

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 23, 1988

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No. 88-646
NAPS/JHL
Docket Nos. 50-338
50-339
License Nos. NPF-4
NPF-7

Gentlemen:

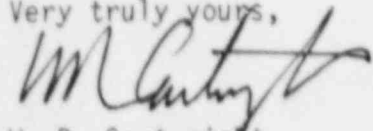
VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
TRANSMITTAL OF COUNTROOM EFFICIENCY CALIBRATION DATA

During the week of August 15 - 19, 1988, Mr. Hector Bermudez conducted a routine inspection of the Health Physics sample program at North Anna Power Station. During the exit interview on August 19, 1988, Mr. Bermudez requested that the revised calibration data for the countroom sample equipment be transmitted to the NRC for further review. The attachments provide the revised efficiency calibration data for the three high purity germanium (Ge) detectors in the North Anna countroom. The efficiency calibration data includes the following multichannel analyzer geometries:

- 15 milliliter vial
- 100 milliliter cup
- charcoal filter cartridge
- 47 millimeter particulate filter
- 100 cubic centimeter gas chamber
- 1000 milliliter marinelli beaker

If you have any questions, please contact Mr. M. L. Bowling at (703)894-5151.

Very truly yours,



W. R. Cartwright
Vice President - Nuclear

Attachments

BB10030350 880923
PDR ADOCK 05000338
Q PNU

IE06
11

cc: U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N. W.
Suite 2900
Atlanta, Georgia 30323

Mr. J. L. Caldwell
NRC Senior Resident Inspector
North Anna Power Station

Mr. Hector Bermudez
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N. W.
Suite 2900
Atlanta, Georgia 30323

MCA DETECTOR CALIBRATION DATA

Detector Serial or ID Number: DCT #1
SN # 24-P 445C

- | | | | | |
|-----------------------------|---|--|---|---|
| Check applicable Geometries | <input type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input checked="" type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| | <input type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwet smear, contact | <input type="checkbox"/> Radwet smear, 8 cm |
| | <input type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| | <input type="checkbox"/> 1 liter Marinelli Liquid | <input checked="" type="checkbox"/> 100 ml cup, liq. contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| | <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-01

Geometry: 15 ml vial on contact

Efficiency File: GELI. TAB 11

Calibration Source ID number: MCA-02

Geometry: 100 ml. cup, liquid, contact

Efficiency File: GELI. TAB 12

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	26.7	540.4	4.94
Co-57 122 keV	27.8	467.6	5.95
Ce-139 166 keV	25.0	447.9	5.58 DEC Sub 9-13-85
Hg-203 279 keV	24.9	669.3	3.72
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	33.3	1259.6	2.64
Sr-88 514 keV	34.9	1708.3	2.04
Ce-137 662 keV	38.7	2269.7	1.71
Co-58 811 keV	N/A	N/A	N/A
Mn-54 838 keV	N/A	N/A	N/A
Y-88 898 keV	43.8	3645.5	1.20
Co-60 1173 keV	29.5	3157.4	0.93
Co-60 1332 keV	25.9	3162.0	0.82
Y-88 1836 keV	24.9	3886.5	0.64

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	22.1	634.7	3.23
Co-57 122 keV	23.4	596.4	3.45
Ce-139 166 keV	21.2	567.5	3.74
Hg-203 279 keV	22.2	848.0	2.62
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	31.4	1595.9	1.97
Sr-88 514 keV	33.2	2164.4	1.53
Ce-137 662 keV	35.7	2375.7	1.24
Co-58 811 keV	N/A	N/A	N/A
Mn-54 838 keV	N/A	N/A	N/A
Y-88 898 keV	42.0	4618.6	0.91
Co-60 1173 keV	28.9	4000.2	0.72
Co-60 1332 keV	24.9	4006.1	0.62
Y-88 1836 keV	24.3	4923.9	0.49

Detector Calibration Data Prepared by David E. Lane M Young Date 9-13-85

Comments _____

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA 01 Date Source Prepared: 7-19-88

Date Calibration Source Gammas Per Second Valid: 12 Aug 88 thru 15 Aug 88

Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹⁰⁹ Cd, ⁵⁷ Co, ¹³⁷ Cs ¹³⁷ Cs, ¹³⁷ Sr, ¹³⁷ Sr ¹³⁷ Y, ¹³⁷ Y, ¹³⁷ Y, ¹³⁷ Y	American International	QCY-46 R9/105/109	01 JUN 88 @ 1200 GPC	Pipetted 9.4377 gms of standard into 15 ml counting vial and diluted to 15 ml with demin water

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1618.6	0.373	602.1	01 JUN 88	72.5	1.49E-3	540.4
Co-57 122 keV	657.9	0.858	562.5	01 JUN 88	72.5	2.55E-3	467.6
Co-139 166 keV	802.9	0.804	645.5	01 JUN 88	72.5	5.04E-3	447.9
Hg-203 279 keV	2550.5	0.773	1971.5	01 JUN 88	72.5	1.49E-2	669.3
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sr-113 392 keV	3002.9	0.649	1948.9	01 JUN 88	72.5	6.02E-3	1259.6
Sr-88 514 keV	3740.8	0.993	3710.9	01 JUN 88	72.5	1.07E-2	1708.3
Co-137 662 keV	2679.4	0.881	2280.1	01 JUN 88	72.5	6.29E-3	2269.7
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	3.22E-3	N/A
Y-88 898 keV	6252.7	0.934	5840.0	01 JUN 88	72.5	6.50E-3	3645.5
Co-60 1173 keV	3240.9	1.000	3240.9	01 JUN 88	72.5	3.60E-4	3157.4
Co-60 1332 keV	3245.6	1.000	3245.6	01 JUN 88	72.5	3.60E-4	3162.0
Y-88 1836 keV	6263.6	0.994	6226.1	01 JUN 88	72.5	6.50E-3	3886.5

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp (- lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments _____

CALIBRATION COUNT

SPECTRAL FILE NAME: GEL1.MAIN11
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: MLS
 SAMPLE GEOMETRY: 15 ML VIAL
 EFFICIENCY FILE NAME: GEL1.TAB11

ACQUIRE DATE: 12-AUG-88 19:15:33
 PRESET TIME (LIVE): 600. SEC
 ELAPSED REAL TIME: 617. SEC
 ELAPSED LIVE TIME: 600. SEC

* FWHM (1332): 2.225
 * SENSITIVITY: 5.000
 * SHAPE PARAMETER: 20.0 %
 * NBR ITERATIONS: 5

DETECTOR: HPGE #1
 CALIB DATE: 12-AUG-88 16:35:40
 KEV/CHNL: 1.0001038
 OFFSET: 0.0426324 KEV

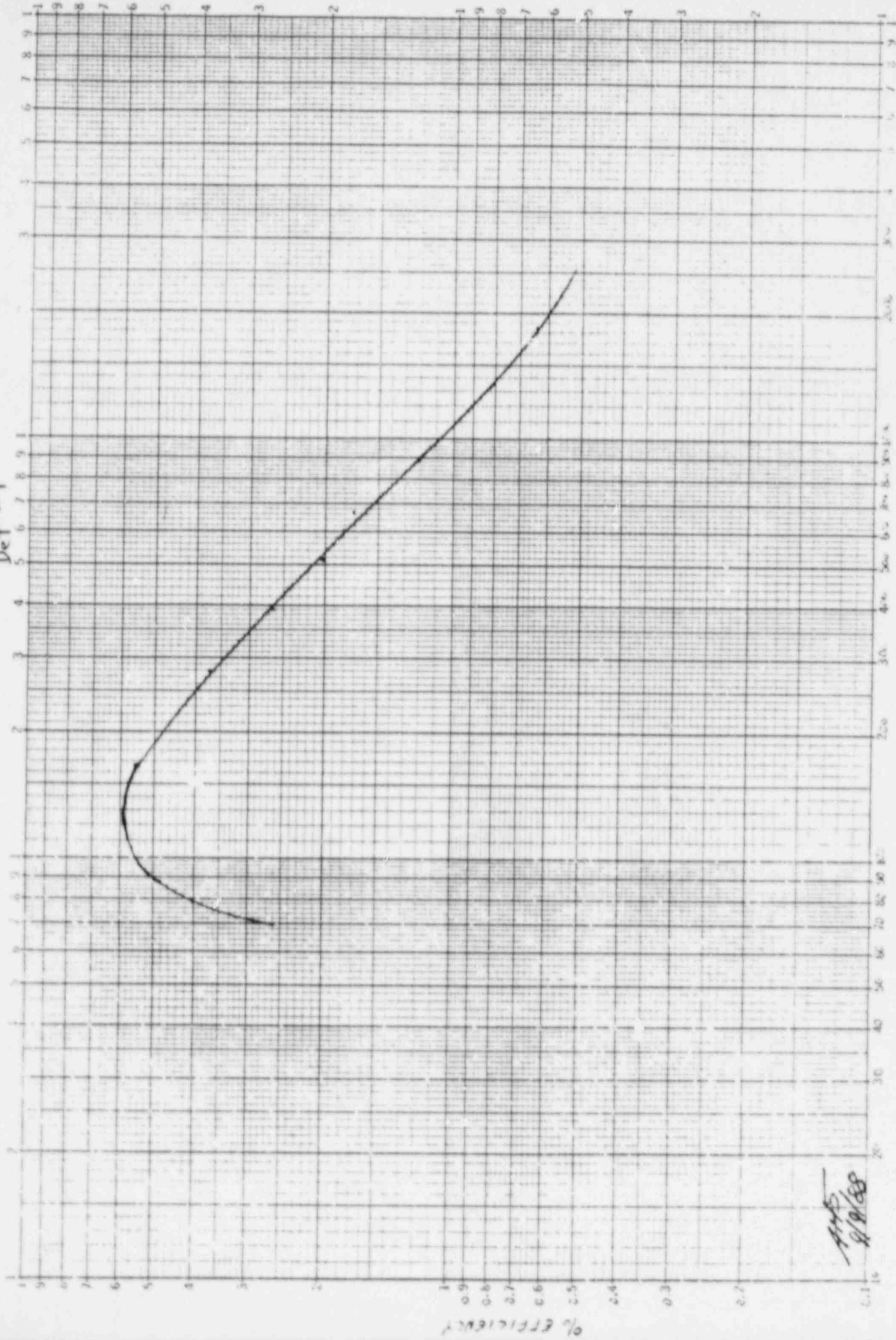
* LIBRARY: GEL1.LIB69
 * ENERGY TOLERANCE: 1.500KV
 * HALF LIFE RATIO: 3.00
 * ABUNDANCE LIMIT: 80.00%

ENERGY WINDOW 50.05 TO 2048.26
 1.00-SIGMA %ERR

PK	LT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PH	CTS/SEC	%ERR	FIT
1	0	73.31	667.	5212.	1.07	73.26	72	4	1.12E 00	15.9	
2	5	82.98	1136.	9550.	2.50	82.93	79	14	1.89E 00	15.2	1.69E 01
3	5	88.13	15998.	4648.	1.23	88.08	79	14	2.67E 01	1.0	
4	0	122.20	16701.	9829.	1.23	122.15	118	8	2.78E 01	1.3	
5	0	135.55	2154.	9151.	1.87	135.53	131	8	3.61E 00	7.9	
6	0	165.02	14996.	8981.	1.24	165.06	162	8	2.50E 01	1.4	
7	0	255.25	999.	5752.	1.34	255.18	252	7	1.66E 00	12.9	
8	0	279.27	14919.	7571.	1.40	279.20	274	10	2.49E 01	1.4	
9	0	391.80	19996.	5783.	1.70	391.72	387	10	3.33E 01	1.0	
10	5	520.81	236.	1398.	1.59	520.72	509	14	3.94E -01	21.5	2.22E 01
11	3	524.01	20915.	2144.	1.52	523.91	509	14	3.49E 01	0.8	
12	0	61.77	23226.	5039.	2.00	61.59	606	11	3.87E 01	0.9	
13	0	711.91	461.	2119.	1.86	711.78	710	3	7.89E -01	17.9	
14	0	807.03	26278.	2975.	1.76	807.09	793	10	4.38E 01	0.7	
15	0	1173.22	17718.	1794.	1.84	1173.06	1167	12	2.95E 01	0.9	
16	1	1327.09	405.	829.	2.72	1324.91	1323	22	6.08E -01	11.1	7.72E 00
17	0	1611.11	13550.	570.	2.01	1610.25	1600	22	2.59E 01	0.8	
18	0	1845.95	14940.	320.	2.33	1845.72	1829	14	2.49E 01	0.9	

PEAK SEARCH COMPLETED (18/15.7)

Fig. TAB II
15 ml vial, contact
Det #1



AMP
9/10/68

Energy (keV)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA-02 Date Source Prepared: 7-19-88
Date Calibration Source Gamma Per Seconds Valid: 12 Aug 88 thru 13 Aug 88

- Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Rad rate smear
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³⁷ Ba, ¹³⁴ Ba, ¹³² Sr, ¹³⁵ Sr, ¹³⁷ Y, ¹³⁸ La, ¹³⁸ Pr, ¹³⁹ La, ¹⁴⁰ La	Amersham International	QCY. 46 R8/125/109	01 June 87 @ 1200 cpm	PIPETTED 16.957 grams OF STANDARD INTO 100 ml COUNTING CUP AND DILUTED TO 100 ml WITH DEMINERALISED WATER.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.355	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2050.69	0.372	762.86	6-1-88	72.5	1.49E-3	684.7
Co-57 122 keV	833.49	0.855	712.64	6-1-88	72.5	2.55E-3	592.4
Ce-139 168 keV	1017.24	0.804	817.86	6-1-88	72.5	5.04E-3	567.5
Hg-203 279 keV	3231.33	0.773	2497.82	6-1-88	72.5	1.49E-2	845.0
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sr-85 392 keV	3204.50	0.649	2469.12	6-1-88	72.5	6.02E-3	1595.7
Sr-85 514 keV	4739.41	0.993	4701.49	6-1-88	72.5	1.07E-2	2164.4
Co-137 662 keV	3394.61	0.881	2838.81	6-1-88	72.5	6.29E-3	2875.7
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 828 keV	7926.83	0.934	7395.99	6-1-88	72.5	6.50E-3	4618.6
Co-60 1173 keV	4106.03	1.000	4106.03	6-1-88	72.5	3.60E-4	4000.2
Co-60 1332 keV	4112.01	1.000	4112.01	6-1-88	72.5	3.60E-4	4006.1
Y-88 1836 keV	7935.65	0.934	7538.03	6-1-88	72.5	6.50E-3	4933.9

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments _____

 ***** 12-AUG-88 19:15:34 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.MAIN11
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: OLS
 SAMPLE GEOMETRY: 100 ML CUP
 EFFICIENCY FILE NAME: GELI.TAB12.,

 *
 ACQUIRE DATE: 12-AUG-88 18:52:18 * FWHM(1332) 2.223
 PRESET TIME (LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 619. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.
 *

 *
 DETECTOR: HPGE #1 * LIBRARY:GELI.LIB67
 CALIB DATE: 12-AUG-88 16:35:40 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0001033 * HALF LIFE RATIO: 3.00
 OFFSET: 0.0426324 KEV * ABUNDANCE LIMIT: 80.00%
 *

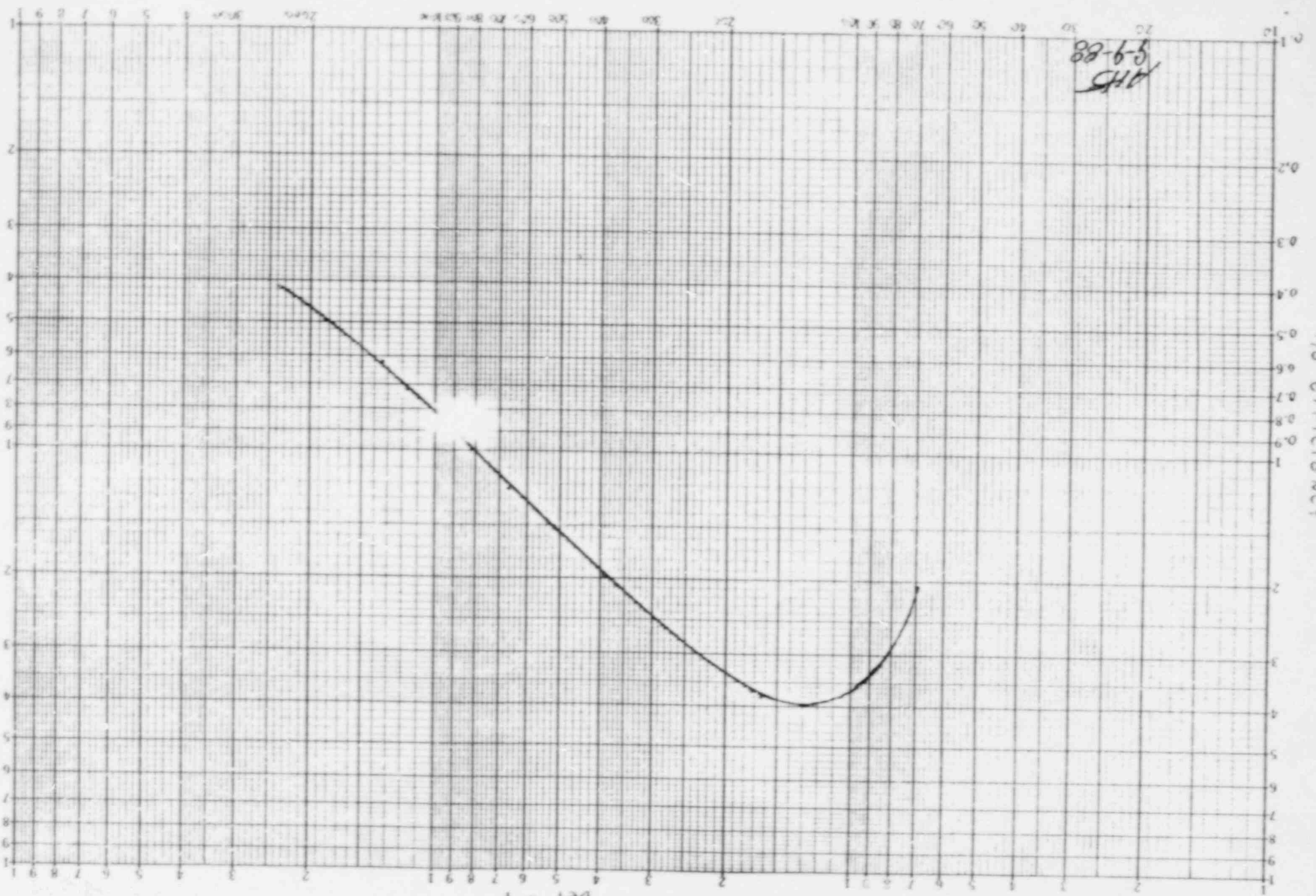
ENERGY WINDOW 50.05 TO 2048.26
 1.00-SIGMA ZERR

PK	IT	ENERGY	AREA	BKGD	FWHM	CHANNEL	LEFT	PW	CIS/SEC	ZERR	IT
1	0	72.03	1417.	12312.	3.06	71.98	68	9	2.36E 00	14.4	
2	0	88.16	13246.	11433.	1.25	88.10	84	8	2.21E 01	1.6	
3	0	122.21	14032.	11315.	1.27	122.15	118	8	2.34E 01	1.6	
4	0	136.78	1925.	10549.	1.92	136.72	133	8	3.21E 00	9.5	
5	0	166.02	12711.	9003.	1.27	165.96	163	7	2.12E 01	1.5	
6	0	255.27	901.	6371.	1.35	255.20	252	7	1.50E 00	15.0	
7	0	279.33	13308.	5949.	1.44	279.23	277	7	2.22E 01	1.3	
8	0	391.78	18832.	5772.	1.80	391.69	387	10	3.14E 01	1.1	
9	0	514.01	19926.	4551.	1.48	513.91	509	10	3.32E 01	0.9	
10	0	661.69	21418.	4777.	2.01	661.58	657	11	3.57E 01	0.9	
11	0	813.95	531.	2377.	1.93	813.82	810	9	8.85E-01	17.0	
12	0	898.06	25208.	3606.	1.81	897.93	892	12	4.20E 01	0.8	
13	0	1173.20	17327.	1701.	1.92	1173.03	1167	12	2.89E 01	0.9	
14	4	1325.18	552.	816.	3.00	1325.00	1319	21	9.20E-01	10.0	1.15E 01
15	4	1332.42	14923.	525.	2.03	1332.23	1319	21	2.49E 01	0.9	
16	0	1835.93	14577.	315.	2.38	1835.70	1829	14	2.43E 01	0.9	

PEAK SEARCH COMPLETED (REV 15.7)

ENERGY (KeV)

AHS
5-9-88



100 ml cup, control

6611 TAG 12

Det # 1

46 7320
LO ANTIMIC
E X CELL
KODAK SAFETY FILM
KODAK SAFETY FILM

MCA DETECTOR CALIBRATION DATA

Det # 1

Detector Serial or ID Number: SN# 24-P-44 SC

- | | | | |
|---|---|--|---|
| <input type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| <input type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwat smear, contact | <input type="checkbox"/> Radwat smear, 8 cm |
| <input type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| <input type="checkbox"/> 1 liter Marinelli Liquid | <input type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-03

Geometry: Charcoal Cart, contact

Efficiency File: GeL TAB 13

Calibration Source ID number: MCA 04

Geometry: 47 mm Part on contact

Efficiency File: GeL TAB 14

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	32.3	361.5	8.94
Co-57 122 keV	31.6	312.0	10.13
Ce-139 166 keV	27.8	297.5	9.35
Hg-203 279 keV	32.2	435.8	7.39
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	43.6	834.8	5.22
Sr-88 514 keV	38.5	1121.7	3.43
Ce-137 662 keV	42.1	1522.4	2.77
Co-58 811 keV	N/A	N/A	N/A
Mn-54 836 keV	N/A	N/A	N/A
Y-88 828 keV	44.9	2413.8	1.86
Co-60 1173 keV	31.3	2116.5	1.48
Co-60 1332 keV	27.3	2119.5	1.29
Y-88 1836 keV	25.3	2573.3	0.98

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	30.6	282.7	10.82
Co-57 122 keV	34.5	244.6	14.10
Ce-139 166 keV	31.1	234.3	13.27
Hg-203 279 keV	30.8	350.2	8.79
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	35.5	658.9	5.39
Sr-88 514 keV	43.7	893.7	4.89
Ce-137 662 keV	42.1	1187.4	3.55
Co-58 811 keV	N/A	N/A	N/A
Mn-54 836 keV	N/A	N/A	N/A
Y-88 828 keV	49.2	1907.1	2.58
Co-60 1173 keV	32.8	1651.8	1.99
Co-60 1332 keV	28.6	1654.2	1.73
Y-88 1836 keV	27.3	2033.1	1.34

Detector Calibration Data Prepared by YM/0202 Date 8-15-88

Comments: _____

NORTH ANNA POWER STATION

HP-90.302
Form HP-90.302-2
Page 1 of 1
(Rev 0)

NCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA-03 Date Source Prepared: 8-13-88

Date Calibration Source Gamma Per Seconds Valid: 8-14-88 thru 8-15-88

- Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
 Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
 Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³⁷ Ba, ¹³⁴ Ba, ¹³⁷ Sr, ¹³⁴ Sr, ¹³⁷ Y, ¹³⁴ Y, ¹³⁷ Co, ¹³⁴ Co	Amerisham International	QC4.46 RY/125/110	6-1-88 0.1200 cur	Ported 6.5208 gms. into charcoal and dried

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.355	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1085.77	0.372	403.91	6-1-88	74.5	1.49E-3	361.5
Co-57 122 keV	1144.41.20	0.855	377.32	6-1-88	74.5	2.55E-3	312.0
Ce-139 166 keV	538.59	0.804	433.02	6-1-88	74.5	5.04E-3	297.5
Hg-203 279 keV	1710.87	0.773	1322.50	6-1-88	74.5	1.49E-2	435.8
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	2014.25	0.849	1307.31	6-1-88	74.5	6.02E-3	834.8
Sr-85 514 keV	2509.35	0.993	2489.27	6-1-88	74.5	1.07E-2	1121.7
Ce-137 662 keV	1797.32	0.881	1529.52	6-1-88	74.5	6.29E-3	1522.4
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 898 keV	4194.32	0.934	3917.50	6-1-88	74.5	6.50E-3	2413.8
Co-60 1173 keV	2174.00	1.000	2174.00	6-1-88	74.5	3.60E-4	2116.5
Co-60 1332 keV	2177.16	1.000	2177.16	6-1-88	74.5	3.60E-4	2119.5
Y-88 1836 keV	4201.64	0.994	4176.43	6-1-88	74.5	6.50E-3	2573.3

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp (- lambda x days decay)

Calibration Source Prepared by M. Young Date 8-13-88

Comments _____

 14-AUG-88 19:36:09 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.MAIN11
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: RADIOIODINES
 SAMPLE QUANTITY: 1.000000 UNITS: NLS
 SAMPLE GEOMETRY: CHARCOAL FILTER
 EFFICIENCY FILE NAME: GELI.TA115.

 *
SAMPLE DATE: 14-AUG-88 19:25:40 * FWHM(1332) 2.225
PK FIT TIME (LIVE): 600. SEC * SENSITIVITY: 5.000
CLAMPED REL. TIME: 620. SEC * SHAPE PARAMETER: 20.0 %
CLAMPED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.
 *

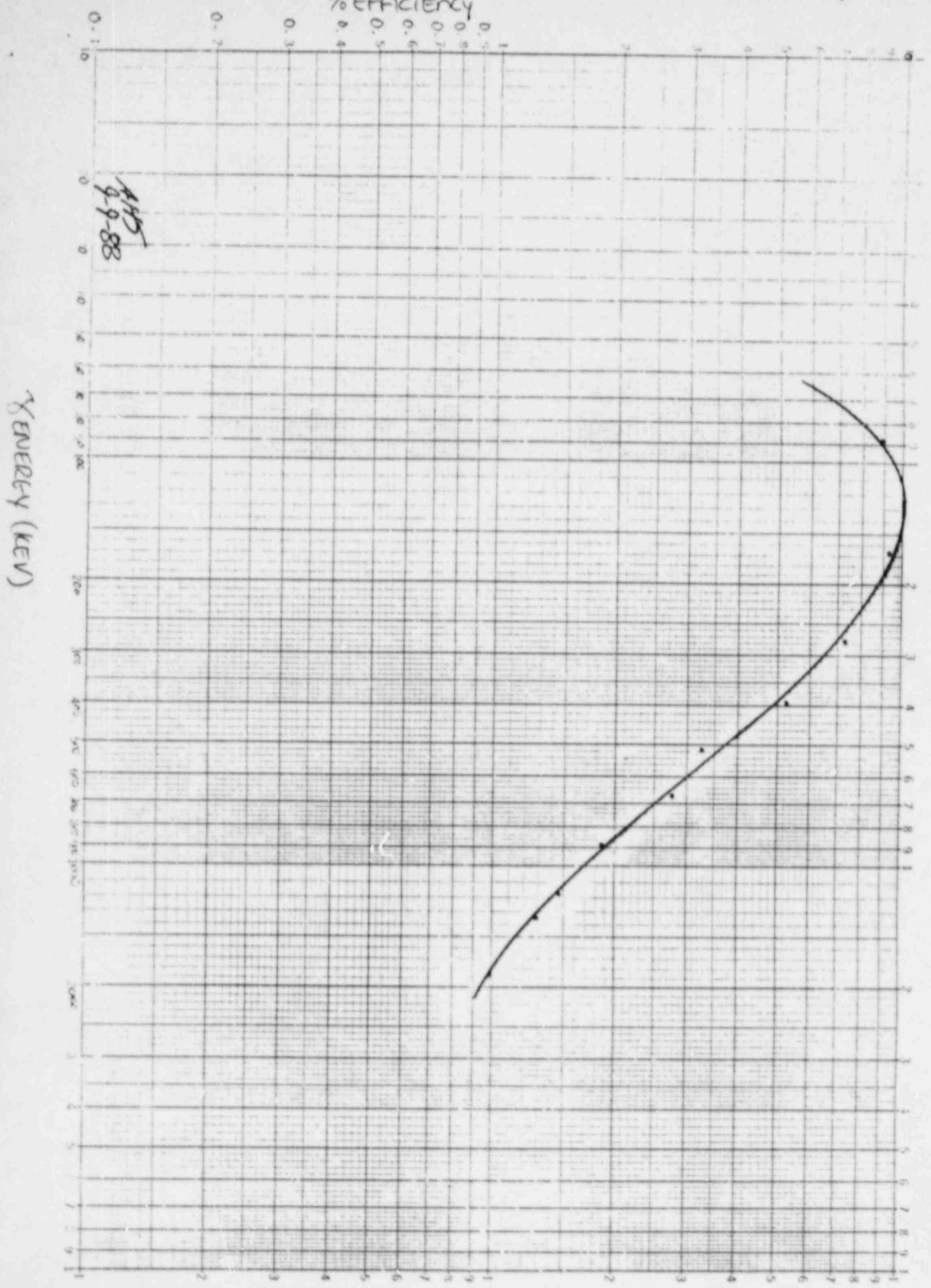
 *
DETECTOR: HPGE #1 * LIBRARY: GELI.LIB10D
CALIB DATE: 14-AUG-88 18:49:52 * ENERGY TOLERANCE: 1.500KV
REV/CHNL: 1.0002559 * HALF LIFE RATIO: 3.00
OFFSET: -0.1708498 KEV * ABUNDANCE LIMIT: 80.00%
 *

ENERGY WINDOW 49.84 TO 2046.35
 1.00-SIGMA ZERR

PK	IT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PH	CTS/SEC	ZERR	FIT
1	0	72.77	669.	6977.	1.01	72.92	72	5	1.11E 00	19.3	
2	4	82.67	713.	7566.	2.08	82.82	78	16	1.53E 00	15.3	1.83E 01
3	4	88.13	19397.	4960.	1.25	88.30	78	16	3.23E 01	0.9	
4	0	122.24	18938.	10780.	1.61	122.38	118	9	3.16E 01	1.2	
5	0	134.57	2383.	9440.	1.42	136.73	133	8	3.97E 00	1.3	
6	0	165.89	16697.	9140.	1.24	166.12	162	8	2.78E 01	1.3	
7	0	255.16	1352.	6901.	1.57	255.26	252	8	2.25E 00	11.0	
8	0	279.36	19329.	7847.	1.81	279.46	275	10	3.22E 01	1.1	
9	0	341.82	26187.	5464.	1.42	341.89	388	9	4.36E 01	0.8	
10	0	514.06	23087.	4805.	1.42	514.10	509	10	3.85E 01	0.9	
11	0	661.70	25280.	5535.	1.80	661.71	658	12	4.21E 01	0.9	
12	0	814.03	517.	2360.	1.95	813.99	810	9	8.62E-01	17.6	
13	0	893.09	26924.	3528.	1.62	898.03	893	10	4.49E 01	0.7	
14	0	1173.27	18796.	1810.	1.87	1173.14	1168	11	3.13E 01	0.8	
15	0	1332.68	16401.	565.	2.33	1332.31	1317	25	1.03E 00	9.5	1.02E 01
16	0	1836.04	15150.	447.	2.31	1835.73	1829	14	2.53E 01	0.9	

PEAK SEARCH COMPLETED (REV 15.7)

Dot #1 /
Ech. TAB13
ANALOGICAL CONTACT



ENERGY (KEV)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA 04 Date Source Prepared: 7-19-88

Date Calibration Source Gamma Per Seconds: 12 Aug 88 thru 13 Aug 88

- 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste smear
 Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
 Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mix of standard to calibration source etc)
¹⁰⁹ Cd, ⁵⁷ Co, ¹³⁷ Cs, ²⁴² Am, ¹³⁵ Sr, ¹³⁷ Y, ⁶⁰ Co	Amersham International	QC9 46 28/125/109	01 June 87 61200 GRT	Patched 4.9372 gms of standard into 4 T.M.P. 100 ml. filter. used 400 gms patch.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	846.76	0.373	314.99	6-1-88	72.5	1.49E-3	282.7
Co-57 122 keV	344.10	0.888	294.26	6-1-88	72.5	2.55E-3	244.6
Ce-139 166 keV	420.03	0.804	337.70	6-1-88	72.5	5.04E-3	234.3
Hg-203 279 keV	1334.26	0.773	1031.38	6-1-88	72.5	1.49E-2	350.2
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sr-85 392 keV	1570.43	0.649	1019.53	6-1-88	72.5	6.02E-3	658.7
Sr-85 314 keV	1956.96	0.993	1941.31	6-1-88	72.5	1.07E-2	873.7
Co-137 662 keV	1401.63	0.881	1192.83	6-1-88	72.5	6.29E-3	1187.4
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.12E-3	N/A
Y-88 828 keV	3271.03	0.924	3055.14	6-1-88	72.5	6.50E-3	1907.1
Co-60 1173 keV	1695.43	1.000	1695.43	6-1-88	72.5	3.60E-4	1651.8
Co-60 1332 keV	1697.90	1.000	1697.90	6-1-88	72.5	3.60E-4	1654.2
Y-88 1836 keV	3276.73	0.994	3257.07	6-1-88	72.5	6.50E-3	2033.1

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp (- lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments _____

 ***** 12-AUG-88 20:48:11 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GEL1.MAIN11
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: PARTICULATES
 SAMPLE QUANTITY: 1.000000 UNITS: MCG
 SAMPLE GEOMETRY: PART. FILTER
 EFFICIENCY FILE NAME: GEL1.LAB14.,

 *
 ACQUIRE DATE: 12-AUG-88 20:17:48 * FWHM(13.7) 2.225
 PRESET TIME (LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 622. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NHR ITERATIONS: 5.
 *

 *
 DETECTOR: HPGE #1 * LIBRARY:GEL1.LIBPAR
 CALIB DATE: 12-AUG-88 20:21:42 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0001748 * HALF LIFE RATIO: 8.00
 OFFSET: -0.0074171 KEV * ABUNDANCE LIMIT: 80.00%
 *

ENERGY WINDOW 50.00 TO 2048.35
 1.00-SIGMA ZERR

PK	IT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PH	CTS/SEC	ZERR	ITT
1	0	72.19	1773.	9073.	2.87	72.19	69	7	2.95E 00	9.3	
2	5	82.67	1151.	7752.	2.83	82.66	79	14	1.92E 00	12.3	1.85E 01
3	5	88.11	18371.	4996.	1.22	88.10	79	14	3.06E 01	0.9	
4	0	122.15	20677.	10240.	1.21	122.14	118	8	3.45E 01	1.1	
5	0	136.69	2746.	9374.	1.93	136.67	133	8	4.58E 00	6.4	
6	0	165.99	18661.	9449.	1.23	165.97	162	8	3.11E 01	1.1	
7	0	255.29	887.	6321.	1.44	255.25	252	7	1.48E 00	15.3	
8	0	279.32	18459.	6802.	1.40	279.27	276	8	3.08E 01	1.1	
9	0	391.79	21303.	6168.	1.79	391.73	387	10	3.55E 01	1.0	
10	0	514.04	26212.	5155.	1.43	513.96	509	10	4.37E 01	0.8	
11	0	661.67	25273.	5946.	2.00	661.56	656	12	4.21E 01	0.9	
12	0	814.12	699.	2274.	1.96	813.98	810	8	1.16E 00	12.4	
13	0	898.07	29527.	3784.	1.71	897.92	893	10	4.92E 01	0.7	
14	0	1173.23	19703.	2289.	1.85	1173.03	1167	12	3.28E 01	0.8	
15	4	1325.06	622.	994.	3.16	1324.83	1320	20	1.04E 00	10.3	1.29E 01
16	4	1332.48	17148.	694.	2.02	1332.26	1320	20	2.86E 01	0.8	
17	0	1836.02	16336.	567.	2.33	1835.71	1830	13	2.72E 01	0.8	

PEAK SEARCH COMPLETED (REV 15.7)

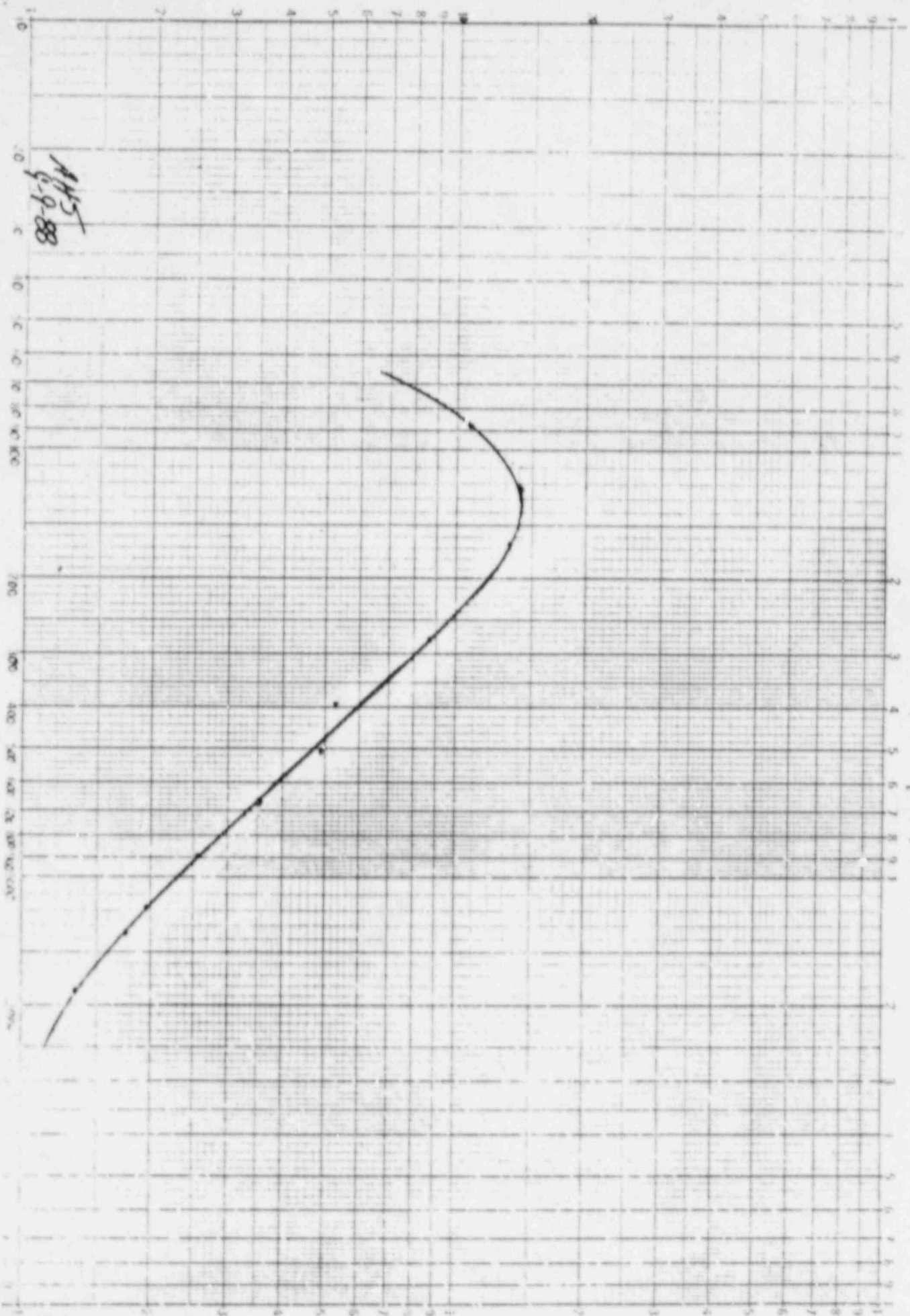
% EFFICIENCY

48 7320
MILITARY & NAVAL CO.

Date: 11/1
Cell: T0614
4mm part on contact

AHS
9-9-88

X ENERGY (eV)



MCA DETECTOR CALIBRATION DATA

Det # 1

Detector Serial or ID Number: SN# 24-P 445C

- | | | | |
|--|---|--|---|
| <input checked="" type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| <input type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwat smear, contact | <input type="checkbox"/> Radwat smear, 8 cm |
| <input type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| <input checked="" type="checkbox"/> 1 liter Marinelli Liquid | <input type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-05

Geometry: 100cc GAS, CONTACT

Efficiency File: GELI, TAB15

Calibration Source ID number: MCA-06

Geometry: 1 liter MARINELLI, CONT.

Efficiency File: GELI, TAB16

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	28.3	674.7	4.19
Co-57 122 keV	30.2	583.6	5.17
Ce-139 166 keV	26.6	559.2	4.76
Hg-203 279 keV	25.5	835.6	3.05
Ba-133 356 keV	N/A	N/A	N/A
Sr-88 514 keV	34.9	1572.4	2.22
Sr-88 514 keV	38.7	2132.5	1.81
Co-137 662 keV	41.6	2833.3	1.47
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	46.7	4550.6	1.03
Co-60 1173 keV	32.2	3941.4	0.82
Co-60 1332 keV	28.1	3947.1	0.71
Y-88 1836 keV	26.8	4851.4	0.55

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	25.8	1314.9	1.96
Co-57 122 keV	29.4	1137.5	2.58
Ce-139 166 keV	27.6	1089.8	2.53
Hg-203 279 keV	29.1	1628.5	1.79
Ba-133 356 keV	N/A	N/A	N/A
Sr-113 392 keV	42.4	3064.5	1.38
Sr-88 514 keV	45.4	4156.2	1.09
Co-137 662 keV	49.9	5522.1	0.90
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	57.7	8869.1	0.65
Co-60 1173 keV	39.8	7681.7	0.52
Co-60 1332 keV	35.6	7692.9	0.46
Y-88 1836 keV	34.6	9455.3	0.37

Detector Calibration Data Prepared by D. E. Lane / m yanny Date 8-13-80

Comments _____

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MC 405 Date Source Prepared: 7-19-88

Date Calibration Source Gamma Per Second Valid: 12 Aug 88 thru 13 Aug 88

- Indicite 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radon Seal
 Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
 Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³² Sr, ¹³¹ I, ¹³⁰ Te	Amerishen International	GCY-46 28/125/109	01 June 88 @ 1200 GMP	Pipetted 11.751 gms of standard into media and suspended. Piped media into chamber.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2020.50	0.372	751.63	6-1-88	72.5	1.49E-3	674.7
Co-57 122 keV	321.23	0.855	702.15	6-1-88	72.5	2.55E-3	583.6
Ce-139 166 keV	1002.26	0.804	805.82	6-1-88	72.5	5.04E-3	559.2
Hg-203 279 keV	3153.77	0.773	2461.05	6-1-88	72.5	1.49E-2	835.6
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	3748.50	0.649	2432.78	6-1-88	72.5	6.02E-3	1572.4
Sr-88 514 keV	4661.65	0.992	4632.29	6-1-88	72.5	1.07E-2	2132.5
Ce-137 602 keV	3744.64	0.881	2846.29	6-1-88	72.5	6.29E-3	2233.3
Co-58 611 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
At-214 617 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 624 keV	7225.28	0.984	7290.08	6-1-88	72.5	6.50E-3	4550.6
Y-88 624 keV	4045.6	1.000	4045.60	6-1-88	72.5	3.60E-4	3741.4
Y-88 624 keV	4051.49	1.000	4051.49	6-1-88	72.5	3.60E-4	3747.1
Y-88 624 keV	7771.93	0.994	7771.93	6-1-88	72.5	6.50E-3	4851.4

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments _____

CALIBRATION COUNT

SPECTRAL FILE NAME: GEL1.MAIN11
 SAMPLE DATE: 01-JUN-88 12100:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: GASEOUS
 SAMPLE QUANTITY: 1.000000 UNITS: BLS
 SAMPLE GEOMETRY: 1000C GAS CHAM
 EFFICIENCY FILE NAME: GEL1.TAB15..

XX
 *
 ACQUIRE DATE: 12-AUG-88 20149125 * FWHM(1312) 2.225
 PRESET TIME (LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 621. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NRK ITERATIONS: 5.
 *
 XXX

*
 DETECTOR: HPGE #1 * LIBRARY: GEL1.LIBGAS
 CALIB DATE: 12-AUG-88 20121142 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0001748 * HALF LIFE RATIO: 8.00
 OFFSET: -0.0074171 KEV * ABUNDANCE LIMIT: 30.00%
 *
 XXX

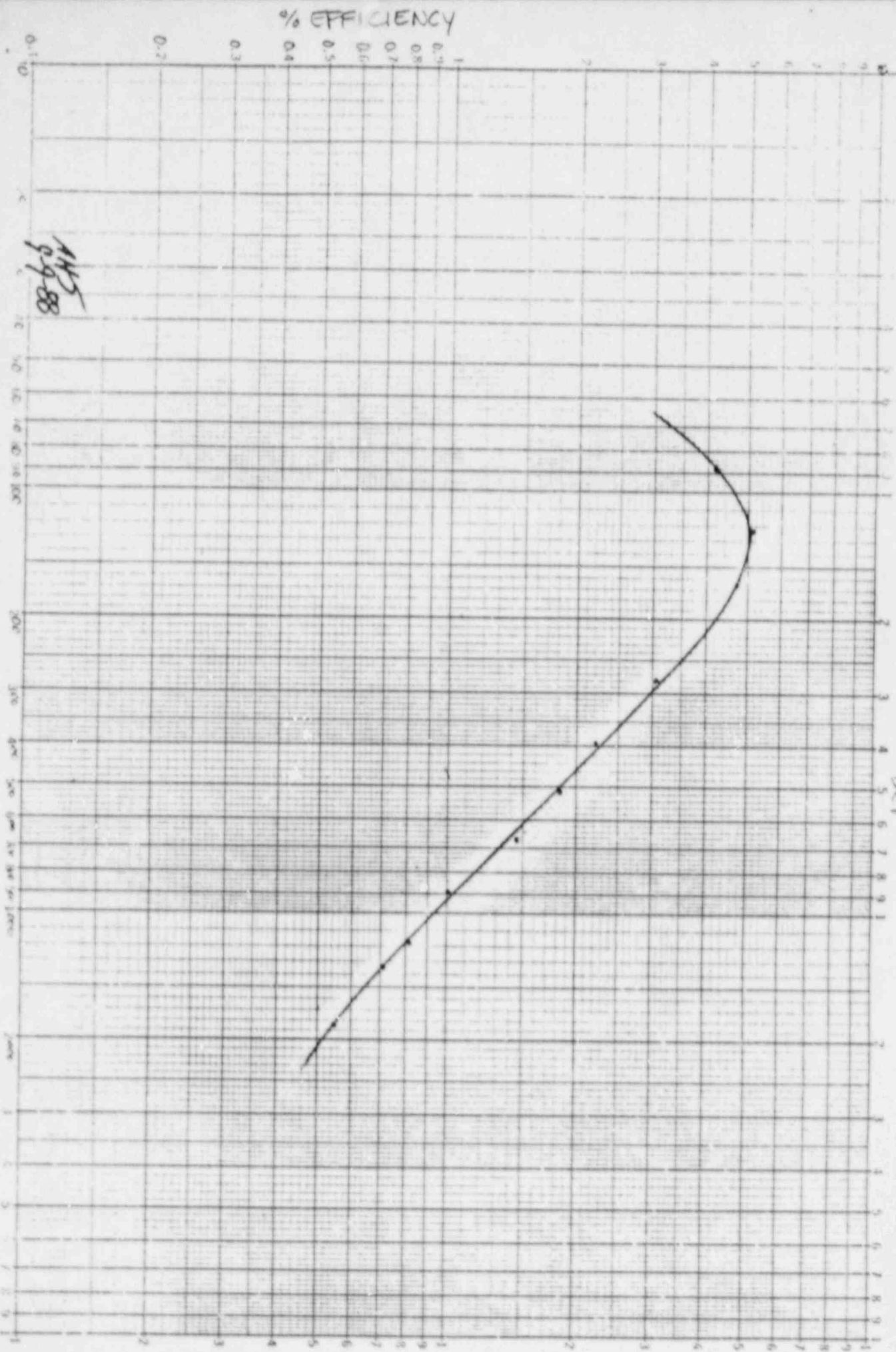
ENERGY WINDOW 50.00 TO 2048.35
 1.00-SIGMA ZERR

PK	IT	ENERGY	AREA	BKGD	FWHM	CHANNEL	LEFT	PW	CTS/SEC	ZERR	FIT
1	0	72.15	2125.	12336.	2.77	72.14	68	9	3.34E 00	9.7	
2	0	88.13	17002.	12398.	1.20	88.12	84	8	2.83E 01	1.4	
3	0	122.16	18108.	10071.	1.22	122.15	119	7	3.02E 01	1.2	
4	0	136.55	2436.	11800.	1.93	136.53	133	8	4.06E 00	8.0	
5	0	165.98	15965.	10366.	1.27	165.96	163	7	2.66E 01	1.3	
6	0	254.95	936.	7223.	1.20	254.91	252	7	1.56E 00	15.5	
7	0	279.27	15300.	7634.	1.33	279.22	275	8	2.55E 01	1.3	
8	0	391.78	20915.	4935.	1.78	391.72	389	8	3.49E 01	0.9	
9	0	514.00	23228.	5072.	1.44	513.92	509	10	3.87E 01	0.9	
10	0	661.69	24949.	5081.	2.00	661.58	657	11	4.16E 01	0.8	
11	0	814.45	570.	2168.	1.76	814.32	811	8	9.17E-01	15.3	
12	0	898.06	28167.	3443.	1.70	897.91	893	10	4.69E 01	0.7	
13	0	1173.24	19293.	1899.	1.84	1173.03	1167	12	3.22E 01	0.8	
14	X	1324.97	651.	741.	2.83	1324.75	1319	20	1.09E 00	8.7	1.09E 01
15	3	1332.46	16899.	601.	2.01	1332.24	1319	20	2.81E 01	0.8	
16	0	1836.02	16051.	339.	2.33	1835.71	1829	14	2.68E 01	0.8	

PEAK SEARCH COMPLETED (REV 15.7)

GEU TAB 15
100 CC GAS CHAMBER, CONTACT
Dec 1st '01

X ENERGY (KCAL)



AHS
9-9-88

XX
 XXXXXXXXXXXXXXXXXXXX 12-AUG-88 2111127 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX

CALIBRATION COUNT

SPECTRAL FILE NAME: GEL1.MATH1
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1983
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: MLS
 SAMPLE CONTAINER: HARIOELLI BEAKER
 SPECIAL: FILE NAME: GEL1.TAB10.

ACQUISITION DATE: 12-AUG-88 21100148 * FWHM(1537) 2.725
 PRESET EFFECTIVE 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 630. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIFETIME: 600. SEC * HNR ITERATIONS: 5.

DETECTOR: HPGe #1 * LIBRARY: GEL1.LIB09
 CALIB DATE: 12-AUG-88 20:21:42 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0001748 * HALF LIFE RATIO: 8.00
 OFFSET: -0.0074171 KEV * ABUNDANCE LIMIT: 30.00%

ENERGY WINDOW 50.00 TO 2048.35
 1.00-SIGMA XERR

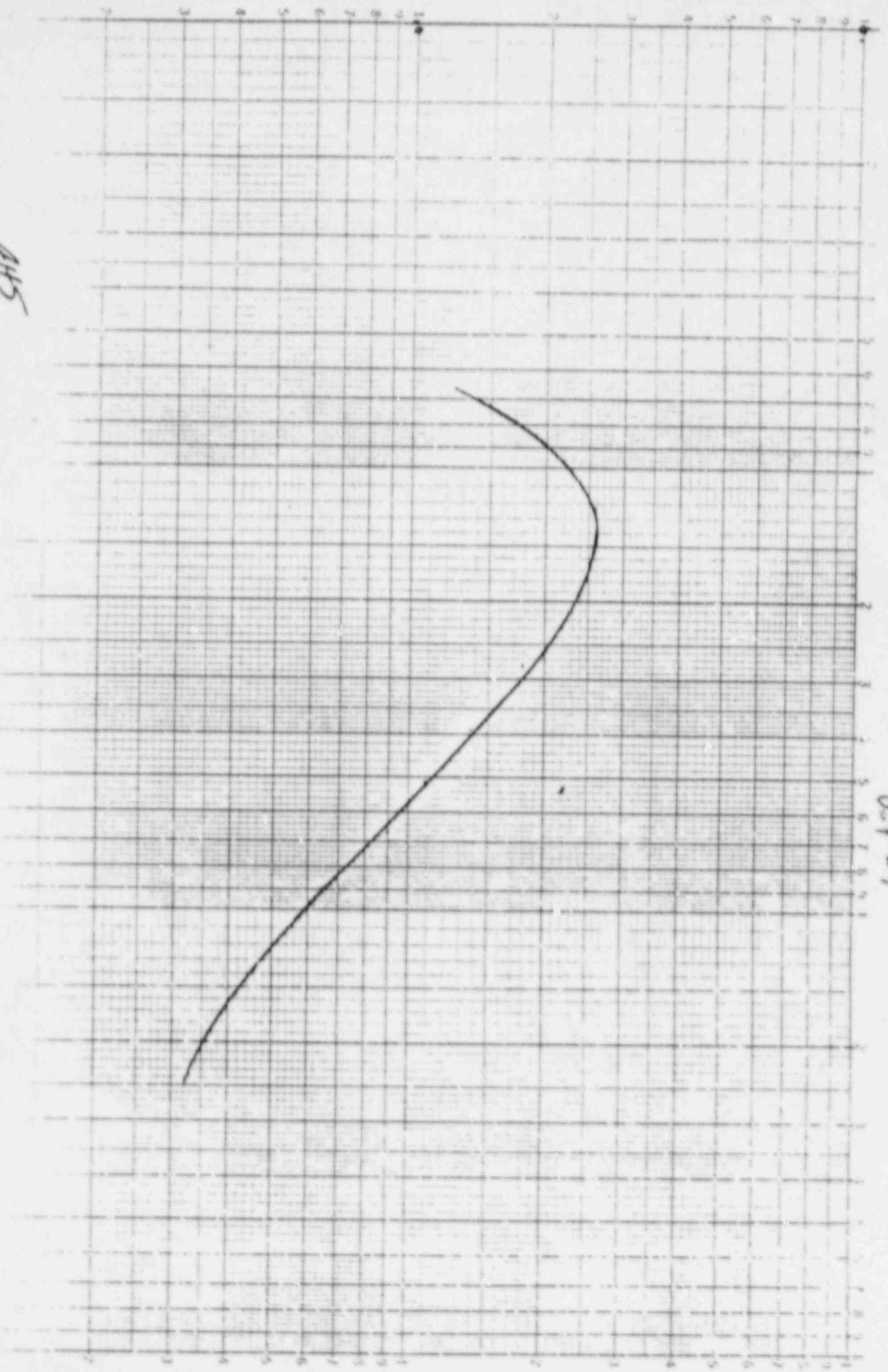
PK	CH	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PW	CTS/SEC	%ERR	FILE
1	0	72.28	1350.	14721.	1.21	72.28	70	6	2.27E 00	14.4	
2	0	88.07	15466.	21852.	1.20	88.06	84	8	2.58E 01	1.8	
3	0	122.15	17647.	21894.	1.22	122.14	118	8	2.94E 01	1.6	
4	0	146.75	2582.	18186.	1.93	146.73	134	7	4.30E 00	8.9	
5	0	165.98	13547.	17194.	1.24	165.96	163	7	2.76E 01	1.5	
6	0	255.19	1056.	9778.	1.33	255.15	253	6	1.76E 00	15.1	
7	0	279.23	17450.	12022.	1.30	279.23	273	8	2.91E 01	1.3	
8	0	314.01	25421.	9228.	1.79	314.01	387	10	4.24E 01	0.9	
9	0	341.70	27213.	7178.	1.44	341.73	509	10	4.54E 01	0.8	
10	0	361.70	29940.	6946.	2.02	361.59	657	11	4.99E 01	0.8	
11	0	414.10	824.	3227.	1.60	413.96	510	9	1.37E 00	13.1	
12	0	500.38	34601.	4238.	1.74	500.73	894	9	5.77E 01	0.6	
13	0	1243.26	23900.	2469.	1.05	1243.07	1167	12	1.96E 01	0.8	
14	0	1402.71	770.	1203.	3.01	1404.94	1310	23	1.28E 00	8.9	1.00E 01
15	0	1537.40	21337.	785.	2.03	1537.27	1318	23	3.56E 01	0.7	
16	0	1876.07	20777.	504.	2.33	1835.76	1829	14	3.46E 01	0.7	

PEAK SEARCH COMPLETED (REV 15.7)

% EFFICIENCY

46 7320
RESEARCH & DESIGN CO.
NEW YORK, N. Y.

Gr 1, Tab 16
1 in. diam. ball, contact
Out #1



AHS
9-9-88

(...)

MCA DETECTOR CALIBRATION DATA

Out # 2

Detector Serial or ID Number: SN # 21-P-846A

- | | | | | |
|-----------------------------|---|--|---|---|
| Check applicable Geometries | <input type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input checked="" type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| | <input type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwet smear, contact | <input type="checkbox"/> Radwet smear, 8 cm |
| | <input type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| | <input type="checkbox"/> 1 liter Marinelli Liquid | <input checked="" type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| | <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-01

Geometry: 15 ml vial, contact

Efficiency File: Geli.Tab 21

Calibration Source ID number: MCA-02

Geometry: 100 ml cup, liq, contact

Efficiency File: Geli.Tab 22

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	23.8	540.4	4.40
Co-57 122 keV	25.0	467.6	5.35
Ce-139 106 keV	21.1	447.9	4.71
Hg-203 279 keV	21.6	669.3	3.23
Ba-133 356 keV	N/A	N/A	N/A
Sr-90 392 keV	29.2	1259.6	2.32
Sr-85 514 keV	30.8	1708.3	1.80
Ce-137 602 keV	31.9	2269.7	1.41
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	37.4	3645.5	1.03
Co-60 1173 keV	25.3	3157.4	0.80
Co-60 1332 keV	22.3	3162.0	0.71
Y-88 1830 keV	21.4	3886.5	0.55

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	20.0	684.7	2.92
Co-57 122 keV	21.3	592.4	3.60
Ce-139 106 keV	19.5	567.5	3.44
Hg-203 279 keV	20.0	848.0	2.63
Ba-133 356 keV	N/A	N/A	N/A
Sr-90 392 keV	27.6	1595.9	1.73
Sr-85 514 keV	29.2	2164.4	1.35
Ce-137 602 keV	30.9	2875.7	1.07
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	36.4	4618.6	0.79
Co-60 1173 keV	25.5	4000.2	0.64
Co-60 1332 keV	22.0	4006.1	0.55
Y-88 1830 keV	21.0	4923.9	0.43

Detector Calibration Data Prepared by JH Young

Date 8-14-88

Comments _____

NORTH ANNA POWER STATION

HP-90302
Form HP-90302-2
Page 1 of 1
(Rev 0)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number MCA 01 Date Source Prepared 7-19-88

Date Calibration Source Gamma Per Seconds Valid: 12 Aug 88 thru 15 Aug 88

Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Mannelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³² Ce-138	Amerishan International	QCY-46	01 Jun 88	Pipetted 9.4377 gms of standard into 15 ml counting vial and diluted to 15 ml with deion water
¹³⁷ Cs, ¹³² Ce-138		89/145/109	01 Jun 88	

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1618.6	0.372	602.1	01 Jun 88	72.5	1.49E-3	540.4
Co-57 122 keV	657.9	0.858	562.5	01 Jun 88	72.5	2.88E-3	467.6
Ce-139 168 keV	802.9	0.804	645.5	01 Jun 88	72.5	1.04E-3	447.9
Hg-203 279 keV	2550.5	0.773	1971.5	01 Jun 88	72.5	1.49E-3	669.3
¹³⁷ Cs-138 662 keV	N/A	0.800	N/A	N/A	N/A	1.81E-4	N/A
Sr-88 292 keV	3002.9	0.849	1948.9	01 Jun 88	72.5	4.02E-3	1259.6
Sr-88 514 keV	3740.8	0.992	3710.9	01 Jun 88	72.5	1.07E-3	1708.3
Co-58 662 keV	2679.4	0.881	2280.1	01 Jun 88	72.5	8.79E-3	2269.7
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.71E-3	N/A
Y-88 898 keV	6252.7	0.984	5840.0	01 Jun 88	72.5	6.50E-3	3645.5
Co-60 1173 keV	3240.9	1.000	3240.9	01 Jun 88	72.5	3.80E-4	3157.4
Co-60 1332 keV	3245.6	1.000	3245.6	01 Jun 88	72.5	3.80E-4	3162.0
Y-88 1836 keV	6363.6	0.994	6226.1	01 Jun 88	72.5	6.50E-3	3886.5

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp (- lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments

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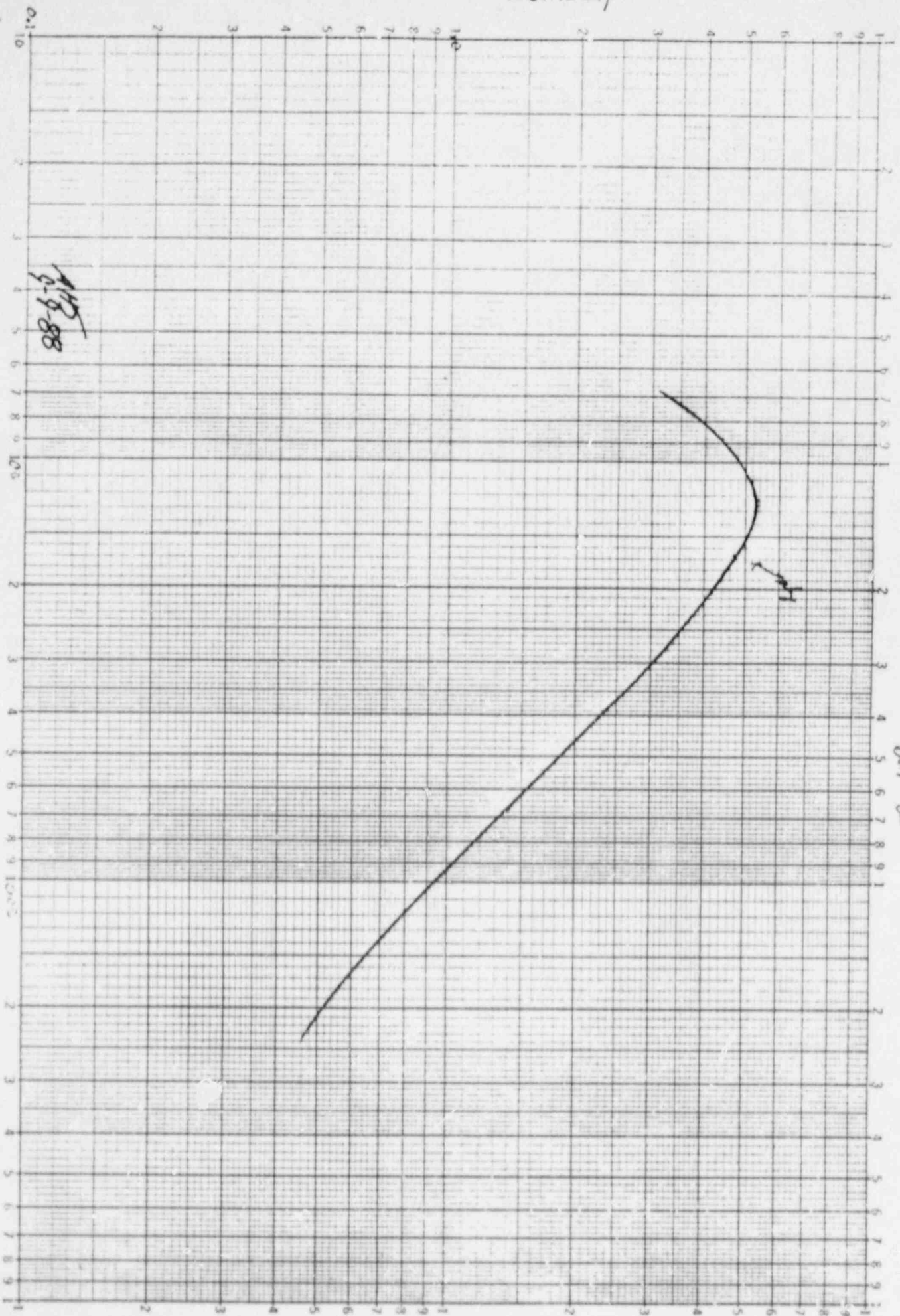
ENERGY RADIATION 20.01 TO 200.21
 LOW-SIGMA ZERO

NO.	WAVELENGTH	AREA	HEIGHT	FWHM	CHANNEL	LEFT	PH	DTG/RES	MARK
1	11.00	497.	5450.	0.93	72.99	72	4	6.71E 01	0.1
2	40.53	18130.	10409.	1.26	88.17	84	3	3.48E 01	1.1
3	122.72	14989.	7502.	1.34	122.20	119	3	2.59E 01	1.4
4	135.75	1994.	7526.	1.74	136.74	134	7	1.31E 00	7.0
5	146.93	13858.	8776.	1.20	166.07	162	5	2.11E 01	1.6
6	255.07	890.	5306.	1.57	255.06	232	7	1.48E 00	14.1
7	277.70	13942.	6415.	1.60	277.27	274	9	2.16E 01	1.4
8	391.62	17526.	5518.	1.50	391.78	357	10	2.82E 01	1.1
9	404.00	18460.	4536.	1.43	403.99	369	10	3.03E 01	1.0
10	447.67	19152.	5372.	1.09	447.60	406	12	2.19E 01	1.0
11	473.33	464.	1845.	2.28	473.75	410	3	7.73E 00	1.1
12	518.09	22441.	3286.	1.72	518.60	493	15	3.74E 01	0.0
13	517.25	15196.	1926.	2.07	1173.14	1167	12	2.53E 01	1.0
14	518.43	722.	1102.	3.67	1325.35	1317	25	1.20E 00	5.1 2.58E 01
15	542.51	13364.	628.	2.18	1181.47	1171	25	2.24E 00	0.9
16	570.14	12819.	107.	2.52	1635.75	1629	13	2.11E 01	1.0

PEAK SEARCH COMPLETED CREV 15.71

(incl. 14621
15 ml vial, contact
Dot #2

% Efficiency



117-88
2.9-88

X Energy (keV)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA-02 Date Source Prepared 7-19-88
Date Calibration Source Gamma Far Seconds Valid 12 Aug 88 thru 13 Aug 88

Ind state 10 cc Gas 15 ml Vial liquid PASS Dia Vial Point Source Rad waste Stream
Applicable 47 mm Part Filter 100 ml Cup liquid PASS Char Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli Liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³² Sr, ¹³⁵ Sr, ¹³⁷ Y, ¹³⁸ La	Amer sham International	QCY. 46 R8/125/109	01 June 87 6:13:00 PM	PIPETTED 11.957 grams OF STANDARD INTO 100 ml COUNTING CUP AND DILUTED TO 100 ml WITH DEMINERALISED WATER.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2050.69	0.377	762.86	6-1-88	72.5	1.49E-3	684.7
Co-57 122 keV	833.49	0.855	712.64	6-1-88	72.5	2.55E-3	592.4
Ce-139 166 keV	1017.24	0.804	817.86	6-1-88	72.5	5.04E-3	567.5
Hg-203 279 keV	3231.33	0.775	2497.32	6-1-88	72.5	1.49E-2	848.0
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sr-85 192 keV	3804.50	0.649	2469.12	6-1-88	72.5	6.02E-3	1595.9
Sr-85 114 keV	4759.41	0.993	4701.49	6-1-88	72.5	1.07E-2	2164.4
Ca-137 62 keV	3394.61	0.881	2838.81	6-1-88	72.5	8.29E-3	2875.7
Co-58 11 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 35 keV	N/A	1.000	N/A	N/A	N/A	2.22E-2	N/A
Y-88 28 keV	7921.83	0.934	7398.99	6-1-88	72.5	6.50E-3	4618.6
Co-60 73 keV	4106.03	1.000	4106.03	6-1-88	72.5	3.60E-4	4000.2
Co-60 32 keV	4112.01	1.000	4112.01	6-1-88	72.5	3.60E-4	4006.1
Y-88 36 keV	7935.65	0.994	7888.03	6-1-88	72.5	6.50E-3	4933.9

Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by JH Young Date 7-19-88

11. SECTION COUNT

FEDERAL FILE NAME: 0511.MAINT
 SAMPLE DATE: 01-JUN-80 12.00100
 NAME IDENTIFICATION: 1990
 SAMPLE VOLUME: 1.00000
 SAMPLE DENSITY: 1.00000
 SAMPLE ELEMENTS: 290 BL CMP

SECTION 1: 1.00000
 SECTION 2: 1.00000
 SECTION 3: 1.00000
 SECTION 4: 1.00000
 SECTION 5: 1.00000

SECTION 6: 1.00000
 SECTION 7: 1.00000
 SECTION 8: 1.00000
 SECTION 9: 1.00000
 SECTION 10: 1.00000

SECTION 11: 1.00000
 SECTION 12: 1.00000
 SECTION 13: 1.00000
 SECTION 14: 1.00000
 SECTION 15: 1.00000
 SECTION 16: 1.00000
 SECTION 17: 1.00000
 SECTION 18: 1.00000
 SECTION 19: 1.00000
 SECTION 20: 1.00000

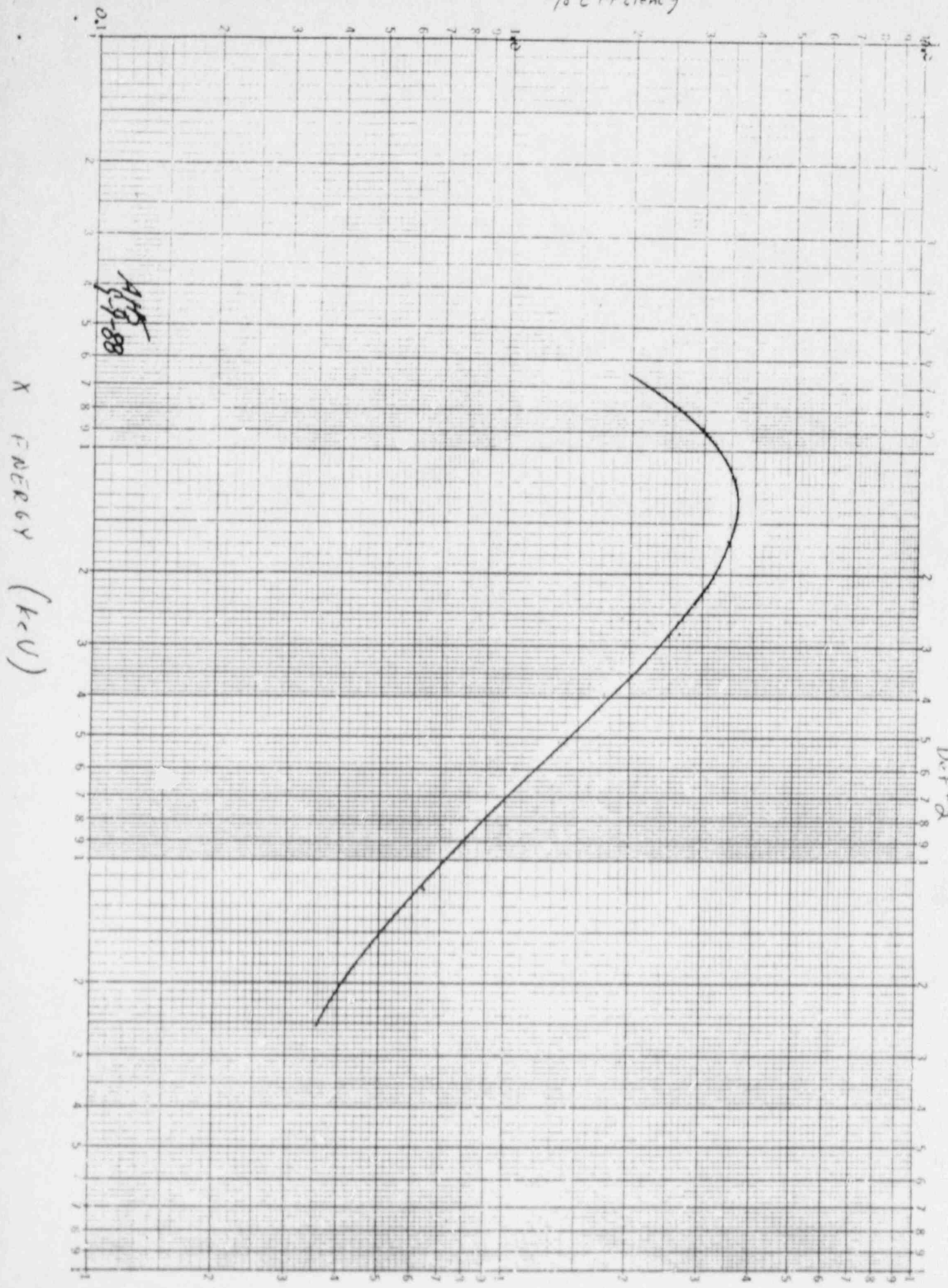
ENERGY WINDOW 10.01 TO 2010.01
1.00-SIGMA XERR

PK	ENERGY	AREA	BGND	FWHM	CHANNEL	LEFT	FW	RIGHT	CLAS	PK
1	72.05	475	6092	0.74	73.05	72	4	71.231-01	72.05	
2	83.73	10004	11902	1.24	89.11	84	8	82.008-01	83.73	
3	112.29	12919	11130	1.31	122.19	116	8	112.13-01	112.29	
4	122.44	7557	10494	1.61	136.92	133	8	122.33-50	122.44	
5	172.91	22639	10749	1.71	165.04	161	8	172.93-01	172.91	
6	206.31	806	6129	1.23	255.29	252	7	206.44-06	206.31	
7	247.29	17002	7381	1.39	279.26	274	10	247.09E-01	247.29	
8	347.79	16541	5600	1.23	341.74	341	12	347.64-01	347.79	
9	447.02	17491	4643	1.41	413.27	509	10	447.78-01	447.02	
10	547.07	18563	5416	1.41	661.50	656	12	547.04-01	547.07	
11	647.41	399	1911	2.19	814.32	811	9	647.55-01	647.41	
12	747.76	11817	3403	1.26	890.50	875	12	747.64-01	747.76	
13	847.73	15316	1399	1.17	1111.13	1157	13	847.55E-01	847.73	
14	947.05	853	1207	4.23	1325.51	1314	20	947.25-01	947.05	
15	1047.24	11227	529	1.11	1532.40	1515	22	1047.08-01	1047.24	
16	1147.51	18276	577	2.00	1835.92	1827	24	1147.13-01	1147.51	

USA SEARCH DONE TSC (REV 10.7)

Col. TPB 22
100 ml cup, contact
Det #2

% Efficiency



X ENERGY (keV)

A19-88

MCA DETECTOR CALIBRATION DATA

Det # 2

Detector Serial or ID Number: SN # 21-P-846A

- | | | | | |
|-----------------------------|---|---|--|---|
| Check applicable Geometries | <input type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| | <input checked="" type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwat smear, contact | <input type="checkbox"/> Radwat smear, 8 cm |
| | <input checked="" type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| | <input type="checkbox"/> 1 liter Marinelli Liquid | <input type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| | <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-03

Geometry: Charcoal Cart, contact

Efficiency File: GeLi TAB23

Calibration Source ID number: MCA-04

Geometry: 47mm Part filter, contact

Efficiency File: GeLi TAB24

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	29.0	361.5	8.02
Co-57 122 keV	27.2	312.0	8.72
Ce-139 166 keV	23.5	297.5	7.90
Hg-203 279 keV	27.2	435.8	6.24
Ba-133 356 keV	N/A	N/A	N/A
Sr-88 514 keV	32.8	1121.7	2.92
Cs-137 662 keV	35.4	1522.4	2.33
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	38.8	2413.8	1.61
Co-60 1173 keV	26.6	2116.5	1.26
Co-60 1332 keV	23.5	2119.5	1.11
Y-88 1836 keV	21.4	2573.3	0.83

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	28.1	282.7	9.94
Co-57 122 keV	30.7	244.6	12.55
Ce-139 166 keV	25.8	234.3	11.01
Hg-203 279 keV	26.9	350.2	7.68
Ba-133 356 keV	N/A	N/A	N/A
Sr-88 514 keV	30.0	658.9	4.55
Cs-137 662 keV	36.9	893.7	4.13
Co-58 811 keV	35.3	1187.4	2.97
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	41.6	1907.1	2.18
Co-60 1173 keV	27.9	1651.8	1.69
Co-60 1332 keV	24.3	1654.2	1.47
Y-88 1836 keV	22.6	2033.1	1.11

Detector Calibration Data Prepared by M Young

Date 8-15-87

Comments _____

NORTH ANNA POWER STATION

HP-90302
Form HP-90302-2
Page 1 of 1
(Rev 0)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA-03 Date Source Prepared 8-13-88
Date Calibration Source Gamma Per Seconds Valid: 8-14-88 thru 8-15-88

- Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
Co-57, Ce-139, Sn-113, Sr-85, Y-88, Co-60	Amerishan International	QC4.46 R4/125/110	6-1-88 @1200 cpr	Ported 6.3308 grms. into charcoal and dried

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1085.77	0.373	403.91	6-1-88	74.5	1.49E-3	361.5
Co-57 122 keV	411.30 411.30	0.858	377.32	6-1-88	74.5	2.55E-3	312.0
Co-139 166 keV	538.59	0.804	433.02	6-1-88	74.5	5.04E-3	297.5
Hg-203 279 keV	1710.87	0.773	1322.50	6-1-88	74.5	1.49E-2	435.8
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	2014.35	0.649	1307.31	6-1-88	74.5	6.02E-3	834.8
Sr-85 514 keV	2509.35	0.992	2489.27	6-1-88	74.5	1.07E-2	1121.7
Co-137 562 keV	1797.32	0.881	1529.52	6-1-88	74.5	6.39E-3	1522.4
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	3.22E-3	N/A
Y-88 898 keV	4194.32	0.984	3917.50	6-1-88	74.5	6.50E-3	2413.8
Co-60 1173 keV	2174.00	1.000	2174.00	6-1-88	74.5	3.60E-4	2116.5
Co-60 332 keV	2177.16	1.000	2177.16	6-1-88	74.5	3.60E-4	2119.5
Y-88 836 keV	4201.64	0.994	4176.43	6-1-88	74.5	6.50E-3	2573.3

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by N. Young Date 8-13-88

Comments

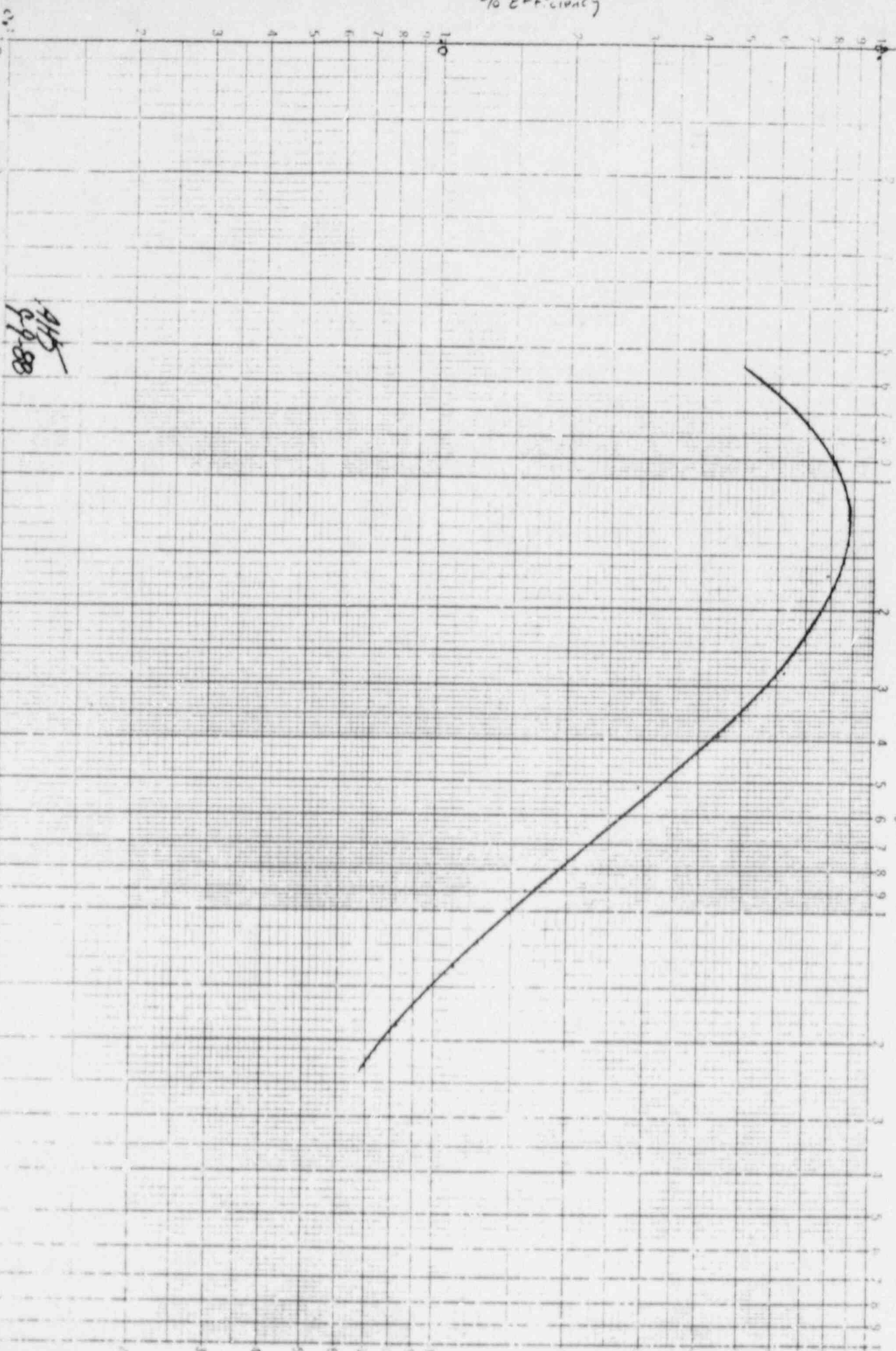
ENERGY WINDOW 47.92 TO 2048.01
 1.00 MICHA ZERR

PK	TY	ENERGY	AREA	BXND	CH	CHANNL	LEFT	PR	CL/SEC	1	OR
1	0	71.17	723.	9831.	1.04	71.25	7	4	1.21E 00	13.7	
2	0	95.10	17307.	12260.	1.43	98.27	04	9	2.30E 01	1.4	
3	0	123.77	16320.	7652.	1.89	112.77	111	8	2.75E 01	1.3	
4	0	155.80	1269.	8854.	1.70	138.76	133	0	3.75E 00	1.0	
5	0	165.78	1477.	8043.	1.47	165.16	162	0	2.35E 01	1.4	
6	0	275.38	1004.	6411.	1.92	225.74	252	0	1.76E 00	13.7	
7	0	377.17	16277.	8370.	1.59	377.45	274	11	3.72E 01	1.3	
8	0	371.84	22221.	4922.	1.57	351.91	280	0	3.74E 01	1.7	
9	0	514.98	19795.	4800.	1.74	514.12	709	10	1.30E 01	1.0	
10	0	637.78	21232.	4610.	1.66	637.07	657	10	3.54E 01	9.9	
11	0	814.11	334.	1748.	1.71	814.16	811	7	5.55E-01	21.4	
12	0	850.08	23266.	3797.	1.71	850.11	692	11	3.80E 01	1.5	
13	0	1171.35	15947.	1969.	2.17	1171.40	1164	11	2.46E 01	1.0	
14	0	1325.73	1046.	1297.	4.76	1325.76	1316	20	1.74E 00	11.1	1.03E 01
15	0	1332.83	14115.	853.	2.17	1332.82	1318	20	2.35E 01	0.7	
16	0	1836.24	12842.	687.	2.35	1836.24	1830	13	2.14E 01	1.0	

PEAK SEARCH COMPLETED (REV 15.71)

Col. TAB 23
Charcoal filter, contact
Def # 2

% Efficiency



915
29.88

Energy (KeV)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number MCA CH Date Source Prepared 7-19-88
Date Calibration Source Gamma Per Second Valid 12 Aug 88 thru 13 Aug 88

Indicate 100 cc Gas 15 ml Vial liquid
Apparatus 47 mm Part Filter 100 ml Cup liquid
Configuration Charcoal Cartridge 1 liter Marinelli liquid
 PASS Gas Vial Point Source Pad rate smear
 PASS Char Syringe Reactor crud particulate
 PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
⁶⁰ Co, ⁵⁷ Co, ⁵⁹ Fe, ⁶⁵ Zn, ¹¹³ Sr, ¹³⁷ Cs, ²²⁸ Ac, ²²⁸ Pb, ²²⁸ Th, ²²⁸ Ra, ²³² Th, ²³⁸ U, ²⁴¹ Am, ²⁴⁴ Cm, ²⁴⁸ Cm	Amerishen International	QCJ 46 28/125/109	01 June 87 @ 1200 GM	Ppd. H ₂ O 4.9372 gms of standard onto 47mm part filter used evaporated.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
⁶⁰ Co-133 10 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
¹⁰⁶ Ag-109 28 keV	846.76	0.372	314.99	6-1-88	72.5	1.49E-3	282.7
⁶⁰ Co-57 122 keV	344.16	0.858	294.26	6-1-88	72.5	2.55E-3	244.6
⁶⁰ Co-139 166 keV	420.03	0.804	337.70	6-1-88	72.5	5.04E-3	234.3
²⁰³ Hg-203 279 keV	1334.26	0.773	1031.38	6-1-88	72.5	1.49E-3	350.2
¹³³ Ba-133 356 keV	N/A	0.800	N/A	N/A	N/A	1.81E-4	N/A
¹¹³ Sr-113 392 keV	1570.93	0.849	1091.53	6-1-88	72.5	6.02E-3	658.9
⁸⁵ Sr-85 514 keV	1956.96	0.992	1941.31	6-1-88	72.5	1.07E-2	893.7
¹³⁷ Cs-137 562 keV	1401.68	0.851	1192.83	6-1-88	72.5	6.29E-3	1187.4
⁵⁸ Co-58 911 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
⁵⁴ Mn-54 935 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
⁸⁸ Y-88 928 keV	3271.03	0.954	3055.14	6-1-88	72.5	6.50E-3	1907.1
⁸⁰ Co-80 172 keV	1695.43	1.000	1695.43	6-1-88	72.5	3.60E-4	1651.8
⁶⁰ Co-60 332 keV	1697.40	1.000	1697.90	6-1-88	72.5	3.60E-4	1654.2
⁸⁸ Y-88 956 keV	3276.73	0.994	3257.07	6-1-88	72.5	6.50E-3	2033.1

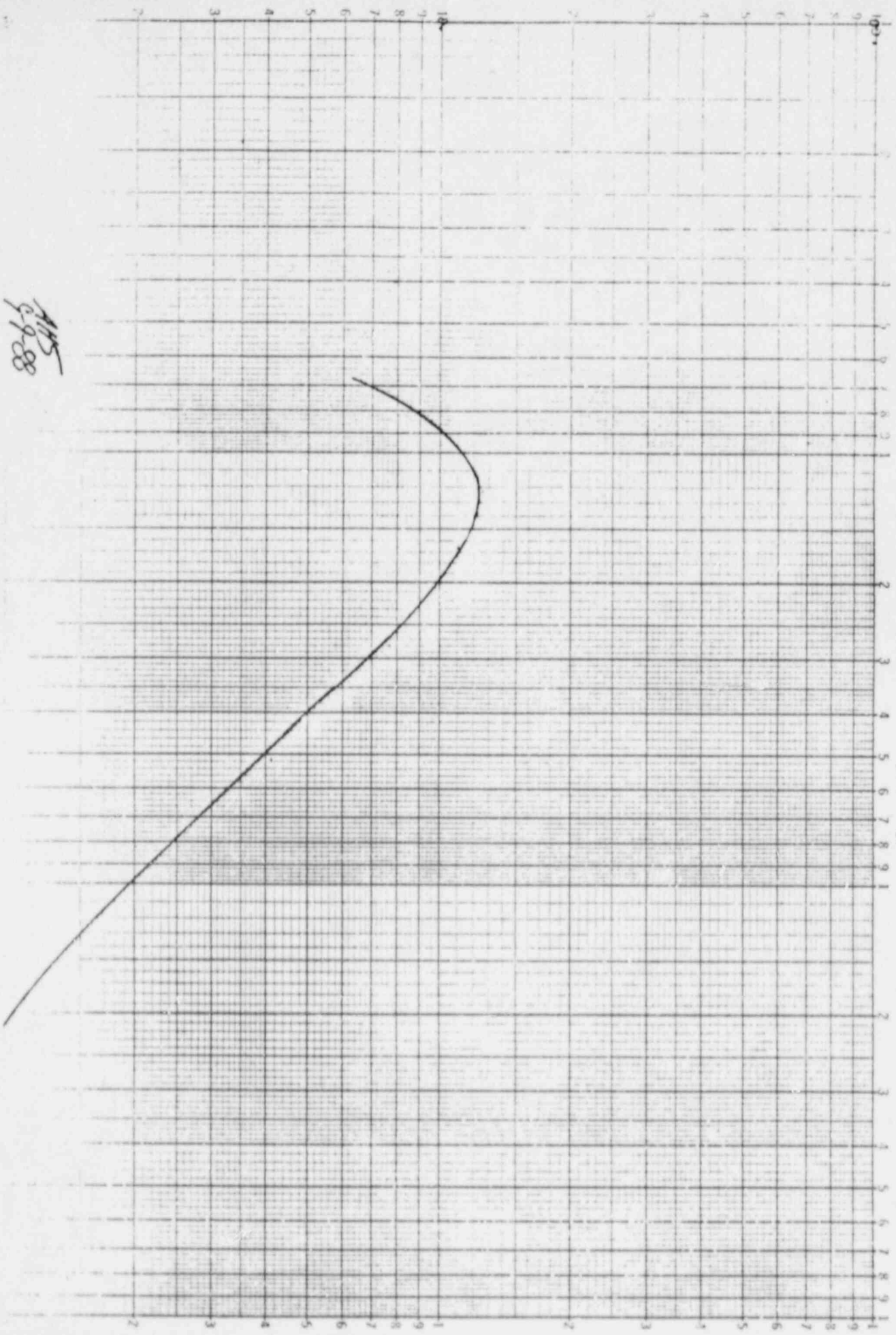
Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments

Col. 10624
47 mm Paot. filter, contact
Det # 2

% Efficiency



MS
9-9-88

1 Curve (hr)

MCA DETECTOR CALIBRATION DATA

Det # 2

Detector Serial or ID Number: SN # 21-P-846A

Check applicable Geometries

- 100 cc Gas, contact
- Char. Cart. contact
- 47 mm Part. contact
- 1 liter Marinelli Liquid
- PASS Part at 8 cm

- 100 cc Gas at 8 cm
- Char Cart. at 8 cm
- 47 mm Part at 8 cm
- 100 ml cup, liq, contact
- PASS Chr Sy at 8 cm

- 15 ml vial on contact
- Radwat smear, contact
- Rx crud, contact
- Point Source, contact
- 15 ml vial at 8 cm
- Radwat smear, 8 cm
- Rx crud, at 8 cm
- Point Source at 8 cm

Calibration Source ID number: MCA-05

Geometry: 100 cc Gas chamber, contact

Efficiency File: Geli.TAB25

Calibration Source ID number: MCA-06

Geometry: 1 liter Marinelli, liquid, contact

Efficiency File: Geli.TAB26

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	25.5	674.7	3.78
Co-57 122 keV	27.6	583.6	4.73
Ce-139 166 keV	24.2	559.2	4.33
Hg-203 279 keV	23.3	835.6	2.79
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	30.7	1572.4	1.95
Sr-85 514 keV	33.6	2132.5	1.58
Cs-137 662 keV	35.7	2833.3	1.26
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	41.0	4550.6	0.90
Co-60 1173 keV	27.8	3941.4	0.71
Co-60 1332 keV	23.9	3947.1	0.61
Y-88 1836 keV	23.1	4851.4	0.48

Nuclide & Energy	Gamma/sec Peak Area	Gamma/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	23.8	1314.9	1.81
Co-57 122 keV	26.4	1137.5	2.32
Ce-139 166 keV	24.7	1089.8	2.27
Hg-203 279 keV	26.8	1628.5	1.65
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	36.2	3064.5	1.18
Sr-85 514 keV	40.6	4156.2	0.98
Cs-137 662 keV	43.2	5522.1	0.78
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	51.5	8867.1	0.58
Co-60 1173 keV	35.6	7681.7	0.46
Co-60 1332 keV	30.8	7692.9	0.40
Y-88 1836 keV	30.8	9455.3	0.33

Detector Calibration Data Prepared by M Young

Date 8-14-88

Comments _____

NCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MC1-05 Date Source Prepared: 7-19-88
Date Calibration Source Gamma Per Seconds Valid: 12 Aug 88 thru 13 Aug 88

Indicase: 100 cc Gas 15 ml Vial liquid
Applicable: 47 mm Fast Filter 100 ml Cup liquid PASS Gas Vial Point Source Raduate Source
Configuration: Charcoal Cartridge 1 liter Marinelli liquid PASS Char Syringe Reactor crud particulate
 PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³⁷ Ba, ¹³⁴ Ba, ¹³² Te, ¹³² I, ¹³² Xe, ¹³² Te, ¹³² I, ¹³² Xe, ¹³² Te, ¹³² I, ¹³² Xe	Amerishon International	GCY-46 28/125/09	01 June 88 6:1200 AM	Pipette 11.73 ml of standard into media and evaporated 2.23 media into chamber.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.355	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2020.50	0.372	751.63	6-1-88	72.5	1.49E-3	674.7
Co-57 122 keV	321.23	0.855	702.15	6-1-88	72.5	2.55E-3	583.6
Co-139 166 keV	1002.26	0.804	805.82	6-1-88	72.5	5.04E-3	559.2
Hg-203 279 keV	3183.77	0.773	2461.05	6-1-88	72.5	1.49E-2	835.6
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	3748.50	0.649	2432.78	6-1-88	72.5	6.02E-3	1572.4
Sr-85 514 keV	4669.65	0.992	4632.29	6-1-88	72.5	1.07E-2	2132.5
Co-137 662 keV	3344.64	0.851	2846.29	6-1-88	72.5	6.29E-3	2833.3
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 837 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 837 keV	7805.23	0.934	7290.08	6-1-88	72.5	6.50E-3	4550.6
Co-60 1173 keV	4045.6	1.000	4045.60	6-1-88	72.5	3.60E-4	3941.4
Co-60 1332 keV	4051.59	1.000	4051.49	6-1-88	72.5	3.60E-4	3947.1
Y-88 1836 keV	7518.84	0.994	7171.93	6-1-88	72.5	6.50E-3	4851.4

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by T. Young Date 7-19-88

Comments _____

DETECTOR UNIT

DETECTOR UNIT NAME: GELI.MAIN21
 CALL DATE: 01-AUG-88 12:00:00
 SAMPLE IDENTIFICATION: 1998
 TYPE OF SAMPLE: GAS/ORG
 SAMPLE QUANTITY: 1.000000
 SAMPLE WEIGHT: 1.000000 GRS
 SAMPLE VOLUME: 1.000000 ML

DATE: 12-AUG-88 12:06:15
 PULSE AMPLITUDE: 600.00V
 PULSE RATE: 522.000
 PULSE WIDTH: 600.00V

* PERCENTAGE: 1.00
 * SENSITIVITY: 1.00
 * SHARP P-FACTOR: 10.0 %
 * NEW IDENTIFICATION: *

DETECTOR UNIT #2

CALL DATE: 12-AUG-88 17:31:42
 KEY CHANNEL: 1.0001018
 OFFSET: 0.0010059 KEV

* LIBRARY: GELI.LIBGAS
 * ENERGY TOLERANCE: 1.500KV
 * HALF LIFE RATIO: 3.00
 * ABUNDANCE LIMIT: 90.00%

ENERGY WINDOW 50.0170 2048.21
 1.00-SIGMA YEAR

PK	CH	ENERGY	AREA	DKND	FWHM	CHANNEL	LEFT	PR	CTS/SEC	YEAR
1	0	51.11	709.	6145.	1.07	71.40	72	4	1.19E 00	16.0
2	0	68.36	15296.	12679.	1.24	88.15	89	6	2.55E 01	1.0
3	0	117.71	16547.	12231.	1.34	122.22	118	0	2.76E 01	1.4
4	0	136.54	2781.	11420.	1.71	136.53	137	0	3.80E 00	8.4
5	0	154.70	14345.	11426.	1.71	154.70	157	0	2.42E 01	1.5
6	0	217.29	1192.	7508.	1.56	217.32	217	8	1.29E 00	13.0
7	0	274.04	14004.	8751.	1.46	274.26	274	10	2.13E 01	1.5
8	0	311.77	16430.	6265.	1.59	311.77	317	10	3.07E 01	1.1
9	0	374.02	20133.	5216.	1.47	374.37	369	10	3.36E 01	1.0
10	0	411.65	21449.	5720.	1.47	411.68	416	12	3.57E 01	1.0
11	0	474.11	408.	2029.	1.59	474.13	470	8	6.80E 01	17.0
12	0	536.02	24618.	3622.	1.73	536.03	533	10	4.10E 01	0.9
13	0	573.13	16698.	2271.	2.01	573.08	567	12	2.78E 01	1.0
14	0	635.05	976.	1200.	3.11	635.13	630	21	1.44E 00	8.3
15	0	672.10	14332.	875.	2.17	672.10	672	21	2.79E 01	0.9
16	0	734.27	13896.	712.	2.01	734.27	729	24	2.31E 01	0.9

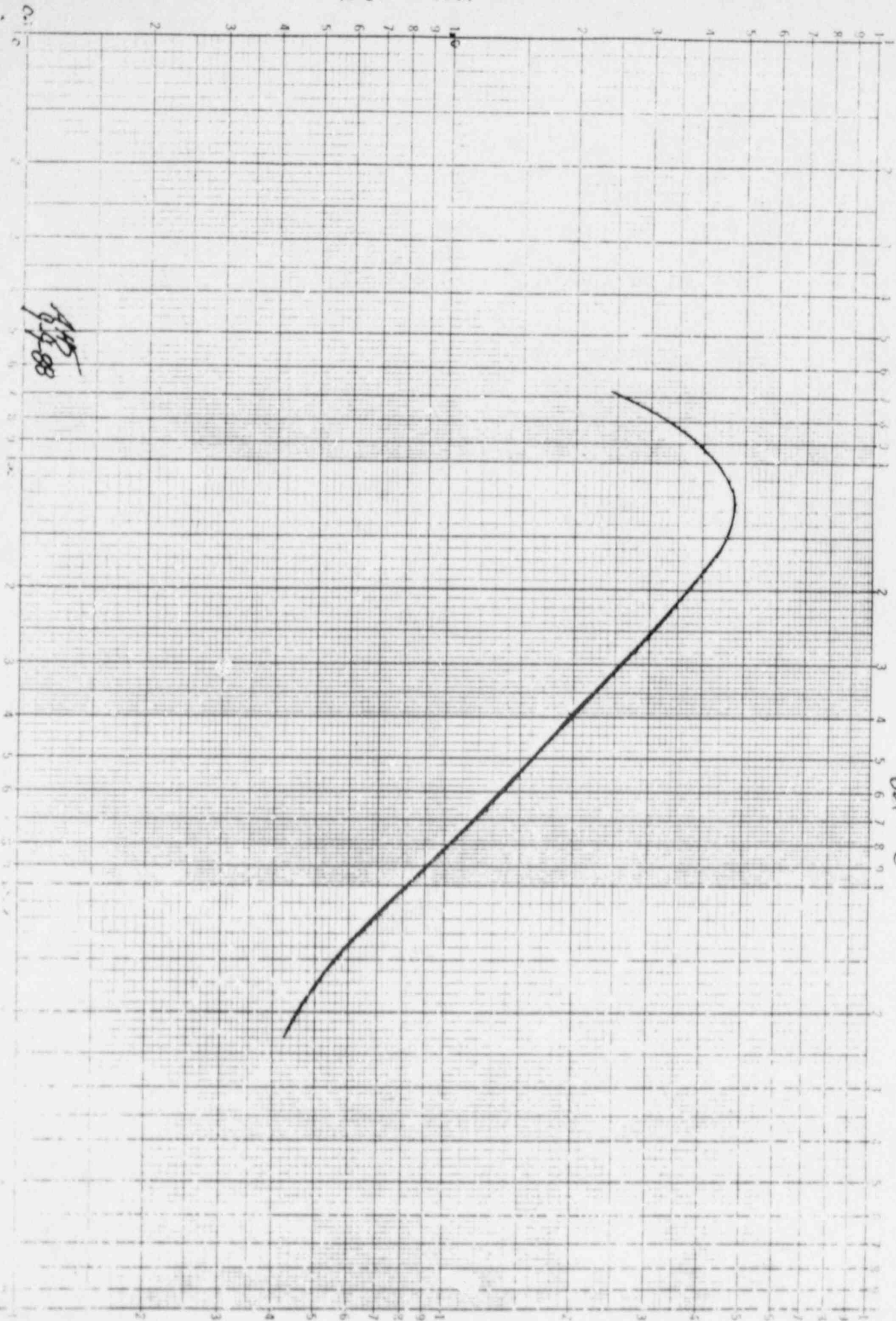
PEAK SEARCH COMPLETED 12-AUG-88 17:37

6. H. TP 35

100 cc gas chamber, contact

Dot # 2

% EFFICIENCY



AMS
9/2/68

ENERGY (1000)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number MCA-06 Date Source Prepared 7-20-88
Date Calibration Source Gamma Per Second Valid 12 Aug 88 thru 13 Aug 88

- Indicate 100 cc Gas 15 ml. Vial Liquid PASS Gas Vial Point Source Radwaste Stream
Applicable 47 mm Part Filter 100 ml. Disp. Liquid PASS Char Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Mannell liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
⁶⁰ Co, ⁵⁷ Co, ¹³⁷ Cs, ¹³² I, ¹³¹ I, ¹³⁴ Cs, ¹³⁷ Cs, ¹³⁸ La, ¹³⁹ La, ¹⁴⁰ La	Amersham International	QC3-46 28/125/110	June 87 1200 cpm	Pipetted 22.9610 gms of standard into 1 liter Mannell and diluted to 1000mls with deion water.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.355	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	3937.93	0.372	1464.91	6-1-88	72.5	1.49E-3	1314.7
Co-57 122 keV	1600.56	0.855	1365.48	6-1-88	72.5	2.55E-3	1137.5
Co-139 166 keV	1953.40	0.804	1570.53	6-1-88	72.5	5.04E-3	1089.5
Hg-203 279 keV	6205.11	0.773	4776.55	6-1-88	72.5	1.49E-2	1628.5
Ba-133 356 keV	N/A	0.800	N/A	N/A	N/A	1.81E-4	N/A
Sn-115 392 keV	7305.77	0.649	4741.45	6-1-88	72.5	6.02E-3	3064.5
Sr-85 514 keV	9101.07	0.992	9028.27	6-1-88	72.5	1.07E-2	4156.2
Co-137 652 keV	6518.66	0.881	5547.38	6-1-88	72.5	6.29E-3	5522.1
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.27E-3	N/A
Y-88 898 keV	15212.28	0.934	14208.27	6-1-88	72.5	6.50E-3	8869.1
Co-60 1173 keV	7884.51	1.000	7884.51	6-1-88	72.5	3.60E-4	7681.7
Co-60 332 keV	7896.29	1.000	7896.29	6-1-88	72.5	3.60E-4	7692.7
Y-88 836 keV	15238.80	0.994	15147.37	6-1-88	72.5	6.50E-3	9455.3

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-20-88

12-009-08 17:14:21

CALL TO THE CITY
12-009-08 17:14:21
12-009-08 17:14:21
12-009-08 17:14:21
12-009-08 17:14:21
12-009-08 17:14:21

12-009-08 17:14:21
12-009-08 17:14:21
12-009-08 17:14:21
12-009-08 17:14:21

LIBRARY 0217.1188
HENRY JOL RAJCE 1.5007
HALF LIFE RA 101 0.00
AMINOACID LIBS 11 10.00

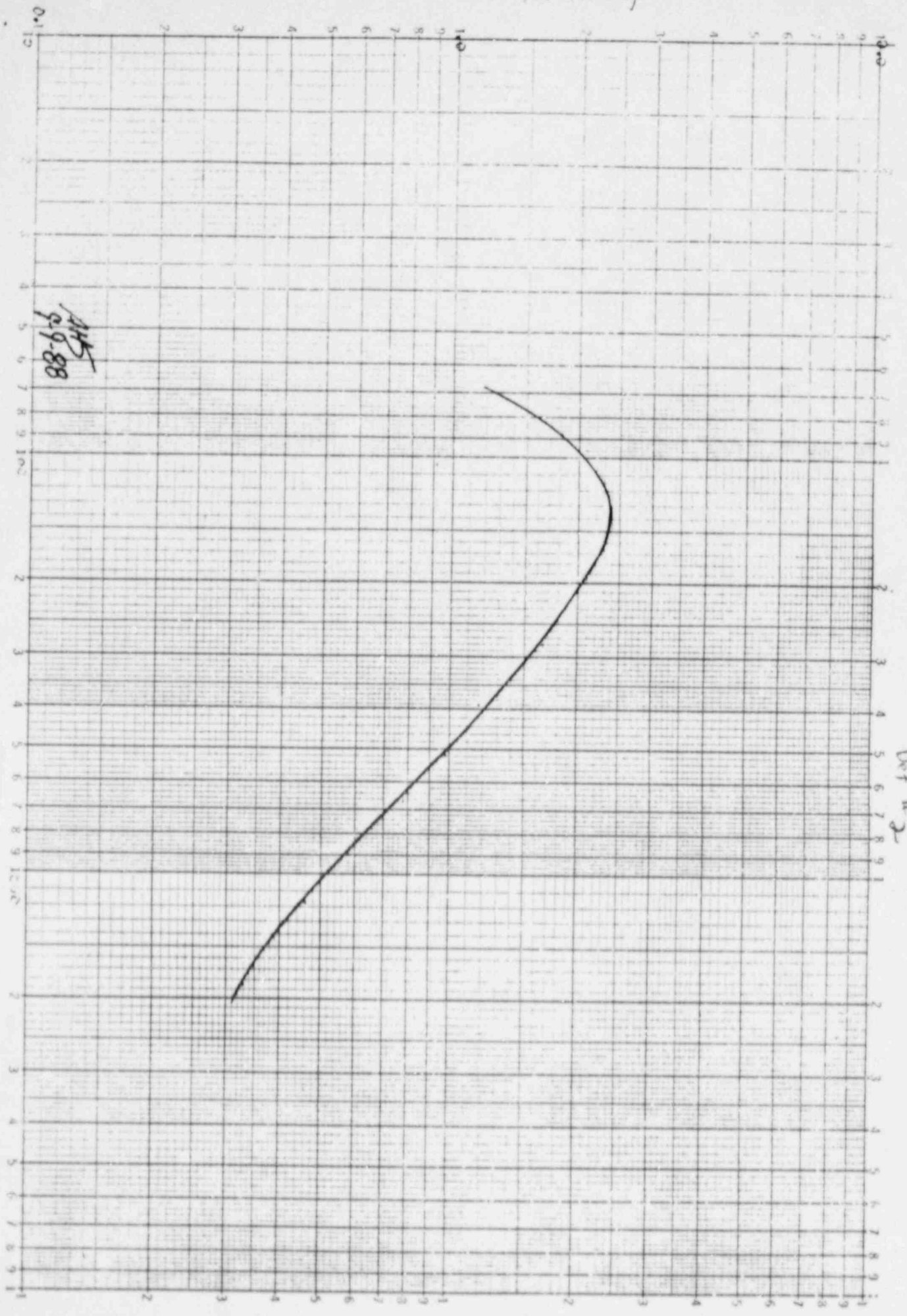
ENERGY R. 0099 50.01 15 1748.21
1.00-8708A 2887

	1	2	AREA	PKNO	WBB	CHANNEL	177	14	CYBER	1187	
1	0	17.42	1273.	16184.	2.37	12.41	70	0	7.126	04	14.70
2	0	81.56	14770.	22775.	1.31	88.08	84	8	6.105	01	1.70
3	0	22.14	13333.	28160.	1.42	122.11	117	10	3.646	07	6.1
4	0	135.21	2000.	18818.	1.88	136.87	134	7	3.736	09	11.8
5	0	160.03	14706.	19231.	1.77	166.01	166	8	2.576	01	1.9
6	0	272.14	1745.	11374.	1.81	250.32	257	7	1.931	00	16.8
7	0	277.24	16075.	14169.	1.73	279.26	274	10	2.608	01	1.6
8	0	391.64	21742.	9438.	1.57	391.77	387	10	3.675	01	1.1
9	0	478.01	24311.	7378.	1.54	513.90	369	10	4.066	11	0.8
10	0	603.85	25944.	8296.	1.94	581.58	606	12	4.377	01	0.7
11	0	714.11	634.	2998.	1.33	814.03	811	8	1.066	00	10.8
12	0	879.05	30899.	6175.	1.05	897.76	673	12	5.108	01	0.0
13	0	1174.25	21362.	3183.	2.20	1173.13	1167	12	3.566	07	0.9
14	0	1305.48	1293.	2280.	4.74	1305.34	1319	21	2.166	00	11.1
15	0	1337.67	18463.	1075.	0.77	1332.48	1317	21	1.081	01	0.8
16	0	1437.05	18443.	1144.	2.89	1835.89	1825	15	3.086	07	0.8

PIAN SEARCH COMPLETED (REV 10.7)

661, 146 de
1 liter, Maxwell, bakker, contact
Oct # 2

% Efficiency



AHS
9-9-88

X ENERGY (keV)

MCA DETECTOR CALIBRATION DATA

Detector Serial or ID Number: SN # 21-P-829A D: + # 3

- Check applicable Geometries:
 - 100 cc Gas, contact
 - Char. Cart, contact
 - 47 mm Part, contact
 - 1 liter Marinelli Liquid
 - PASS Part at 8 cm
- 100 cc Gas at 8 cm
 - Char Cart. at 8 cm
 - 47 mm Part at 8 cm
 - 100 ml cup, liq, contact
 - PASS Chr Sy at 8 cm
- 15 ml vial on contact
 - Radwat smear, contact
 - Rx crud, contact
 - Point Source, contact
- 15 ml vial at 8 cm
 - Radwat smear, 8 cm
 - Rx crud, at 8 cm
 - Point Source at 8 cm

Calibration Source ID number: MCA 01

Geometry: 15 ml vial, contact

Efficiency File: Geli. TAB 31

Calibration Source ID number: MCA 02

Geometry: 100 ml cup, liquid, contact

Efficiency File: Geli. TAB 32

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	22.2	540.4	4.11
Co-57 122 keV	25.4	467.6	5.43
Ce-139 166 keV	23.3	447.9	5.20
Hg-203 279 keV	22.9	669.3	3.42
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	31.3	1259.6	2.48
Sr-85 514 keV	33.8	1708.3	1.98
Ce-137 662 keV	35.7	2269.7	1.57
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	40.3	3645.5	1.11
Co-60 1173 keV	27.2	3157.4	0.86
Co-60 1332 keV	24.6	31620	0.78
Y-88 1836 keV	23.1	3886.5	0.59

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	17.6	684.7	2.57
Co-57 122 keV	22.1	592.4	3.73
Ce-139 166 keV	20.6	567.5	3.63
Hg-203 279 keV	21.6	848.0	2.55
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	29.3	1595.9	1.87
Sr-85 514 keV	32.0	2164.4	1.48
Ce-137 662 keV	34.3	2875.7	1.19
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	40.1	4618.6	0.87
Co-60 1173 keV	27.7	4000.2	0.69
Co-60 1332 keV	24.1	4006.1	0.60
Y-88 1836 keV	23.4	4923.9	0.48

Detector Calibration Data Prepared by M. Yang Date 2-14-88

Comments _____

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA 01 Date Source Prepared: 7-19-88

Date Calibration Source Gamma Per Seconds Valid: 12 Aug 88 thru 13 Aug 88

- Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
 Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
 Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹⁰⁹ Co, ⁵⁷ Co, ¹³⁷ Cs, ¹³⁴ Cs, ¹³² I, ¹³¹ I, ¹³⁵ Cs, ¹³⁷ Cs, ¹³⁴ Cs, ¹³² I, ¹³¹ I, ¹³⁵ Cs, ¹³⁷ Cs, ¹³⁴ Cs	Amersthan International	QCY-46 89/125/109	01 JUN 88 @ 1000 GMR	Pipetted 9.4377 gms of standard into 15 ml counting vial and diluted to 15 ml with dem. water

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.358	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1618.6	0.373	602.1	01 JUN 88	72.5	1.49E-3	540.4
Co-57 122 keV	657.9	0.858	562.5	01 JUN 88	72.5	2.55E-3	467.6
Ce-139 168 keV	802.9	0.804	645.5	01 JUN 88	72.5	5.04E-3	447.9
Hg-203 279 keV	2550.5	0.773	1971.5	01 JUN 88	72.5	1.49E-2	669.3
Ba-133 356 keV	N/A	0.800	N/A	N/A	N/A	1.81E-4	N/A
Sr-90 392 keV	3002.9	0.649	1948.9	01 JUN 88	72.5	6.02E-3	1259.6
Si-88 314 keV	3740.8	0.993	3710.9	01 JUN 88	72.5	1.07E-2	1708.3
Ce-137 662 keV	2679.4	0.861	2280.1	01 JUN 88	72.5	6.29E-3	2269.7
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 898 keV	6252.7	0.934	5840.0	01 JUN 88	72.5	6.50E-3	3645.5
Co-60 1173 keV	3240.9	1.000	3240.9	01 JUN 88	72.5	3.60E-4	3157.4
Co-60 1332 keV	3245.6	1.000	3245.6	01 JUN 88	72.5	3.60E-4	3162.0
Y-88 1835 keV	6263.6	0.994	6226.1	01 JUN 88	72.5	6.50E-3	3556.5

Cal Source orig GPS = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

Comments

 ***** 12-AUG-88 17:11:38 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.PAIN31
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: MLS
 SAMPLE GEOMETRY: 15 ML VIAL

EFFICIENCY FILE NAME: GELI.FAB31.,

 *
 ACQUIRE DATE: 12-AUG-88 18:52:17 * FWHM(1332) 2.225
 PRKSET TIME(LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 618. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.
 *

 *
 DETECTOR: HPGE #3 * LIBRARY:GELI.LIB69
 CALIB DATE: 12-AUG-88 16:23:11 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0000226 * HALF LIFE RATIO: 8.00
 OFFSET: 0.0086215 KEV * ABUNDANCE LIMIT: 80.00%
 *

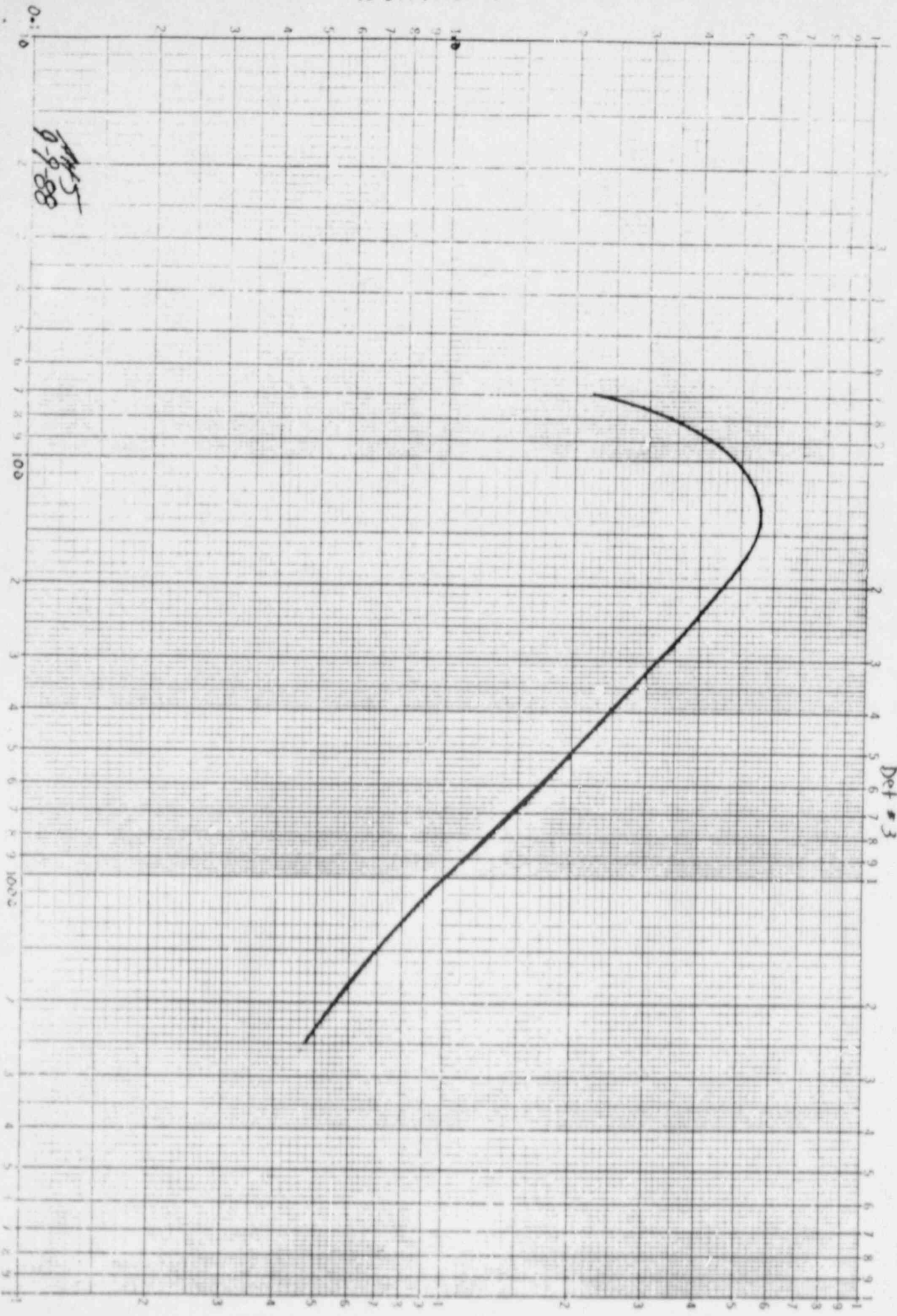
ENERGY WINDOW 50.01 TO 2048.05
 1.00-SIGMA %ERR

PK	IT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PW	CTS/SEC	%ERR	F11
1	0	71.90	1064.	8606.	2.53	71.89	69	7	1.67E 00	13.7	
2	0	87.97	13322.	9904.	1.19	87.95	84	8	2.22E 01	1.6	
3	0	122.06	15245.	9740.	1.20	122.05	118	8	2.54E 01	1.4	
4	0	136.28	2007.	9255.	1.95	136.27	133	8	3.48E 00	8.2	
5	0	165.82	14002.	8673.	1.25	165.83	162	6	2.33E 01	1.4	
6	0	255.17	905.	4923.	1.23	255.15	253	6	1.51E 00	12.7	
7	0	279.21	13720.	5943.	1.42	279.20	276	8	2.29E 01	1.3	
8	0	391.70	18799.	5530.	1.67	391.68	387	10	3.13E 01	1.0	
9	0	513.94	20262.	4175.	1.42	513.92	509	10	3.36E 01	0.9	
10	0	661.62	21434.	4511.	1.93	661.60	656	11	3.57E 01	0.9	
11	0	814.14	588.	2152.	1.72	814.11	810	9	9.80E 01	14.3	
12	0	897.96	24179.	2917.	1.70	897.93	893	10	4.03E 01	0.8	
13	0	1173.11	16312.	1809.	2.02	1173.08	1167	12	2.72E 01	0.9	
14	4	1495.01	583.	851.	3.34	1324.97	1320	18	4.71E 01	10.3	2.01E 01
15	1	1332.41	11730.	544.	2.07	1332.39	1320	18	2.46E 01	0.9	
16	0	1835.78	13845.	407.	2.41	1835.73	1829	14	2.31E 01	0.9	

PEAK SEARCH COMPLETED (REV 15.7)

15 ml vial, content
Gel. TAB 31
Det # 3

% EFFICIENCY



ENERGY (keV)

MS
9-9-88

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number MCA-02 Date Source Prepared 7-19-88
Date Calibration Source Gamma Per Seconds Valid 12 Aug 88 thru 13 Aug 88

Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Rad. rate S-meter
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marine G. Liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹³⁷ Cs, ¹³⁴ Cs, ¹³² Sr, ¹³¹ Sr, ¹³⁰ Sr, ¹²⁹ Sr, ¹²⁸ Sr, ¹²⁷ Sr, ¹²⁶ Sr, ¹²⁵ Sr, ¹²⁴ Sr, ¹²³ Sr, ¹²² Sr, ¹²¹ Sr, ¹²⁰ Sr, ¹¹⁹ Sr, ¹¹⁸ Sr, ¹¹⁷ Sr, ¹¹⁶ Sr, ¹¹⁵ Sr, ¹¹⁴ Sr, ¹¹³ Sr, ¹¹² Sr, ¹¹¹ Sr, ¹¹⁰ Sr, ¹⁰⁹ Sr, ¹⁰⁸ Sr, ¹⁰⁷ Sr, ¹⁰⁶ Sr, ¹⁰⁵ Sr, ¹⁰⁴ Sr, ¹⁰³ Sr, ¹⁰² Sr, ¹⁰¹ Sr, ¹⁰⁰ Sr, ⁹⁹ Sr, ⁹⁸ Sr, ⁹⁷ Sr, ⁹⁶ Sr, ⁹⁵ Sr, ⁹⁴ Sr, ⁹³ Sr, ⁹² Sr, ⁹¹ Sr, ⁹⁰ Sr, ⁸⁹ Sr, ⁸⁸ Sr, ⁸⁷ Sr, ⁸⁶ Sr, ⁸⁵ Sr, ⁸⁴ Sr, ⁸³ Sr, ⁸² Sr, ⁸¹ Sr, ⁸⁰ Sr, ⁷⁹ Sr, ⁷⁸ Sr, ⁷⁷ Sr, ⁷⁶ Sr, ⁷⁵ Sr, ⁷⁴ Sr, ⁷³ Sr, ⁷² Sr, ⁷¹ Sr, ⁷⁰ Sr, ⁶⁹ Sr, ⁶⁸ Sr, ⁶⁷ Sr, ⁶⁶ Sr, ⁶⁵ Sr, ⁶⁴ Sr, ⁶³ Sr, ⁶² Sr, ⁶¹ Sr, ⁶⁰ Sr, ⁵⁹ Sr, ⁵⁸ Sr, ⁵⁷ Sr, ⁵⁶ Sr, ⁵⁵ Sr, ⁵⁴ Sr, ⁵³ Sr, ⁵² Sr, ⁵¹ Sr, ⁵⁰ Sr, ⁴⁹ Sr, ⁴⁸ Sr, ⁴⁷ Sr, ⁴⁶ Sr, ⁴⁵ Sr, ⁴⁴ Sr, ⁴³ Sr, ⁴² Sr, ⁴¹ Sr, ⁴⁰ Sr, ³⁹ Sr, ³⁸ Sr, ³⁷ Sr, ³⁶ Sr, ³⁵ Sr, ³⁴ Sr, ³³ Sr, ³² Sr, ³¹ Sr, ³⁰ Sr, ²⁹ Sr, ²⁸ Sr, ²⁷ Sr, ²⁶ Sr, ²⁵ Sr, ²⁴ Sr, ²³ Sr, ²² Sr, ²¹ Sr, ²⁰ Sr, ¹⁹ Sr, ¹⁸ Sr, ¹⁷ Sr, ¹⁶ Sr, ¹⁵ Sr, ¹⁴ Sr, ¹³ Sr, ¹² Sr, ¹¹ Sr, ¹⁰ Sr, ⁹ Sr, ⁸ Sr, ⁷ Sr, ⁶ Sr, ⁵ Sr, ⁴ Sr, ³ Sr, ² Sr, ¹ Sr	Amerishem International	QCY-46 RS/25/109	01 June 87 6:12:00 PM	PIPETTED 11.957 grams OF STANDARD INTO 100 ml COUNTING CUP AND DILUTED TO 100 ml WITH DEMINERALIZED WATER.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.355	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2050.69	0.373	762.86	6-1-88	72.5	1.49E-3	684.7
Co-57 122 keV	833.49	0.855	712.64	6-1-88	72.5	2.55E-3	592.4
Ce-139 166 keV	1017.24	0.804	817.86	6-1-88	72.5	5.04E-3	567.5
Hg-203 279 keV	3231.33	0.773	2497.82	6-1-88	72.5	1.49E-2	848.0
Ba-133 356 keV	N/A	0.800	N/A	N/A	N/A	1.81E-4	N/A
Sr-113 392 keV	3804.50	0.649	2469.12	6-1-88	72.5	6.02E-3	1595.9
Sr-85 514 keV	4757.41	0.992	4701.49	6-1-88	72.5	1.07E-2	2164.4
Ca-137 562 keV	3394.61	0.881	2838.81	6-1-88	72.5	6.39E-3	2875.7
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 828 keV	7921.83	0.934	7395.99	6-1-88	72.5	6.50E-3	4618.6
Co-60 173 keV	4106.03	1.000	4106.03	6-1-88	72.5	3.60E-4	4000.2
Co-60 332 keV	4112.01	1.000	4112.01	6-1-88	72.5	3.60E-4	4006.1
Y-88 836 keV	7935.65	0.994	7888.03	6-1-88	72.5	6.50E-3	4923.9

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(-lambda x days decay)

Calibration Source Prepared by M Young Date 7-19-88

 ***** 12-AUG-88 19:48:56 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.MAIN31
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1288
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: MLS
 SAMPLE GEOMETRY: 100 ML CUP
 EFFICIENCY FILE NAME: GELI.TAB52,

ACQUIRE DATE: 12-AUG-88 19:28:32 * FWHM(1332) 2.225
 PRESET TIME(LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 619. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.

DETECTOR: HPGE #1 * LIBRARY:GELI.LIB69
 CALIB DATE: 12-AUG-88 16:23:11 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0000226 * HALF LIFE RATIO: 8.00
 OFFSET: 0.0086215 KEV * ABUNDANCE LIMIT: 80.00%

ENERGY WINDOW 50.01 TO 2048.05
 1.00-SIGMA %ERR

PK	IT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PW	CTS/SEC	%ERR	FIT
1	0	72.01	937.	10814.	3.23	72.00	68	8	1.65E 00	18.7	
2	0	88.16	10555.	11361.	1.28	88.15	84	8	1.76E 01	2.0	
3	0	122.16	13248.	11138.	1.33	122.14	118	8	2.21E 01	1.6	
4	0	136.59	1777.	10671.	1.78	136.58	133	8	2.95E 00	10.4	
5	0	165.75	12382.	10508.	1.24	165.94	162	8	2.06E 01	1.7	
6	0	255.19	854.	6468.	1.45	255.17	252	7	1.42E 00	16.1	
7	0	279.33	12948.	7412.	1.69	279.31	273	9	2.16E 01	1.5	
8	0	391.78	17893.	5829.	1.55	391.76	387	10	2.98E 01	1.1	
9	0	514.00	19172.	4529.	1.50	513.98	509	10	3.20E 01	1.0	
10	0	661.64	20606.	4090.	1.88	661.61	656	10	3.43E 01	0.9	
11	0	814.55	470.	1743.	1.52	814.52	812	7	7.33E-01	15.6	
12	0	898.01	24045.	2936.	1.73	897.98	893	10	4.01E 01	0.8	
13	0	1173.13	16599.	1671.	2.04	1173.10	1167	12	2.77E 01	0.9	
14	5	1324.86	685.	890.	3.63	1324.82	1318	21	1.14E 00	9.6	1.08E 01
15	5	1332.46	14462.	482.	2.08	1332.42	1318	21	2.41E 01	0.9	
16	0	1835.86	14023.	345.	2.45	1835.81	1829	13	2.34E 01	0.9	

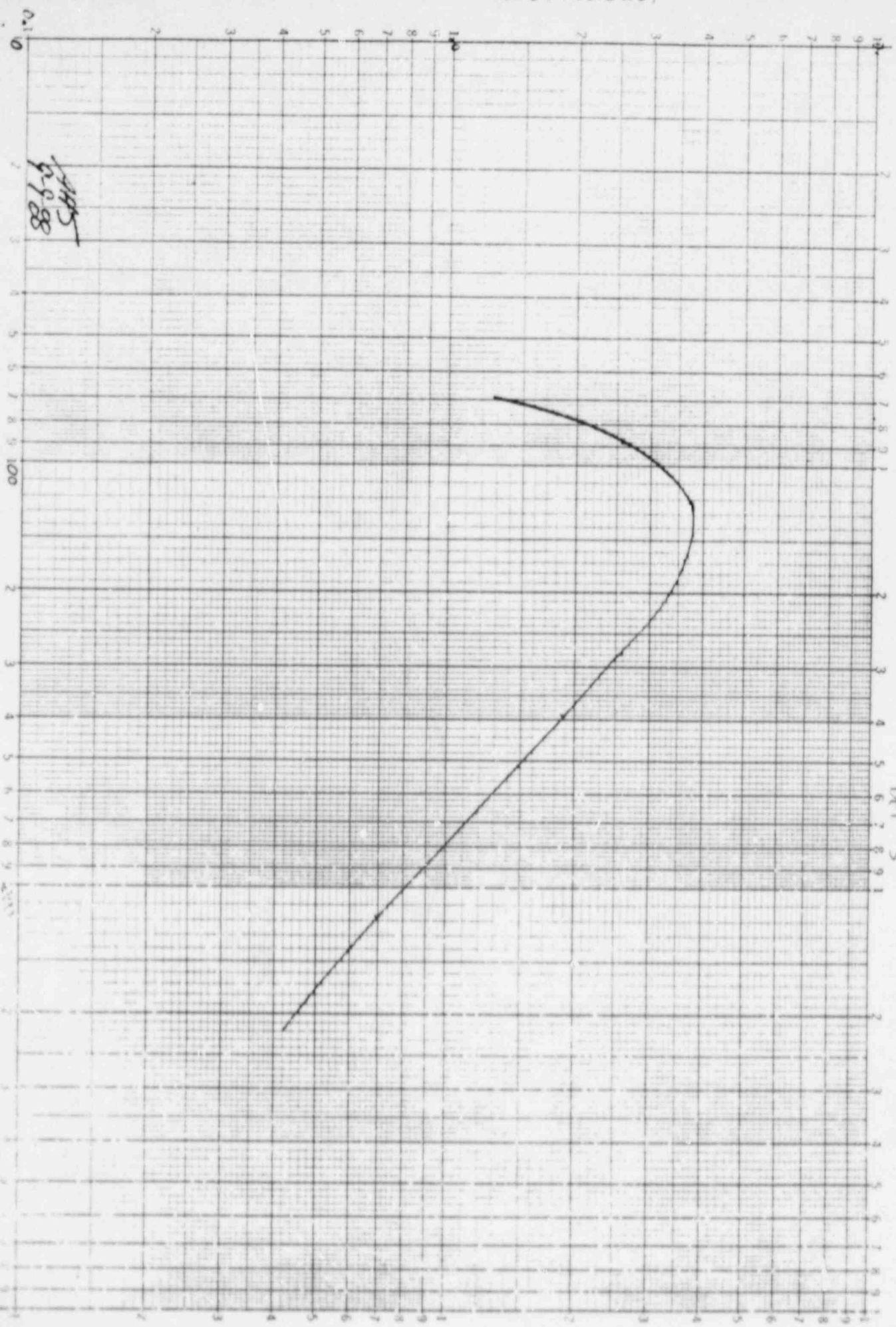
PEAK SEARCH COMPLETED (REV 15.7)

GELT 71632

100 ml cup, contact

DET # 3

% EFFICIENCY



1145
88-9-98

X ENERGY (kV)

MCA DETECTOR CALIBRATION DATA

Dx + # 3

Detector Serial or ID Number: SN # 21-P-329A

- Check applicable Geometries
- | | | | |
|---|---|--|---|
| <input checked="" type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| <input checked="" type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart at 8 cm | <input type="checkbox"/> Radwat smear, contact | <input type="checkbox"/> Radwat smear, 8 cm |
| <input checked="" type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| <input type="checkbox"/> 1 liter Marinelli Liquid | <input type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-03

Geometry: Charcoal CART, contact

Efficiency File: 6eli TAB33

Calibration Source ID number: MCA-04

Geometry: 47mm PART, contact

Efficiency File: 6eli TAB34

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	25.2	361.5	6.97
Co-57 122 keV	27.7	312.0	8.88
Ce-139 166 keV	25.7	297.5	8.64
Hg-203 279 keV	29.2	435.8	6.70
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	41.4	834.8	4.96
Sr-85 514 keV	36.1	1121.7	3.22
Ce-137 662 keV	39.7	1522.4	2.61
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	42.3	2413.8	1.75
Co-60 1173 keV	29.1	2116.5	1.37
Co-60 1332 keV	25.5	2119.5	1.20
Y-88 1836 keV	23.6	2573.3	0.92

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	24.0	282.7	8.49
Co-57 122 keV	30.6	244.6	12.51
Ce-139 166 keV	28.7	234.3	12.25
Hg-203 279 keV	29.4	350.2	8.40
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	33.0	658.9	5.01
Sr-85 514 keV	41.4	893.7	4.63
Ce-137 662 keV	39.3	1187.4	3.31
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	45.5	1907.1	2.39
Co-60 1173 keV	30.4	1651.8	1.84
Co-60 1332 keV	26.5	1654.2	1.60
Y-88 1836 keV	24.8	2053.1	1.22

Detector Calibration Data Prepared by M Young

Date 3-15-88

Comments _____

NORTH ANNA POWER STATION

HP-9.0.302
Form HP-9.0.302-2
Page 1 of 1
(Rev 0)

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number: MCA-03 Date Source Prepared: 8-13-88
Date Calibration Source Gammas Per Second Valid: 8-14-88 thru 8-15-88

- Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Radwaste Smear
Applicable 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
¹⁰⁹ Cd, ¹³⁷ Cs, ¹³⁴ Cs, ¹³⁵ Cs, ¹³⁷ Sr, ¹³⁸ La, ¹³⁹ La	Amer sham Instru	QC4.46 RY/125/110	6-1-88 @1200 cpm	Pipetted 6.5303 grams onto charcoal and dried

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.388	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	1085.77	0.373	403.91	6-1-88	74.5	1.49E-3	361.5
Co-57 122 keV	4444.41.0	0.858	377.32	6-1-88	74.5	7.88E-3	312.0
Co-130 106 keV	538.59	0.804	433.08	6-1-88	74.5	5.04E-3	297.5
Hg-203 279 keV	1710.87	0.173	1322.50	6-1-88	74.5	1.49E-3	435.8
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	2014.75	0.649	1307.31	6-1-88	74.5	6.02E-3	934.8
Sr-85 514 keV	2509.35	0.993	2489.27	6-1-88	74.5	1.07E-3	1121.7
Cs-137 662 keV	1797.32	0.881	1529.52	6-1-88	74.5	6.79E-5	1522.4
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 835 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 893 keV	4194.32	0.984	3917.50	6-1-88	74.5	6.60E-3	2413.8
Co-60 1173 keV	2174.00	1.000	2174.00	6-1-88	74.5	3.60E-4	2116.5
Co-60 1332 keV	2177.16	1.000	2177.16	6-1-88	74.5	3.60E-4	2119.5
Y-88 1836 keV	4201.64	0.994	4176.43	6-1-88	74.5	6.50E-3	2573.3

Cal Source orig (GPS) = Cal Source orig DPS x gamma abundance; Cal Source current GPS = orig GPS x exp (- lambda x days decay)

Calibration Source Prepared by T. Young Date 8-13-88

Comments _____

CALIBRATION COUNT

SPECTRAL FILE NAME: GEL1.MAIN31
 SAMPLE DATE: 01 JUN 88 12:00:00
 SAMPLE IDENTIFICATION: 1938
 TYPE OF SAMPLE: RADIOIODINES
 SAMPLE QUANTITY: 1.000000 UNITS: BLD
 SAMPLE GEOMETRY: ~~STANDARD PILE~~ Steel canister charcoal filter July 8-14-88
 LITERATURE FILE NAME: GEL1.LAN33.

ACQUIRE DATE: 14-AUG-88 21:26:16 * PWD: 13321 2.200
 PROMPT TIME (LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 620. SEC * SHAPE PARAMETER: 21.0 %
 ELAPSED LIVE TIME: 600. SEC * NRR ITERATIONS: 5.

DETECTOR: 4PGF #3 * LIBRARY: GEL1.LIB100
 CALIB DATE: 14-AUG-88 21:07:04 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 0.9999732 * HALF LIFE RATIO: 8.00
 OFFSET: 0.0837416 KEV * ABUNDANCE LIMIT: 80.00%

ENERGY WINDOW 50.08 TO 2048.03
 1.00-SIGMA ZERR

PK	CH	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PH	CTS/SEC	%ERR	F11
1	0	73.22	665.	5517.	1.01	73.14	72	4	1.11E 00	16.4	
2	0	88.13	15135.	10756.	1.18	88.05	84	8	2.52E 01	1.4	
3	0	122.17	16629.	9820.	1.22	122.09	118	8	2.77E 01	1.3	
4	0	136.62	2137.	9615.	1.91	136.54	133	8	3.56E 00	8.2	
5	0	165.99	15391.	6625.	1.21	165.91	164	6	2.57E 01	1.2	
6	0	255.30	1269.	7074.	1.43	255.23	252	8	2.11E 00	11.8	
7	0	279.31	17514.	6912.	1.51	279.24	275	9	2.92E 01	1.1	
8	0	391.79	24825.	5413.	1.61	391.72	387	10	4.14E 01	0.8	
9	0	514.04	21633.	4542.	1.42	513.97	509	10	3.61E 01	0.9	
10	0	661.65	23817.	4719.	1.91	661.58	656	11	3.97E 01	0.9	
11	0	813.97	560.	1973.	1.39	813.91	810	8	9.33E-01	14.3	
12	0	897.02	25379.	3027.	1.66	897.96	893	10	4.23E 01	0.7	
13	0	1173.17	17478.	1894.	2.03	1173.12	1167	12	2.91E 01	0.9	
14	0	1325.07	545.	640.	3.18	1325.02	1322	19	9.08E-01	8.4	1.34E 01
15	0	1332.43	15233.	582.	2.05	1332.43	1322	19	2.55E 01	0.7	
16	0	1835.91	14146.	421.	2.39	1835.87	1829	14	2.36E 01	0.9	

PEAK SEARCH COMPLETED (REV 15.7)

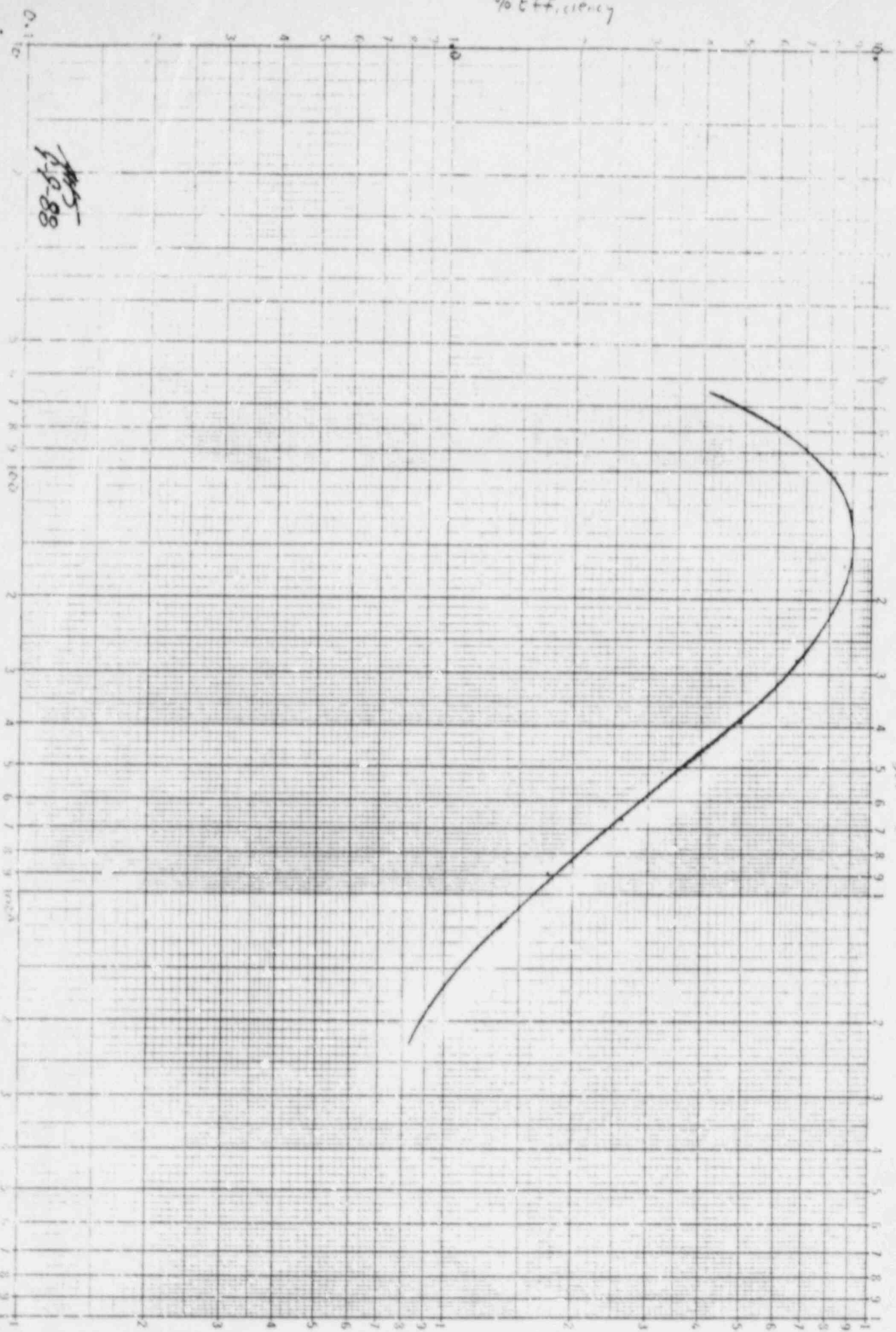
Carl TAB 33

Charcoal filter, contact

Dist # 3

% Efficiency

88-5-54



X Energy (kev)

 ***** 12-AUG-88 20:26:06 *****

CALIBRATION CURVE

SPECTRAL FILE NAME: GEL1.MAIN31
 SAMPLE DATE: 01-JUN-88 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: PARTICULATES
 SAMPLE QUANTITY: 1.000000 UNITS: MLS
 SAMPLE GEOMETRY: PART. FILTER
 EFFICIENCY FILE NAME: GEL1.FAB34.,

 *
 ACQUIRE DATE: 12-AUG-88 20:15:35 * FWHM(1332) 2.225
 PREFET TIME(LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 621. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.
 *

 *
 DETECTOR: HPGE #3 * LIBRARY:GEL1.LIBPAR
 CARTR DATE: 12-AUG-88 20:04:09 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0000224 * HALF LIFE RATIO: 8.00
 OFFSET: 0.0763344 KEV * ABUNDANCE LIMIT: 80.00%
 *

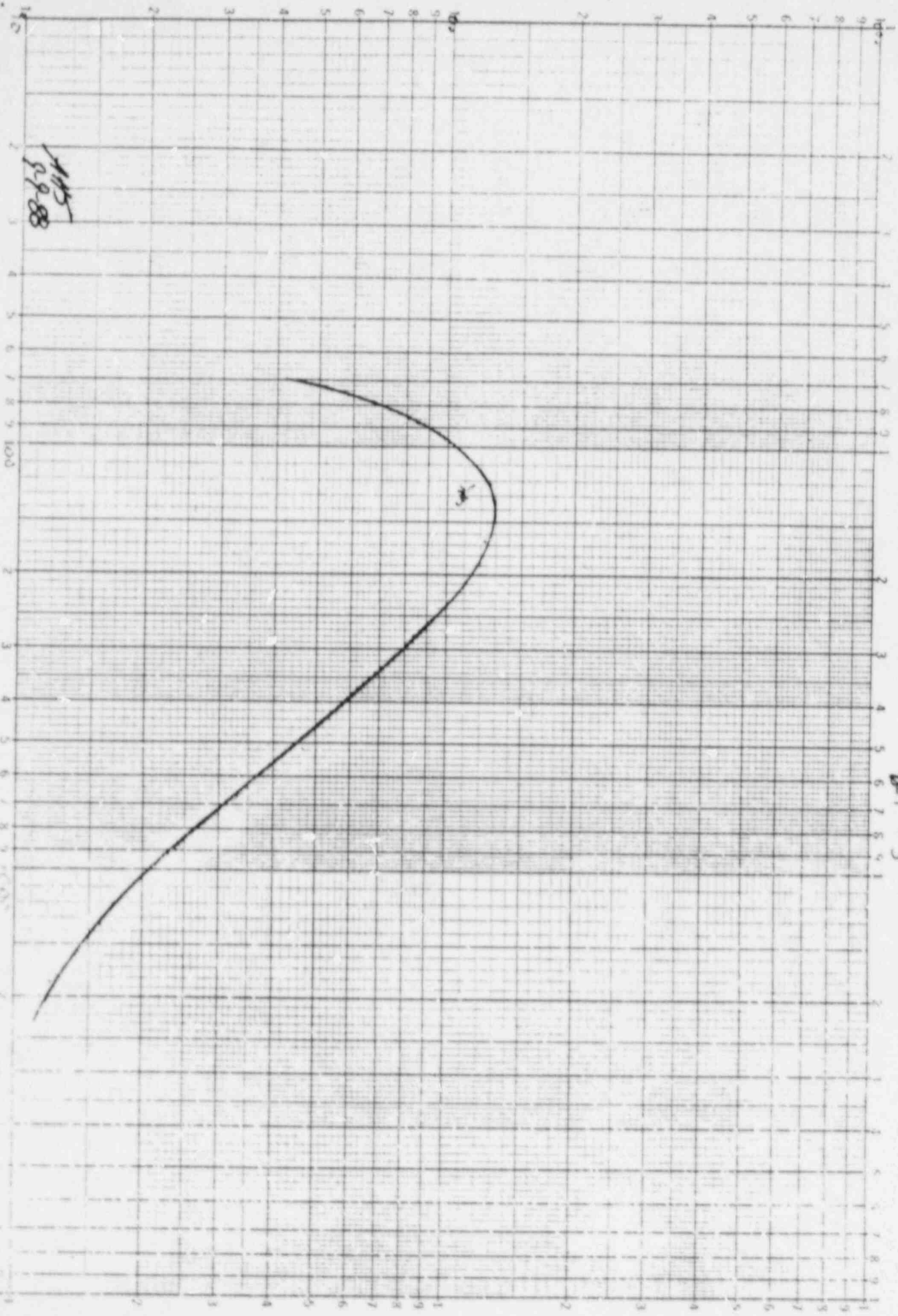
ENERGY WINDOW 50.08 TO 2048.12
 1.00-SIGMA %ERR

PK	IT	ENERGY	AREA	BKGND	FWHM	CHANNEL	LEFT	PH	CTS/SEC	%ERR	FIT
1	0	73.25	576.	5496.	1.07	73.17	72	4	9.60E-01	18.8	
2	0	88.15	14381.	10930.	1.22	88.07	84	8	2.40E 01	1.5	
3	0	122.20	18348.	9945.	1.28	122.12	118	8	3.06E 01	1.2	
4	0	136.75	2496.	9348.	1.85	136.67	133	8	4.16E 00	7.0	
5	0	166.03	17213.	9032.	1.26	165.95	162	8	2.87E 01	1.2	
6	0	255.35	1097.	6145.	1.78	255.27	252	7	1.83E 00	12.3	
7	0	279.31	17613.	8048.	1.60	279.22	274	10	2.94E 01	1.2	
8	0	391.81	19806.	4651.	1.61	391.72	388	8	3.30E 01	0.9	
9	0	514.05	24824.	4596.	1.45	513.96	509	10	4.14E 01	0.8	
10	0	661.68	23564.	4969.	1.91	661.59	656	11	3.93E 01	0.9	
11	0	813.99	623.	2669.	1.57	813.89	809	10	1.04E 00	16.2	
12	0	898.95	27281.	3260.	1.73	897.95	893	10	4.55E 01	0.7	
13	0	1173.18	18248.	2001.	2.07	1173.08	1167	12	3.04E 01	0.9	
14	4	1325.18	525.	1222.	3.04	1325.07	1320	18	8.75E-01	12.6	8.22E 01
15	4	1332.50	15892.	760.	2.07	1332.39	1320	18	2.65E 01	0.8	
16	0	1831.87	14809.	612.	2.40	1831.76	1829	14	2.48E 01	0.9	

PEAK SEARCH COMPLETED (REV 15.7)

Geli TAB 34
47mm PAET Filter, contact
Dot # 3

% Efficiency



ENERGY (e.v.)

145
99.88

MCA DETECTOR CALIBRATION DATA

Detector Serial or ID Number: SN # 21-P-329A

- Check applicable Geometries
- | | | | |
|--|---|--|---|
| <input checked="" type="checkbox"/> 100 cc Gas, contact | <input type="checkbox"/> 100 cc Gas at 8 cm | <input type="checkbox"/> 15 ml vial on contact | <input type="checkbox"/> 15 ml vial at 8 cm |
| <input type="checkbox"/> Char. Cart, contact | <input type="checkbox"/> Char Cart. at 8 cm | <input type="checkbox"/> Radwat smear, contact | <input type="checkbox"/> Radwat smear, 8 cm |
| <input type="checkbox"/> 47 mm Part, contact | <input type="checkbox"/> 47 mm Part at 8 cm | <input type="checkbox"/> Rx crud, contact | <input type="checkbox"/> Rx crud, at 8 cm |
| <input checked="" type="checkbox"/> 1 liter Marinelli Liquid | <input type="checkbox"/> 100 ml cup, liq, contact | <input type="checkbox"/> Point Source, contact | <input type="checkbox"/> Point Source at 8 cm |
| <input type="checkbox"/> PASS Part at 8 cm | <input type="checkbox"/> PASS Chr Sy at 8 cm | | |

Calibration Source ID number: MCA-05

Geometry: 100 cc GAS, Contact

Efficiency File: Geli. TAB 35

Calibration Source ID number: MCA-06

Geometry: 1 liter Marinelli liquid, contact

Efficiency File: Geli. TAB 36

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	23.3	674.7	3.45
Co-57 122 keV	28.8	583.6	4.93
Ce-139 166 keV	26.2	559.2	4.69
Hg-203 279 keV	25.3	835.6	3.03
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	33.7	1572.4	2.14
Sr-88 514 keV	37.9	2132.5	1.78
Co-137 662 keV	39.3	2833.3	1.39
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	45.2	4550.6	0.99
Co-60 1173 keV	30.9	3941.4	0.78
Co-60 1332 keV	26.4	3947.1	0.67
Y-88 1836 keV	25.5	4851.4	0.53

Nuclide & Energy	Gammas/sec Peak Area	Gammas/sec Cal source	% Efficiency
Ba-133 80 keV	N/A	N/A	N/A
Cd-109 88 keV	23.4	1314.9	1.78
Co-57 122 keV	27.5	1137.5	2.42
Ce-139 166 keV	27.1	1089.8	2.49
Hg-203 279 keV	29.0	1628.5	1.78
Ba-133 356 keV	N/A	N/A	N/A
Sn-113 392 keV	40.7	3064.5	1.33
Sr-88 514 keV	44.0	4156.2	1.06
Co-137 662 keV	47.2	5522.1	0.85
Co-58 811 keV	N/A	N/A	N/A
Mn-54 835 keV	N/A	N/A	N/A
Y-88 898 keV	56.6	8869.1	0.64
Co-60 1173 keV	38.7	7681.7	0.50
Co-60 1332 keV	34.3	7692.9	0.45
Y-88 1836 keV	33.1	9455.3	0.35

Detector Calibration Data Prepared by M. H. Gandy

Date 5-14-83

Comments _____

NCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number NCA-05 Date Source Prepared 7-19-88
Date Calibration Source Gamma Per Seconds Valid 12 Aug 88 thru 13 Aug 88

Indicate 100 cc Gas 15 ml Vial liquid PASS Gas Vial Point Source Rad Waste Stream
Applicable 47 mm Part Filter 100 ml Cup liquid PASS Char Syringe Reactor crud particulate
Configuration Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
⁶⁰ Co, ⁶⁷ Co, ¹³⁷ Cs, ¹³⁸ La, ¹⁵² Eu, ¹⁵⁴ Eu, ²⁴¹ Am, ²⁴² Am, ²⁴³ Am, ²⁴⁴ Am, ²⁴⁷ Bk, ²⁵² Cf, ²⁵³ Cf, ²⁵⁴ Cf, ²⁵⁵ Cf, ²⁵⁶ Cf, ²⁵⁷ Cf, ²⁵⁸ Cf, ²⁵⁹ Cf, ²⁶⁰ Cf, ²⁶¹ Cf, ²⁶² Cf, ²⁶³ Cf, ²⁶⁴ Cf, ²⁶⁵ Cf, ²⁶⁶ Cf, ²⁶⁷ Cf, ²⁶⁸ Cf, ²⁶⁹ Cf, ²⁷⁰ Cf, ²⁷¹ Cf, ²⁷² Cf, ²⁷³ Cf, ²⁷⁴ Cf, ²⁷⁵ Cf, ²⁷⁶ Cf, ²⁷⁷ Cf, ²⁷⁸ Cf, ²⁷⁹ Cf, ²⁸⁰ Cf, ²⁸¹ Cf, ²⁸² Cf, ²⁸³ Cf, ²⁸⁴ Cf, ²⁸⁵ Cf, ²⁸⁶ Cf, ²⁸⁷ Cf, ²⁸⁸ Cf, ²⁸⁹ Cf, ²⁹⁰ Cf, ²⁹¹ Cf, ²⁹² Cf, ²⁹³ Cf, ²⁹⁴ Cf, ²⁹⁵ Cf, ²⁹⁶ Cf, ²⁹⁷ Cf, ²⁹⁸ Cf, ²⁹⁹ Cf, ³⁰⁰ Cf, ³⁰¹ Cf, ³⁰² Cf, ³⁰³ Cf, ³⁰⁴ Cf, ³⁰⁵ Cf, ³⁰⁶ Cf, ³⁰⁷ Cf, ³⁰⁸ Cf, ³⁰⁹ Cf, ³¹⁰ Cf, ³¹¹ Cf, ³¹² Cf, ³¹³ Cf, ³¹⁴ Cf, ³¹⁵ Cf, ³¹⁶ Cf, ³¹⁷ Cf, ³¹⁸ Cf, ³¹⁹ Cf, ³²⁰ Cf, ³²¹ Cf, ³²² Cf, ³²³ Cf, ³²⁴ Cf, ³²⁵ Cf, ³²⁶ Cf, ³²⁷ Cf, ³²⁸ Cf, ³²⁹ Cf, ³³⁰ Cf, ³³¹ Cf, ³³² Cf, ³³³ Cf, ³³⁴ Cf, ³³⁵ Cf, ³³⁶ Cf, ³³⁷ Cf, ³³⁸ Cf, ³³⁹ Cf, ³⁴⁰ Cf, ³⁴¹ Cf, ³⁴² Cf, ³⁴³ Cf, ³⁴⁴ Cf, ³⁴⁵ Cf, ³⁴⁶ Cf, ³⁴⁷ Cf, ³⁴⁸ Cf, ³⁴⁹ Cf, ³⁵⁰ Cf, ³⁵¹ Cf, ³⁵² Cf, ³⁵³ Cf, ³⁵⁴ Cf, ³⁵⁵ Cf, ³⁵⁶ Cf, ³⁵⁷ Cf, ³⁵⁸ Cf, ³⁵⁹ Cf, ³⁶⁰ Cf, ³⁶¹ Cf, ³⁶² Cf, ³⁶³ Cf, ³⁶⁴ Cf, ³⁶⁵ Cf, 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Place media into chamber.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.385	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	2020.50	0.372	751.63	6-1-88	72.5	1.49E-3	674.7
Co-57 122 keV	321.23	0.855	702.15	6-1-88	72.5	2.85E-3	583.6
Co-139 166 keV	1002.26	0.804	805.82	6-1-88	72.5	5.04E-3	559.2
Hg-203 279 keV	3153.77	0.773	2461.05	6-1-88	72.5	1.49E-2	835.6
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	3748.50	0.649	2432.78	6-1-88	72.5	6.02E-3	1572.4
Sr-85 514 keV	4669.65	0.992	4632.29	6-1-88	72.5	1.07E-2	2132.5
Co-137 662 keV	3344.64	0.881	2846.29	6-1-88	72.5	6.39E-3	2833.3
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 837 keV	N/A	1.000	N/A	N/A	N/A	2.32E-3	N/A
Y-88 894 keV	7805.23	0.934	7290.08	6-1-88	72.5	6.50E-3	4550.6
Co-60 1170 keV	4045.6	1.000	4045.60	6-1-88	72.5	3.60E-4	3941.4
Co-60 1332 keV	4051.59	1.000	4051.49	6-1-88	72.5	3.60E-4	3947.1
Y-88 831 keV	7818.84	0.994	7771.93	6-1-88	72.5	3.50E-3	4851.4

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp^{-lambda x days decay}

Calibration Source Prepared by M. Young Date 7-19-88

Comments _____

***** 12-AUG-88 20:39:52 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.MAIN31
SAMPLE DATE: 01-JUN-88 12:00:00
SAMPLE IDENTIFICATION: 1988
TYPE OF SAMPLE: GASEOUS
SAMPLE QUANTITY: 1.000000 UNITS: MLS
SAMPLE GEOMETRY: 100 CC GAS CHAM.
EFFICIENCY FILE NAME: GELI.IAB35.,

*
ACQUIRE DATE: 12-AUG-88 20:27:12 * FWHM(1332) 2.225
PRESET TIME(LIVE): 600. SEC * SENSITIVITY: 5.000
ELAPSED REAL TIME: 621. SEC * SHAPE PARAMETER: 20.0 %
ELAPSED LIVE TIME: 600. SEC * NBR ITERATIONS: 5.
*

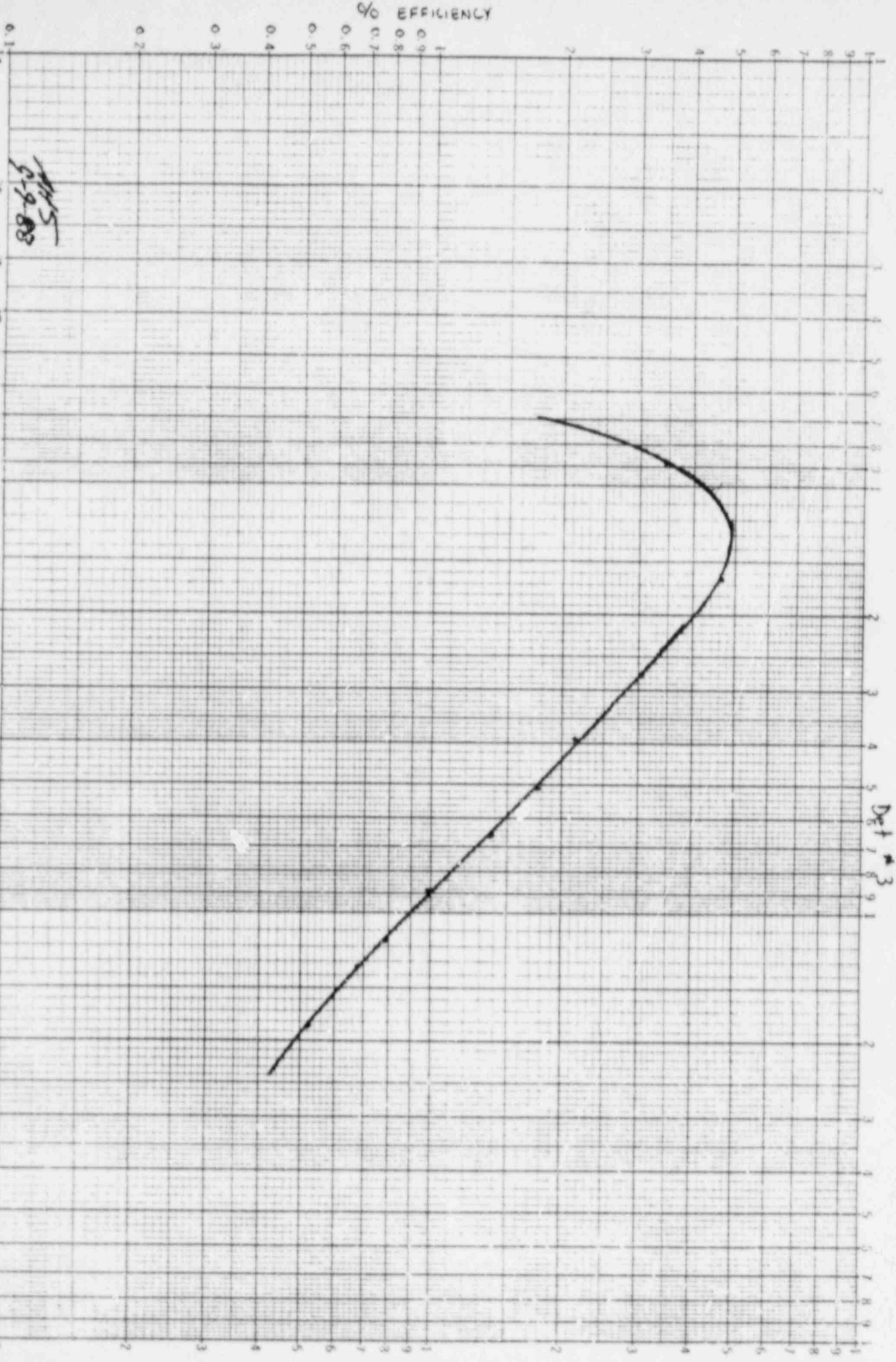
*
DETECTOR: HPGE #3 * LIBRARY:GELI.LIBGAS
CALIB DATE: 12-AUG-88 20:04:09 * ENERGY TOLERANCE: 1.500KV
KEY/CHNL: 1.0000224 * HALF LIFE RATIO: 8.00
OFFSET: 0.0763344 KEV * ABUNDANCE LIMIT: 80.00%
*

ENERGY WINDOW 50.08 TO 2048.12
1.00-SIGMA %ERR

PK	IT	ENERGY	AREA	BKGD	FWHM	CHANNEL	LEFT	PW	CTS/SEC	%ERR	FIT
1	0	73.35	586.	5999.	1.02	73.27	72	4	9.77E-01	19.2	
2	0	88.16	14007.	12486.	1.26	88.08	84	8	2.33E 01	1.6	
3	0	122.22	17255.	12498.	1.35	122.14	118	8	2.88E 01	1.3	
4	0	136.65	2045.	9337.	1.72	136.57	135	6	3.41E 00	7.8	
5	0	165.95	15718.	11808.	1.25	165.97	162	8	2.62E 01	1.4	
6	0	255.20	1146.	7109.	1.52	255.12	252	7	1.91E 00	12.6	
7	0	279.38	15156.	8075.	1.68	279.30	275	9	2.53E 01	1.3	
8	0	391.85	20248.	5587.	1.53	391.76	387	9	3.37E 01	1.0	
9	0	514.06	22761.	4631.	1.47	513.97	509	10	3.79E 01	0.9	
10	0	661.72	23593.	4464.	1.88	661.63	656	10	3.93E 01	0.8	
11	0	814.06	551.	2057.	1.70	813.96	810	8	9.18E-01	14.9	
12	0	898.08	27090.	3072.	1.77	897.98	893	10	4.52E 01	0.7	
13	0	1115.26	150.	1708.	2.87	1115.16	1113	8	2.51E-01	49.4	
14	0	1173.21	18512.	1849.	2.08	1173.10	1167	12	3.09E 01	0.9	
15	4	1325.12	730.	834.	3.19	1325.01	1319	20	1.22E 00	8.8	1.53E 01
16	4	1342.54	15828.	520.	2.12	1332.43	1319	20	2.64E 01	0.8	
17	0	1835.92	15277.	311.	2.39	1835.81	1829	14	2.55E 01	0.8	

PEAK SEARCH COMPLETED (REV 15.7)

100 cc GAS, COMPACT
Gen TAG 35
Det # 3



X ENERGY (KeV)

M/S
9-9-88

MCA CALIBRATION SOURCE PREPARATION DATA

Calibration Source ID Number MCA-06 Date Source Prepared 7-20-88
Date Calibration Source Gammas Per Seconds Valid 12 Aug 88 thru 13 Aug 88

Instrument: 100 cc Gas 15 ml Vial liq. PASS Gas Vial Point Source Radwaste S-ear
Applicator: 47 mm Part. Filter 100 ml Cup liquid PASS Char. Syringe Reactor crud particulate
Configuration: Charcoal Cartridge 1 liter Marinelli liquid PASS Filter

Nuclide	Standard Supplier	Standard ID Number	Standard Assay date	Description of calibration source preparation (mls of standard to calibration source etc)
⁹⁰ Sr, ⁹⁰ Zr, ⁹⁰ Y, ⁹⁰ Y, ⁹⁰ Co, ⁹⁰ Y, ⁹⁰ Co, ⁹⁰ Y	Amerishon International	QC3-46 R4/125/110	01 June 88 6:1240 PM	Pipetted 22.9610 gms of standard into 1 liter Marinelli and diluted to 1000mls with deion water.

Nuclide & Energy	Cal Source DPS	Gamma Abundance	Cal Source orig. GPS	as of Date	Days Decay	Lambda day ⁻¹	Cal Source current GPS
Ba-133 80 keV	N/A	0.358	N/A	N/A	N/A	1.81E-4	N/A
Cd-109 88 keV	337.93	0.372	1464.91	6-1-88	72.5	1.49E-3	1314.9
Co-57 122 keV	1400.56	0.858	1368.48	6-1-88	72.5	2.55E-3	1137.5
Co-139 166 keV	1953.40	0.804	1570.53	6-1-88	72.5	5.04E-3	1099.5
Hg-203 279 keV	6205.11	0.773	4746.55	6-1-88	72.5	1.49E-2	1628.5
Ba-133 356 keV	N/A	0.600	N/A	N/A	N/A	1.81E-4	N/A
Sn-113 392 keV	7305.77	0.649	4741.45	6-1-88	72.5	6.02E-3	3064.5
Sr-85 514 keV	901.07	0.992	9028.27	6-1-88	72.5	1.07E-2	4156.2
Co-137 662 keV	2518.66	0.881	5547.38	6-1-88	72.5	6.29E-3	5522.1
Co-58 811 keV	N/A	0.994	N/A	N/A	N/A	9.79E-3	N/A
Mn-54 833 keV	N/A	1.000	N/A	N/A	N/A	2.22E-3	N/A
Y-88 898 keV	15212.28	0.934	14208.27	6-1-88	72.5	6.50E-3	8869.1
Co-60 173 keV	7354.51	1.000	7884.31	6-1-88	72.5	3.80E-4	7681.7
Co-60 322 keV	736.29	1.000	7896.29	6-1-88	72.5	3.80E-4	7692.4
Y-88 836 keV	15235.80	0.994	15147.37	6-1-88	72.5	6.50E-3	9455.3

Cal Source orig GPS = Cal Source orig DPS x gamma abundance. Cal Source current GPS = orig GPS x exp(- lambda x days decay).

Calibration Source Prepared by M Young Date 7-20-88

 ***** 12-AUG-88 20:50:39 *****

CALIBRATION COUNT

SPECTRAL FILE NAME: GELI.MAIN31
 SAMPLE DATE: 01-JUN-83 12:00:00
 SAMPLE IDENTIFICATION: 1988
 TYPE OF SAMPLE: LIQUID
 SAMPLE QUANTITY: 1.000000 UNITS: HLS
 SAMPLE GEOMETRY: MARINELLI BEAKER
 EFFICIENCY FILE NAME: GELI.LAB36

 *
 ACQUIRE DATE: 12-AUG-88 20:57:59 * FWHM(1332) 2.225
 PRESET TIME(LIVE): 600. SEC * SENSITIVITY: 5.000
 ELAPSED REAL TIME: 630. SEC * SHAPE PARAMETER: 20.0 %
 ELAPSED LIVE TIME: 600. SEC * NBK ITERATIONS: 5.
 *

 *
 DETECTOR: HPGE #3 * LIBRARY:GELI.LIB69
 CALIB DATE: 12-AUG-88 20:04:09 * ENERGY TOLERANCE: 1.500KV
 KEV/CHNL: 1.0000224 * HALF LIFE RATIO: 8.00
 OFFSET: 0.0763344 KEV * ABUNDANCE LIMIT: 80.00%
 *

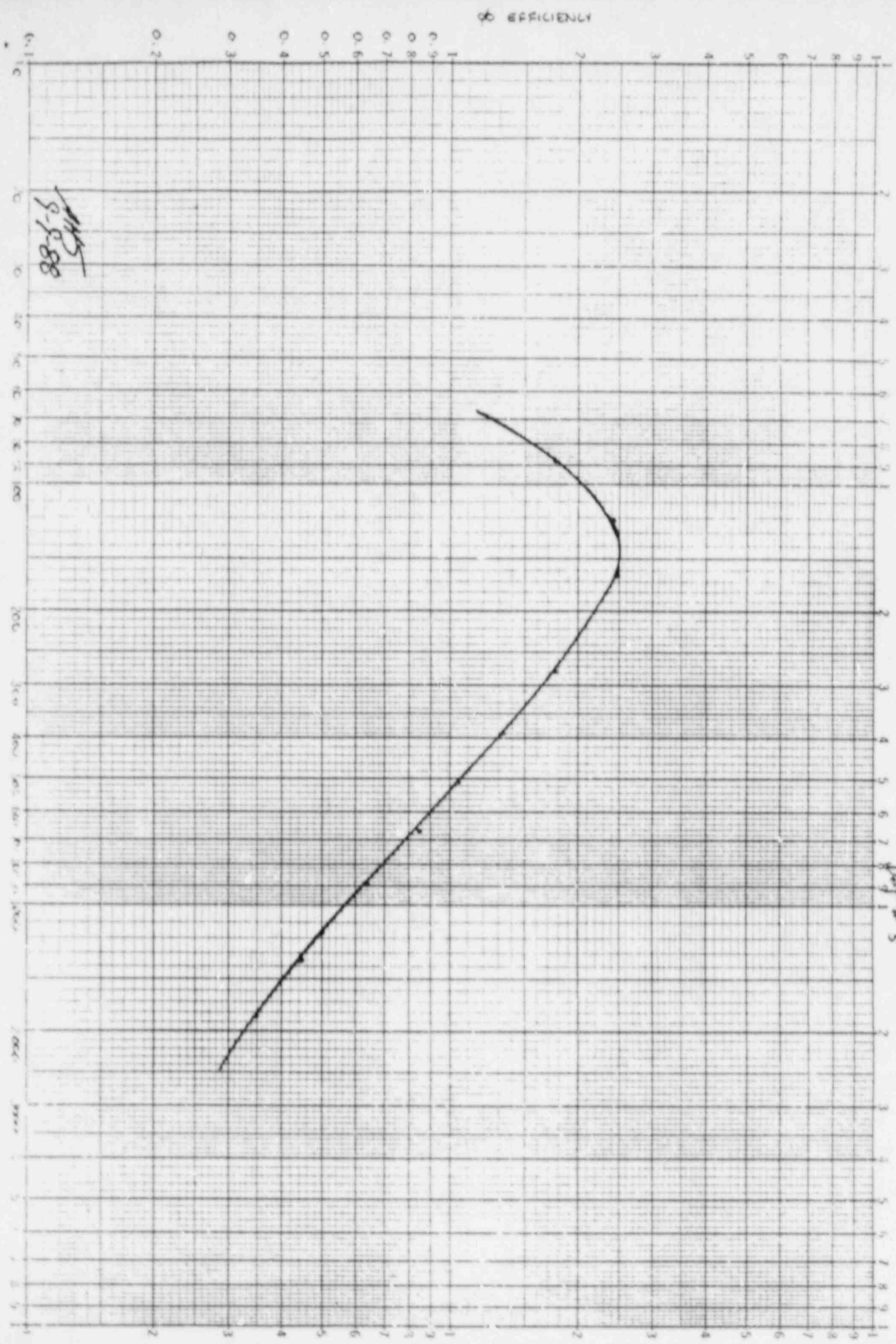
ENERGY WINDOW 50.08 TO 2048.12
 1.00-SIGMA %ERR

PK	IT	ENERGY	AREA	BKGD	FWHM	CHANNEL	LEFT	PH	CTS/SEC	%ERR	FIT
1	0	73.30	603.	10419.	1.12	73.22	72	4	1.00E 00	24.3	
2	0	88.17	14063.	22065.	1.28	88.09	84	8	2.34E 01	2.0	
3	0	122.20	16481.	22486.	1.37	122.12	118	3	2.75E 01	1.8	
4	0	136.83	2474.	19117.	1.80	136.75	134	7	4.12E 00	9.5	
5	0	155.09	15230.	17544.	1.26	155.01	154	7	2.71E 01	1.6	
6	0	205.16	922.	10131.	1.54	205.08	203	6	1.54E 00	17.5	
7	0	279.42	17410.	11378.	1.74	279.34	276	3	2.90E 01	1.3	
8	0	391.88	24416.	8939.	1.51	391.79	387	10	4.07E 01	1.0	
9	0	514.08	26402.	6801.	1.50	514.00	509	10	4.40E 01	0.8	
10	0	661.78	28318.	6840.	1.82	661.69	655	11	4.72E 01	0.8	
11	0	914.01	577.	2323.	1.69	913.92	912	6	9.62E 01	14.0	
12	0	998.12	33931.	4290.	1.77	998.02	995	10	5.66E 01	0.7	
13	0	1173.27	23225.	1465.	2.07	1173.17	1167	12	3.87E 01	0.8	
14	4	1325.17	791.	1335.	3.46	1325.06	1319	20	1.32E 00	9.5	1.40E 01
15	4	1332.37	20801.	861.	2.99	1332.46	1317	20	3.43E 01	0.7	
16	0	1835.99	15883.	546.	2.41	1835.87	1829	14	3.31E 01	0.7	

PLAK SEARCH COMPLETED (REV 15.7)

LINEAR MEASUREMENTS, INPUT, CURRENT

GEIG. TAB 36
Prof # 3



MS
9-9-88

X CURRENT (VOLT)