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LA-UR-21-XXXXXX

Countroom Gamma Spectroscopy Library Updates

21-Jan-2021

Michael James and Sarah Chong

The C-NR Countroom analyzes gamma spectroscopy data using three codes, SAP [1](which is the combination of SPECANAL and RAYGUN), GAMANAL [2] and UNISAMPO[3]. The codes use libraries which are chosen by the user of gamma emission data to do the identification and quantification. The Countroom maintains nine unique libraries for use in analysis. Historically, the values contained in these libraries has not been consistently updated and many values are quite old and do not reflect the state-of-the-art.

A comprehensive update of Gamma Spectroscopy Libraries has been undertaken using data from the from IAEA Livechart website [4] which has been confirmed to derive from latest Nuclear Data Sheets. The work to update all nine libraries was carried out in Summer 2020[5]. The SAP code data libraries are maintained in ASCII files which are human-readable and carries a RAY suffix. This file was chosen to the master record for all library updates. From this master file, the RGN program can be used to generated the library binary files which are used as input to SAP processing.

Almost all entries in each library required some change to update the values to modern data. In most cases these changes were minor. Larger changes are called out individually below grouped by library type. A value of 365.2422 was used to convert from years to days from IAEA Livechart website.

Each library was also tested running at least one spectrum with the old and new versions. The counts used are listed by the Countroom serial numbers. The output comparisons are listed in the Appendix.

GAMANAL and UNISAMPO Library Files

For the GAMANAL code, a spreadsheet was used to convert the data from the format in the RAY file to the elibx.in files (where x is the library number). These elibx.in files are then processed by the libgen program to create the GAMANAL libraries.

UNISAMPO uses an ASCII file as it's library format with a suffix ILF. In order to update the UNISAMPO libraries, a Python script, sampo_lib.py, was written to create the library in the proper format using the listing which is generated by the RGN program from the original SAP library master file. In this way, the updates were applied universally to all three analysis codes.

Library 1 Changes

K-40 (19040) half-life change from 4.675E+11 to 4.555E+11
Ti-44 (22044) Significant change in half-life from 1.753E+4 to 2.159E+4 days
Cd-109 (48109) Changed 88.03 from 3.9% to 3.644%
Sn-113 (50113) Changed 255.1 line from 2.3% to 2.11%
Sb-124 (51124) 1325.08 line from 1.41% to 1.58%
Sb-126 (51126) Removed 605 – Not in IAEA LiveChart
Sb-126 (51126) Removed 730 - Not in IAEA LiveChart
Te-129m (52429) Half-life change to 33.6 from 4.833e-2 days(reflects metastable half-life)
Nd-147 (60147) Changed 91.1 line from 30.77% to 28.1%
Eu-152 (63152) Changed half-life from 5.128E+3 to 4.937E+3 days
Eu-152 (63152) Removed 443.98 – Not in IAEA LiveChart, merged with adjacent line 0.2 eV away
Eu-154 (63154) Changed half-life from 2.864E+3 to 3.141e+3 days
Eu-154 (63154) Remove 1397.8 line – not in IAEA LiveChart
Eu-155 (63155) Changed half-life from 1.855E+3 to 1.735e+3 days
Eu-156 (63156) Almost every line yield reduced by 10-13%.
Ra-224 (under 90228) 240.99 line increased yield from 2.24% to 4.1%

Baseline count	Test Count
248_509.19	248_510.19
071_486.20	071_487.20
196_487.20	196_488.20

Library 2 Changes

Te-131m (52431) Half-life changed from 1.25d to 1.385d
Te-131m (52431) 452.30 intensity changed from 5.65% to 1.50%
Tc-99m (43399) 140.5 line changed from 80.14% to 89%
I-126 (53126) Removed 656 line – not present on Livechart
I-126 (53126) Removed 664.5 line – not present on Livechart
I-126 (53126) Removed 730 line – not present on Livechart
Xe-133 (54133) 79.6 line changed from 0.22% to 0.44%.
Pu-239 (94239) Removed 42.06 line – not present on Livechart

059_096.20 Baseline count (reprocessed from 059_095.20) using old library 2
059_098.20 Test count with new library 2.

Library 3 Changes

Se-81m (34381) Half changed to isomeric state from 1.278E-02d to 3.978E-02d
102.7 line changed to 103.01 and intensity from 1% to 12.8%
K-42 (19042) 312 line intensity changed from 0.18% to 0.336%
Ca-47 (20047) 1878 line intensity changed from 2.90% to 2.50E-02%
Br-82 (35082) 92 line intensity changed from 0.39% to 0.719%
Ag-110n (47410) changed to 667.9 at 0.75% to 677.62 10.7% (better line to use)

Sb-124 (51124) changes:
400.3 line from 0.530% to 0.139%
444.09 line from 0.350% to 0.189%
525.5 line from 0.310% to 0.138%
1580 line from 0.200% to 0.380%

Eu-154 (63154) changes:
69.67 3 line from 7.80% to 2.42%
97.43 3 line from 56.5% to 29.0%
103.18 3 line from 41.3% to 21.1%

Yb-169 (70169) changes:
515 line from 4.50E-01% to 4.17E-03%
625 line from 4.00E-01% to 4.92E-03%

Yb-175 (70175) changes:
113.81 line from 1.91% to 3.87%
144.86 line from 3.60E-01% to 6.72E-01%
282.52 line from 3.10% to 6.13%
396.33 line from 6.50% to 13.1%

Hf-181 (72181) changes:
136.86 line from 1.8% to 0.86%
475.99 line from 0.43% to 0.703%

Pt-197 (78197) 77.35 line from 80% to 17%
As-76 (33076) Removed 554.45 not present on Livechart
As-76 (33076) Removed 624.00 not present on Livechart
Br-82 (35082) Removed 451.00 not present on Livechart
Br-82 (35082) Removed 1410.00 not present on Livechart
Nb-97 (41097) Removed 480.90 not present on Livechart

Ag-110m (47410) Removed 565.50 not present on Livechart
Ag-110m (47410) Removed 752.70 not present on Livechart
Ag-110m (47410) Removed 867.00 not present on Livechart

010_001.20 Baseline Count old library 3
010_098.20 Test count with new library 3

Library 4 Changes

Set intensity of Rb-82 776 line to 13.4% for Isotope Production program.
Nb-90 (41090) Removed 1522.00 not present on Livechart
Co-55 (27055) 91.9 line from 3.00% to 1.16%
Ni-65 (28065) 1623.42 line from 0.760% to 0.498%
As-76 (35076) 1213.1 line from 0.620% to 1.70%
As-77 (35077) 585.48 line from 1.15% to 1.57%
Kr-79 (36079) 136.09 line from 0.600% to 0.850%
Kr-79 (36079) 217.07 line from 1.80% to 2.37%
Rb-82 (37082) 1395 line from 0.47% to 0.57%
Nb-96 (41096) 350.05 line from 1.11% to 1.54% (added two lines together)
Nb-91m (41391) 1204.67 line from 3.40% to 2.02%

Add Ge-68/Ga-68 parent-daughter with
1077.34 3.22%
1883.16 0.137%

Two tests of Library 4

Baseline Counts	Test Counts
161_081.20	161_087.20 (New LIB4)
210_063.20	210_072.20 (New LIB4)

Library 5 Changes

In previous version of Library 5, numerous half-lives set from long-lived precursors.
Pb-209 (82209) set from Ac-225, 9.92d
At-217 (85217) set from Ac-225, 9.92d
Fr-221 (87221) set from Ac-225, 9.92d
Bi-213 (83213) set from Ac-225, 9.92d

Pb-211 (82211) set from Ra-223, 11.4d
Bi-211 (83211) set from Ra-223, 11.4d
Po-215 (84215) set from Ra-223, 11.4d
Rn-219 (86219) set from Ra-223, 11.4d

Po-215 (84215) 438.9 frequency not listed, kept at 4e-4%
At-217 (85217) 257.9 frequency greatly reduced in new library, 2.87E-4% vs. 5.6e-4%

Ac-225 (89225) 83.23 x-ray line from 1.17% to 0.76%
86.1. x-ray line from 1.94% to 1.26%

These X-ray lines left in the library unchanged:
Th-2289 (90229) 100.13 5.5%
Pa-229 (91229) 105.60 6.91%

104_039.20 Baseline count
104_051.20 Test count (new lib 5)

Library 6 Changes

I-126 (53126) Removed 656 line – not present on Livechart
I-126 (53126) Removed 664.5 line – not present on Livechart
I-126 (53126) Removed 730 line – not present on Livechart

I-135 (53135) 526.56 line has no frequency on Livechart, kept at 13.32%

Replace Sb-127 (51127) 583.4 line at 2.91% with 543.5 line 2.90%
583.4 should have been 0.33%, might have been an error in previous library.

248_040.20 Baseline count
248_045.20 Test count (new lib 6)

Library 7 Changes

Only minor adjustments

196_087.20 Baseline count
196_088.20 Test count (new lib 7)

Library 8 Changes

Only minor adjustments

011_045.20 Baseline count
011_046.20 Test count (new lib 8)

Library 9 Changes

Nb-95m (41395) 204.12 line intensity reduced from 2.34% to 0.960%
Cd-115 (48115) 336.24 line changed from 50.1% to 46.02%
Fix Ru-106/Rh-106 (44106) half-life from 3.212e7 to 371.8 (seconds to days).
Xe-133 (54133) 160.61 line increased from 5.40E-02% to 0.107%
W-187 (74187) Almost all lines frequency increased ~25%
Po-215 (84215) no frequency listed for 438.90, use old value of 4.000E-04
Ac-227 (89227) Yields for all 4 listed lines (70, 99, 147 and 160) reduced by a factor of 4.
Th-232 (90232) 59 line changed to 63.81, yield changed from0.19% to 0.263%
124 line changed to 140.88, yield changed from 0.043% to 0.021%.
Pa-231 (91231) 303 line increased from 1.71% to 2.30%
Pa-233 (91233) no frequency listed for 111.50 use old value of 6.000E-02
Pa-233 (91233) no frequency listed for 114.90 use old value of 2.000E-02
Pa-234m (91634) 766 line changed from 0.207% to 0.317%
U-235 (92235) 105.36 line not listed in gammas or X-rays but leave in as is (from ThKbeta1) with frequency 1.980E-02
U-237 (92237) no frequency listed for 114.09, use old value of 9.600E-02
U-238 (92238) 110.5 line changed to 113.5. Yield changed from 0.024% to 0.0102%.

056_076.20 Baseline count
056_083.20 Test count (new lib 9)

References

[1] SAP Operations Manual, LANL-INC11-001, April 1993

[2] Gunnink R, Niday JD (1972) UCRL-51061

[3] Aarnio P, Nikkinen M, Routti J (2012) UNISAMPO manual v2.5. Doletum, Helsinki

[4] https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html

[5] Chong, Sarah Wing Ting ; James, Michael R., “Gamma Spectroscopy Library Update“, Virtual Student Symposium 2020, Los Alamos, New Mexico, United States, LA-UR-20-25368

APPENDIX

Comparisons of SPECANAL outputs using new libraries. The new libraries outputs are listed on the left side and old library outputs are on the right. These comparisons were used to confirm that the library worked and identified the same set of isotopes and computed approximately the same yields.

Library 1 Comparison

248_510_19_specanal.lis

```
Linux-SPECANL Version 1.0 (05-AUG-2016)                    DATE:2020/07/15 15:01:02.231
*****************************************************************************************
SN: 248_510 SHOT:    9997 JUG:       71 MASS:            2 CTR:        56 ROT: 248.951 ZT:  91.708
NCHAN: 4096 CHAN0:  180.0 CHAN1:  181.0 DELTA TIME:  157.180 GAIN: 0.499950 ZERO:  0.057 CD:  71
*****************************************************************************************

                    DPM at  Peak   Err  Std    DPM at     Atoms at   Err
Nuclide  Energy     T-zero  wght   (%)  dev  count time    T-zero    (%)
-----------------------------------------------------------------------

  CO 57  - - - - 1.831E+04 - - - - - - - - -  1.226E+04  1.033E+10   3.9

         121.95  1.821E+04  1.01   1.0 -0.1
         136.31  1.965E+04  0.93   3.5  0.4

   Y 88  - - - - 7.633E+04 - - - - - - - - -  2.747E+04  1.690E+10   1.2

         897.38  7.633E+04  1.00   1.2  0.0

  CD109  - - - - 7.819E+05 - - - - - - - - -  6.176E+05  7.503E+11   0.8

          87.96  7.819E+05  1.00   0.8  0.0

  SN113  - - - - 4.555E+04 - - - - - - - - -  1.768E+04  1.089E+10   9.6

         254.96  5.696E+04  0.80   8.6  0.7
         391.42  4.541E+04  1.00   1.2 -0.0

 TE129M - - - - 1.565E+02 - - - - - - - - -  6.115E+00  1.093E+07   1.7

         278.97  1.955E+07  0.00   1.7  0.0

  CS137  - - - - 2.235E+04 - - - - - - - - -  2.213E+04  5.103E+11   1.0

         661.18  2.235E+04  1.00   1.0  0.0

  CE139  - - - - 2.626E+04 - - - - - - - - -  1.190E+04  7.507E+09   0.9

         165.69  2.626E+04  1.00   0.9  0.0

  HG203  - - - - 5.531E+04 - - - - - - - - -  5.336E+03  5.354E+09   1.7

         278.97  5.531E+04  1.00   1.7  0.0

  TH228  - - - - 1.681E+04 - - - - - - - - -  1.439E+04  2.439E+10   8.4

         510.55  1.681E+04  1.00   8.4 -0.0
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------

   U237  - - - - 5.063E-03 - - - - - - - - -  4.951E-10  7.100E+01   1.5

          59.48  5.727E+11  0.00   1.5  0.0

  AM241  - - - - 5.385E+04 - - - - - - - - -  5.381E+04  1.768E+13   1.5
+--  2 lines: 59.48  5.385E+04  1.00   1.5  0.0-----------------------------------------------
```

248_509_19_specanal.lis

```
Linux-SPECANL Version 1.0 (05-AUG-2016)                    DATE:2020/07/14 23:10:01.895
*****************************************************************************************
SN: 248_509 SHOT:    9997 JUG:       71 MASS:            2 CTR:        56 ROT: 248.951 ZT:  91.708
NCHAN: 4096 CHAN0:  180.0 CHAN1:  181.0 DELTA TIME:  157.180 GAIN: 0.499950 ZERO:  0.057 CD:  71
*****************************************************************************************

                    DPM at  Peak   Err  Std    DPM at     Atoms at   Err
Nuclide  Energy     T-zero  wght   (%)  dev  count time    T-zero    (%)
-----------------------------------------------------------------------

  CO 57  - - - - 1.836E+04 - - - - - - - - -  1.227E+04  1.030E+10   4.0

         121.95  1.826E+04  1.01   1.0 -0.1
         136.31  1.985E+04  0.93   3.5  0.4

   Y 88  - - - - 7.658E+04 - - - - - - - - -  2.756E+04  1.696E+10   1.2

         897.38  7.658E+04  1.00   1.2  0.0

  CD109  - - - - 7.295E+05 - - - - - - - - -  5.771E+05  7.044E+11   0.8

          87.96  7.295E+05  1.00   0.8  0.0

  SN113  - - - - 4.594E+04 - - - - - - - - -  1.782E+04  1.098E+10   9.2

         254.96  5.230E+04  0.88   8.6  0.4
         391.42  4.585E+04  1.00   1.2 -0.0

  SB126  - - - - 2.350E+00 - - - - - - - - -  4.129E-04  6.152E+04   1.7

         278.97  1.304E+09  0.00   1.7  0.0

  CS137  - - - - 2.235E+04 - - - - - - - - -  2.213E+04  5.089E+11   1.0

         661.18  2.235E+04  1.00   1.0  0.0

  CE139  - - - - 2.624E+04 - - - - - - - - -  1.189E+04  7.501E+09   0.9

         165.69  2.624E+04  1.00   0.9 -0.0

  EU154  - - - - 3.530E+04 - - - - - - - - -  3.398E+04  2.100E+11  12.8

         846.16  3.530E+04  1.00  12.8  0.0

  HG203  - - - - 5.535E+04 - - - - - - - - -  5.340E+03  5.358E+09   1.7

         278.97  5.535E+04  1.00   1.7  0.0

  TH228  - - - - 1.782E+04 - - - - - - - - -  1.525E+04  2.587E+10   8.4

         510.55  1.782E+04  1.00   8.4  0.0

   U237  - - - - 5.063E-03 - - - - - - - - -  4.951E-10  7.100E+01   1.5

          59.48  5.727E+11  0.00   1.5  0.0

  AM241  - - - - 5.385E+04 - - - - - - - - -  5.381E+04  1.768E+13   1.5
+--  2 lines: 59.48  5.385E+04  1.00   1.5  0.0-----------------------------------------------
```

071_487_20_specanal.lis

```
Linux-SPECANL Version 1.0 (05-AUG-2016)                    DATE:2020/07/15 15:00:02.895
*****************************************************************************************
SN: 071_487 SHOT:    9997 JUG:       71 MASS:          205 CTR:       172 ROT:  71.634 ZT:  91.708
NCHAN: 4096 CHAN0: 2485.6 CHAN1: 2514.5 DELTA TIME:  344.052 GAIN: 0.499700 ZERO:  0.436 CD:  41
*****************************************************************************************

                     DPM at  Peak   Err  Std    DPM at     Atoms at   Err
 Nuclide  Energy     T-zero  wght   (%)  dev  count time    T-zero    (%)
-------------------------------------------------------------------------

   K 40  - - - - 2.184E+03 - - - - - - - - -  2.184E+03  2.067E+18   9.8

        1460.63  2.184E+03  1.00   9.8  0.0

  CO 57  - - - - 8.293E+04 - - - - - - - - -  3.447E+04  4.681E+10   0.7

         122.05  8.232E+04  1.01   0.5 -0.1
         136.45  8.379E+04  0.99   0.6  0.1

  CO 60  - - - - 1.671E+05 - - - - - - - - -  1.476E+05  6.681E+11   0.6

        1173.17  1.666E+05  1.00   0.5 -0.0
        1332.45  1.675E+05  1.00   0.5  0.0

   Y 88  - - - - 3.586E+05 - - - - - - - - -  3.828E+04  7.941E+10   0.7

         897.99  3.583E+05  1.00   0.6 -0.0
        1836.17  3.591E+05  1.00   0.7  0.0

  CD109  - - - - 4.810E+06 - - - - - - - - -  2.870E+06  4.615E+12   0.5

          88.11  4.810E+06  1.00   0.5  0.0

  SN113  - - - - 2.144E+05 - - - - - - - - -  2.700E+04  5.127E+10   2.8

         255.14  2.418E+05  0.89   2.3  0.7
         391.69  2.132E+05  1.01   0.6 -0.1

  SB124  - - - - 3.134E+06 - - - - - - - - -  5.966E+04  3.920E+11   3.3

        1325.08  3.134E+06  1.00   3.3  0.0

  CS137  - - - - 1.031E+05 - - - - - - - - -  1.009E+05  2.355E+12   0.5

         661.62  1.031E+05  1.00   0.5  0.0

  CE139  - - - - 1.249E+05 - - - - - - - - -  2.208E+04  3.571E+10   0.5

         165.85  1.249E+05  1.00   0.5  0.0

  EU154  - - - - 7.034E+03 - - - - - - - - -  6.519E+03  4.590E+10  24.1

         691.99  7.034E+03  1.00  24.1  0.0

  HG203  - - - - 2.681E+05 - - - - - - - - -  1.605E+03  2.595E+10   1.3

         279.21  2.681E+05  1.00   1.3  0.0

  RA226  - - - - 2.312E+03 - - - - - - - - -  2.311E+03  2.807E+12  19.1

         185.74  2.312E+03  1.00  19.1  0.0

  TH228  - - - - 2.678E+02 - - - - - - - - -  1.903E+02  3.883E+08  25.7

         238.74  3.042E+02  0.88  15.3  0.3
         583.06  2.317E+02  1.16  20.0 -0.3
```

071_486_20_specanal.lis

```
Linux-SPECANL Version 1.0 (05-AUG-2016)                    DATE:2020/07/14 23:11:02.147
*****************************************************************************************
SN: 071_486 SHOT:    9997 JUG:       71 MASS:          205 CTR:       172 ROT:  71.634 ZT:  91.708
NCHAN: 4096 CHAN0: 2485.6 CHAN1: 2514.5 DELTA TIME:  344.052 GAIN: 0.499700 ZERO:  0.436 CD:  41
*****************************************************************************************

                     DPM at  Peak   Err  Std    DPM at     Atoms at   Err
 Nuclide  Energy     T-zero  wght   (%)  dev  count time    T-zero    (%)
-------------------------------------------------------------------------

   K 40  - - - - 2.176E+03 - - - - - - - - -  2.176E+03  2.113E+18   9.8

        1460.63  2.176E+03  1.00   9.8  0.0

  CO 57  - - - - 8.364E+04 - - - - - - - - -  3.458E+04  4.691E+10   0.7

         122.05  8.278E+04  1.01   0.5 -0.1
         136.45  8.489E+04  0.99   0.6  0.2

  CO 60  - - - - 1.671E+05 - - - - - - - - -  1.476E+05  6.681E+11   0.6

        1173.17  1.666E+05  1.00   0.5 -0.0
        1332.45  1.675E+05  1.00   0.5  0.0

   Y 88  - - - - 3.591E+05 - - - - - - - - -  3.834E+04  7.952E+10   0.8

         897.99  3.595E+05  1.00   0.6  0.0
        1836.17  3.585E+05  1.00   0.7 -0.0

  CD109  - - - - 4.479E+06 - - - - - - - - -  2.682E+06  4.325E+12   0.5

          88.11  4.479E+06  1.00   0.5  0.0

  SN113  - - - - 2.158E+05 - - - - - - - - -  2.713E+04  5.155E+10   2.5

         255.14  2.222E+05  0.97   2.3  0.2
         391.69  2.154E+05  1.00   0.6 -0.0

  SB124  - - - - 3.512E+06 - - - - - - - - -  6.685E+04  4.392E+11   3.3

        1325.08  3.512E+06  1.00   3.3 -0.0

  CS137  - - - - 1.031E+05 - - - - - - - - -  1.009E+05  2.348E+12   0.5

         661.62  1.031E+05  1.00   0.5  0.0

  CE139  - - - - 1.248E+05 - - - - - - - - -  2.206E+04  3.568E+10   0.5

         165.85  1.248E+05  1.00   0.5  0.0

  EU154  - - - - 7.631E+03 - - - - - - - - -  7.021E+03  4.540E+10  24.1

         691.99  7.631E+03  1.00  24.1  0.0

  HG203  - - - - 2.683E+05 - - - - - - - - -  1.606E+03  2.597E+10   1.3

         279.21  2.683E+05  1.00   1.3  0.0

  RA226  - - - - 2.364E+03 - - - - - - - - -  2.363E+03  2.873E+12  19.1

         185.74  2.364E+03  1.00  19.1  0.0

  TH228  - - - - 2.731E+02 - - - - - - - - -  1.941E+02  3.964E+08  23.9

         238.74  2.960E+02  0.92  15.3  0.2
         583.06  2.462E+02  1.11  20.0 -0.2
```

Left file: C:\Users\121611\Desktop\010_098_specanal.lis
Right file: C:\Users\121611\Desktop\010_001_specanal.lis

Library 3 Comparison

☐ Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 20 Line(s) match | 14 Block(s) diff | 18 : 23 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\010_098_specanal.lis

```
1  *  FILE:010_098.LIS          SAP Version 4.2 (30-May-2008)      DATE:13-SEP-2020 17:50:07.92
                                     PAGE:  1
   !>
2
3                          DPM at  Peak   Err  Std    DPM at     Atoms at   Err
4     Nuclide  Energy      T-zero  wght   (%)  dev  count time    T-zero    (%)
5    ---------------------------------------------------------------------
6
7  *    MN 54  - - - - 6.987E+00 - - - - - - - - -  5.451E+00  4.532E+06  34.8
8
9  *           834.84  6.987E+00  1.00  34.8  0.0
10
11 *    CO 58  - - - - 1.519E+05 - - - - - - - - -  5.090E+04  2.237E+10   4.0
12
13 *           810.72  1.523E+05  1.00   0.5  0.0
14 *           863.90  1.414E+05  1.07   2.0 -0.5
15 *          1674.68  1.810E+05  0.84   3.3  0.9
16
17      CO 60  - - - - 3.421E+01 - - - - - - - - -  3.286E+01  1.368E+08  12.4
18
19 *          1173.10  3.627E+01  0.94  10.9  0.2
20 *          1332.51  3.288E+01  1.04   9.6 -0.1
   !>
   !>
   !>
   !>
21
22 *    EU152  - - - - 1.811E+02 - - - - - - - - -  1.783E+02  1.858E+09   3.6
23
24 *           122.01  1.811E+02  1.00   3.6  0.0
25
26 *    TM170  - - - - 4.199E+02 - - - - - - - - -  2.299E+02  1.122E+08  27.6
27
28 *            84.15  4.199E+02  1.00  27.6  0.0
29
30 *    YB169  - - - - 4.217E+02 - - - - - - - - -  3.750E+01  2.805E+07  38.8
31
32 *            63.31  3.684E+02  1.14  14.8 -0.4
33 *           197.73  3.400E+03  0.12  12.0  2.5
34
35 *    HF181  - - - - 1.127E+03 - - - - - - - - -  1.811E+02  9.926E+07  19.5
36
37 *           136.57  1.127E+03  1.00  19.5  0.0
38
```

C:\Users\121611\Desktop\010_001_specanal.lis

```
1   FILE:010_001.LIS          SAP Version 4.2 (30-May-2008)      DATE:10-JAN-2020 02:01:10.84
                                     PAGE:  1
2
3
4                          DPM at  Peak   Err  Std    DPM at     Atoms at   Err
5   Nuclide  Energy      T-zero  wght   (%)  dev  count time    T-zero    (%)
6  ---------------------------------------------------------------------
7
8     MN 54  - - - - 6.985E+00 - - - - - - - - -  5.451E+00  4.535E+06  34.8
9
10           834.88  6.985E+00  1.00  34.8  0.0
11
12    CO 58  - - - - 1.519E+05 - - - - - - - - -  5.087E+04  2.235E+10   3.9
13
14           810.76  1.523E+05  1.00   0.5  0.0
15           863.94  1.406E+05  1.08   2.0 -0.6
16          1674.75  1.766E+05  0.86   3.3  0.8
17
18    CO 60  - - - - 3.421E+01 - - - - - - - - -  3.286E+01  1.368E+08  12.4
19
20          1173.15  3.627E+01  0.94  10.9  0.2
21          1332.57  3.288E+01  1.04   9.6 -0.1
22
23    BA131  - - - - 1.628E+06 - - - - - - - - -  2.289E+03  3.991E+10   9.5
24
25           92.57  1.628E+06  1.00   9.5  0.0
26
27    EU152  - - - - 1.822E+02 - - - - - - - - -  1.793E+02  1.839E+09   3.6
28
29           122.02  1.822E+02  1.00   3.6  0.0
30
31    TM170  - - - - 3.230E+02 - - - - - - - - -  1.749E+02  8.474E+07  27.6
32
33            84.16  3.230E+02  1.00  27.6  0.0
34
35    YB169  - - - - 4.522E+02 - - - - - - - - -  3.623E+01  2.884E+07  38.9
36
37            63.31  3.962E+02  1.14  14.8 -0.4
38           197.74  3.766E+03  0.12  12.0  2.5
39
40    HF181  - - - - 1.080E+03 - - - - - - - - -  1.737E+02  9.517E+07  19.5
41
42           136.58  1.080E+03  1.00  19.5  0.0
43
```

Left file: C:\Users\121611\Desktop\161_087_specanal.lis
Right file: C:\Users\121611\Desktop\161_081_specanal.lis

Library 4 Comparison

Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 14 Line(s) match | 5 Block(s) diff | 7 : 6 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\161_087_specanal.lis

```
1  *  FILE:161_087.LIS          SAP Version 4.2 (30-May-2008)      DATE:13-SEP-2020 17:24:07.76
                                     PAGE:  1
2  <!
3
4     ANALYTICAL RESULTS USING LIBRARY #4
5    0 NUCLIDE         DPM AT    PEAK  PEAK   DPM AT    ATOMS AT
6              ENERGY ZERO TIME   FRAC  ERR  COUNT TIME ZERO TIME  ERROR
7
8  *   1 AS 71 - - - - 4.361E+08 - - - - - - 7.945E+03  2.465E+12  21.2
9
10 *             175.  4.361E+08  1.00  21.2
11
12 *   2 SR 82 - - - - 5.136E+06 - - - - - - 1.592E+06  2.704E+11   2.5
13
14 *             777.  5.156E+06  1.00   2.4
15 *            1396.  4.436E+06  1.00  17.6
16
17     3 SR 85 - - - - 1.489E+06 - - - - - - 9.422E+05  2.006E+11   1.7
18
19              514.  1.489E+06  1.00   1.5
20
21
```

C:\Users\121611\Desktop\161_081_specanal.lis

```
1   FILE:161_081.LIS          SAP Version 4.2 (30-May-2008)      DATE: 9-JUN-2020 20:16:09.50
                                     PAGE:  1
2
3   ANALYTICAL RESULTS USING LIBRARY #4
4  0 NUCLIDE         DPM AT    PEAK  PEAK   DPM AT    ATOMS AT
5            ENERGY ZERO TIME   FRAC  ERR  COUNT TIME ZERO TIME  ERROR
6
7    1 AS 71 - - - - 4.294E+08 - - - - - - 7.186E+03  2.408E+12  21.2
8
9              175.  4.294E+08  1.00  21.2
10
11   2 SR 82 - - - - 5.163E+06 - - - - - - 1.599E+06  2.717E+11   2.5
12
13             777.  5.158E+06  1.00   2.4
14            1396.  5.383E+06  1.00  17.6
15
16   3 SR 85 - - - - 1.489E+06 - - - - - - 9.422E+05  2.006E+11   1.7
17
18             514.  1.489E+06  1.00   1.5
19
20
```

Left file: C:\Users\121611\Desktop\210_072_specanal.lis
Right file: C:\Users\121611\Desktop\210_063_specanal.lis

Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 9 Line(s) match | 3 Block(s) diff | 12 : 3 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\210_072_specanal.lis

```
1  *  FILE:210_072.LIS          SAP Version 4.2 (30-May-2008)      DATE:13-SEP-2020 17:18:08.34
                                     PAGE:  1
2  <!
3
4
5                          DPM at  Peak   Err  Std    DPM at     Atoms at   Err
6     Nuclide  Energy      T-zero  wght   (%)  dev  count time    T-zero    (%)
7    ---------------------------------------------------------------------
8
9  <!    GE 68  - - - - 5.300E+06 - - - - - - - - -  4.751E+06  2.983E+12   2.5
10 <!
11 <!          1077.75  7.273E+06  0.73   2.5  0.0
12 <!
13 <!    RB 86  - - - - 3.234E+06 - - - - - - - - -  6.591E+05  1.252E+11   2.5
14 <!
15 <!          1077.75  1.192E+07  0.27   2.5  0.0
16 <!
17 *    TC 96  - - - - 4.079E+08 - - - - - - - - -  4.000E+05  3.626E+12  29.7
18
19 *           314.29  4.079E+08  1.00  29.7  0.0
20
21
```

C:\Users\121611\Desktop\210_063_specanal.lis

```
1  FILE:210_063.LIS          SAP Version 4.2 (30-May-2008)      DATE:28-JUL-2020 18:41:07.94
                                 PAGE:  1
2
3
4                          DPM at  Peak   Err  Std    DPM at     Atoms at   Err
5  Nuclide  Energy      T-zero  wght   (%)  dev  count time    T-zero    (%)
6 ---------------------------------------------------------------------
7
8    TC 96  - - - - 4.062E+08 - - - - - - - - -  3.984E+05  3.612E+12  29.7
9
10          314.29  4.062E+08  1.00  29.7  0.0
11
12
```

Library 5 Comparison

104_051_specanal.LIS vs. 104_039_specanal.LIS

104_051_specanal.LIS - /Users/mrjames/CDIV/LIBRARIES/MODERNISE

FILE:104_051.LIS SAP Version 4.2 (30-May-2008) DATE:22-SEP-2020 19:50:09.78 PAGE: 1

```
                DPM at  Peak   Err  Std    DPM at     Atoms at   Err
Nuclide  Energy    T-zero  wght   (%)  dev  count time   T-zero    (%)
-------------------------------------------------------------------------

 PB211  - - - - 2.488E+09 - - - - - - - - - 4.643E+06  5.908E+13   3.9

      404.76  2.521E+09  0.99   2.3  0.1
      426.99  2.550E+09  0.98   3.1  0.1
      831.79  2.363E+09  1.05   3.3 -0.3

 BI211  - - - - 2.409E+09 - - - - - - - - - 4.495E+06  5.720E+13   1.1

      350.99  2.409E+09  1.00   1.1  0.0

 PO215  - - - - 2.164E+09 - - - - - - - - - 4.039E+06  5.139E+13  26.4

      439.02  2.164E+09  1.00  26.4  0.0

 RN219  - - - - 2.776E+09 - - - - - - - - - 5.179E+06  6.591E+13   1.7

      401.74  2.776E+09  1.00   1.7  0.0

 RA223  - - - - 2.946E+09 - - - - - - - - - 5.497E+06  6.994E+13   3.9

       81.13  3.013E+09  0.98   1.0  0.2
       83.88  2.802E+09  1.05   0.9 -0.6
       94.74  4.027E+09  0.73   1.1  2.5
      144.24  2.974E+09  0.99   1.5  0.1
      154.19  2.985E+09  0.99   1.2  0.1
      323.83  2.422E+09  1.22   1.9 -1.6
      338.25  2.488E+09  1.18   2.3 -1.2
```

104_039_specanal.LIS - /Users/mrjames/CDIV/LIBRARIES/MODERNISE

FILE:104_039.LIS SAP Version 4.2 (30-May-2008) DATE:15-APR-2018 14:52:08.57 PAGE: 1

```
                DPM at  Peak   Err  Std    DPM at     Atoms at   Err
Nuclide  Energy    T-zero  wght   (%)  dev  count time   T-zero    (%)
-------------------------------------------------------------------------

 PB211  - - - - 2.475E+09 - - - - - - - - - 4.643E+06  5.881E+13   3.9

      404.79  2.507E+09  0.99   2.3  0.1
      427.02  2.536E+09  0.98   3.1  0.1
      831.84  2.350E+09  1.05   3.3 -0.3

 BI211  - - - - 2.416E+09 - - - - - - - - - 4.533E+06  5.742E+13   1.1

      351.02  2.416E+09  1.00   1.1  0.0

 PO215  - - - - 2.153E+09 - - - - - - - - - 4.039E+06  5.116E+13  26.4

      439.05  2.153E+09  1.00  26.4  0.0

 RN219  - - - - 2.860E+09 - - - - - - - - - 5.367E+06  6.798E+13   1.7

      401.76  2.860E+09  1.00   1.7  0.0

 RA223  - - - - 2.945E+09 - - - - - - - - - 5.527E+06  7.000E+13   3.9

       81.13  3.005E+09  0.98   1.0  0.2
       83.88  2.775E+09  1.06   0.9 -0.7
       94.75  4.012E+09  0.73   1.1  2.5
      144.24  3.004E+09  0.98   1.5  0.2
      154.20  3.011E+09  0.98   1.2  0.2
      323.85  2.446E+09  1.20   1.9 -1.5
      338.27  2.519E+09  1.17   2.3 -1.1
```

status: 2 differences

Actions

Left file: C:\Users\121611\Desktop\196_088_specanal.LIS
Right file: C:\Users\121611\Desktop\196_087_specanal.LIS

Library 7 Comparison

☐ Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 10 Line(s) match | 4 Block(s) diff | 16 : 14 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\196_088_specanal.LIS

```
1  *  FILE:196_088.LIS          SAP Version 4.2 (30-May-2008)      DATE:22-SEP-2020 20:08:08.32
                                     PAGE:  1
2  <!
3
4
5                        DPM at  Peak   Err  Std    DPM at     Atoms at   Err
6     Nuclide  Energy    T-zero  wght   (%)  dev  count time    T-zero    (%)
7    ---------------------------------------------------------------------
8
9  *    EU152  - - - - 1.172E+06 - - - - - - - - -  4.305E+05  1.202E+13  24.9
10
11 *          121.85  1.176E+06  1.00   0.7  0.0
12 *          244.75  1.236E+06  0.95   1.7  0.4
13 *          344.30  1.137E+06  1.03   1.3 -0.3
14            411.15  1.155E+06  1.01   5.7 -0.1
15 *          443.98  1.117E+06  1.05   6.2 -0.2
16 *          778.85  1.132E+06  1.04   4.9 -0.2
17 *          867.31  1.034E+06  1.13  10.2 -0.4
18 *          964.03  1.184E+06  0.99   5.1  0.0
19 *         1085.86  1.203E+06  0.97   7.0  0.1
20 *         1112.03  1.174E+06  1.00   6.0  0.0
21 *         1213.08  1.172E+06  1.00  24.2  0.0
22 *         1299.18  1.262E+06  0.93  19.2  0.2
23 *         1407.96  1.134E+06  1.03   6.2 -0.1
24 <!
25
26
```

C:\Users\121611\Desktop\196_087_specanal.LIS

```
1   FILE:196_087.LIS          SAP Version 4.2 (30-May-2008)      DATE:21-SEP-2020 18:44:08.27
                                     PAGE:  1
2
3
4                        DPM at  Peak   Err  Std    DPM at     Atoms at   Err
5     Nuclide  Energy    T-zero  wght   (%)  dev  count time    T-zero    (%)
6    ---------------------------------------------------------------------
7
8     EU152  - - - - 1.169E+06 - - - - - - - - -  4.300E+05  1.201E+13  24.8
9
10          121.85  1.172E+06  1.00   0.7  0.0
11          244.75  1.229E+06  0.95   1.7  0.4
12          344.30  1.139E+06  1.03   1.3 -0.2
13          411.15  1.155E+06  1.01   5.7 -0.1
14          443.98  1.107E+06  1.06   6.2 -0.2
15          778.85  1.130E+06  1.04   4.9 -0.2
16          867.31  1.029E+06  1.14  10.2 -0.4
17          964.03  1.174E+06  1.00   5.1  0.0
18         1085.86  1.189E+06  0.98   7.0  0.1
19         1112.03  1.175E+06  1.00   6.0  0.0
20         1213.08  1.164E+06  1.00  24.2  0.0
21         1299.18  1.268E+06  0.92  19.2  0.2
22         1407.96  1.125E+06  1.04   6.2 -0.2
23
24
```

Library 6 Comparison

248_045_specanal.LIS vs. 248_040_specanal.LIS

248_045_specanal.LIS - /Users/mrjames/CDIV/LIBRARIES/MODERNISE

FILE:248_045.LIS SAP Version 4.2 (30-May-2008) DATE:22-SEP-2020 20:01:08.73 PAGE: 1

Nuclide	Energy	DPM at T-zero	Peak wght	Err (%)	Std dev	DPM at count	Atoms at time	Err T-zero	(%)
SE 75	- - - -	3.628E+02	- - - - - - - - -			3.611E+02	9.030E+07	10.2	
	198.32	3.628E+02	1.00	10.2	0.0				
I133	- - - -	1.622E+03	- - - - - - - - -			8.542E+02	2.925E+06	4.3	
	510.92	6.355E+03	0.26	4.3	0.0				
XE133	- - - -	2.771E+03	- - - - - - - - -			1.033E+03	3.021E+07	4.3	
	510.92	8.976E+03	0.74	4.3	0.0				
W188	- - - -	1.240E+04	- - - - - - - - -			1.230E+04	1.797E+09	11.0	
	63.47	6.770E+03	1.00	11.0	0.0				

248_040_specanal.LIS - /Users/mrjames/CDIV/LIBRARIES/MODERNISE

FILE:248_040.LIS SAP Version 4.2 (30-May-2008) DATE: 4-SEP-2020 15:39:08.57 PAGE: 1

Nuclide	Energy	DPM at T-zero	Peak wght	Err (%)	Std dev	DPM at count	Atoms at time	Err T-zero	(%)
SE 75	- - - -	3.933E+02	- - - - - - - - -			3.915E+02	9.804E+07	10.2	
	198.30	3.933E+02	1.00	10.2	0.0				
SB127	- - - -	2.295E+02	- - - - - - - - -			1.988E+02	1.848E+06	14.1	
	583.24	2.295E+02	1.00	14.1	0.0				
I133	- - - -	1.484E+03	- - - - - - - - -			7.805E+02	2.671E+06	4.3	
	510.87	5.820E+03	0.25	4.3	0.0				
XE133	- - - -	2.536E+03	- - - - - - - - -			9.468E+02	2.766E+07	4.3	
	510.87	8.201E+03	0.75	4.3	0.0				
W188	- - - -	1.261E+04	- - - - - - - - -			1.251E+04	1.818E+09	11.0	
	63.47	6.894E+03	1.00	11.0	0.0				

FILE:248_040.LIS SAP Version 4.2 (30-May-2008) DATE: 4-SEP-2020 15:39:08.57 PAGE: 1

Nuclide	Energy	DPM at T-zero	Peak wght	Err (%)	Std dev	DPM at count	Atoms at time	Err T-zero	(%)
SE 75	- - - -	3.933E+02	- - - - - - - - -			3.915E+02	9.804E+07	10.2	
	198.30	3.933E+02	1.00	10.2	0.0				

status: 2 differences

Actions

Left file: C:\Users\121611\Desktop\011_046_specanal.LIS
Right file: C:\Users\121611\Desktop\011_045_specanal.LIS

Library 8 Comparison

☐ Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 14 Line(s) match | 10 Block(s) diff | 22 : 22 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\011_046_specanal.LIS

```
1  * Analysis Code: specanl  Peaks: 36  Overall QA:    0.00  Library: 8  CD: 71  Timestamp:2020-09-22 20:13:02.0
2    Analysis ZT: 008.0000      AnalysisZY: 2020     Original: Yes     Comment:
3
4    Line   Nuclide   Isotope   Meta      DPM@ZT       DPM@CT        Atoms@ZT       Error      Accept  Comment
5       Energy      DPM@ZT             Fraction   Error   StdDev
6
7  *   1      CS         134           1.7070E+02    1.7010E+02    2.6740E+08      13.9
    0        u
8
9  *    802.51      1.7070E+02           1.00    13.90     0.00
10 *   2      EU         152           2.1960E+02    2.1950E+02    2.2520E+09      27.6
    0        u
11
12 *    121.71      2.2310E+02           0.98     2.70     0.10
13 *    244.68      3.9190E+02           0.56     9.00     1.50
14 *    344.01      2.0790E+02           1.06     3.60    -0.30
15 *    443.58      2.0790E+02           1.06    18.10    -0.10
16 *    778.26      2.1390E+02           1.03     8.80    -0.10
17 *    866.84      2.2640E+02           0.97    23.80     0.10
18 *   3      EU         154           4.9190E+02    4.9150E+02    3.2100E+09      33.5
    0        u
19
20 *    692.88      4.9190E+02           1.00    33.50     0.00
21 *   4      PB         212           6.2920E+03    2.8230E+01    5.7950E+06       9.5
    0        u
22
23 *    238.35      6.2920E+03           1.00     9.50     0.00
24     5      AC         228           4.7280E+05    4.1060E+01    2.5170E+08      18.2
    0        u
25
26 *    910.51      4.7280E+05           1.00    18.20     0.00
27 *   6      TH         232           1.7860E+03    1.7860E+03    1.8970E+19      14.5
    0        u
28
29 *     63.37      1.7030E+04           0.10    14.50     0.00
30 *   7      TH         234           1.1970E+03    1.0840E+03    5.9940E+07      14.5
    0        u
31
32 *     63.37      1.3370E+03           0.90    14.50     0.00
33 *     92.64      1.1970E+03           1.00     7.90     0.00
34 *   8      U          235           1.7670E+01    1.7670E+01    9.4370E+15      10.70        u
35
36 *    185.50      1.7670E+01           1.00    10.70     0.00
```

C:\Users\121611\Desktop\011_045_specanal.LIS

```
1  Analysis Code: specanl  Peaks: 36  Overall QA:    0.00  Library: 8  CD: 71  Timestamp:2020-03-10 13:18:07.0
2  Analysis ZT: 008.0000      AnalysisZY: 2020     Original: Yes     Comment:
3
4  Line   Nuclide   Isotope   Meta      DPM@ZT       DPM@CT        Atoms@ZT       Error      Accept  Comment
5     Energy      DPM@ZT             Fraction   Error   StdDev
6
7    1      CS         134           1.7060E+02    1.7010E+02    2.6740E+08      13.9
    0        u
8
9     802.54      1.7060E+02           1.00    13.90     0.00
10   2      EU         152           2.1960E+02    2.1950E+02    2.2550E+09      27.6
    0        u
11
12    121.72      2.2270E+02           0.99     2.70     0.10
13    244.69      3.9020E+02           0.56     9.00     1.50
14    344.03      2.0860E+02           1.05     3.60    -0.30
15    443.60      2.0640E+02           1.06    18.10    -0.10
16    778.29      2.1380E+02           1.03     8.80    -0.10
17    866.87      2.2560E+02           0.97    23.80     0.10
18   3      EU         154           4.8510E+02    4.8470E+02    3.1630E+09      33.5
    0        u
19
20    692.91      4.8510E+02           1.00    33.50     0.00
21   4      PB         212           6.3360E+03    2.8430E+01    5.8350E+06       9.5
    0        u
22
23    238.36      6.3360E+03           1.00     9.50     0.00
24   5      AC         228           4.7280E+05    4.1060E+01    2.5170E+08      18.2
    0        u
25
26    910.55      4.7280E+05           1.00    18.20     0.00
27   6      TH         232           2.0380E+03    2.0380E+03    2.1720E+19      14.5
    0        u
28
29     63.37      1.7030E+04           0.12    14.50     0.00
30   7      TH         234           9.0740E+02    8.2150E+02    4.5430E+07      14.5
    0        u
31
32     63.37      1.0310E+03           0.88    14.50     0.00
33     92.64      9.0740E+02           1.00     7.90     0.00
34   8      U          235           1.7610E+01    1.7610E+01    9.4040E+15      10.70        u
35
36    185.51      1.7610E+01           1.00    10.70     0.00
```

Left file: C:\Users\121611\Desktop\056_083_specanal.LIS
Right file: C:\Users\121611\Desktop\056_076_specanal.LIS

Library 9 Comparison

☐ Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 18 Line(s) match | 10 Block(s) diff | 145 : 142 Line(s) diff

Ignore options: Ignore line terminators

C:\Users\121611\Desktop\056_083_specanal.LIS

```
1
2   * Analysis Code: specanl  Peaks: 102  Overall QA:    0.00  Library: 9  CD: 71  Timestamp:2020-11-18 21:05:02.0
3     Analysis ZT: 052.7597      AnalysisZY: 2020     Original: Yes     Comment:
4
5     Line   Nuclide   Isotope   Meta      DPM@ZT       DPM@CT        Atoms@ZT       Error      Accept  Comment
6        Energy      DPM@ZT             Fraction   Error   StdDev
7
8   *  1      CO          60           8.2060E+06    8.1940E+06    3.2820E+13      11.70        u
9
10  *  1174.01      8.2060E+06           1.00    11.70     0.00
11  *  2      ZR          95           1.3380E+08    1.2800E+08    1.7790E+13       2.60        u
12
13  *   723.62      2.1090E+08           0.63     2.60     0.00
14  *   757.12      1.3380E+08           1.00     2.00     0.00
15  *  3      ZR          97           1.0350E+10    1.7810E+08    1.5010E+13      22.30        u
16  *
17  *   355.78      9.8680E+09           1.05    18.60    -0.10
18  *   602.72      1.3750E+10           0.75    22.10     0.00
19  *   743.77      1.0350E+10           1.00     1.30     0.00
20  *  4      NB          95           8.3330E+06    7.6850E+06    6.0580E+11       8.80        u
21  *
22  *   766.12      8.3330E+06           1.00     8.80     0.00
23  *  5      MO          99           1.4960E+09    5.3310E+08    8.5390E+12       6.50        u
24  *
25  *   181.11      1.3400E+09           1.12     2.20    -0.80
26  *   739.86      2.7890E+09           0.54     1.50    -0.10
27  *   778.29      3.0010E+09           0.50     2.90     2.90
28  *  6      TC          99       M   7.2480E+10    8.7350E+05    3.7690E+13       0.60        u
29  *
30  *   140.49      2.7860E+13           0.00     0.60     0.00
31  *  7      RU         103           9.1310E+07    8.4940E+07    7.4450E+12      19.10        u
32  *
33  *   497.28      9.1210E+07           1.00     1.60     0.00
34  *   610.70      1.0830E+08           0.84    18.30     0.40
35  *  8      RU         106           1.4350E+08    1.4240E+08    1.1090E+14       6.10        u
36  *
37  *   621.31      1.4350E+08           1.00     6.10     0.00
38  *  9      RH         105           7.7210E+08    1.1270E+08    2.3630E+12       3.20        u
39  *
40  *   319.36      8.5110E+08           0.91     3.20     0.00
41  *  10      SB         127           3.6190E+07    1.7330E+07    2.8950E+11      30.10        u
42  *
43  *   473.49      5.0570E+07           0.72    21.90     0.60
44  *   685.38      3.3220E+07           1.09    15.20    -0.20
45  *  11      TE         129           1.4890E+08    1.3690E+08    1.0400E+13       1.00        u
46  *
47  *   487.24      1.4800E+10           0.01     1.00     0.00
48  *  12      TE         132           1.1400E+09    4.7080E+08    7.5910E+12       0.60        u
49  *
50  *   228.37      1.1400E+09           1.00     0.60     0.00
51  *  13      TE         131       M   3.5530E+08    4.5880E+07    1.0220E+12      29.60        u
52  *
53  *   149.50      5.9120E+08           0.60    17.70     0.90
54  *   241.35      5.3660E+08           0.66    18.20     0.00
55  *   334.48      3.3720E+08           1.05    23.50    -0.10
56  *   794.23      3.4460E+08           1.03    12.80    -0.10
57  *   852.68      3.3100E+08           1.07    10.50    -0.20
58  *  1126.10      3.7400E+08           0.95    14.10     0.10
59  *  14      I          124           2.5280E+06    1.2820E+06    2.1930E+10      22.10        u
60  *
```

C:\Users\121611\Desktop\056_076_specanal.LIS

```
1
2   Analysis Code: specanl  Peaks: 102  Overall QA:    0.00  Library: 9  CD: 71  Timestamp:2020-10-26 03:23:31.0
3   Analysis ZT: 052.7597      AnalysisZY: 2020     Original: Yes     Comment:
4
5   Line   Nuclide   Isotope   Meta      DPM@ZT       DPM@CT        Atoms@ZT       Error      Accept  Comment
6      Energy      DPM@ZT             Fraction   Error   StdDev
7
8   1      CO          60           8.2020E+06    8.1900E+06    3.2800E+13      11.70        u
9
10  1174.03      8.2020E+06           1.00    11.70     0.00
11  2      ZR          95           1.3350E+08    1.2770E+08    1.7750E+13       2.60        u
12
13   723.64      2.1170E+08           0.63     2.60     0.00
14   757.13      1.3350E+08           1.00     2.00     0.00
15  3      ZR          97           1.0010E+10    1.7860E+08    1.4640E+13      22.70        u
16
17   355.79      8.7620E+09           1.14    18.60    -0.30
18   602.73      1.3160E+10           0.76    22.10     0.00
19   743.78      1.0010E+10           1.00     1.30     0.00
20  4      NB          95           8.3360E+06    7.6860E+06    6.0560E+11       8.80        u
21
22   766.14      8.3360E+06           1.00     8.80     0.00
23  5      MO          99           1.4830E+09    5.2850E+08    8.4660E+12       6.50        u
24
25   181.11      1.3350E+09           1.11     2.20    -0.70
26   739.87      2.8020E+09           0.53     1.50    -0.20
27   778.30      2.9720E+09           0.50     2.90     2.90
28  6      TC          99       M   2.8440E+13    3.4270E+08    1.4790E+16       0.60        u
29
30   140.50      2.8440E+13           1.00     0.60     0.00
31  7      RU         103           9.3670E+07    8.7150E+07    7.6380E+12      19.00        u
32
33   497.29      9.3580E+07           1.00     1.60     0.00
34   610.72      1.1070E+08           0.85    18.30     0.40
35  8      RU         106           1.4250E+08    1.4250E+08    9.5060E+18       6.10        u
36
37   621.33      1.4250E+08           1.00     6.10     0.00
38  9      RH         105           7.8260E+08    1.1420E+08    2.3950E+12       3.20        u
39
40   319.37      8.5560E+08           0.91     3.20     0.00
41  10      SB         127           3.3940E+07    1.6250E+07    2.7150E+11      32.30        u
42
43   473.50      5.2820E+07           0.64    21.90     0.80
44   685.39      3.4640E+07           0.98    15.20    -0.30
45  11      TE         129           2.8040E+08    2.5770E+08    1.9570E+13       1.00        u
46
47   487.24      1.4800E+10           0.02     1.00     0.00
48  12      TE         132           1.1380E+09    4.6970E+08    7.5740E+12       0.60        u
49
50   228.38      1.1380E+09           1.00     0.60     0.00
51  13      TE         131       M   4.4330E+08    4.5890E+07    1.1510E+12      31.00        u
52
53   149.50      7.0850E+08           0.63    17.70     0.90
54   241.36      6.4640E+08           0.69    18.20     0.70
55   334.49      4.0610E+08           1.09    23.50    -0.20
56   794.25      4.1740E+08           1.06    12.80    -0.20
57   852.70      4.0630E+08           1.09    10.50    -0.30
58  1126.12      4.4970E+08           0.99    14.10     0.00
59  14      I          124           2.5260E+06    1.2820E+06    2.1940E+10      22.10        u
60
```

```
61  *    602.72     1.0230E+07          0.25    22.10     0.00
62  *   15      I        130          1.7380E+10    7.0700E+07    1.8600E+13      1.60        u
63  *
64  *    668.06     2.0590E+11          0.08     0.70     0.20
65  *    739.86     3.6360E+10          0.48     1.50    -0.10
66  *   16      I        131          4.2010E+08    2.9510E+08    7.0040E+12      5.80        u
67  *
68  *    284.54     5.4770E+08          0.77     3.90     1.20
69  *    364.60     4.1700E+08          1.01     0.80    -0.10
70  *    637.30     4.1110E+08          1.02     4.60    -0.10
71  *   17      I        132          1.7730E+09    7.3210E+08    1.1800E+13      4.20        u
72  *
73  *    506.12     1.6080E+09          1.10     3.50    -0.60
74  *    522.91     1.5870E+09          1.12     1.30    -1.00
75  *    630.52     1.7890E+09          0.99     1.40     0.10
76  *    668.06     1.9740E+09          0.90     0.70     0.20
77  *    773.10     1.8170E+09          0.98     0.70     0.30
78  *    812.61     2.0780E+09          0.85     2.70     0.90
79  *    955.18     1.7400E+09          1.02     1.50    -0.20
80  *   18      I        133          9.3810E+09    3.5780E+08    1.6910E+13     20.70        u
81  *
82  *    530.18     9.3590E+09          1.00     0.90     0.00
83  *    707.06     1.0650E+10          0.88    16.70     0.30
84  *    856.71     8.1150E+09          1.16    18.80    -0.40
85  *   1298.88     1.4610E+10          0.64     8.40     1.20
86  *   19      XE       133          5.7570E+08    3.3540E+08    6.2760E+12      0.90        u
87  *
88  *     80.92     5.7770E+08          1.00     0.90     0.00
89  *   20      XE       135          4.1600E+10    2.4310E+07    3.2910E+13      2.80        u
90  *
91  *    249.79     4.1600E+10          1.00     2.80     0.00
92  *   21      CS       136          1.2450E+07    1.0010E+07    3.3650E+11     12.20        u
93  *
94  *    340.24     1.2490E+07          1.00    12.20     0.00
95  *   22      BA       140          5.2020E+08    4.1650E+08    1.3780E+13     16.10        u
96  *
97  *    162.70     2.8640E+08          1.82     4.10    -4.00
98  *    305.11     6.5120E+08          0.80     4.80     0.90
99  *    423.85     6.3800E+08          0.82     5.50     0.80
100 *    437.67     5.8470E+08          0.89     9.80     0.40
101 *    537.54     5.9530E+08          0.87     1.20     1.10
102 *   23      LA       140          2.2740E+09    4.2030E+08    7.9330E+12      8.90        u
103 *
104 *    328.88     2.0590E+09          1.10     1.30    -0.90
105 *    432.62     3.3340E+09          0.68     5.60     1.30
106 *    487.24     2.2970E+09          0.99     1.00     0.00
107 *    751.95     2.4800E+09          0.92     5.30     0.40
108 *    816.23     2.7330E+09          0.83     1.70     1.30
109 *    868.30     2.5610E+09          0.89     4.20     0.50
110 *    920.14     2.5070E+09          0.91     6.90     0.40
111 *    925.76     2.6790E+09          0.85     3.80     0.80
112 *   24      CE       141          7.8260E+07    7.1730E+07    5.2860E+12      1.70        u
113 *
114 *    145.44     7.8260E+07          1.00     1.70     0.00
115 *   25      CE       143          4.0280E+09    5.1400E+08    1.1520E+13      6.90        u
116 *
117 *    293.35     4.0090E+09          1.00     0.70    -0.10
118 *    350.77     4.2260E+09          0.95     4.10     0.20
119 *    490.46     5.8110E+09          0.69     5.60     1.30
120 *   26      ND       147          1.3390E+08    1.0340E+08    3.0540E+12      3.20        u
121 *
122 *     91.09     1.3390E+08          1.00     2.90     0.00
123 *    319.36     1.4420E+09          0.09     3.20     0.00
124 *   27      PM       151          6.7750E+05    6.1680E+04    1.6650E+09     12.20        u
```

```
61    602.73     1.0550E+07          0.24    22.10     0.00
62    15      I        130          1.7800E+10    7.2390E+07    1.9040E+13     15.50        u
63
64    668.08     2.0570E+11          0.09     0.70     0.30
65    685.39     1.3470E+11          0.13    15.20    -0.30
66    739.87     3.6230E+10          0.49     1.50    -0.20
67    16      I        131          4.2120E+08    2.9600E+08    7.0350E+12      5.80        u
68
69    284.55     5.5270E+08          0.76     3.90     1.20
70    364.61     4.1830E+08          1.01     0.80    -0.10
71    637.31     4.0460E+08          1.04     4.60    -0.20
72    17      I        132          1.7550E+09    7.2430E+08    1.1680E+13      4.20        u
73
74    506.13     1.5820E+09          1.11     3.50    -0.60
75    522.92     1.5770E+09          1.11     1.30    -1.00
76    630.54     1.7250E+09          1.02     1.40    -0.10
77    668.08     1.9740E+09          0.89     0.70     0.30
78    773.11     1.8030E+09          0.97     0.70     0.30
79    812.63     2.0400E+09          0.86     2.70     0.90
80    955.20     1.6910E+09          1.04     1.50    -0.30
81    18      I        133          9.5330E+09    3.6190E+08    1.7160E+13     20.70        u
82
83    530.19     9.5110E+09          1.00     0.90     0.00
84    707.08     1.0850E+10          0.88    16.70     0.30
85    856.73     8.2190E+09          1.16    18.80    -0.40
86    1298.91     1.4800E+10          0.64     8.40     1.20
87    19      XE       133          5.5890E+08    3.2570E+08    6.0970E+12      0.90        u
88
89     80.92     5.6080E+08          1.00     0.90     0.00
90    20      XE       135          4.2840E+10    2.4310E+07    3.3760E+13      2.80        u
91
92    249.80     4.2840E+10          1.00     2.80     0.00
93    21      CS       136          1.1960E+07    9.6440E+06    3.2700E+11     12.20        u
94
95    340.25     1.1990E+07          1.00    12.20     0.00
96    22      BA       140          5.2040E+08    4.1670E+08    1.3790E+13     16.10        u
97
98    162.71     2.8690E+08          1.81     4.10    -4.00
99    305.12     6.4970E+08          0.80     4.80     0.90
100   423.86     6.3400E+08          0.82     5.50     0.80
101   437.67     5.8440E+08          0.89     9.80     0.30
102   537.55     5.9530E+08          0.87     1.20     1.10
103   23      LA       140          2.2370E+09    4.1290E+08    7.7970E+12      8.90        u
104
105   328.88     2.0220E+09          1.11     1.30    -0.90
106   432.63     3.2370E+09          0.69     5.60     1.30
107   487.24     2.2800E+09          0.98     1.00     0.00
108   751.96     2.5000E+09          0.89     5.30     0.50
109   816.24     2.6990E+09          0.83     1.70     1.30
110   868.31     2.5230E+09          0.89     4.20     0.60
111   920.16     2.4910E+09          0.90     6.90     0.40
112   925.78     2.6330E+09          0.85     3.80     0.80
113   24      CE       141          7.8260E+07    7.1730E+07    5.2840E+12      1.70        u
114
115   145.45     7.8260E+07          1.00     1.70     0.00
116   25      CE       143          4.1100E+09    5.2290E+08    1.1740E+13      7.10        u
117
118   293.36     4.0980E+09          1.00     0.70     0.00
119   350.77     4.0270E+09          1.02     4.10    -0.10
120   490.47     6.3910E+09          0.64     5.60     1.50
121   26      ND       147          1.3440E+08    1.0380E+08    3.0650E+12      3.20        u
122
123    91.09     1.3440E+08          1.00     2.90     0.00
124   319.37     1.5750E+09          0.09     3.20     0.00
```

```
125 *
126 *    340.24      2.2940E+08            0.00    12.20     0.00
127 *   28      SM         153            6.8900E+07    1.5850E+07    2.7610E+11      15.20        u
128 *
129 *    102.82      6.8900E+07            1.00    15.20     0.00
130 *   29      EU         156            7.2870E+08    6.0470E+08    2.3000E+13       2.60        u
131 *
132 *    723.62      1.9930E+09            0.37     2.60     0.00
133 *   30      TB         161            4.1240E+08    2.7330E+08    5.9030E+12      24.30        u
134 *
135 *     57.37      1.1770E+09            0.35    15.10     1.70
136 *     74.92      4.0170E+08            1.03     5.20    -0.10
137 *   31      AC         228            6.6920E+10    1.0290E+06    3.5560E+13       9.40        u
138 *
139 <!    910.74      2.7850E+12            0.02     9.40     0.00
140 <!   32      TH         228            4.1960E+07    4.1790E+07    6.0860E+13      18.20        u
141 <!
142 <!    241.35      1.2420E+08            0.34    18.20     0.00
143 <!    910.74      4.2990E+07            0.98     9.40     0.00
144 <!   33      TH         232            1.4190E+12    1.4190E+12    1.5080E+28       0.60        u
145
146 *    140.49      1.4230E+12            1.00     0.60     0.00
147 *   34      TH         234            6.4390E+03    5.7250E+03    3.2240E+08       8.80        u
148
    !>
    !>
    !>
149 *    766.12      1.0780E+10            0.00     8.80     0.00
150 *   35      PA         231            2.4100E+07    2.2430E+07    5.9930E+17       0.90        u
151
152       80.92      1.4830E+10            0.00     0.90     0.00
153 *   36      U          234            7.2430E+03    7.2430E+03    1.3490E+15       8.80        u
154
155 *    766.12      9.5880E+09            0.00     8.80     0.00
156 *   37      U          235            2.4100E+07    2.4100E+07    1.2870E+22       0.90        u
157
158       80.92      1.3800E+10            0.00     0.90     0.00
159 *   38      U          238            8.0380E+02    8.0380E+02    2.7250E+18       8.80        u
160
161 *    766.12      9.5880E+09            0.00     8.80     0.00
162
163
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125   27      PM         151            6.1150E+05    5.5670E+04    1.5030E+09      12.20        u
126
127    340.25      2.3460E+08            0.00    12.20     0.00
128   28      SM         153            7.0300E+07    1.6380E+07    2.8420E+11      15.20        u
129
130    102.82      7.0300E+07            1.00    15.20     0.00
131   29      EU         156            6.7280E+08    5.5830E+08    2.1230E+13       2.60        u
132
133    723.64      1.8210E+09            0.37     2.60     0.00
134   30      TB         161            4.2830E+08    2.8420E+08    6.1490E+12      24.70        u
135
136     57.37      1.3150E+09            0.33    15.10     1.70
137     74.92      4.1760E+08            1.03     5.20    -0.10
138   31      AC         228            5.8030E+02    8.7670E-03    3.0790E+05       9.40        u
139
140    910.76      2.5210E+12            0.00     9.40     0.00
141   32      TH         228            3.8250E+07    3.8090E+07    5.5520E+13       9.40        u
142
143    910.76      3.8250E+07            1.00     9.40     0.00
144   33      TH         234            1.6670E+04    1.4820E+04    8.3470E+08       8.80        u
145
146    766.14      4.1680E+09            0.00     8.80     0.00
147   34      PA         231            2.2710E+07    2.1140E+07    5.6480E+17       0.90        u
148
149     80.92      1.4830E+10            0.00     0.90     0.00
150   35      U          234            1.8750E+04    1.8750E+04    3.4920E+15       8.80        u
151
152    766.14      3.7050E+09            0.00     8.80     0.00
153   36      U          235            2.2710E+07    2.2710E+07    1.2130E+22       0.90        u
154
155     80.92      1.3800E+10            0.00     0.90     0.00
156   37      U          238            2.0810E+03    2.0810E+03    7.0550E+18       8.80        u
157
158    766.14      3.7050E+09            0.00     8.80     0.00
159
160
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