THE TOLEDO EDISON COMPANY
DAVIS-BESSE NUCLEAR POWER STATION
EMERGENCY PLAN SUPPORTING PROCEDURES
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Davis-Besse Nuclear Power Station

Unit No. 1

Administrative Procedure AD 1850.04

Post Accident Radiological Sampling and Counting

NUCLEAR SAFETY RELATED

Record of Approval and Changes

Prepared by Dave Briden — 12/19/79 (Date)

Submitted by D. W. Briden (Section Head) — 11/17/80 (Date)

Recommended by B R Boyd (SRB Chairman) — 1/22/80 (Date)

QA Approved (Manager of Quality Assurance) — 2/9/80 (Date)

Approved by T D Murray (Station Superintendent) — 2/12/80 (Date)

Revision No.	SRB Recommendation	Date	QA Approved	Date	Sta. Supt. Approved	Date
1	B R Boyd	3/11/80		4/16/80	T D Murray/BDB	7/18/80
2	B R Boyd	1/9/81	C T Daft/CTD	11/20/81	T D Murray	11/23/81
3	T D Murray	1/22/82	C T Daft	2-3-82	T D Murray	2/3/82
4	B R Boyd	5/25/82	C T Daft	6/25/82	T D Murray	6/28/82
5	D. W. Briden	2/8/83	C. T. Daft/CTD	2/22/83	T D Murray	2/28/83

DAVIS-BESSE REVISION COVER SHEET

March 4, 1983
DATE

TO: Dir of NRC

FROM: EMERGENCY PLANNING & PREPAREDNESS SUPV.

SUBJECT: Davis-Besse EMERGENCY PLAN SUPPORTING PROCEDURES Manual Changes

This letter transmits additions and revisions to the Davis-Besse EMERGENCY PLAN SUPPORTING PROCEDURES Manual. Control Copy 50 9.

Instructions for the material are as follows:

REMOVE AND RETURN	INSERT
Revision Index, Revision 167	Revision Index, Revision 168
AD 1850.04.4	AD 1850.04.5

Date Revision Entered _____

Addressee Signature _____

RETURN TO THE OFFICE MANAGER - STOP #3050

THE TOLEDO EDISON COMPANY
DAVIS-BESSE NUCLEAR POWER STATION
EMERGENCY PLAN SUPPORTING PROCEDURES
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Revision 168
March, 1983

Davis-Besse Nuclear Power Station

Unit No. 1

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1	B K Bergen	3/11/80	[signature]	4/16/80	T D Murray/BKB	7/18/80
2	B K Bergen	1/9/81	C. T. Daft/ejp	11/20/81	T D Murray	11/23/81
3	A M Sweeney	1/22/82	[signature]	2-3-82	T D Murray	2/3/82
4	B K Bergen	5/25/82	C. T. Daft	6/25/82	T D Murray	6/28/82
5	D. W. Briden	2/8/83	C. T. Daft/bch	2/23/83	T D Murray	2/26/83

1. PURPOSE

The purpose of this procedure is to address short-term preparedness in responding to radiological sampling and counting for a potential accident which would make normal sampling and counting impractical.

2. SCOPE

2.1 Gamma Spectral counting capability

2.1.1 In the event of such an accident, the existing counting room could not be used.

2.1.2 A temporary counting room would be set up in the Water Plant lab or other suitable location for gross counting, and gamma spectroscopy.

2.2 Reactor Coolant System (RCS) sampling

2.2.1 Depending on Radiation exposure, the normal sampling system can be used.

2.2.2 A shielded high pressure sampling sampler can be used for pressurizer samples when the normal sampling system cannot be used.

2.3 Containment atmosphere sampling

2.3.1 The normal sampling assemblies on Containment Monitors RE 4597AA and BA are in area where the expected radiation levels would be too high to enter.

5

2.3.2 A high pressure sampling assembly will be used for sampling at the Containment Hydrogen Analyzers.

2.4 Station vent sampling

2.4.1 Silver zeolite filters should be used for iodine sampling.

2.4.2 If RE 2024C or RE 2025C indications are off scale, direct radiation dose rates from a Noble Gase Tube are converted to uCi/cc.

3. REFERENCES

3.1 NUREG-0578, July, 1979, TMI-2 Lesson Learned Task Force Status Report and Short-Term Recommendations

3.2 NUREG-0585, October, 1979, TMI-2 Lesson Learned Task Force Final Report

3.3 NRC September 13, 1979 Letter (Followup Actions Resulting from the NRC Staff Reviews Regarding the TMI-2 Accident)

5 3.4 TED September 23, 1979 Letter (TED Response to NRC September 13, 1979 Letter for DBNPS)

3.5 NRC October 30, 1979 Letter (Discussion of Lessons Learned Short-Term Requirements)

5 3.6 TED November 21, 1979, Letter (TED Response to NRC October 30, 1979 Letter for DBNPS)

4. PRECAUTIONS

4.1 Individuals collecting samples shall not receive in excess of 3 and 18 3/4 rems to the whole body or extremities, respectively.

4.2 The requirements for exceeding 1.25 rem to the whole body during a quarter should be followed as defined in Section 6.10 of HP 1601.01 (Guides and Limits for Exposures to Radiation)

4.3 No entries shall be made into areas exceeding 100 mR/hr without a high range survey instrument, and an individual qualified to evaluate radiological conditions. Unless airborne activities are known, respiratory equipment is to be worn.

4.4 Since Chemistry and Health Physics personnel will collect the samples, new REP's are not required.

4.5 WARNING WHEN COLLECTING SAMPLES

Potential radiation levels during accident conditions are:

4.5.1 Containment Atmosphere Sampling

1. 585' elevation in front of the high pressure sampler may be 0.1 - 5 R/hr.

2. Hallway on 585' elevation adjacent to sampling may be 5 - 50 R/hr.

4.5.2 Station Vent Sampling

1. Inside the Non-Radwaste Ventilation Room by sampling system may be 5 R/hr.

2. At RE 2024 and RE 2025, the radiation could be 100 - 1000 R/hr if EVS system is operating.

4.5.3 RCS Sampling

1. Sample system could be 0.1 - 5 R/hr.

2. Hallway to sample system could be 15 - 100 mR/hr.

3. Pathway to the RCS sampling system is to take the elevator or stairs in the southeast corner of the Auxiliary Building to the 545 ft. elevation.

5. PROCEDURE

5.1 Containment Atmosphere Sampling

5 The normal sample points for Containment atmosphere at RE 4597AA and BA cannot be used because the radiation levels in the Mechanical Penetration Room will be excessive. When a high pressure sample is collected, only radioactive noble gases and iodines are determined. Particulates are not applicable based on Lessons Learned Item 2.1.6.b.

5.1.1 The sampler is evacuated by connecting a vacuum pump V-2 with V-2. With gauge attached, V-1 closed, and V-2 open, evacuate the sample assembly. Close V-2 and remove from vacuum pump.

5.1.2 Connect 75cc high pressure sampler (HPS) to quick disconnect 'A' from CV 337 (CV 342) located above Hydrogen Analyzer Cabinet on 585' elevation, as in Figure 1 shown below:

5

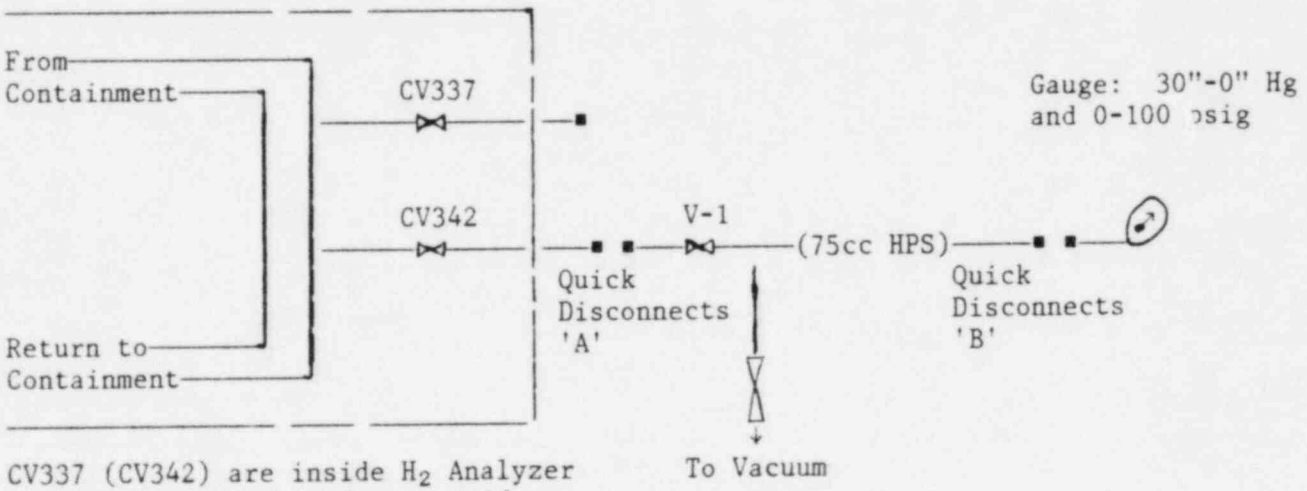

Figure 1

5.1.3 Verify flow through the hydrogen analyzer. (This system is isolated during an SFAS trip and Operations would have to open isolated valves to reestablish flow.)

5.1.4 Open valve v-1 on the sampler.

5.1.5 Slowly open valve CV 337 (CV 342). After the pressure indication has stabilized as indicated on the pressure gauge, close CV 337 (CV 342) and V-1. Disconnect HPS assembly from CV 337 (CV 342) at disconnect 'A'.

5.1.6 Remove gauge at quick disconnects 'B' and count 75 cc HPS assembly for gamma emitting radionuclides.

5.2 Station Vent Sampling

The station vent is continuously monitored by RE 2024 and RE 2025, however, they do not meet the range required by January 1, 1981, from Items 2.1.8.b of NUREG 0578. During a post accident condition, noble gas readings can be obtained every 15 minutes by the use of a portable high range survey instrument next to the sampling line. Interference from noble gases for measuring radioiodine can be reduced by using silver zeolite filters.

5.2.1 If RE 2024C and RE 2025C readings are off scale, the emergency station vent sampling assembly located in the non-radwaste ventilation room on Elev. 623' is put into service.

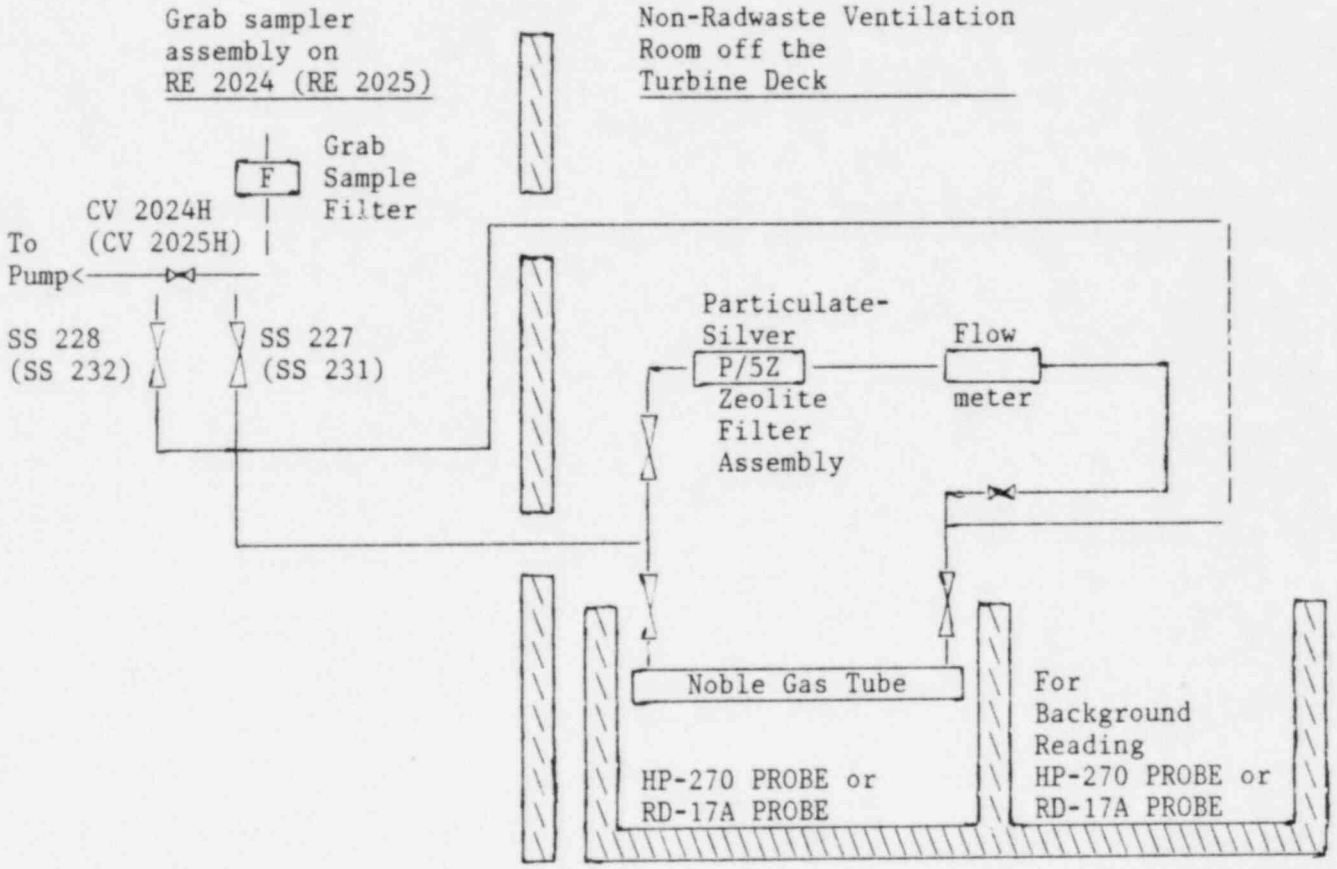

Figure 2

NOTE: The RD-17A Probe is positioned 12-inches from the Noble Gas Tube, and the HP-270 Probe is in contact with the Noble Gas Tube.

3

1. Set up the interim stati a vent monitoring assembly as shown in Figure 2. (Either RE 2024 or RE 2025 may be used for connecting up to the normal grab sampling valves.)

2. Remove the particulate and charcoal filters in RE 2024 (RE 2025) grab sampler, and reconnect.

3. Close valve CV-2024H (CV-2025H)

4. Connect the tygon tubing labeled "Inlet" to valve SS-227 (SS-231).

5. Connect the tygon tubing labeled "OUTLET" to valve SS-228 (SS-232).

6. Open valves SS-227 (SS-231) and SS-228 (SS-232).

7. Noble gases are monitored by a HP-270 Probe for Xe-133 concentrations between 0.054 to 540 μCi/cc, and a RD-17A Probe for Xe-133 concentrations between 520 to 5.2 x 10^6 μCi/cc. Readouts are shown in Figure 3.

3

NOTE: RE 2024C and 2025C have ranges of 1 x 10^{-7} to 0.02 μCi/cc.

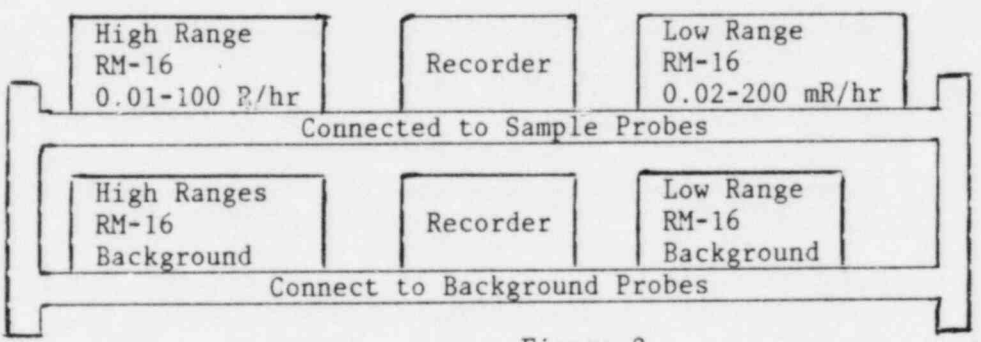

Figure 3

3

8. Determine the net close rate for the appropriate monitors used to monitor the Noble Gas Tube using Attachment 1.

9. Calculate the Xe-133 concentrations using Attachment 1.

10. If RE 2024C or 2025C reading are of scale, then readings from emergency high range or low range probes are to be given to the Shift Supervisor or Emergency Duty Officer every 15 minutes.

5.2.2 Iodine analyses can be collected at the interim Station Vent Samples.

1. Silver zeolite cartridges are used for iodine sampling with a particulate filter infront of the cartridge.

2. Calculate the volume of air that passed through the particulate-silver zeolite filter assembly by multiplying the sample flow rate times the collection period.

3. Iodine analyses and calculations can be performed by:

(1) Normal computerized gamma spectroscopy counting.

(2) Emergency on site counting described in Section 5.4.

(3) SAM-2 operation described in AD 1850.05.

5.3 Reactor Coolant Liquid Sampling

During post accident conditions the letdown system would be isolated to prevent excessive radiation levels in the Auxiliary Building resulting from high levels of radioactivity in the reactor coolant liquid. In the interim, until the permanent RCS sampling system is available, a pressurizer sample will be collected at the normal sample point, provided the radiation levels within the room can be controlled with shielding.

5.3.1 Interim RCS Sampling

2 The RC System Accident Sampling System shown in Attachment 2 is designed to obtain a reactor coolant sample from the pressurizer vapor or water space following an accident, which renders the normal sample room inaccessible, while maintaining the radiation exposure to personnel as low as practicable.

The system consists of tubing and valves to obtain the sample and return it to the Quench Tank, a sample panel with a cooler for conditioning the sample, solenoid valves for recirculation, sampling, and flushing and a shielded sample cylinder which collects

the sample. The sample panel and its associated control station are designed for storage until required. The demineralized water, for cooling the sample, and the sample tubing are permanently installed at the same location.

1. Open demineralized water valve to the emergency sample cooler located at approximately head level at the entrance to the room where the cooler is installed.

2. Using quick disconnects, attach the shielded sample container to the sample panel.

3. Open the manual inlet and isolation valves SV-10 and SV-11 on the shielded sample container.

4. Open manual sample inlet and outlet isolation valves SV-8 and SV-9. (These are located on the wall above the sample panel).

5 5. Ensure RC 111 and SV-24 on interim RCS sampling return to quench tank are open. Valves are shown on M-040-A at location F-5. These valves are physically located in Mechanical Penetration Room No. 2 approximately 10 feet along Containment wall from area at door.

6. From the Control Room, open control valves RC 239B (pressurizer water sample), RC 240A, and RC 240B. (This pressurizes the sample system up to solenoid valves SV-3 and SV-4.)

7. At the remote control panel, place switch SW-1 (sample low) to "ON". (This opens cooling water valve SV-2, the low sample valve SV-3, and sample cylinder inlet and outlet valves SV-5 and SV-6.)

8. Allow the system to circulate for 30 minutes.

   NOTE: Recirculation can also be accomplished with the high sample switch SW-2 which is provided to sampling at low system pressure. SW-2 opens SV-2, SV-4, SV-5 and SV-6.

9. To collect the sample in the cylinder, place SW-1 (SW-2) in the "OFF" position to trap the liquid.

10. From the Control Room, close valves HV-240A and HV-240B to isolate the sample system from the pressurizer.

11. At the remote station, place SW-3 (flush) in the "ON" position. (This opens valves SV-1, demineralized water flush; SV-4, high sample; and SV-7, sample cylinder bypass.)

12. Flush until radiation levels are reduced to the lowest level.

13. Close inlet and outlet manual isolations valves SV-10 and SV-11 on the sample cylinder and disconnect the quick disconnects.

14. After disconnecting the sample cylinder, switch SW-3 (flush) should be placed to "OFF".

5.4 Onsite Counting Facility

4 In order to meet the 3-hour post-accident radiological sampling and analysis requirement for RCS and containment atmosphere samples, an operational, adequately equipped, onsite counting facility must be available.

The location chosen for the Onsite Counting Facility must be set up where the radiation level is low, such as the entrance lobby on the east side of the Office Building (585 ft. elevation)or in the Water Plant Lab.

5.4.1 Equipment

A Canberra Model 8100 or 8180 multichannel pulse height analyzer (MCA), presently onsite, has been assigned for use in the Onsite Counting Facility in the event of an accident. Should utilization of the Facility be required, a Ge(Li) detector assembly will be removed from the Counting Room (603 ft. elevation) and relocated in a low radiation area where it will be connected with the Canberra MCA and other necessary equipment to provide the required gamma spectral analysis capability.

Efficiency charts and/or data tables are available in the counting room manual to provide necessary counting information for each of the following samples:

1. Reactor coolant

2. Containment atmosphere (noble gases)

3. Stack exhaust (noble gases)

4. Stack particulates filter

5. Stack iodine cartridge.

5.4.2 Procedure

Upon declaration of an emergency requiring activation of the Onsite Counting Facility, the following procedure will be followed:

4

1. If the Counting Room cannot be used transport Canberra Model 8100 or 8180 to a suitable location, i.e., the Station Lobby, Water Plant Lab, or Radiological Testing Lab at the DBAB.

2. In Counting Room, gradually reduce high voltage to the Ge(Li) detector until high voltage is off. Turn off power to the NIM bin in which the high voltage supply and amplifier are located.

3. Disconnect cables at the Ge(Li) detector, amplifier, and MCA.

4. Remove Ge(Li) detector from shield and immediately place in a dewar of LN_2. Relocate in a low radiation area with NIM bin containing high voltage and amplifier. Bring a sample shelf assembly along.

5. Reconnect high voltage, pre-amp power, and signal cables between the NIM bin components and the Ge(Li) detector per Attachment 3.

6. Turn on NIM bin power and gradually bring high voltage up to normal operating voltage (3000 volts). Allow about 15 minutes for the system to stabilize.

7. To achieve 0.5 kev/channel energy calibration, adjust the amplifier fine gain until the number of channels between two reference peaks is two times the difference between the peaks in kev. Then adjust the baseline until a reference peak is in the channel equal to two times the energy in kev. It is not necessary to have exactly 0.5 kev/channel.

8. Determine background spectrum before counting samples. Good operating practice would recommend the stationing of an operating thin-window G-M

survey meter with audible output at the Onsite Counting Facility. This would alert personnel to high atmospheric noble gas activity which could disrupt counting.

9. After counting appropriate samples, the data reduction necessary to determine the activity for each principal gamma emitter will be performed per RC 4502.00, Gamma Spectral Analysis.

10. Specific information for counting the RCS sampling system (i.e., the 40-cc bomb inside 3-inches of lead shielding).

4

(1) Remove the collimator pin from the shielding.

(2) Use Attachment 4 for radionuclide data.

(3) Use Attachment 5 for efficiencies. These efficiencies in Attachment 5 are for counting at 1 1/4 inches between the container (at the collimator) and the detector edge with the collimator centered on the center of the detector. To get efficiencies for one foot divide the 1 1/4 inch efficiencies by 116. To get three foot efficiencies, divide the 1 1/4 inch efficiencies by 1208.

(4) Use Attachment 6 for instructions to perform calculations manually if the computer is not available.

(5) If the RCS sampling system is needed to collect another sample, the sample which has been counted will be flushed out of the bomb when the next sample is to be recirculated.

Data Sheet for Calculating the Xe-133
Concentration in the Station Vent

If the low range probe (HP-270) is used:

Date time	RM-16 Sample Reading in mR/hr	RM-16 Background Reading in mR/hr	Net dose rate in mR/hr	Xe-133 in uCi/cc equals net mR/hr times 2.7
____				
____				
____				
____				
____				
____				
____				
____				

If the high range probe (RD-17A) is used:

Date time	RM-16 Sample Reading in R/hr	RM-16 Background Reading in R/hr	Net dose rate in R/hr	Xe-133 in uCi/cc equals net R/hr times 5.2×10^4
____				
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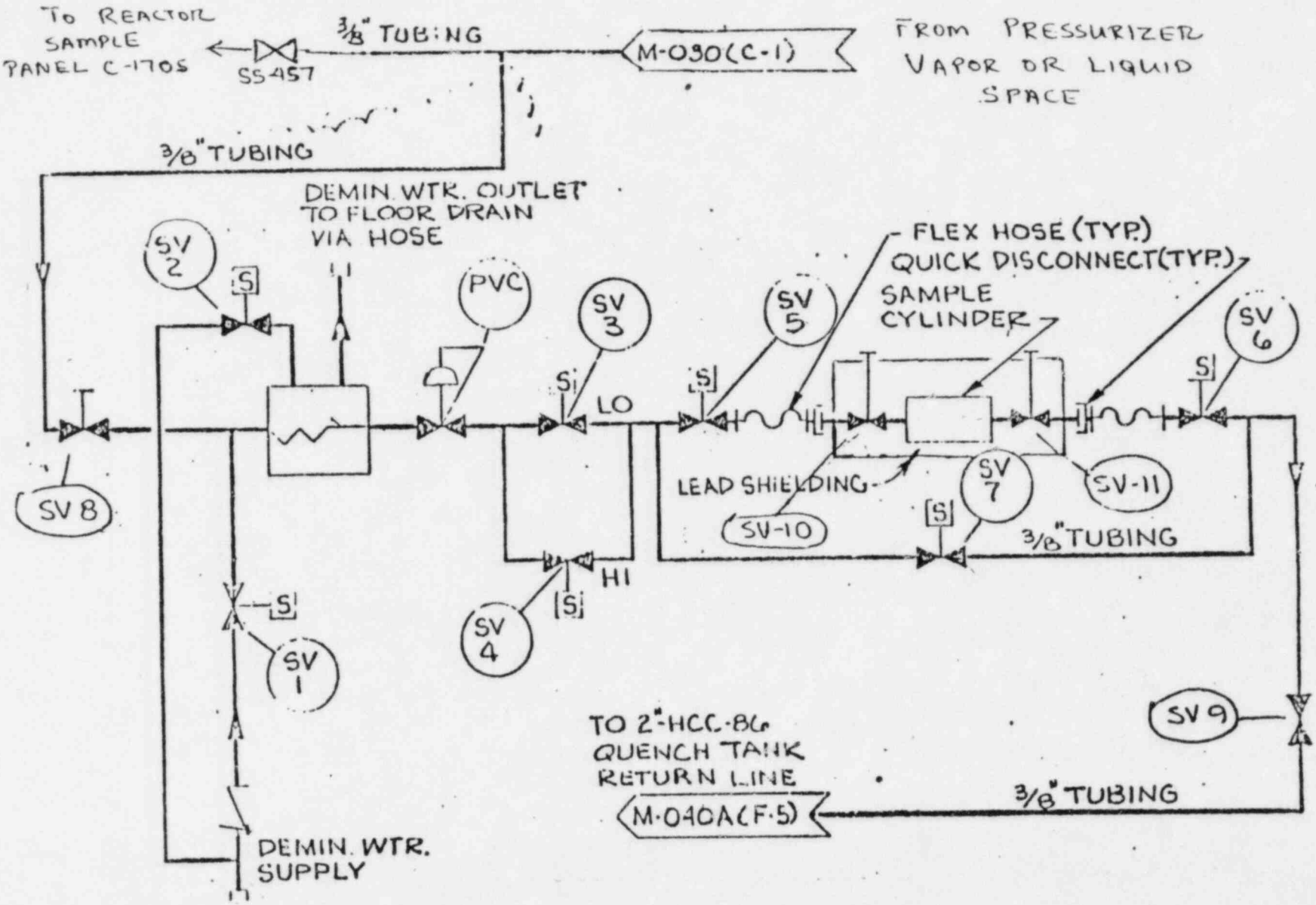
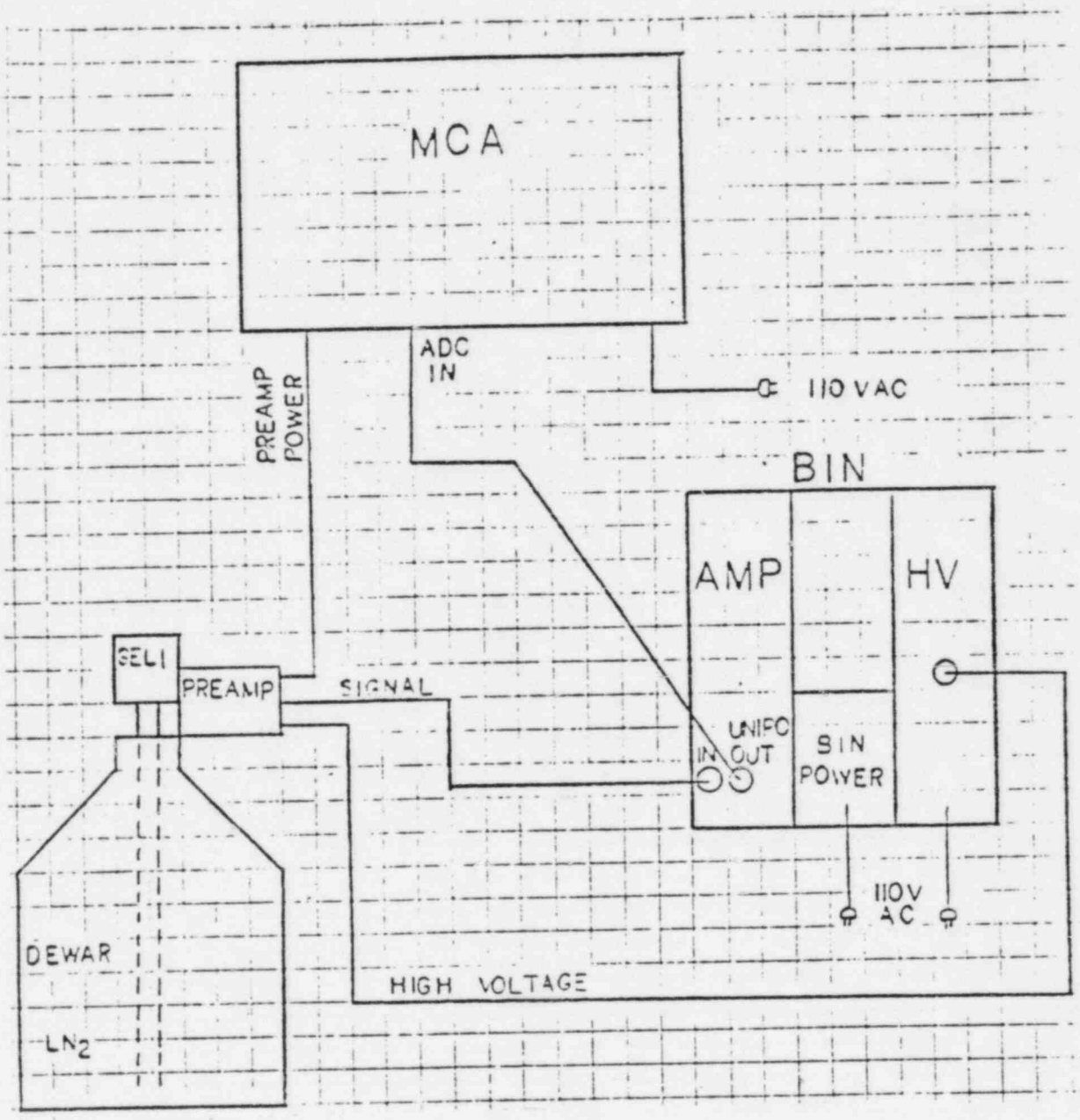


EMERGENCY REACTOR COOLANT SAMPLING

Portable GeLi Gamma Spectroscopy System



NUCLIDE	GAMMA ABUND	HALF-LIFE(MIN)	KEV
CR-51	9.800000E-02	39893.7	320.070
MN-54	0.99970	450144.	834.827
CO-60	0.99860	2.768861E+06	1173.21
ZN-65	0.50750	351504.	1115.52
KR-87	0.49400	76.0000	402.580
ZR-95	0.54600	94320.0	756.720
ZR-97	0.93300	1020.00	743.400
NB-95	0.99000	50544.0	765.790
I-131	0.82000	11577.6	364.500
I-132	0.98000	136.800	667.700
I-133	0.87000	1248.00	529.889
I-134	0.15300	52.6000	1072.55
XE-133	0.37100	7617.60	80.9970
XE133M	0.10200	3155.04	233.180
XE-135	0.90600	550.200	249.741
XE135M	0.81200	15.3000	526.620
CS-137	0.85000	1.578377E+07	661.638
CS-138	0.75000	32.2000	1435.86
BA-140	0.23800	18417.6	537.380
KR85M	0.75500	268.800	151.180
Y91M	0.94900	49.7000	555.570
HG-203	0.81500	67334.4	279.210
SN-113	0.64000	165600.	391.700
SR-85	1.00000	93888.0	513.980
BA-133	0.67000	5.729040E+06	355.900
NA-22	0.99950	1.377072E+06	1274.52
TA-182	0.35800	165600.	1121.30
NA-24	0.99993	900.000	1368.60
I-135	0.29300	396.600	1260.41
W-187	0.32000	1434.00	685.700
BE-7	0.10300	76723.2	477.590
AR-41	0.99160	109.620	1293.64
SC-46	0.99984	120744.	889.258
KR-85	4.300000E-03	5.639688E+06	513.990
RB-88	0.22100	17.8000	1836.00
EU-152	0.26710	7.148160E+06	344.300
SB-124	0.98000	86688.0	602.700
CU-64	5.000000E-03	762.600	1345.80
BR-84	0.41600	31.8000	881.600
Y-91	2.200000E-03	84254.4	1208.00
Y-92	0.13720	211.800	934.500
TE-132	0.88000	4680.00	228.200
XE131M	2.000000E-02	17265.6	163.930
KR-90	0.58000	0.53866	121.500
XE-137	0.32000	3.84000	455.380
XE-138	0.29000	14.1700	258.310
XE-139	0.45000	0.67333	218.590
CS-139	6.700000E-02	9.30000	1283.23
BA-139	0.19000	83.3000	165.800
PU-236	3.800000E-04	4.614768E+07	43.4500
NP-239	0.27800	3384.00	106.140
MN-56	0.99000	155.220	846.600
SR-91	0.33400	585.000	1024.30
RB-89	0.64100	15.6000	1031.88
CS-134	0.88000	1.083787E+06	795.800
CS-136	1.00000	18720.0	818.500
CO-57	0.85200	388800.	122.060
CE-141	0.48000	46728.0	145.400
KR-89	0.22500	3.16000	220.900
PA-233	0.34000	38880.0	311.890
CE-143	0.41300	1980.00	293.260
F-18	1.94000	109.700	511.000
CE-144	0.10800	409248.	133.530
AU-198	0.94700	3882.24	411.800
AG110M	0.73300	360576.	884.650
NI-65	0.25700	153.600	1481.90
FE-59	0.56500	64224.0	1099.22
TC99M	0.90000	361.800	140.300
LA-140	0.95330	2415.60	1596.18
CO-58	0.99440	102571.	810.757
KR-88	0.28000	171.600	196.300
MO-99	0.14000	4001.40	739.580
CL-38	0.40000	37.1800	1642.40
NB-97	0.99000	73.6000	658.100
SR-92	0.90000	162.600	1383.94
RB*88	0.22100	171.600	1836.00

KEV ********** EFFICIENCIES FOR GEOMETRY 30 DETECTOR 1 **********

40 ML,STEEL + LEAD,COLLIMATED,1.25 INCHES

KEV										
10	1.141E-08	1.837E-08	2.794E-08	4.053E-08	5.657E-08	7.640E-08	1.003E-07	1.286E-07	1.615E-07	1.991E-07
20	2.416E-07	2.890E-07	3.412E-07	3.984E-07	4.603E-07	5.270E-07	5.983E-07	6.741E-07	7.542E-07	8.383E-07
30	9.264E-07	1.018E-06	1.113E-06	1.212E-06	1.313E-06	1.418E-06	1.524E-06	1.633E-06	1.745E-06	1.858E-06
40	1.973E-06	2.089E-06	2.206E-06	2.325E-06	2.444E-06	2.564E-06	2.684E-06	2.805E-06	2.925E-06	3.046E-06
50	3.166E-06	3.286E-06	3.406E-06	3.525E-06	3.643E-06	3.761E-06	3.877E-06	3.992E-06	4.107E-06	4.220E-06
60	4.331E-06	4.442E-06	4.551E-06	4.658E-06	4.764E-06	4.868E-06	4.970E-06	5.071E-06	5.170E-06	5.267E-06
70	5.362E-06	5.456E-06	5.547E-06	5.637E-06	5.725E-06	5.810E-06	5.894E-06	5.976E-06	6.056E-06	6.134E-06
80	6.210E-06	6.284E-06	6.357E-06	6.427E-06	6.495E-06	6.561E-06	6.626E-06	6.688E-06	6.749E-06	6.808E-06
90	6.865E-06	6.920E-06	6.973E-06	7.024E-06	7.074E-06	7.122E-06	7.168E-06	7.212E-06	7.255E-06	7.296E-06
100	7.335E-06	7.373E-06	7.409E-06	7.443E-06	7.476E-06	7.507E-06	7.537E-06	7.566E-06	7.592E-06	7.618E-06
110	7.642E-06	7.665E-06	7.686E-06	7.706E-06	7.724E-06	7.742E-06	7.758E-06	7.772E-06	7.786E-06	7.798E-06
120	7.810E-06	7.820E-06	7.828E-06	7.836E-06	7.843E-06	7.849E-06	7.853E-06	7.857E-06	7.860E-06	7.861E-06
130	7.862E-06	7.862E-06	7.861E-06	7.859E-06	7.856E-06	7.852E-06	7.848E-06	7.842E-06	7.836E-06	7.829E-06
140	7.822E-06	7.813E-06	7.804E-06	7.795E-06	7.784E-06	7.773E-06	7.761E-06	7.749E-06	7.736E-06	7.723E-06
150	7.709E-06	7.694E-06	7.679E-06	7.663E-06	7.647E-06	7.630E-06	7.613E-06	7.595E-06	7.577E-06	7.559E-06
160	7.540E-06	7.520E-06	7.500E-06	7.480E-06	7.460E-06	7.439E-06	7.417E-06	7.396E-06	7.374E-06	7.351E-06
170	7.329E-06	7.306E-06	7.283E-06	7.259E-06	7.236E-06	7.212E-06	7.187E-06	7.163E-06	7.138E-06	7.113E-06
180	7.088E-06	7.063E-06	7.037E-06	7.011E-06	6.985E-06	6.959E-06	6.933E-06	6.907E-06	6.880E-06	6.853E-06
190	6.827E-06	6.800E-06	6.773E-06	6.745E-06	6.718E-06	6.691E-06	6.663E-06	6.636E-06	6.608E-06	6.580E-06
200	6.552E-06	6.525E-06	6.497E-06	6.469E-06	6.441E-06	6.412E-06	6.384E-06	6.356E-06	6.328E-06	6.300E-06
210	6.271E-06	6.243E-06	6.215E-06	6.187E-06	6.158E-06	6.130E-06	6.102E-06	6.073E-06	6.045E-06	6.017E-06
220	5.988E-06	5.960E-06	5.932E-06	5.904E-06	5.875E-06	5.847E-06	5.819E-06	5.791E-06	5.763E-06	5.735E-06
230	5.707E-06	5.679E-06	5.651E-06	5.623E-06	5.595E-06	5.568E-06	5.540E-06	5.512E-06	5.485E-06	5.457E-06
240	5.430E-06	5.402E-06	5.375E-06	5.348E-06	5.321E-06	5.293E-06	5.266E-06	5.239E-06	5.213E-06	5.186E-06
250	5.159E-06	5.087E-06	5.063E-06	5.039E-06	5.016E-06	4.993E-06	4.970E-06	4.947E-06	4.925E-06	4.903E-06
260	4.880E-06	4.859E-06	4.837E-06	4.815E-06	4.794E-06	4.773E-06	4.752E-06	4.731E-06	4.711E-06	4.690E-06
270	4.670E-06	4.650E-06	4.630E-06	4.610E-06	4.591E-06	4.571E-06	4.552E-06	4.533E-06	4.514E-06	4.495E-06
280	4.477E-06	4.458E-06	4.440E-06	4.422E-06	4.404E-06	4.386E-06	4.368E-06	4.350E-06	4.333E-06	4.316E-06
290	4.299E-06	4.282E-06	4.265E-06	4.248E-06	4.231E-06	4.215E-06	4.198E-06	4.182E-06	4.166E-06	4.150E-06
300	4.134E-06	4.118E-06	4.103E-06	4.087E-06	4.072E-06	4.056E-06	4.041E-06	4.026E-06	4.011E-06	3.996E-06
310	3.982E-06	3.967E-06	3.953E-06	3.939E-06	3.924E-06	3.910E-06	3.896E-06	3.882E-06	3.868E-06	3.854E-06
320	3.840E-06	3.827E-06	3.813E-06	3.800E-06	3.786E-06	3.773E-06	3.760E-06	3.747E-06	3.734E-06	3.721E-06
330	3.709E-06	3.696E-06	3.683E-06	3.671E-06	3.658E-06	3.646E-06	3.634E-06	3.622E-06	3.610E-06	3.598E-06
340	3.586E-06	3.574E-06	3.562E-06	3.550E-06	3.539E-06	3.527E-06	3.516E-06	3.504E-06	3.493E-06	3.482E-06
350	3.471E-06	3.460E-06	3.449E-06	3.438E-06	3.427E-06	3.416E-06	3.405E-06	3.394E-06	3.384E-06	3.373E-06
360	3.363E-06	3.352E-06	3.342E-06	3.332E-06	3.322E-06	3.312E-06	3.301E-06	3.291E-06	3.281E-06	3.272E-06
370	3.262E-06	3.252E-06	3.242E-06	3.233E-06	3.223E-06	3.213E-06	3.204E-06	3.195E-06	3.185E-06	3.176E-06
380	3.167E-06	3.157E-06	3.148E-06	3.139E-06	3.130E-06	3.121E-06	3.112E-06	3.103E-06	3.094E-06	3.086E-06
390	3.077E-06	3.068E-06	3.060E-06	3.051E-06	3.042E-06	3.034E-06	3.026E-06	3.017E-06	3.009E-06	3.001E-06
400	2.992E-06	2.984E-06	2.976E-06	2.968E-06	2.960E-06	2.952E-06	2.944E-06	2.936E-06	2.928E-06	2.920E-06
410	2.912E-06	2.905E-06	2.897E-06	2.889E-06	2.882E-06	2.874E-06	2.866E-06	2.859E-06	2.851E-06	2.844E-06
420	2.837E-06	2.829E-06	2.822E-06	2.815E-06	2.807E-06	2.800E-06	2.793E-06	2.786E-06	2.779E-06	2.772E-06
430	2.765E-06	2.758E-06	2.751E-06	2.744E-06	2.737E-06	2.730E-06	2.724E-06	2.717E-06	2.710E-06	2.703E-06
440	2.697E-06	2.690E-06	2.683E-06	2.677E-06	2.670E-06	2.664E-06	2.657E-06	2.651E-06	2.644E-06	2.638E-06
450	2.632E-06	2.626E-06	2.619E-06	2.613E-06	2.607E-06	2.601E-06	2.595E-06	2.588E-06	2.582E-06	2.576E-06
460	2.570E-06	2.564E-06	2.558E-06	2.552E-06	2.547E-06	2.541E-06	2.535E-06	2.529E-06	2.523E-06	2.517E-06
470	2.512E-06	2.506E-06	2.500E-06	2.495E-06	2.489E-06	2.483E-06	2.478E-06	2.472E-06	2.467E-06	2.461E-06

KEV									
480	2.456E-06	2.450E-06	2.445E-06	2.439E-06	2.434E-06	2.429E-06	2.423E-06	2.418E-06	2.413E-06	2.407E-06
490	2.402E-06	2.397E-06	2.392E-06	2.387E-06	2.382E-06	2.376E-06	2.371E-06	2.366E-06	2.361E-06	2.356E-06
500	2.351E-06	2.346E-06	2.341E-06	2.336E-06	2.331E-06	2.326E-06	2.322E-06	2.317E-06	2.312E-06	2.307E-06
510	2.302E-06	2.298E-06	2.293E-06	2.288E-06	2.283E-06	2.279E-06	2.274E-06	2.269E-06	2.265E-06	2.260E-06
520	2.256E-06	2.251E-06	2.246E-06	2.242E-06	2.237E-06	2.233E-06	2.228E-06	2.224E-06	2.220E-06	2.215E-06
530	2.211E-06	2.206E-06	2.202E-06	2.198E-06	2.193E-06	2.189E-06	2.185E-06	2.180E-06	2.176E-06	2.172E-06
540	2.168E-06	2.164E-06	2.159E-06	2.155E-06	2.151E-06	2.147E-06	2.143E-06	2.139E-06	2.135E-06	2.131E-06
550	2.127E-06	2.122E-06	2.118E-06	2.114E-06	2.110E-06	2.107E-06	2.103E-06	2.099E-06	2.095E-06	2.091E-06
560	2.087E-06	2.083E-06	2.079E-06	2.075E-06	2.071E-06	2.068E-06	2.064E-06	2.060E-06	2.056E-06	2.053E-06
570	2.049E-06	2.045E-06	2.041E-06	2.038E-06	2.034E-06	2.030E-06	2.027E-06	2.023E-06	2.019E-06	2.016E-06
580	2.012E-06	2.009E-06	2.005E-06	2.001E-06	1.998E-06	1.994E-06	1.991E-06	1.987E-06	1.984E-06	1.980E-06
590	1.977E-06	1.973E-06	1.970E-06	1.966E-06	1.963E-06	1.960E-06	1.956E-06	1.953E-06	1.950E-06	1.946E-06
600	1.943E-06	1.939E-06	1.936E-06	1.933E-06	1.930E-06	1.926E-06	1.923E-06	1.920E-06	1.916E-06	1.913E-06
610	1.910E-06	1.907E-06	1.904E-06	1.900E-06	1.897E-06	1.894E-06	1.891E-06	1.888E-06	1.885E-06	1.882E-06
620	1.878E-06	1.875E-06	1.872E-06	1.869E-06	1.866E-06	1.863E-06	1.860E-06	1.857E-06	1.854E-06	1.851E-06
630	1.848E-06	1.845E-06	1.842E-06	1.839E-06	1.836E-06	1.833E-06	1.830E-06	1.827E-06	1.824E-06	1.821E-06
640	1.818E-06	1.815E-06	1.813E-06	1.810E-06	1.807E-06	1.804E-06	1.801E-06	1.798E-06	1.796E-06	1.793E-06
650	1.790E-06	1.787E-06	1.784E-06	1.782E-06	1.779E-06	1.776E-06	1.773E-06	1.771E-06	1.768E-06	1.765E-06
660	1.762E-06	1.760E-06	1.757E-06	1.754E-06	1.752E-06	1.749E-06	1.746E-06	1.744E-06	1.741E-06	1.738E-06
670	1.736E-06	1.733E-06	1.730E-06	1.728E-06	1.725E-06	1.723E-06	1.720E-06	1.718E-06	1.715E-06	1.712E-06
680	1.710E-06	1.707E-06	1.705E-06	1.702E-06	1.700E-06	1.697E-06	1.695E-06	1.692E-06	1.690E-06	1.687E-06
690	1.685E-06	1.682E-06	1.680E-06	1.678E-06	1.675E-06	1.673E-06	1.670E-06	1.668E-06	1.665E-06	1.663E-06
700	1.661E-06	1.658E-06	1.656E-06	1.654E-06	1.651E-06	1.649E-06	1.646E-06	1.644E-06	1.642E-06	1.639E-06
710	1.637E-06	1.635E-06	1.633E-06	1.630E-06	1.628E-06	1.626E-06	1.623E-06	1.621E-06	1.619E-06	1.617E-06
720	1.614E-06	1.612E-06	1.610E-06	1.608E-06	1.605E-06	1.603E-06	1.601E-06	1.599E-06	1.597E-06	1.594E-06
730	1.592E-06	1.590E-06	1.588E-06	1.586E-06	1.584E-06	1.581E-06	1.579E-06	1.577E-06	1.575E-06	1.573E-06
740	1.571E-06	1.569E-06	1.567E-06	1.565E-06	1.562E-06	1.560E-06	1.558E-06	1.556E-06	1.554E-06	1.552E-06
750	1.550E-06	1.548E-06	1.546E-06	1.544E-06	1.542E-06	1.540E-06	1.538E-06	1.536E-06	1.534E-06	1.532E-06
760	1.530E-06	1.528E-06	1.526E-06	1.524E-06	1.522E-06	1.520E-06	1.518E-06	1.516E-06	1.514E-06	1.512E-06
770	1.510E-06	1.508E-06	1.506E-06	1.504E-06	1.502E-06	1.500E-06	1.499E-06	1.497E-06	1.495E-06	1.493E-06
780	1.491E-06	1.489E-06	1.487E-06	1.485E-06	1.483E-06	1.482E-06	1.480E-06	1.478E-06	1.476E-06	1.474E-06
790	1.472E-06	1.471E-06	1.469E-06	1.467E-06	1.465E-06	1.463E-06	1.461E-06	1.460E-06	1.458E-06	1.456E-06
800	1.454E-06	1.452E-06	1.451E-06	1.449E-06	1.447E-06	1.445E-06	1.444E-06	1.442E-06	1.440E-06	1.438E-06
810	1.437E-06	1.435E-06	1.433E-06	1.431E-06	1.430E-06	1.428E-06	1.426E-06	1.425E-06	1.423E-06	1.421E-06
820	1.419E-06	1.418E-06	1.416E-06	1.414E-06	1.413E-06	1.411E-06	1.409E-06	1.408E-06	1.406E-06	1.404E-06
830	1.403E-06	1.401E-06	1.399E-06	1.398E-06	1.396E-06	1.395E-06	1.393E-06	1.391E-06	1.390E-06	1.388E-06
840	1.386E-06	1.385E-06	1.383E-06	1.382E-06	1.380E-06	1.378E-06	1.377E-06	1.375E-06	1.374E-06	1.372E-06
850	1.371E-06	1.369E-06	1.367E-06	1.366E-06	1.364E-06	1.363E-06	1.361E-06	1.360E-06	1.358E-06	1.357E-06
860	1.355E-06	1.354E-06	1.352E-06	1.351E-06	1.349E-06	1.348E-06	1.346E-06	1.345E-06	1.343E-06	1.342E-06
870	1.340E-06	1.339E-06	1.337E-06	1.336E-06	1.334E-06	1.333E-06	1.331E-06	1.330E-06	1.328E-06	1.327E-06
880	1.325E-06	1.324E-06	1.322E-06	1.321E-06	1.319E-06	1.318E-06	1.317E-06	1.315E-06	1.314E-06	1.312E-06
890	1.311E-06	1.309E-06	1.308E-06	1.307E-06	1.305E-06	1.304E-06	1.302E-06	1.301E-06	1.300E-06	1.298E-06
900	1.297E-06	1.295E-06	1.294E-06	1.293E-06	1.291E-06	1.290E-06	1.289E-06	1.287E-06	1.286E-06	1.285E-06
910	1.283E-06	1.282E-06	1.280E-06	1.279E-06	1.278E-06	1.276E-06	1.275E-06	1.274E-06	1.272E-06	1.271E-06
920	1.270E-06	1.268E-06	1.267E-06	1.266E-06	1.264E-06	1.263E-06	1.262E-06	1.261E-06	1.259E-06	1.258E-06
930	1.257E-06	1.255E-06	1.254E-06	1.253E-06	1.252E-06	1.250E-06	1.249E-06	1.248E-06	1.246E-06	1.245E-06

KEV

940	1.244E-06	1.243E-06	1.241E-06	1.240E-06	1.239E-06	1.238E-06	1.236E-06	1.235E-06	1.234E-06	1.233E-06
950	1.231E-06	1.230E-06	1.229E-06	1.228E-06	1.226E-06	1.225E-06	1.224E-06	1.223E-06	1.222E-06	1.220E-06
960	1.219E-06	1.218E-06	1.217E-06	1.216E-06	1.214E-06	1.213E-06	1.212E-06	1.211E-06	1.210E-06	1.208E-06
970	1.207E-06	1.206E-06	1.205E-06	1.204E-06	1.202E-06	1.201E-06	1.200E-06	1.199E-06	1.198E-06	1.197E-06
980	1.196E-06	1.194E-06	1.193E-06	1.192E-06	1.191E-06	1.190E-06	1.189E-06	1.187E-06	1.186E-06	1.185E-06
990	1.184E-06	1.183E-06	1.182E-06	1.181E-06	1.180E-06	1.178E-06	1.177E-06	1.176E-06	1.175E-06	1.174E-06
1000	1.173E-06	1.172E-06	1.171E-06	1.170E-06	1.168E-06	1.167E-06	1.166E-06	1.165E-06	1.164E-06	1.163E-06
1010	1.162E-06	1.161E-06	1.160E-06	1.159E-06	1.158E-06	1.156E-06	1.155E-06	1.154E-06	1.153E-06	1.152E-06
1020	1.151E-06	1.150E-06	1.149E-06	1.148E-06	1.147E-06	1.146E-06	1.145E-06	1.144E-06	1.143E-06	1.142E-06
1030	1.141E-06	1.140E-06	1.139E-06	1.138E-06	1.136E-06	1.135E-06	1.134E-06	1.133E-06	1.132E-06	1.131E-06
1040	1.130E-06	1.129E-06	1.128E-06	1.127E-06	1.126E-06	1.125E-06	1.124E-06	1.123E-06	1.122E-06	1.121E-06
1050	1.120E-06	1.119E-06	1.118E-06	1.117E-06	1.116E-06	1.115E-06	1.114E-06	1.113E-06	1.112E-06	1.111E-06
1060	1.110E-06	1.109E-06	1.108E-06	1.107E-06	1.106E-06	1.105E-06	1.104E-06	1.104E-06	1.103E-06	1.102E-06
1070	1.101E-06	1.100E-06	1.099E-06	1.098E-06	1.097E-06	1.096E-06	1.095E-06	1.094E-06	1.093E-06	1.092E-06
1080	1.091E-06	1.090E-06	1.089E-06	1.088E-06	1.087E-06	1.086E-06	1.086E-06	1.085E-06	1.084E-06	1.083E-06
1090	1.082E-06	1.081E-06	1.080E-06	1.079E-06	1.078E-06	1.077E-06	1.076E-06	1.075E-06	1.074E-06	1.074E-06
1100	1.073E-06	1.072E-06	1.071E-06	1.070E-06	1.069E-06	1.068E-06	1.067E-06	1.066E-06	1.065E-06	1.065E-06
1110	1.064E-06	1.063E-06	1.062E-06	1.061E-06	1.060E-06	1.059E-06	1.058E-06	1.058E-06	1.057E-06	1.056E-06
1120	1.055E-06	1.054E-06	1.053E-06	1.052E-06	1.051E-06	1.051E-06	1.050E-06	1.049E-06	1.048E-06	1.047E-06
1130	1.046E-06	1.045E-06	1.045E-06	1.044E-06	1.043E-06	1.042E-06	1.041E-06	1.040E-06	1.039E-06	1.039E-06
1140	1.038E-06	1.037E-06	1.036E-06	1.035E-06	1.034E-06	1.034E-06	1.033E-06	1.032E-06	1.031E-06	1.030E-06
1150	1.029E-06	1.029E-06	1.028E-06	1.027E-06	1.026E-06	1.025E-06	1.025E-06	1.024E-06	1.023E-06	1.022E-06
1160	1.021E-06	1.020E-06	1.020E-06	1.019E-06	1.018E-06	1.017E-06	1.016E-06	1.016E-06	1.015E-06	1.014E-06
1170	1.013E-06	1.012E-06	1.012E-06	1.011E-06	1.010E-06	1.009E-06	1.008E-06	1.008E-06	1.007E-06	1.006E-06
1180	1.005E-06	1.005E-06	1.004E-06	1.003E-06	1.002E-06	1.001E-06	1.001E-06	9.999E-07	9.992E-07	9.984E-07
1190	9.976E-07	9.968E-07	9.961E-07	9.953E-07	9.946E-07	9.938E-07	9.930E-07	9.923E-07	9.915E-07	9.908E-07
1200	9.900E-07	9.893E-07	9.885E-07	9.877E-07	9.870E-07	9.863E-07	9.855E-07	9.848E-07	9.840E-07	9.833E-07
1210	9.825E-07	9.818E-07	9.810E-07	9.803E-07	9.796E-07	9.788E-07	9.781E-07	9.774E-07	9.766E-07	9.759E-07
1220	9.752E-07	9.745E-07	9.737E-07	9.730E-07	9.723E-07	9.716E-07	9.708E-07	9.701E-07	9.694E-07	9.687E-07
1230	9.680E-07	9.672E-07	9.665E-07	9.658E-07	9.651E-07	9.644E-07	9.637E-07	9.630E-07	9.623E-07	9.616E-07
1240	9.609E-07	9.602E-07	9.594E-07	9.587E-07	9.580E-07	9.573E-07	9.567E-07	9.560E-07	9.553E-07	9.546E-07
1250	9.539E-07	9.532E-07	9.525E-07	9.518E-07	9.511E-07	9.504E-07	9.497E-07	9.491E-07	9.484E-07	9.477E-07
1260	9.470E-07	9.463E-07	9.456E-07	9.450E-07	9.443E-07	9.436E-07	9.429E-07	9.423E-07	9.416E-07	9.409E-07
1270	9.403E-07	9.396E-07	9.389E-07	9.382E-07	9.376E-07	9.369E-07	9.363E-07	9.356E-07	9.349E-07	9.343E-07
1280	9.336E-07	9.329E-07	9.323E-07	9.316E-07	9.310E-07	9.303E-07	9.297E-07	9.290E-07	9.284E-07	9.277E-07
1290	9.271E-07	9.264E-07	9.258E-07	9.251E-07	9.245E-07	9.238E-07	9.232E-07	9.226E-07	9.219E-07	9.213E-07
1300	9.206E-07	9.200E-07	9.194E-07	9.187E-07	9.181E-07	9.175E-07	9.168E-07	9.162E-07	9.156E-07	9.149E-07
1310	9.143E-07	9.137E-07	9.131E-07	9.124E-07	9.118E-07	9.112E-07	9.106E-07	9.099E-07	9.093E-07	9.087E-07
1320	9.081E-07	9.075E-07	9.069E-07	9.062E-07	9.056E-07	9.050E-07	9.044E-07	9.038E-07	9.032E-07	9.026E-07
1330	9.020E-07	9.013E-07	9.007E-07	9.001E-07	8.995E-07	8.989E-07	8.983E-07	8.977E-07	8.971E-07	8.965E-07
1340	8.959E-07	8.953E-07	8.947E-07	8.941E-07	8.935E-07	8.929E-07	8.923E-07	8.917E-07	8.912E-07	8.906E-07
1350	8.900E-07	8.894E-07	8.888E-07	8.882E-07	8.876E-07	8.870E-07	8.865E-07	8.859E-07	8.853E-07	8.847E-07
1360	8.841E-07	8.835E-07	8.830E-07	8.824E-07	8.818E-07	8.812E-07	8.807E-07	8.801E-07	8.795E-07	8.789E-07
1370	8.784E-07	8.778E-07	8.772E-07	8.767E-07	8.761E-07	8.755E-07	8.749E-07	8.744E-07	8.738E-07	8.733E-07
1380	8.727E-07	8.721E-07	8.716E-07	8.710E-07	8.704E-07	8.699E-07	8.693E-07	8.688E-07	8.682E-07	8.677E-07
1390	8.671E-07	8.665E-07	8.660E-07	8.654E-07	8.649E-07	8.643E-07	8.638E-07	8.632E-07	8.627E-07	8.621E-07
1400	8.616E-07	8.610E-07	8.605E-07	8.600E-07	8.594E-07	8.589E-07	8.583E-07	8.578E-07	8.572E-07	8.567E-07
1410	8.562E-07	8.556E-07	8.551E-07	8.546E-07	8.540E-07	8.535E-07	8.529E-07	8.524E-07	8.519E-07	8.513E-07
1420	8.508E-07	8.503E-07	8.498E-07	8.492E-07	8.487E-07	8.482E-07	8.476E-07	8.471E-07	8.466E-07	8.461E-07
1430	8.455E-07	8.450E-07	8.445E-07	8.440E-07	8.435E-07	8.429E-07	8.424E-07	8.419E-07	8.414E-07	8.409E-07
1440	8.404E-07	8.398E-07	8.393E-07	8.388E-07	8.383E-07	8.378E-07	8.373E-07	8.368E-07	8.363E-07	8.357E-07
1450	8.352E-07	8.347E-07	8.342E-07	8.337E-07	8.332E-07	8.327E-07	8.322E-07	8.317E-07	8.312E-07	8.307E-07
1460	8.302E-07	8.297E-07	8.292E-07	8.287E-07	8.282E-07	8.277E-07	8.272E-07	8.267E-07	8.262E-07	8.257E-07
1470	8.252E-07	8.247E-07	8.242E-07	8.237E-07	8.232E-07	8.227E-07	8.223E-07	8.218E-07	8.213E-07	8.208E-07
1480	8.203E-07	8.198E-07	8.193E-07	8.188E-07	8.184E-07	8.179E-07	8.174E-07	8.169E-07	8.164E-07	8.159E-07

KEV										
1490	8.155E-07	8.150E-07	8.145E-07	8.140E-07	8.136E-07	8.131E-07	8.126E-07	8.121E-07	8.116E-07	8.112E-07
1500	8.107E-07	8.102E-07	8.098E-07	8.093E-07	8.088E-07	8.083E-07	8.079E-07	8.074E-07	8.069E-07	8.065E-07
1510	8.060E-07	8.055E-07	8.051E-07	8.046E-07	8.041E-07	8.037E-07	8.032E-07	8.027E-07	8.023E-07	8.018E-07
1520	8.013E-07	8.009E-07	8.004E-07	8.000E-07	7.995E-07	7.991E-07	7.986E-07	7.981E-07	7.977E-07	7.972E-07
1530	7.968E-07	7.963E-07	7.959E-07	7.954E-07	7.950E-07	7.945E-07	7.941E-07	7.936E-07	7.932E-07	7.927E-07
1540	7.923E-07	7.918E-07	7.914E-07	7.909E-07	7.905E-07	7.900E-07	7.896E-07	7.891E-07	7.887E-07	7.882E-07
1550	7.878E-07	7.874E-07	7.869E-07	7.865E-07	7.860E-07	7.856E-07	7.852E-07	7.847E-07	7.843E-07	7.838E-07
1560	7.834E-07	7.830E-07	7.825E-07	7.821E-07	7.817E-07	7.812E-07	7.808E-07	7.804E-07	7.799E-07	7.795E-07
1570	7.791E-07	7.786E-07	7.782E-07	7.778E-07	7.773E-07	7.769E-07	7.765E-07	7.761E-07	7.756E-07	7.752E-07
1580	7.748E-07	7.743E-07	7.739E-07	7.735E-07	7.731E-07	7.727E-07	7.722E-07	7.718E-07	7.714E-07	7.710E-07
1590	7.705E-07	7.701E-07	7.697E-07	7.693E-07	7.689E-07	7.685E-07	7.680E-07	7.676E-07	7.672E-07	7.668E-07
1600	7.664E-07	7.660E-07	7.655E-07	7.651E-07	7.647E-07	7.643E-07	7.639E-07	7.635E-07	7.631E-07	7.627E-07
1610	7.623E-07	7.618E-07	7.614E-07	7.610E-07	7.606E-07	7.602E-07	7.598E-07	7.594E-07	7.590E-07	7.586E-07
1620	7.582E-07	7.578E-07	7.574E-07	7.570E-07	7.566E-07	7.562E-07	7.558E-07	7.554E-07	7.550E-07	7.546E-07
1630	7.542E-07	7.538E-07	7.534E-07	7.530E-07	7.526E-07	7.522E-07	7.518E-07	7.514E-07	7.510E-07	7.506E-07
1640	7.502E-07	7.498E-07	7.494E-07	7.490E-07	7.486E-07	7.482E-07	7.478E-07	7.475E-07	7.471E-07	7.467E-07
1650	7.463E-07	7.459E-07	7.455E-07	7.451E-07	7.447E-07	7.443E-07	7.440E-07	7.436E-07	7.432E-07	7.428E-07
1660	7.424E-07	7.420E-07	7.416E-07	7.413E-07	7.409E-07	7.405E-07	7.401E-07	7.397E-07	7.394E-07	7.390E-07
1670	7.386E-07	7.382E-07	7.378E-07	7.375E-07	7.371E-07	7.367E-07	7.363E-07	7.359E-07	7.356E-07	7.352E-07
1680	7.348E-07	7.344E-07	7.341E-07	7.337E-07	7.333E-07	7.329E-07	7.326E-07	7.322E-07	7.318E-07	7.315E-07
1690	7.311E-07	7.307E-07	7.304E-07	7.300E-07	7.296E-07	7.292E-07	7.289E-07	7.285E-07	7.281E-07	7.278E-07
1700	7.274E-07	7.270E-07	7.267E-07	7.263E-07	7.259E-07	7.256E-07	7.252E-07	7.249E-07	7.245E-07	7.241E-07
1710	7.238E-07	7.234E-07	7.230E-07	7.227E-07	7.223E-07	7.220E-07	7.216E-07	7.212E-07	7.209E-07	7.205E-07
1720	7.202E-07	7.198E-07	7.195E-07	7.191E-07	7.187E-07	7.184E-07	7.180E-07	7.177E-07	7.173E-07	7.170E-07
1730	7.166E-07	7.163E-07	7.159E-07	7.156E-07	7.152E-07	7.149E-07	7.145E-07	7.142E-07	7.138E-07	7.135E-07
1740	7.131E-07	7.128E-07	7.124E-07	7.121E-07	7.117E-07	7.114E-07	7.110E-07	7.107E-07	7.103E-07	7.100E-07
1750	7.096E-07	7.093E-07	7.090E-07	7.086E-07	7.083E-07	7.079E-07	7.076E-07	7.072E-07	7.069E-07	7.066E-07
1760	7.062E-07	7.059E-07	7.055E-07	7.052E-07	7.048E-07	7.045E-07	7.042E-07	7.038E-07	7.035E-07	7.032E-07
1770	7.028E-07	7.025E-07	7.021E-07	7.018E-07	7.015E-07	7.011E-07	7.008E-07	7.005E-07	7.001E-07	6.998E-07
1780	6.995E-07	6.991E-07	6.988E-07	6.985E-07	6.981E-07	6.978E-07	6.975E-07	6.971E-07	6.968E-07	6.965E-07
1790	6.962E-07	6.958E-07	6.955E-07	6.952E-07	6.948E-07	6.945E-07	6.942E-07	6.939E-07	6.935E-07	6.932E-07
1800	6.929E-07	6.926E-07	6.922E-07	6.919E-07	6.916E-07	6.913E-07	6.909E-07	6.906E-07	6.903E-07	6.900E-07
1810	6.896E-07	6.893E-07	6.890E-07	6.887E-07	6.884E-07	6.880E-07	6.877E-07	6.874E-07	6.871E-07	6.868E-07
1820	6.864E-07	6.861E-07	6.858E-07	6.855E-07	6.852E-07	6.849E-07	6.845E-07	6.842E-07	6.839E-07	6.836E-07
1830	6.833E-07	6.830E-07	6.826E-07	6.823E-07	6.820E-07	6.817E-07	6.814E-07	6.811E-07	6.808E-07	6.805E-07
1840	6.801E-07	6.798E-07	6.795E-07	6.792E-07	6.789E-07	6.786E-07	6.783E-07	6.780E-07	6.777E-07	6.774E-07
1850	6.770E-07	6.767E-07	6.764E-07	6.761E-07	6.758E-07	6.755E-07	6.752E-07	6.749E-07	6.746E-07	6.743E-07
1860	6.740E-07	6.737E-07	6.734E-07	6.731E-07	6.728E-07	6.725E-07	6.722E-07	6.719E-07	6.716E-07	6.713E-07
1870	6.710E-07	6.707E-07	6.704E-07	6.701E-07	6.698E-07	6.695E-07	6.692E-07	6.689E-07	6.686E-07	6.683E-07
1880	6.680E-07	6.677E-07	6.674E-07	6.671E-07	6.668E-07	6.665E-07	6.662E-07	6.659E-07	6.656E-07	6.653E-07
1890	6.650E-07	6.647E-07	6.644E-07	6.641E-07	6.638E-07	6.635E-07	6.632E-07	6.629E-07	6.627E-07	6.624E-07
1900	6.621E-07	6.618E-07	6.615E-07	6.612E-07	6.609E-07	6.606E-07	6.603E-07	6.600E-07	6.597E-07	6.595E-07
1910	6.592E-07	6.589E-07	6.586E-07	6.583E-07	6.580E-07	6.577E-07	6.574E-07	6.572E-07	6.569E-07	6.566E-07
1920	6.563E-07	6.560E-07	6.557E-07	6.554E-07	6.552E-07	6.549E-07	6.546E-07	6.543E-07	6.540E-07	6.537E-07
1930	6.535E-07	6.532E-07	6.529E-07	6.526E-07	6.523E-07	6.520E-07	6.518E-07	6.515E-07	6.512E-07	6.509E-07
1940	6.506E-07	6.504E-07	6.501E-07	6.498E-07	6.495E-07	6.493E-07	6.490E-07	6.487E-07	6.484E-07	6.481E-07
1950	6.479E-07	6.476E-07	6.473E-07	6.470E-07	6.468E-07	6.465E-07	6.462E-07	6.459E-07	6.457E-07	6.454E-07
1960	6.451E-07	6.448E-07	6.446E-07	6.443E-07	6.440E-07	6.438E-07	6.435E-07	6.432E-07	6.429E-07	6.427E-07
1970	6.424E-07	6.421E-07	6.419E-07	6.416E-07	6.413E-07	6.410E-07	6.408E-07	6.405E-07	6.402E-07	6.400E-07
1980	6.397E-07	6.394E-07	6.392E-07	6.389E-07	6.386E-07	6.384E-07	6.381E-07	6.378E-07	6.376E-07	6.373E-07
1990	6.370E-07	6.368E-07	6.365E-07	6.362E-07	6.360E-07	6.357E-07	6.354E-07	6.352E-07	6.349E-07	6.347E-07
2000	6.344E-07	6.341E-07	6.339E-07	6.336E-07	6.333E-07	6.331E-07	6.328E-07	6.326E-07	6.323E-07	6.320E-07

Manual Calculations for Gamma Spectroscopy

Sample No._____ Description_____

Sample Date and Time_____

Counting Date and Time_____Decay Time_____min

Volume_____ml Count Time_____sec

Detector_____ Geometry_____

Nuclide_____ Energy_____kev

$$\mu Ci/ml = \frac{A - B \times \left(\frac{C + D}{2}\right)}{3.7 \times 10^4 \times E \times F \times G \times H \times J}$$

Where:

A = Counts in total peak area
B = Number of channels integrated
C = Counts in first channel of peak
D = Counts in last channel of peak
E = Efficiency for the detector and geometry used
F = Volume of sample in milliliters
G = Gamma abundance of photopeak (decimal fraction)
H = Decay factor $e^{-\lambda t_1}$. Where λ equals 0.693147 divided by the half life and t_1 is the decay time in the same units as the half-life.
J = $\frac{(1 - e\lambda t_2)}{\lambda}$ where t_2 is the count time in seconds and λ is in inverse seconds. If the count time is less than 10% of the half-life, simply enter the count time in seconds for "J".

END