QA/QC for `Actinide Migration Studies at the Rocky Flats Environmental Technology Site' FY'98

Peter H Santschi, Texas A&M University at Galveston

A total of 56 samples were run The duplicate error ratio (DER) for the 8 samples run in duplicate ranged from 1 5 ±1 0 to 3 3±1 6 The alpha spectrometers were energy and efficiency calculated prior to counting samples During counting, energy calibration checks were performed once a week No recalibrations were performed as the peaks remained within 40keV of the expected energy The breakdown of tracer recoveries is as follows two >100%, twenty eight between 75-100%, eighteen <75%, 2<30% and 6<10% All samples greater than 100% and less than 10% recovery were considered unusable and labeled HR (high recovery) or LR (low recovery) During sample processing one sample was combined, accounting for high recovery An explanation for the low recoveries is the difficult matrix, primarily algae, which caused problems with digestion and columns Matrix spikes were not run as all water collected was processed to some degree and time for processing did not allow it Laboratory control samples were the basis for the laboratory test samples prior to sampling Tracer recoveries were 100% Two blanks were run and all samples were blank and background corrected The blank values were 0 0058 ± 0 0016 pCi for ^{241}Am and 0 0013 ± 0 0009pCi for $^{239\,240}$Pu

Using the guidelines set forth by Mike Peters, Terry McKibben and Bruce Honeyman, all originals are on file in Room 200H Ft Crockett Campus Texas A&M University We have enclosed copies of the following

1 Chain of Custody Forms
2 Calibration Data
3 Raw data tables
4 Radiation Safety license, permit and training
5 Sample procedure checklists

Best Available Copy

ADMIN RECORD

1/238

ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
CHAIN OF CUSTODY NUMBER: 98D000A#001

SAMPLERS (Signature) R.L. Singleton

REPORT IDENTIFICATION NUMBER (RIN) 98D5323

LABORATORY Colorado School of Mines

AGGREGATE AREA

RFETS CONTRACTOR. Commodore - ASI & Wright Water Eng, Inc.

No Analysis defined

Bottle Num.	User Samp. Num.	Date	Time	Location	Container	Matrix	Preservation	
10 bottles	98D00A-001	08-26-98	12:48	4th stream from WTF pipe	125 Liters	Water	None	X

CHAIN OF POSSESSION

Sign/Print Names

Relinquished By	Date/Time 8-26-98 1310	Received By	Date/Time 8-26-98 @ 1310
Relinquished By	Date/Time 8-26-98 1356	Received By Ken Roberts	Date/Time 8-26-98 @ 1400
Relinquished By	Date/Time	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time

REMARKS

Charge #

Project.

Shipping Requirements

Air Bill No.

Page of

3

ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
CHAIN OF CUSTODY NUMBER: 98D000A #002

SAMPLERS (Signature) [signature] 8/27/98

REPORT IDENTIFICATION NUMBER (RIN) 98D5323

LABORATORY Colorado School of Mines / Texas A&M

AGGREGATE AREA

RFETS CONTRACTOR. Commodore / ASL & Wright Water Engineers

Bottle Num.	User Samp. Num.	Date	Time	Location	Container	Matrix	Preservation
15 Bottles	98D000A-002	8-27-98	1030	GS03	209 Liters	Water	None

CHAIN OF POSSESSION — **Sign/Print Names**

Relinquished By	Date/Time	Received By	Date/Time
[signature] Greg Wetherbee	8/27/98 @ 1236	[signature] Kim Roberts	8/27/98 1236

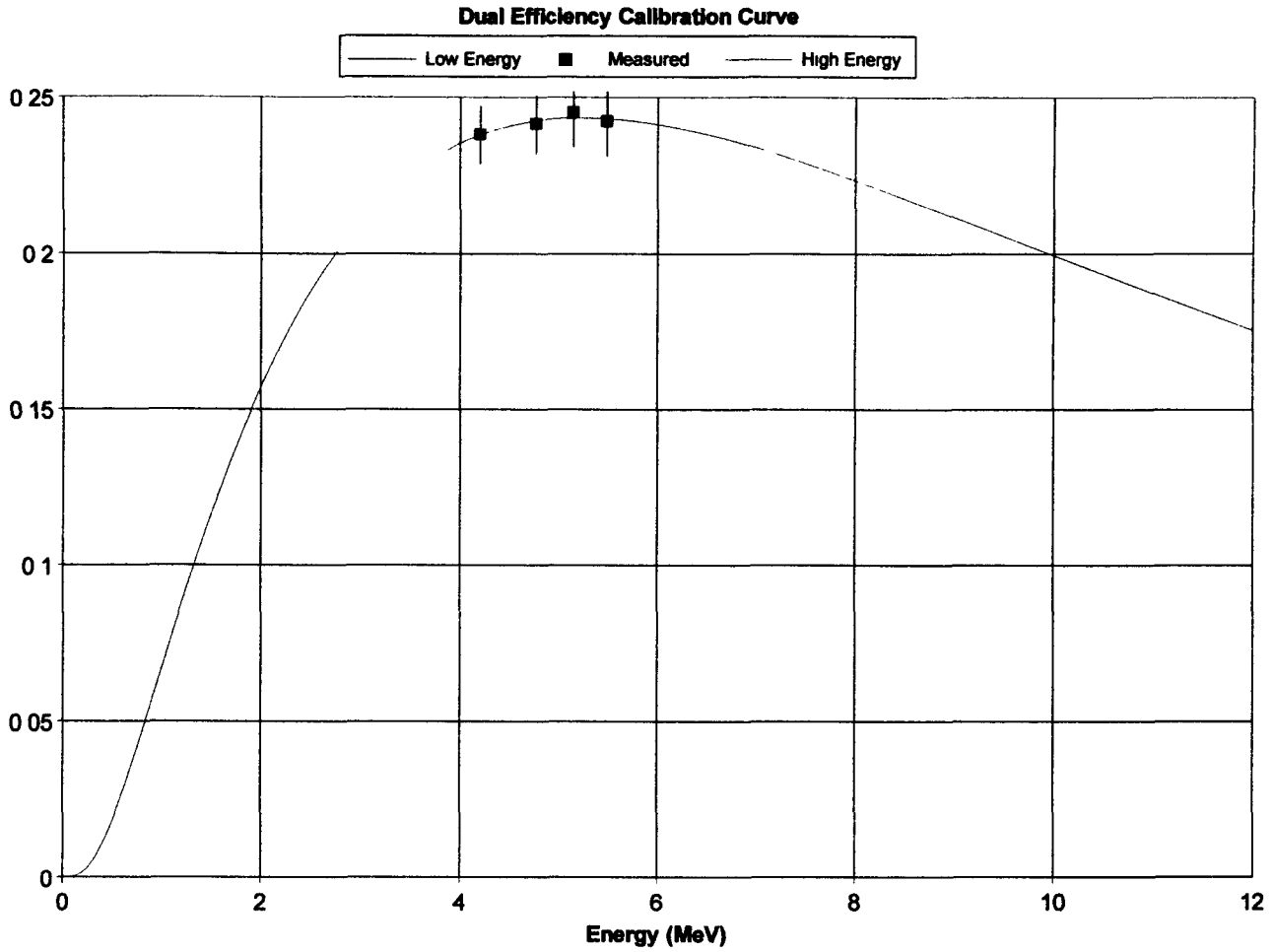
REMARKS

Charge #

Project

Shipping Requirements **Air Bill No** **Page of**

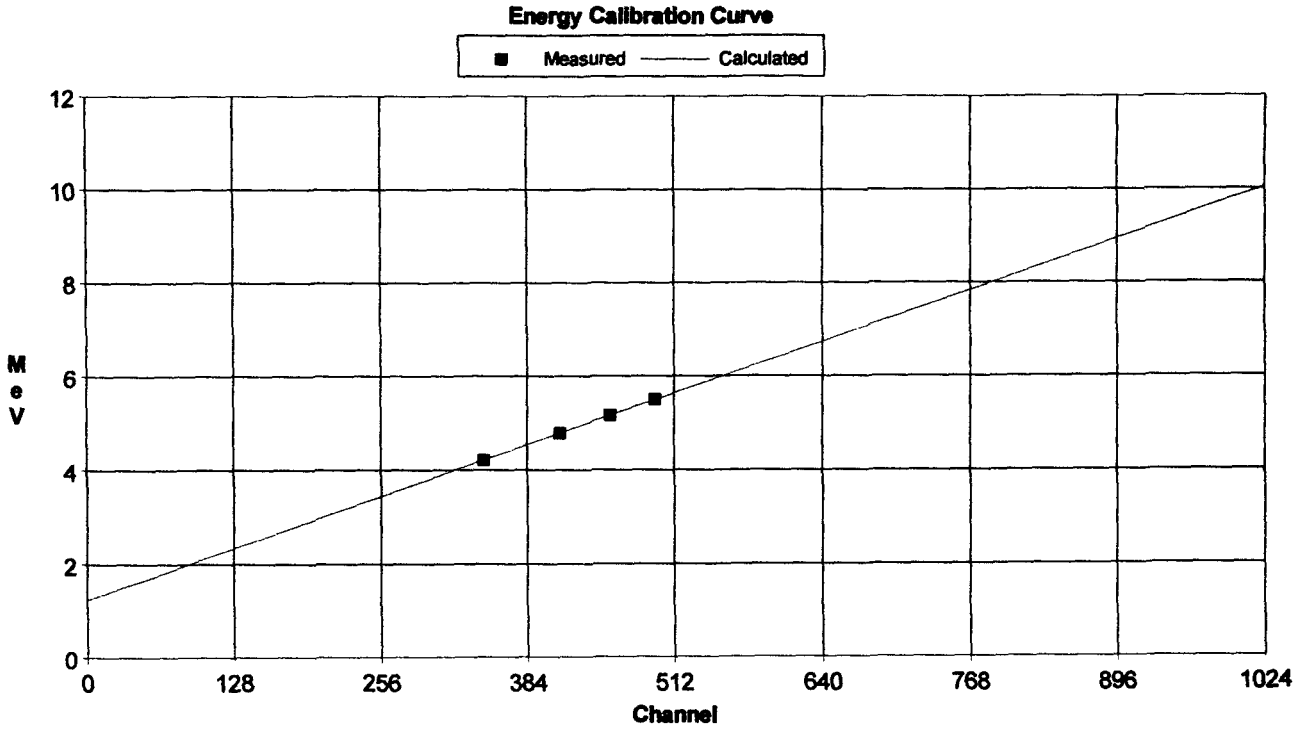
4



Datasource Q3-DET12
ln(Eff) = -3 635e+001 + 8 160e+000*ln(E) - 4 764e-001*ln(E)^2

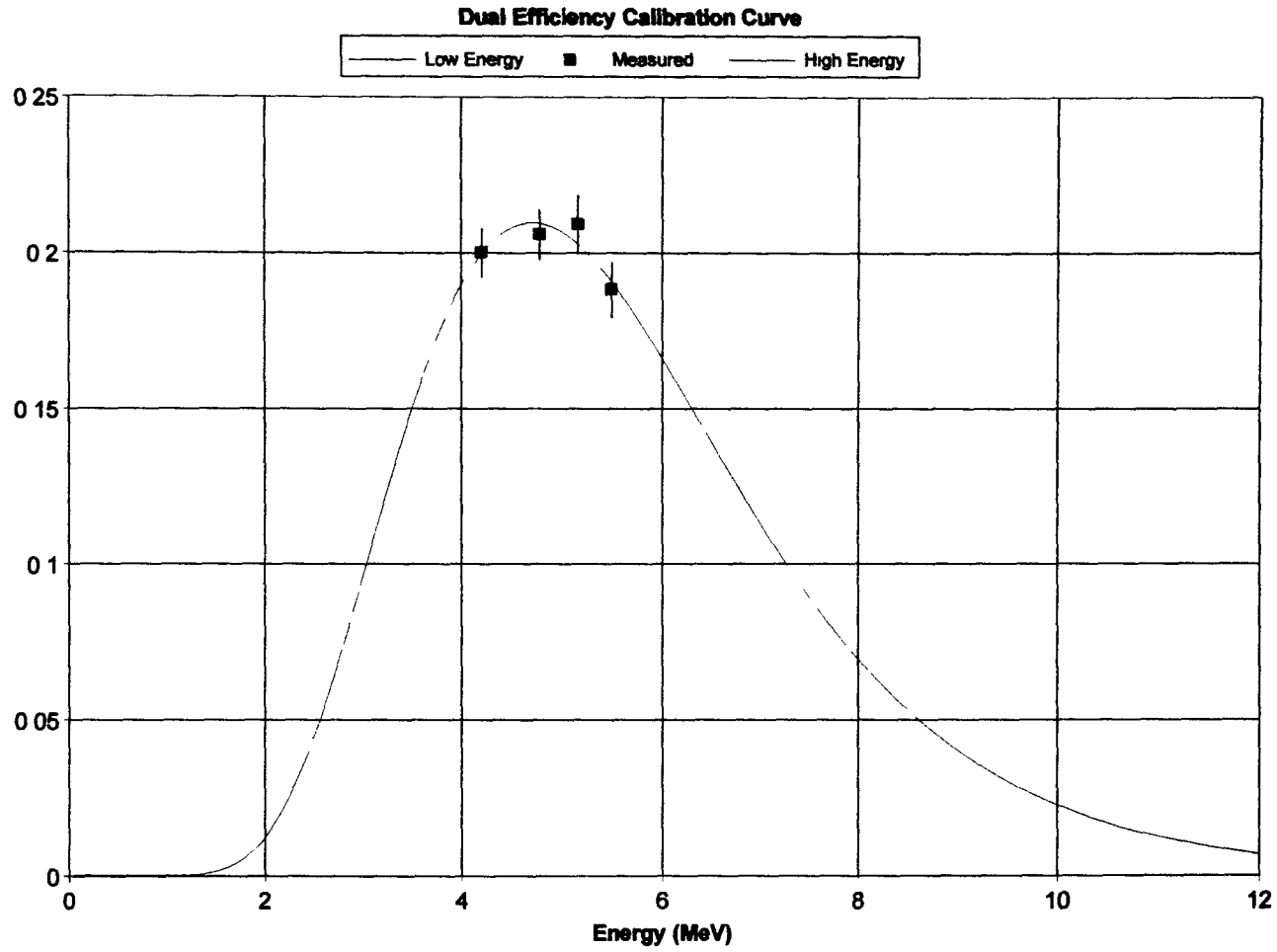
MeV	Meas Efficiency
4.20	0 23795
4.77	0 24138
5.15	0.24504
5 49	0.24233
	0.24168

8/4/98



Datasource Q1-DET01
Energy = 1 230e+000 MeV + 8 588e-003*Ch
FWHM = -3 430e-002 MeV + 3 204e-002*E^1/2
Lo Tail = -8 222e-003 MeV + 2 824e-003*E

8/14/98

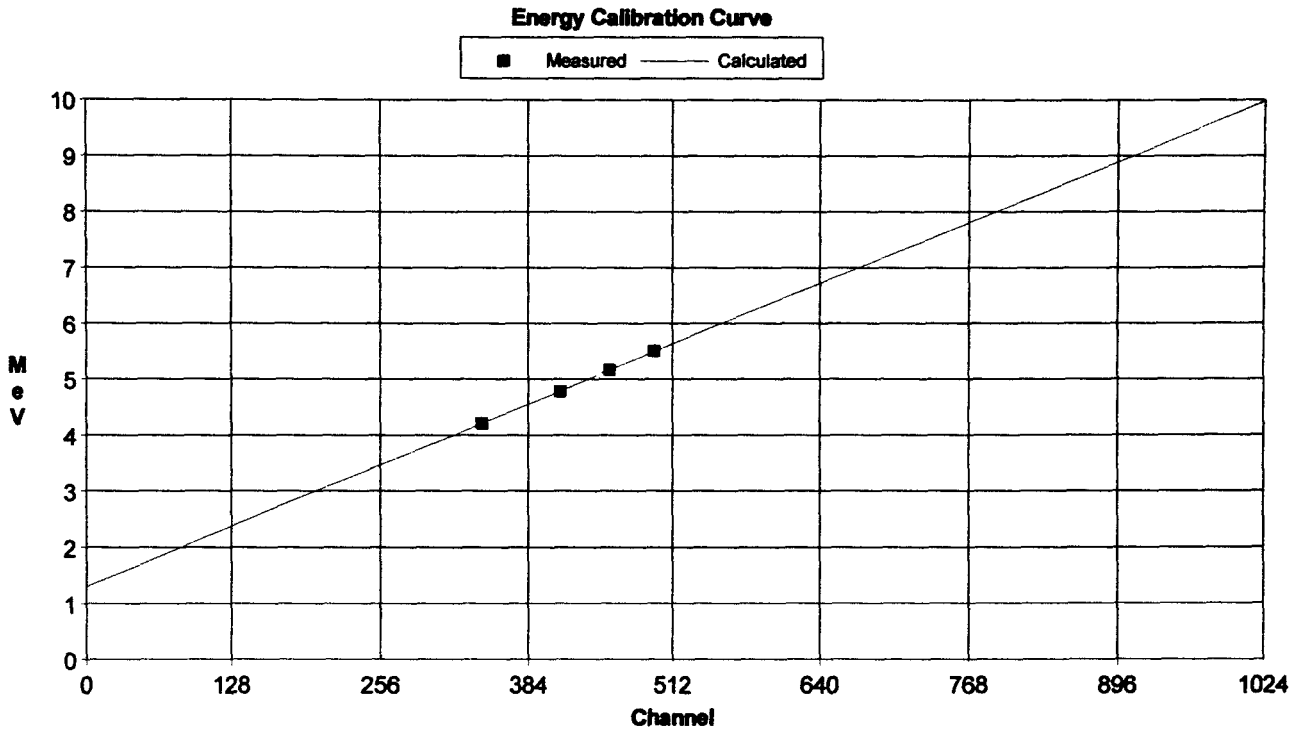


Datasource Q1-DET01
ln(Eff) = -2 810e+002 + 6 610e+001*ln(E) - 3 909e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0 20012
4 77	0 20590
5 15	0 20922
5 49	0.18813
	0.20084

8

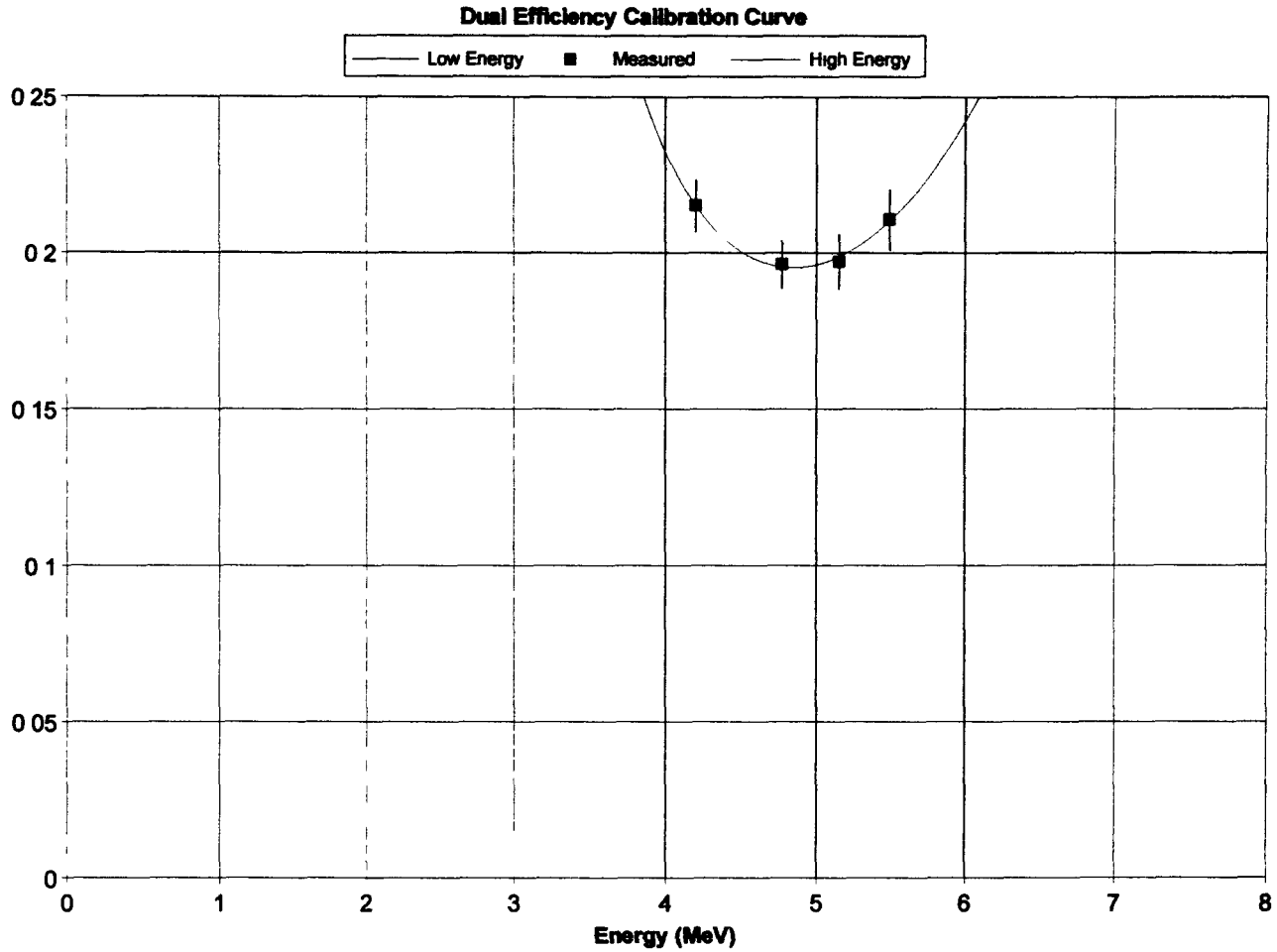
5/17/10



Datasource Q1-DET02
Energy = 1 281e+000 MeV + 8 480e-003*Ch
FWHM = 1 572e-002 MeV + 7 529e-003*E^1/2
Lo Tail = 7 672e-003 MeV - 9 405e-004*E

2

8/4/13

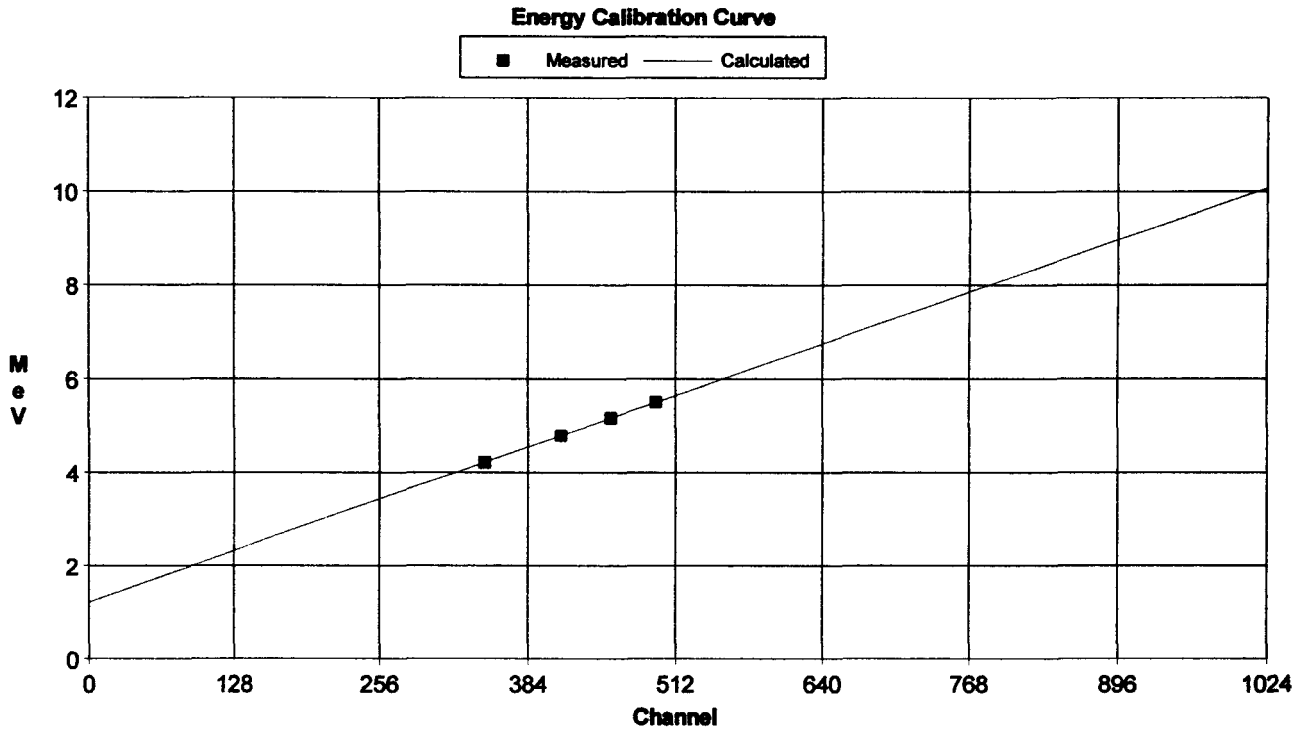


Datasource Q1-DET02
ln(Eff) = 3 391e+002 - 8 030e+001*ln(E) + 4 731e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0.21509
4.77	0 19622
5.15	0 19717
5 49	0.21059
	0.20477

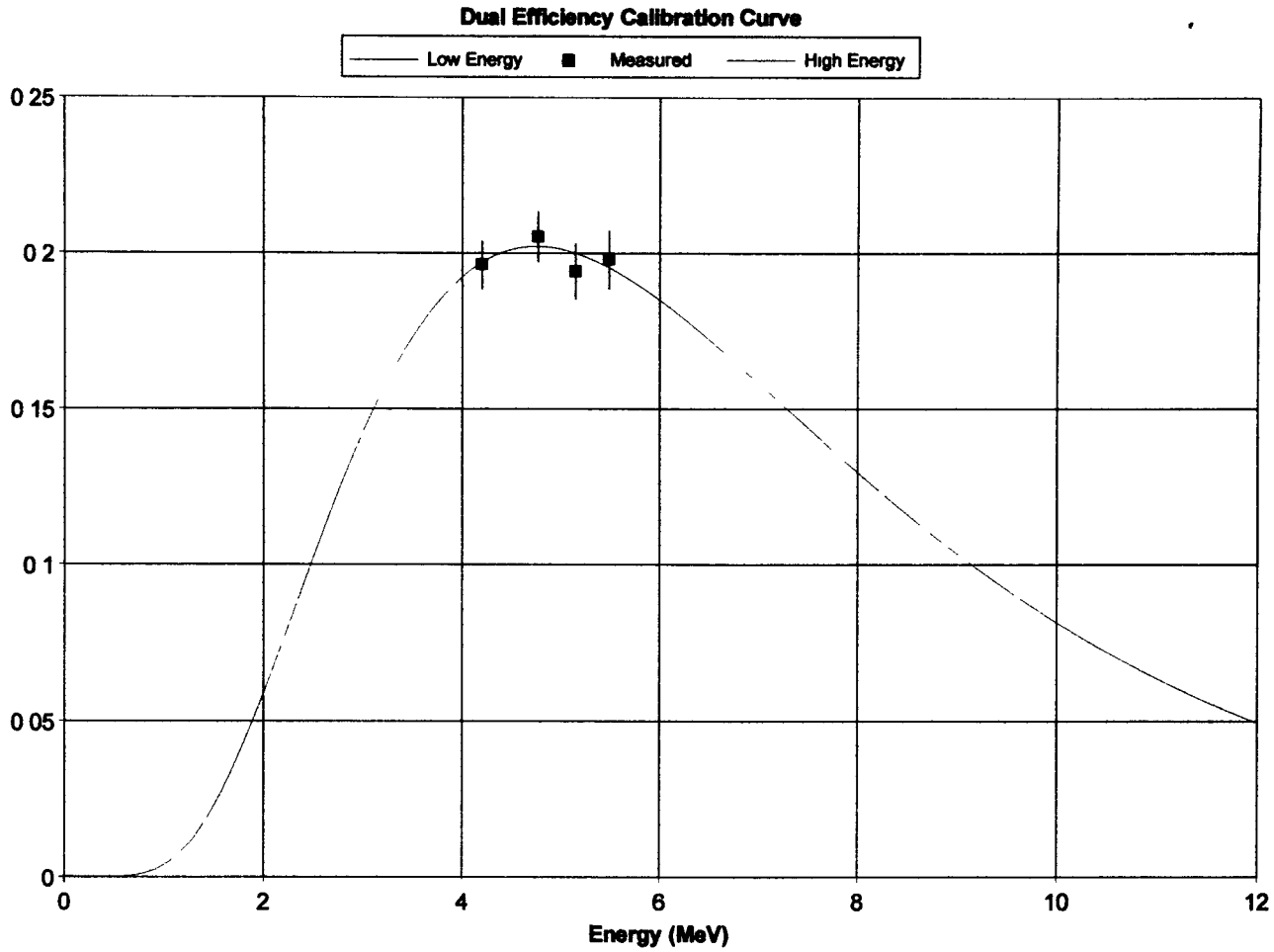
10

6/7/16



Datasource Q1-DET03
Energy = 1 200e+000 MeV + 8 654e-003*Ch
FWHM = -6 374e-002 MeV + 4 536e-002*E^1/2
Lo Tail = -1 160e-002 MeV + 3 545e-003*E

6/4/10

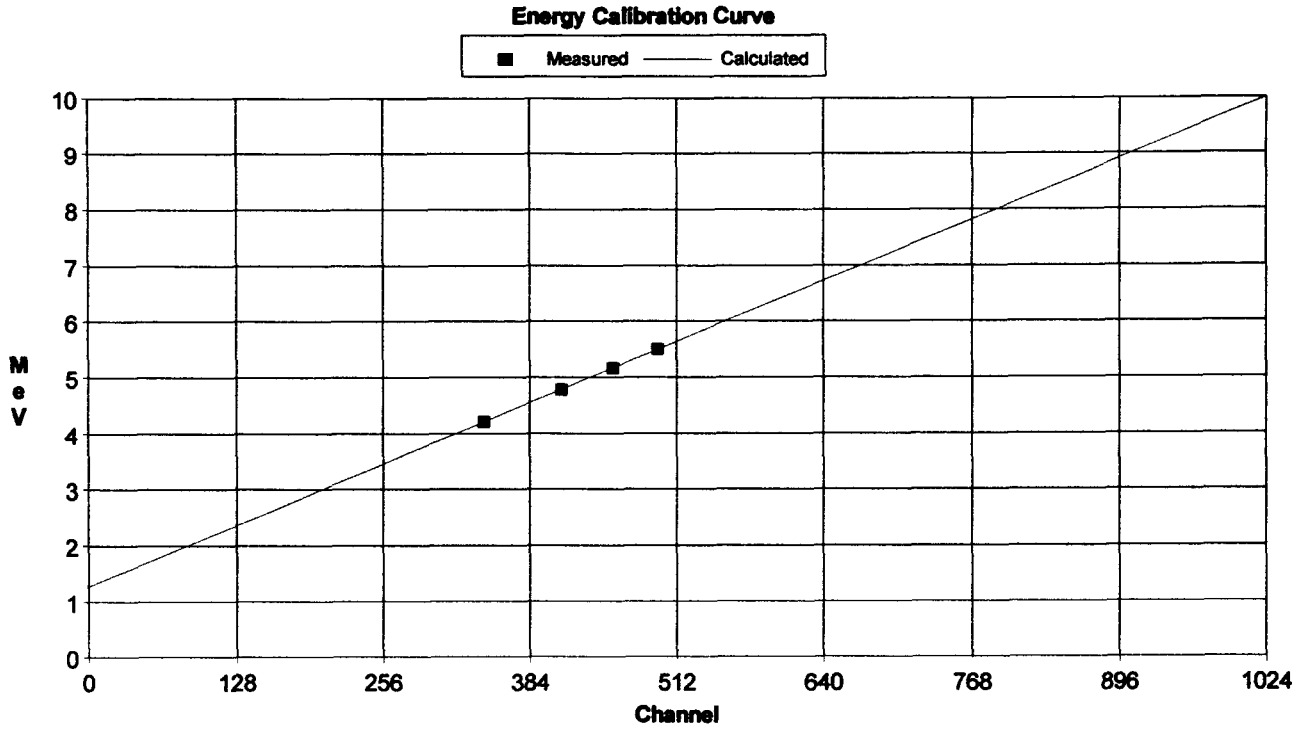


Datasource Q1-DET03
ln(Eff) = -1 197e+002 + 2 789e+001*ln(E) - 1 647e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0.19618
4.77	0.20524
5.15	0.19410
5.49	0.19789
	0.19835

12

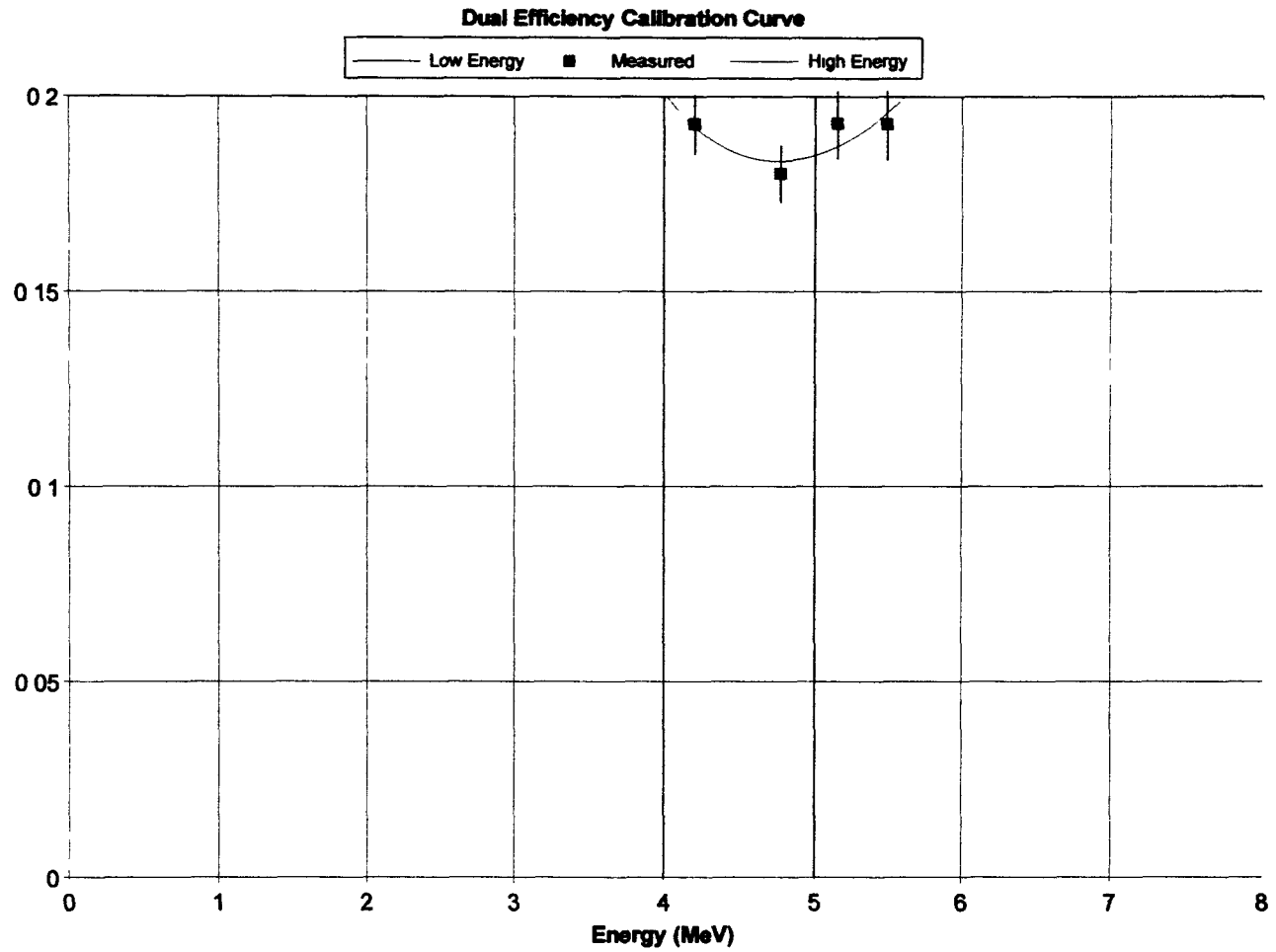
8/4/98



Datasource Q1-DET04
Energy = 1 264e+000 MeV + 8 522e-003*Ch
FWHM = -3 939e-002 MeV + 3 314e-002*E^1/2
Lo Tail = -1 050e-002 MeV + 3 323e-003*E

13

8/4/98

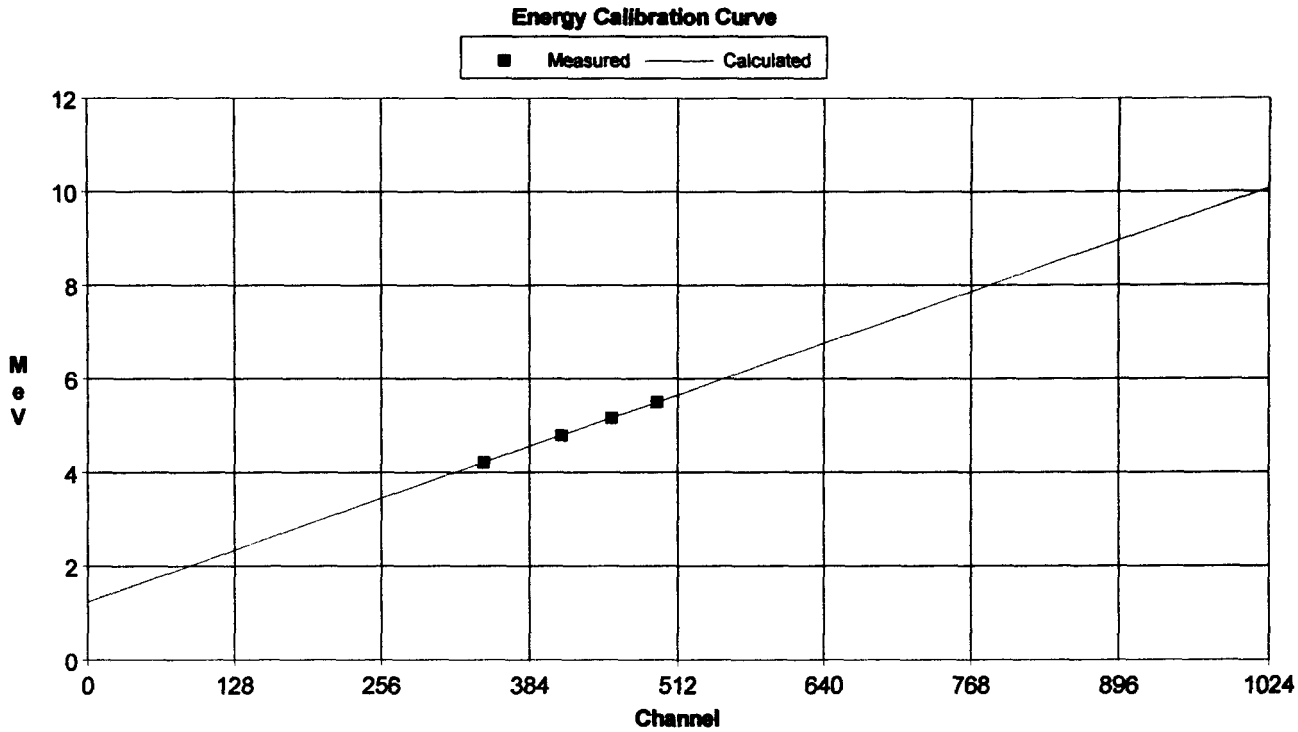


Datasource Q1-DET04
ln(Eff) = 2 202e+002 - 5 243e+001*ln(E) + 3 096e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0 19290
4.77	0.18020
5.15	0.19293
5 49	0 19290
	0.18973

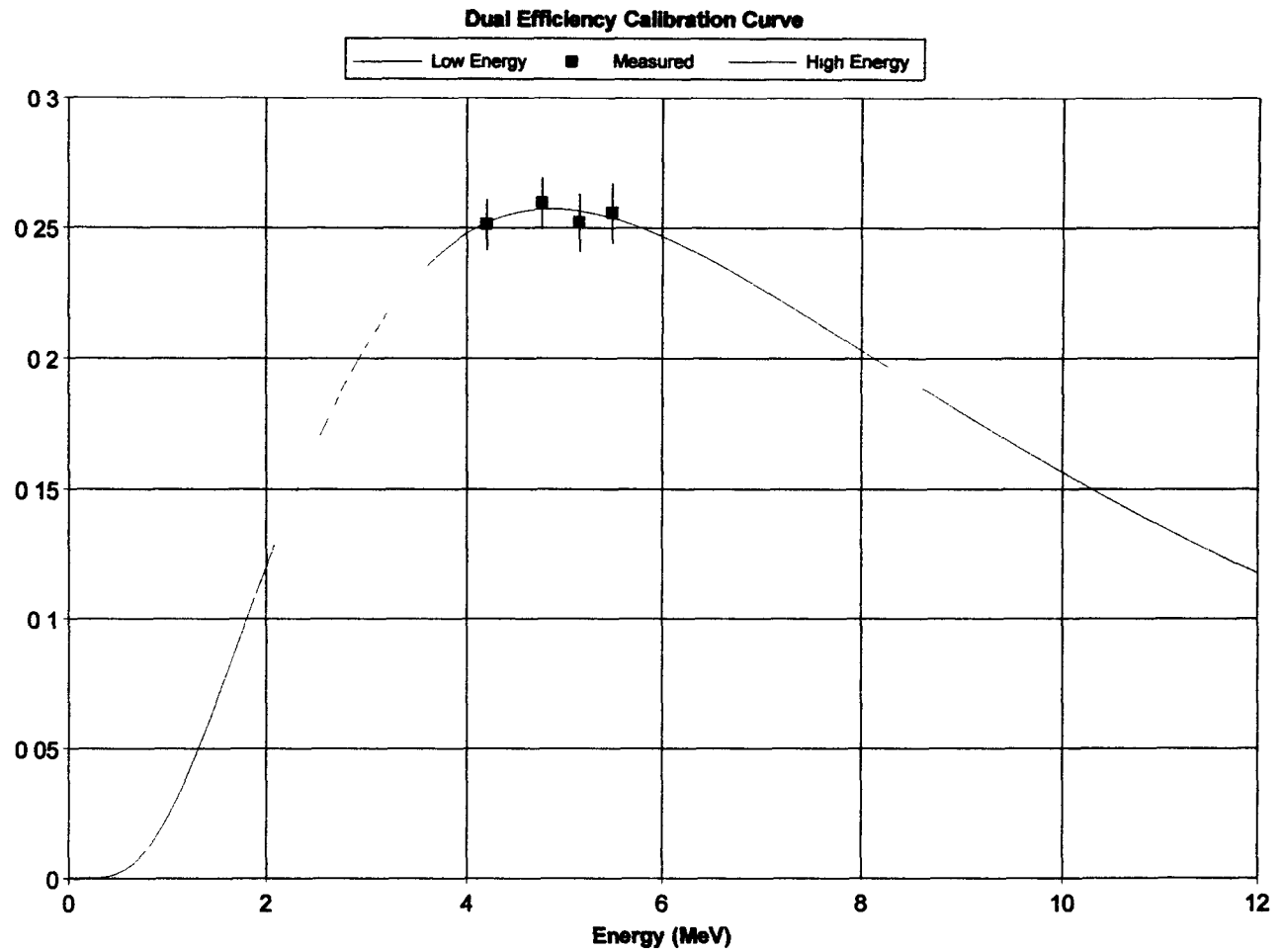
14

8/4/10



Datasource Q2-DET05
Energy = 1 224e+000 MeV + 8 628e-003*Ch
FWHM = -1 607e-002 MeV + 2 254e-002*E^1/2
Lo Tail = -1 493e-004 MeV + 1 003e-003*E

8/7/98

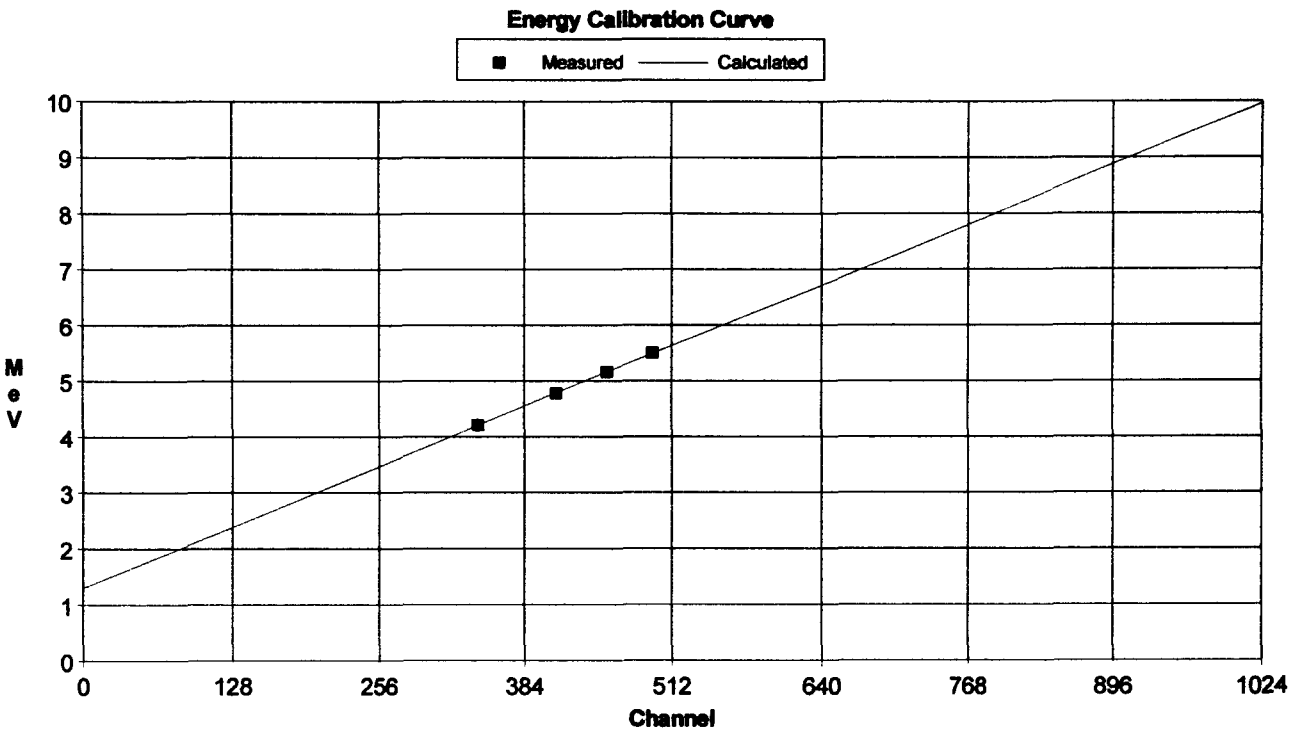


Datasource Q2-DET05
ln(Eff) = -7 098e+001 + 1 640e+001*ln(E) - 9 654e-001*ln(E)^2

MeV	Meas Efficiency
4.20	0.25122
4 77	0 25946
5.15	0 25213
5.49	0.25560
	0.25460

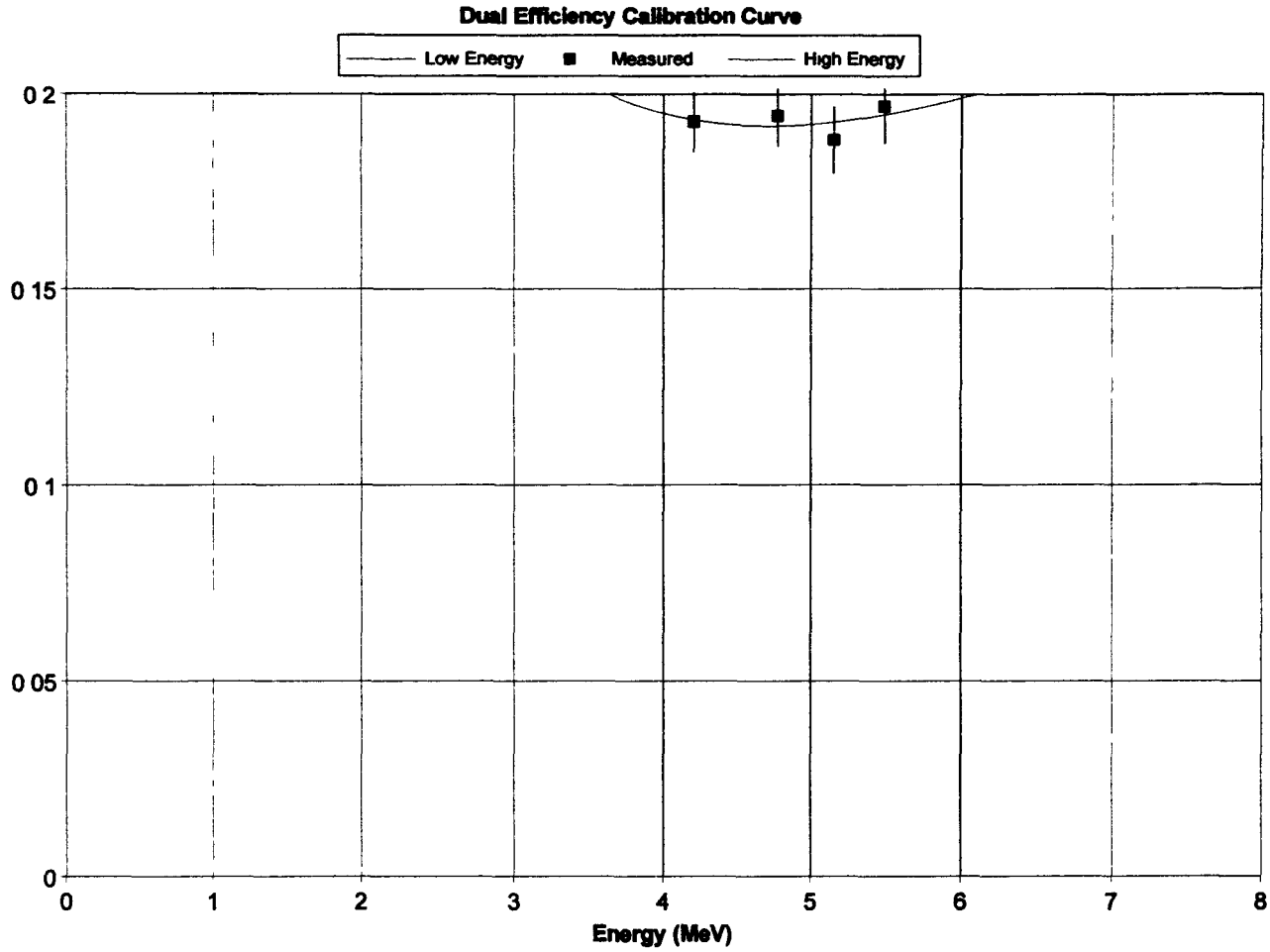
16

8/14/98



Datasource Q2-DET06
Energy = 1 290e+000 MeV + 8 459e-003*Ch
FWHM = -9 672e-003 MeV + 1 822e-002*E^1/2
Lo Tail = 3 938e-003 MeV - 2 011e-004*E

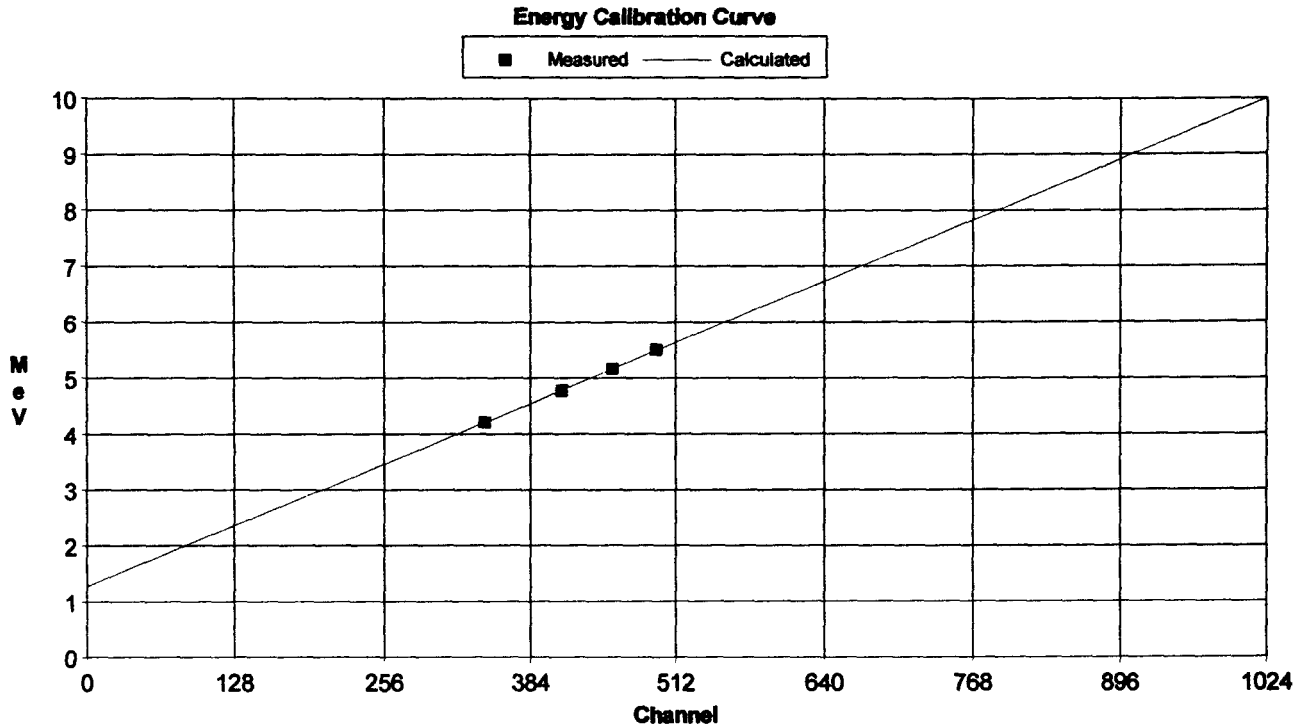
17



Datasource Q2-DET06
ln(Eff) = 4 265e+001 - 1 048e+001*ln(E) + 6 193e-001*ln(E)^2

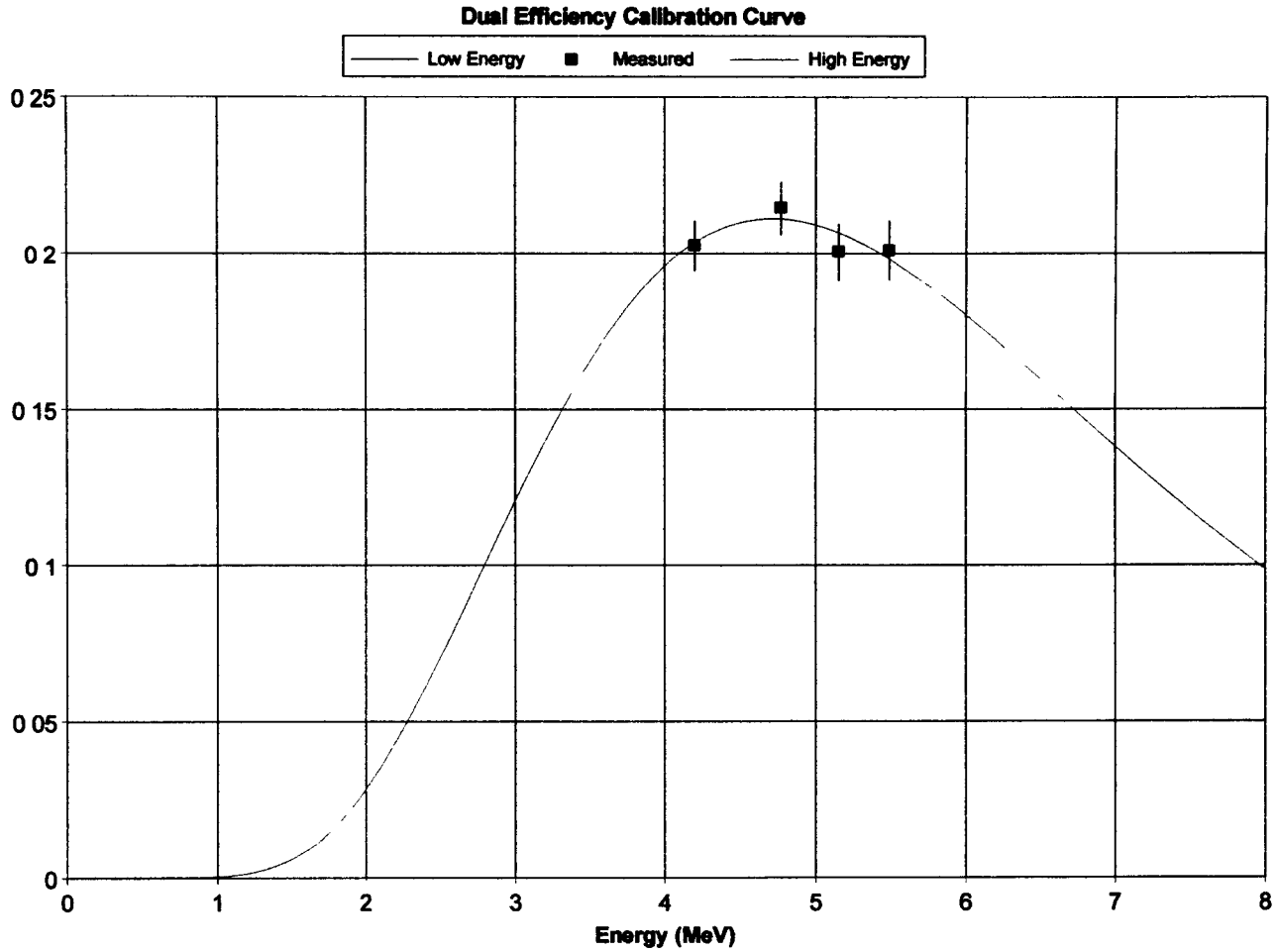
MeV	Meas Efficiency
4.20	0.19285
4.77	0.19434
5.15	0.18816
5.49	0.19666

5/5/95



Datasource Q2-DET07
Energy = 1 260e+000 MeV + 8 529e-003*Ch
FWHM = 3 075e-002 MeV - 1 343e-003*E^1/2
Lo Tail = 9 854e-003 MeV - 1 439e-003*E

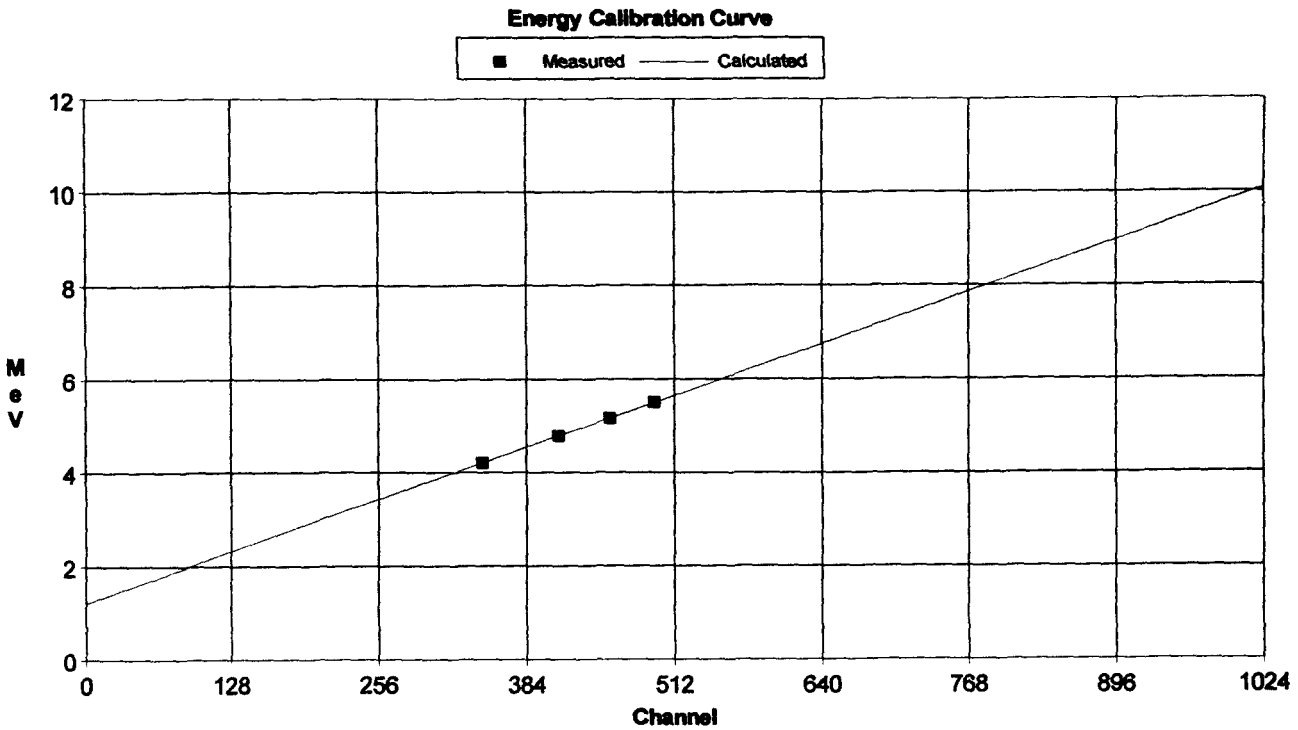
8/5/98



Datasource Q2-DET07
ln(Eff) = -1 974e+002 + 4 631e+001*ln(E) - 2 737e+000*ln(E)^2

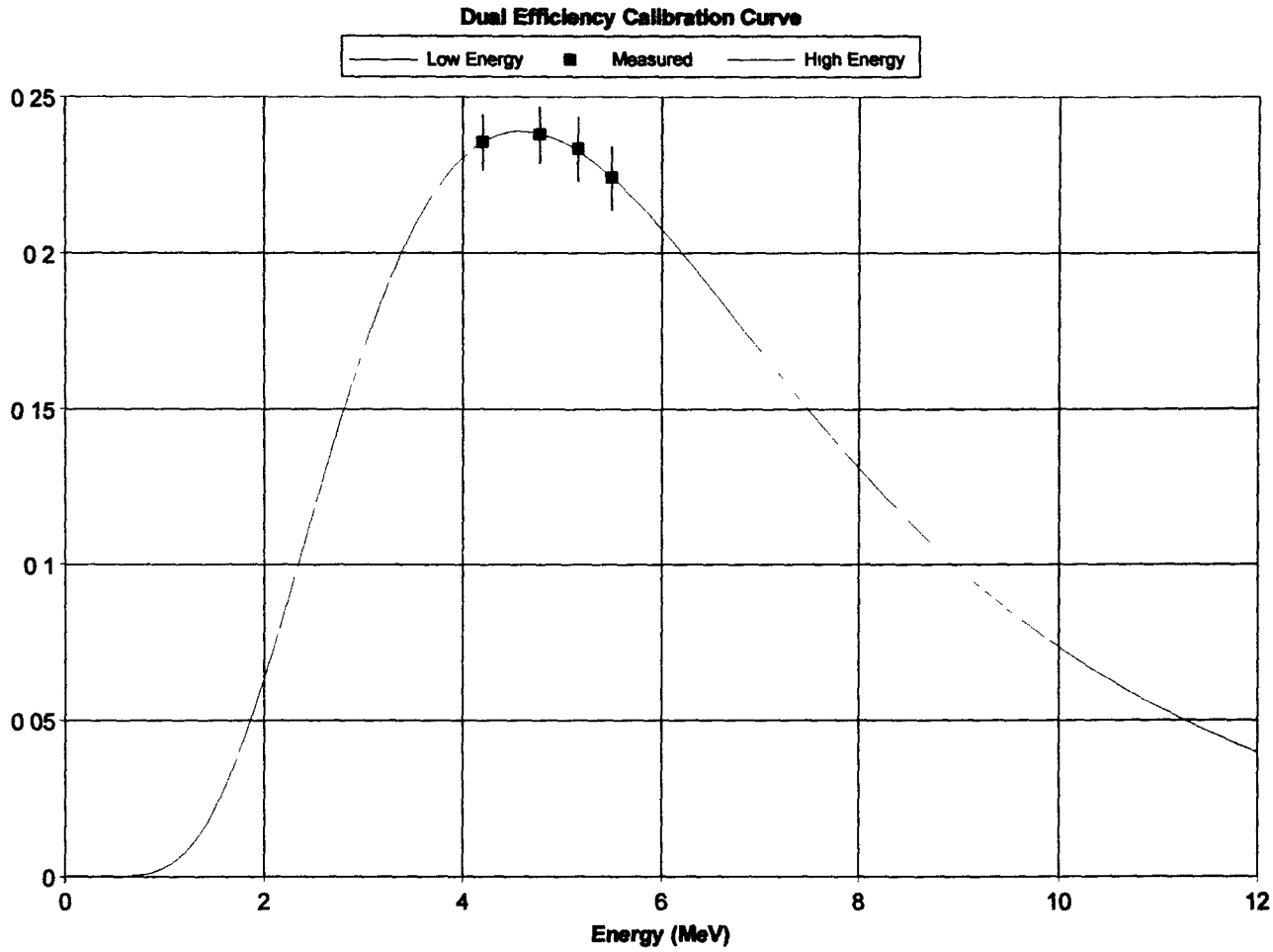
MeV	Measured Efficiency
4.20	0.20261
4 77	0 21452
515	0 20044
5.49	0 20100
	0.20464

8/5/12



Datasource Q2-DET08
Energy = 1 207e+000 MeV + 8 646e-003*Ch
FWHM = -3 479e-002 MeV + 3 134e-002*E^1/2
Lo Tail = -4 653e-004 MeV + 1 045e-003*E

8/2/10

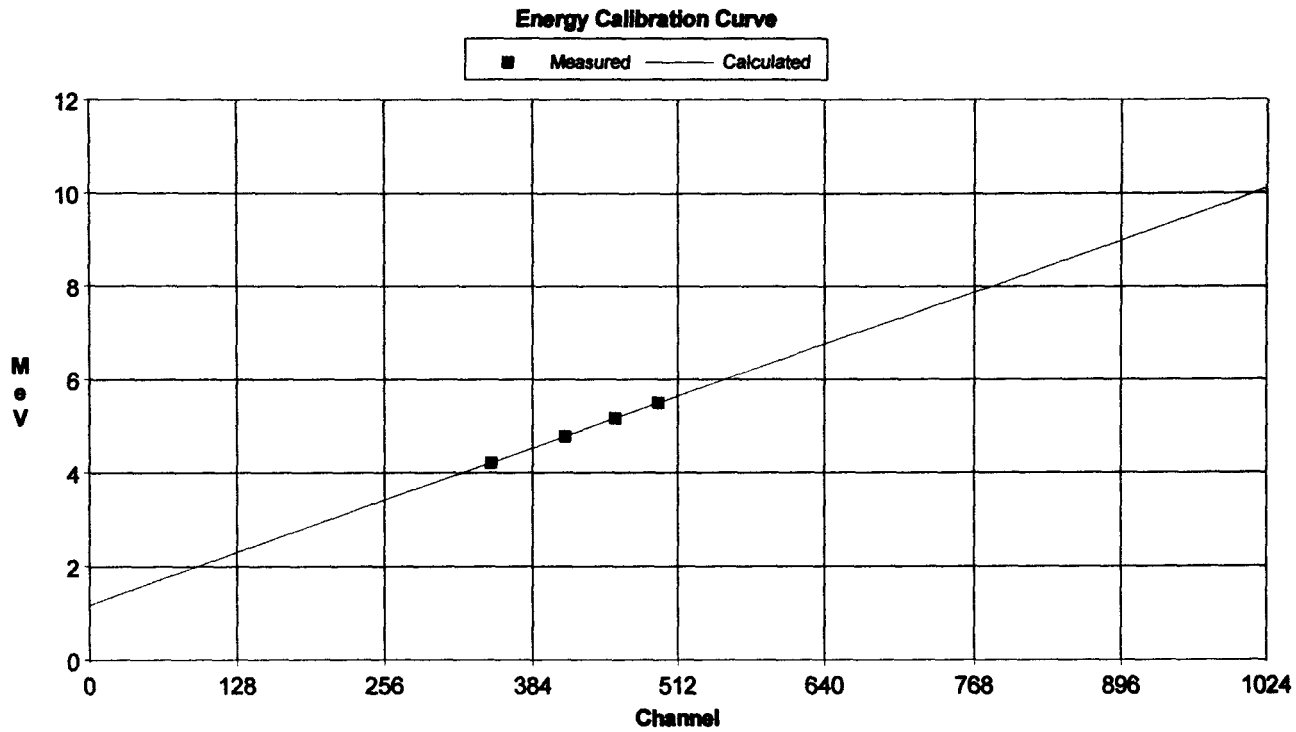


Datasource Q2-DET08
ln(Eff) = -1 392e+002 + 3 269e+001*ln(E) - 1 939e+000*ln(E)^2

MeV	Meas Efficiency
4 20	0.23534
4.77	0.23773
5.15	0.23334
5.49	0.22399
	0 232605

22

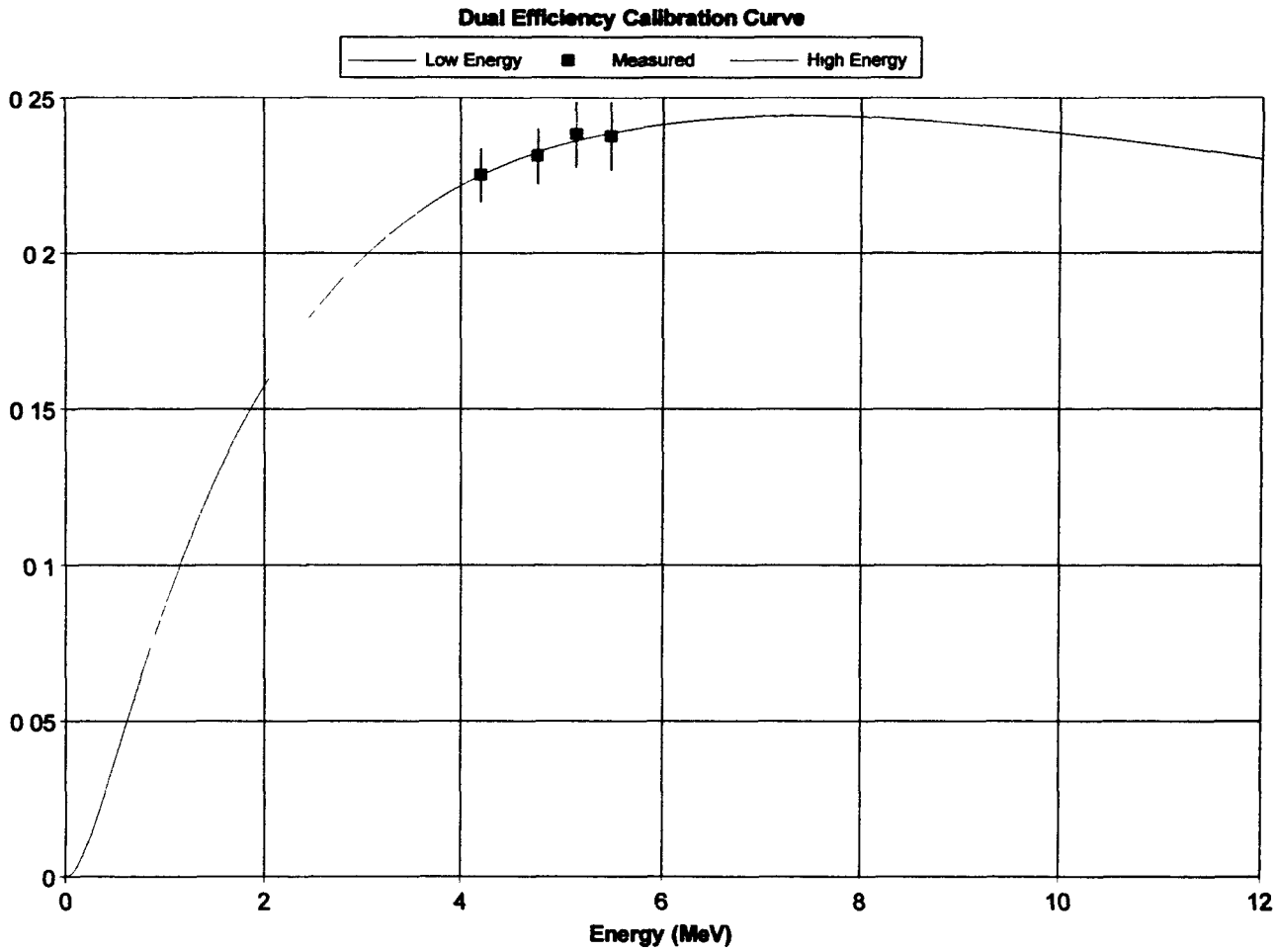
8/5/98



Datasource Q3-DET09
Energy = 1 176e+000 MeV + 8 705e-003*Ch
FWHM = -1 201e-001 MeV + 6 897e-002*E^1/2
Lo Tail = -1 701e-002 MeV + 4 462e-003*E

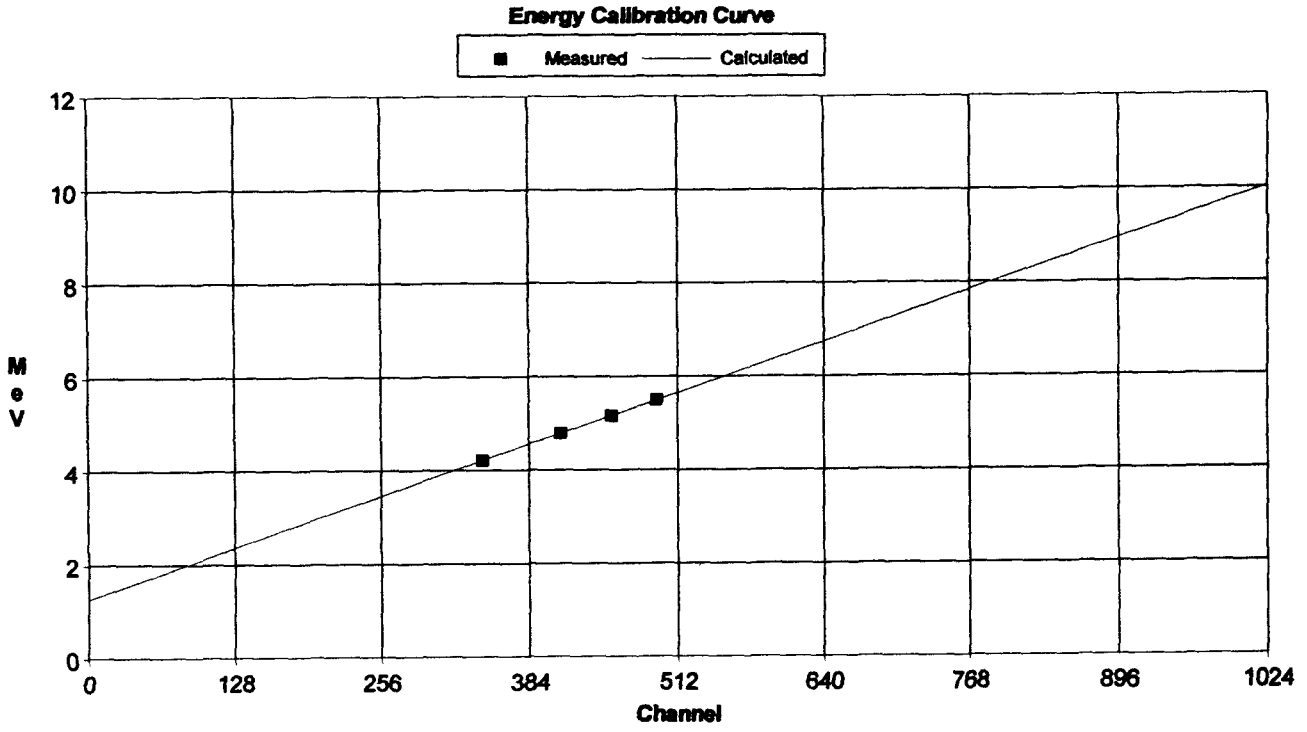
23

8/5/98

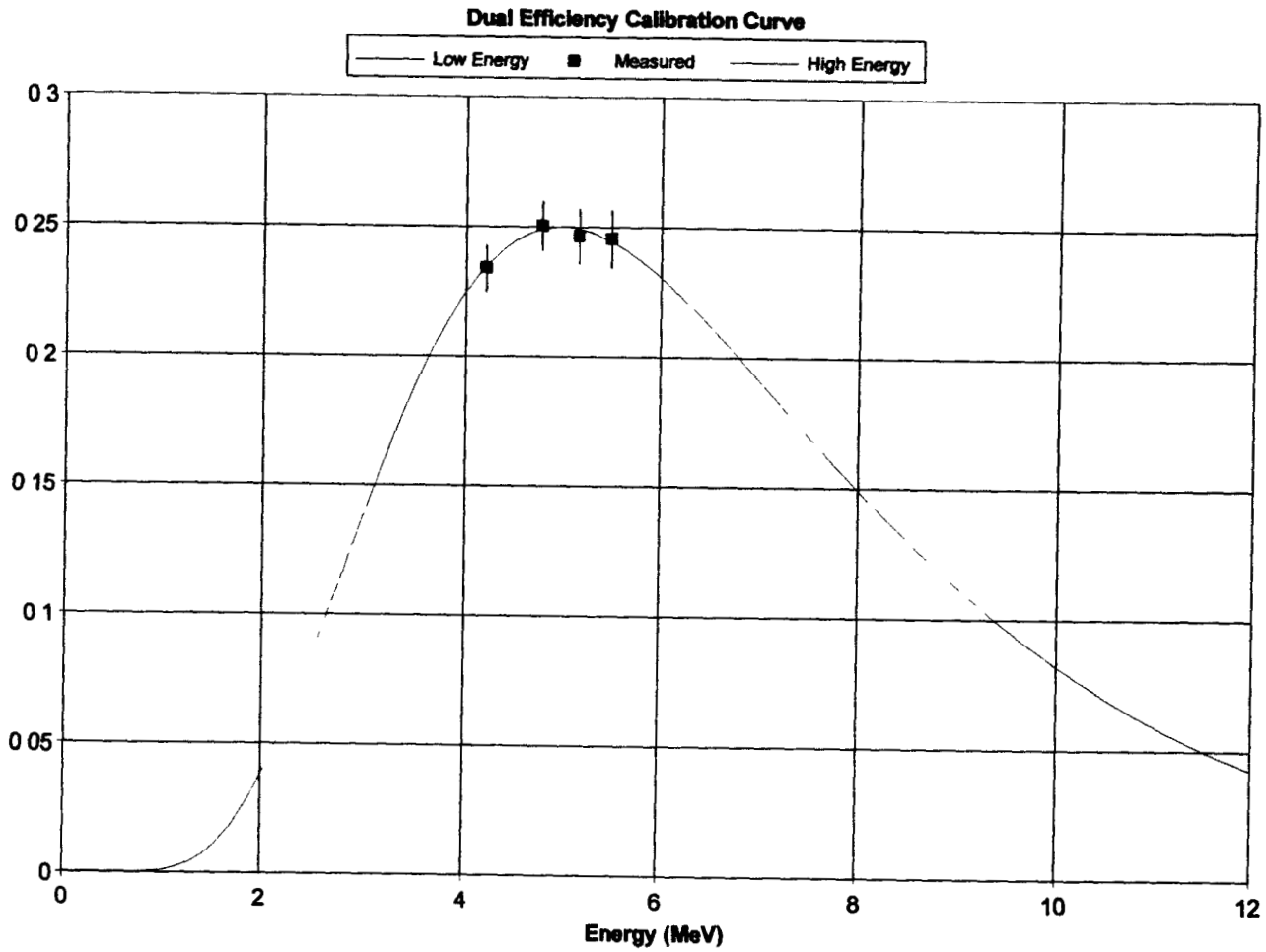


Datasource Q3-DET09
ln(Eff) = -2 179e+001 + 4 573e+000*ln(E) - 2 566e-001*ln(E)^2

MeV	Meas Efficiency
4 20	0.22501
4 77	0.23114
5.15	0.23816
5.49	0 23766
	0 23299



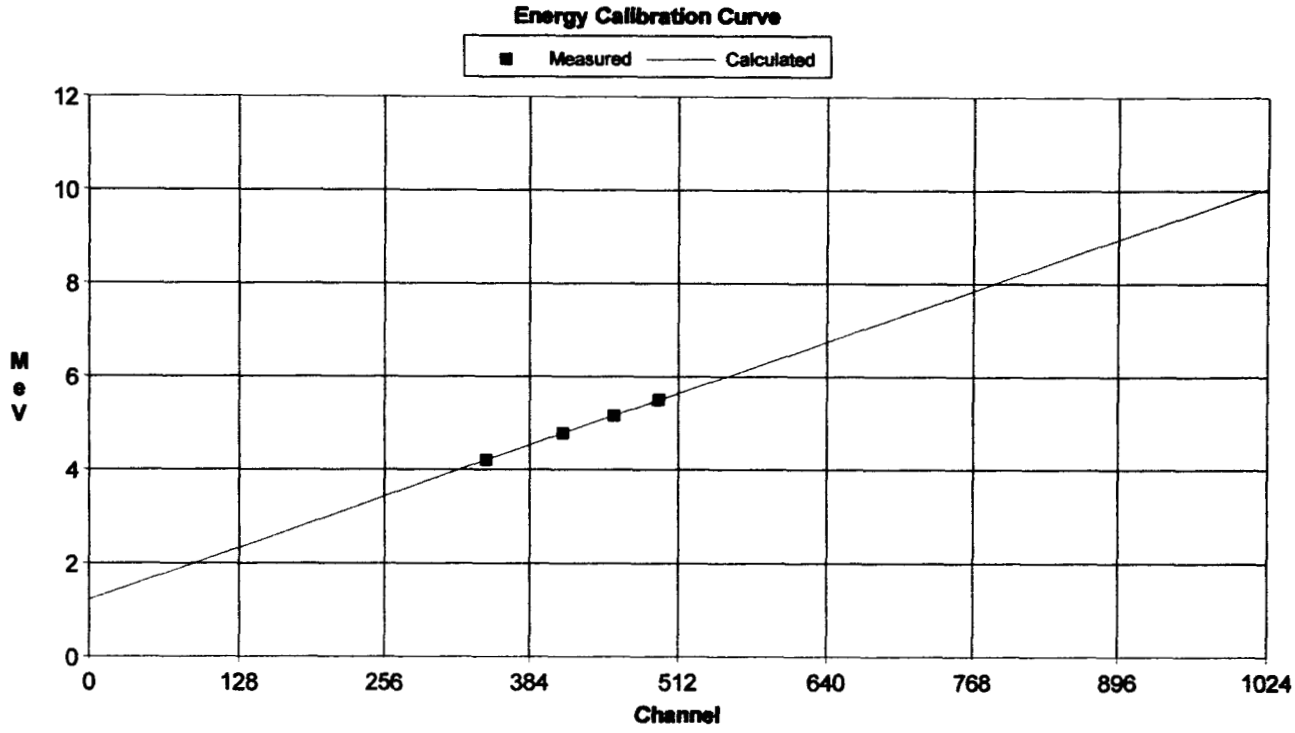
Datasource: Q3-DET10
Energy = 1 250e+000 MeV + 8 569e-003*Ch
FWHM = -5 791e-002 MeV + 4 073e-002*E^1/2
Lo Tail = -3 471e-003 MeV + 1 535e-003*E



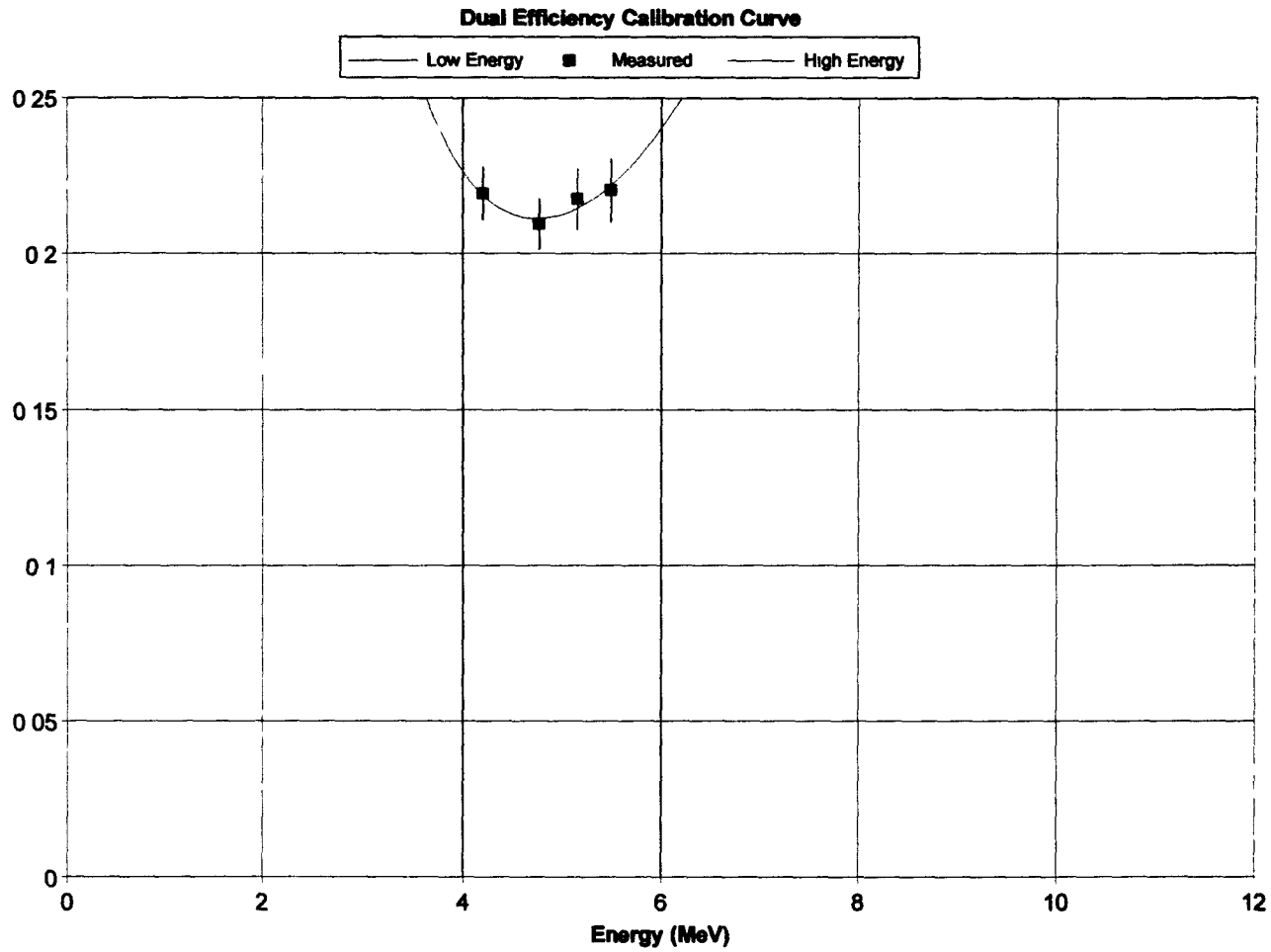
Datasource Q3-DET10
ln(Eff) = -1 667e+002 + 3 884e+001*ln(E) - 2.281e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0 23387
4.77	0 25041
5.15	0 24650
5.49	0 24554
	0.24408

5/5/98

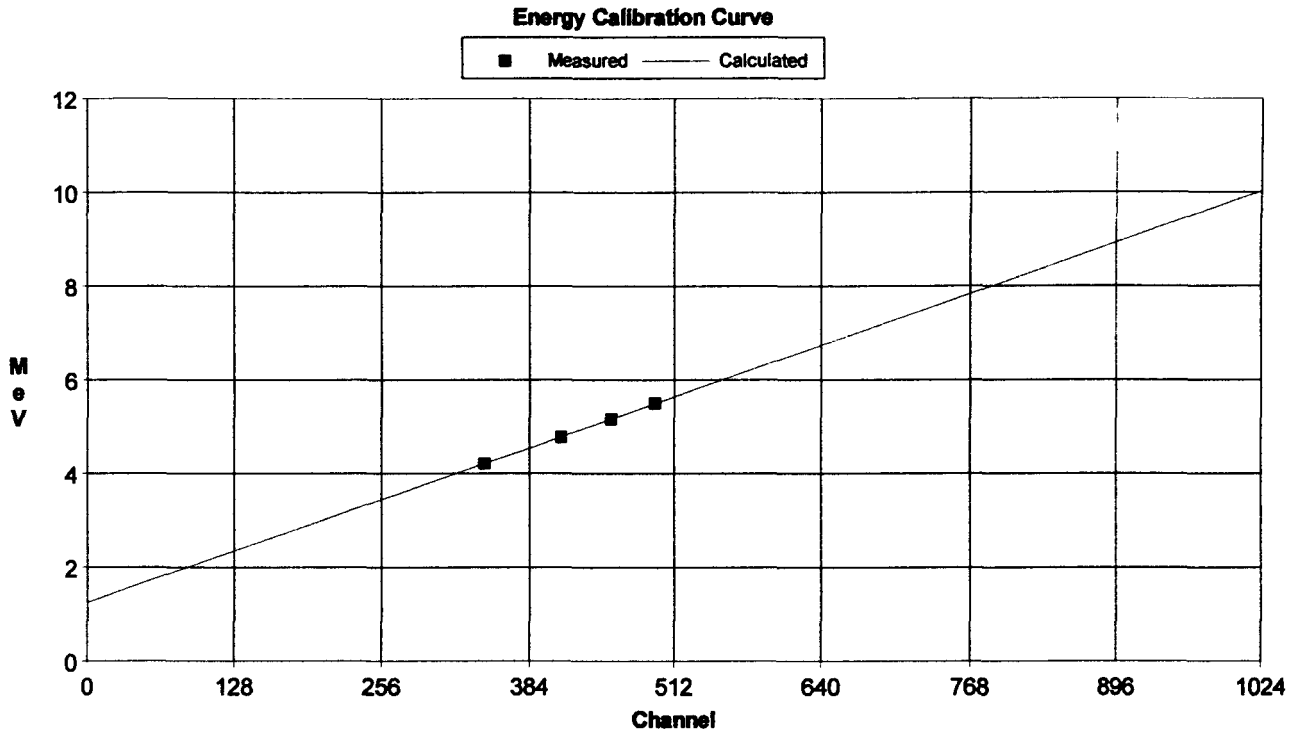


Datasource Q3-DET11
Energy = 1 214e+000 MeV + 8 622e-003*Ch
FWHM = -6 773e-002 MeV + 4 565e-002*E^1/2
Lo Tail = -6 904e-003 MeV + 2 379e-003*E



Datasource Q3-DET11
ln(Eff) = 1 680e+002 - 4 005e+001*ln(E) + 2 365e+000*ln(E)^2

MeV	Meas Efficiency
4.20	0.21914
4.77	0 20935
5.15	0.21740
5 49	0 22030
	0.21655



Datasource Q3-DET12
Energy = 1 242e+000 MeV + 8 569e-003*Ch
FWHM = -2 132e-002 MeV + 2 539e-002*E^1/2
Lo Tail = -2 683e-003 MeV + 1 645e-003*E

29

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

ɔort Generated On                : 11/06/98 11:25:24 AM

mple Title                       : CALIBRATION CHECK
ectrum Description               :
mple Identification              : D1110698
mple Type                        :
mple Geometry                    :

ak Locate Threshold              :  2.00
ak Locate Range (in channels)    :     1 - 65535
 k Area Range (in channels)      :     1 - 65535
 ntification Energy Tolerance    :    0.020 MeV

 ple Size                        :  1.000E+000 Unit

 ɔle Taken On                    :
 ıisition Started                : 11/06/98 10:54:26 AM

 › Time                          :      601.0 seconds
   Time                          :      601.0 seconds


        Energy Calibration Used Done On       :  8/04/98
        Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET01
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 11:25:25 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	321-	343	336.04	4115.52	3.76E+002	20.65	1.24E+001
2	385-	408	402.11	4682.97	3.65E+002	20.41	1.10E+001
3	431-	453	446.49	5064.03	2.32E+002	15.23	0.00E+000
4	470-	496	484.79	5392.97	2.06E+002	15.88	1.04E+001

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

Errors quoted at 1.000 sigma

31

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


  port Generated On              : 10/28/98  2:29:38 PM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : D1102898
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              : 10/28/98 11:42:37 AM

Live Time                        :      600.0 seconds
Real Time                        :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

32

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

Detector Name: Q1-DET01
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:29:39 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	328-	349	343.22	4177.16	3.58E+002	20.26	1.25E+001	20
2	396-	415	408.45	4737.41	3.15E+002	19.95	2.19E+001	33
3	437-	460	454.13	5129.68	2.37E+002	15.39	0.00E+000	22
4	482-	503	493.01	5463.53	1.90E+002	15.25	1.21E+001	30

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

Errors quoted at 1.000 sigma

33

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

Report Generated On                : 10/16/98 12:45:19 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D1101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98 12:34:46 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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


 port Generated On                : 10/07/98 10:06:36 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D1100798
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  5.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.030 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               : 10/07/98  9:16:18 AM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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


ı  ort Generated On                : 10/07/98 10:05:15 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D1092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  5.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.030 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98  9:10:15 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

36

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

Detector Name: Q1-DET01
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:05:16 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	402-	417	411.29	4761.80	3.14E+002	18.94	1.52E+001
2	445-	461	456.12	5146.73	2.00E+002	15.56	1.22E+001
3	483-	505	494.61	5477.26	1.96E+002	15.08	8.29E+000

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

Errors quoted at 1.000 sigma

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


  port Generated On              : 10/19/98  3:37:44 PM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : D1092898
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              :  9/28/98  9:10:15 AM

Live Time                        :      600.0 seconds
Real Time                        :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

8

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

Detector Name: Q1-DET01
Sample Title: Calibration check
Peak Analysis Performed on: 10/19/98 3:37:45 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	
1	329-	350	344.35	4186.87	3.31E+002	20.04	1.65E+001	10
2	365-	373	~~369.00~~	~~4398.59~~	~~2.75E+000~~	~~2.75~~	~~2.25E+000~~	
3	402-	417	411.29	4761.80	3.14E+002	18.94	1.52E+001	9
4	445-	461	456.12	5146.73	2.00E+002	15.56	1.22E+001	5
5	483-	505	494.61	5477.26	1.96E+002	15.08	8.29E+000	17

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

Errors quoted at 1.000 sigma

39

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


  ›ort Generated On                : 10/07/98 10:04:47 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D1091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  5.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.030 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98  9:50:36 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

40

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

Detector Name: Q1-DET01
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:04:48 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	330-	351	345.58	4197.48	3.73E+002	20.37	9.77E+000	0
2	395-	418	412.36	4770.96	3.73E+002	21.88	2.24E+001	+3
3	442-	463	456.99	5154.27	2.54E+002	17.22	9.84E+000	+2
4	478-	506	496.04	5489.59	2.27E+002	15.07	0.00E+000	-4

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

Errors quoted at 1.000 sigma

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


  port Generated On              : 10/19/98  3:36:49 PM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : d1091098
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              :  9/10/98 12:46:47 PM

Live Time                        :      360.0 seconds
Real Time                        :      360.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET01
Sample Title: Calibration check
Peak Analysis Performed on: 10/19/98 3:36:49 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	330-	350	345.34	4195.37	2.09E+002	15.34	6.35E+000	2
2	395-	417	412.32	4770.58	1.97E+002	14.56	3.45E+000	1
3	445-	462	456.00	5145.75	1.45E+002	12.71	4.78E+000	4
4	482-	505	495.93	5488.63	1.27E+002	11.27	0.00E+000	5

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

Errors quoted at 1.000 sigma

43

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


Report Generated On                  : 11/06/98 11:46:30 AM

Sample Title                         : CALIBRATION CHECK
Spectrum Description                 :
Sample Identification                : D2110698
Sample Type                          :
Sample Geometry                      :

Peak Locate Threshold                :  2.00
Peak Locate Range (in channels)      :     1 - 65535
Peak Area Range (in channels)        :     1 - 65535
Identification Energy Tolerance      :    0.020 MeV

Sample Size                          :  1.000E+000 Unit

Sample Taken On                      :
Acquisition Started                  : 11/06/98 11:26:00 AM

Live Time                            :      600.0 seconds
Real Time                            :      600.0 seconds


              Energy Calibration Used Done On       :  8/04/98
              Efficiency Calibration Used Done On   :  8/04/98
```

4

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

Detector Name: Q1-DET02
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 11:46:31 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	328-	349	342.82	4188.69	2.96E+002	17.92	6.19E+000
2	395-	416	411.08	4767.50	3.16E+002	19.32	1.33E+001
3	441-	461	456.49	5152.60	2.11E+002	14.53	0.00E+000
4	484-	504	493.93	5470.07	1.66E+002	14.15	9.70E+000

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

Errors quoted at 1.000 sigma

45

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


  port Generated On              : 10/28/98  2:30:27 PM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : D2102898
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              : 10/28/98 12:33:56 PM

Live Time                        :      600.0 seconds
Real Time                        :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET02
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:30:28 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	328-	349	343.54	4194.75	3.11E+002	20.36	2.49E+001	15
2	395-	416	411.05	4767.23	3.34E+002	19.59	1.22E+001	9
3	440-	462	455.97	5148.19	2.09E+002	14.97	3.46E+000	4
4	479-	503	495.21	5480.97	2.30E+002	15.17	0.00E+000	10

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

Errors quoted at 1.000 sigma

47

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


I  ort Generated On                : 10/16/98 12:57:12 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D2101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98 12:46:24 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET02
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 12:57:13 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	328-	349	342.91	4189.39	2.26E+002	17.31	1.81E+001	21
2	395-	416	411.07	4767.47	2.14E+002	16.71	1.56E+001	9
3	445-	461	454.56	5136.22	1.37E+002	12.59	6.54E+000	18
4	479-	503	494.72	5476.80	1.41E+002	11.87	0.00E+000	14

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

Errors quoted at 1.000 sigma

49

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


F  ort Generated On                : 10/07/98 10:16:04 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D2100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98  9:29:25 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

50

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

Detector Name: Q1-DET02
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:16:05 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	Δkev
1	327-	348	342.29	4184.18	3.13E+002	18.48	6.57E+000	-2.4
2	395-	416	410.41	4761.88	3.02E+002	20.10	2.46E+001	-1.4
3	439-	461	454.88	5138.91	2.24E+002	15.46	3.47E+000	-1.0
4	481-	504	494.76	5477.13	2.07E+002	14.39	0.00E+000	-1.4

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

Errors quoted at 1.000 sigma

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


F  ort Generated On              : 10/07/98 10:15:24 AM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : D2092898
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              :  9/28/98  9:13:58 AM

Live Time                        :      600.0 seconds
Real Time                        :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

52

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

Detector Name: Q1-DET02
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:15:25 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel. 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	328-	348	343.05	4190.63	3.18E+002	20.73	2.86E+001	-20
2	394-	415	409.84	4757.01	3.42E+002	19.27	6.70E+000	-19
3	444-	460	455.51	5144.31	2.21E+002	16.21	1.21E+001	-10
4	483-	505	493.88	5469.69	2.14E+002	15.49	7.44E+000	-21

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

Errors quoted at 1.000 sigma

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

. port Generated On                : 10/07/98 10:14:50 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D2091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98 10:11:52 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

54

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

Detector Name: Q1-DET02
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:14:51 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	329-	349	343.83	4197.19	3.16E+002	19.01	1.15E+001	-13
2	395-	416	410.98	4766.71	2.95E+002	18.39	9.98E+000	-10
3	443-	461	456.14	5149.63	2.29E+002	16.15	8.45E+000	-11
4	482-	505	495.03	5479.44	2.04E+002	15.09	5.90E+000	-12

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

Errors quoted at 1.000 sigma

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


ı port Generated On                : 10/07/98 10:14:10 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D2091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  1:21:44 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET02
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:14:11 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	327-	349	342.58	4186.62	2.18E+002	16.63	1.35E+001	-23
2	397-	416	410.43	4762.03	2.06E+002	16.08	1.38E+001	-14
3	440-	461	455.57	5144.83	1.44E+002	12.59	3.38E+000	-9
4	484-	504	494.42	5474.27	1.43E+002	12.94	7.14E+000	-17

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

Errors quoted at 1.000 sigma

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

 ort Generated On                : 11/06/98 12:35:16 PM

Sample Title                     : CALIBRATION CHECK
Spectrum Description             :
Sample Identification            : D3110698
ample Type                       :
ample Geometry                   :

eak Locate Threshold             :  2.00
eak Locate Range (in channels)   :     1 - 65535
eak Area Range (in channels)     :     1 - 65535
dentification Energy Tolerance   :    0.020 MeV

ample Size                       :  1.000E+000 Unit

ample Taken On                   :
cquisition Started               : 11/06/98 11:48:34 AM

ive Time                         :      600.0 seconds
eal Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q1-DET03
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 12:35:17 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	332-	353	345.82	4193.07	3.53E+002	20.57	1.76E+001
2	367-	374	370.18	4403.88	8.35E+000	3.45	1.65E+000
3	396-	418	412.35	4768.77	3.13E+002	20.54	2.43E+001
4	439-	462	456.44	5150.33	2.57E+002	16.03	0.00E+000
5	483-	507	495.35	5487.07	2.00E+002	15.31	8.67E+000

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

Errors quoted at 1.000 sigma

59

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


  port Generated On                : 10/28/98  2:31:17 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D3102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  1:00:41 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

20

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

Detector Name: Q1-DET03
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:31:18 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	333-	352	346.57	4199.51	3.56E+002	19.91	1.08E+001	11
2	396-	418	412.64	4771.26	3.30E+002	18.80	5.75E+000	4
3	443-	463	457.04	5155.52	2.16E+002	15.75	8.39E+000	4
4	484-	506	495.42	5487.71	2.17E+002	16.04	1.07E+001	9

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

Errors quoted at 1.000 sigma

61

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

I  ›ort Generated On                : 10/16/98  1:08:41 PM

Sample Title                        : CALIBRATION CHECK
Spectrum Description                :
Sample Identification               : D3101698
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 : 10/16/98 12:58:15 PM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

67

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

Detector Name: Q1-DET03
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 1:08:41 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	354	346.13	4195.68	3.70E+002	21.33	2.10E+001	7
2	395-	418	412.29	4768.26	3.43E+002	18.52	0.00E+000	1
3	444-	462	456.91	5154.43	2.29E+002	15.83	5.58E+000	2
4	484-	505	495.53	5488.65	1.99E+002	14.47	2.69E+000	8

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

Errors quoted at 1.000 sigma

63

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

Report Generated On                : 10/07/98  9:28:23 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D3100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  5.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.001 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98  9:16:18 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

64

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

Detector Name: Q1-DET01
Sample Title:
Peak Analysis Performed on: 10/07/98 9:28:24 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	328-	349	343.00	4175.31	2.96E+002	21.00	3.59E+001	-14
2	393-	415	409.80	4748.94	3.13E+002	18.54	6.90E+000	-18
3	436-	461	453.88	5127.48	2.10E+002	15.73	7.64E+000	-25
4	473-	501	492.39	5458.20	2.15E+002	15.46	4.45E+000	-39

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

Errors quoted at 1.000 sigma

65

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


I  ›ort Generated On                : 10/07/98 10:19:19 AM

Sample Title                        : Calibration check
Spectrum Description                :
Sample Identification               : D3092898
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 :  9/28/98  9:40:00 AM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

66

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

Detector Name: Q1-DET03
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:19:19 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	332-	352	345.59	4191.07	3.12E+002	20.21	2.52E+001	+2
2	398-	417	411.92	4765.08	3.40E+002	19.60	1.15E+001	-2
3	440-	462	456.37	5149.72	2.22E+002	14.90	0.00E+000	-2
4	485-	503	493.72	5472.99	1.59E+002	14.16	1.28E+001	-24

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

Errors quoted at 1.000 sigma

67

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

›ort Generated On	:	10/07/98 10:18:35 AM
Sample Title	:	Calibration check
Spectrum Description	:	
Sample Identification	:	D3091898
Sample Type	:	
Sample Geometry	:	
Peak Locate Threshold	:	2.00
Peak Locate Range (in channels)	:	1 - 65535
Peak Area Range (in channels)	:	1 - 65535
Identification Energy Tolerance	:	0.020 MeV
Sample Size	:	1.000E+000 Unit
Sample Taken On	:	
Acquisition Started	:	9/18/98 10:24:07 AM
Live Time	:	600.0 seconds
Real Time	:	600.0 seconds

Energy Calibration Used Done On	:	8/04/98
Efficiency Calibration Used Done On	:	8/04/98

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

Detector Name: Q1-DET03
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:18:36 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	353	345.72	4192.15	3.23E+002	19.57	1.49E+001	+3
2	398-	418	412.76	4772.35	2.85E+002	18.91	1.80E+001	+5
3	446-	464	456.18	5148.11	1.91E+002	16.00	1.88E+001	-4
4	487-	506	494.89	5483.07	1.92E+002	16.43	2.40E+001	-14

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

Errors quoted at 1.000 sigma

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


  port Generated On                : 10/07/98 10:18:13 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D3091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  1:35:09 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

70

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

Detector Name: Q1-DET03
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:18:13 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	DkeV
1	332-	351	345.59	4191.08	1.80E+002	14.53	8.30E+000	+2
2	402-	417	412.18	4767.28	1.88E+002	14.96	1.17E+001	—
3	442-	462	456.43	5150.28	1.58E+002	13.06	3.08E+000	2
4	482-	502	494.20	5477.10	1.18E+002	11.37	2.85E+000	-20

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

Errors quoted at 1.000 sigma

71

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

Report Generated On                  : 11/06/98 12:51:42 PM

Sample Title                         : CALIBRATION CHECK
Spectrum Description                 :
Sample Identification                : D4110698
Sample Type                          :
Sample Geometry                      :

Peak Locate Threshold                :  2.00
Peak Locate Range (in channels)      :     1 - 65535
Peak Area Range (in channels)        :     1 - 65535
Identification Energy Tolerance      :    0.020 MeV

Sample Size                          :  1.000E+000 Unit

Sample Taken On                      :
Acquisition Started                  : 11/06/98 12:36:28 PM

Live Time                            :      600.0 seconds
Real Time                            :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

72

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

Detector Name: Q1-DET04
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 12:51:43 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	330-	351	344.14	4196.54	2.16E+002	15.11	3.06E+000
2	363-	371	366.49	4387.04	9.66E+000	3.60	1.34E+000
3	396-	417	412.05	4775.29	2.22E+002	15.38	3.41E+000
4	447-	463	456.67	5155.62	1.60E+002	13.65	8.45E+000
5	484-	506	496.23	5492.72	1.42E+002	13.16	8.23E+000

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

Errors quoted at 1.000 sigma

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


  ɔort Generated On                : 10/28/98  2:31:59 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D4102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  1:24:18 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

14

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

Detector Name: Q1-DET04
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:32:00 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	Δkev
1	331-	350	344.68	4201.21	2.89E+002	17.64	5.69E+000	7
2	395-	417	411.39	4769.71	2.96E+002	17.86	5.75E+000	7
3	446-	462	456.68	5155.66	1.96E+002	15.15	9.62E+000	—
4	483-	505	495.13	5483.37	2.02E+002	14.62	2.95E+000	12

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

Errors quoted at 1.000 sigma

75

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


l  ›ort Generated On              : 10/16/98  1:34:48 PM

Sample Title                      : CALIBRATION CHECK
Spectrum Description              :
Sample Identification             : D4101698
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               : 10/16/98  1:10:11 PM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

70

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

Detector Name: Q1-DET04
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 1:34:49 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	349	344.52	4199.84	2.27E+002	16.55	1.29E+001	8
2	396-	417	411.68	4772.19	2.81E+002	17.15	3.18E+000	5
3	447-	464	457.06	5158.96	1.56E+002	13.58	8.74E+000	3
4	482-	505	495.66	5487.86	1.86E+002	14.09	3.10E+000	7

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

Errors quoted at 1.000 sigma

77

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


I   ort Generated On              : 10/07/98 10:26:11 AM

Sample Title                      : Calibration Check
Spectrum Description              :
Sample Identification             : D4100798
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               : 10/07/98  9:55:02 AM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

78

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

Detector Name: Q1-DET04
Sample Title: Calibration Check
Peak Analysis Performed on: 10/07/98 10:26:12 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
	1	330-	349	344.01	4195.43	1.96E+002	14.78	5.72E+000	-13
M	~~2~~	~~395-~~	~~416~~	~~405.89~~	~~4722.84~~	~~6.20E+001~~	~~9.18~~	~~4.00E+000~~	
m	3	395-	416	411.77	4772.90	1.36E+002	13.21	5.50E+000	-5
	4	439-	461	456.47	5153.91	1.61E+002	13.62	5.75E+000	-2
	5	482-	506	495.40	5485.64	1.46E+002	12.57	3.01E+000	-9

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

Errors quoted at 1.000 sigma

79

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


:  ›ort Generated On                : 10/07/98 10:25:07 AM

Sample Title                        : Calibration check
Spectrum Description                :
Sample Identification               : D4092898
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 :  9/28/98  9:55:08 AM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

80

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

Detector Name: Q1-DET04
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:25:08 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	330-	349	343.90	4194.55	2.61E+002	17.21	8.84E+000	-13
2	396-	418	411.63	4771.76	2.46E+002	16.49	6.32E+000	-5
3	440-	462	455.68	5147.18	1.83E+002	13.53	0.00E+000	-9
4	483-	504	494.48	5477.82	1.59E+002	13.39	5.47E+000	-17

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

Errors quoted at 1.000 sigma

81

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


R  ort Generated On                : 10/07/98 10:24:30 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D4091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98 10:46:19 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On        :  8/04/98
            Efficiency Calibration Used Done On    :  8/04/98
```

82

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

Detector Name: Q1-DET04
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:24:31 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	352	344.38	4198.66	2.68E+002	17.40	8.76E+000	-9
2	396-	418	412.02	4775.07	2.68E+002	17.28	6.86E+000	-2
3	444-	463	457.59	5163.48	1.91E+002	13.82	0.00E+000	+7
4	480-	505	496.36	5493.86	1.81E+002	13.45	0.00E+000	-1

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

Errors quoted at 1.000 sigma

83

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


F  ort Generated On                : 10/07/98 10:23:38 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D4091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  3:45:49 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


              Energy Calibration Used Done On       :  8/04/98
              Efficiency Calibration Used Done On   :  8/04/98
```

84

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

Detector Name: Q1-DET04
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:23:39 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	330-	350	344.35	4198.37	1.62E+002	13.61	5.84E+000	-10
2	395-	417	411.47	4770.37	1.75E+002	14.34	8.07E+000	-7
3	443-	461	456.10	5150.75	1.23E+002	11.09	0.00E+000	-5
4	485-	503	495.63	5487.59	9.57E+001	10.17	2.33E+000	-7

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

Errors quoted at 1.000 sigma

85

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


l  ›ort Generated On                : 11/06/98  2:04:38 PM

Sample Title                        : CALIBRATION CHECK
Spectrum Description                :
Sample Identification               : D5110698
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 : 11/06/98  1:17:22 PM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

86

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

Detector Name: Q2-DET05
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 2:04:39 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	322-	328	324.97	4027.88	2.50E-001	3.37	4.75E+000
2	331-	352	345.96	4208.98	4.09E+002	20.73	5.50E+000
3	401-	418	412.77	4785.39	3.49E+002	21.16	2.86E+001
4	440-	463	457.26	5169.29	3.09E+002	18.11	3.86E+000
5	482-	505	495.59	5500.00	2.64E+002	16.65	3.18E+000

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

Errors quoted at 1.000 sigma

87

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


  ɔort Generated On                : 10/28/98  2:35:50 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D5102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  1:56:41 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

88

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

Detector Name: Q2-DET05
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:35:52 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	354	345.59	4205.80	4.10E+002	22.35	2.16E+001	2
2	397-	418	412.56	4783.59	3.96E+002	20.61	6.59E+000	4
3	440-	464	457.02	5167.26	2.60E+002	17.80	1.16E+001	3
4	478-	505	495.52	5499.46	2.44E+002	16.26	4.03E+000	10

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

Errors quoted at 1.000 sigma

89

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


  ›ort Generated On                : 10/16/98  1:55:25 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D5101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98  1:37:51 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

20

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

Detector Name: Q2-DET05
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 1:55:27 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	352	346.19	4210.93	4.23E+002	22.20	1.75E+001	10
~~2~~	~~361-~~	~~375~~	~~369.33~~	~~4410.60~~	~~1.73E+001~~	~~5.29~~	~~3.75E+000~~	
3	396-	418	412.35	4781.78	4.14E+002	21.45	1.04E+001	2
4	440-	462	457.14	5168.24	2.77E+002	16.64	0.00E+000	4
5	484-	505	495.59	5500.06	2.42E+002	16.70	1.03E+001	8

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

Errors quoted at 1.000 sigma

ql

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

R  ort Generated On                  : 10/07/98 10:31:26 AM

Sample Title                         : Calibration check
Spectrum Description                 :
Sample Identification                : d5100798
Sample Type                          :
Sample Geometry                      :

Peak Locate Threshold                :  2.00
Peak Locate Range (in channels)      :     1 - 65535
Peak Area Range (in channels)        :     1 - 65535
Identification Energy Tolerance      :    0.020 MeV

Sample Size                          :  1.000E+000 Unit

Sample Taken On                      :
Acquisition Started                  : 10/07/98 10:09:33 AM

Live Time                            :      600.0 seconds
Real Time                            :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

12

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

Detector Name: Q2-DET05
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:31:27 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	351	345.64	4206.21	4.27E+002	22.13	1.54E+001	+2
2	396-	418	412.15	4780.07	3.84E+002	21.45	1.72E+001	—
3	445-	462	456.25	5160.56	2.67E+002	17.62	1.25E+001	-3
4	478-	505	495.31	5497.57	2.55E+002	16.59	4.02E+000	-10

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

Errors quoted at 1.000 sigma

23

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


Report Generated On                : 10/07/98 10:29:37 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D5092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 10:14:58 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

gk

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

Detector Name: Q2-DET05
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:29:38 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	Δkev
1	331-	351	345.53	4205.24	3.75E+002	21.55	2.16E+001	+1
2	396-	418	412.14	4780.02	3.33E+002	19.43	1.01E+001	—
3	440-	462	456.36	5161.54	2.60E+002	17.51	1.15E+001	-3
4	484-	505	495.32	5497.66	2.51E+002	16.71	7.76E+000	-10

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

Errors quoted at 1.000 sigma

95

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


 port Generated On                : 10/07/98 10:29:04 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D5091898
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               :  9/18/98 11:40:57 AM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

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

Detector Name: Q2-DET05
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:29:05 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	353	346.46	4213.29	4.07E+002	21.85	1.77E+001	+9
2	396-	418	412.34	4781.68	3.91E+002	21.72	1.77E+001	+2
3	440-	464	457.20	5168.79	2.92E+002	17.62	3.81E+000	+5
4	479-	505	495.26	5497.14	2.50E+002	15.81	0.00E+000	-11

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

Errors quoted at 1.000 sigma

97

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


Report Generated On                : 10/07/98 10:28:24 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D5091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  2:07:38 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

98

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

Detector Name: Q2-DET05
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:28:25 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	338-	351	344.83	4199.23	1.77E+002	17.91	5.04E+001	-5
2	396-	417	411.59	4775.25	2.45E+002	17.00	1.01E+001	-5
3	443-	461	456.12	5159.48	1.71E+002	13.50	2.89E+000	-5
4	487-	502	494.21	5488.12	1.62E+002	13.87	1.05E+001	-20

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

Errors quoted at 1.000 sigma

99

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


I  ort Generated On                : 11/06/98  2:39:35 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D6110698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 11/06/98  2:27:06 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

100

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

Detector Name: Q2-DET06
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 2:39:36 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	330-	350	343.18	4193.11	3.67E+002	20.19	1.08E+001
2	397-	418	411.35	4769.71	3.35E+002	19.24	8.86E+000
3	445-	462	456.61	5152.61	2.30E+002	15.73	4.96E+000
4	479-	506	495.20	5478.99	2.31E+002	15.20	0.00E+000

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

Errors quoted at 1.000 sigma

.01

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

Report Generated On                : 10/28/98  2:40:36 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D6102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  2:11:32 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

102

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

Detector Name: Q2-DET06
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:40:37 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	Δkev
1	329-	349	343.05	4192.03	4.00E+002	20.93	1.05E+001	31
2	397-	418	411.44	4770.47	3.47E+002	20.08	1.45E+001	19
3	446-	463	456.37	5150.60	2.52E+002	16.54	6.58E+000	16
4	483-	506	494.31	5471.53	2.11E+002	15.60	8.48E+000	33

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

Errors quoted at 1.000 sigma

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


l  ›ort Generated On                : 10/16/98  2:08:24 PM

Sample Title                        : CALIBRATION CHECK
Spectrum Description                :
Sample Identification               : D6101698
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 : 10/16/98  1:57:45 PM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

104

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

Detector Name: Q2-DET06
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 2:08:25 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	330-	349	343.20	4193.25	3.52E+002	19.86	1.22E+001	30
~~2~~	~~390-~~	~~395~~	~~392.70~~	~~4612.02~~	~~1.43E+000~~	~~3.96~~	~~8.43E+000~~	
3	396-	417	411.18	4768.33	3.15E+002	20.36	2.44E+001	21
4	441-	462	455.98	5147.31	2.68E+002	16.79	3.27E+000	20
5	479-	506	495.21	5479.14	2.26E+002	15.66	3.90E+000	26

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

Errors quoted at 1.000 sigma

105

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


ı  ɔort Generated On                : 10/07/98 10:47:34 AM

Sample Tıtle                        : Calıbratıon check
Spectrum Descrıptıon                :
Sample Identıfıcatıon               : D6100798
Sample Type                         .
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (ın channels)     :     1 - 65535
Peak Area Range (ın channels)       :     1 - 65535
Identıfıcatıon Energy Tolerance     :    0.020 MeV

Sample Sıze                         :  1.000E+000 Unıt

Sample Taken On                     :
Acquısıtıon Started                 : 10/07/98 10:23:51 AM

Lıve Tıme                           :      600.0 seconds
Real Tıme                           :      600.0 seconds


          Energy Calıbratıon Used Done On       :  8/04/98
          Efficiency Calıbratıon Used Done On   :  8/04/98
```

106

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

Detector Name: Q2-DET06
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:47:35 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	329-	349	343.06	4192.07	3.62E+002	20.08	1.09E+001	-31
2	396-	417	410.50	4762.52	3.50E+002	19.35	6.07E+000	-24
3	440-	461	455.61	5144.15	2.37E+002	16.40	7.07E+000	-23
4	479-	503	495.59	5482.31	2.16E+002	14.70	0.00E+000	-23

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

Errors quoted at 1.000 sigma

107

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

  ɔort Generated On                : 10/07/98 10:47:05 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D6092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 10:27:44 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

108

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

Detector Name: Q2-DET06
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:47:06 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	329-	349	342.72	4189.24	3.55E+002	20.78	1.98E+001	-34
2	396-	416	410.63	4763.70	3.31E+002	19.13	8.81E+000	-26
3	440-	462	455.26	5141.19	2.60E+002	17.92	1.37E+001	-26
4	484-	504	494.72	5474.99	1.94E+002	16.26	1.96E+001	-30

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

Errors quoted at 1.000 sigma

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


I  ,ort Generated On              : 10/07/98 10:46:23 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D6091898
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               :  9/18/98 12:21:55 PM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/04/98
          Efficiency Calibration Used Done On   :  8/04/98
```

110

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

Detector Name: Q2-DET06
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:46:24 AM
Peak Analysis From Channel. 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	330-	349	343.79	4198.27	3.47E+002	20.45	1.90E+001	-25
2	397-	416	411.36	4769.85	3.57E+002	20.10	1.18E+001	-19
3	445-	462	456.28	5149.83	2.66E+002	16.82	4.89E+000	-17
4	484-	505	495.53	5481.85	2.39E+002	17.67	1.92E+001	-23

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

Errors quoted at 1.000 sigma

111

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


I  ort Generated On                : 10/07/98 10:45:34 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D6091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  2:17:39 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


            Energy Calibration Used Done On       :  8/04/98
            Efficiency Calibration Used Done On   :  8/04/98
```

112

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

Detector Name: Q2-DET06
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:45:35 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	329-	349	342.41	4186.59	2.31E+002	16.93	1.43E+001	-36
2	396-	416	410.75	4764.70	2.19E+002	15.60	6.04E+000	-25
3	440-	461	455.67	5144.68	1.71E+002	14.21	6.92E+000	-22
4	481-	503	494.50	5473.10	1.34E+002	13.05	8.99E+000	-32

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

Errors quoted at 1.000 sigma

113

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

  port Generated On                : 11/06/98  2:50:55 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D7110698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 11/06/98  2:40:14 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On        :  8/05/98
            Efficiency Calibration Used Done On    :  8/05/98
```

114

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

Detector Name: Q2-DET07
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 2:50:56 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	330-	350	343.88	4193.44	3.65E+002	19.41	2.92E+000
2	398-	416	411.29	4768.39	3.32E+002	19.76	1.59E+001
3	443-	462	456.00	5149.67	2.23E+002	16.92	1.65E+001
4	484-	505	494.89	5481.40	1.97E+002	16.43	2.01E+001

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

Errors quoted at 1.000 sigma

115

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


  port Generated On                : 10/28/98  2:37:51 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D7102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  2:27:22 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

116

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

Detector Name: Q2-DET07
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 2:37:51 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	333-	348	343.53	4190.43	2.79E+002	19.99	3.77E+001	16
2	397-	416	410.77	4763.96	3.24E+002	18.83	8.17E+000	12
3	445-	460	455.59	5146.18	2.10E+002	16.09	1.52E+001	9
4	481-	503	494.72	5479.89	2.39E+002	15.46	0.00E+000	15

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

Errors quoted at 1.000 sigma

117

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


  port Generated On                : 10/16/98  2:21:52 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : D7101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98  2:11:09 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

118

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

Detector Name: Q2-DET07
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 2:21:53 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	330-	349	343.27	4188.22	3.12E+002	19.32	1.64E+001	18
2	397-	415	410.69	4763.24	3.18E+002	20.91	3.20E+001	13
3	441-	461	454.81	5139.51	2.13E+002	14.99	2.94E+000	15
4	487-	503	493.62	5470.54	1.79E+002	15.45	2.06E+001	24

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

Errors quoted at 1.000 sigma

119

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

Report Generated On                : 10/07/98 10:56:47 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D7100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98 10:45:57 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

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

Detector Name: Q2-DET07
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:56:48 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	350	344.49	4198.62	3.30E+002	19.44	1.31E+001	-7
~~2~~	~~364-~~	~~371~~	~~368.27~~	~~4401.40~~	~~8.08E+000~~	~~4.03~~	~~3.92E+000~~	
3	398-	416	411.12	4766.88	2.95E+002	18.19	1.01E+001	-9
4	442-	462	455.92	5148.97	2.32E+002	16.74	1.20E+001	-6
5	482-	504	494.96	5481.94	2.18E+002	15.86	8.53E+000	-13

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

Errors quoted at 1.000 sigma

12)

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


Report Generated On                : 10/07/98 10:50:52 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D7092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 10:40:30 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

122

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

Detector Name: Q2-DET07
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:50:53 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	328-	349	341.72	4174.96	3.32E+002	19.18	8.96E+000	-31
2	396-	415	409.69	4754.70	2.89E+002	19.62	2.51E+001	-21
3	441-	459	454.06	5133.17	2.32E+002	16.30	8.56E+000	-22
4	479-	501	492.61	5461.88	2.02E+002	15.05	6.08E+000	-33

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

Errors quoted at 1.000 sigma

123

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


  ɔort Generated On                : 10/19/98  3:40:17 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D7091898
Sample Type                        .
Sample Geometry                    :

Peak Locate Threshold              :  1.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.010 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98 12:47:58 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

124

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

Detector Name: Q2-DET07
Sample Title: Calibration check
Peak Analysis Performed on: 10/19/98 3:40:17 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	330-	351	343.49	4190.09	3.05E+002	20.42	2.85E+001	14
2	386-	393	~~388.40~~	~~4573.10~~	~~3.00E+000~~	~~3.62~~	~~5.00E+000~~	
3	398-	416	411.29	4768.36	3.22E+002	18.90	1.00E+001	8
4	434-	439	~~436.48~~	~~4983.17~~	~~2.50E-001~~	~~2.26~~	1.75E+000	
5	442-	461	455.63	5146.53	2.57E+002	16.41	3.05E+000	8
6	481-	504	494.41	5477.24	2.06E+002	15.26	6.42E+000	18

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

Errors quoted at 1.000 sigma

125

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


l  ›ort Generated On                : 10/07/98 10:49:45 AM

Sample Title                        : Calibration check
Spectrum Description                :
Sample Identification               : D7091098
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 :  9/10/98  2:39:55 PM

Live Time                           :      360.0 seconds
Real Time                           :      360.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

126

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

Detector Name: Q2-DET07
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:49:46 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
	1	330-	348	343.56	4190.68	1.71E+002	14.22	8.28E+000	-15
	2	397-	416	410.49	4761.53	2.07E+002	15.38	7.99E+000	-14
	3	441-	460	454.92	5140.49	1.43E+002	11.96	0.00E+000	-15
M	4	~~479-~~	~~504~~	~~489.39~~	~~5434.46~~	~~2.92E+001~~	~~5.80~~	~~2.98E+000~~	
m	5	479-	504	495.00	5482.30	6.96E+001	11.03	3.31E+000	-13

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

Errors quoted at 1.000 sigma

127

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

ı  ,ort Generated On              : 11/06/98  3:18:17 PM

Sample Title                      : CALIBRATION CHECK
Spectrum Description              :
Sample Identification             : D8110698
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               : 11/06/98  2:57:59 PM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

128

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

Detector Name: Q2-DET08
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 3:18:18 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	331-	351	345.44	4193.44	3.79E+002	20.86	1.44E+001
2	396-	418	412.55	4773.69	3.35E+002	19.70	1.25E+001
3	439-	463	456.51	5153.81	2.33E+002	15.88	3.90E+000
4	480-	505	495.29	5489.09	2.49E+002	16.24	3.42E+000

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

Errors quoted at 1.000 sigma

129

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


  port Generated On                : 10/28/98  2:54:12 PM

Sample Title                       : Calibration Check
Spectrum Description               :
Sample Identification              : D8102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  2:41:25 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

130

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

Detector Name: Q2-DET08
Sample Title: Calibration Check
Peak Analysis Performed on: 10/28/98 2:54:13 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	Δkev
1	332-	351	346.00	4198.26	3.42E+002	19.34	8.44E+000	4
2	396-	417	412.17	4770.36	2.86E+002	18.56	1.35E+001	1
3	439-	462	456.10	5150.23	2.31E+002	15.42	2.17E+000	6
4	481-	505	494.53	5482.50	2.07E+002	16.52	1.56E+001	17

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

Errors quoted at 1.000 sigma

131

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

›ort Generated On	: 10/16/98 2:39:24 PM
Sample Title	: CALIBRATION CHECK
Spectrum Description	:
Sample Identification	: D8101698
Sample Type	:
Sample Geometry	:
Peak Locate Threshold	: 2.00
Peak Locate Range (in channels)	: 1 - 65535
Peak Area Range (in channels)	: 1 - 65535
Identification Energy Tolerance	: 0.020 MeV
Sample Size	: 1.000E+000 Unit
Sample Taken On	:
Acquisition Started	: 10/16/98 2:24:14 PM
Live Time	: 600.0 seconds
Real Time	: 600.0 seconds

Energy Calibration Used Done On	: 8/05/98
Efficiency Calibration Used Done On	: 8/05/98

132

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

Detector Name: Q2-DET08
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 2:39:25 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	~~325-~~	~~331~~	~~328.13~~	~~4043.74~~	~~-6.82E+000~~	~~6.39~~	~~1.38E+001~~	
2	331-	352	345.49	4193.85	3.44E+002	20.87	2.19E+001	0
3	400-	417	411.71	4766.41	3.17E+002	19.70	2.10E+001	5
4	439-	462	456.18	5150.92	2.49E+002	15.78	0.00E+000	4
5	480-	504	494.82	5485.00	2.23E+002	16.41	1.04E+001	15

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

Errors quoted at 1.000 sigma

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


' ›ort Generated On                : 10/07/98 11:46:10 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D8100798
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               : 10/07/98 11:03:58 AM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

134

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

Detector Name: Q2-DET08
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:46:11 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	350	345.47	4193.74	3.26E+002	20.46	2.33E+001	~~0~~
2	395-	417	411.14	4761.54	3.29E+002	19.92	1.60E+001	9
3	440-	461	455.71	5146.87	2.40E+002	15.49	0.00E+000	9
4	482-	504	493.84	5476.56	1.82E+002	15.05	1.15E+001	23

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

Errors quoted at 1.000 sigma

135

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


  ɔort Generated On                : 10/07/98 10:55:46 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D8092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 10:53:18 AM

Live Time                          :      601.0 seconds
Real Time                          :      601.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

136

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

Detector Name: Q2-DET08
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:55:47 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	350	344.77	4187.65	3.84E+002	21.01	1.45E+001	6
2	396-	417	411.61	4765.53	4.09E+002	21.51	1.27E+001	5
3	439-	460	455.94	5148.88	2.46E+002	16.92	9.27E+000	7
4	480-	504	493.38	5472.52	2.34E+002	16.20	6.51E+000	27

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

Errors quoted at 1.000 sigma

137

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


'  ›ort Generated On                : 10/07/98 10:53:43 AM

Sample Title                        : Calibration check
Spectrum Description                :
Sample Identification               : D8091898
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 :  9/18/98  1:04:04 PM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

138

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

Detector Name: Q2-DET08
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:53:44 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	352	345.56	4194.50	3.28E+002	19.51	1.25E+001	+1
2	396-	418	412.15	4770.19	3.63E+002	20.58	1.36E+001	1
3	442-	462	456.14	5150.60	2.94E+002	17.52	3.14E+000	5
4	480-	505	494.55	5482.69	2.32E+002	16.14	6.55E+000	17

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

Errors quoted at 1.000 sigma

139

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


  port Generated On                : 10/07/98 10:53:05 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D8091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  3:00:03 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

140

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

Detector Name: Q2-DET08
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:53:06 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
	1	331-	350	345.27	4192.01	2.25E+002	16.47	1.16E+001	2
M	2	~~400-~~	~~417~~	~~405.17~~	~~4709.90~~	~~3.79E+001~~	~~7.73~~	~~6.08E+000~~	
m	3	400-	417	412.10	4769.80	1.46E+002	15.57	6.82E+000	1
	4	444-	462	455.84	5148.00	1.43E+002	13.41	1.03E+001	8
	5	479-	504	493.55	5474.02	1.50E+002	12.25	0.00E+000	24

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

Errors quoted at 1.000 sigma

141

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

Report Generated On	:	11/06/98 3:43:16 PM
Sample Title	:	CALIBRATION CHECK
Spectrum Description	:	
Sample Identification	:	D910698
Sample Type	:	
Sample Geometry	:	
Peak Locate Threshold	:	2.00
Peak Locate Range (in channels)	:	1 - 65535
Peak Area Range (in channels)	:	1 - 65535
Identification Energy Tolerance	:	0.020 MeV
Sample Size	:	1.000E+000 Unit
Sample Taken On	:	
Acquisition Started	:	11/06/98 3:20:19 PM
Live Time	:	600.0 seconds
Real Time	:	600.0 seconds

Energy Calibration Used Done On	:	8/05/98
Efficiency Calibration Used Done On	:	8/05/98

142

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

Detector Name: Q3-DET09
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 3:43:17 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	337-	352	347.64	4202.11	2.71E+002	18.44	2.29E+001
2	399-	419	413.12	4772.05	2.81E+002	17.73	8.53E+000
3	443-	462	457.02	5154.19	1.85E+002	14.49	6.13E+000
4	483-	505	495.01	5484.95	1.86E+002	14.44	5.73E+000

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

Errors quoted at 1.000 sigma

143

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


I  ort Generated On                : 10/28/98  3:22:26 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D9102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  2:56:44 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

144

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

Detector Name: Q3-DET09
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 3:22:28 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	DKeV
1	~~324-~~	~~329~~	~~326.33~~	~~4016.53~~	~~2.15E+000~~	~~3.06~~	~~2.85E+000~~	
2	337-	352	347.19	4198.17	3.00E+002	18.56	1.51E+001	15
3	399-	418	413.05	4771.44	2.88E+002	20.26	3.14E+001	7
4	444-	462	457.16	5155.40	2.23E+002	16.66	1.42E+001	4
5	483-	505	495.16	5486.21	2.24E+002	16.05	8.52E+000	12

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

Errors quoted at 1.000 sigma

145

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

  ɔort Generated On                : 10/16/98  2:52:32 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               .
Sample Identification              : D9101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98  2:41:36 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

146

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

Detector Name: Q3-DET09
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 2:52:33 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	
1	336-	352	346.57	4192.73	3.36E+002	20.10	2.14E+001	10
2	399-	419	413.18	4772.60	3.32E+002	19.14	8.69E+000	9
3	440-	463	457.68	5159.96	2.69E+002	16.40	0.00E+000	9
4	483-	506	495.34	5487.80	2.26E+002	15.41	2.88E+000	10

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

Errors quoted at 1.000 sigma

147

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

I  ɔrt Generated On                : 10/07/98  1:20:05 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D9100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98 11:48:00 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

148

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

Detector Name: Q3-DET09
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 1:20:07 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	336-	352	346.36	4190.90	2.93E+002	19.14	2.31E+001	8
2	398-	417	412.38	4765.62	3.15E+002	19.00	1.16E+001	2
3	444-	462	456.76	5151.97	2.21E+002	15.84	8.05E+000	1
4	480-	505	495.22	5486.73	2.17E+002	16.18	1.01E+001	11

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

Errors quoted at 1.000 sigma

49

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


F ort Generated On                : 10/07/98 11:00:22 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D9092898
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               :  9/28/98 11:14:37 AM

Live Time                         :      600.0 seconds
Real Time                         :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

150

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

Detector Name: Q3-DET09
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:00:23 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
~~1~~	~~328-~~	~~346~~	~~337.24~~	~~4111.53~~	~~1.23E+002~~	~~23.70~~	~~1.57E+002~~	
2	346-	352	347.25	4198.65	1.42E+002	19.48	4.15E+001	16
3	398-	419	412.49	4766.58	4.17E+002	21.60	1.22E+001	3
4	443-	463	456.77	5152.07	2.43E+002	17.81	1.83E+001	1
5	481-	505	495.36	5487.95	2.06E+002	14.83	3.29E+000	10

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

Errors quoted at 1.000 sigma

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


r port Generated On                : 10/07/98 10:59:46 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : D9091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98  1:32:44 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

152

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

Detector Name: Q3-DET09
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:59:47 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	337-	352	347.63	4201.99	3.18E+002	20.64	3.38E+001	19
2	399-	419	413.36	4774.18	3.25E+002	20.28	2.25E+001	10
3	446-	463	457.96	5162.44	2.27E+002	16.75	1.51E+001	11
4	480-	506	496.47	5497.63	2.39E+002	17.11	1.13E+001	–

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

Errors quoted at 1.000 sigma

153

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

 ɔort Generated On                : 10/07/98 10:59:14 AM

Sample Title                      : Calibration check
Spectrum Description              :
Sample Identification             : D9091098
Sample Type                       :
Sample Geometry                   :

Peak Locate Threshold             :  2.00
Peak Locate Range (in channels)   :     1 - 65535
Peak Area Range (in channels)     :     1 - 65535
Identification Energy Tolerance   :    0.020 MeV

Sample Size                       :  1.000E+000 Unit

Sample Taken On                   :
Acquisition Started               :  9/10/98  3:17:49 PM

Live Time                         :      360.0 seconds
Real Time                         :      360.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

154

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

Detector Name: Q3-DET09
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 10:59:15 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	336-	352	346.03	4188.07	1.88E+002	15.67	1.84E+001	5
2	398-	418	412.65	4768.01	2.23E+002	17.17	1.78E+001	4
3	448-	462	457.01	5154.15	1.36E+002	13.32	1.36E+001	3
4	481-	504	494.56	5480.96	1.51E+002	12.83	3.26E+000	17

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

Errors quoted at 1.000 sigma

155

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


I  ort Generated On                : 11/06/98  4:11:04 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : 10110698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 11/06/98  3:55:13 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

156

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

Detector Name: Q3-DET10
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 11/06/98 4:11:05 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	331-	349	343.60	4194.04	3.47E+002	20.55	2.07E+001
2	396-	416	411.27	4773.93	3.54E+002	20.40	1.53E+001
3	440-	461	456.16	5158.55	2.59E+002	16.74	5.50E+000
4	486-	504	494.18	5484.35	1.83E+002	14.85	1.20E+001

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

Errors quoted at 1.000 sigma

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

Detector Name: Q3-DET10
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 3:36:09 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	
1	331-	349	343.46	4192.83	3.50E+002	21.43	2.95E+001	17
2	396-	415	411.21	4773.42	3.68E+002	20.12	9.11E+000	9
3	439-	462	455.45	5152.50	2.71E+002	16.46	0.00E+000	10
4	477-	503	494.26	5485.02	2.22E+002	14.90	0.00E+000	19

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

Errors quoted at 1.000 sigma

158

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


  port Generated On                : 10/28/98  3:36:09 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 10102898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/28/98  3:22:20 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

159

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


  ɔort Generated On                : 10/16/98  3:06:53 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : 10101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98  2:56:21 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

160

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

Detector Name: Q3-DET10
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 3:06:54 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel. 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	349	343.11	4189.88	3.58E+002	20.56	1.80E+001	20
2	396-	416	410.71	4769.13	3.68E+002	20.40	1.20E+001	13
3	439-	461	455.38	5151.86	2.69E+002	16.91	3.59E+000	11
4	480-	504	494.29	5485.24	2.83E+002	17.65	6.54E+000	19

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

Errors quoted at 1.000 sigma

161

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


I  ort Generated On                : 10/07/98  1:58:10 PM

Sample Title                       . Calibration check
Spectrum Description               :
Sample Identification              : 10100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98  1:21:38 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

162

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

Detector Name: Q3-DET10
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 1:58:15 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	348	343.02	4189.12	3.71E+002	21.84	2.99E+001	21
2	396-	415	410.72	4769.19	3.39E+002	19.95	1.48E+001	13
3	442-	460	455.08	5149.27	2.38E+002	17.11	1.42E+001	14
4	476-	503	493.92	5482.08	2.44E+002	16.28	4.11E+000	22

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

Errors quoted at 1.000 sigma

163

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

. ›ort Generated On                : 10/07/98 11:03:44 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 10092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 11:29:42 AM

Live Time                          :      600.0 seconds
Real Time                          :      601.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

164

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

Detector Name: Q3-DET10
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:03:45 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	349	343.07	4189.57	3.44E+002	19.73	1.27E+001	20
2	396-	416	410.52	4767.48	3.81E+002	21.54	2.07E+001	15
3	438-	461	455.03	5148.92	2.94E+002	17.67	3.75E+000	14
4	481-	502	493.47	5478.24	2.32E+002	16.23	8.36E+000	26

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

Errors quoted at 1.000 sigma

165

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


F  ort Generated On                : 10/07/98 11:02:42 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 10091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  3:34:05 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

166

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

Detector Name: Q3-DET10
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:02:43 AM
Peak Analysis From Channel. 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	331-	348	343.68	4194.77	2.25E+002	16.63	1.47E+001	15
2	395-	415	410.25	4765.18	2.11E+002	16.28	1.28E+001	17
3	445-	462	454.78	5146.76	1.43E+002	13.36	1.09E+001	16
4	480-	503	492.67	5471.37	1.33E+002	12.56	6.08E+000	33

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

Errors quoted at 1.000 sigma

167

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

I  ort Generated On                : 10/07/98 11:03:11 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 10091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98  2:04:33 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

168

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

Detector Name: Q3-DET10
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11 03:12 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	349	344.10	4198.33	3.49E+002	20.60	2.17E+001	12
~~2~~	~~365-~~	~~375~~	~~368.07~~	~~4403.75~~	~~7.08E+000~~	~~4.38~~	~~4.92E+000~~	
3	395-	416	410.33	4765.83	3.49E+002	19.79	9.89E+000	16
4	444-	461	455.54	5153.27	2.35E+002	16.74	1.26E+001	10
5	476-	504	494.21	5484.61	2.33E+002	16.00	4.35E+000	17

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

Errors quoted at 1.000 sigma

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


  port Generated On                : 11/06/98  4:25:31 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 11110698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 11/06/98  4:13:12 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

170

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 11/06/98 4:25:32 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	334-	355	346.47	4200.98	3.23E+002	19.41	1.51E+001
2	398-	418	413.04	4774.96	3.43E+002	19.51	9.25E+000
3	445-	463	457.58	5158.94	2.20E+002	16.49	1.37E+001
4	477-	506	495.62	5486.93	2.21E+002	14.87	0.00E+000

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

Errors quoted at 1.000 sigma

171

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

ı  ɔort Generated On                : 10/28/98  4:06:55 PM

Sample Title                        : Calibration check
Spectrum Description                :
Sample Identification               : 11102898
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (in channels)     :     1 - 65535
Peak Area Range (in channels)       :     1 - 65535
Identification Energy Tolerance     :    0.020 MeV

Sample Size                         :  1.000E+000 Unit

Sample Taken On                     :
Acquisition Started                 : 10/28/98  3:55:36 PM

Live Time                           :      600.0 seconds
Real Time                           :      600.0 seconds


          Energy Calibration Used Done On       :  8/05/98
          Efficiency Calibration Used Done On   :  8/05/98
```

172

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 4:06:56 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	333-	352	345.49	4192.54	3.61E+002	20.45	1.57E+001	1
2	398-	419	413.24	4776.64	3.45E+002	20.79	2.14E+001	10
3	443-	464	457.31	5156.57	2.44E+002	16.50	6.50E+000	5
4	484-	505	496.37	5493.38	2.06E+002	15.78	1.12E+001	2

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

Errors quoted at 1.000 sigma

173

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


  ɔort Generated On                : 10/16/98  3:19:28 PM

Sample Title                       : CALIBRATION CHECK
Spectrum Description               :
Sample Identification              : 11101698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/16/98  3:09:06 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

174

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

Detector Name: Q3-DET11
Sample Title: CALIBRATION CHECK
Peak Analysis Performed on: 10/16/98 3:19:29 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	
1	333-	354	345.04	4188.68	3.43E+002	20.70	2.34E+001	3
2	397-	418	412.44	4769.76	3.30E+002	20.76	2.33E+001	2
3	440-	463	457.02	5154.13	2.25E+002	15.00	0.00E+000	2
4	481-	505	495.37	5484.73	2.17E+002	14.73	0.00E+000	10

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

Errors quoted at 1.000 sigma

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


ı  ɔort Generated On                : 10/07/98  1:54:23 PM

Sample Tıtle                        : Calıbratıon check
Spectrum Descrıptıon                :
Sample Identıfıcatıon               : 11100798
Sample Type                         :
Sample Geometry                     :

Peak Locate Threshold               :  2.00
Peak Locate Range (ın channels)     :     1 - 65535
Peak Area Range (ın channels)       :     1 - 65535
Identıfıcatıon Energy Tolerance     :    0.020 MeV

Sample Sıze                         :  1.000E+000 Unıt

Sample Taken On                     :
Acquısıtıon Started                 : 10/07/98  1:35:23 PM

Lıve Tıme                           :      600.0 seconds
Real Tıme                           :      600.0 seconds


          Energy Calıbratıon Used Done On       :  8/05/98
          Efficıency Calıbratıon Used Done On   :  8/05/98
```

176

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 1:54:24 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	333-	353	345.81	4195.25	3.08E+002	19.58	2.07E+001	3
2	397-	418	412.02	4766.15	3.45E+002	20.00	1.29E+001	3
3	442-	465	456.98	5153.78	2.70E+002	16.43	0.00E+000	1
4	487-	506	496.18	5491.70	1.76E+002	14.63	1.21E+001	4

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

Errors quoted at 1.000 sigma

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

  ɔort Generated On                : 10/07/98 11:13:14 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 11092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 11:59:53 AM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

178

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:13:15 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	334-	353	346.29	4199.43	3.40E+002	21.23	3.18E+001	7
2	397-	419	412.20	4767.69	3.37E+002	20.77	2.23E+001	4
3	441-	462	457.09	5154.72	2.47E+002	15.72	0.00E+000	
4	485-	506	495.59	5486.68	2.32E+002	15.49	2.44E+000	8

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

Errors quoted at 1.000 sigma

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

  ›ort Generated On                : 10/07/98 11:12:40 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 11091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98  4:28:27 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:12:41 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	334-	354	346.53	4201.49	2.84E+002	18.83	1.88E+001	9
2	398-	419	413.59	4779.62	3.18E+002	18.61	6.50E+000	12
3	444-	463	458.04	5162.92	2.14E+002	15.96	9.56E+000	11
4	480-	506	496.30	5492.77	2.20E+002	14.83	0.00E+000	2

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

Errors quoted at 1.000 sigma

181

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


. ›ort Generated On                : 10/07/98 11:12:12 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 11091098
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/10/98  4:01:00 PM

Live Time                          :      360.0 seconds
Real Time                          :      360.0 seconds


            Energy Calibration Used Done On       :  8/05/98
            Efficiency Calibration Used Done On   :  8/05/98
```

182

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

Detector Name: Q3-DET11
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:12:13 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	332-	351	344.59	4184.80	1.86E+002	14.42	5.63E+000	7
2	397-	418	412.58	4770.98	1.89E+002	15.56	1.26E+001	2
3	446-	462	457.06	5154.42	1.40E+002	13.74	1.43E+001	2
4	481-	506	494.85	5480.23	1.47E+002	12.12	0.00E+000	15

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

Errors quoted at 1.000 sigma

183

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

Report Generated On                : 11/06/98  4.46:34 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 12110698
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 11/06/98  4:27:17 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/06/98
          Efficiency Calibration Used Done On   :  8/06/98
```

184

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

Detector Name: Q3-DET12
Sample Title: Calibration check
Peak Analysis Performed on: 11/06/98 4:46:35 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	329-	350	344.12	4190.73	3.53E+002	20.79	1.90E+001
2	395-	416	411.37	4766.94	3.47E+002	20.54	1.70E+001
3	443-	462	455.37	5144.04	2.58E+002	17.01	8.37E+000
4	481-	503	494.01	5475.15	2.13E+002	14.59	0.00E+000

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

Errors quoted at 1.000 sigma

185

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

 ort Generated On                : 10/28/98  4:31:27 PM

Sample Title                     : Calibration check
Spectrum Description             :
Sample Identification            : 12102898
Sample Type                      :
Sample Geometry                  :

Peak Locate Threshold            :  2.00
Peak Locate Range (in channels)  :     1 - 65535
Peak Area Range (in channels)    :     1 - 65535
Identification Energy Tolerance  :    0.020 MeV

Sample Size                      :  1.000E+000 Unit

Sample Taken On                  :
Acquisition Started              : 10/28/98  4:08:56 PM

Live Time                        :      600.0 seconds
Real Time                        :      600.0 seconds


          Energy Calibration Used Done On       :  8/06/98
          Efficiency Calibration Used Done On   :  8/06/98
```

186

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

Detector Name: Q3-DET12
Sample Title: Calibration check
Peak Analysis Performed on: 10/28/98 4:31:28 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
1	333-	349	343.75	4187.56	3.49E+002	22.18	4.30E+001	14
2	360-	370	~~367.38~~	~~4390.07~~	~~1.43E+001~~	~~4.56~~	~~2.75E+000~~	
3	395-	416	411.11	4764.77	3.70E+002	20.15	8.85E+000	9
4	438-	461	455.35	5143.84	2.74E+002	17.12	3.90E+000	11
5	484-	504	494.07	5475.62	2.47E+002	17.45	1.65E+001	20

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

Errors quoted at 1.000 sigma

187

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

I  ort Generated On                : 10/07/98  2:17:18 PM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 12100798
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                : 10/07/98  1:57:12 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


          Energy Calibration Used Done On       :  8/06/98
          Efficiency Calibration Used Done On   :  8/06/98
```

188

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

Detector Name: Q3-DET12
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 2:17:19 PM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	329-	349	343.75	4187.56	3.82E+002	20.80	1.24E+001	14
2	394-	418	410.52	4759.65	3.89E+002	20.50	6.97E+000	14
3	444-	460	455.29	5143.31	2.27E+002	17.02	1.86E+001	12
4	479-	503	493.58	5471.43	2.30E+002	16.13	6.77E+000	25

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

Errors quoted at 1.000 sigma

189

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


  port Generated On                : 10/07/98 11:15:24 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              : 12092898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/28/98 12:34:59 PM

Live Time                          :      601.0 seconds
Real Time                          :      601.0 seconds


            Energy Calibration Used Done On       :  8/06/98
            Efficiency Calibration Used Done On   :  8/06/98
```

190

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

Detector Name: Q3-DET12
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:15:25 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔKeV
1	329-	349	343.59	4186.21	3.73E+002	22.73	3.45E+001	16
2	394-	416	410.58	4760.23	3.86E+002	20.61	9.28E+000	14
3	443-	461	455.09	5141.59	2.77E+002	17.53	8.17E+000	13
4	478-	504	493.49	5470.68	2.62E+002	16.19	0.00E+000	25

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

Errors quoted at 1.000 sigma

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


  port Generated On                : 10/07/98 11:16:34 AM

Sample Title                       : Calibration check
Spectrum Description               :
Sample Identification              · 12091898
Sample Type                        :
Sample Geometry                    :

Peak Locate Threshold              :  2.00
Peak Locate Range (in channels)    :     1 - 65535
Peak Area Range (in channels)      :     1 - 65535
Identification Energy Tolerance    :    0.020 MeV

Sample Size                        :  1.000E+000 Unit

Sample Taken On                    :
Acquisition Started                :  9/18/98  3:40:40 PM

Live Time                          :      600.0 seconds
Real Time                          :      600.0 seconds


            Energy Calibration Used Done On       :  8/06/98
            Efficiency Calibration Used Done On   :  8/06/98
```

12

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

Detector Name: Q3-DET12
Sample Title: Calibration check
Peak Analysis Performed on: 10/07/98 11:16:35 AM
Peak Analysis From Channel: 1
Peak Analysis To Channel: 1024

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts	ΔkeV
	1	330-	350	344.54	4194.34	4.07E+002	21.40	1.24E+001	8
M	~~2~~	~~393-~~	~~417~~	~~404.85~~	~~4711.08~~	~~6.65E+001~~	~~10.42~~	~~1.47E+001~~	
m	3	393-	417	411.78	4770.48	3.24E+002	23.55	1.56E+001	4
	4	439-	462	456.45	5153.25	3.02E+002	17.38	0.00E+000	2
	5	479-	504	494.26	5477.25	2.63E+002	16.74	3.65E+000	19

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

Errors quoted at 1.000 sigma

193

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	ROCKY FLATS Am Raw data																			
2	Samples 8-98		3/2/99																	
3								Background			count									
4	Sample		ID	vol	DET	eff	243	+/	241	+/	time	(min)	Am-243	+/	bkg corr		Am 241	+/-	bkg corr	
5	98826WH	whole water	RF1Am	4	1	0 201	0 0002	0 00017	0 00051	0 0003	351938	5865 6	1330	36 48	1329 0115	36 48	60	7 75	57 03	7 75
6	98826TD	<0 45micron	RF2Am	20	1	0 201	0 0003	0 00024	0 00051	0 0003	419025	6983 8	1170	34 22	1167 646	34 22	42	6 48	38 47	6 48
7	98826>20F	>20 micron	RF3Am	10	1	0 201	0	0	0 00051	0 0003	232713	3878 6	104	10 2	104	10 2	21	4 58	19 04	4 58
8	*98826>20F*	*>20 micron*	*RF3Am2*	*10*	*1*	*0 201*	0 0002	0 00017	0 00051	0 0003	*1E+06*	*16821*	*696*	*26 38*	693 16511	26 38	*86*	*9 27*	77 50	9 27
9	98826>5C	>5 micron	RF4Am	122	11	0 217	0 0008	0 00038	0 00084	0 0004	415469	6924 5	1600	39 97	1594 1649	39 97	1290	35 86	1284 16	35 86
10	98826>0 45F	0 45 20micr	RF5Am	1	2	0 205	0 0003	0 00024	0 00084	0 0004	232804	3880 1	762	27 6	760 69217	27 6	11	3 32	7 73	3 32
11	*98826>0 45F*	*0 45 20micr*	*RF5Am2*	*1*	*2*	*0 205*	0 0003	0 00024	0 00084	0 0004	*1E+06*	*16822*	*3620*	*60 14*	3614 33	60 14	*69*	*8 31*	54 82	8 31
12	98826>0 45C	0 45 5 micr	RF6Am	122	3	0 198	0 0012	0 00045	0 00034	0 0002	232804	3880 1	702	26 5	697 4226	26 5	43	6 56	41 69	6 56
13	*98826>0 45C*	*0 45 5 micr*	*RF6Am2*	*122*	*3*	*0 198*	0 0019	0 00056	0 00034	0 0002	*1E+06*	*16822*	*3840*	*61 98*	3808 814	61 98	*191*	*13 82*	185 33	13 82
14	988260 1U	<0 1 micron	RF7Am	20	2	0 205	0 0003	0 00024	0 00084	0 0004	419078	6984 6	1130	33 66	1127 6457	33 66	18	4 24	12 11	4 24
15	988260 1R	0 1 0 45	RF8Am	20	2	0 205	0 0002	0 00017	0 00084	0 0004	328068	5467 8	455	21 33	454 0785	21 33	13	3 61	8 39	3 61
16	98826100U	<100kDa	RF9Am	40	3	0 198	0 0013	0 00048	0 00034	0 0002	419138	6985 6	961	31	951 58159	31	27	5 2	24 65	5 20
17	98826100R	100kDa 0 4	RF10Am	40	3	0 198	0 0008	0 00038	0 00034	0 0002	351938	5865 6	11	3 32	6 0572727	3 32	2	1 41	0 02	1 41
18	BLANK SPIKE		RF11Am	1	7	0 205	0 0003	0 00024	0 00034	0 0002	432967	7216 1	7	2 65	4 5677446	2 65	11	3 32	8 57	3 32
19	98827AWH	whole water	RF13Am	10	4	0 190	0	0	0 00034	0 0002	351938	5865 6	1650	40 56	1650	40 56	59	7 68	57 02	7 68
20	98827ATD	<0 45micron	RF14Am	20	5	0 255	0 0002	0 00017	0 00017	0 0002	410759	6846	1560	39 5	1558 8462	39 5	32	5 66	30 85	5 66
21	98827A>20F	>20 micron	RF15Am	12	9	0 233	0 0015	0 00051	0 00067	0 0003	433155	7219 3	1730	41 61	1719 0499	41 61	120	10 95	115 13	10 95
22	98827A>5C	>5 micron	RF16Am	180	12	0 242	0 0006	0 00029	0 00072	0 0003	415476	6924 6	1610	40 06	1605 9943	40 06	924	30 4	918 99	30 40
23	**98827A>5C**	**>5 micron**	**RF16Am**				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
24	98827A>0 45	0 45 20micr	RF17Am	6	10	0 244	0 0015	0 00051	0 00017	0 0002	433155	7219 3	1870	43 22	1859 0499	43 22	43	6 56	41 78	6 56
25	98827A>0 45	0 45 5 micr	RF18Am	180	11	0 217	8E 05	3 8E-05	8 4E-05	4E-05	433154	7219 2	124	11 14	123 39166	11 14	143	11 96	142 39	11 96
26	*98827A>0 45*	*0 45 5 micr*	*RF18Am2*	*180*	*4*	*0 190*	0	0	0 00017	0 0002	*1E+06*	*16823*	*276*	*16 61*	276	16 61	*240*	*15 49*	237 16	15 49
27	98827A0 1U	<0 1 micron	RF19Am	20	4	0 190	0	0	0 00017	0 0002	419190	6986 5	821	28 65	821	28 65	14	3 74	12 82	3 74
28	98827A0 1U	<0 1 micron	RF19Am				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
29	98827A0 1R	0 1 0 45	RF20Am	20	9	0 233	0 0012	0 00045	0 00067	0 0003	410524	6842 1	292	17 082	283 92822	17 082	7	2 646	2 39	2 65
30	*98827A0 1R*	*0 1 0 45*	*RF20Am2*	*20*	*5*	*0 255*	0 0002	0 00017	0 00017	0 0002	*1E+06*	*16793*	*143*	*11 96*	140 16988	11 96	*17*	*4 12*	14 17	4 12
31	98827A100U	<100kDa	RF21Am	40	10	0 244	0 0015	0 00051	0 00017	0 0002	414697	6911 6	1510	38 85	1499 5165	38 85	28	5 29	26 84	5 29
32	98827A100R	100kDa 0 4	RF22Am	40	9	0 233	0 0015	0 00051	0 00067	0 0003	413052	6884 2	673	25 94	662 55808	25 94	23	4 8	18 36	4 80
33	98827A<0 45	<0 45	RF23Am	5	8	0 233	0	0	0 00017	0 0002	410766	6846 1	1260	35 5	1260	35 5	29	5 39	27 85	5 39
34	98827BWH	whole water	RF24Am	10	1	0 201	0 0002	0 00017	0 00051	0 0003	410518	6842	763	27 62	761 84691	27 62	19	4 36	15 54	4 36
35	98827b>20f	>20 micron	RF26Am	12	12	0 242	0 0007	0 00032	0 00072	0 0003	433155	7219 3	1310	36 12	1304 7798	36 12	58	7 62	52 78	7 62
36	98827B0 1U	<0 1micron	RF27Am	*20*	*6*	*0 193*	*0 0008*	*0 00038*	*0 00135*	*0 0005*	*410760*	*6846*	*1590*	*39 91*	*1584 2312*	*39 91*	30	5 48	20 77	5 48
37	98827B0 1U	<0 1micron	RF27Am				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
38	98827B0 1R	0 1 0 45 mi	RF28Am	20	2	0 205	0 0003	0 00024	0 00084	0 0004	410518	6842	652	25 53	649 69383	25 53	31	5 57	25 23	5 57
39	98827B100U	<100kDa	RF29Am	40	3	0 198	0 0012	0 00045	0 00017	0 0002	410517	6842	786	28 04	777 9284	28 04	47	6 86	45 85	6 86
40	98827B100R	100kDa 0 4	RF30Am	40	4	0 190	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	410524	6842 1	288	16 97	#DIV/0!	#DIV/0!	8	2 83	#DIV/0!	#DIV/0!
41	*98827B100R*	*100kDa 0 4*	*RF30Am2*	*40*	*6*	*0 193*	0 0007	0 00034	0 00135	0 0005	*1E+06*	*16794*	*1540*	*39 29*	1528 6792	39 29	*57*	*7 55*	34 36	7 55
42	BLANK SPIKE		RF31Am	1	7	0 205	0 0005	0 00029	0 00034	0 0002	410759	6846	1290	35 97	1286 5388	35 97	17	4 12	14 69	4 12
43																				
44																				
45																				
46																				
47																				
48																				
49	Blank																			
50	0 0128	0 0036	dpm																	
51	0 0058	0 0016	pCi																	

195

	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1																
2																
3	Am 243		Am 241		Am 243		Am 241		Am 241				Am 241			
4	cpm		cpm		dpm added		dpm	+/-	blank corrected		pCi		pCi/l		%recovery	
5	0 23	0 01	0 01	0 00	1 12	0 0087	0 0481	0 0067	0 0353	0 0076	0 0160	0 0034	0 0040	0 0009	100 73	2 771
6	0 17	0 00	0 01	0 00	1 12	0 0087	0 0369	0 0063	0 0241	0 0073	0 0110	0 0033	0 0005	0 0002	74 328	2 1828
7	0 03	0 00	0 00	0 00	1 12	0 0087	0 2050	0 0533	0 1922	0 0534	0 0874	0 0243	0 0087	0 0024	11 921	1 1699
8	*0 04*	*0 00*	*0 00*	*0 00*	*1 12*	*0 009*	*0 1252*	*0 0157*	*0 1124*	0 0161	*0 0511*	*0 0073*	*0 0051*	*0 0007*	*18 32*	*0 698*
9	0 23	0 01	0 19	0 01	1 13	0 0088	0 9103	0 0342	0 8975	0 0344	0 4079	0 0156	0 0033	0 0001	94 083	2 3646
10	0 20	0 01	0 00	0 00	1 12	0 0087	0 0114	0 0049	0 0014	0 0061	-0 0006	0 0028	0 0006	0 0028	85 484	3 1068
11	*0 21*	*0 00*	*0 00*	*0 00*	*1 12*	*0 009*	*0 0170*	*0 0026*	*0 0042*	0 0044	*0 0019*	*0 0020*	*0 0019*	*0 0020*	*93 68*	*1 565*
12	0 18	0 01	0 01	0 00	1 12	0 0087	0 0670	0 0108	0 0542	0 0114	0 0246	0 0052	0 0002	0 0000	80 911	3 0793
13	*0 23*	*0 00*	*0 01*	*0 00*	*1 12*	*0 009*	*0 0545*	*0 0042*	*0 0417*	0 0055	*0 0190*	*0 0025*	*0 0002*	*0 0000*	*101 9*	*1 665*
14	0 16	0 00	0 00	0 00	1 12	0 0087	0 0120	0 0042	0 0008	0 0056	-0 0003	0 0025	0 00002	0 0001	70 395	2 1056
15	0 08	0 00	0 00	0 00	1 12	0 0087	0 0207	0 0090	0 0079	0 0097	0 0036	0 0044	0 0002	0 0002	36 21	1 7032
16	0 14	0 00	0 00	0 00	1 13	0 0088	0 0293	0 0062	0 0165	0 0072	0 0075	0 0033	0 0002	0 0001	60 776	1 9836
17	0 00	0 00	0 00	0 00	1 12	0 0087	0 0042	0 2607	0 0086	0 2607	-0 0039	0 1185	0 0001	0 0030	0 4648	0 2548
18	0 00	0 00	0 00	0 00	1 12	0 0087	2 1008	1 4656	2 0880	1 4657	0 9491	0 6662	0 9491	0 6662	0 2762	0 1602
19	0 28	0 01	0 01	0 00	1 12	0 0087	0 0387	0 0053	0 0259	0 0064	0 0118	0 0029	0 0012	0 0003	132 38	3 2621
20	0 23	0 01	0 00	0 00	1 12	0 0087	0 0222	0 0041	0 0094	0 0055	0 0043	0 0025	0 0002	0 0001	79 853	2 0283
21	0 24	0 01	0 02	0 00	1 14	0 0089	0 0764	0 0075	0 0636	0 0083	0 0289	0 0038	0 0024	0 0003	89 651	2 1755
22	0 23	0 01	0 13	0 00	1 13	0 0088	0 6466	0 0268	0 6338	0 0270	0 2881	0 0123	0 0016	0 0001	84 812	2 1207
23										0 0036			**0 0016**	**0 0001**	**84 812**	**2 1207**
24	0 26	0 01	0 01	0 00	1 13	0 0088	0 0254	0 0040	0 0126	0 0054	0 0057	0 0025	0 0010	0 0004	93 366	2 1763
25	0 02	0 00	0 02	0 00	1 13	0 0088	1 3040	0 1608	1 2912	0 1608	0 5869	0 0731	0 0033	0 0004	6 9849	0 631
26	*0 02*	*0 00*	*0 01*	*0 00*	*1 13*	*0 009*	*0 9710*	*0 0862*	*0 9582*	0 0863	*0 4356*	*0 0392*	*0 0024*	*0 0002*	*7 652*	*0 461*
27	0 12	0 00	0 00	0 00	1 12	0 0087	0 0175	0 0051	0 0047	0 0063	0 0021	0 0029	0 00011	0 0001	55 301	1 9332
28										0 0036			0 00011	0 0001	55 301	1 9332
29	0 04	0 00	0 00	0 00	1 12	0 0087	0 0094	0 0105	-0 0034	0 0111	-0 0015	0 0050	-0 00008	0 0003	15 902	0 9577
30	*0 01*	*0 00*	*0 00*	*0 00*	*1 12*	*0 009*	*0 1132*	*0 0343*	*0 1004*	0 0345	*0 0457*	*0 0157*	*0 00228*	*0 0008*	*2 927*	*0 25*
31	0 22	0 01	0 00	0 00	1 13	0 0088	0 0202	0 0040	0 0074	0 0054	0 0034	0 0025	0 0001	0 0001	78 661	2 0428
32	0 10	0 00	0 00	0 00	1 12	0 0087	0 0310	0 0082	0 0182	0 0090	0 0083	0 0041	0 0002	0 0001	36 882	1 4462
33	0 18	0 01	0 00	0 00	1 11	0 0087	0 0245	0 0048	0 0117	0 0060	0 0053	0 0027	0 0011	0 0005	71 281	2 0127
34	0 11	0 00	0 00	0 00	1 12	0 0087	0 0228	0 0065	0 0101	0 0074	0 0046	0 0034	0 0005	0 0003	49 502	1 7976
35	0 18	0 01	0 01	0 00	1 13	0 0088	0 0457	0 0067	0 0329	0 0076	0 0150	0 0035	0 0012	0 0003	66 18	1 8361
36	0 23	0 01	0 00	0 00	1 12	0 0087	0 0147	0 0039	0 0019	0 0053	0 0009	0 0024	0 0000	0 0001	107 05	2 7034
37										0 0036			0 0000	0 0001	107 05	2 7034
38	0 09	0 00	0 00	0 00	1 11	0 0087	0 0431	0 0097	0 0303	0 0103	0 0138	0 0047	0 0007	0 0002	41 777	1 6442
39	0 11	0 00	0 01	0 00	1 13	0 0088	0 0666	0 0102	0 0538	0 0109	0 0245	0 0049	0 0006	0 0001	50 728	1 8316
40	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1 11	0 0087	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
41	*0 09*	*0 00*	*0 00*	*0 00*	*1 11*	*0 009*	*0 0249*	*0 0055*	*0 0122*	0 0066	*0 0055*	*0 0030*	*0 00014*	*0 0001*	*42 49*	*1 095*
42	0 19	0 01	0 00	0 00	1 12	0 0087	0 0128	0 0036	0 0000	0 0051	0 0000	0 0023	0 0000	0 0023	81 993	2 2974
43																
44																
45																
46																
47																
48																
49																
50																
51																

196

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	ROCKY FLATS PU																			
2	Sample 8-98		3/2/99				242		240											
3							det				count									
4	Sample		ID	vol	DET	eff	bkg				time	(min)	242Pu	+/-	bkg corrected		239 240Pu	+/	Bkg corrected	
5	98826WH	whole water	RF1Pu	4	1	0 2	0 0025	0 0025	0 0003	0 0002	401793	6696 6	77	8 77	60 071	19 065	121	11	118 7428	11 115
6	98826TD	<0 45micron	RF2Pu	20	10	0 24	0 001	0 001	0 0007	0 0003	409848	6830 8	1540	39 22	1533 1	39 824	49	7	44 39516	7 369
7	98826>20F	>20 micron	RF3Pu	10	4	0 19	0 0007	0 0007	0 0002	0 0002	370278	6171 3	1480	38 52	1475 8	38 744	129	11 36	127 96	11 408
8	*98826>20F*	*>20 micron*	*RF3Pu2*	*10*	*7*	*0 2*	*0 0012*	*0 0012*	*0 0003*	*0 0002*	*1E+06*	*16795*	*2690*	*51 87*	*2670*	*55 53*	*227*	*15 07*	*221 339*	*15 593*
9	98826>5C	>5 micron	RF4Pu	122	2	0 2	0 0017	0 0017	0 0002	0 0002	401794	6696 6	1250	35 37	1238 7	37 127	2250	47 4	2248 871	47 413
10	98826>0 45F	0 45 20micr	RF5Pu	1	2	0 2	0 0017	0 0017	0 0002	0 0002	370278	6171 3	1310	36 19	1299 6	37 655	14	3 74	12 95994	3 882
11	98826>0 45F	0 45 20micr	RF5Pu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
12	98826>0 45C	0 45 5 micr	RF6Pu	122	3	0 2	0 001	0 001	0 0008	0 0004	370278	6171 3	1280	35 71	1273 8	36 251	103	10 15	97 7997	10 413
13	98826>0 45C	0 45 - 5 micr	RF6Pu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
14	988260 1U	<0 1 micron	RF7Pu	20	11	0 22	0 0015	0 0015	0 0005	0 0003	409849	6830 8	1253	35 46	1242 6	36 943	24	4 8984	20 54632	5 289
15	988260 1R	0 1 0 45	RF8Pu	20	8	0 23	0 0008	0 0008	0 0003	0 0002	401795	6696 6	1200	34 64	1194 4	35 097	38	6 16	35 74283	6 363
16	98826100U	<100kDa	RF9Pu	40	12	0 24	0 0006	0 0006	0 0006	0 0003	409844	6830 7	91	9 5368	87 049	10 323	12	3 4644	8 048601	3 988
17	98826100R	100kDa 0 4	RF10Pu	40	4	0 19	0 0007	0 0007	0 0002	0 0002	401794	6696 6	2710	52 04	2705 5	52 235	49	7	47 87144	7 090
18	BLANK SPIKE		RF11Pu	1	4	0 19	0 0013	0 0013	0 0003	0 0002	370283	6171 4	1190	34 45	1181 7	35 441	2	1 41	0 08012	2 038
19	98827AWH	whole water	RF13Pu	10	5	0 25	0 0002	0 0002	0 0002	0 0002	401921	6698 7	1250	35 28	1248 9	35 298	73	8 54	71 87107	8 614
20	98827ATD	<0 45micron	RF14Pu	20	5	0 25	0 0002	0 0002	0 0002	0 0002	232948	3882 5	1010	31 72	1009 3	31 727	14	3 74	13 34569	3 797
21	98827A>20F	>20 micron	RF15Pu	12	6	0 19	0 0005	0 0005	0 0008	0 0004	341755	5695 9	1080	32 79	1077 1	32 916	129	11 36	124 2003	11 561
22	98827A>5C	>5 micron	RF16Pu	180	6	0 19	0 0007	0 0007	0 0013	0 0005	401921	6698 7	1670	40 89	1665 5	41 139	2140	46 24	2130 969	46 350
23	*98827A>5C*	*>5 micron*	*RF16Pu*	*180*	*11*	*0 22*	*0 0015*	*0 0015*	*0 0005*	*0 0003*	*591473*	*9857 9*	*2340*	*48 37*	*2325*	*50 63*	*3220*	*56 71*	*3215 02*	*56 783*
24	98827A>0 45F	0 45 20micr	RF17Pu	6	7	0 2	0 001	0 001	0 0007	0 0003	369805	6163 4	826	28 74	819 77	29 408	50	7 07	45 84506	7 369
25	98827A>0 45C	0 45 5 micr	RF18Pu	180	8	0 23	0 0015	0 0015	0 0005	0 0003	369806	6163 4	1320	36 3	1310 7	37 485	155	12 45	151 8838	12 579
26	98827A>0 45C	0 45 - 5 micr	RF18Pu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
27	98827A0 1U	<0 1 micron	RF19Pu	20	6	0 19	0 0007	0 0007	0 0013	0 0005	232948	3882 5	980	31 262	977 38	31 371	13	3 6062	7 765522	4 053
28	*98827A0 1U*	*<0 1 micron*	*RF19Pu*	*20*	*8*	*0 23*	*0 001*	*0 001*	*0*	*0*	*1E+06*	*16796*	*3870*	*62 2*	*3853*	*64 48*	*35*	*5 92*	*35*	*5 920*
29	98827A0 1R	0 1 - 0 45	RF20Pu	20	5	0 25	0 0002	0 0002	0 0002	0 0002	432965	7216 1	2330	48 22	2328 8	48 235	26	5 1	24 78387	5 243
30	98827A0 1R	0 1 0 45	RF20Pu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
31	98827A100U	<100kDa	RF21Pu	40	6	0 19	0 0008	0 0008	0 0013	0 0005	432966	7216 1	1470	38 33	1463 9	38 809	42	6 48	32 271	7 336
32	98827A100R	100kDa - 0 4	RF22Pu	40	7	0 2	0 0013	0 0013	0 0003	0 0002	401921	6698 7	830	28 81	820 97	30 192	19	5 0787	4 36	5 324
33	98827A<0 45 cart	<0 45	RF23Pu	5	8	0 23	0	0	0 0002	0 0002	401921	6698 7	1060	32 51	1060	32 51	8	2 83	6 871075	3 047
34	98827BWH	whole water	RF24Pu	10	9	0 23	0 0005	0 0005	0 0008	0 0004	401942	6699	653	25 55	649 61	25 774	22	4 69	16 35497	5 326
35	98827b>20f	>20 micron	RF26Pu	12	9	0 23	0 0006	0 0006	0 0006	0 0003	369891	6164 9	1320	36 39	1316 4	36 564	80	8 94	76 4338	9 116
36	98827B0 1U	<0 1micron	RF27Pu	20	7	0 2	0 0013	0 0013	0 0003	0 0002	232948	3882 5	965	31 073	959 77	31 511	6	2 4492	4 691381	2 618
37	*98827B0 1U*	*<0 1micron*	*RF27Pu*	*20*	*9*	*0 23*	*0 0005*	*0 0005*	*0 0008*	*0 0004*	*1E+06*	*16777*	*3950*	*62 87*	*3942*	*63 44*	*42*	*6 48*	*27 8627*	*9 053*
38	98827B0 1R	0 1 0 45 mic	RF28Pu	20	10	0 24	0 001	0 001	0 0007	0 0003	401943	6699 1	1700	41 28	1693 2	41 832	14	3 74	9 483977	4 369
39	98827B100U	<100kDa	RF29Pu	40	11	0 22	0 0015	0 0015	0 0005	0 0003	401942	6699	566	23 79	555 84	25 869	16	4	12 61295	4 452
40	98827B100R	100kDa - 0 4	RF30Pu	40	12	0 24	0 0006	0 0006	0 0006	0 0003	401941	6699	1610	40 1	1606 1	40 287	22	4 69	18 1248	5 074
41	98827B100R	100kDa - 0 4	RF30Pu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										
42	BLANK SPIKE		RF31Pu	1	8	0 23	0	0	0 0002	0 0002	232948	3882 5	960	31 296	960	31 296	3	1 7322	2 34569	1 852
43	*BLANK SPIKE*		*RF31Pu*	*1*	*10*	*0 24*	*0 001*	*0 001*	*0 0007*	*0 0003*	*1E+06*	*16779*	*4870*	*69 81*	*4853*	*71 84*	*13*	*3 61*	*1 68857*	*6 710*
44																				
45																				
46																				
47																				
48	Blank																			
49	0 0005	0 0019	dpm																	
50	0 000211927	0 00084211	pCi																	

197

	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1																
2																
3					242 spike		239 240Pu						Pu 239 240			
4	242 cpm		240 cpm		(dpm)	err	DPM	+/	dpm blank corr		pCi		pCi/l		% recovery	+/
5	0 0090	0 0028	0 0177	0 0017	1 35	0 0100	2 669	0 883	2 668	0 883	1 213	0 401	0 3032	0 1003	3 31	1 05
6	0 2244	0 0058	0 0065	0 0011	1 35	0 0100	0 039	0 007	0 039	0 007	0 018	0 003	0 0009	0 0002	68 11	1 84
7	0 2391	0 0063	0 0207	0 0018	0 996	0 0074	0 086	0 008	0 086	0 008	0 039	0 004	0 0039	0 0004	126 55	3 45
8	*0 1590*	*0 0033*	*0 0132*	*0 0009*	*0 996*	*0 0074*	*0 083*	*0 006*	*0 082*	0 006	*0 037*	*0 003*	*0 0037*	*0 0003*	*78 00*	*1 72*
9	0 1850	0 0055	0 3358	0 0071	0 996	0 0074	1 808	0 066	1 808	0 066	0 822	0 030	0 0067	0 0002	90 70	2 80
10	0 2106	0 0061	0 0021	0 0006	0 996	0 0074	0 010	0 003	0 009	0 004	0 004	0 002	0 0043	0 0016	103 25	3 09
11													0 0030	0 0016	103 25	3 09
12	0 2064	0 0059	0 0158	0 0017	0 996	0 0074	0 076	0 008	0 076	0 009	0 035	0 004	0 0003	0 0000	104 48	3 07
13													0 0003	0 0000	104 48	3 07
14	0 1819	0 0054	0 0030	0 0008	1 35	0 0100	0 022	0 006	0 022	0 006	0 010	0 003	0 0005	0 0001	62 23	1 91
15	0 1784	0 0052	0 0053	0 0010	1 35	0 0100	0 040	0 007	0 040	0 008	0 018	0 003	0 0009	0 0002	56 80	1 72
16	0 0127	0 0015	0 0012	0 0006	1 37	0 0101	0 127	0 065	0 126	0 065	0 057	0 029	0 0014	0 0007	3 85	0 46
17	0 4040	0 0078	0 0071	0 0011	1 35	0 0100	0 024	0 004	0 023	0 004	0 011	0 002	0 0003	0 0000	157 73	3 26
18	0 1915	0 0057	0 0000	0 0003	0 996	0 0074	0 0001	-0 002	-0 001	0 003	0 000	0 001	-0 0002	0 0011	101 32	3 13
19	0 1864	0 0053	0 0107	0 0013	1 35	0 0100	0 078	0 010	0 077	0 010	0 035	0 004	0 0035	0 0004	54 24	1 58
20	0 2600	0 0082	0 0034	0 0010	1 35	0 0100	0 018	0 005	0 017	0 005	0 008	0 002	0 0004	0 0001	75 64	2 44
21	0 1891	0 0058	0 0218	0 0020	0 996	0 0074	0 115	0 011	0 114	0 011	0 052	0 005	0 0043	0 0004	98 37	3 09
22	0 2486	0 0061	0 3181	0 0069	0 996	0 0074	1 274	0 042	1 274	0 042	0 579	0 019	0 0032	0 0001	129 34	3 34
23	*0 2359*	*0 0051*	*0 3261*	*0 0058*	*0 996*	*0 0074*	*1 377*	*0 039*	*1 377*	0 039	*0 626*	*0 018*	*0 0035*	*0 0001*	*109 35*	*2 51*
24	0 1330	0 0048	0 0074	0 0012	0 996	0 0074	0 056	0 009	0 055	0 009	0 025	0 004	0 0042	0 0007	65 26	2 39
25	0 2126	0 0061	0 0246	0 0020	0 996	0 0074	0 115	0 010	0 115	0 010	0 052	0 005	0 0003	0 0000	91 79	2 71
26										0 002			0 0003	0 0000	91 79	2 71
27	0 2517	0 0081	0 0020	0 0010	1 36	0 0101	0 011	0 006	0 010	0 006	0 005	0 003	0 0002	0 0001	95 91	3 16
28	*0 2294*	*0 0038*	*0 0021*	*0 0004*	*1 36*	*0 0101*	*0 012*	*0 002*	*0 012*	0 003	*0 005*	*0 001*	*0 0003*	*0 0001*	*72 52*	*1 33*
29	0 3227	0 0067	0 0034	0 0007	1 35	0 0100	0 014	0 003	0 014	0 004	0 006	0 002	0 0003	0 0001	93 89	2 07
30													0 0003	0 0001	93 89	2 07
31	0 2029	0 0054	0 0045	0 0010	1 35	0 0100	0 030	0 007	0 029	0 007	0 013	0 003	0 0003	0 0001	77 86	2 14
32	0 1226	0 0045	0 0007	0 0008	1 35	0 0100	0 007	0 009	0 007	0 009	0 003	0 004	0 0001	0 0001	44 36	1 66
33	0 1582	0 0049	0 0010	0 0005	1 34	0 0099	0 009	0 004	0 008	0 004	0 004	0 002	0 0007	0 0004	50 77	1 60
34	0 0970	0 0038	0 0024	0 0008	1 35	0 0100	0 034	0 011	0 034	0 011	0 015	0 005	0 0015	0 0005	30 83	1 24
35	0 2135	0 0059	0 0124	0 0015	0 996	0 0074	0 058	0 007	0 057	0 007	0 026	0 003	0 0022	0 0003	92 02	2 65
36	0 2472	0 0081	0 0012	0 0007	1 35	0 0100	0 007	0 004	0 006	0 004	0 003	0 002	0 0001	0 0001	89 48	3 01
37	*0 2349*	*0 0038*	*0 0017*	*0 0005*	*1 35*	*0 0100*	*0 010*	*0 003*	*0 009*	0 004	*0 004*	*0 002*	*0 0002*	*0 0001*	*74 69*	*1 32*
38	0 2528	0 0062	0 0014	0 0007	1 34	0 0099	0 008	0 003	0 007	0 004	0 003	0 002	0 0002	0 0001	77 28	1 99
39	0 0830	0 0039	0 0019	0 0007	1 36	0 0101	0 031	0 011	0 030	0 011	0 014	0 005	0 0003	0 0001	28 17	1 33
40	0 2398	0 0060	0 0027	0 0008	1 34	0 0099	0 015	0 004	0 015	0 005	0 007	0 002	0 0002	0 0001	74 03	1 94
41													0 0001	0 0001	74 03	1 94
42	0 2473	0 0081	0 0006	0 0005	1 34	0 0099	0 003	0 003	0 003	0 003	0 001	0 001	0 0013	0 0014	79 33	2 65
43	*0 2892*	*0 0043*	*0 0001*	*0 0004*	*1 34*	*0 0099*	*0 0005*	*0 002*	*0 000*	0 003	*0 000*	*0 001*	*0 0000*	*0 0012*	*88 43*	*1 46*
44																
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198

TEXAS A&M UNIVERSITY
Environmental Health and Safety Department

PERMIT # 565
Expiration Date of March 27, 2001

Peter Santschi, Ph D is authorized to receive, possess use the following licensed or registered source of radiation

1 Radioisotope	2 Form of Material	3 Maximum Activity	Unit
AC-227	ANY EXCEPT SEALED SOURCES	0 00020	mCi
AG-110M	ANY EXCEPT SEALED SOURCES	2 00000	mCi
AM-241	ANY EXCEPT SEALED SOURCES	0 00100	mCi
AM-243	ANY EXCEPT SEALED SOURCES	0 00100	mCi
BA-133	ANY EXCEPT SEALED SOURCES	1 00000	mCi
C-14	ANY EXCEPT SEALED SOURCES	6 00000	mCi
CA-45	ANY EXCEPT SEALED SOURCES	1 00000	mCi
CD-109	ANY EXCEPT SEALED SOURCES	1 00000	mCi
CO-60	ANY EXCEPT SEALED SOURCES	1 00000	mCi
CR-51	ANY EXCEPT SEALED SOURCES	1 00000	mCi
CS-137	ANY EXCEPT SEALED SOURCES	0 00030	mCi
FE-55	ANY EXCEPT SEALED SOURCES	1 00000	mCi
FE-59	ANY EXCEPT SEALED SOURCES	2 50000	mCi
H-3	ANY EXCEPT SEALED SOURCES	10 5000	mCi
HG-203	ANY EXCEPT SEALED SOURCES	4 00000	mCi
I-125	ANY EXCEPT SEALED SOURCES	1 00000	mCi
I-131	ANY EXCEPT SEALED SOURCES	2 00000	mCi
MN-54	ANY EXCEPT SEALED SOURCES	1 00000	mCi
NI-63	ANY EXCEPT SEALED SOURCES	1 00000	mCi
NP-237	ANY EXCEPT SEALED SOURCES	0 00010	mCi
PB-210	ANY EXCEPT SEALED SOURCES	0 00025	mCi
PO-208	ANY EXCEPT SEALED SOURCES	0 00001	mCi
PO-209	ANY EXCEPT SEALED SOURCES	0 00100	mCi
PO-210	ANY EXCEPT SEALED SOURCES	0 00100	mCi
PU-236	REFERENCE STD SOLUTION	0 00050	mCi
PU-239	ENVIRONMENTAL SAMPLES	0 00010	mCi
PU-240	ENVIRONMENTAL SAMPLES	0 10000	uCi
PU-241	ENVIRONMENTAL SAMPLES	0 01000	uCi
PU-242	REFERENCE STD SOLUTION	0 10000	uCi
RA-226	ANY EXCEPT SEALED SOURCES	0 00007	mCi
RA-228	ANY EXCEPT SEALED SOURCES	0 00001	mCi
S-35	ANY EXCEPT SEALED SOURCES	1 00000	mCi
SN-113	ANY EXCEPT SEALED SOURCES	1 30000	mCi
TH-228	ANY EXCEPT SEALED SOURCES	0 00100	mCi
TH-229	ANY EXCEPT SEALED SOURCES	0 02000	mCi
TH-230	ANY EXCEPT SEALED SOURCES	0 00015	mCi
TH-232	ANY EXCEPT SEALED SOURCES	0 00100	mCi
TH-234	ANY EXCEPT SEALED SOURCES	1 00000	mCi
U-232	ANY EXCEPT SEALED SOURCES	0 00025	mCi
U-236	ANY EXCEPT SEALED SOURCES	0 00010	mCi
U-238	ANY SOLID OR LIQUID	0 17000	mCi
ZN-65	ANY EXCEPT SEALED SOURCES	2 00000	mCi

Mail Stop 4472 • College Station Texas 77843-4472 • (409) 845-2132 FAX (409) 845-1348

200

4 Location

TAMU AT GALVESTON
GALVESTON TEXAS, SITE NO 011
FT CROCKETT 201 200B 200F, 207B, 207A 100 & 206

5 Restrictions and Conditions

NONE

Christopher M. Meyer
Radiological Safety Officer

February 15, 1999
Date

201

TRC Form 12-1
(7/90)

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

Pursuant to the Texas Radiation Control Act and Texas Health Department regulations on radiation, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess and transfer radioactive material listed below, and to use such radioactive material for the purpose(s) and at the place(s) designated below This license is subject to all applicable rules, regulations and orders of the Texas Department of Health (TDH) now or hereafter in effect and to any conditions specified below

LICENSEE	
1 Name	CHRISTOPHER M MEYER CHP TEXAS A & M UNIVERSITY
2. Address	ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT COLLEGE STATION TEXAS 77843-3261

This license is issued pursuant to and in accordance with a letter
Dated. August 27, 1998
Signed by: Chris Meyer, RSO, M.A Walker, RSC & R.L. Floyd, VP

3. License Number	Amendment Number
L00448	96

PREVIOUS AMENDMENTS ARE VOID

4. Expiration Date
September 30, 2004

RADIOACTIVE MATERIAL AUTHORIZED

5 Radioisotope	6 Form of Material	7 Maximum Activity*	8 Authorized Use
A. Any radioactive material with Atomic Number less than 84	A. Any (except sealed sources)	A. 20 Ci of any single radionuclide. Total not to exceed 200 Ci	A. Research and education.
B. Any radioactive material with Atomic Number less than 84	B. Sealed sources and devices	B. Any single source not to exceed 20 Ci. Total not to exceed 200 Ci	B. Research and education.
C. Any radioactive material (per TAMU ltr dtd June 12, 96)	C. Sealed sources and devices	C. Any single source not to exceed 20 Ci. Total not to exceed 200 Ci	C. Research and education
D. Any radioactive material with Atomic Number 84 or greater, except special nuclear material	D. Any (except sealed sources)	D. 50 mCi of any single radionuclide. Total not to exceed 5 Ci	D. Research and education.
E. Any radioactive material with Atomic Number or greater, except special nuclear material	E. Sealed sources and devices	E. Any single source not to exceed 100 mCi Total not to exceed 500 mCi	E. Research and education.

*Ci-Curie mCi-Millicuries μCi-Microcuries

°Texas Administrative Code (TAC)

202

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

5 Radioisotope (continued)	6 Form of Material (continued)	7 Maximum Activity (continued)	8 Authorized Use (continued)
F. H-3	F. Any (except sealed sources)	F. 100 Ci	F. Research and education.
G. H-3	G. Sealed sources	G. 30 Ci	G. Research and education.
H. Uranium (non-enriched)	H. Any solid or liquid	H. 2555 Kg	H. Research and education.
I. U-233	I. Any solid or liquid	I. 1 gm	I. Research and education.
J. Am-241	J. Sealed sources	J. 5 Ci	J. Research, education and soil testing in portable moisture and moisture/density gauges.
K. Cs-137	K. Sealed sources	K. 0.5 Ci	K. Research and education and soil testing in portable moisture and moisture/density gauges.
L. Pu-242	L. Plated foils	L. 3 μCi	L. Research and education.
M. Co-60	M Sealed sources (U.S. Nuclear Corp.)	M. 12,000 Ci	M. Radiation research in a U.S. Nuclear custom made self-shielded irradiator.
N. Co-60	N. Sealed sources (AECL C-146, C-151; NPI NPTT Series)	N. Two sources not to exceed 10,000 Ci each Total: 20,000 Ci	N. One source for research and treatment of animals in a Theratronics Theratron 780 teletherapy unit and the other source for storage in its authorized shipping container during periods of source exchange.
O. Any radio-active material	O. Any except gaseous	O. 0.1 μCi per gram or ml, not to exceed 1 μCi per sample	O. Analysis of samples.
P. Am-243	P. Solid	P. 500 mg	P. Research and education in accordance with the letter of April 26, 1993.

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

5 Radioisotope (continued)	6 Form of Material (continued)	7 Maximum Activity* (continued)	8 Authorized Use (continued)
Q. Ni-63	Q. Foil sources in ECD cells	Q. No single source to exceed 20 mCi. Total: 600 mCi	Q. ECD cell sources used in gas chromatographs.
R. Pu-236	R. Reference standard solution	R. 1 μCi	R. Research and education.
S. Pu-239	S. Environmental samples	S. 1 μCi	S. Research and education.
T. Pu-240	T. Environmental samples	T. 1 μCi	T. Research and education.
U. Pu-241	U. Environmental samples	U. 0.1 μCi	U. Research and education.
. Pu-242	V. Reference standard solution	V. 1 μCi	V. Research and education.
W. Am-241	**W. Sealed (Schlumberger Dwg. No. H-142108)**	**W. 20 Ci**	**W. Research and education.**

9. Radioactive material shall be used at:

Site Number	Location
	Texas Public Health Region 1
002	Plainview - Texas Agricultural Experiment Station (TAES): 15 miles west of Plainview on Highway 70, southwest corner of Halfway community.
003	Lubbock - TAES: I-27 north of Lubbock, take Exit 11 to FM 1294, 1/2 mile east to station.
004	Amarillo - TAES: 6500 Amarillo, Boulevard West.
006	Bushland - TAES: I-40, 1/2 mile west of Bushland, on south access road to station.
	Texas Public Health Region 2
017	Vernon - TAES: U.S. 70 southwest of Vernon, 5 miles to station on the right.
020	Munday - TAES: Hwy 277 east to station at city limits.

204

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

9. (Continued).

Texas Public Health Region 3

Site Number	Location
016	Stephenville - Tarleton State University, Biology Department, 1299 Washington Avenue.
019	Stephenville - TAES: U.S. 281 north to intersection with FM 8.

Texas Public Health Region 4

023	Overton - TAES: FM 850 west of Overton to Motley Drive to FM 3053, 2 miles to station.

Texas Public Health Region 6

011	Galveston - Texas A & M University at Galveston: Fort Crockett, 5007 Avenue U.
014	Prairie View - Prairie View A & M University: Cooperative Agriculture Research Center; Department of Physics.

Texas Public Health Region 7

000	College Station - The Texas A & M main campus and contiguous sites which are under the licensee's administrative control, excluding the areas inside the fenced property of the Nuclear Engineering Station (reactor facility, laboratories and grounds).
032	Temple - Olin E. Teague Veteran's Center, 1901 South First Street, Building No. 147 and Building No. 4.

Texas Public Health Region 9

009	Pecos - TAES: I-20 West of Pecos, 7 miles to exit 33, west on South access road to station.
010	San Angelo - TAES: 7887 North Highway 87.
034	Sonora - TAES: Highway 277 South 22 miles, turn southeast (left) 5 miles to station.
037	Fort Stockton - TAES: Highway 285 North and Airport Drive.

205

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

9. (Continued).

Site Number	Location
	Texas Public Health Region 10
007	El Paso - TAES: 1380 A and M Circle.
	Texas Public Health Region 11
026	Weslaco - TAES: 2415 East Highway 83.
027	Corpus Christi - TAES: Highway 44 west to Clarkwood past the airport station on the left, 1/4 mile past Clarkwood Road.
028	Beeville - TAES: Highway 59 east 5 miles; station on the left.
035	Alice - TAES La Copita Research Area: Highway 281 south to Ben Bolt, the west 7 miles on County Road 106. At sign, turn north 1 mile on to La Copita Ranch to station.

10. Each site shall maintain documents and records pertinent to the operations at that site. Copies of all documents and records required by this license shall be maintained for Agency review at Site 000.

11. **The licensee shall comply with the provisions (as amended) of 25 Texas Administrative Code (TAC) §289.201 [Texas Regulations for Control of Radiation (TRCR) Part 11], §289.202 [TRCR Part 21], §289.203 [TRCR Part 22], §289.204 [TRCR Part 12], §289.251 [TRCR Part 40], §289.252 [TRCR Part 41], §289.256 [TRCR Part 33] and §289.257. Further, the licensee shall comply with the provisions of Part 13 of the TRCR.**

12. A. Radioactive material in portable gauges or instruments may also be used at temporary job sites throughout Texas.

    B. H-3, C-14, P-32, S-35, Ca-45, Ni-63, and Cs-134 may also be used as described by letters of May 15, 1991 and December 3, 1991 aboard the research vessels GYRE and POWELL, while it is in port or sailing in waters where the Texas Department of Health, Bureau of Radiation Control (TDH-BRC) maintains jurisdiction.

    C. Radioactive material authorized by conditions 5, 6, 7 and 8, items R, S, T, U and V, shall be used only at Site 011.

206

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

13. Radioactive material shall only be used by, or under the supervision of, individuals designated by the licensee's Radiological Safety Board, M. Walker, D.V.M., Chair. Individuals authorized to serve on this board are:

J. W. Dieckert, Ph.D.	(Plant Pathology Department)
J. W. Evans, Ph.D.	(Animal Sciences Department)
Ken D. Kihm, Ph.D.	(Mechanical Engineering Department)
James R. Manhart, Ph.D.	(Biology Department)
J. W. Poston, Ph.D.	(Nuclear Engineering Department)
R. P. Schmitt. Ph.D.	(Chemistry Department)
M. Walker, D.V.M.	(Veterinary Radiology Department)

Ex Officio Members

Richard L Floyd, Ph.D.	(V. P. for Finance and Controller)
Lucille B Isdale, Ph.D.	(Beutel Health Center)

14. The individual designated to perform the functions of Radiation Safety Officer (RSO) for activities covered by this license is Christopher M. Meyer, C.H.P.

15. Sealed sources containing radioactive material shall not be opened.

16. In accordance with 25 TAC §289.201(g) [TRCR 11.7(a)(2)], each sealed source that is not designed to emit alpha particles may be tested at intervals specified by the Registry of Radioactive Sealed Sources and Devices (SSD) safety evaluation.

17. The licensee shall maintain a copy of the SSD safety evaluation for each radioactive sealed source model received under Parts B, E, G, J, K, L and Q of License Conditions 5, 6, 7 and 8.

18. A. The licensee is authorized to perform in-house leak and/or contamination tests of sealed sources and calibrations of survey instruments. The licensee is also authorized to provide these services to others as a commercial service. Such tests and calibrations shall be performed by or under the supervision of individuals named by Christopher M. Meyer, C.H.P.

    B. Results of leak and/or contamination tests shall be reported in microcuries.

    C. Instruments which are routinely transported shall calibrated at intervals not to exceed six months.

    D. Records of survey instrument calibrations and leak tests shall be retained for inspection for five years. Names of individuals authorized to perform leak tests or survey instrument calibrations shall be maintained by the licensee for inspection.

207

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

18. (Continued).

    E. Survey instrument calibrations shall be performed so that radiation field uniformity is maintained within five percent throughout the active volume of the detector for the instrument under test.

19. The licensee shall not use radioactive material in or on human beings.

20. A current copy of the licensee's Precedure Manual for the Use of Radioactive Materials (formerly known as Policy Manual for the use of Radionuclides) shall be readily available to each person who uses radioactive material authorized by this license.

21. The licensee is authorized to discard radioactive material authorized in Conditions 5, 6, 7, and 8, whose half lives do not exceed 300 days, in accordance with 25 TAC §289.202(fff)(3) [TRCR 21.1304(d)].

22. All maintenance on a teletherapy unit which involves the source, source shielding or beam control mechanism, safety circuits, control panel electrical circuits, or other mechanisms that could compromise safety of the unit shall only be performed by the unit's manufacturer or by other persons specifically licensed to perform such services by the TDH-BRC an Agreement State, or by the NRC. Minor maintenance may be performed by persons approved by the licensee's Radiation Safety Board.

23. The licensee shall not open or remove sealed sources containing radioactive material from a teletherapy unit.

24. Each teletherapy facility shall be provided with a system permitting continuous observation of the patient from outside of the treatment room during patient treatment.

25. Prior to the initiation of a treatment program, each teletherapy unit shall be equipped with electrical or mechanical stops limiting use of the primary beam of radiation so as to assure compliance with TRCR 21.301 as evidenced by a radiation survey. Necessary use restrictions shall be fully described in radiation survey reports submitted in accordance with Condition 29.

26. Written instructions shall be posted at each teletherapy machine control panel. These instructions shall inform the machine operator of the procedures to be followed should he/she be unable to turn a machine's primary beam of radiation "off" with the controls outside the treatment room. These instructions shall caution individuals to avoid exposure to the primary beam of radiation when in the treatment room and shall include specific instructions for:

    A. Locating and using the device for manually turning "off" the teletherapy unit's primary beam of radiation.

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

26. (Continued).

B. Removing the patient from the treatment room.

C. Securing the treatment room against unauthorized entry.

D. Notifying the responsible physician or RSO.

27. A. Access to a teletherapy room shall be controlled by a door at each entrance. Such doors shall be normally closed.

B. Each entrance to a teletherapy room shall be equipped with an electrical interlock system that will turn the teletherapy machine's primary beam of radiation "off" immediately upon opening of any entrance door. The interlock system shall be connected in such a manner that the teletherapy machine's primary beam of radiation cannot be turned "on" until all treatment room entrance doors are closed and the beam "on-off" control is reset at the control panel.

C. Electrical interlocks on each entrance door to a teletherapy room shall be tested for proper operation at least once every six months. Records of test results shall be maintained for inspection by the TDH-BRC.

D. In the event of malfunction of any door interlock, the teletherapy machine control panel shall be locked in the "off" position and not used, except as may be necessary for the repair or replacement of the interlock system, until the interlock system is shown to be functioning properly.

28. Prior to initiation of a treatment program, and subsequent to each installation of a teletherapy source, radiation surveys and tests shall be performed in accordance with the following requirements.

A. A radiation survey shall be made of:

1. The teletherapy source housing, with the teletherapy source in the "off" position. The maximum and average radiation levels at one meter from the teletherapy source in the "off" position shall not exceed 10 milliroentgens per hour and ten milliroentgens per hour, respectively.

2. All areas adjacent to the treatment room, with the teletherapy source in the "on" position. The survey, except Part (c), shall be performed with a phantom in the primary beam of radiation and shall clearly establish:

a. That radiation levels in restricted areas are not likely to cause personnel exposure in excess of the limits specified in 25 TAC §289.202(f) [TRCR 21.201].

209

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

28. (Continued).

   b. That radiation levels in unrestricted areas do not exceed the limits specified in 25 TAC §289.202(n) [TRCR 21.301].
   c. The intensity of the primary beam of radiation at a specified distance from the teletherapy source.

   B. Tests shall be made to determine proper operation of:

      1. Electrical interlocks on entrance doors to the teletherapy treatment room.

      2. The teletherapy source "on-off" indicators, both at the source housing and on the teletherapy machine control panel.

      3. Electrical or mechanical stops installed for the purpose of limiting use of the primary beam of radiation (restriction of source housing angulation or elevation, carriage or stand travel and operation of the beam "on-off" mechanism).

      4. The teletherapy treatment timing device.

   C. A report of the results of the above surveys and tests shall be sent to the Deputy Director, Radioactive Material Inspection and Enforcement, not later than 30 days following installation of a teletherapy source.

29. Any change made in treatment room shielding, location, or use of the teletherapy machine which could result in an increase in radiation levels in unrestricted areas outside the teletherapy treatment room and made subsequent to the completion of the initial radiation survey performed in accordance with Condition 28 shall be evaluated by a radiation survey performed in accordance with Part A of Condition 28. A report describing the change(s), and giving the results of the survey(s), shall be sent to the Deputy Director, Radioactive Material Inspection and Enforcement, not later than 30 days following completion of such changes.

30. Each teletherapy machine shall be fully inspected and serviced, with the source removed from the machine, during source replacement or at intervals not to exceed five years, whichever comes first, to assure proper functioning of the source exposure mechanism. This inspection and servicing must be performed by persons specifically authorized to do so by the TDH-BRC, an Agreement State, or the NRC. A report of the inspection and servicing must be kept on file for inspection by the TDH-BRC.

210

Texas Department of Health
Bureau of Radiation Control

RADIOACTIVE MATERIAL LICENSE

LICENSE NUMBER	AMENDMENT NUMBER
L00448	96

31. The licensee shall cease treatment of patients when any safety related system of a teletherapy unit is found inoperative, including source drive mechanisms, treatment timing systems, safety interlocks and radiation field alarms. The licensee shall report to the Deputy Director, Emergency Response and Incident Investigation, any malfunction which requires the termination of patient treatments for more than 24 hours and shall submit a written report of the incident and corrective actions within seven calendar days.

32. Radiation hazard surveys shall be conducted by individuals using radioactive material as described by the licensee's Procedure Manual for the Use of Radioactive Materials (formerly known as Policy Manual for the use of Radionuclides).

33. The licensee is hereby authorized to dispose of animal carcasses containing gadolinium-153 in accordance the limitations described in letter dated April 10, 1991, and the requirements specified in 25 TAC §289.202(fff)(4) [TRCR 21.1304(d)] and 25 TAC §289.202(ggg)(4) [Appendix 21-E]. Total disposal shall not exceed 1.0 mCi of gadolinium-153.

    This training course is not authorized for medical or nuclear pharmacy technicians unless additional training, specifically approved by the TDH-BRC, is also obtained.

34. Except as specifically provided otherwise by this license, the licensee shall possess and use the radioactive material authorized by this license in accordance with statements, representations, and procedures contained in the following:

    application dated August 29, 1995 and
    letters dated August 1, 1997 and September 10, 1997.

    Title 25 TAC Chapter 289 [TRCR] shall prevail over statements contained in the above documents unless such statements are more restrictive than the regulations.

RJ:jg

FOR THE TEXAS DEPARTMENT OF HEALTH

Date October 8, 1998

D. Ray Jisha, Chief
Medical and Academic Licensing

211

Certificate Of Completion

RADIOLOGICAL SAFETY
SHORT COURSE

This certifies that **KIMBERLY ROBERTS** has satisfactorily completed the above Short Course sponsored by the

Texas A&M University

Office of Radiological Safety

and is hereby awarded this

CERTIFICATE

JUNE 19, 1998

Christopher M Meyer

Radiological Safety Officer

212

	SAMPLE LIST - ROCKY FLATS at CSM August 1998							
		sample	type	vol water	Pu-242	Am-243	vol Ppt	Notes
				(L)	(dpm)	(dpm)	(ml)	
RF1	98826__	WH	ppt	4	1 35	1 12	8	
RF2		TD	ppt	20	1 35	1 12	30	
RF3		>20	filter paper	10	0 996	1 12	-	
RF4		>5	cartridge	122	0 996	1 13	-	
RF5		>0 45	filter paper	?	0 996	1 12	-	
RF6		>0 45	cartridge	122	0 996	1 12	-	
RF7		0 1U	ppt	16	1 35	1 12	18	
RF8		O 1R	ppt	4	1 35	1 12	8	
RF9		100U	ppt	36	1 37	1 13	35	
RF10		100R	ppt	4	1 35	1 12	8	
RF11		Blank spike			0 996	1 12		
RF12		Blank			-	-		
RF13	98827A__	WH	ppt	10	1 35	1 12	47	
RF14		TD	ppt	20	1 35	1 12	25	
RF15		>20	filter paper	12	0 996	1 14	-	
RF16		>5	cartridge	180	0 996	1 13	-	
RF17		>0 45	filter paper	6?	0 996	1 13	-	
RF18		>0 45	cartridge	180	0 996	1 13	-	
RF19		0 1U	ppt	16	1 36	1 12	20	
RF20		O 1R	ppt	4	1 35	1 12	7	
RF21		100U	ppt	36	1 35	1 13	30	
RF22		100R	ppt	4	1 35	1 12	10	
RF23		<0 45	cart,filtered	5	1 34	1 11	6	
RF24	98827B__	WH	ppt	10	1 35	1 12	30	
RF25		TD	ppt	20	1 35	1 12	?	
RF26		>20	filter paper	12	0 996	1 13	-	
RF27		0 1U	ppt	16	1 35	1 12	20	
RF28		O 1R	ppt	4	1 34	1 11	20	
RF29		100U	ppt	36	1 36	1 13	25	
RF30		100R	ppt	4	1 34	1 11	14	
RF31		Blank spike		-	1 34	1 12	-	
RF32		Blank		-	-	-	-	

Solid Sample Digestion (SOP 773)

	RF4	RF14	RF1	RF13	RF2J	
1 ~~Combust sample if applicable~~ samples in 3N HCl w/tracers evaporate then to Step 3	9/10/98 →				→	
2 ~~Add tracers~~						
3 In teflon beaker add 20 ml conc HNO_3, 20 ml conc HCL and 20 ml conc HF	9/11/98 →				→	
4 Ensure solids go in to solution (IF not repeat step 3) Evaporate to dryness	✓	✓	✓	✓	✓	
5 Add 10 ml conc HNO_3 and 5 ml 30% H_2O_2 Let stand at room temp for a few minutes then evaporate to dryness	9/12/98 →				→	
6 Add 10 ml conc HNO_3, 100ml DI and 2g H_3BO_3 Heat to ensure dissolution	✓	✓	✓	✓	✓	
7 Transfer to 250 ml cent Tube using DI	✓	✓	✓	✓	✓	
8 Add 1 ml (40mg/ml) Fe carrier	✓	✓	✓	✓	✓	
9 Ppt $Fe(OH)_3$ by adding conc NH_4OH (~50ml)	✓	✓	✓	✓	✓	
10 Centrifuge at 3500 rpm for 30 minutes	✓	✓	✓	✓	✓	
11 Dissolove ppt With 3x the vol of ppt with conc HCL	✓	✓	✓	✓	✓	
12 Add 75 ml 9N HCl	9/14/98 →				→	
13 Add 1 ml saturated $NaNO_2$ mix thoroughly						

Pu column (SOP 778)

	RF4	RF16	RF1	RF13	RF24	
1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)	9/16/98 →					
2 Place funnel on top of column with Whatman filter paper	✓	✓	✓	✓	✓	
3 Wet filter paper with 9N HCl	✓	✓	✓	✓	✓	
4 Condition resin with 50 ml 9 N HCl	✓	✓	✓	✓	✓	
5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)	✓1	✓1	✓1	✓1	✓1	
6 Rinse 2x with 20 ml 9N HCl, discard	11	11	11	11	11	
7 Elute Pu with 20ml 9N HCl + 1 5 ml HI	✓	✓	✓	✓	✓	
8 Add 1 ml conc HNO_3, evaporate to dryness	✓	✓	✓	✓	✓	

Pu Microprecipitation (SOP 778)

	RF4	RF14	RF11	RF13	RF24	
1 Add 1 ml conc HCl, mix well to resolubilize	9/17/98 →					
2 Add 14 ml DI, mix well	✓	✓	✓	✓	✓	
3 Add 1 0 ml lanthanum carrier + 0 5 ml H_20_2 mix well	✓	✓	✓	✓	✓	
4 Add 5 ml 3N HF	✓	✓	✓	✓	✓	
5 Let sample sit for min 15-20 minutes	✓	✓	✓	✓	✓	
6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock	✓	✓	✓	✓	✓	
7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI	✓	✓	✓	✓	✓	
8 Transfer sample, rinsing beaker once with 5 ml DI	✓	✓	✓	✓	✓	
9 Rinse filter with 10-15 ml DI	✓	✓	✓	✓	✓	
10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓	✓	✓	✓	✓	
11 Mount filter on stainless steel planchet with double sided adhesive tape	✓	✓	✓	✓	✓	

Am Methanolic Anion Exchange Column (SOP 780)

1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight

2 Add 5-10 ml conc HNO3,

3 Add 100-125 ml DI,

4 Add 1 0 ml Fe carrier

5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/

6 Add conc HNO_3 and evaporate, Repeat

7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3)

8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin

9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution

10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution

8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution

9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle

10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column

11 Evaporate to dryness

RF4	RF16	RF1	RF13	RF24	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
9/17/98 →					
✓	✓	✓	✓	✓	
9/21/98 →					
mls 1 ~~11~~	~~111~~	111	111	111	
9/22/98 →		9/23/98 →			
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
1✓	1✓	✓1	✓1	✓1	
✓1	✓	11	11	11	
111	111	111	111	111	
		9/24/98 →			

217

Am Teva Resin (SOP 780)

	RF4	RF14	RF1	RF13	RF21	
1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution	10/22/98		9/24/98		→	
2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution	✓	✓	✓	✓	✓	
3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column	✓ II	✓ II	✓ II	✓ II	✓ II	
4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)	II	II	II	II	II	
5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely	III	III	III	III	III	
6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining	✓	✓	✓	✓	✓	
7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop			9/25/98		→	

Am Micro-precipitation (SOP 780)

	RF4	RF14	RF1	RF13	RF21	
1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI			9/25/98		→	
2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well	✓	✓	✓	✓	✓	
3 Allow sample to stand for 15-20 minutes minimum	✓	✓	✓	✓	✓	
4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol			✓	✓	✓	
5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel			✓	✓	✓	
6 After sample has passed through filter Rinse filter with 10-15 ml DI			✓	✓	✓	
7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min			✓	✓	✓	
8 Mount filter on stainless steel planchet with double sided adhesive tape			✓	✓	✓	

Rocky Flats Am and Pu Sample Procedures

Coprecipitation (SOP 778)

1 To 10L of sample add of conc HNO_3 until pH <2 Let sample sit for 16 hours after acidification before processing

2 Add 50 ml conc HCl ~~Slupped in 3N HCl w/tracers~~

3 Add tracers (^{243}Am and ^{242}Pu)

4 Add 5 ml ferric chloride carrier (40 mg Fe3+/ml)

5 Mix sample and measure pH with pH paper, if pH >1 add 12N HCl until pH <1 Cover and stir for 30 min

6 Check pH again If <1, gently add conc NH4OH, add until turbidity persists than add additional 50 ml

7 Stir for 30 minutes then let settle overnight

8 Siphon ~9L of solution, discard

9 Transfer remaining ~1L into 250ml centrifuge tubes, rinsing bucket and transfer beaker (if used) with minimum DI

10 Centrifuge for 15 min at 3500 rpm

11 Decant and discard supernate

12 To dissolve precipitate add 3 times ppt volume of conc HCl and mix by vortexing
Slupped in 3N HCl, evaporated; add conc HCl

13 Add 75 ml of 9 N HCl

14 Add 2 ml of saturated NaNO2 to samples, mix well and set aside for 15 minutes

RF23	RF28	RF29	RF30		
7/14/98 ✓	✓	✓	✓		•
✓	✓	✓	✓		

Pu column (SOP 778)

	KF23	KF26	KF29	KF30		
1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)	9/19/98 ✓	✓	✓	✓		
2 Place funnel on top of column with Whatman filter paper	✓	✓	✓	✓		
3 Wet filter paper with 9N HCl	✓	✓	✓	✓		
4 Condition resin with 50 ml 9 N HCl	✓	✓	✓	✓		
5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)	✓ "	✓ "	✓ "	✓ "		
6 Rinse 2x with 20 ml 9N HCl, discard	"	"	"	"		
7 Elute Pu with 20ml 9N HCl + 1 5 ml HI	✓	✓	✓	✓		
8 Add 1 ml conc HNO_3, evaporate to dryness	✓	✓	✓	✓		

Pu Microprecipitation (SOP 778)

	KF23	KF26	KF29	KF30		
1 Add 1 ml conc HCl, mix well to resolubilize	✓	✓	✓	✓		
2 Add 14 ml DI, mix well	✓	✓	✓	✓		
3 Add 1 0 ml lanthanum carrier + 0 5 ml H_20_2 mix well	✓	✓	✓	✓		
4 Add 5 ml 3N HF	✓	✓	✓	✓		
5 Let sample sit for min 15-20 minutes	✓	✓	✓	✓		
6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock	✓	✓	✓	✓		
7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI	✓	✓	✓	✓		
8 Transfer sample, rinsing beaker once with 5 ml DI	✓	✓	✓	✓		
9 Rinse filter with 10-15 ml DI	✓	✓	✓	✓		
10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓	✓	✓	✓		
11 Mount filter on stainless steel planchet with double sided adhesive tape	✓	✓	✓	✓		

Am Methanolic Anion Exchange Column (SOP 780)

	RF23	RF28	RF29	RF30		
1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight						
2 Add 5-10 ml conc HNO3,	✓	✓	✓	✓		
3 Add 100-125 ml DI,	✓	✓	✓	✓		
4 Add 1 0 ml Fe carrier	9/17/98 →					
5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/	✓	✓	✓	✓		
6 Add conc HNO_3 and evaporate, Repeat	9/21/98 ✓ →					
7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3) mls	✓ III	✓ III	III	III		
8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin	9/23/98 →					
9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution	✓	✓	✓	✓		
10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution	✓	✓	✓	✓		
8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution	✓ I	✓ I	✓ I	✓ I		
9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle	II	II	II	II		
10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column	III	III	III	III		
11 Evaporate to dryness	9/24/98 →					

Am Teva Resin (SOP 780)

	RF23	RF28	RF29	RF30		
1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution	9/24/98 →					
2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution	✓	✓	✓	✓		
3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column	✓ ✓	✓ ✓	✓ ✓	✓ ✓		
4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)	✓ ✓	✓ ✓	✓ ✓	✓ ✓		
5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓		
6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining	✓	✓	✓	✓		
7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop	9/25/98 →					

Am Micro-precipitation (SOP 780)

	RF23	RF28	RF29	RF30		
1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI	9/25/98 →					
2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well	✓	✓	✓	✓		
3 Allow sample to stand for 15-20 minutes minimum	✓	✓	✓	✓		
4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol	✓		✓	✓		
5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel	✓		✓	✓		
6 After sample has passed through filter Rinse filter with 10-15 ml DI	✓		✓	✓		
7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓		✓	✓		
8 Mount filter on stainless steel planchet with double sided adhesive tape	✓		✓	✓		

222

Rocky Flats Am and Pu Sample Procedures

Coprecipitation (SOP 778)

1 To 10L of sample add of conc HNO_3 until pH <2 Let sample sit for 16 hours after acidification before processing

2 Add 50 ml conc HCl

3 Add tracers (^{243}Am and ^{242}Pu)

4 Add 5 ml ferric chloride carrier (40 mg Fe3+/ml)

5 Mix sample and measure pH with pH paper, if pH >1 add 12N HCl until pH <1 Cover and stir for 30 min

6 Check pH again If <1, gently add conc NH4OH, add until turbidity persists than add additional 50 ml

7 Stir for 30 minutes then let settle overnight

8 Siphon ~9L of solution, discard

9 Transfer remaining ~1L into 250ml centrifuge tubes, rinsing bucket and transfer beaker (if used) with minimum DI

10 Centrifuge for 15 min at 3500 rpm

11 Decant and discard supernate

12 To dissolve precipitate add 3 times ppt volume of conc HCl and mix by vortexing (skipped in 3N HCl -> evaporated

13 Add 75 ml of 9 N HCl

14 Add 2 ml of saturated NaNO2 to samples, mix well and set aside for 15 minutes

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
9/10/98							✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	

Pu column (SOP 778)

1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)

2 Place funnel on top of column with Whatman filter paper

3 Wet filter paper with 9N HCl

4 Condition resin with 50 ml 9 N HCl

5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)

6 Rinse 2x with 20 ml 9N HCl, discard

7 Elute Pu with 20ml 9N HCl + 1 5 ml HI

8 Add 1 ml conc HNO_3, evaporate to dryness

Pu Microprecipitation (SOP 778)

1 Add 1 ml conc HCl, mix well to resolubilize

2 Add 14 ml DI, mix well

3 Add 1 0 ml lanthanum carrier + 0 5 ml H_2O_2 mix well

4 Add 5 ml 3N HF

5 Let sample sit for min 15-20 minutes

6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock

7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI

8 Transfer sample, rinsing beaker once with 5 ml DI

9 Rinse filter with 10-15 ml DI

10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min

11 Mount filter on stainless steel planchet with double sided adhesive tape

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
9/11/98							
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓		✓	✓	✓	✓		

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
✓	4/12/98	✓	✓	✓	✓	9/12/98	✓
✓	✓	✓	✓	✓	✓	✓	✓
9/12/98							
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓

Am Methanolic Anion Exchange Column (SOP 780)

1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight

2 Add 5-10 ml conc HNO3,

3 Add 100-125 ml DI,

4 Add 1 0 ml Fe carrier

5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/

6 Add conc HNO_3 and evaporate, Repeat

7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3)

8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin

9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution

10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution

8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution

9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle

10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column

11 Evaporate to dryness

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
9/13/98 →						9/13/98	
✓	✓	✓	✓	✓		✓	✓
✓	✓	✓	✓	✓		✓	✓
9/14/98 →							
✓	✓	✓	✓	✓	✓	✓	✓
III	III	III	III	III	III	III	III
9/16/98 →							
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓ I	✓ I	✓ I	✓ I	✓ I	✓ I	✓ I	✓
II	II	II	II	II	II	II	I
III	III	III	II	III	II	II	I
✓	✓	✓	✓	✓	✓	✓	✓

Am Teva Resin (SOP 780)

1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution

2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution

3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column

4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)

5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely

6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining

7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓

Am Micro-precipitation (SOP 780)

1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI

2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well

3 Allow sample to stand for 15-20 minutes minimum

4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol

5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel

6 After sample has passed through filter Rinse filter with 10-15 ml DI

7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min

8 Mount filter on stainless steel planchet with double sided adhesive tape

RF2	RF7	RF9	RF14	RF19	RF27	RF31	RF32
✓	✓	✓	✓	✓	✓	✓	✓
9/28/98	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓

Completed 9/28/98

Rocky Flats Am and Pu Sample Procedures

Coprecipitation (SOP 778)

	RF8	RF10	RF20	RF21	RF22	
1 To 10L of sample add of conc HNO_3 until pH <2 Let sample sit for 16 hours after acidification before processing						
2 Add 50 ml conc HCl						
3 Add tracers (^{243}Am and ^{242}Pu)						
4 Add 5 ml ferric chloride carrier (40 mg Fe3+/ml)						
5 Mix sample and measure pH with pH paper, if pH >1 add 12N HCl until pH <1 Cover and stir for 30 min						
6 Check pH again If <1, gently add conc NH4OH, add until turbidity persists than add additional 50 ml						
7 Stir for 30 minutes then let settle overnight						
8 Siphon ~9L of solution, discard						
9 Transfer remaining ~1L into 250ml centrifuge tubes, rinsing bucket and transfer beaker (if used) with minimum DI						
10 Centrifuge for 15 min at 3500 rpm						
11 Decant and discard supernate						
12 To dissolve precipitate add 3 times ppt volume of conc HCl and mix by vortexing						
13 Add 75 ml of 9 N HCl	✓	✓	✓	✓	✓	
14 Add 2 ml of saturated NaNO2 to samples, mix well and set aside for 15 minutes	✓	✓	✓	✓	✓	

Pu column (SOP 778)

	KF8	KF19	KF20	KF21	KF22	
1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)	9/15/93 ✓	✓	✓	✓	✓	
2 Place funnel on top of column with Whatman filter paper	✓	✓	✓	✓	✓	
3 Wet filter paper with 9N HCl	✓	✓	✓	✓	✓	
4 Condition resin with 50 ml 9 N HCl	✓	✓	✓	✓	✓	
5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)	✓ II	✓ II	✓ II	✓ II	✓ II	
6 Rinse 2x with 20 ml 9N HCl, discard	II	II	II	II	II	
7 Elute Pu with 20ml 9N HCl + 1 5 ml HI	✓	✓	✓	✓	✓	
8 Add 1 ml conc HNO_3, evaporate to dryness	✓	✓	✓	✓	✓	

Pu Microprecipitation (SOP 778)

	KF8	KF19	KF20	KF21	KF22	
1 Add 1 ml conc HCl, mix well to resolubilize	✓	✓	✓	✓	✓	
2 Add 14 ml DI, mix well	✓	✓	✓	✓	✓	
3 Add 1 0 ml lanthanum carrier + 0 5 ml H_2O_2 mix well	✓	✓	✓	✓	✓	
4 Add 5 ml 3N HF	✓	✓	✓	✓	✓	
5 Let sample sit for min 15-20 minutes	✓	✓	✓	✓	✓	
6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock	✓	✓	✓	✓	✓	
7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI	✓	✓	✓	✓	✓	
8 Transfer sample, rinsing beaker once with 5 ml DI	✓	✓	✓	✓	✓	
9 Rinse filter with 10-15 ml DI	✓	✓	✓	✓	✓	
10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓	✓	✓	✓	✓	
11 Mount filter on stainless steel planchet with double sided adhesive tape	✓	✓	✓	✓	✓	

Am Methanolic Anion Exchange Column (SOP 780)

1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight

2 Add 5-10 ml conc HNO3,

3 Add 100-125 ml DI,

4 Add 1 0 ml Fe carrier

5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/

6 Add conc HNO_3 and evaporate, Repeat

7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3)

8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin

9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution

10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution

8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution

9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle

10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column

11 Evaporate to dryness

RA8	RA10	RA20	RA21	RA22	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
9/19/98 →					
✓	✓	✓	✓	✓	
9/21/98 →			✓	✓	
9/23/98 →					
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
9/24/98 →					

229

Am Teva Resin (SOP 780)

	RF8	RF10	RF20	RF21	RF22	
1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution	9/24/98				→	
2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution	✓	✓	✓	✓		
3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column	✓ II	✓ II	✓ II	✓ II		
4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)	II	II	II	II		
5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely	III	III	III	III		
6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining	✓	✓	✓	✓		
7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop	9/25/98			→		

Am Micro-precipitation (SOP 780)

	RF8	RF10	RF20	RF21	RF22	
1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI	9/25/98				→	
2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well	✓	✓	✓	✓	✓	
3 Allow sample to stand for 15-20 minutes minimum	✓	✓	✓	✓	✓	
4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol	✓	✓	✓	✓	✓	
5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel	✓	✓ *	✓	✓	✓	
6 After sample has passed through filter Rinse filter with 10-15 ml DI	✓	✓ *	✓	✓	✓	
7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓	✓	✓	✓	✓	
8 Mount filter on stainless steel planchet with double sided adhesive tape	✓	✓	✓	✓	✓	

* filtered v.quickly

Solid Sample Digestion (SOP 773)

		F98826 7045 (RF5)	F98826 7220 (RF3)	F98827A 7645 (RF17)	F98827A 7220 (RF15)	F98827B 7220 (RF26)	
		F	F	F	F	F	
1	Combust sample if applicable *leached in 8N HNO3*	9/6/98 →				→	
2	Add tracers	9/7/98 →				→	
3	In teflon beaker add 20 ml conc HNO_3, 20 ml conc HCL and 20 ml conc HF	✓	✓	✓	✓	✓	
4	Ensure solids go in to solution (IF not repeat step 3) Evaporate to dryness	✓	✓	✓	✓	✓	
5	Add 10 ml conc HNO_3 and 5 ml 30% H_2O_2 Let stand at room temp for a few minutes then evaporate to dryness	9/10/98 →				→	
6	Add 10 ml conc HNO_3, 100ml DI and 2g H_3BO_3 Heat to ensure dissolution	✓	✓	✓	✓	✓	
7	Transfer to 250 ml cent Tube using DI	✓	✓	✓	✓	✓	
8	Add 1 ml (40mg/ml) Fe carrier	✓	✓	✓	✓	✓	
9	Ppt $Fe(OH)_3$ by adding conc NH_4OH (~50ml)	✓	✓	✓	✓	✓	
10	Centrifuge at 3500 rpm for 30 minutes	✓	✓	✓	✓	✓	
11	Dissolove ppt With 3x the vol of ppt with conc HCL	1.5ml	5ml	2ml	3ml	3ml	
12	Add 75 ml 9N HCl	✓	✓	✓	✓	✓	
13	Add 1 ml saturated $NaNO_2$ mix thoroughly	✓	✓	✓	✓	✓	

Pu column (SOP 778)

	RF5	RF3	RF17	RF15	RF24	
1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)	9/9/98 →					
2 Place funnel on top of column with Whatman filter paper	✓	✓	✓	✓	✓	
3 Wet filter paper with 9N HCl	✓	✓	✓	✓	✓	
4 Condition resin with 50 ml 9 N HCl	✓	✓	✓	✓	✓	
5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)	✓	✓	✓	✓	✓	
6 Rinse 2x with 20 ml 9N HCl, discard	✓	✓	✓	✓	✓	
7 Elute Pu with 20ml 9N HCl + 1 5 ml HI	✓	✓	✓	✓	✓	
8 Add 1 ml conc HNO_3, evaporate to dryness	✓	✓	✓	✓	✓	

Pu Microprecipitation (SOP 778)

1 Add 1 ml conc HCl, mix well to resolubilize	✓	✓	✓	✓	✓	
2 Add 14 ml DI, mix well	✓	✓	✓	✓	✓	
3 Add 1 0 ml lanthanum carrier + 0 5 ml H_20_2 mix well	✓	✓	✓	✓	✓	
4 Add 5 ml 3N HF	✓	✓	✓	✓	✓	
5 Let sample sit for min 15-20 minutes	✓	✓	✓	✓	✓	
6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock	✓	✓	✓	✓	✓	
7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI	✓	✓	✓	✓	✓	
8 Transfer sample, rinsing beaker once with 5 ml DI	✓	✓	✓	✓	✓	
9 Rinse filter with 10-15 ml DI		✓	✓	✓	✓	
10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min		✓	✓	✓	✓	
11 Mount filter on stainless steel planchet with double sided adhesive tape		✓	✓	✓	✓	

Am Methanolic Anion Exchange Column (SOP 780)

1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight

2 Add 5-10 ml conc HNO3,

3 Add 100-125 ml DI,

4 Add 1 0 ml Fe carrier

5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/

6 Add conc HNO_3 and evaporate, Repeat

7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3)

8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin

9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution

10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution

8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution

9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle

10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column

11 Evaporate to dryness

RF5	RF3	RF17	RF15	RF26	
9/10/98 →					
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
9/11/98 →					
11	11	11	11	11	
11	~~1111~~	~~1111~~	1111	1111	
9/12/98 →					
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓1	✓1	✓1	✓1	✓1	
11	11	11	11	11	
111	111	111	111	111	
9/13/98	9/13/98	9/12/98	9/12/98	9/13/98	

Am Teva Resin (SOP 780)

1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution

2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution

3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column

4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)

5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely

6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining

7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop

RF5	RF3	RF7	RF15	RF26	
9/13/98 →					
✓	✓	✓	✓	✓	
9/14/98 →					
✓1	✓1	✓1	✓1	✓1	
11	11	11	11	11	
111	111	111	111	111	
11	11	11	11	11	
✓	✓	✓	✓	✓	

Am Micro-precipitation (SOP 780)

1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI

2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well

3 Allow sample to stand for 15-20 minutes minimum

4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol

5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel

6 After sample has passed through filter Rinse filter with 10-15 ml DI

7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min

8 Mount filter on stainless steel planchet with double sided adhesive tape

RF5	RF3	RF7	RF15	RF26	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	

Completed 9/15/98

Solid Sample Digestion (SOP 773)

		C98826 5 (RF4)	C98826 0.45 (RF6)	C98827 5 (RF10)	C98827 0.45 (RF8)	Blankspike (RF11)	Blank (RF12)
1	Combust sample if applicable	9/6/98 →					
2	Add tracers	9/7/98 →					
3	In teflon beaker add 20 ml conc HNO_3, 20 ml conc HCL and 20 ml conc HF	✓	✓	✓	✓	✓	✓
4	Ensure solids go in to solution (IF not repeat step 3) Evaporate to dryness	✱	✓	✱	✓	✓	✓
5	Add 10 ml conc HNO_3 and 5 ml 30% H_2O_2 Let stand at room temp for a few minutes then evaporate to dryness		9/8/98		9/8/98 →		
6	Add 10 ml conc HNO_3, 100ml DI and 2g H_3BO_3 Heat to ensure dissolution		✓		✓	✓	✓
7	Transfer to 250 ml cent Tube using DI		✓		✓	✓	✓
8	Add 1 ml (40mg/ml) Fe carrier		✓		✓	✓	✓
9	Ppt $Fe(OH)_3$ by adding conc NH_4OH (~50ml)		✓		✓	✓	✓
10	Centrifuge at 3500 rpm for 30 minutes		✓		✓	✓	✓
11	Dissolove ppt With 3x the vol of ppt with conc HCL		7ml 9/9/98		5ml 9/9/98	2ml →	2ml
12	Add 75 ml 9N HCl		✓		✓	✓	✓
13	Add 1 ml saturated $NaNO_2$ mix thoroughly		✓		✓	✓	✓

✱ repeated digestion w/ conc HCl & HNO_3 moved to bath of other solids to start digestion from beginning.

Pu column (SOP 778)

	RF 4	RF 6	RF 16	RF 18	RF 11	RF 12
	~~9/9/98~~	~~9/9/98~~	~~9/9/98~~	~~9/9/98~~	—	—
1 Fill disposable plastic column with 7 cm AG1x8 resin (by resin/DI slurry)		✓		✓	✓	✓
2 Place funnel on top of column with Whatman filter paper		✓		✓	✓	✓
3 Wet filter paper with 9N HCl		✓		✓	✓	✓
4 Condition resin with 50 ml 9 N HCl		✓		✓	✓	✓
5 Load sample through filter, rinse 2x with 20 ml 9N HCl (= Am fraction)		✓		✓	✓	✓
6 Rinse 2x with 20 ml 9N HCl, discard		✓		✓	✓	✓
7 Elute Pu with 20ml 9N HCl + 1 5 ml HI		✓		✓	✓	✓
8 Add 1 ml conc HNO_3, evaporate to dryness		✓		✓	✓	✓

Pu Microprecipitation (SOP 778)

1 Add 1 ml conc HCl, mix well to resolubilize	✓		✓	✓	✓
2 Add 14 ml DI, mix well	✓		✓	✓	✓
3 Add 1 0 ml lanthanum carrier + 0 5 ml H_20_2 mix well	✓		✓	✓	✓
4 Add 5 ml 3N HF	✓		✓	✓	✓
5 Let sample sit for min 15-20 minutes	✓		✓	✓	✓
6 Set up filtration apparatus place 25 mm filter membrane on support screen and lock	✓		✓	✓	✓
7 Apply vacuum, rinse filter with 1-2 ml methanol, rinse filter with DI	✓		✓	✓	✓
8 Transfer sample, rinsing beaker once with 5 ml DI	✓		✓	✓	✓
9 Rinse filter with 10-15 ml DI	✓		✓	✓	✓
10 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min	✓		✓	✓	✓
11 Mount filter on stainless steel planchet with double sided adhesive tape	✓		✓	✓	✓

Am Methanolic Anion Exchange Column (SOP 780)

1 Mix anion exchange resin with twice the volume of 1N HNO_3/93% methanol solution (for 160 ml 10ml conc HNO_3, 150 ml methanol) overnight

2 Add 5-10 ml conc HNO3,

3 Add 100-125 ml DI,

4 Add 1 0 ml Fe carrier

5 Transfer to cent tube and ppt with conc NH4OH Cent @3500 rpm for 15 min/

6 Add conc HNO_3 and evaporate, Repeat

7 Add conc HNO_3 until dissolved Add methanol (15 ml of methanol for each 1 ml conc HNO_3)

8 Pour resin slurry into disposable column and let resin settle to 7cm, place a layer of silica or glass beads on top of resin

9 Place funnel on top of column with Whatman filter paper, wet filter with 1N HNO_3 /93% methanol solution

10 Condition column with 40 ml of 1N HNO_3 /93% methanol solution

8 Load the sample onto column through filter, rinse with 25 ml 1N HNO_3 /93% methanol solution

9 Remove and discard filter and rinse twice with 25 ml 1N HNO_3 / 93% methanol solution Discard into methanolic waste receptacle

10 Strip Am by passing three 20 ml volumes of 8 N HNO_3 through the column allowing each rinse to pass completely before adding next rinse Collect eluate in beaker for Teva column

11 Evaporate to dryness

RF4	RF9	RF10	RF8	RF11	RF12
	9/10/98		9/10/98	→	→
	✓		✓	✓	✓
	✓		✓	✓	✓
	✓		✓	✓	✓
	✓		✓	✓	✓
	9/11/98		9/11/98	→	→
	✓✓✓		✓✓✓	✓✓✓	✓✓✓
	9/12/98		9/12/98	→	→
	✓		✓	✓	✓
	✓		✓	✓	✓
	✓✓		✓✓	✓✓	✓✓
	✓✓		✓✓	✓✓	✓✓
	✓✓✓		✓✓✓	✓✓✓	✓✓✓
	9/12/98		9/12/98	9/13/98	9/13/98

Am Teva Resin (SOP 780)

1 Redisolve sample from above in 10 ml 2M NH_4SCN/ 0 1M formic acid (for 100ml 15 2 g NH_4SCN & 0 35 ml 98% formic acid in 100ml DI) Allow sample to sit for 1 hour to ensure dissolution

2 Condition a TEVA resin 2 ml column with 5 ml of 2M NH_4SCN/ 0 1M formic acid solution

3 Transfer sample into TEVA column in two portions using disposable polyethylene transfer pipet Rinse the sample container with 1 ml of 2M NH_4SCN/ 0 1M formic acid and transfer to column Repeat rinse and add to column

4 Rinse the TEVA column with two 5 ml volumes of 1M NH_4SCN/ 0 1M formic acid (for 100 ml dissolve 7 6 g NH_4SCN and 0 35 ml 98% formic acid in 100 ml of DI) Allow first wash to pass completely before adding the second wash (This washes lanthanides from column)

5 Strip Am from column with 15 ml of 2N HCl in three 5ml portions allowing each 5 ml to pass completely

6 To decompose thiocyanate, add 2 5 ml conc HNO3 and 7 5 ml conc HCL to the Am solution Swirl gently Evaporate until ~1 drop solution is remaining

7 Add 5 ml conc HNO3 Evaporate until volume is ~1 drop

	RF 6		RF 8	RF 11	RF 12
9/11	9/13/98		9/13/98	→	→
	9/14/98		9/14/98	→	→
	✓1		✓1	✓1	✓1
	11		11	11	11
	111		111	111	111
	11		11	11	11
	✓		✓	✓	✓

Am Micro-precipitation (SOP 780)

1 Add 1 ml conc HCl to sample Heat for 5 minutes Add 15 ml DI

2 Add 0 5 ml lanthanum carrier mix well Add 5 ml HF Mix well

3 Allow sample to stand for 15-20 minutes minimum

4 Place 25 mm filter membrane in a filter funnel assembly and turn on vacuum Rinse with 1-2 ml alcohol

5 Load sample into filter Rinse sample beaker once with 5 ml DI and add to funnel

6 After sample has passed through filter Rinse filter with 10-15 ml DI

7 Turn off vacuum, use "sharpie" and place dot on outside edge of filter marking which side is up Place filter in pyrex beaker and put in drying oven (90-100°C) for ~ 1min

8 Mount filter on stainless steel planchet with double sided adhesive tape

	RF 6		RF 8	RF 11	RF 12
	✓		✓	✓	✓
	✓		✓	✓	✓
	✓		✓	✓	✓
	✓		✓	✓	✓
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Completed 9/15/98