2.13
- # - Duplicate RPQ not within limits.
- LT - Result is less than Request MDC, greater than sample specific MDC.
- * - Alclute Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Alclute Basis is 'Dry Weight' while the Report Basis is 'As Received'.
- M - Requested MDC not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery control limits.
- NC - Not Calculated for duplicate results less than 5 times MDC.
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

**Notes:**
1) The Trace results are not yield corrected (i.e. activity measured not activity added).
2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

**Abbreviations:**
- TR - Trace
- TA - Target Analyte
- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- DER - Duplicate Error Ratio
- BD - Below Detection Limit

**Date Printed:** Friday, May 21, 2004  
**LIMS Version:** 5.018A
### Isotopic Uranium By Alpha Spectroscopy Raw Data Report

**Laboratory Name:** Paragon Analytics  
**PAI Work Order:** 0404241  
**Prep SOP:** PAI 778  
**Analytical SOP:** PAI 714  
**Reported on:** Friday, May 21, 2004  
**Time:** 9:49:38 AM

| Sample ID  | Nuclide Type | Sample Date/Time | Prep Batch GC/Order ID | Ingrowth Date/Time | Decay Date/Time | Matrix % Moist | Samp Aq Analy Aq | Inst ID Det ID | RunID | File Name | Count Date/Time | Net Cntrt | BaseEff Bkg (mV) | CntDur (min) | Activity +/- 2 s TPO | MDC Declev | Report/Units | Report/Unit Basis | DER RPD | % Spk. Recov | Flags |
|------------|--------------|------------------|------------------------|-------------------|---------------|--------------|---------------|---------------|------------|--------|---------------|--------------|---------------|----------------|----------------|----------------|------------|----------------|--------|
| 0404241-17 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 229,800        | 30.21%        | 300            | 0.96          | 0.03          | pCi/g     | NA          | NA        |
| 0404241-21 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 1013,600       | 29.54%        | 300            | 2.49          | 0.04          | pCi/g     | NA          | NA        |
| 0404241-13 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 217,500        | 29.54%        | 300            | 0.89          | 0.03          | pCi/g     | 0.48        |
| 0404241-17 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 11,800         | 29.54%        | 300            | 0.057         | 0.037         | pCi/g     | NA          | NA        |
| 0404241-17 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 244,500        | 29.54%        | 300            | 1.00          | 0.03          | pCi/g     | NA          | LT         |
| 0404241-17 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 473,400        | 31.06%        | 300            | 1.11          | 0.03          | pCi/g     | NA          | Y2         |
| 0404241-21 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 600,700        | 31.06%        | 300            | 58            | 0             | pCi/g     | NA          | Y2         |
| 0404241-21 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 338,400        | 31.06%        | 300            | 3.49          | 0.07          | pCi/g     | NA          | Y2         |
| 0404241-21 | U-238        | 4/19/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.06 ± 17     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 675,800        | 31.06%        | 300            | 59            | 0             | pCi/g     | NA          | Y2         |
| 0404241-11 | U-238        | 4/22/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.02 ± 60     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 420,400        | 25.75%        | 300            | 1.22          | 0.03          | pCi/g     | NA          | Y2         |
| 0404241-11 | U-238        | 4/22/2004        | AS040424-5             | NA                | NA            | SOIL         | 2.02 ± 60     | Alpha Spec    | AS040424-5A  | 5/10/2004 | 557,400        | 25.75%        | 300            | 54.2          | 0.1           | pCi/g     | NA          | Y2         |

**Comments:**

**Data Package ID:** U0404241-1

**Qualifiers/Flags:**

- **U** - Result is less than the sample specific MDC.  
- **Y1** - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.  
- **Y2** - Chemical Yield outside default limits.  
- **W** - DER is greater than Warning Limit of 1.42  
- **D** - DER is greater than Control Limit of 2.13  
- **+** - Duplicate RPD not within limits.  
- **LT** - Result is less than Request MDC, greater than sample specific MDC  
- **-** - Aliquot Basis is 'As Recieved' while the Report Basis is 'Dry Weight'.  
- **#** - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Recieved'.  

**Notes:**

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).  
2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

**Abbreviations:**

- **TR** - Tracer  
- **TA** - Target Analyte  
- **TPU** - Total Propagated Uncertainty (see PAI SOP 743)  
- **MDC** - Minimum Detectable Concentration (see PAI SOP 709)  
- **DER** - Duplicate Error Ratio  
- **BDL** - Below Detection Limit

**Date Prepared:** Friday, May 21, 2004

---

**Paragon Analytics**  
**LIMS Version:** 5.018A  
**Page 2 of 4**
# Isotopic Uranium By Alpha Spectroscopy Raw Data Report

**Laboratory Name:** Paragon Analytics  
**PAI Work Order:** 0404241  
**Prep SOP:** PAI 778  
**Analytical SOP:** PAI 714  
**Reported on:** Friday, May 21, 2004  
**Reported Time:** 9:49:38 AM

## Sample Data Table

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Nuclide Type</th>
<th>Sample QC Type</th>
<th>Sample QC Batch ID</th>
<th>Sample Date/Time</th>
<th>Prep Batch QC Batch ID</th>
<th>Ingrowth Date/Time</th>
<th>Decay Date/Time</th>
<th>Matrix %Moist</th>
<th>Sample/Act Analyte</th>
<th>Inst ID</th>
<th>Det ID</th>
<th>Analyte QID</th>
<th>Activity +/- 2 s TPU s</th>
<th>MDC Dectlev</th>
<th>Report Units/Report Basis</th>
<th>DER %Spk Recovery Flags</th>
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<td>0.26</td>
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## Comments:

**Data Package ID:** U0404241-1

### Qualifiers/Flags:
- **U**: Result is less than the sample specific MDC.
- **Y1**: Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- **Y2**: Chemical Yield outside default limits.
- **W**: DER is greater than Warning Limit of 1.42
- **D**: DER is greater than Control Limit of 2.13
- **L**: Result is less than Request MDC, greater than sample specific MDC
- **N**: Not Calculated for duplicate results less than 5 times MDC
- **A**: Analyte concentration greater than MDC
- **S**: Analyte concentration less than MDC but less than Requested MDC
- **B**: Analyte concentration less than MDC but less than Requested MDC
- **F**: Analyte concentration greater than MDC

### Notes:
1. The Trace results are not yield corrected (i.e. activity measured not activity added).
2. Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

### Abbreviations:
- **TR**: Trace Analyte  
- **TA**: Target Analyte  
- **TPU**: Total Propagated Uncertainty (see PAI SOP 743)  
- **MDC**: Minimum Detectable Concentration (see PAI SOP 709)  
- **DER**: Duplicate Error Ratio  
- **BDL**: Below Detection Limit

---

**Date Printed:** Friday, May 21, 2004
## Isotopic Uranium By Alpha Spectroscopy Raw Data Report

**Laboratory Name:** Paragon Analytics  
**Prep SOP:** PAI 778  
**Preparing:** PAI 714  
**Reported on:** Friday, May 21, 2004  
**Date:** 9:49:38 AM

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<th>Date/Time</th>
<th>Prep Batch</th>
<th>Ingrowth</th>
<th>Decay</th>
<th>Matrix</th>
<th>Samp Aq Analy Aq</th>
<th>Inst ID</th>
<th>File Name</th>
<th>Count Date/Time</th>
<th>Net CNs</th>
<th>BaseEff Bkg(min)</th>
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**Comments:**

**Data Package ID:** UO404241-1

**Qualifiers/Flags:**
- "U" - Result is less than the sample specific MDC.
- "Y1" - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- "Y2" - Chemical Yield outside default limits.
- "W" - DER is greater than Warning Limit of 1.42
- "D" - DER is greater than Control Limit of 2.13
- "=" - Duplicate RP not within limits.
- "LT" - Result is less than Request MDC, greater than sample specific MDC
  
  * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
  
  # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

**Notes:**
1) The tracer results are not yield corrected (i.e. activity measured not activity added).
2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

**Abbreviations:**
- TR - Tracer
- TA - Target Analyte
- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 769)
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit

**Date Updated:** Friday, May 21, 2004
Paragon Analytics
Alpha Spectroscopy Analysis

Sample Name: 0404241-3 UAS040428-5
Detector: MCB 2 Input 7
Sample Volume: 2.129 Total, 2.129 Aliquot.
Chem. Yield: 50.84%
Total Eff.: 15.25 %
Tracer Amount: 18.976 DPM.
Efficiency: 29.99%

Analysis Type: Uranium Default
Date/Time of Count: 5/10/04 2:37:37 PM
Live Time: 300.00 Minutes
Real Time: 300.01 Minutes
Dead Time: 0.0 %
Acquisition: 512 Channels
Analysis: Relative Region-Of-Interest

Original: 3,029 + 9.9308 * Chn + -0.00052 * Chn **2.
Spectrum Calibration: 3,029 + 10.0273 * Chn + -0.00052 * Chn **2.

Cal File: Spectral File: C:\User\Alpha\ALPHA\U42413.SPC
Background File: C:\USER\ALPHA\BKGND\B4050415.SPC
Library File: C:\User\Alpha\ALPHA\VIS\ALB

Peaks

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<th>Peak</th>
<th>Channel</th>
<th>Start</th>
<th>End</th>
<th>FWHM</th>
<th>Height</th>
<th>Gross Cts</th>
<th>Bkg Cts</th>
<th>Net Area</th>
<th>DPM</th>
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Analysis Results

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<th>Energy (keV)</th>
<th>Width (keV)</th>
<th>Aliquot pCi</th>
<th>MDA pCi</th>
<th>% Error</th>
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<tbody>
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Totals

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Analyzed By: [Signature]
Checked By: [Signature]

000023
Acquired: 14:37:37 on 10-May-2004
File: C:\User\Alpha\ALPHA\U42413.SPC
Sample: 0404241-3 UAS040428-5

Real Time: 18000.30 s. Live Time: 18000.00 s.
Detector: #15 MCB 2 Input 7
Type: Uranium Default
Sample Name: 0404241-5 UAS040428-5

Detector: MCB 2 Input 8
Sample Volume: 2.035 Total, 2.035 Aliquot.

Chem. Yield: 62.09%
Total Eff.: 18.03 %
Tracer Amount: 18.976 DPM.
Efficiency: 29.04%

Analysis Type: Uranium Default
Date/Time of Count: 5/10/04 2:37:56 PM
Live Time: 300.00 Minutes
Real Time: 300.01 Minutes
Dead Time: 0.0 %
Acquisition: 512 Channels
Analysis: Relative Region-Of-Interest

Original: 3,019 + 10.0498 * Chn + -0.00064 * Chn **2.
Spectrum Calibration: 3,019 + 10.0842 * Chn + -0.00064 * Chn **2.

Cal File:
Spectrum File: C:\User\Alpha\ALPHA\U42415.SPC
Background File: C:\USER\ALPHA\BKGND\B4050416.SPC
Library File: C:\User\Alpha\ALPHAVIS.ALB

### Peaks

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<th>End</th>
<th>FWHM</th>
<th>Height</th>
<th>Gross Cts</th>
<th>Bkg Cts</th>
<th>Net Area</th>
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### Analysis Results

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<th>Width (keV)</th>
<th>Aliquot pCi</th>
<th>MDA pCi</th>
<th>% Error</th>
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### Totals

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Analyzed By: [Signature]
Checked By: [Signature]
**Paragon Analytics**  
**Alpha Spectroscopy Analysis**

**Sample Name:** 0404241-7 UAS040428-5  
**Analysis Type:** Uranium Default

**Detector:** MCB 3 Input 1  
**Sample Volume:** 2.060 Total, 2.060 Aliquot.

**Chem. Yield:** 56.62%  
**Total Eff.:** 17.10 %

**Tracer Amount:** 18.976 DPM.  
**Efficiency:** 30.21%

**Original:** $3,045 + 9.7400 \times \text{Chn} + -0.00013 \times \text{Chn}^{**2}.$

**Spectrum Calibration:** $3,045 + 9.8704 \times \text{Chn} + -0.00013 \times \text{Chn}^{**2}.$

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\U42417.SPC  
**Background File:** C:\USER\ALPHA\BKGND\B4050417.SPC  
**Library File:** C:\User\Alpha\ALPHA\ALPHAIS.ALB

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### Analysis Results

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<td>Residuals:</td>
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**Analyzed By:** [Signature]

**Checked By:** [Signature]
Sample Name: 0404241-7D UAS040428-5

Detector: MCB 3 Input 2
Sample Volume: 2.069 Total, 2.069 Aliquot.
Chem. Yield: 60.27%
Total Eff.: 17.80 %
Tracer Amount: 18.976 DPM.
Efficiency: 29.54%

Analysis Type: Uranium Default
Date/Time of Count: 5/10/04 2:38:29 PM
Live Time: 300.00 Minutes
Real Time: 300.01 Minutes
Dead Time: 0.0 %
Acquisition: 512 Channels
Analysis: Relative Region-Of-Interest

Original: 3,055 + 9.7892 * Chn + -0.00024 * Chn **2.
Spectrum Calibration: 3,055 + 9.8423 * Chn + -0.00024 * Chn **2.

Cal File:
Spectrum File: C:\User\Alpha\ALPHA\U42417D.SPC
Background File: C:\USER\ALPHA\BKGNDB4050418.SPC
Library File: C:\User\Alpha\ALPHAVIS. ALB

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<th>Height</th>
<th>Gross Cts</th>
<th>Bkg Cts</th>
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Analysis Results

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<th>Width (keV)</th>
<th>Aliquot pCi</th>
<th>MDA pCi</th>
<th>% Error</th>
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<td>39.15</td>
<td>0.996</td>
<td>n/a</td>
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Totals

| Gross Count: | 1,711.00 | 100.00 |
| Net Area:    | 1,615.60 | 94.42  |
| Background:  | 95.40    | 5.58   |
| Composite Fit: | 1,500.00 | 87.67  |
| Residuals:   | 211.00   | 12.33  |

Analyzed By: _____________________________

Checked By: _____________________________
Sample Name: 0404241-9 UAS040428-5

Detector: MCB 3 Input 2
Sample Volume: 2.056 Total, 2.056 Aliquot.
Chem. Yield: 26.76%
Total Eff.: 8.32%
Tracer Amount: 18.976 DPM.
Efficiency: 31.08%

Analysis Type: Uranium Default
Date/Time of Count: 5/19/04 2:14:16 PM
Live Time: 300.00 Minutes
Real Time: 300.01 Minutes
Dead Time: 0.0%
Acquisition: 512 Channels
Analysis: Relative Region-Of-Interest

Original: 3,025 + 10.1587 * Chn + -0.00110 * Chn **2.
Spectrum Calibration: 3,025 + 10.4851 * Chn + -0.00110 * Chn **2.

Cal File:
Spectrum File: C:\User\Alpha\ALPHA\UZ42419.SPC
Background File: C:\USER\ALPHA\BKGND\B4051818.SPC
Library File: C:\User\Alpha\ALPHA\VIS\ALB

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<th>Height</th>
<th>Gross Cts</th>
<th>Bkg Cts</th>
<th>Net Area</th>
<th>DPM</th>
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Analysis Results

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<tr>
<th>Peak</th>
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<th>Width (keV)</th>
<th>Aliquot pCi</th>
<th>MDA pCi</th>
<th>% Error</th>
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Totals

Gross Count: 15,188.00  100.00%
Net Area: 15,108.50  99.48%
Background: 79.50  0.52%
Composite Fit: 14,181.00  93.37%
Residuals: 1,007.00  6.63%

Analyzed By: [Signature]
Checked By: [Signature]
Acquired: 14:14:16 on 19-May-2004
File: C:\User\Alpha\ALPHA\UZ42419.SPC
Sample: 0404241-9 UAS040428-5

Real Time: 18000.88 s.  Live Time: 18000.00 s.
Detector: #18 MCB 3 Input 2
Type: Uranium Default
**Sample Name:** 0404241-11 UAS040428-5  
**Analysis Type:** Uranium Default

**Detector:** MCB 8 Input 4  
**Date/Time of Count:** 5/16/04 2:16:48 PM

**Sample Volume:** 2.016 Total, 2.016 Aliquot  
**Live Time:** 300.00 Minutes

**Chem. Yield:** 28.68%  
**Real Time:** 300.02 Minutes

**Total Eff.:** 7.38%  
**Dead Time:** 0.0%

**Tracer Amount:** 18.976 DPM  
**Acquisition:** 512 Channels

**Efficiency:** 25.75%  
**Analysis:** Relative Region-Of-Interest

**Original:**  $3,016 + 10.1594 \times \text{Chn} + -0.00120 \times \text{Chn}^2$.

**Spectrum Calibration:**  $3,016 + 10.2438 \times \text{Chn} + -0.00120 \times \text{Chn}^2$.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\UC424111.SPC  
**Background File:** C:\USER\ALPHA\BKGND\B4051160.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

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<th>End</th>
<th>FWHM</th>
<th>Height</th>
<th>Gross Cts</th>
<th>Bkg Cts</th>
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<th>DPM</th>
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### Analysis Results

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<th>Aliquot pCi</th>
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### Totals

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**Analyzed By:** [Signature]  
**Checked By:** [Signature]

**Report Number:** 000033
### Peaks

<table>
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<th>Peak</th>
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<th>Height</th>
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<th>Bkg Cts</th>
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### Analysis Results

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<tr>
<th>Peak</th>
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<th>Energy (keV)</th>
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<th>Aliquot pCi</th>
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File: C:\User\Alpha\ALPHA\UZ424112.SPC
Sample: 0404241-12 UAS040428-5
Real Time: 18000.88 s.  Live Time: 18000.00 s.
Detector: #19 MCB 3 Input 3
Type: Uranium Default
**Paragon Analytics**
**Alpha Spectroscopy Analysis**

**Sample Name:** AS040428-5MB UAS040428-5
**Analysis Type:** Uranium Default

**Detector:** MCB 3 Input 7
**Date/Time of Count:** 5/10/04 2:39:38 PM

**Sample Volume:** 2.000 Total, 2.000 Aliquot
**Live Time:** 300.00 Minutes
**Chem. Yield:** 69.55%
**Real Time:** 300.01 Minutes
**Total Eff.:** 19.75 %
**Dead Time:** 0.0 %
**Tracer Amount:** 18.937 DPM
**Acquisition:** 512 Channels
**Efficiency:** 28.40%
**Analysis:** Relative Region-Of-Interest

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\U4285B.SPC

**Background File:** C:\USER\ALPHA\BKGND\B4050423.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

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### Totals

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Analyzed By: [Signature]

Checked By: [Signature]
**Paragon Analytics**  
**Alpha Spectroscopy Analysis**

**Sample Name:** AS040428-5LCS UAS040428-5  
**Analysis Type:** Uranium Default

**Detector:** MCB 6 Input 2  
**Sample Volume:** 2.000 Total, 2.000 Aliquot.

**Chem. Yield:** 76.38%  
**Total Eff.:** 24.41%  
**Tracer Amount:** 18.976 DPM.

**Efficiency:** 31.96%

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\U4285L.SPC  
**Background File:** C:\USER\ALPHA\BKGND\B4050442.SPC  
**Library File:** C:\User\Alpha\ALPHAVIS.ALB

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**Analyzed By:** [Signature]  
**Checked By:**

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000033
## Paragon Analytics
### Alpha Spectrometer Instrument Run Log

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**Notes:**

**Cad. on page 277715.** JP 5/10/04
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Notes: Cont. from page 277725. JP 5/16/04

Reviewed by: JP
Date: 5/17/04
## Paragon Analytics

Alpha Spectrometer Instrument Run Log

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**Notes:**
Cont. on page 277730. JP 5/19/04.

Reviewed by: JP
Date: 5/19/04
Section 5

QUALITY ASSURANCE
SUMMARY REPORTS
CONTROLLED
NON-CONFORMANCE REPORT

Initiated by JP Date 5/13/04
Reason:
- Non-Conformance
- Client Inquiry
- Other

Method/Procedure 590-U
Work Orders Affected 0404241

Clients New Horizons

SECTION I TYPE OF EVENT (circle as appropriate)

1. LCS / Surrogate / IS Tracer or Chemical Yield Criteria Not Met
2. Calibration Criteria Not Met (ICAL, ICV, CCV)
3. Method Requirements Not Met (HTV, MB,)
4. Deviation from LQAP / SOP (i.e., PA criteria not met)
5. Client Criteria Not Met (MDC, DER,)
6. Equipment Failure or Laboratory Incident / Error
7. Other Spectral Quality (Mass Attenuation)

Explanation:
- Samples 0404241-9 + 12 have chemical recoveries below 76.30% LCL at 28.48% + 25.16% respectively.
- This is likely caused by high levels of native uranium present in the samples, causing mass attenuation.

Actions to Prevent Recurrence (Retrain, etc.):

N/A — See comments below

SECTION II NOTIFICATION

Client Contacted? Y Name: __________________________ Date: ____________ Time: ____________

SECTION III CORRECTIVE ACTIONS

X 1. Submit for Re-Prep. or Clean-up
   2. Re-analyze 9/11/12
   3. Resubmit Data (hc, edd, narrative)
   4. Document in Narrative
   5. Other

Approved by: RG DPM PM 5/13/04 7/9/04

SECTION IV REQUEST FOR REWORK

Initial Batch ID: AS040428-5 Date: 4/28/04
Reworked Batch ID: AS040428-5 Date: 4/28/04

Outcome: Clean-up improved spectral quality. Quantification of requested analytes is now possible.
However, chemical recovery for sample...

Approved by: RG 5/12/04 (conf. below)

SECTION V DISPOSITION

Use as is Repair Reject

SECTION VI COMMENTS

0404241-9 + 11 is below 76.30% LCL at 26.76% and 28.68% respectively. Chemical recovery for sample 0404241-12 is now above 76.30% at 38.03% (no more attenuation). Spectral quality for all samples is acceptable for accurate quantification.

SECTION VII APPROVAL SIGNATURES

Project Manager (PM) Debbie Per Date 5/21/04
Department Manager (DPM) Date 5/11/04 (Verification of Disposition)
QA Manager Date 5/21/04

SECTION VIII DISTRIBUTION

PM DPM Dept. Manager Lab Director Rpt. Group or

RG 0000045

FORM 313r14.doc (3/8/04)
QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. #/BATCH FOR ALL CLEAN-UPS
TEST ACTINIDES
METHOD Prep
SOP/REV (PREP) N/A
SOP/REV (ANAL) 

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

The following procedure was implemented for all samples designated for "clean-up":

1. Filter was peeled from the planchet using forceps and placed in a labeled plastic cup.

2. 2g Boric acid was added with 20mL of concentrated nitric acid.

3. Cup was placed on steambath for at least 1 hour with the filter completely submerged in the acid the entire time.

4. The cup was then rinsed with approximately 100mL DI water into a labeled centrifuge bottle. (leaving the filter behind)

5. 1mL iron carrier was added and precipitated with ammonium hydroxide and centrifuged at 3500rpm for 15 minutes.

6. Sample(s) were taken to micro precipitation where the appropriate SOP was followed.

TECHNICIAN/ANALYST Macaluso

DATE 5/3/04

DEPARTMENT MANAGER

DATE 5/3/04

FORM 3025.RM (04/30/01)
Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH: For all uranium batches
TEST: urine
METHOD: 9.09
SOP/REV (PREP): 778 10 29 8204
SOP/REV (ANAL): ____________

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO’s or sample characteristics.

1. A consistent 20-25 ml of ammonium hydroxide was used per sample in order to form the ferric hydroxide precipitate prior to running a chloride column.

TECHNICIAN/ANALYST ___________________________ DATE 4/14/04

DEPARTMENT MANAGER ___________________________ DATE 4/14/04
PARAGON ANALYTICS
Radiochemistry Data Package

Section 6

LABORATORY
BENCH SHEETS
# Radiochemistry Instrument Worksheet

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- **Solution #**: T1
- **Nuclide**: U-232
- **Solution ID**: 511.2613.29
- **Prep Conc**: 37.952
- **Units**: DPM/ml
- **Prep Date**: 04/28/04
- **Aliquot**: 0.5 ml
- **Pipet ID**: AW004

**Spike Solution Information**

- **Solution #**: S1
- **Nuclide**: U-234
- **Solution ID**: 643.2382.44
- **Prep Conc**: 38.522
- **Units**: DPM/ml
- **Prep Date**: 04/28/04
- **Aliquot**: 0.5 ml
- **Pipet ID**: AW004

**Supersedes**: N/A
## Radiochemistry Instrument Worksheet

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**Prep Batch:** AS040428-5  
**Analytical QASS:** N  
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### Radiochemistry Prep Worksheet

**Prep Procedure:** UISO

**Prep Analyst:** Carissa Moncavage

**Prep Date:** 4/28/04

**Prep Dept:** AP

**Samp Num** | **LabID** | **Prep Num** | **QC Type** | **Dash No.** | **Init Alq g** | **Fin Alq g** | **Prep Basis** | **Micro Init** | **Micro Date** | **Standards** | **Prep Notes**
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2 | 1 | 0404241-5 | SMP | | 2.0345 | 2.0345 | Dry Weight | | | | |
3 | 1 | 0404241-7 | SMP | | 2.0602 | 2.0602 | Dry Weight | | | | |
4 | 1 | 0404241-7 | DUP | | 2.0693 | 2.0693 | Dry Weight | | | | |
5 | 1 | 0404241-9 | SMP | | 2.0559 | 2.0559 | Dry Weight | | | | |
6 | 1 | 0404241-11 | SMP | | 2.016 | 2.016 | Dry Weight | | | | |
7 | 1 | 0404241-12 | SMP | | 2.051 | 2.051 | Dry Weight | | | | |
8 | 1 | AS040428-5 | MB | | 2 | 2 | Dry Weight | | | | |
9 | 1 | AS040428-8 | LCS | | 2 | 2 | Dry Weight | | | | |

**Spiked By:** Carissa Moncavage  
**Date:** 4/29/04

**Witnessed By:** Grace Campagnola  
**Date:** 4/29/04

**Tracer/Carrier Solution Information**

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**Comments:**  
ALL SAMPLES WERE MUFFLED. ALL SAMPLES RECEIVED PEG TREATMENT.

**Reviewed By:** CDM  
**Review Date:** 5/3/04

**Supersedes:**  
4/29/04 15:23
## Radiochemistry Prep Worksheet

**Prep Procedure:** UISO

**Prep SOP:** PAI 778

**Matrix Class:** solid

### Non-Routine Pre-Treatment
- **Batch:** Clean-Up
- **Re-Prep?: Y/N**

### Prep SOP
- **Prep SOP:** NONE

### Prep Analyst
- **Carissa Moncavage**

### Prep Date
- **4/28/04**

### Prep Dept
- **AP**

### Balance
- **23**

### Prep QASS / NCR
- **Y / N**

### Prep Notes

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**Spiked By:** Carissa Moncavage

**Date:** 4/29/04

**Witnessed By:** Grace Campagna

**Date:** 4/29/04

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**Comments:**

ALL SAMPLES WERE MUFFLED. ALL SAMPLES RECEIVED PEG TREATMENT.  

**Reviewed By:** CDM 5/16/04  
**Review Date:** 5/3/04
**Radiochemistry Prep Worksheet**

**Prep Batch Not Validated!!!**

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<td>0404241-11 SMP</td>
<td>2</td>
<td>2</td>
<td>Dry Weight</td>
<td>958</td>
<td>2.0140</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>1</td>
<td>AS040428-5 MB</td>
<td>2</td>
<td>2</td>
<td>Dry Weight</td>
<td>431</td>
<td>2.0536</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>1</td>
<td>AS040428-5 LCS</td>
<td>2</td>
<td>2</td>
<td>Dry Weight</td>
<td>504</td>
<td>2.0</td>
<td>T1, B1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spiked By:  
Date: 4/29/04  
Witnessed By:  
Date: 4/29/04

---

**Tracer/CARRIER SOLUTION INFORMATION**

<table>
<thead>
<tr>
<th>Soln #</th>
<th>Nuclide</th>
<th>SolnID</th>
<th>Prep Conc</th>
<th>Units</th>
<th>Prep Date</th>
<th>Alqout</th>
<th>Units</th>
<th>Pipet ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>U-238</td>
<td>511.2613.20</td>
<td>37.947</td>
<td>DPM/ml</td>
<td>04/28/04</td>
<td>U.5 ml</td>
<td>AW004</td>
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</tbody>
</table>

**Spike Solution Information**

<table>
<thead>
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<th>Soln #</th>
<th>Nuclide</th>
<th>SolnID</th>
<th>Prep Conc</th>
<th>Units</th>
<th>Prep Date</th>
<th>Alqout</th>
<th>Units</th>
<th>Pipet ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>U-234</td>
<td>643.2382.44</td>
<td>33.522</td>
<td>DPM/ml</td>
<td>04/28/04</td>
<td>0.5 ml</td>
<td>AW004</td>
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<tr>
<td>S1</td>
<td>U-238</td>
<td>643.2382.44</td>
<td>39.964</td>
<td>DPM/ml</td>
<td>04/28/04</td>
<td>0.5 ml</td>
<td>AW004</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

U-232 S11.2613.26 1.000Dpm/ml 0.5 ml AW004

exp 11/10/04
# SAMPLE CONDITION FORM (SOLIDS)

**ANALYST:** COM  
**ANALYSIS DATE:** 4/28/04  
**METHOD:** PROP

<table>
<thead>
<tr>
<th>ORDER</th>
<th>SAMPLE</th>
<th>SAMPLE CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0404241</td>
<td>3</td>
<td>dry ground</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** more

**Signature:** COM  
**Date:** 4/28/04
### New Horizons

**Date:** 4/28/04

**W.O. #:** 04-04-241

**Notes:**
- In oven: 4/27 @ 1100
- Out oven: 4/28 @ 1100
- 5.0, P: 721-R10
- Balance #15, oven #1
- 5 balls, shake 15 min.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Sample (con/balls%)</th>
<th>Con/balls%</th>
<th>Ground Sample(s)</th>
<th>Type Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>04-04-241-3</td>
<td>126.6</td>
<td>96.4</td>
<td>30.2</td>
<td>Soil</td>
</tr>
<tr>
<td>-5</td>
<td>126.5</td>
<td>96.3</td>
<td>30.2</td>
<td></td>
</tr>
<tr>
<td>-7</td>
<td>126.8</td>
<td>96.4</td>
<td>30.4</td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td>127.0</td>
<td>96.9</td>
<td>30.1</td>
<td></td>
</tr>
<tr>
<td>-11</td>
<td>127.1</td>
<td>96.7</td>
<td>30.4</td>
<td></td>
</tr>
<tr>
<td>-12</td>
<td>125.7</td>
<td>96.5</td>
<td>29.2</td>
<td></td>
</tr>
</tbody>
</table>

**C.O.: 4/28/04**

**Read and understood by:**

Carson R. O'Dell 4/28/04

Date: 4/28/04

Signed: [Signature]

Date: [Signature]
Section 7

STANDARDS
TRACEABILITY
DOCUMENTS
**PROJECT U-232 WORKING LEVEL DILUTION**

Prepare a working level dilution of U-232 at 20 dpm/mL by diluting 511.0172.82 with 2N HCl.

1. **Determine the density of 2N HCl, lot # 43174**
   - Mass of 100 ml class A volumetric flask: 68.2958 g
   - Mass of flask + 100 ml 2N HCl: 171.2342 g
   - Net mass of 2N HCl: 102.9374 g
   - Density: \( \rho = 1.0295 \) g/cm³

2. **Transfer U-232 (511.0172.82) to a 1L Nalgene bottle**
   - Mass of bottle without lid: 75.5713 g
   - Mass of bottle and standard: 92.8370 g
   - Net mass of standard transferred: 17.3057 g

3. **Dilute to final volume with 2N HCl**
   - Mass of bottle without lid (from above): 75.5713 g
   - Net mass of bottle, standard, 2N HCl transferred: 93.0475 g
   - Net mass of standard: 855.13 g

**Final Activity Calculation**

\[
\text{Activity} = \frac{1920.0 \text{ dpm/mL} \times 17.3057 \text{ g/mL}}{855.13 \text{ g}} = 40.00 \text{ dpm/mL}
\]

**U-232 Information**

- **Description:** U-232
- **Expiration:** 9/27/04
- **Activity:** 40.00 dpm/mL

**2s Uncertainty:** 2.00 dpm/mL

- **Ref. Date:** 2/4/99
- **Ref. Time:** N/A
- **Prep. Date:** 9/11/03
- **Prep. by:** CDM
- **Matrix/Comp.:** 2N HCl
- **Half Life:** 6.98E+01

- **SD 10/22/03**
- **SD 10/22/03**

**Notes:**

- Requires NCR for IOPGT Work!

**Signature:**

- **Chenealage 9/11/03**
- **Signed 9/23/03**

**Documents:**

- **SD 7/28/03**
Transfer U²³⁵ standard 880 = 511 to a 1 L HNaLugene bottle.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>empty bottle</td>
<td>59.2300 g</td>
</tr>
<tr>
<td>full bottle</td>
<td>594.40 g</td>
</tr>
<tr>
<td>balance</td>
<td>51 g</td>
</tr>
</tbody>
</table>

Activity of standard (data from calibration sheet for 880 = 511)

\[(17170 \text{ dpm} \times 60 \text{ sec/min}) = 1,030,200 \text{ dpm}\]

\[1000 \text{ dpm} / 530.54 \text{ g} = 1920.0 \text{ dpm/g}\]

Et date: 2/14/99
T/2 = 0.928 yr

Subsequent dilutions to be verified.

This was a direct transfer, no dilution.
CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

57106-307

U-232 500 mL Liquid in Flame Sealed Bottle

This standard radionuclide source was prepared using an aliquot measured gravimetrically from a master radionuclide solution standard. The master radionuclide solution standard was calibrated by the Department Des Applications Et De La Metrologie Des Rayonnements Ionisants (DAMRI), Paris, France, as Number 23236.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

<table>
<thead>
<tr>
<th>ISOTOPE</th>
<th>U-232</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVITY (dps)</td>
<td>1.717 E+04</td>
</tr>
<tr>
<td>CALIBRATION DATE</td>
<td>February 4, 1999 12:00 EST</td>
</tr>
<tr>
<td>HALF-LIFE</td>
<td>69.8 years</td>
</tr>
<tr>
<td>TOTAL UNCERTAINTY</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

536.56 grams of solution 2M HNO₃.
Impurities detected: U-233 <50 dps/bottle, Am-241 <25 dps/bottle on above referenced date.

P O NUMBER 22055, Item 1

SOURCE PREPARED BY: E. A. Taskaev, Radiochemist

Q A APPROVED: 2-4-79
U-238 working dilution

Prepare a working dilution of U-238 1043.2382.443 to 40 dpm/ml by diluting w/ 1NHNO₃ (Lot # 42207).

1) Determine the density of 1NHNO₃ (Lot # 42207)

| Mass of flask | 144.4647 g (Bal 12) |
| Mass of flask w/ NHNO₃ | 197.4861 g |
| Net mass of solution | 152.819 g |

\[ \rho = \frac{152.819 g}{100 ml} = 1.52819 g/ml \]

2) Transfer approx. 20 g of U-238 (1043.2382.443) to a wide mouth bottle.

| Mass of wide mouth bottle w/ lid | 714.14603 g (Bal 12) |
| Mass of bottle & std | 92.0243 g |
| Net mass of std transferred | 17.878 g |

3) Dilute to final vol w/ 1NHNO₃

| Mass of wide mouth (from above) | 741.14632 g (Bal 12) |
| Mass of wide mouth & std w/ NHNO₃ | 953.032 g (Bal 26) |
| Net mass of std | 879.25 g |

4) Final Activity Calculation

\[ A = \frac{20.86 \times 10^{12} dpm}{879.25 g} \]

\[ = 4.21 \times 10^{15} dpm/ml \]

Standard reverified 4/25/03.
New expiration date 4/1/04.

Said ID: 643.2382.44
Prep: 1/1/02

Description: U-238
Activity: 39.99 dpm/ml
2σ Uncertainty: 0.24 dpm/ml
Ref. Date: 4/1/04
Ref Time: a
Prep Date: 4/1/02
Prep by: CWDCG
Expiration: 4/1/03
Meas/Comp: 1NHN03
Half Life (y): 4.47E+09

Read and Understood By

[Signature]
11/10/04

[Signature]
10/18/03

[Signature]
11/10/04
W-238 primary dilution
Prepare a primary dilution of W-238 (NIST 3753 d10)

1) Transfer ampule to a 40 ml VOA Vial
   Mass of empty 50 ml beaker
   2.93895 g (Bal 1)
   Mass of beaker + ampule
   3.0584 g
   Mass of ampule	2.11988 g

   Mass of beaker + empty ampule: 2.93975 g (mlw) Net mass of std transferred: 2.11988 g

2) Dilute to final volume w/ IN HNO3
   Mass of empty VOA Vial
   2.03989 g (Bal 2)
   Mass of VOA Vial + std + IN HNO3
   3.82681 g
   Net mass of diluted std + HNO3
   38.7878 g

3) Final activity calculation
   \[
   \text{Activity} = \left( \frac{124.2 \text{ mCi}}{1 \text{ g}} \times \frac{3.1109 \text{ g}}{38.7878 \text{ g}} \right) \times \frac{1.028 \text{ g/cm}^3}{\text{cm}^3} \times \frac{1 \text{ cm}^3}{1 \text{ mL}}
   \]
   \[
   \text{Activity} = \frac{19116.5608 \text{ dpm/mL}}{\text{cm}^3}
   \]
   \[
   = \frac{13331.02 \text{ dpm/mL}}{\text{cm}^3}
   \]
   \[
   = \frac{1913.24 \text{ dpm/g}}{\text{cm}^3}
   \]
   \[
   = \frac{1342.09 \text{ dpm/g}}{\text{cm}^3}
   \]

Read and understood by:

[Handwritten signatures with dates]
National Institute of Standards & Technology

Certificate

Standard Reference Material 4321C

Natural Uranium Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive natural uranium nitrate and nitric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of alpha-particle counting instruments and for the monitoring of radiochemical procedures.

Radiological Hazard

The SRM ampoule contains uranium-238, uranium-235, and uranium-234 with a total activity of approximately 2600 Bq. Uranium decays by alpha-particle emission. The progeny of uranium-238, uranium-235, and uranium-234 have a total activity of approximately 2600 Bq and decay by alpha- and beta-particle emission. None of the alpha or beta particles escape from the SRM ampoule. During the decay process X-rays and gamma-rays with energies from 11 keV to 2.0 MeV are also emitted. Most of these photons escape from the SRM ampoule but their intensities are so small that they do not represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note (1). The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains nitric acid (HNO₃) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 ºC. The solution in an unopened ampoule should remain stable and homogeneous until at least August 2007.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Guithersburg, Maryland 20899
November 1987

Thomas E. Gillis, Chief
Standard Reference Materials Program

SRM 4321C, page 1 of 6

*Notes and references are on pages 5 and 6.*
Recommended Procedure for Opening the SRM Ampoule

If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

1) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution contains strong acid and is corrosive.

2) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

3) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

4) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

5) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

6) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

7) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

8) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4].
## Properties of SRM 4321C
*(Certified values are shown in bold type)*

### Physical Properties:

<table>
<thead>
<tr>
<th>Source Identification Number</th>
<th>NIST SRM 4321C</th>
</tr>
</thead>
</table>

#### Source Description
- **Liquid in flame-sealed NIST borosilicate-glass ampoule**

#### Ampoule Specifications
- **Body outside diameter**: (16.5 ± 0.5) mm
- **Wall Thickness**: (0.60 ± 0.04) mm
- **Barium content**: Less than 2.5%
- **Lead-oxide content**: Less than 0.02%
- **Other heavy elements**: Trace quantities

#### Solution Density
- (1.053 ± 0.001) g·mL⁻¹ at 21.4 °C [b]

#### Solution Mass
- (5.258 ± 0.002) g [b]

### Chemical Properties:

#### Solution Composition

<table>
<thead>
<tr>
<th>Chemical Formula</th>
<th>Concentration (mol·L⁻¹)</th>
<th>Mass Fraction (g·g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O</td>
<td>53</td>
<td>0.91</td>
</tr>
<tr>
<td>HNO₃</td>
<td>1.0</td>
<td>0.06</td>
</tr>
<tr>
<td>UO₂(NO₃)₂</td>
<td>0.09</td>
<td>0.03</td>
</tr>
</tbody>
</table>

### Radiological Properties:

#### Radioactivity
- **Natural Uranium** (Mixture of U-238, U-235, and U-234)

<table>
<thead>
<tr>
<th>Reference Time</th>
<th>1200 EST, 1 August 1992</th>
</tr>
</thead>
</table>

#### Mass Activity of the Solution [c]
- U-238: 242.0 Bq·g⁻¹
- U-235: 11.14 Bq·g⁻¹
- U-234: 233.1 Bq·g⁻¹

#### Relative Expanded Uncertainty (k=2)
- U-238: 0.60% [d] [e]
- U-235: 0.62% [d] [e]
- U-234: 0.98% [d] [e]

#### Mass Fraction of Uranium
- (0.01960 ± 0.00010) g·g⁻¹ [b]

#### Photon-emitting Impurities
- None detected [f]

#### Half Lives Used
- Uranium-238: (4.468 ± 0.003) x 10⁶ a [g]
- Uranium-235: (7.038 ± 0.005) x 10⁶ a [g]
- Uranium-234: (2.455 ± 0.006) x 10² a [g]

### Measuring Instruments
- Mass spectrometer, silicon surface-barrier detector, and 4π(α+β) liquid-scintillation counting systems.
<table>
<thead>
<tr>
<th>Input Quantity $x_i$, the source of uncertainty (and individual uncertainty components where appropriate)</th>
<th>Method Used To Evaluate $u(x_i)$, the standard uncertainty of $x_i$ (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods</th>
<th>Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [b]</th>
<th>Relative Sensitivity Factor, $[\delta y/\delta x_i] = (x_i/y)$ [i]</th>
<th>Relative Uncertainty Of Output Quantity, $u(y)/y$, (%) [i]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isotopic uranium atom fraction in SRM 960</td>
<td>Standard deviation of the mean for repeated mass-spectrometric measurements (A)</td>
<td>U-238: 0.001</td>
<td>1.0</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>U-235: 0.07</td>
<td>1.0</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>U-234: 0.31</td>
<td>1.0</td>
<td>0.31</td>
</tr>
<tr>
<td>Half life</td>
<td>Standard uncertainty of the half life (A)</td>
<td>U-238: 0.07</td>
<td>1.0</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>U-235: 0.07</td>
<td>1.0</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>U-234: 0.25</td>
<td>1.0</td>
<td>0.25</td>
</tr>
<tr>
<td>Uranium mass fraction in SRM 960</td>
<td>Certificate value (B)</td>
<td>0.003</td>
<td>1.0</td>
<td>0.003</td>
</tr>
<tr>
<td>Quantitative dissolution</td>
<td>Estimated (B)</td>
<td>0.25</td>
<td>1.0</td>
<td>0.25</td>
</tr>
<tr>
<td>Gravimetric measurements</td>
<td>Estimated (B)</td>
<td>0.10</td>
<td>1.0</td>
<td>0.10</td>
</tr>
<tr>
<td>Photon-emitting impurities</td>
<td>Limit of detection (B) [k]</td>
<td>100.0</td>
<td>0.001</td>
<td>0.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative Combined Standard Uncertainty of the Output Quantity, $u(y)/y$, (%)</th>
<th>U-238:</th>
<th>U-235:</th>
<th>U-234:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.30</td>
<td>0.31</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Coverage Factor, $k$ = 2

<table>
<thead>
<tr>
<th>Relative Expanded Uncertainty of the Output Quantity, $U_y$, (%)</th>
<th>U-238:</th>
<th>U-235:</th>
<th>U-234:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.60</td>
<td>0.62</td>
<td>0.98</td>
</tr>
</tbody>
</table>
NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.
Distance from Ampoule (cm):  1  30  100
Approximate Dose Rate (μSv/h):  <0.1

[b] The stated uncertainty is twice the standard uncertainty.

[c] Massic activity is the preferred name for the quantity activity divided by the total mass of the sample.
See reference [1].

[d] The reported value, \( y \), of massic activity (activity per unit mass) at the reference time was not
measured directly but was derived from measurements and calculations of other quantities. This can
be expressed as \( y = f(x_1, x_2, x_3, \ldots x_n) \), where \( f \) is a mathematical function derived from the assumed
model of the measurement process.

The value, \( x_i \), used for each input quantity \( i \) has a standard uncertainty, \( \sigma(x_i) \), that generates a
formally uncertainty in \( y \), \( \sigma(y) = |\partial y/\partial x_i| \cdot \sigma(x_i) \). called a component of combined standard
uncertainty of \( y \).

The combined standard uncertainty of \( y \), \( \sigma_c(y) \), is the positive square root of the sum of the squares
of the components of combined standard uncertainty.

The combined standard uncertainty is multiplied by a coverage factor of \( k = 2 \) to obtain \( U \), the
expanded uncertainty of \( y \).

Since it can be assumed that the possible estimated values of the massic activity are approximately
normally distributed with approximate standard deviation \( \sigma(y) \), the unknown value of the massic
activity is believed to lie in the interval \( y \pm U \) with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[e] The value of each standard uncertainty component, and hence the value of the expanded uncertainty
itself, is a best estimate based upon all available information, but is only approximately known. That
is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard
deviation of the mean for the massic count rate is approximately 50%) and for uncertainties evaluated
by other methods (which could easily be overestimated or underestimated by substantial amounts).
The unknown value of the expanded uncertainty is believed to lie in the interval \( U/2 \) to \( 2U \) (i.e., within
a factor of 2 of the estimated value).

[f] Estimated limits of detection for photon-emitting impurities are:
1.4 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 8 and 59 keV,
1.1 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 67 and 88 keV,
0.5 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 10 and 197 keV,
0.3 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 205 and 762 keV,
0.2 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 770 and 996 keV, and
0.1 γ·s\(^{-1}\)·g\(^{-1}\) for energies between 1006 and 1900 keV,
provided that the photons are separated in energy by 4 keV or more from photons emitted in the
decay of uranium-238, uranium-235, uranium-234, or their progeny.

[g] The stated uncertainty is the standard uncertainty. See reference [5].
Relative standard uncertainty of the input quantity $x_i$.

The relative change in the output quantity $y$ divided by the relative change in the input quantity $x_i$. If $|\delta y / \delta x_i| \cdot (x_i/y) = 1.0$, then a 1% change in $x_i$ results in a 1% change in $y$. If $|\delta y / \delta x_i| \cdot (x_i/y) = 0.05$, then a 1% change in $x_i$ results in a 0.05% change in $y$.

Relative component of combined standard uncertainty of output quantity $y$, rounded to two significant figures or less. The relative component of combined standard uncertainty of $y$ is given by $u_i(y) / y = |\delta y / \delta x_i| \cdot u(x_i) / x_i$. The numerical values of $u(x_i) / x_i$, $|\delta y / \delta x_i|$, and $u_i(y) / y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u_i(y) / y = 100\%$. $|\delta y / \delta x_i| \cdot (x_i/y) = ((\text{response per Bq of impurity}) / (\text{response per Bq of U-238})) \cdot ((\text{Bq of impurity}) / (\text{Bq of U-238}))$. Thus $u_i(y) / y$ is the relative change in $y$ if the impurity were present with a mass activity equal to the estimated limit of detection.

REFERENCES


Section 8

CHAIN OF CUSTODY
Paragon Analytics
Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0404241
Client Name: New Horizons
Client Project Name: CSMRI
Client Project Number: 2135
Client PO Number:

<table>
<thead>
<tr>
<th>Client Sample</th>
<th>Lab Sample Number</th>
<th>COC Number</th>
<th>Matrix</th>
<th>Date Collected</th>
<th>Time Collected</th>
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# Chain-of-Custody

**Project Name / No.:** CSMRT / 2135  
**Sampler(s):** 
**Turnaround:** Standard or Rush (Due)  
**Dispose or Return to Client:**

## Sample ID

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Date</th>
<th>Time</th>
<th>Lab ID</th>
<th>Matrix</th>
<th>No. of Containers</th>
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<td>13</td>
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</table>

**Comments:**
- *Driv Pfizer*  
- *Ethan Aquino*  
- *Tripp*  
- *Perform TCLP metals - arsenic, cadmium, chromium, lead, selenium, silver, vanadium, zinc, mercury, molybdenum, - use alpha spectrometer*
- *Rush gamma scan - then do alpha spectrometer isotope Th, U, Pu-238, Pu-239*

**Reinquisition by:**  
**Printed Name:**  
**Date:** 1/23/04  
**Time:** 11:00  
**Company:** NHEC

**Disposition:** white I yellow (Paragon): pink retained by originator.
## CONDITION OF SAMPLE UPON RECEIPT FORM

**CLIENT:** New Horizons **WORKORDER NO.:** 0404241

**PROJECT MANAGER:** Deb Feiozo **INITIALS:** AF DATE: 4/23/04

<table>
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<tr>
<th>Q</th>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Does this project require any special handling in addition to standard Paragon procedures?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2.</td>
<td>Are custody seals on shipping containers intact? How many custody seals are provided?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>3.</td>
<td>Are the custody seals on sample containers intact?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>4.</td>
<td>Is there a Chain-of-Custody (COC) or other representative documents, letters, or shipping memos?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5.</td>
<td>Is the COC complete? Relinquished: Yes/No Analyses Requested: Yes/No</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>6.</td>
<td>Is the COC in agreement with the samples received? No. of Samples: Yes/No Sample ID's: Yes/No Matrix: Yes/No No. of Containers: Yes/No</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>7.</td>
<td>Were COC (if applicable) and sample labels legible?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>8.</td>
<td>Were airbills present and/or removable?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>9.</td>
<td>Are all aqueous samples requiring chemical preservation preserved correctly (excluding volatile organics)? Are all aqueous non-preserved samples at the correct pH?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>10.</td>
<td>Is there enough sample for requested analyses? If so, were samples placed in the proper containers?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11.</td>
<td>Are all samples within holding times for the requested analyses?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>12.</td>
<td>Were all sample containers received intact? (not broken or leaking, etc.)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>13.</td>
<td>Are samples requiring no headspace (volatiles, reactive cyanide/sulfide, radon), headspace-free? Size of bubble: &lt; green pea; &gt; green pea (List sample IDs and affected containers on Page 2)</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>14.</td>
<td>Were samples checked for and free from the presence of residual chlorine?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>15.</td>
<td>Were the sample(s) shipped on ice?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>16.</td>
<td>Were cooler temperatures measured at 0.1 - 6 °C? IR Gun Used*: 1 2</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>17.</td>
<td>Were all samples cooled that should have been cooled?</td>
<td>N/A</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Cooler #’s**

Temperature [Ambient] °C

Project Manager Signature / Date: Deb Feiozo 4/23/04

A NO RESPONSE TO ANY QUESTION EXCEPT #1 REQUIRES THE COMPLETION OF PAGE 2 OF THIS FORM

* IR Gun #1 (original): Raytek, SN SC-PM3/T29403
  IR Gun #2 (newer): Oakton, SN 2SC1201

FORM 20116.fm (4/10/2002)
## Calibration Data Summary

**Laboratory Name:** Paragon Analytics  
**Prep SOP:** PAI 778  
**Reported on:** Friday, May 21, 2004  
**PAI Work Order:** 0404241  
**Analytical SOP:** PAI 714  
**Date Printed:** Friday, May 21, 2004  
**LIMS Version:** 5.018A

<table>
<thead>
<tr>
<th>Lab Sample ID Spectrum Analysis Date</th>
<th>QC Type</th>
<th>Batch ID Analysis Run</th>
<th>Test Name</th>
<th>Detector Id</th>
<th>Eff Spectrum Bkg Spectrum Egy Spectrum</th>
<th>Eff Date Bkg Date Egy Date</th>
<th>RESULTS</th>
<th>FLAGS</th>
<th>LCL</th>
<th>LWL</th>
<th>UWL</th>
<th>UCL</th>
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<tr>
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<td>AS040428-5</td>
<td>UIOS</td>
<td>15</td>
<td>C4050415 C4050415 B4050415 C4050415</td>
<td>5/4/2004 0.4370 5537.2</td>
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<td>31.43</td>
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## Data Package ID: U0404241-1

**Abbreviations:**  
- **Eff:** Efficiency  
- **Bkg:** Background  
- **LCL:** Lower Control Limit  
- **UWL:** Upper Warning Limit  
- **Egy:** Energy  
- **CPM:** Counts per Minute  
- **LWL:** Lower Warning Limit  
- **UCL:** Upper Control Limit  
- **CI:** The Analysis Date exceeds the Calibration Date by more than 7 days.
Alpha Spectroscopy

Quality Control Data

Weekly Background, Energy, and Efficiency Calibrations
# Alpha Spec Calibration Source Re-Certification

**Primary Certified Source**
Source PAI ID 190 was recalibrated by Isotope Products Laboratories on 03-01-2005 and received by PAI on 03-04-2005.

- **Source ID:** 92MIX223027; PAI ID 190 (Labeled #9)
- **Total Activity:** 3754 dpm
- **Ref. Date:** 3/1/03
- **Count Date:** 3/22/04

- **U-234 Activity:** 79.06% = 2967.80 dpm (decay corrected)
- **Am-241 Activity:** 19.20% = 719.56 dpm (decay corrected)
- **Combined Activity:** = 3687.46 dpm (decay corrected)

## Detector 13 Efficiency Determination

<table>
<thead>
<tr>
<th>Source Serial #</th>
<th>PAI ID</th>
<th>Sequential #</th>
<th>Count Date</th>
<th>Am-241 net cts</th>
<th>U-234 net cts</th>
<th>count dur(s)</th>
<th>Combined Known</th>
<th>detector efficiency</th>
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<td>97-19-103-09</td>
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<td>1184.128</td>
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## Sources 1 through 6 activity determination

<table>
<thead>
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<th>Source Serial #</th>
<th>PAI ID</th>
<th>Sequential #</th>
<th>Count Date</th>
<th>Am-241 net cts</th>
<th>U-234 net cts</th>
<th>count dur(s)</th>
<th>detector efficiency</th>
<th>Am-241</th>
<th>U-234</th>
<th>combined/</th>
<th>% difference from 1st count</th>
</tr>
</thead>
<tbody>
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<td>19909.84</td>
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## Detector 13 Efficiency Verification

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<tr>
<th>Source Serial #</th>
<th>PAI ID</th>
<th>Sequential #</th>
<th>Count Date</th>
<th>Am-241 net cts</th>
<th>U-234 net cts</th>
<th>count dur(s)</th>
<th>Combined Known</th>
<th>detector efficiency</th>
<th>Am-241</th>
<th>U-234</th>
<th>combined/</th>
<th>% difference from 1st count</th>
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</thead>
<tbody>
<tr>
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<td>97-19-103-09</td>
<td>3/22/04</td>
<td>7948.69</td>
<td>22241.76</td>
<td>2100</td>
<td>1184.128</td>
<td>3687.46</td>
<td>30.63%</td>
<td>2.35%</td>
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## Sources 1 through 6 activity re-verification

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<th>Source Serial #</th>
<th>PAI ID</th>
<th>Sequential #</th>
<th>Combined Observed</th>
<th>Combined Certified</th>
<th>Percent Difference</th>
<th>Within 5% of Certified value</th>
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</thead>
<tbody>
<tr>
<td>92MIX223026</td>
<td>182</td>
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<td>8575.42</td>
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<td>183</td>
<td>97-19-103-02</td>
<td>15257.54</td>
<td>15767.93</td>
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<tr>
<td>92MIX223028</td>
<td>184</td>
<td>97-19-103-03</td>
<td>13248.30</td>
<td>13517.34</td>
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<td>92MIX223029</td>
<td>185</td>
<td>97-19-103-04</td>
<td>7771.83</td>
<td>8130.72</td>
<td>4.41%</td>
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<td>92MIX223030</td>
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<td>97-19-103-05</td>
<td>20655.23</td>
<td>20651.92</td>
<td>0.17%</td>
<td>Yes</td>
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<td>92MIX223031</td>
<td>187</td>
<td>97-19-103-06</td>
<td>14571.72</td>
<td>15242.25</td>
<td>4.40%</td>
<td>Yes</td>
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<tr>
<td>92MIX223032</td>
<td>188</td>
<td>97-19-103-07</td>
<td>10558.09</td>
<td>10756.77</td>
<td>1.59%</td>
<td>Yes</td>
</tr>
<tr>
<td>92MIX223033</td>
<td>189</td>
<td>97-19-103-08</td>
<td>23066.71</td>
<td>23263.22</td>
<td>0.84%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Sources 918.16, 187.16, & 188 decay corrected to 04/01/03.
*Sources 182, 183, 184, & 186 decay corrected to 05/01/03.
CERTIFICATE OF CALIBRATION
MIXED ALPHA STANDARD SOURCE

| Radionuclide A: | U-234 | Customer: | PARAGON ANALYTICS, INC. |
| Radionuclide B: | U-235 | P.O. No.: | EW04203/R2193 |
| Radionuclide C: | Am-241 | Catalog No.: | Misc-STD |
| Half Life (U-234): | (2.454 ± 0.006)E+05 years | Reference Date: | 1-May-03 12:00 PST |
| Half Life (U-235): | (7.037 ± 0.011)E+08 years | Source No.: | 92MIX2203026 |
| Half Life (Am-241): | 432.17 ± 0.65 years |

| Contained Radioactivity: | Am-241: 0.6793 nCi (21.43 Bq) |
| U-234: 3.354 nCi (124.1 Bq) | Total Activity: 3.999 nCi (148.0 Bq) |
| U-235: 0.06586 nCi (2.429 Bq) |

Physical description:
A. Capsule type: Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 19 mm
D. Backing: Stainless steel
E. Cover: None

Radioimpurities: Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Mar 1998.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.7%
B. Type B (systematic) uncertainty: ± 3.0%
C. Uncertainty in aliquot weighing: ± 0.0%
D. Total uncertainty at the 95% confidence level: ± 3.1%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radiactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 4483 c/min in 2π on 11 Apr 03.

Quality Control: [Signature]

IPL Ref. No.: 587-7

Medical Imaging Laboratory
14937 Avenue Tibbitts, Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street, Berriman, California 91304

000076
CERTIFICATE OF CALIBRATION
MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241

Half Life (U-234): (2.454 ± 0.008)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 432.17 ± 0.66 years

Conserved Radioactivity:
- U-234: 6.467 nCi (239.3 Bq)
- U-235: 0.1136 nCi (4,200 Bq)
- Am-241: 0.8366 nCi (23.55 Bq)

Total Activity: 7.217 nCi (267.1 Bq)

Physical description:
- Disk (22 mm OD X 0.79 mm THK)
- Electrodeposited gold: Stainless steel
- Backing: None
- Cover: Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.7%
B. Type B (systematic) uncertainty: ± 3.0%
C. Uncertainty in aliquot weighing: ± 0.0%
D. Total uncertainty at the 99% confidence level: ± 3.1%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (see NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1985.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 8091 α/min in 2m on 11 Apr 03.

Quality Control

Date Signed

IPL Ref. No.: 967-7

Medical Imaging Laboratory
3495 Avenue Tibbitts
Valencia, California 91355

Industrial Gauging Laboratory
1400 South Keystone Street
Burbank, California 91504
CERTIFICATE OF CALIBRATION
MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241
Half Life (U-234): (2.454 ± 0.006)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 4.326 ± 0.06 years

<table>
<thead>
<tr>
<th>Contained Radioactivity:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U-234</td>
<td>5.227 nCi (119.4 Bq)</td>
<td>Am-241</td>
</tr>
<tr>
<td>U-235</td>
<td>0.05205 nCi (1.286 Bq)</td>
<td>Total Activity:</td>
</tr>
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</table>

Physical description:
- A. Capsule type: Disk (22 mm OD X 0.79 mm THK)
- B. Nature of active deposit: Electrodeposited, and diffusion bonded oxides
- C. Active Diameter: 19 mm
- D. Backing: Stainless steel
- E. Cover:

Radioimpurities:
- Not determined

Method of Calibration:
- This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
- A. Type A (random) uncertainty: ± 0.6%
- B. Type B (systematic) uncertainty: ± 3.0%
- C. Uncertainty in aliquot weighing: ± 0.0%
- D. Total uncertainty at the 99% confidence level: ± 3.1%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 8869 α/min in 2π on 11 Apr 03.

Quality Control

Date Signed

IPL Ref. No.: 967-7
CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241

Half Life (U-234): (2.454 ± 0.006)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 432.17 ± 0.66 years

Customer: PARAGON ANALYTICS, INC.
P.O. No.: EW030603/R2155
Catalog No.: MISC-STD
Reference Date: 1-Apr-03 12:00 PST
Source No.: 92MIX22C3021

Contaminated Radioactivity:
U-234: 2.731 nCi (101.0 Bq)
U-235: 0.03416 nCi (1.284 Bq)
Am-241: 0.9325 nCi (34.50 Bq)
Total Activity: 3.668 nCi (136.8 Bq)

Physical description:
A. Capsule type: Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 19 mm
D. Backing: Stainless steel
E. Cover: None

Radiimpurities:
Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.8%
B. Type B (systematic) uncertainty: ± 3.1%
C. Uncertainty in aliquot weighing: ± 0.0%
D. Total uncertainty at the 95% confidence level: ± 3.2%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1966.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 4145 d/ min in 2x on 18 Mar 03.

Quality Control

Date Signed: 17-Febr-03
IPL Ref. No.: 987-2

ISO 9001 CERTIFIED
Medical Imaging Laboratory
1300 North Keck Street, Burbank, California 91504

Industrial Gauging Laboratory
1361 North Keck Street, Burbank, California 91504
CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radioisotope A: U-234
Radioisotope B: U-235
Radioisotope C: Am-241
Half Life (U-234): (2.454 ± 0.005)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 432.17 ± 0.66 years

Contained Radioactivity:
U-234: 5.486 nCi (203.0 Bq)
U-235: 0.09221 nCi (3.412 Bq)
Am-241: 3.658 nCi (146.4 Bq)
Total Activity: 9.534 nCi (352.8 Bq)

Physical Description:
A. Capsule type: Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 19 mm
D. Backing: Stainless steel
E. Cover: None

Radioimpurities:
Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.8%
B. Type B (systematic) uncertainty: ± 3.1%
C. Uncertainty in aliquot weighing: ± 0.0%
D. Total Uncertainty at the 99% confidence level: ± 3.2%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.13).
- Nuclear date was taken from "Table of Radioactive isotopes", edited by Virginia Shirley, 1969.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 10590 α/min in 2π on 18 Mar 03.

[Signature]
Quality Control
19-Mar-03

Date Signed
IPL Ref. No.: 967-2

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts
Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street
Burbank, California 91504

000080
CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241
Half Life (U-234): (2.454 ± 0.006)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 432.17 ± 0.86 years

Contained Radioactivity:
U-234: 3.592 nCi (132.9 Bq)
U-235: 0.09558 nCi (3.166 Bq)
Am-241: 3.279 nCi (121.3 Bq)

Total Activity: 6.857 nCi (257.4 Bq)

Physical description:
A. Capsule type: Disk (22 mm OD × 0.79 mm THK)
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 19 mm
D. Backing: Stainless steel
E. Cover: None

Radioimpurities:
Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.8%
B. Type B (systematic) uncertainty: ± 3.1%
C. Uncertainty in aliquot weighing: ± 0.6%
D. Total uncertainty at the 99% confidence level: ± 3.2%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from “Table of Radioactive Isotopes”, edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 7799 α/min in 2π on 18 Mar 03.

[Signature]
Quality Control

Date Signed: 19-Mar-03
IPL Ref. No.: 987-2

Medical Imaging Laboratory
2407 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
2407 North Newtsort Street Burbank, California 91504

000081
CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Isotope Products Laboratories
24937 Avenue Tibbitts
Valencia, California 91355

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241

Half Life (U-234): (2.454 ± 0.006)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 4.32 ± 0.86 years

Customer: PARAGON ANALYTICS, INC.
P.O. No.: EW030603/R2155
Catalog No.: MISC-STD
Reference Date: 1-Apr-03 12:00 PST
Source No.: 82MIX2203023

Contained Radioactivity:
U-234: 2.895 nCi (107.1 Bq)
U-235: 0.02502 nCi (0.9257 Bq)
Am-241: 1.953 nCi (72.26 Bq)
Total Activity: 4.873 nCi (180.3 Bq)

Physical description:
A. Capsule type: Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 19 mm
D. Backing: Stainless steel
E. Cover: None
F. Radiopurities: Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

Uncertainty of Measurement:
A. Type A (random) uncertainty: ± 0.8%
B. Type B (systematic) uncertainty:
  a. Uncertainty in aliquot weighing: ± 3.1%
  b. Uncertainty in aliquot weighing: ± 0.0%
  c. Total uncertainty at the 95% confidence level: ± 3.2%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 5463 c/d/min in 2π on 18 Mar 03.

Quality Control

Date Signed

IPL Ref. No.: 987-2

Medical Imaging Laboratory
24937 Avenue Tibbitts, Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keyston Street, Burbank, California 91504

000082
CERTIFICATE OF CALIBRATION
MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234
Radionuclide B: U-235
Radionuclide C: Am-241

Half Life (U-234): (2.454 ± 0.006)E+05 years
Half Life (U-235): (7.037 ± 0.011)E+08 years
Half Life (Am-241): 432.17 ± 0.66 years

Contained Radioactivity:
U-234: 9.048 nCl (334.8 Bq)
U-235: 0.1771 nCl (6.553 Bq)
Am-241: 1.433 nCl (52.02 Bq)
Total Activity: 10.68 nCl (394.4 Bq)

Physical description:
A. Capsule type: Disk
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides
C. Active Diameter: 18 mm
D. Backing: Stainless steel
E. Cover: Non

Radioimpurities:
Not determined

Method of Calibration:
This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Mar 1996.

Uncertainty of Measurement:
A. Type A (random) uncertainty:
± 0.5%
B. Type B (systematic) uncertainty:
± 5.0%
C. Uncertainty in aliquot weighing:
± 0.0%
D. Total uncertainty at the 99% confidence level:
± 3.0%

Notes:
- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 1.1050 α/min in 2π on 11 Apr 03.

Quality Control: [Signature]
Date Signed: [Signature] 15 - Apr - 03
IPL Ref. No.: 967-7