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**Program MASTERCALC:
An Interactive Computer Program for
Radioanalytical Computations
Description and Operating Instructions**

MASTER

University of California

LOS ALAMOS SCIENTIFIC LABORATORY

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Program

MASTERCALC

**AN INTERACTIVE COMPUTER PROGRAM FOR RADIOANALYTICAL COMPUTATIONS
DESCRIPTION AND OPERATING INSTRUCTIONS**

by

W. Goode

ABSTRACT

MASTERCALC is a computer program written to support radioanalytical computations in the Los Alamos Scientific Laboratory (LASL) Environmental Surveillance Group. Included in the program are routines for gross alpha and beta, ^3H , gross gamma, ^{90}Sr and alpha spectroscopic determinations. A description of MASTERCALC is presented and its source listing is included. Operating instructions and example computing sessions are given for each type of analysis.

I. INTRODUCTION

Program MASTERCALC is the principal tool used for the reduction of nuclear counting data generated from routine radioanalytical work in the Environmental Surveillance Group (H-8). Specifically, it provides computational support for analyses requiring alpha spectroscopy, gross alpha and beta counting, gross gamma counting, and specific ^{90}Sr and ^3H determinations. MASTERCALC was written in 1976-1977 to provide an automated means of handling data from the analyses mentioned above and at the same time create a convenient link to the computer based data storage facility for H-8 environmental analyses (H8DATA).⁵

MASTERCALC is written in the language PASCAL and is implemented as a set of procedures that handle the specific computations for the analyses listed above; each set of procedures may share routines for such things as output formatting and data management, which are common to H-8 analytical work in general. The program is resident at the Los Alamos Scientific Laboratory Central Computing Facility (LASL CCF) on machine M and is available from any terminal connected to the CCF network.

II. FLOW OF INTERACTION

MASTERCALC was designed around the interaction flow shown in Fig. 1. This scheme was chosen as the most effective way to handle the required computational chores with the equipment available at the time the program was written.

III. FEATURES COMMON TO ALL MASTERCALC MODULES

Some basic features, restrictions, and syntactical points are common to all MASTERCALC data analysis procedures.

MASTERCALC was designed to be operated interactively. Although it is possible to use the program in a batch environment, program input and output will normally be through the user's terminal, thus avoiding the delays inherent in batch processing.

Each data analysis procedure (module) within MASTERCALC generally requires three sources of input

1. An "ID" file, which is a Network Operating System (NOS)—a time sharing system in the CCF—disk file containing information about sample identification, owner, quantity, etc.
2. A "DATA" file, which is a NOS disk file containing actual counting data from a given instrument.
3. Terminal keyboard input, which supplies certain instrument parameters, such as date of count, counter background, efficiency, etc.

The ID and DATA files consist of one or more lines of input. The correlation of identification and counting data is order dependent, therefore, each file must maintain a line-for-line correspondence to the other so that data are paired properly when read by MASTERCALC. A line of input consists of multiple data fields; each field must be separated from the next by one or more blanks (any number of blanks is permissible). Fields designed to have an alphanumeric value may be composed of any characters that are legal under NOS. Integer fields must be composed of

Fig. 1.
MASTERCALC—flow of interaction.

positive or negative whole numbers only (no decimal point). Fields that are for real numbers can be composed of any whole number (integer) or any whole number with decimal fraction (example 1, 1., 1.5). Any real number of absolute value <1. must be expressed with the leading zero included (0.5 is correct, .5 is not).

Date specifications must be made in the form MM/DD/YY where MM is the month, DD the day, and YY the year. Leading zeros must be included where MM or DD is less than 10 (e.g., 02/09/79).

In many cases, fields may be duplicated from line to line. Where duplication is provided for, a "0" (zero) is used to duplicate all field types, except for date fields that are duplicated by the letter "X." Availability of the duplication option is noted in each of the module descriptions discussed in Section IV.

Analytical results are stripped of insignificant digits before reporting. To see the method employed by MASTERCALC, consider an analytical result in the form

$$\sum_j A_j \times 10^j \pm \sum_j E_j \times 10^j$$

where A_j , E_j are nonnegative integers (digits) and j is an integer. Equivalently then the result may be expressed in the form

$$\dots A_2 A_1 A_0. A_{-1} A_{-2} A_{-3} \dots \pm E_2 E_1 E_0. E_{-1} E_{-2} E_{-3} \dots$$

Using this notation, the algorithm used to determine the number of significant digits in an analytical result is

1. Find the first nonzero digit of the error term and note the index j .
2. If the digit E_j is a 1, then round and report the answer and error terms to the j -1st digit. Otherwise, round and report the answer and error terms to the j th digit.

Examples:

<u>Computed Value</u>	<u>Reported Value</u>
5.1246 ± 1.2516	5.1 ± 1.3
5.1246 ± 0.2516	5.1 ± 0.3
5.1245 ± 2.4132	5. ± 2
5.1246 ± 24.1323	10. ± 20
5.1246 ± 0.0241	5.12 ± 0.02

Output from MASTERCALC is in two forms. A printer listing of raw and computed data is output to the user's terminal, and in addition, a local file is created under the name "RES" in which the analytical results are stored in System 2000 (a data base management system on NOS) compatible format. The listings are divided into 8.5 by 11 in. pages, with each page boundary delineated by a dashed line. The user should retain these listings as a record of the sample analyses. The "RES" file is generally translated into punched cards, which can later be loaded directly into the H-8 analytical data base (H8DATA).

The file names "ID," "DATA," and "RES," which have been used thus far and will appear frequently in Section IV, must be adhered to in a generic sense only. The user may substitute any legal NOS file name of his choosing as long as the names are substituted consistently throughout the operational sequences and the file contents satisfy the requirements for that particular analysis module.

IV. OPERATING INSTRUCTIONS

This section contains step by step instruction in the use of the various computational modules of MASTERCALC. It is assumed that the user has a basic familiarity with NOS, a text editor, and computer terminals. For help with these types of problems, the user is referred to the following sources:

LASL Guide to NOS (PIM-4)⁽¹⁾
NOS Version 1 Time Sharing User's Guide⁽²⁾
NOS Version 1 Reference Manual⁽³⁾
XEDIT (PIM-2)⁽⁴⁾
C-DIV Consulting Office, Telephone No. 7-7547

An example of an actual terminal session is presented for each analysis module. To delineate the responses of the user from those of the computer, all text typed by the user is ***Bold Italic***. Sometimes, non-printing control characters are part of a response; when this is the case they are noted by enclosing the control sequence in brackets []. For example, [CTRL/C] indicates that the user is to press the "CTRL" and "C" keys of his terminal simultaneously. Responses, which will necessarily vary for different users, are enclosed in "<>" and carry a generic meaning only. A carriage return is always required to terminate a line of keyboard input. The reader must keep this in mind while following the operational sequences, as carriage returns are not noted.

A. Gross Alpha and Beta Analyses

1. **Overview.** The alpha/beta analysis procedure is used for reducing data from the Beckman Wide Beta II proportional counter. Sample and counting information is entered into the ID and DATA files via a terminal keyboard. Predetermined efficiency relations based on the sample matrix and mass loading of the planchet are internal to the program. The user must supply background counting rates appropriate for the data set being analyzed.

2. Procedure

(A) Sign on CCF machine M.

<***security password***>

idm ↓ U <***znumbr***>

79/08/14. 14.45.08.

LASL 6600 - 00 (2*ACTUAL CP TIME)

NOS1.3-485C 790813

USER NUMBER: <***usrnbr,passwd***>

TERMINAL: 13, TTY

RECOVER/SYSTEM:

(B) Create the ID and DATA files. Each file may have up to 60 entries.

The ID file may be entered as follows:

/NEW,ID

/TEXT

ENTER TEXT MODE.

(1)	(2)	(3)	(4)	(5)	
78.06020	JWO	0.5	0.067	LITER	
78.06021	JWO	0	0.066	LITER	
78.06022	JWO	0	0.064	LITER	

[CTRL C] ← Depress "CTRL" and "C" keys simultaneously.
 EXIT TEXT MODE
NOSORT
/PACK
 PACK COMPLETE.
/REPLACE

where the fields (1) - (5) are

- (1) Sample identification: alphanumeric, 10 characters or less.
- (2) Sample owner: alphanumeric, 2 or 3 characters.
- (3) Sample quantity: an integer or real number.
- (4) Sample mass residue on the counting planchet: a real number expressed in *grams*.
- (5) Sample unit quantity: the units in which field (3) is expressed. Legal units are **LITER**, **GRAM**, **M..3** (for cubic meters) and **SAMPLE**.

Verify the contents of the ID file.

/LNH
 78.06020 JWO 0.5 0.067 LITER
 78.06021 JWO 0 0.966 LITER
 78.06022 JWO 0 0.064 LITER } (Contents of file "ID")

If the file is not as desired, use a text editor to correct the file or return to the beginning of step (B).

The DATA file may be created as follows:

/NEW,DATA
/TEXT
 ENTER TEXT MODE.

(1)	(2)	(3)	(4)	(5)	
0	0	894	130	50	
0	0	957	128	50	

[CTRL/C] ← Depress "CTRL" and "C" keys simultaneously)
 EXIT TEXT MODE.
NOSORT
/PACK
 PACK COMPLETE.
/REPLACE

where fields (1) - (5) are

- (1), (2) Dummy fields not currently used by the program. They are included for potential use of the upper tape output of the Beckman counter, but presently serve only as position holders. Any number will suffice for these fields.
- (3) Total beta counts observed for the counting period: an integer number.
- (4) Total alpha counts observed for the counting period: an integer number.
- (5) The counting period: a real number expressed in minutes.

Verification of the DATA file may be accomplished via the LNH command in the same manner as for the ID file.

(C) Execute the alpha/beta analysis module by following the sequence below.

```
/ATTACH,LGO/UN=900027  
/ATTACH,PASLIB/UN=LIBRARY  
/RFL,50000  
RFL,50000.  
/GET,ID,DATA  
/LGO(,RES,ID,DATA)
```

PLACE AN X UNDER THE DESIRED ANALYSIS

A	A	A	T	G	S
L	L	L	R	R	R
P	P	P	I	O	-
H	H	H	T	S	9
A	A	A	I	S	0
S	B	C	U	G	
P	E	A	M	A	
E	T	L		M	
C	A				
?		X			

ENTER DATA COUNTED - EXAMPLE 12/01/76

?04/19/79

ALPHA BACKGROUND=

?30

BETA BACKGROUND

?468

BACKGROUND COUNTING TIME=

?50

The backgrounds are derived from counting the appropriate blanks with the sample set.

Program output will commence here.

(D) Collect the output. The output generated from the example sequence discussed thus far is shown in Figs. 2 and 3. By performing the sequence below, one obtains a listing of the file RES and also creates a deck of punched cards containing the same information.

RAW DATA

SAMPLE ID	OWNER	QUANTITY	UNIT QUAN	COUNT TIME	ALPHA COUNTS	BETA COUNTS
78.06020	JWO	0.50	LITER	50.00	130	894
78.06021	JWO	0.50	LITER	50.00	128	957
78.06022	JWO	0.50	LITER	50.00	135	893

*Fig. 2.**Alpha/beta procedure output - raw data.*

DATE COUNTED=04/19/79

PAGE 2

CALCULATED RESULTS

SAMPLE ID	OWNER	ALPHA PCI/LITER	BETA PCI/LITER
78.06020	JWO	1.2 +/- 0.3 x 10E 1	1.7 +/- 0.2 x 10E 1
78.06021	JWO	1.1 +/- 0.3 x 10E 1	1.9 +/- 0.2 x 10E 1
78.06022	JWO	1.2 +/- 0.3 x 10E 1	1.7 +/- 0.2 x 10E 1

*Fig. 3.**Alpha/beta procedure output - computed results***/PACK,RES**

PACK COMPLETE.

/COPY,RES

*PUTA(12.0000, 3.0000,PCI/L,04/19/79,78.06020,JWO,ALPHA);

*PUTA(17.0000, 2.0000,PCI/L,04/19/79,78.06020,JWO,BETA);

*PUTA(11.0000, 3.0000,PCI/L,04/19/79,78.06021,JWO,ALPHA);

*PUTA(12.0000, 3.0000,PCI/L,04/19/78.06022,JWO,ALPHA);

*PUTA(17.0000, 2.0000,PCI/L,04/19/78.06022,JWO,BETA);

EOI ENCOUNTERED.

/REWIND,RES

\$REWIND,RES.

/DISPOSE,RES=PH

H8

The punched card deck will be available on the "H8" shelf at the CCF approximately 30 minutes following program execution. If further sets of data are to be calculated, the user should return to step B of this section; otherwise, proceed to step E.

(E) Sign off.

/BYE

900027 LOG OFF 11.24.19.

900027 SRU 10.848 UNTS.

B. Tritium Analysis

1. **Overview.** The tritium analysis procedure is for reducing counting data from the Beckman LSC-200 liquid scintillation counter or other tritium counting instrument. Sample and counting information is entered into the ID and DATA files via a terminal keyboard. All counting parameters must be supplied by the user at program execution time.

2. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **/U** **<znumbr>**

79/08/14. 14.45.08.

LASL 6600 - 00 (2*ACTUAL CP TIME) NOS1.3-485C 790813

USER NUMBER: **<usrnbr,passwd>**

TERMINAL: 13,TTY

RECOVER/SYSTEM:

(B) Construct the input files ID and DATA. Data from up to 100 samples may be processed at once.

The ID file may be entered as follows:

/NEW,ID

/TEXT

ENTER TEXT MODE.

(1) (2) (3) (4) (5)

78.08482 TG 0.005 2.71 0.0036

78.07483 TG 0.005 2.71 0.0078

78.07484 TG 0.005 2.71 0.0076

[CTRL/C]

EXIT TEXT MODE

NOSORT

/PACK

PACK COMPLETE.

/REPLACE

where the fields (1) through (5) are defined as

(1) Sample identification: alphanumeric, 10 characters or less.

(2) Sample owner: alphanumeric, 2 or 3 characters.

(3) Sample quantity: a real number expressed in liters. Fields (4) and (5) are applicable only to tritium in air determinations. If the user is computing for a sample type other than tritium, these two fields should be omitted.

(4) Sample air volume: a real number expressed in cubic meters.

(5) Volume of water extracted from the sample air volume: a real number expressed in liters.

Verify the contents of the ID file.

/LNH

78.08482 TG 0.005 2.71 0.0036

78.07483 TG 0.005 2.71 0.0073

78.07484 TG 0.005 2.71 0.0076

If the contents are not as desired, use a text editor to correct the file or return to the beginning of step (B).

The Data file may be created as follows:

/NEW,DATA

/TEXT

(1) (2) (3)

50.0 1597 0.810

50.0 1358 0.800

50.0 1428 0.832

[CTRL/C]

EXIT TEXT MODE

NOSORT

/PACK

PACK COMPLETE.

/REPLACE

where the fields (1) through (3) are defined as

(1) counting time: a real number expressed in minutes.

(2) Total tritium counts: an integer number.

(3) "S-Factor:" A unitless real number. This field is included for use with the Beckman LSC-200 or other counter which is able to produce an "external standard ratio." The external standard ratio is a measure of quenching in liquid scintillation samples. This field is included for information only, however, and it is not used in calculation of tritium activity. Therefore, any number is legal in this field but it is suggested that the user enter a 0 in this position if the value is not meaningful so that "dummy" values may be easily distinguished from actual external standard ratios.

Verify the DATA file.

/LNH

50.0 1597 0.810

50.0 1358 0.800

50.0 1428 0.832

If the contents of the DATA file are not as desired, use a text editor to correct the problem or return to middle of step (B) and recreate the file.

(C) Execute the tritium analysis module by following the sequence below.

/GET,ID,DATA

/ATTACH,LGO/UN=900027

ATTACH,PASLIB/UN=LIBRARY

/RFL,50000

RFL,50000.

/LGO(,RES,ID,DATA)

PLACE AN X UNDER THE DESIRED ANALYSIS

A	A	A	T	G	S
L	L	L	R	R	R
P	P	P	I	O	-
H	H	H	T	S	9
A	A	A	I	S	0
S	B	C	U	G	
P	E	A	M	A	
E	T	L		M	
C	A				

? **X**

ENTER DATE COUNTED - EXAMPLE 12/01/76

?08/23/79

ENTER COUNTING EFFICIENCY (C/D)

?0.282

ENTER RELATIVE STD OF COUNTING EFFICIENCY

?0.02

ENTER TRITIUM BKG - TOTAL COUNTS

?1066

ENTER BACKGROUND COUNTING TIME (MIN)

?50

IS THE CTDAT FILE IS LSC 200 PAPER TAPE FORMAT

?NO

Background and efficiency parameters should be derived from counting appropriate blank and standard samples with each sample set. Program output will commence at this point.

(D) Collect the output. The output generated from the example sequence discussed in this section is shown in Figs. 4 and 5. By performing the sequence below, the user obtains a printer listing and a punched card deck of the file RFS.

TRITIUM RESULTS

DATE COUNTFD=08/23/79

PAGE 1

SAMPLE ID	OWNER	SAMPLE (L)	WATER (L)	AIR (M)	H-3 COUNTS	COUNT TIME	SFACTOR
78.07482	TG	0.005	0.0036	2.71	1597	50.00	0.810
78.07483	TG	0.005	0.0073	2.71	1358	50.00	0.800
78.07484	TG	0.005	0.0076	2.71	1428	50.00	0.832

Fig. 4.
Tritium procedure output—raw data.

TRITIUM RESULTS

DATE COUNTED=08/23/79

PAGE 2

SAMPLE ID	OWNER	HTO CONCENTRATION
78.07482	TG	4.5 +/- 0.8 x 10E 0 PCI/M
78.07483	TG	5.0 +/- 1.2 x 10E 0 PCI/M
78.07484	TG	6.5 +/- 1.4 x 10E 0 PCI/M

Fig. 5.
Tritium procedure output—computed results.

/PACK,RES

PACK COMPLETE.

/COPY,RES

*PUTA(4.5000, 0.8000,PCI/M,08/23/79,78.08482,TG,H-3);

*TGW(2.7100,M);

*PUTA(5.0000, 1.2000,PCI/M,08/23/79,78.07483,TG,H-3);

*TGW(2.7100,M);

*PUTA(6.5000, 1.4000,PCI/M,08/23/79,78.07484,TG,H-3);

*TGW(2.7100,M);

EOI ENCOUNTERED.

/REWIND,RES

\$REWIND,RES.

/DISPOSE,RES=PH

H8

The punched card deck should be available at the CCF on the "H8" shelf approximately 30 minutes after execution. If further sets of data are to be calculated, the user should return to step (B) of this section; otherwise, proceed to step (E).

(E) Sign off.

/BYE

900027 LOG OFF 15.50.38.

900027 SRU 2.827 UNITS.

C. Gross Gamma Analysis

1. **Overview.** The gross gamma procedure is designed to reduce data from the NaI (Tl) detector and single channel analyzer counting system. Sample information and counting data are entered into the ID and DATA files via a terminal keyboard. The background counting rate appropriate for the data set being calculated must be supplied at program execution time. Results are reported in terms of net counts per minute per unit quantity; therefore, counting efficiency parameters are not required.

2. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **U** **<znumber>**

79/08/14. 14.45.08.

LASL 6600 - 00 (2*ACTUAL CP TIME) NOS1.3-485C 790813

USER NUMBER: **<usrnbr,passwd>**

TERMINAL: 13,TTY

RECOVER/SYSTEM:

(B) Create the ID and DATA files. The gross gamma procedure can process an unlimited number of sample entries at each execution.

The ID file may be created as follows:

/NEW,ID

/TEXT

ENTER TEXT MODE.

(1) (2) (3) (4)

79.01234 AS 0.5 L

79.01235 AS 0.5 L

79.01236 AS 0.5 L

79.01237 AS 0.5 L

79.01238 AS 0.5 L

79.01239 AS 0.5 L

[CTRL/C]

EXIT TEXT MODE

/NOSORT

/PACK

PACK COMPLETE.

/REPLACE

where the fields (1) through (4) are

- (1) Sample identification: alphanumeric, 10 characters or less.
- (2) Sample owner: alphanumeric, 2 or 3 characters.
- (3) Sample quantity: a real number expressed in the units supplied for field (4).
- (4) Sample unit quantity: alphanumeric, one character.

Verify the ID file.

/LNH

79.01234 AS 0.5 L
79.01235 AS 0.5 L
79.01236 AS 0.5 L
79.01237 AS 0.5 L
79.01238 AS 0.5 L
79.01239 AS 0.5 L

If the contents of the ID file are not as desired, use a text editor to correct the error(s) or return to the beginning of step (B) and recreate the file.

The data file may be entered as follows:

/NEW,DATA

/TEXT

ENTER TEXT MODE.

(1) (2)

37084 30
36653 30
36612 30
36494 30
36377 30
36274 30

[CTRL/C]

EXIT TEXT MODE

NOSORT

/PACK

PACK COMPLETE.

/REPLACE

where the fields (1), (2) are defined as

- (1) Total gamma counts detected: an integer number.
- (2) Counting period: a real number expressed in minutes.

GROSS GAMMA RESULTS

DATE COUNTED=08/28/79

PAGE 1

SAMPLE ID	OWNER	QUAN	COUNTS	TIME	GROSS GAMMA CONCENTRATION
79.01234	AS	0.50	37084	30.00	5.8 +/- 1.3 x 10E 1 NCPM/L
79.0235	AS	0.50	36653	30.00	2.9 +/- 1.3 x 10E 1 NCPM/L
79.01236	AS	0.50	36612	30.00	2.6 +/- 1.3 x 10E 1 NCPM/L
79.01237	AS	0.50	36494	30.00	1.9 +/- 1.3 x 10E 1 NCPM/L
79.01238	AS	0.50	36377	30.00	1.1 +/- 1.3 x 10E 1 NCPM/L
79.01239	AS	0.50	36274	30.00	0.4 +/- 1.3 x 10E 1 NCPM/L

Fig. 6.

*Gross gamma procedure output.***/COPY,RES**

```
*PUTA( 58.0000, 13.0000, NCPM/L,08/28/79,79.01234,AS,GAMMA);
*PUTA( 29.0000, 13.0000, NCPM/L,08/28/79,79.01235,AS,GAMMA);
*PUTA( 26.0000, 13.0000, NCPM/L,08/28/79,79.01236,AS,GAMMA);
*PUTA( 19.0000, 13.0000, NCPM/L,08/28/79,79.01237,AS,GAMMA);
*PUTA( 11.0000, 13.0000, NCPM/L,08/28/79,79.01238,AS,GAMMA);
*PUTA( 4.0000, 13.0000, NCPM/L,08/28/79,79.01239,AS,GAMMA);
```

EOI ENCOUNTERED.

/REWIND,RES

\$REWIND.RES.

/DISPOSE,RES=PH

H8

The punched card deck should be available at the CCF on the "H8" shelf approximately 30 minutes after execution. If further sets of data are to be calculated, the user should return to step (B) of this section; otherwise, proceed to step (E).

(E) Sign off.

/BYE

900027 LOG OFF 09.27.19.

900027 SRU 2.921 UNITS.

D. ⁹⁰Sr Analysis

1. Overview. This procedure is for reducing data from low background proportional counting of samples having undergone previous chemical processing for ⁹⁰Y (6) isolation. Sample, counting, and pertinent chemistry information is keyboard entered into the ID file. The DATA file is not required. Counter background and efficiency parameters must be supplied by the user at program execution time.

2. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **U****<znumbr>**

79/08/14. 14.45.08.

LASL 6600 - 00 (2*ACTUAL CP TIME) NOS1.3-485C 790813

USER NUMBER: **<usnrbr,passwd>**

TERMINAL: 13, TTY

RECOVER/SYSTEM:

(B) Create the ID file. Up to 49 sample entries may be processed at once. Duplication of fields is denoted by an "X" for date fields and a "0" (zero) for other field types as shown.

NEW,ID

/TEXT

ENTER TEXT MODE.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
78.06011	JWO	1	S	3453	300	25	16.7	08/13/79	8	34	08/13/79	16	37
78.06012	0	0	0	1958	300	0	11.4	X	0	0	08/14/79	8	12
78.06015	0	0.5	L	526	297	0	15.8	X	0	0	08/15/79	8	31

[CTRL/C]

EXIT TEXT MODE

NOSORT

/PACK

PACK COMPLETE.

REPLACE

The fields (1) through (14) are defined as follows:

- (1) Sample identification: alphanumeric, 10 characters or less.
- (2) Sample owner: alphanumeric, 2 or 3 characters.
- (3) Sample quantity: a real number expressed in the units of field (4).
- (4) Sample unit quantity: alphanumeric, one character.
- (5) total beta counts: an integer number.
- (6) Count duration: a real number expressed in minutes.
- (7) Amount of Y carrier added to the sample: a real number expressed in milligrams.
- (8) Amount of Y carrier recovered from the sample: a real number expressed in milligrams.
- (9) Separation date.

(10) Separation hour of the day: an integer number in 24 hour clock terms (leading zeros *not* required). ($1 \leq \text{separation hour} < 24$).

(11) Separation minute: an integer number (leading zeros *not* required). ($1 \leq \text{separation minute} < 60$).

(12) Counting date.

(13) Counting hour of the day: an integer number (leading zeros *not* required). ($1 \leq \text{count hour} < 24$).

(14) Counting minute: an integer number (leading zeros *not* required). ($1 \leq \text{count minute} < 60$).

Verify the contents of the ID file.

/LNH

78.06011	JWO	1	S	3453	300	25	16.7	08/13/79	8	34	08/13/79	16	37
78.06012	0	0	0	1958	300	0	11.4	X	0	0	08/14/79	8	12
78.06015	0	0.5	L	526	297	0	15.8	X	0	0	08/15/79	8	31

If the contents are not as desired, use a text editor to correct the error or return to the beginning of step (B) and reenter the file.

(C) Execute the ⁹⁰Sr analysis module by following the sequence below:

/GET,ID

/ATTACH,LGO/UN=900027

/ATTACH,PASLIB/UN=LIBRARY

/RFL,40000

RFL,40000.

/LGO(,RES,ID)

PLACE AN X UNDER THE DESIRED ANALYSIS

A	A	A	T	G	S
L	L	L	R	R	R
P	P	P	I	O	-
H	H	H	T	S	9
A	A	A	I	S	0
S	B	C	U	G	
P	E	A	M	A	
E	T	L		M	
C	A				

X

ENTER REQUESTED INFORMATION

EFFICIENCY (C/D) SIGEFF (RELATIVE) BKG(TOTAL) BKG DURATION(MIN)

?0.374

0.036

359

500

The background and efficiency parameters should be derived from the performance log maintained on the low background beta counting system (LA Notebook Y-91). Program output will commence at this point.

(D) Collect the output. The output generated from the example sequence is shown in Figs. 7, 7a, and 8. By performing the sequence below, the user will obtain a printer listing and a punched card deck of the result file RES.

```

/PAK,RES
PAK COMPLETE.
COPY,RES
*PUTA( 21.8000, 0.9000,PCI/S,08/13/79,78.06011,JWO,SR-90);
*PUTA( 20.4000, 0.9000,PCI/S,08/14/79,78.06012,JWO,SR-90);
*PUTA( 6.9000, 0.6000,PCI/L,08/15/79,78.06015,JWO,SR-90);
EOI ENCOUNTERED.
/REWIND,RES
$REWIND,RES.
/DISPOSE,RES=PH
H8

```

The punched cards should be available on the "H8" shelf approximately 30 minutes after execution. If further sets of data are to be calculated, the user should return to step (B) of this section; otherwise proceed to step (E).

(E) Sign off.

```

/BYE
900027 LOG OFF 15.28.58.
900027 SRU 1.748 UNITS.

```

SR-90 ANALYSES

PAGE 1

<u>SAMPLE ID</u>	<u>OWNER</u>	<u>QUAN</u>	<u>UNIT QUAN</u>	<u>COUNTS</u>	<u>CNT MIN</u>
78.06011	JWO	1.00	S	3453	300.00
78.06012	JWO	1.00	S	1958	300.00
78.06015	JWO	0.50	L	526	297.00

Fig. 7.
SR-90 Procedure output—raw data.

SR-90 ANALYSES

PAGE 2

<u>SAMPLE ID</u>	<u>CARRIER ADDED</u>	<u>CARRIER RECOVD</u>	<u>DATA</u>	<u>HR</u>	<u>MN</u>	<u>DATE</u>	<u>HR</u>	<u>MN</u>
78.06011	25.00	16.70	08/13/79	8	34	08/13/79	16	37
78.06012	25.00	11.40	08/13/79	8	34	08/14/79	8	12
78.06015	25.00	15.80	08/13/79	8	34	08/15/79	8	31

Fig. 7A.
SR-90 procedure output—raw data.

<u>ID</u>	<u>OWNER</u>	<u>SR-90 CONCENTRATION</u>
78.06011	JWO	2.18 $\pm$ 0.09 $\times 10^1$ PCI/S
78.06012	JWO	2.04 $\pm$ 0.09 $\times 10^1$ PCI/S
78.06015	JWO	6.9 $\pm$ 0.6 $\times 10^0$ PCI/L

*Fig. 8.**SR-90 procedure output—calculated results.*

E. Alpha Spectral Analysis

The alpha spectral analysis software consists of a procedure to reduce the spectral data and two supporting routines to keep necessary detector dependent parameters available to the analysis program. The alpha spectral analysis procedure is described in section E.1. The alpha calibration procedure maintains a file of calibration information, which is used by the spectral analysis program and is described in Section E.2. Program BKGD2, although not an integral part of MASTERCALC, maintains the necessary detector background information for the analysis code, and because of its kinship to MASTERCALC, it is described in Section E.3.

It is imperative that the person in charge of alpha spectral analyses keep the calibration and background information current via the two utilities mentioned above. When this is the case, alpha spectral data reduction may be handled relatively easily by using the alpha spectral analysis procedure of MASTERCALC as described in the next section.

1. Alpha Spectral Analysis Procedure

a. Overview. The alpha spectroscopy procedure of MASTERCALC is designed to provide an automated means of interpreting and reducing spectral information obtained from solid state counting of previously prepared electrodeposited plates resultant of specific radiochemistry.⁶ Sample information and pertinent radiochemical parameters are entered via a keyboard terminal into the ID file. A cassette tape containing the counting data from a Canberra 8100 multichannel analyzer is read into the DATA file from a Texas Instruments (TI-733) data terminal. Program execution echos the ID file information and produces spectral data listings and a final isotopic concentration summary for the data set under consideration. As in all other MASTERCALC analysis modules, a System 2000 data base (H8DATA) compatible result file is also produced.

The analysis procedure is applicable to any alpha spectral data after appropriate internal program tables have been loaded with the necessary information. Currently, analysis for ²³⁶Pu, ²³⁸Pu, ²³⁹Pu, ²⁴¹Am, ²⁴³Am, ²⁰⁸Po, ²¹⁰Po is provided for, where one isotope is designated as the tracer and up to three isotopes of the same element are specified as analytes. The necessary tasks of peak location, peak integration, background subtraction, interference correction for tracer impurities, peak fitting, and correction for poorly resolved peaks are all provided for in the analysis code.

b. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **U** <znumbr>

79/08/14. 14.45.08.

LASL 6600 - 00 (2*ACTUAL CP TIME) NOS1.3-485C 790813

USER NUMBER: <usrnbr,passwd>

TERMINAL: 13, TTY

RECOVER/SYSTEM:

(B) Construct the ID and DATA files. Up to 32 samples may be processed at once. Value duplication is provided for by the use of a "0" (zero) as shown. The ID file may be created as follows:

/NEW,ID

/TEXT

ENTER TEXT MODE.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NO-SAMPLE								
79.01395	WP	PU238,PU239	PU242	11.8	10	1	G	
79.01396	0	0,0	0	0	0	0	0	
NO-SAMPLE								
NO-SAMPLE								
79.01398	WP	PU238,PU239	PU242	11.8	10	1	G	
79.01399	0	0,0	0	0	0	0	0	
79.01400	0	0,0	0	0	0	0	0	
79.01401	0	0,0	0	0	0	0	0	
79.01402	0	0,0	0	0	0	0	0	
79.01403	0	0,0	0	0	0	0	0	
NO-SAMPLE								
79.02144	TH	PU238,PU239	PU242	11.8	1	1	S	
79.02145	0	0,0	0	0	0	0	0	
79.00501	TG	0,0	0	0	0	0	0	

[CTRL/C]

EXIT TEXT MODE

NOSORT

/PACK

PACK COMPLETE.

/REPLACE

where the fields (1) through (9) are defined as

(1) Sample identification: alphanumeric, 10 characters or less. The identifier "NO-SAMPLE" has a special meaning in that it signals the program that no data input or output is to take place for that detector. Its role as a position holder is important and it is necessary that all empty detector positions up to the last sample counted be marked with the NO-SAMPLE identifier to ensure the proper sample and counting information correlation for the sample set. Note also that a NO-SAMPLE entry disables the "0" (zero) duplicator and parameters for the next real sample must be entered in full.

- (2) Sample owner: alphanumeric, 2 or 3 characters.
- (3) Analysis isotopes: alphanumeric, 5 characters. This field consists of one to three isotopes of the same element, separated by a comma(s).
- (4) Tracer isotope: alphanumeric 5 characters.
- (5) Tracer activity: a real number expressed in disintegrations per minute of the tracer isotope added to the sample.
- (6) Sample quantity: a real number expressed in the units specified by field (8).
- (7) Aliquot fraction: a real number specifying the portion of the total sample which was used for the analysis.
- (8) Sample unit quantity: alphanumeric, 1 character.
- (9) Separation date (optional): a date in the form MM/DD/YY. This field is included only for use with ^{210}Pu analyses so that the concentrations may be decay corrected back to the separation date. The field is left blank for all other analyses. The duplication character for this field is "X."

Verify the contents of the ID file.

/LNH

NO-SAMPLE							
79.01395	WP	PU238,PU239	PU242	11.8	10	1	G
79.01396	0	0,0	0	0	0	0	0
NO-SAMPLE							
NO-SAMPLE							
79.01398	WP	PU238,PU239	PU242	11.8	10	1	G
79.01399	0	0,0	0	0	0	0	0
79.01400	0	0,0	0	0	0	0	0
79.01401	0	0,0	0	0	0	0	0
79.01402	0	0,0	0	0	0	0	0
79.01403	0	0,0	0	0	0	0	0
NO-SAMPLE							
79.02144	TH	PU238,PU239	PU242	11.8	1	1	S
79.02145	0	0,0	0	0	0	0	0
79.00501	TG	0,0	0	0	0	0	0

If the contents of the ID file are not as desired, use a text editor to correct the error or return to the beginning of step (B) and recreate the file.

Read the cassette tape containing the alpha spectral counting data into the DATA file. The DATA file may be created by following the steps below.

(a) With the PLAYBACK and PRINTER switches in LOCAL mode (see Fig. 9),⁷ use the REWIND, FF (fast forward) and BLOCK FWD controls to position the cassette tape at the beginning of the counting data for the sample set of interest.

(b) Return the PLAYBACK and PRINTER switches to LINE mode and execute the following sequence.

Fig. 9.
TI733 switch panel.

/NEW,DATA

TAPE

TEXT

ENTER TEXT MODE.

[PRESS CONT START ON PLAYBACK CONTROL]

07/02/79 ALPHA SPEC 79.01395 (1)

080000 (2)

0001 (3)

000000	000000	000000	000000	000000	000000	000000	000000	000002	000001	} (4)
000001	000001	000000	000001	000001	000001	000001	000000	000002	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000001	
000000	000000	000000	000000	000001	000000	000000	000000	000001	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000002	000002	000001	000000	000001	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
0101 (3)										} (4)
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	

•
•
•

000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
4001									
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000

[Turn playback control "OFF"]
[CR/LF]

[CTRL/C]

NOSORT

NORMAL

/PACK

PACK COMPLETE.

/REPLACE

The elements (1) through (4) are

(1) **Spectrum identifier:** A line of text up to 80 characters to positively identify data that immediately follows it. It is used for informational purposes only and is not used by the analysis program.

(2) **Time channel:** counting time in seconds.

(3) **Channel marker:** channel number of the next data value following. Channel markers are recorded onto the tape every 100 channels from 1 to 4001.

(4) **Data block:** The data data blocks contain the alpha spectral data. Each data block contains 100 channels, with the exception of the last block, which contains 95 channels. There should be 41 data blocks in each spectrum, yielding a total of 4095 channels.

The data file is so long that it is not practical to list the entire file for verification. A text editor may be used to proof the file in an abbreviated form, however, by checking for the most commonly occurring errors, as shown in the following errors as shown in the following example.

/XEDIT,DATA

XEDIT VER.8.1 REVISED 78/08/25. 08.08.06.

DATA IS EDIT FILE

?PRINT (check identifier line)

07/02/79 ALPHA SPEC 79.0135

>?BOTTOM (find the last line of the file)

000000 000000 000000 000000 000000

>?WHERE

453 (file length)

>?END

DATA IS A LOCAL FILE

/

If the DATA file has been entered properly, it should consist of the identification line and 452 lines of data, for a total file length of 453 lines. It frequently happens (because of improper termination of the cassette tape readback) that the last line of data will not be included in the file. This condition is allowed for in the analysis program, however, and should not affect its execution. If for any other reason, the file is less than 453 lines long or if it is greater than 453 lines long, the DATA file should be considered unreliable and it should be reentered in its entirety.

(C) Execute the alpha spectral analysis procedure by following the sequence below:

```
/GET,ID,DATA,BKGDFL,DETDATA
/ATTACH,LGO/UN=900027
/ATTACH,PASLIB/UN=LIBRARY
/RFL,130000
RFL,130000.
/LGO(,OUTPUT,RES,ID,DATA)
```

PLACE AN X UNDER THE DESIRED ANALYSIS

A	A	A	T	G	S
L	L	L	R	R	R
P	P	P	I	O	-
H	H	H	T	S	9
A	A	A	I	S	0
S	B	C	U	G	
P	E	A	M	A	
E	T	L		M	
C	A				

? **X**

ENTER DATE COUNTED - EXAMPLE 12/01/76

?08/31/79

All necessary counting parameters are obtained from internal program tables or from the supporting files DETDATA and BKGDFL; thus only the counting date is requested. Program output commences at this point. Because of the volume of output that may be generated by the analysis program, it may be desirable to reroute the output to a device other than the user's terminal. Refer to Appendix A for details.

(D) Collect the output. The output generated from the example sequence discussed in this section is shown in Figs. 10 through 14.

Figure 10 is an echo of the information passed to the program through the ID file.

Figure 11 contains the isotopic activity concentrations for the sample set. Note that for sample 79.02145 there are entries under the "FIT COEFF" column indicating that the alpha peaks were poorly resolved and a least squares fit was attempted on the data. The fit coefficients are the square root of the correlation coefficients obtained from the regression calculations on each alpha peak. The fit coefficients are a measure of the closeness of fit of the calculated model $Y = Ae^{Bx}$ (A and B determined by regression) to the counting data. A correlation coefficient of 1 indicates a perfect fit; decreasing values indicate decreasingly suitable fits. The "EXTRAP COUNT" entry for sample 79.02145 indicates that the fitted peaks predicted that 35 counts under the ^{242}Pu energy interval were caused by interference from the ^{239}Pu and/or ^{238}Pu peaks. All other peaks were found cleanly resolvable and no fitting was attempted.

SAMPLE INFORMATION

PAGE 1

DET	ID	ANALYSES	TRACER	ACT TRAC	QUAN	ALQT FRAC	UNITS	SEP DATE
1	NO-SAMPLE		::::	0	0	0	:	
2	79.01395	PU238 PU239	PU242	11.8	10.000	1:000	G	
3	79.01396	PU238 PU239	PU242	11.8	10.000	1:000	G	
4	NO-SAMPLE		::::	0	0	0	:	
5	NO-SAMPLE		::::	0	0	:	:	
6	79.01398	PU238 PU239	PU242	11.8	10.000	1:000	G	
7	79.01398	PU238 PU239	PU242	11.8	10.000	1:000	G	
8	79.01400	PU238 PU239	PU242	11.8	10.000	1:000	G	
9	79.01401	PU238 PU239	PU242	11.8	10.000	1:000	G	
10	79.01402	PU238 PU239	PU242	11.8	10.000	1:000	G	
11	79.01403	PU238 PU239	PU242	11.8	10.000	1:000	G	
12	NO-SAMPLE		::::	0	0	0	:	
13	79.02144	PU238 PU239	PU242	11.8	1.000	1:000	S	
14	79.02145	PU238 PU239	PU242	11.8	1.000	1:000	S	
15	79.00501	PU238 PU239	PU242	11.8	1.000	1:000	S	

Column definitions:

DET = detector number

ID = sample identification

ANALYSES = isotopes for which the analyses were performed

TRACER = tracer isotope

ACT TRAC = activity of the tracer in disintegrations per minute

QUAN = sample quantity

ALQT FRAC = aliquot fraction, or the fraction of the sample used in this analysis

UNITS - unit quantity in which QUAN was expressed

SEP DATE = separation date

Fig. 10.
Alpha spectroscopy procedure output—raw data.

ALPHA SPECTRA ANALYSES

DATE COUNTED=08/31/79

COUNTING TIME=80000 SECONDS

DET	SAMPLE ID	ISOTOPE	GROSS COUNT	BKGD COUNT	EXTRAP COUNT	FIT COEFF	SAMPLE ACTIVITY
2	79.01395	PU242	1834	5.00	0	----	-----
		PU238	1	4.00	0	----	-10.0 +/- 7.0 x 10E-4 PCI/G
		PU239	3	5.00	0	----	-6. +/- 9. x 10E-4 PCI/g
3	79.01396	PU242	646	8.00	0	----	-----
		PU238	5	11.00	0	----	-5. +/- 4. x 10E-3 PCI/G
		PU239	11	6.00	0	----	4. +/- 4. x 10E-3 PCI/G
6	79.01398	PU242	933	10.00	0	----	-----
		PU238	6	4.00	0	----	1. +/- 2. x 10E-3 PCI/G
		PU239	62	7.00	0	----	3.2 +/- 0.5 x 10E-2 PCI/G
7	79.01399	PU242	725	9.00	0	----	-----
		PU238	0	6.00	0	----	-5. +/- 2. x 10E-3 PCI/G
		PU239	17	16.00	0	----	1. +/- 5. x 10E-3 PCI/G
8	79.01400	PU242	1011	5.00	0	----	-----
		PU238	3	4.00	0	----	-0.7 +/- 1.8 x 10E-3 PCI/G
		PU239	2	5.00	0	----	-1.6 +/- 1.7 x 10E-3 PCI/G
9	79.01401	PU242	1449	10.00	0	----	-----
		PU238	2	8.00	0	----	-2.4 +/- 1.2 x 10E-3 PCI/G
		PU239	3	9.00	0	----	-2.3 +/- 1.3 x 10E-3 PCI/G
10	79.01402	PU242	1263	9.00	0	----	-----
		PU238	6	2.00	0	----	1.6 +/- 1.5 x 10E-3 PCI/G
		PU239	6	3.00	0	----	1.2 +/- 1.6 x 10E-3 PCI/G
11	79.01403	PU242	1182	9.00	0	----	-----
		PU238	4	3.00	0	----	0.3 +/- 1.4 x 10E-3 PCI/G
		PU239	3	2.00	0	----	0.4 +/- 1.3 x 10E-3 PCI/G
13	79.02144	PU242	869	8.00	0	----	-----
		PU238	8	2.00	0	----	4. +/- 2. x 10E-2 PCI/S
		PU239	40	4.00	0	----	2.2 +/- 0.4 x 10E-1 PCI/S
14	79.02145	PU242	1265	6.00	35	0.97	-----
		PU238	11	3.00	0	0.02	3.3 +/- 1.8 x 10E-2 PCI/S
		PU239	1075	7.00	0	0.93	4.6 +/- 3.2 x 10E-2 PCI/S
15	79.00501	PU242	1529	20.00	0	----	-----
		PU238	2	5.00	0	----	-1.2 +/- 0.9 x 10E-2 PCI/S
		PU239	8	4.00	0	----	1.4 +/- 1.5 x 10E-2 PCI/S

Column definitions:

DET - detector number

SAMPLE ID = sample identification

ISOTOPE - isotope for which the analysis was performed

GROSS COUNT = gross total counts under the alpha peak for the given isotope

EXTRAP COUNT = total extrapolated counts under the alpha peak from isotopes other than the analysis isotope

FIT COEFF = fit coefficient (refer to the discussion in this section)

SAMPLE ACTIVITY = concentration of the analysis isotope in pCi/unit quantity

Fig. 11.
Alpha spectroscopy procedure output—computed results.

SPECTRUM

CHAN NO.	2 PRMRY	3 PRMRY	6 PRMRY	7 PRMRY	8 PRMRY	9 PRMRY	10 PRMRY	11 PRMRY
5	1	0	2	6	1	4	12	4
6	10	0	1	7	7	2	10	4
7	12	2	4	7	9	7	20	2
8	25	2	4	7	12	7	25	11
9	35	6	7	16	19	5	25	14
10	33	13	7	12	10	6	26	8
11	51	9	9	18	13	11	35	23
12	70	11	9	31	27	9	46	21
13	62 T	22 T	19 T	31 T	23	15	52 T	22
14	101	21	24	42	24	30	61	34 T
15	154	27	57	51	22 T	49 T	93	58
16	236	49	71	60	72	62	115	96
17	264	48	88	67	79	107	135	127
18	241	81	133	99	97	166	170	153
19	313	110	169	125	124	211	186	195
20	258	89	154	96	123	268	179	223
21	147	109	111	85	155	286	161	189
22	58 T	90 T	107 T	69 T	132	203	111 T	81
23	24	73	39	31	120	68	86	26 T
24	4	34	15	7	87 T	29 T	34	4
25	0	15	2	1	39	5	16	0
26	0	0	1	1	13	0	2	0
27	0	0	0	1	4	0	3	0
28	0	0	0	0	0	0	0	0
29	0	0	0	2	0	0	1	0
30	0	1	2 B	0	0	0	0	0
31	0	1	1	2	0	1	0	0
32	0	1 B	8	0 B	0	0	0 B	0 B
33	0 B	1	3	4	0 B	0 B	0	0
34	1	2	9	3	1	0	1	0
35	1	1	7	2	1	1	1	0
36	0	1	14	4	0	1	2	0
37	0	2	6	0	1	0	0	0
38	1	1	7	1	0	0	1	1
39	0	2	5 B	0	0	0	0	1
40	0	0	2	2	0	0	0	0
41	0	0 B	2	1 B	0	0	1 B	0 B
42	0 B	0	0	0	0 B	0 B	0	0
43	0	0	1	0	1	0	0	1
44	0	0	0	0	0	0	0	0
45	0	0	0	0	0	1	0	1
46	1	0	2	0	0	0	0	0
47	0	0	0	0	0	0	0	0
48	0	1	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	0	1	0	0	1	0	0	0
52	0	0	0	1	0	0	0	0
53	0	0 A	0	0 A	0	0	0 A	0 A
54	0	0	0	0	0	0	1	0
55	0	0	1	0	1	0	1	0

Fig. 12.
Alpha spectroscopy procedure output—spectrum listing.

56	0 A	1	1	0	0 A	0 A	1	1
57	0	2	0	0	0	1	1	0
58	0	0	1 A	0	0	0	1	0
59	0	0	2	0	0	0	1	1
60	0	0	0	0	1	1	0	0
61	0	1	0	0	0	0	0	0
62	1	1 A	1	0 A	1	0	0 A	1 A
63	0	2	1	0	0	0	0	0
64	0	0	1	0	1	0	0	0
65	0 A	0	0	0	0 A	0 A	0	0
66	0	0	0	0	1	0	0	0
67	0	0	0 A	0	0	0	0	0
68	0	0	0	0	0	0	0	0
69	0	1	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0
83	0	0	0	0	0	0	0	0
84	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0	0
87	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0
89	0	0	0	1	0	0	1	0
90	0	0	0	0	0	0	0	0
91	0	0	0	0	0	0	0	0
92	0	0	0	0	1	0	0	0
93	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	1	0
97	0	1	0	0	0	0	0	0
98	1	0	0	0	0	0	0	0
99	0	0	0	0	0	0	0	0
100	0	1	0	0	0	0	0	0
101	0	0	1	0	0	0	0	0
102	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0
106	0	0	0	0	0	0	0	0
107	0	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0	0
109	0	0	0	0	0	0	0	0
110	0	1	0	0	0	0	0	0

Fig. 12 (cont).

SPECTRUM

CHAN NO	13 PRMRY	14 PRMRY	14 PU239	14 PU242	15 PRMRY
5	8	9	0	8	14
6	13	8	0	10	10
7	13	8	0	12	22
8	17	15	0	15	21
9	22	16	0	19	32
10	15	17	0	24	48
11	32	28	0	30	53
12	29	35	0	38	86 T
13	49	56	0	47	105
14	56 T	51 T	0 T	0 T	113
15	77	83	1	0	134
16	103	93	2	0	183
17	111	135	2	0	206
18	121	151	3	0	210
19	122	190	3	0	182
20	131	196	4	0	183
21	83	169	5	0	127 T
22	47	134	7	0	80
23	18 T	63 T	8 T	0 T	32
24	5	35	11	0	13
25	1	33	13	0	1
26	0	19	17	0	0
27	0	20	21	0	0
28	2	21	27	0	2
29	0 B	27	34	0	1
30	1	52	43	0	1
31	1	67 B	0 B	0 B	0
32	5	79	0	0	2
33	3	95	0	0	5 B
34	9	123	0	0	1
35	10	140	0	0	0
36	8	164	0	0	2
37	3	168	0	0	0
38	0 B	124	0	0	0
39	2	65	0	0	0
40	1	50 B	0 B	0 B	0
41	1	17	0	0	0
42	1	3	0	0	0 B
43	0	0	0	0	0
44	0	0	0	0	0
45	0	0	0	0	0
46	0	0	0	0	0
47	1	2	0	0	0
48	0	0	0	0	0
49	0	0	0	0	0
50	0	0	0	0	0
51	0	0	0	0	0
52	0	0	0	0	0
53	0 A	0 A	0 A	0 A	0
54	0	2	0	0	0 A

Fig. 13.
Alpha spectroscopy procedure output—spectrum listing.

55	3	2	0	0	1
56	1	3	0	0	0
57	2	0	0	0	0
58	1	1	0	0	0
59	0	0	0	0	0
60	1	1	0	0	1
61	0	1	0	0	0
62	0 A	1 A	0 A	0 A	0
63	0	0	0	0	0 A
64	0	0	0	0	0
65	0	0	0	0	0
66	0	0	0	0	0
67	0	0	0	0	0
68	0	0	0	0	0
69	0	0	0	0	0
70	0	0	0	0	0
71	0	0	0	0	0
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	0	0
75	0	0	0	0	0
76	0	0	0	0	0
77	0	0	0	0	0
78	0	0	0	0	0
79	0	0	0	0	0
80	0	0	0	0	0
81	0	0	0	0	0
82	0	0	0	0	0
83	0	0	0	0	0
84	0	0	0	0	0
85	0	0	0	0	0
86	0	0	0	0	0
87	0	0	0	0	0
88	0	0	0	0	0
89	0	0	0	0	1
90	0	1	0	0	0
91	0	0	0	0	0
92	0	0	0	0	0
93	0	0	0	0	0
94	0	0	0	0	0
95	0	0	0	0	1
96	2	0	0	0	0
97	0	0	0	0	0
98	0	0	0	0	0
99	0	0	0	0	1
100	0	0	0	0	0
101	0	0	0	0	0
102	0	0	0	0	0
103	0	0	0	0	0
104	0	0	0	0	0
105	0	0	0	0	0
106	0	0	0	0	0
107	0	0	0	0	0
108	0	0	0	0	0
109	0	0	0	0	0
110	0	0	0	0	0

Fig. 13 (cont).

ALPHA SPECTRA ANALYSES

PAGE 2

DATE COUNTED=08/31/79

COUNTING TIME=80000 SECONDS

DET	SAMPLE ID	% RECOVERY	FWHM(KEV) RESOLUTION
2	79.01395	77	89
3	79.01396	24	100
6	79.01398	36	79
7	79.01399	27	93
8	79.01400	43	112
9	79.01401	53	73
10	79.01402	48	124
11	79.01403	44	83
13	79.02144	31	113
14	79.02145	56	102
15	79.00501	61	135

Fig. 14.

Alpha spectroscopy procedure output—diagnostic summary.

Figures 12 and 13 are spectral representations of the counting data. The spectra are labeled according to detector number and spectrum type. The label "PMRY" designates the data is the primary or unmodified counting data for that detector. The other possible labels for data from a given detector would reflect the extrapolated data from an exponential fit on the alpha peak from the labeled isotope. Detector 14 of Fig. 13, for example, has spectral data listed for the primary spectrum and also extrapolations from peak fitting on the ^{239}Pu and ^{242}Pu isotopes. The markers T, A, and B delineate the integration limits for the peaks of the tracer, analyte A and analyte B, respectively. The order of the analytes A, B (and possibly C) are defined by the order in which they are listed in the ID file; A first, C last.

Figure 14 contains calculated recovery and resolution values, which are of some use in gauging effectiveness of the chemical processing for each sample. Resolution values of 0 (zero) indicate that the analysis program was unable to compute a meaningful ^{242}Pu alpha resolution for that sample.

As in all other MASTERCALC analysis modules, a data base (H8DATA) compatible record of the computed results is produced. By performing the sequence below, the user will obtain a printer listing and a punched card deck of the file RES.

- LOAD FL 025024

/PACK,RES

PACK COMPLETE.

/COPY,RES

```
*PUTA(  -0.0010,    0.0007,PCI/G,08/31/79,79.01395,WP,PU-238);
*PUTA(  -0.006,     0.009,PCI/G,08/31/79,79.01395,WP,PU-239);
*PUTA(  -0.0050,    0.0040,PCI/G,08/31/79,79.01396,WP,PU-238);
*PUTA(   0.0040,    0.0040,PCI/G,08/31/79,79.01396,WP,PU-239);
*PUTA(   0.0010,    0.0020,PCI/G,08/31/79,79.01398,WP,PU-238);
*PUTA(   0.0320,    0.0050,PCI/G,08/31/79,79.01398,WP,PU-239);
*PUTA(  -0.0050,    0.0020,PCI/G,08/31/79,79.01399,WP,PU-238);
*PUTA(   0.0010,    0.0050,PCI/G,08/31/79,79.01399,WP,PU-239);
```

```

*PUTA(  -0.0007,      0.0018,PCI/G,08/31/79,79.01400,WP,PU-238);
*PUTA(  -0.0016,      0.0017,PCI/G,08/31/79,79.01400,WP,PU-239);
*PUTA(  -0.0024,      0.0012,PCI/G,08/31/79,79.01401,WP,PU-238);
*PUTA(  -0.0023,      0.0013,PCI/G,08/31/79,79.01401,WP,PU-239);
*PUTA(   0.0016,      0.0015,PCI/G,08/31/79,79.01402,WP,PU-238);
*PUTA(   0.0012,      0.0016,PCI/G,08/31/79,79.01402,WP,PU-239);
*PUTA(   0.0003,      0.0014,PCI/G,08/31/79,79.01403,WP,PU-238);
*PUTA(   0.0004,      0.0013,PCI/G,08/31/79,79.01403,WP,PU-239);
*PUTA(   0.0400,      0.0200,PCI/S,08/31/79,79.02144,TH,PU-238);
*PUTA(   0.2200,      0.0400,PCI/S,08/31/79,79.02144,TH,PU-239);
*PUTA(   0.0330,      0.0180,PCI/S,08/31/79,79.02145,TH,PU-238);
*PUTA(   4.6000,      0.2000,PCI/S,08/31/79,79.02145,TH,PU-239);
*PUTA(  -0.0120,      0.0090,PCI/S,08/31/79,79.00501,TG,PU-238);
*TDW(    1.0000,S);
*PUTA(   0.0140,      0.0150,PCI/S,08/31/79,79.00501,TG,PU-239);
*TDW(    1.0000,S);

```

EOI ENCOUNTERED.

/REWIND,RES

\$REWIND,RES

/DISPOSE,RES=PH

H8

The punched card deck should be available at the CCF on the "H8" shelf approximately 30 minutes after execution. If further sets of data are to be calculated, the user should return to step (B) of this section; otherwise, proceed to step (E).

(E) Sign off.

/BYE

900027 LOG OFF 15.39.19.

900027 SRU 162.806 UNITS.

2. Alpha Spectrometer Calibration

a. Overview. The alpha calibration procedure is designed to analyze calibration data from the H-8 alpha spectroscopy system. Calibration data are generated by counting known amounts of ²⁴²Pu, ²³⁹Pu, and ²⁴¹Am with each detector. The data are transferred to the DATA file via a cassette tape. The alpha calibration procedure then uses this information to determine a counting efficiency, resolution, and energy scale for each detector. A hard copy record of the calibration data is produced and a summary of the individual detector performance characteristics is loaded into the file DETDATA for later use by the alpha spectral analysis program.

b. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **U****<znumbr>**

79/08/14. 14.45.08.

LASL 6600 - 0 0 (2*ACTUAL CP TIME)

NOS1.3-485C 790813

USER NUMBER: **<usrnbr,passwd>**

TERMINAL: 13, TTY

RECOVER/SYSTEM:

Because this procedure not only reads but also writes files that are used by **MASTERCALC**, 900027 must be entered in the **<USRNBR>** position. Contact the person in charge of program **MASTERCAL** to obtain the current **<PASSWRD>**.

(B) Read the cassette tape containing the calibration counting data into the **DATA** file. The **DATA** file may be created by following the steps below.

(a) With the terminal in **LOCAL** mode, position the cassette tape at the beginning of the calibration data.

(b) Return the terminal to **LINE** mode and execute the following sequence.

/NEW,DATA

/TAPE

TEXT

ENTER TEXT MODE.

[Press cont start on playback control]

ALPHASPEC 08/17/79 1-32 STDS

050400

0001

000000	000000	000000	000000	000000	000003	000003	000000	000001	000003
000005	000002	000002	000003	000016	000011	000026	000061	000168	000290
000389	000896	000912	000255	000028	000001	000001	000001	000001	000006
000006	000005	000009	000015	000031	000074	000131	000275	000505	000356
000096	000008	000001	000002	000001	000001	000001	000001	000000	000002
000000	000002	000001	000004	000009	000011	000035	000057	000083	000226
000385	000274	000121	000066	000027	000005	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000

0101

000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000001

•

•

•

000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000

```

4001
000000 000000 000000 000000 000000 000000 000000 000000 000000 000001
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000001
000001 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000001 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000

```

[Turn playback control off; press **CTRL/C**]

EXIT TEXT MODE

NOSORT

PACK

PACK COMPLETE.

NORMAL

/REPLACE

The structure of the data file is defined in detail in section E.1.a. Refer to page 19 for its description.

Use a text editor to verify the data file, as shown in the following example.

/XEDIT

XEDIT VER.8.1 REVISED 78/08/25. 08.08.06.

DATA IS EDIT FILE

>?P (check identifier line)

ALPHASPEC 08/17/79 1-32 STDS

>?B (examine bottom line of file)

000000 000000 000000 000000 000000

>?W (find line number of last line)

453

>?E (end text editor)

DATA IS A LOCAL FILE

The data file should consist of an identification line, followed by 452 lines of data, for a total file length of 453 lines. The last data line may be omitted without adverse effects on the program's execution. If the file is less than 453 lines for any other reason, or if it is greater than 453 lines, the DATA file should be considered unreliable and it should be reentered in its entirety.

(C) Execute the alpha spectrometer calibration procedure by following the sequence below.

/RFL,600000

RFL,60000.

/ATTACH,LGO

/ATTACH,PASLIB/UN=LIBRARY

/GET,DATA,DETDATA

/LGO(,X,Y,DATA,DETDATA)

PLACE AN X UNDER THE DESIRED ANALYSIS

A	A	A	T	G	S
L	L	L	R	R	R
P	P	P	I	O	-
H	H	H	T	S	9
A	A	S	I	S	0
S	B	C	U	G	
P	E	A	M	A	
E	T	L		M	
C	A				

? X
COUNTDATE =
?08/17/79

PEAK IDENTIFICATION PROBLEM AT DETECTOR 4

PEAK IDENTIFICATION PROBLEM AT DETECTOR 5

PEAK IDENTIFICATION PROBLEM AT DETECTOR 16

PEAK IDENTIFICATION PROBLEM AT DETECTOR 32

All necessary counting parameters are obtained from internal program tables or from the supporting files DETDATA and BKGDFL; thus only the counting date is requested. Program output will commence at this point.

Any diagnostics output by the program will immediately follow the "COUNTDATE" query. In the example case, the procedure was unable to construct valid calibration parameters for detectors 4, 5, 16, 32, so the warnings "PEAK IDENTIFICATION PROBLEM AT DETECTOR- - -" were issued. Referring to the spectral listings (Figs. 15 through 18), the reader will notice that the alpha peaks from detector 4 were poorly resolved and no counting data were collected for detectors 5, 16, and 32.

(D) Collect the output. The output generated from the example sequence discussed in this section is shown in Figs. 15 through 19.

Figures 15 through 18 are listings of the calibration counting data. The data are listed in columns by detector number. Three alpha peaks should be visible for each functioning detector; from page top to page bottom they are ²⁴²Pu, ²³⁹Pu and ²⁴¹Am, respectively. Note that for detectors 5, 16, and 32, there are no calibration data listed. This indicates "dead" detectors and consequently no calibration information will be entered in the DETDATA file for these positions.

Figure 19 is a summary of the calibration information that was derived from the DATA file. The "OLD DATA" column gives a true/false indicator as to whether or not the detector parameters were copied over from a previous calibration run. Under some circumstances the calibration procedure will conclude that the data from the current run are inconsistent and it will retain the previous calibration parameters in the DETDATA file with the OLD DATA flag set to true. The "RESOLUTION" column gives the full width at half maximum (FWHM) alpha resolution in keV for each detector as measured at the ²⁴²Pu alpha energy. The "EFFICIENCY" column lists the alpha detection efficiency in counts/disintegration based on the ²⁴²Pu alpha measurement. "KEV/CH" refers to the energy scale for each detector in terms of keV per channel. The table of leading edge channels is a listing of the peak leading edges determined for the three isotopes in the calibration standards, and an extrapolation to predict the leading edge channels for the other isotopes of interest.

DETECTOR NUMBER										DATE=08/22/79
CH	1	2	3	4	5	6	7	8	9	10
10	3	2	0	38	0	0	2	7	2	7
11	5	1	1	65	0	3	5	4	1	1
12	2	1	2	71	0	1	4	4	1	2
13	2	3	2	80	0	3	12	5	1	1
14	3	10	2	77	0	5	14	6	1	6
15	16	9	3	91	0	2	42	8	5	14
16	11	20	7	115	0	5	121	27	5	42
17	26	44	9	179	0	22	225	69	11	73
18	61	128	18	254	0	30	408	176	19	189
19	168	271	77	291	0	97	700	310	49	345
20	290	439	318	470	0	251	1003	567	203	732
21	389	775	455	550	0	381	961	861	274	983
22	896	1007	802	260	0	712	484	1022	489	988
23	912	529	1644	130	0	1080	219	551	1020	558
24	255	149	948	117	0	717	68	190	805	224
25	28	28	97	94	0	160	14	42	100	35
26	1	5	3	117	0	7	2	3	2	4
27	1	1	1	93	0	0	1	0	0	3
28	1	2	0	83	0	0	3	0	1	1
29	1	1	0	78	0	1	2	0	1	1
30	6	2	0	77	0	0	5	2	1	5
31	6	4	2	89	0	2	13	5	3	6
32	5	4	2	79	0	4	41	5	3	11
33	9	13	7	120	0	3	90	10	4	49
34	15	40	13	164	0	5	184	41	7	117
35	31	90	39	219	0	26	256	106	13	216
36	74	153	84	321	0	52	459	164	52	396
37	131	319	158	242	0	94	541	335	98	485
38	275	534	319	128	0	188	352	483	203	401
39	505	372	806	88	0	363	160	474	474	192
40	356	151	519	79	0	532	55	197	469	52
41	96	37	72	77	0	343	20	69	112	11
42	8	8	1	66	0	74	1	28	6	1
43	1	0	0	67	0	8	0	2	0	1
44	2	0	0	46	0	0	0	1	0	1
45	1	1	0	61	0	0	0	1	0	0
46	1	0	0	42	0	0	0	1	1	3
47	1	0	0	54	0	0	0	0	2	1
48	1	3	0	55	0	0	0	2	0	2
49	0	0	1	51	0	1	1	0	0	2
50	2	1	0	60	0	0	2	0	1	3
51	0	2	1	54	0	0	5	2	1	4
52	2	3	2	64	0	0	8	1	3	18
53	1	4	6	66	0	1	17	4	2	36
54	4	10	10	75	0	1	30	10	3	45
55	9	14	11	110	0	6	75	12	4	133
56	11	37	16	167	0	6	160	31	16	268
57	35	69	61	182	0	9	251	66	39	331
58	57	139	125	150	0	33	391	167	67	404
59	83	289	261	82	0	58	345	274	100	240
60	226	336	549	54	0	122	238	434	299	157
61	385	202	388	52	0	261	134	353	375	67
62	274	107	158	33	0	396	64	170	176	31
63	121	54	90	29	0	275	24	109	85	5
64	66	18	38	26	0	130	10	42	53	0
65	27	8	6	22	0	65	3	7	6	0
66	5	2	0	13	0	32	0	7	0	0
67	0	0	0	22	0	7	0	1	0	0
68	0	0	0	12	0	1	0	0	0	0
69	0	0	0	18	0	0	0	0	0	0
70	0	0	0	14	0	0	0	0	0	0

Fig. 15.
Alpha spectrometer calibration procedure output—spectrum listing.

CH	DETECTOR NUMBER										DATE=08/17/79
	11	12	13	14	15	16	17	18	19	20	
10	3	2	2	5	4	0	0	1	2	0	
11	2	0	2	4	1	0	3	2	0	0	
12	4	3	6	7	4	0	5	1	2	2	
13	2	5	5	11	3	0	5	1	3	3	
14	2	5	8	9	3	0	8	2	2	4	
15	6	7	12	18	8	0	9	5	2	9	
16	6	22	17	22	18	0	19	6	12	22	
17	8	67	42	61	30	0	22	29	11	59	
18	25	155	130	135	55	0	69	65	40	179	
19	90	295	254	209	134	0	169	233	143	348	
20	247	527	478	360	222	0	320	377	391	548	
21	462	900	789	699	415	0	533	640	559	1042	
22	814	902	980	826	580	0	906	1211	1273	1361	
23	1586	497	577	592	501	0	909	1242	1744	691	
24	964	171	173	195	240	0	479	467	627	172	
25	109	20	13	22	49	0	105	60	49	19	
26	3	5	1	2	6	0	11	1	2	1	
27	0	0	3	4	1	0	1	0	0	5	
28	0	1	5	7	0	0	3	0	1	3	
29	0	1	2	10	0	0	2	3	3	1	
30	6	1	7	8	7	0	4	1	3	0	
31	1	7	0	9	2	0	4	2	2	4	
32	4	4	4	16	7	0	5	5	2	7	
33	6	17	19	33	5	0	18	8	8	15	
34	11	36	38	56	18	0	37	19	16	41	
35	46	81	88	139	34	0	78	43	78	88	
36	104	149	191	253	71	0	143	87	115	194	
37	148	338	369	502	147	0	301	187	255	402	
38	473	453	506	853	300	0	482	420	600	661	
39	826	415	332	853	294	0	460	728	853	512	
40	453	206	100	430	167	0	194	486	411	200	
41	51	66	14	88	47	0	40	156	39	42	
42	5	6	0	8	3	0	3	22	0	1	
43	1	0	2	3	2	0	0	2	0	1	
44	1	0	0	0	1	0	0	1	0	1	
45	0	0	0	1	0	0	1	1	0	2	
46	0	0	3	2	1	0	1	2	0	0	
47	1	0	2	3	0	0	1	0	0	1	
48	1	0	3	0	0	0	1	1	0	0	
49	1	1	1	4	0	0	0	0	2	1	
50	0	2	5	4	0	0	3	1	0	2	
51	5	1	5	4	0	0	4	2	1	3	
52	3	5	6	6	1	0	7	0	4	1	
53	7	5	12	10	6	0	6	3	4	6	
54	15	7	16	16	4	0	23	3	8	9	
55	13	16	29	27	9	0	29	9	13	14	
56	40	24	61	27	19	0	54	16	30	40	
57	94	58	140	72	32	0	121	29	83	87	
58	145	128	284	140	81	0	285	63	151	192	
59	431	250	394	238	151	0	376	128	404	365	
60	550	347	325	362	202	0	321	298	558	520	
61	334	342	153	300	169	0	154	452	331	320	
62	130	174	61	179	90	0	56	337	170	150	
63	68	95	28	77	34	0	34	165	78	84	
64	17	47	7	25	21	0	7	100	20	30	
65	2	17	0	11	6	0	3	32	1	7	
66	0	6	0	2	0	0	0	8	0	0	
67	0	1	0	0	0	0	0	0	0	0	
68	0	0	0	0	0	0	0	0	0	0	
69	0	0	0	0	0	0	0	0	0	1	
70	0	0	0	0	0	0	0	0	0	0	

Fig. 16.
Alpha spectrometer calibration procedure output—spectrum listing.

CH	DETECTOR NUMBER										DATE=08/17/79
	21	22	23	24	25	26	27	28	29	30	
10	1	0	0	2	1	1	1	3	6	2	
11	1	4	0	2	2	2	2	2	3	2	
12	1	3	0	5	2	2	0	1	6	5	
13	1	8	0	3	4	3	2	2	4	2	
14	5	3	7	6	3	5	1	2	6	14	
15	2	8	5	9	7	7	5	2	8	12	
16	6	18	2	10	12	11	5	5	7	25	
17	10	8	3	27	4	8	12	6	15	44	
18	19	33	29	98	14	39	33	28	45	95	
19	58	73	104	230	73	146	111	116	160	188	
20	197	176	292	395	232	313	289	303	312	335	
21	345	295	502	591	330	467	449	493	558	547	
22	627	439	820	1090	619	883	879	1075	997	880	
23	1248	938	1534	1166	1061	1629	1381	1227	1164	826	
24	935	732	1010	465	494	1169	963	380	352	351	
25	237	101	179	73	33	285	198	23	33	96	
26	16	3	14	5	1	22	11	0	1	8	
27	1	0	1	1	3	0	1	2	5	4	
28	0	1	2	2	1	1	0	1	4	4	
29	0	5	2	1	0	0	1	2	1	6	
30	2	5	2	3	2	2	1	1	5	9	
31	3	4	2	1	2	3	3	1	3	12	
32	2	7	7	3	2	1	4	5	6	17	
33	6	5	3	3	2	5	5	9	12	30	
34	11	12	5	10	10	7	9	30	51	74	
35	49	29	24	37	26	8	34	74	89	139	
36	113	71	79	81	74	32	78	125	163	307	
37	188	99	126	126	141	82	169	293	415	564	
38	440	243	305	263	241	149	387	611	639	864	
39	635	465	668	541	578	314	692	515	306	895	
40	333	364	712	571	383	655	561	129	46	451	
41	74	68	223	335	74	759	172	6	2	116	
42	7	0	32	73	1	316	17	2	2	18	
43	0	0	3	7	0	30	2	0	2	1	
44	0	0	1	0	0	3	0	0	0	1	
45	0	1	1	1	1	1	0	1	0	1	
46	1	0	0	1	1	0	0	1	0	2	
47	0	2	2	1	0	1	0	1	0	1	
48	1	0	1	0	0	0	2	1	0	2	
49	1	2	0	1	1	0	1	1	4	2	
50	2	1	0	1	2	1	0	1	4	0	
51	1	3	2	1	1	2	1	2	3	5	
52	1	11	1	1	1	3	4	5	12	6	
53	9	4	2	3	1	2	6	6	14	11	
54	4	7	10	6	3	2	6	9	28	20	
55	19	10	8	4	5	5	15	19	49	29	
56	46	31	19	8	11	7	17	64	116	60	
57	107	52	32	11	29	9	58	102	288	106	
58	231	100	78	30	65	19	101	276	475	213	
59	456	201	168	74	145	32	230	513	358	370	
60	371	384	342	116	353	65	505	327	129	365	
61	169	244	553	257	394	131	512	130	56	270	
62	84	119	351	474	191	257	246	81	30	117	
63	43	51	151	415	76	586	108	23	6	56	
64	6	19	82	195	33	508	38	2	0	26	
65	1	2	28	90	13	227	18	0	0	4	
66	0	0	2	37	2	117	2	0	0	1	
67	0	0	0	12	0	74	1	0	0	0	
68	0	0	0	4	0	21	0	0	1	0	
69	0	0	0	0	0	3	0	0	0	0	
70	0	0	0	1	0	0	0	0	0	0	

Fig. 17.
Alpha spectrometer calibration procedure output—spectrum listing.

			DETECTOR NUMBER								DATE=08/17/79	
CH	31	32	33	34	35	36	37	38	39	40		
10	1	0										
11	3	0										
12	1	0										
13	3	0										
14	5	0										
15	5	0										
16	9	0										
17	17	0										
18	31	0										
19	54	0										
20	170	0										
21	260	0										
22	461	0										
23	779	0										
24	429	0										
25	54	0										
26	4	0										
27	1	0										
28	1	0										
29	2	0										
30	2	0										
31	5	0										
32	7	0										
33	6	0										
34	13	0										
35	54	0										
36	61	0										
37	142	0										
38	368	0										
39	379	0										
40	115	0										
41	11	0										
42	1	1										
43	0	0										
44	0	0										
45	0	0										
46	0	0										
47	0	0										
48	2	0										
49	0	0										
50	2	0										
51	2	0										
52	6	0										
53	10	0										
54	14	0										
55	25	0										
56	38	0										
57	73	0										
58	208	0										
59	276	0										
60	171	0										
61	56	0										
62	35	1										
63	11	1										
64	1	0										
65	0	0										
66	0	0										
67	0	0										
68	0	0										
69	0	0										
70	0	0										

Fig. 18.
Alpha spectrometer calibration procedure output—spectrum listing.

ALPHA SPECTROMETER CALIBRATION
DATE=06/17/79

DET NO.	OLD DATA	RESOLUTION	EFFICIENCY	KEV CH	PU242	PU239	PU238	PU236	AM243	AM241	PO210	PO208
1	FALSE	38.6	0.155	15.06	26	43	66	84	51	66	53	40
2	FALSE	43.3	0.151	15.06	26	43	66	84	51	66	53	40
3	FALSE	34.0	0.167	16.00	26	42	63	80	50	63	51	39
4	FALSE	0	0	0	0	0	0	0	0	0	0	0
5	FALSE	0	0	0	0	0	0	0	0	0	0	0
6	FALSE	40.4	0.163	14.22	26	44	68	87	53	68	54	41
7	FALSE	58.3	0.171	16.00	26	42	63	80	50	63	51	39
8	FALSE	50.1	0.149	15.06	26	43	66	84	51	66	53	40
9	FALSE	35.8	0.174	15.06	26	43	66	84	51	66	53	40
10	FALSE	60.9	0.167	16.00	26	42	63	80	50	63	51	39
11	FALSE	36.2	0.171	16.00	26	42	63	80	50	63	51	39
12	FALSE	52.2	0.168	15.06	26	43	66	84	51	66	53	40
13	FALSE	50.8	0.177	16.00	26	42	63	80	50	63	51	39
14	FALSE	52.7	0.138	16.00	26	42	63	80	50	63	51	39
15	FALSE	55.3	0.156	16.00	27	43	64	81	51	64	52	40
16	FALSE	0	0	0	0	0	0	0	0	0	0	0
17	FALSE	58.6	0.180	17.07	27	42	62	78	49	62	51	39
18	FALSE	43.3	0.192	15.06	26	43	66	84	51	66	53	40
19	FALSE	37.5	0.185	16.00	26	42	63	80	50	63	51	39
20	FALSE	44.0	0.173	16.00	26	42	63	80	50	63	51	39
21	FALSE	39.3	0.229	16.00	27	43	64	81	51	64	52	40
22	FALSE	37.7	0.132	16.00	26	42	63	80	50	63	51	39
23	FALSE	37.0	0.180	15.06	26	43	66	84	51	66	53	40
24	FALSE	40.9	0.162	14.22	26	44	68	87	53	68	54	41
25	FALSE	35.9	0.167	16.00	26	42	63	80	50	63	51	39
26	FALSE	38.6	0.198	15.06	27	44	67	85	52	67	54	41
27	FALSE	42.1	0.172	15.06	26	43	66	84	51	66	53	40
28	FALSE	40.3	0.171	16.00	26	42	63	80	50	63	51	39
29	FALSE	45.4	0.186	17.07	26	41	61	77	48	61	50	38
30	FALSE	50.0	0.149	15.06	26	43	66	84	51	66	53	40
31	FALSE	39.4	0.157	16.00	26	42	63	80	50	63	51	39
32	FALSE	0	0	0	0	0	0	0	0	0	0	0

Fig. 19.

Alpha spectrometer calibration procedure output—detector performance summary.

Note that "0" (zero) entries are present for those detectors (4, 5, 16, and 32) where the calibration data suggested that it was unfit for routine use.

(E) Sign off.

/BYE

900027 LOG OFF 11.27.21.
900027 SRU 89.465 UNITS.

3. Alpha Spectrometer Background Analysis Program

a. **Overview.** Program BKGD2 is an adaptation of the alpha spectrometer background program written by Stewart Lombard in 1973. It is written in FORTRAN and was converted in 1975 by W. E. Goode to run interactively.

Background counting data are generated by counting a set of "blank" samples in the alpha spectroscopy system. The counting data are then transferred via a cassette tape to the file CT-DAT.* The background analysis program reads the CTDAT file and combines it with the data entered for the previous three BKGD2 runs to arrive at an average background for each channel of the 4095 channel spectrum over the four run period. The averaged spectrum is then written to the file BKGDFL for subsequent use by the alpha spectral analysis procedure of MASTER-CALC.

b. Procedure

(A) Sign on CCF machine M.

<security passwd>

idm **U <znumbr>**

79/08/14. 14.45.08.

LASL 6600 - 0 0 (2*ACTUAL CP TIME) NOS1.3-485C 790813

USER NUMBER: **<usrnbr,passwd>**

TERMINAL: 13, TTY

RECOVER/SYSTEM:

Because the background analyses program both reads and writes files that are used by MASTER-CALC, 900027 must be entered in the USRNBR position. Contact the person in charge of program MASTERCALC to obtain the current PASSWRD.

(B) Read the cassette tape containing the alpha spectral counting data into the DATA file. The DATA file may be created by following the steps:

(a) With the terminal in LOCAL mode, position the cassette tape at the beginning of the background counting data.

(b) Return the terminal to LINE mode and execute the following sequence.

NEW,CTDAT

/TAPE

TEXT

ENTER TEXT MODE.

[Turn playback control on]

ALPHA SPEC BACKGROUND 08/22/79

*Unlike file names used with MASTERCALC procedures, this file name is fixed and must be used explicitly.

```

080000
0001
000000 000000 000000 000000 000000 000000 000001 000000 000000 000001
000001 000000 000001 000003 000001 000001 000001 000000 000000 000000
000000 000000 000001 000000 000000 000001 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000001 000000
000000 000001 000000 000000 000000 000000 000000 000002 000000 000000
000000 000000 000000 000003 000001 000000 000001 000000 000000 000000
000000 000000 000000 000000 000001 000001 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
0101
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000001 000000 000000 000000 000000 000000
      •
      •
      •
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000 000000 000000 000000 000000 000000
000000 000000 000000 000000 000000

```

[Turn playback control off; press **CTRL/C**]

EXIT TEXT MODE

NOSORT

PACK

PACK COMPLETE.

NORMAL

/REPLACE

The structure of the counting data file is discussed in detail in section E.1.a. The reader may refer to page 19 for its description.

Use a text editor to examine the CTDAT file for obvious errors as shown in the following example.

/XEDIT,CTDAT

XEDIT VER.8.1 REVISED 78/08/25. 08.08.06.

CTDAT IS EDIT FILE

>?P

ALPHA SPEC BACKGROUND 08/22/79

>?B

```
000000 000000 000000 000000 000000 00000000 000000 000000 000000 000000
```

>?W

452

>?I

```
000000 000000 000000 000000 000000
```

>?B;W

```
000000 000000 000000 000000 000000
```

453

>?E

CTDAT IS A LOCAL FILE

If the CTDA1 file contains less than 453 lines for any reason other than the missing last line, or if the file is greater than 453 lines, it should be considered unreliable and should be reentered in its entirety.

(C) Execute the background analyses program by following the sequence below:

```
/GET,BKGD2  
/RETURN,LGO  
$RETURN,LGO.  
/FTN(I=BKGD2,L=0)  
2.996 CP SECONDS COMPILATION TIME  
/X,LIBRARY,LAUTIL  
LIBRARY,LAUTIL.  
/LGO  
?08/22/79
```

The only variable parameter supplied at execution time is the counting date. All other counting parameters are obtained automatically by the program. Program output will commence at this point.

(D) Collect the output.

A sample of the spectral listings from the background analysis program is shown in Figs. 20 and 21. The data are listed in terms of total count per channel for each alpha detector.

Figure 22 contains the background summary generated from the example sequence discussed thus far. The summary includes four weeks of background counting data; week 1 is the oldest, week 4 the most recent. Within each week, the estimated ^{238}Pu , ^{239}Pu and gross total (channels 1 to 128) background is computed for an 80 000 second counting period. The "GRAND TOTAL" entry at the bottom of the table is the summation of all individual detector totals (or the total number of counts in 4095 channels). The user should find this information useful in assessing the contamination level of each detector, and, hence, it should provide some basis for scheduling detector usage and cleaning.

(E) Sign off.

```
/BYE  
900027 LOG OFF 10.29.15.  
900027 SRU 60.570 UNTS.
```

CH	DETECTOR NUMBER							
	1	2	3	4	5	6	7	8
5	0	0	0	0	0	1	1	0
6	0	0	0	0	0	0	0	1
7	1	0	0	0	0	0	0	0
8	0	1	0	0	0	1	0	0
9	0	0	1	0	0	0	1	1
10	1	0	2	0	0	0	0	0
11	1	0	0	0	0	1	1	1
12	0	0	1	0	0	2	1	0
13	1	0	0	0	0	0	1	1
14	3	0	0	0	0	1	1	1
15	1	0	0	0	0	0	0	0
16	1	0	0	0	0	1	1	0
17	1	0	0	1	0	1	2	0
18	0	0	1	1	0	1	0	0
19	0	1	1	0	0	1	0	2
20	0	0	0	0	0	1	0	0
21	0	2	1	0	0	2	0	1
22	0	0	1	0	0	0	1	0
23	1	0	1	0	0	0	0	1
24	0	0	0	1	0	0	0	0
25	0	0	0	0	0	0	3	2
26	1	0	0	0	0	0	3	0
27	0	0	0	0	0	0	2	0
28	0	2	0	0	0	0	1	0
29	0	0	0	0	0	0	0	0
30	0	0	0	1	0	0	0	0
31	0	0	0	0	0	0	2	0
32	0	0	0	0	0	1	1	0
33	0	0	0	0	0	1	1	1
34	0	0	0	0	0	0	1	0
35	0	0	1	0	0	1	0	1
36	0	1	1	0	0	1	0	1
37	0	0	0	0	0	1	1	0
38	0	0	0	1	0	0	0	1
39	1	0	0	1	0	1	0	0
40	0	0	0	0	0	0	1	0
41	0	0	0	1	0	1	0	0
42	1	0	0	2	0	1	0	0
43	0	0	0	1	0	0	0	0
44	0	0	0	0	0	0	0	0
45	0	0	0	1	0	0	0	0
46	0	0	1	1	0	0	1	0
47	0	0	0	0	0	0	1	1
48	2	0	0	0	0	0	0	0
49	0	0	0	0	0	0	1	0
50	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	0	0	0	0	0	1	2	0
53	0	0	0	0	0	0	0	0
54	3	1	0	0	0	0	0	0
55	1	0	1	1	0	0	1	0
56	0	0	0	0	1	1	0	1
57	1	0	3	0	0	0	0	0
58	0	0	1	0	0	0	0	2
59	0	0	2	0	0	1	1	0
60	0	0	0	1	0	0	0	0
61	0	0	0	0	0	0	0	1
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	1	1	0	1	0	0	0	0

Fig. 20.
Background analysis program output—spectrum listing for Channels 5-65.

DETECTOR NUMBER								
CH	1	2	3	4	5	6	7	8
65	1	2	0	1	0	0	0	0
66	1	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0
68	0	0	1	0	0	0	0	0
69	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	1	1
71	0	0	0	1	0	0	0	0
72	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	1	0	0	0	0	0
76	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0
80	0	0	0	0	0	1	0	0
81	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0
83	0	0	0	0	0	0	0	0
84	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0	0
87	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0
89	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0
91	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	1
93	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0
95	0	0	1	0	0	0	0	0
96	0	0	0	0	0	0	0	0
97	0	0	0	0	0	0	0	0
98	0	0	0	0	0	0	0	0
99	0	0	0	0	0	1	0	0
100	0	0	0	0	0	0	0	0
101	0	0	0	1	0	0	0	0
102	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0
105	0	0	0	1	0	0	0	0
106	0	0	1	0	0	0	0	0
107	0	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0	0
109	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0
112	0	0	0	0	0	1	0	0
113	0	0	0	0	0	0	0	0
114	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0
116	0	0	0	0	0	0	0	0
117	0	0	0	0	0	0	0	0
118	0	0	0	0	0	0	0	0
119	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0
121	0	0	0	0	0	0	0	0
122	0	0	0	1	0	1	0	0
123	0	0	0	0	0	0	0	0
124	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0

Fig. 21.
Background analysis program output—spectrum listing for channels 65-125.

BACKGROUND SUMMARY

DET	1			2			3			4		
	238	239	TOT	238	239	TOT	238	239	TOT	238	239	TOT
1	4	2	29	4	1	27	5	2	23	5	2	23
2	2	7	19	2	4	15	1	1	9	1	1	9
3	12	4	32	8	6	25	7	2	23	7	2	23
4	1	5	25	4	3	17	2	5	19	2	5	19
5	0	0	0	0	0	0	0	1	0	2	1	0
6	7	2	29	3	3	27	2	8	28	2	8	28
7	2	19	50	7	16	42	2	5	35	2	5	35
8	3	4	19	0	2	13	4	4	22	4	4	22
9	5	7	30	10	6	36	3	7	23	3	7	23
10	4	3	19	2	4	23	2	3	13	2	3	13
11	1	2	19	4	1	13	2	3	12	2	3	12
12	2	4	17	2	0	9	0	2	12	0	2	12
13	5	5	30	0	3	14	2	3	16	2	3	16
14	1	7	20	1	8	19	5	5	27	5	5	27
15	2	5	32	4	1	29	5	5	29	5	5	29
16	0	0	0	0	0	0	0	0	0	0	0	0
17	4	0	10	4	2	13	3	1	11	3	1	11
18	2	4	14	1	3	20	3	0	15	3	0	15
19	6	6	20	7	4	22	4	5	31	4	5	31
20	1	2	14	2	3	21	1	4	12	1	4	12
21	1	4	14	0	1	11	0	1	10	0	1	10
22	10	2	25	3	2	23	4	4	20	4	4	20
23	3	3	19	4	7	21	5	2	17	5	2	17
24	1	4	13	1	3	14	0	1	15	0	1	15
25	3	3	16	5	2	19	5	2	19	5	2	19
26	0	0	12	0	1	9	1	3	11	1	3	11
27	5	0	18	2	1	11	3	1	10	3	1	10
28	1	1	14	2	1	16	2	2	19	2	2	19
29	5	2	26	9	2	26	5	5	17	5	5	17
30	4	15	31	3	20	38	3	15	37	3	15	37
31	4	105	137	2	95	120	6	85	135	6	85	135
32	0	0	0	0	0	0	0	0	0	0	0	0
		753			693			672			672	

Fig. 22.

Background analysis program output—four week background summary.

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APPENDIX A

REROUTING PROGRAM OUTPUT

Conventions of NOS make it relatively easy to reroute program input and output (I/O) from one file or device to another.

In the header statement of a program, one finds the general form

PROGRAMNAME(FILE₁,FILE₂,...,FILE_n)

Where PROGRAMNAME is the program name and FILE_n are the I/O file arguments for the program. The "load and execute" call to the operating system is of the form

PROGBINARY(FILE₁,FILE₂,...,FILE_n)

where PROGBINARY is the executable file formed from compilation of the source file and FILE_n is the same as in the program header statement.

Assume the executable code has been written to the file LGO. File name substitutions may be made at any position in the LGO statement to reroute I/O from the file declared in the program

header to the file named in the LGO statement. In the timesharing environment, the files INPUT and OUTPUT are connected to the user's terminal by default. Therefore, given the program header statement

PROG(INPUT,OUTPUT,file₁,file₂,...,file_n)

which was compiled into the executable file LGO, one could defer the output from the terminal to the file OUT by entering

LGO(,OUT).

Thus, all output normally received at the terminal would be written to the local file OUT instead. OUT could then later be sent to a high speed line printer by the command sequence

```
REWIND,OUT
COPYSBF(OUT,OUT1)
REWIND,OUT1
DISPOSE,OUT1=PR
```

This output rerouting procedure can be very useful in handling large amounts of printed output, which would take long periods of time to print at a terminal.

APPENDIX B

PROGRAM LISTINGS

This appendix contains source listings for the routines described in the body of this report.

Program MASTERCALC, which is written in PASCAL, occupies the first 39 pages of this section. The reader should note the 6 digit octal number immediately to the left of each line of code. This number gives the approximate relative address of each code segment at execution time and it will be referenced in any error messages reported by the PASCAL runtime system. Thus, in attempting to trace program execution errors, one may relate the error address to the source listing to locate the approximate point at which the program stopped.

Program BKGD2, which is written in FORTRAN, follows program MASTERCALC. Error diagnostics from the FTN system should be related to statement sequence numbers (not statement labels) for rather straightforward interpretation.

```

000006 PROGRAM MASTERCALC(INPUT,OUTPUT,RESULTS,IDENTS,CTDAT,DETDATA,BKGDFL);
000466 (*-----*)
000466 (* PROGRAM MASTERCALC PROVIDES COMPUTING SUPPORT FOR THE H-8 ANA- *)
000466 (*LYTICAL LABORATORIES. WRITTEN BY BILL GOODE, DURING 1976 AND 1977 *)
000466 (*IN PASCAL. PROCEDURES ARE PROVIDED FOR MOST OF THE ANALYTICAL *)
000466 (*ROUTINES PERFORMED IN THE H-8 LABS. COMMON I/O FORMATTING ROU- *)
000466 (*TINES ARE SHARED BY ALL MODULES TO GIVE INTERACTIVE HARD COPY *)
000466 (*OUTPUT AND PROVIDE A FILE LINK TO THE SYSTEM 2000 DATA BASE #HBDATA#*)
000466 (* THE PROGRAM DESCRIPTION AND OPERATING INSTRUCTIONS ARE AVAIL- *)
000466 (*ABLE FROM THE GROUP H-8 CHEMISTRY SECTION. *)
000466 (*-----*)
000466 LABEL 1000;
000466 TYPE
000466 SPECTRUM=ARRAY[1..4095] OF INTEGER; (*DATA ARRAY TYPE*)
000466 VAR
000466 LENGTH%INTEGER; (*CHARACTER LENGTH OF WORD*)
000466 CH%CHAR; (*CHARACTER HOLDER*)
000470 I,J,K,M,N%INTEGER; (*INDEX VARIABLES*)
000475 LINE%INTEGER; (*LINE COUNTER*)
000476 RESULTS%PACKED SEGMENTED FILE OF CHAR; (*RESULT FILE IN S2K FORM*)
000726 IDENTS%PACKED FILE OF CHAR; (*SAMPLE INFO FILE*)
001156 DETDATA%PACKED FILE OF CHAR; (*DET DEPENDENT INFO*)
001406 CTDAT%PACKED FILE OF CHAR; (*DATA INPUT FILE*)
001636 BKGDFL%PACKED FILE OF CHAR; (*ALPHA SPEC BKG FILE*)
002066 PAGE%INTEGER; (*PAGE NUMBER INDICATOR*)
002067 COUNTDATE%ALFA; (*DATE COUNTED*)
002070 EFFICIENCY%REAL; (*COUNTING EFFICIENCY*)
002071 SIGEFF%REAL; (*REL STD DEV OF COUNT EFF*)
002072
002072 PROCEDURE SKIPBLANKS(VAR F%TEXT;
000004 (*-----*)
000004 (*SKIPS SEPARATOR BLANKS IN THE INPUT FILE *)
000004 (*-----*)
000004 BEGIN (*SKIPBLANKS*)
000004 WHILE ((F'= =) AND (NOT(EOLN(F))) AND (NOT(EOF(F))))
000013 DO GET(F);
000016 END; (*SKIPBLANKS*)
000022
000022 PROCEDURE READWORD(VAR F%TEXT; VAR BUFFER%ALFA; VAR LENGTH%INTEGER);
000006 (*-----*)
000006 (*READ CHARS UNTIL A DELIMITING MARKER IS FOUND. DELIMITING MARKERS*)
000006 (*ARE BLANKS AND COMMAS *)
000006 (*-----*)
000006 VAR
000006 K%INTEGER; (*INDEXING VAR*)
000007 BEGIN (*READWORD*)
000007 BUFFER:= =;
000011 K:=1;
000012 SKIPBLANKS(F);
000013 WHILE((NOT(EOF(F)))AND(NOT(EOLN(F)))AND(NOT(F' IN [ = , = , = ]))) DO
000017 BEGIN
000017 READ(F,BUFFER(K));
000033 K:=SUCC(K);
000035 END;
000035 LENGTH:=K-1;
000037 IF F'= =, = THEN GET(F);
000042 SKIPBLANKS(F);
000044 END; (*READWORD*)
000056
000056 PROCEDURE NEWPAGE;

```

```

000003 (*-----*)
000003 (*SEPARATES PAGES BY THREE BLANK LINES *)
000003 (*-----*)
000003 BEGIN (*NEWPAGE*)
000003     FOR K:=1 TO 3 DO WRITELN;
000014     END; (*NEWPAGE*)
000020
000020 PROCEDURE DELIMITER;
000003 (*-----*)
000003 (*WRITES PAGE DELIMITER FOR PAGE SEPARATION *)
000003 (*-----*)
000003 BEGIN (*DELIMITER*)
000003     WRITELN(= - - - - -);
000013     = - - - - -;
000021     END; (*DELIMITER*)
000036
000036 PROCEDURE L;
000003 (*-----*)
000003 (*INCREMENTS THE CURRENT VALUE OF THE GLOBAL VARIABLE LINE BY 1 *)
000003 (*-----*)
000003 BEGIN (*L*)
000003     LINE:=SUCC(LINE);
000007     END; (*L*)
000013
000013 PROCEDURE FILLER;
000003 (*-----*)
000003 (*THIS PROCEDURE ADDS BLANK FILL TO MAINTAIN A 8.5 X 11 PAGE IMAGE *)
000003 (*-----*)
000003     VAR
000003         L:INTEGER; (*LINE COUNTER*)
000004 BEGIN (*FILLER*)
000004     FOR L:=LINE TO 65 DO WRITELN;
000014     END; (*FILLER*)
000022
000022 FUNCTION ET(START:ALFA;STHR:REAL;STMIN:REAL;STOP:ALFA;STPHR:REAL;STPMIN:
000011     REAL):REAL;
000011 (*-----*)
000011 (*COMPUTES THE ELAPSED TIME IN DAYS BETWEEN THE START AND STOP DATES*)
000011 (*IF STOP DATE < START DATE, AN ERROR MESSAGE IS PRINTED *)
000011 (*-----*)
000011     CONST
000011         CENTURY=1900;
000011     VAR
000011         STARTM:INTEGER; (*START MONTH*)
000012         STARTD:INTEGER; (*START DAY*)
000013         STARTY:INTEGER; (*START YEAR*)
000014         STOPM:INTEGER; (*STOP MONTH*)
000015         STOPD:INTEGER; (*STOP DAY*)
000016         STOPY:INTEGER; (*STOP YEAR*)
000017         STPM:INTEGER; (*STOP MONTH TEMPORARY*)
000020         STPD:INTEGER; (*STOP DAY TEMPORARY*)
000021         STPY:INTEGER; (*STOP YEAR TEMPORARY*)
000022         DONE:BOOLEAN; (*FLAG TO TERMINATE ET COMPUTATION*)
000023         TOTAL:INTEGER; (*ACCUMULATOR FOR ET VALUE*)
000024
000024 FUNCTION TODAYS(STRM:(*STARTMONTH*),STPM:(*STOPMONTH*):INTEGER):INTEGER;
000005 (*-----*)
000005 (*COMPUTES THE ELAPSED TIME IN DAYS BETWEEN TWO DATES *)

```

```

000005      (*-----*)
000005      VAR
000005          MONTH%INTEGER;                (*MONTH INDEXING VARIABLE*)
000006          TOTAL%INTEGER;                (*ACCUMULATOR FOR TOTDAYS*)
000007      FUNCTION DAYS(MONTH%INTEGER;YEAR%INTEGER)%INTEGER;
000005      (*-----*)
000005      (*COMPUTES THE NUMBER OF DAYS FOR A GIVEN MONTH OF A GIVEN YEAR *)
000005      (*-----*)
000005      BEGIN (*DAYS*)
000005          CASE MONTH OF
000013              1,3,5,7,8,10,12% DAYS%=31;
000015              2%                IF YEAR MOD 4=0
000016                                THEN DAYS%=29
000017                                ELSE DAYS%=28;
000023              4,6,9,11%        DAYS%=30;
000025          END; (*CASE*)
000041      END; (*DAYS*)
000052      BEGIN (*TOTDAYS*)
000052          TOTAL%=0;
000010          FOR MONTH%=STRTM TO STPM-1 DO TOTAL%=TOTAL+DAYS(MONTH,STARTY);
000021          TOTDAYS%=TOTAL;
000023      END; (*TOTDAYS*)
000037
000037      BEGIN (*ET*)
000037      (*-----*)
000037      (*DECODE CHARACTER REPRESENTATION OF DATES*)
000037      (*-----*)
000037      STARTM%= 10*(ORD(START(1))-27)+(ORD(START(2))-27);
000015      STARTD%= 10*(ORD(START(4))-27)+(ORD(START(5))-27);
000020      STARTY%= 10*(ORD(START(7))-27)+(ORD(START(8))-27)+CENTURY;
000025      STOPM%= 10*(ORD(STOP(1))-27)+(ORD(STOP(2))-27);
000031      STOPD%= 10*(ORD(STOP(4))-27)+(ORD(STOP(5))-27);
000034      STOPY%= 10*(ORD(STOP(7))-27)+(ORD(STOP(8))-27)+CENTURY;
000041      (*-----*)
000041      (*CALCULATE ELAPSED TIME IN DAYS *)
000041      (*-----*)
000041      IF STOPY<STARTY
000041      THEN (*ERROR*) BEGIN
000042          WRITELN(=ERROR IN DATE FOR SAMPLE =,I%3); ET%=0;
000057      END
000057      ELSE BEGIN
000060          DONE%=FALSE;
000061          STPM%=STOPM;
000062          STPD%=STOPD;
000063          STPY%=STOPY;
000063          TOTAL%=0;
000064          WHILE NOT(DONE) DO
000066              BEGIN
000066                  IF (STPY=STARTY)
000067                      THEN BEGIN
000070                          TOTAL%=TOTAL+TOTDAYS(STARTM,STPM)+STPD-STARTD;
000076                          DONE%=TRUE;
000077                      END
000077                  ELSE BEGIN
000077                      STPM%=12; STPD%=31; STPY%=STARTY;
000102                      TOTAL%=TOTAL+TOTDAYS(STARTM,STPM)+STPD-STARTD;
000107                      STARTM%=1; STARTD%=1; STARTY%=STARTY+1;
000111                      STPM%=STOPM; STPD%=STOPD; STPY%=STOPY;
000114                      END;
000114                  END;
000115              END;
000115              ET%=TOTAL+(STPM%*60+STPD%-STHR%-STMIN%/60)/24;
000134      END; (*ET*)

```

```

000201
000201
000201 FUNCTION EX(N%REAL)%INTEGER;
000004 (*-----*)
000004 (*DETERMINES THE BASE TEN EXPONENT OF A REAL NUMBER N *)
000004 (*-----*)
000004 VAR
000004 X%INTEGER; (*EXPONENT VALUE*)
000005 BEGIN (*EX*)
000005 N%=ABS(N);
000010 X%=0;
000010 IF N<>0
000010 THEN BEGIN
000013 WHILE N>=10 DO
000017 BEGIN
000017 N%=N/10;
000022 X%=X+1;
000023 END;
000023 WHILE N<1 DO
000027 BEGIN
000027 N%=N*10;
000032 X%=X-1;
000033 END;
000034 END;
000034 EX%=X;
000036 END; (*EX*)
000046
000046 FUNCTION POWER(X%REAL;Y%INTEGER)%REAL;
000005 (*-----*)
000005 (*RAISES X TO THE Y POWER, TAKEN FROM THE PASCAL USER MANUAL *)
000005 (*-----*)
000005 VAR
000005 W,Z%REAL;
000007 I%INTEGER;
000010 BEGIN (*POWER*)
000010 W%=X; Z%=1; I%=Y;
000013 WHILE I<>0 DO
000015 BEGIN
000015 IF ODD(I) THEN Z%=Z*W;
000020 I%=I DIV 2;
000022 W%=SQR(W);
000023 END;
000023 IF Y<0 THEN POWER%=1/Z
000025 ELSE POWER%=Z;
000032 END; (*POWER*)
000051
000051 PROCEDURE SYS2KFORM(AX%REAL;SAX%REAL;PREFIX%CHAR;UNITS%ALFA;QUAN%REAL;
000010 UNITQUAN%CHAR;DATE%ALFA;ID%ALFA;OWNER%ALFA;ANAL%ALFA);
000015 (*-----*)
000015 (*FORMAT RESULTS INTO S2K LOADABLE FORMAT AND WRITE TO THE RESULTS *)
000015 (*FILE. SIGNIFICANT FIGURES ARE CONSIDERED. INSIGNIFICANT FIGURES *)
000015 (*ARE ZERO FILLED *)
000015 (*-----*)
000015 VAR
000015 K%INTEGER; (*INDEX VARIABLE*)
000016 ORDER%ARRAY[1..7] OF CHAR; (*ARRAY OF PREFIX VALUES*)
000025 PTR%INTEGER; (*PREFIX PTR*)
000026 SIGORD%INTEGER; (*ORDER OF MAGNITUDE OF SIGNIFICANCE*)
000027 BEGIN
000027 (*-----*)
000027 (*CHECK FOR VALID SAMPLE OWNER*)
000027 (*-----*)

```

```

000027      IF NOT( (OWNER==AFG           ==)OR
000012              (OWNER==AS           ==)OR
000014              (OWNER==DBC          ==)OR
000016              (OWNER==DK          ==)OR
000020              (OWNER==DML          ==)OR
000022              (OWNER==EF           ==)OR
000024              (OWNER==ESG          ==)OR
000026              (OWNER==FM           ==)OR
000030              (OWNER==GT           ==)OR
000032              (OWNER==JA           ==)OR
000034              (OWNER==JN           ==)OR
000036              (OWNER==JWO          ==)OR
000040              (OWNER==KB           ==)OR
000042              (OWNER==MAR          ==)OR
000044              (OWNER==MLM          ==)OR
000046              (OWNER==MW           ==)OR
000050              (OWNER==RJP          ==)OR
000052              (OWNER==RWF          ==)OR
000054              (OWNER==TG           ==)OR
000056              (OWNER==TH           ==)OR
000060              (OWNER==WA           ==)OR
000062              (OWNER==WH           ==)OR
000064              (OWNER==WP           ==)OR
000066              (OWNER==NA           ==)OR
000070              (OWNER==DLM          ==)OR
000072              (OWNER==KW           ==)OR
000074              (OWNER==BWB          ==)OR
000076              (OWNER==CK           ==)OR
000100              (OWNER==TGS          ==)OR
000102              (OWNER==RR           ==) )
000104      THEN BEGIN
000105          WRITELN(= INVALID SAMPLE OWNER FOR SAMPLE =.1D%10,= - STOPPING PROGRAM=);
000125          GOTO 1000;
000126      END;
000126      (*-----*)
000126      (*SCALE FACTOR*)
000126      (*-----*)
000126      PTR%=1;
000127      ORDER(1)%===: ORDER(2)%===: ORDER(3)%==M=: ORDER(4)%==N=:
000133      ORDER(5)%==P=: ORDER(6)%==F=: ORDER(7)%==A=:
000136      WHILE ORDER(PTR)<>PREFIX DO PTR%=SUCC(PTR);
000145      WHILE AX>99999.9999 DO
000147      BEGIN
000147          PTR%=PRED(PTR);
000151          AX%=AX/POWER(10,3); SAX%=SAX/POWER(10,3); PREFIX%=ORDER(PTR);
000172      END;
000172      (*-----*)
000172      (*ZERO FILL INSIG FIGURES*)
000172      (*-----*)
000172      IF SAX/POWER(10,EX(SAX))<1.95
000205      THEN SIGORD%=EX(SAX)-1
000210      ELSE SIGORD%=EX(SAX);
000215      SAX%=ROUND(SAX/POWER(10,SIGORD))*POWER(10,SIGORD);
000235      AX%=ROUND(AX/POWER(10,SIGORD))*POWER(10,SIGORD);
000255      (*-----*)
000255      (*WRITE FORMATTED LINE TO THE RESULTS FILE*)
000255      (*-----*)
000255      WRITE(RESULTS,=PUTA(=,AX%10%4,=,=,SA%10%4,=,=);
000300      IF PREFIX IN [= =,=N=,=P=,=F=,=A=]
000300      THEN WRITE(RESULTS,PREFIX)
000307      ELSE CASE PREFIX OF
000314          =*=WRITE(RESULTS,=MILLI=);
000322          =M%=WRITE(RESULTS,=MICRO=);
000330      END: (*CASE*)

```

```

000363      (*-----*)
000363      (*SUPPRESS BLANKS ON REMAINING FIELDS*)
000363      (*-----*)
000363      FOR K=1 TO 10 DO
000364      IF UNITS(K)<>= THEN WRITE(RESULTS,UNITS(K));
000406      IF ((UNITS<>=PPM      =)AND(UNITS<>=PPB      =)AND(UNITS<>=X      =)
000413      AND(UNITS<>=PERCENT      =)) THEN WRITE(RESULTS,=/=,UNITQUAN);
000425      WRITE(RESULTS,=,=);
000427      FOR K=1 TO 10 DO
000430      IF DATE(K)<>= THEN WRITE(RESULTS,DATE(K));
000452      WRITE(RESULTS,=,=);
000454      FOR K=1 TO 10 DO
000455      IF ID(K) IN {=0=..=9=,=.=} THEN WRITE(RESULTS,ID(K));
000477      WRITE(RESULTS,=,=);
000501      FOR K=1 TO 10 DO
000502      IF OWNER(K)<>= THEN WRITE(RESULTS,OWNER(K));
000524      WRITE(RESULTS,=,=);
000526      FOR K=1 TO 10 DO
000527      IF ANAL(K)<>= THEN WRITE(RESULTS,ANAL(K));
000550      WRITELN(RESULTS,=); PUTSEG(RESULTS);
000557      IF ID(9)<>= THEN
000557      THEN (*REPLICATE FORMAT*) BEGIN
000562      WRITE(RESULTS,=*REPLIC( REPLICATE =,ID(9),ID(10),=);=);
000606      PUTSEG(RESULTS);
000607      END;
000607      (*-----*)
000607      (*SPECIAL CASE FOR OWNER=IG*)
000607      (*-----*)
000607      IF OWNER=IG      =
000607      THEN BEGIN
000611      WRITE(RESULTS,=*TGW(=,QUAN%1%4,=,=,UNITQUAN,=);=);
000636      WRITELN(RESULTS); PUTSEG(RESULTS);
000640      END;
000640      END; (*SYS2KFORM*)
000747
000747      PROCEDURE SIGDIGITS(ANSWER%REAL;ERROR%REAL);
000005      (*-----*)
000005      (*GIVEN AN ANSWER PART(AX) AND AN ERROR PART(SAX), THIS PROCEDURE WRITES*)
000005      (*THE ANSWER AND THE ERROR TO THE OUTPUT FILE IN SCIENTIFIC NOTATION *)
000005      (*WITH ONLY THE SIGNIFICANT NUMBER OF DECIMAL PLACES. THE CRITERIA FOR *)
000005      (*DETERMINING SIGNIFICANCE IS AS FOLLOWS- *)
000005      (* 1. IF THE FIRST DIGIT OF THE ERROR IS 1, THEN RETAIN THAT DIGIT PLUS *)
000005      (* ONE MORE AND RETAIN THE CORRESPONDING NUMBER OF DECIMAL PLACES IN *)
000005      (* THE ANSWER. *)
000005      (* 2. IF THE FIRST DIGIT OF THE ERROR IS > 1, THEN RETAIN ONLY THAT DIGIT*)
000005      (* AND THE CORRESPONDING NUMBER OF DECIMAL PLACES IN THE ANSWER *)
000005      (*-----*)
000005      VAR
000005      SIGORD%INTEGER; (*ORDER OF MAG OF SIGNIFICANCE*)
000006      SIGLEVEL%INTEGER; (*NUMBER OF SIGNIFICANT DIGITS*)
000007      WHOLE,DEC%INTEGER; (*FORMATING VARIABLES FOR OUTPUT*)
000011      E%INTEGER; (*EXPONENT OF ANSWER PART*)
000012      SP%CHAR; (*SPACE CHARACTER*)
000013      BEGIN (*SIGDIGITS*)
000013      SP== =;
000010      IF (*FIRST DIGIT ROUNDED IS 1*) (ERROR/POWER(10,EX(ERROR))<1.95)
000024      THEN (*FIRST DIGIT ROUNDED IS A 1, SO KEEP TWO*) BEGIN
000025      SIGORD=EX(ERROR)-1;
000027      SIGLEVEL=2;
000030      END
000030      ELSE (*FIRST DIGIT ROUNDED IS > 1, SO KEEP ONE*) BEGIN
000030      SIGORD=EX(ERROR);
000033      SIGLEVEL=1;

```



```

000033      END;
000033      (*-----*)
000033      (*ROUNDOFF IN SIGNIFICANT DIGITS*)
000033      (*-----*)
000033      ANSWER%=ROUND(ANSWER/POWER(10,SIGORD))*POWER(10,SIGORD);
000053      ERROR%=ROUND(ERROR/POWER(10,SIGORD))*POWER(10,SIGORD);
000073      DEC%=EX(ANSWER)-EX(ERROR);
000101      IF DEC<0
000101      THEN BEGIN
000102          DEC%=SIGLEVEL-1;
000103          E%=EX(ERROR);
000106      END
000106      ELSE BEGIN
000106          DEC%=DEC+SIGLEVEL-1;
000110          E%=EX(ANSWER);
000112      END;
000112      WHOLE%=DEC+3;
000114      (*-----*)
000114      (*ADJUST ONE ELEMENT TO ZERO POWER AND SCALE COMPANION APPROPRIATELY*)
000114      (*-----*)
000114      ANSWER%=ANSWER/POWER(10,E);
000121      ERROR%=ERROR/POWER(10,E);
000126      (*-----*)
000126      (*WRITE ROUNDED RESULT TO THE OUTPUT FILE*)
000126      (*-----*)
000126      WRITE(ANSWER%WHOLE%DEC,SP%(4-DEC),=+/- =,ERROR%WHOLE%DEC,SP%(4-DEC),
000157      =X 10E=,E%2);
000170      END;      (*SIGDIGITS*)
000217
000217
000217      PROCEDURE ALPHASPEC;
000003      (*-----*)
000003      (*ALPHA SPECTROSCOPY ANALYSIS PROCEDURE. THIS PROCEDURE REDUCES *)
000003      (*COUNTING DATA FROM THE H-B ALPHA SPECTROSCOPY COUNTING SYSTEM *)
000003      (*AND REPORTS RESULTS IN PC1 OF ANALYTE PER SAMPLE UNIT QUANTITY *)
000003      (*-----*)
000003      CONST
000003          SIZE=32;                                (*MAXIMUM NUMBER OF SAMPLES*)
000003          SPECTRUMSIZE=128;                        (*DETECTOR CHANNEL ALLOCATION*)
000003          NUMANALYSES=8;                          (*NUMBER OF POSSIBLE ANALYSES*)
000003          PRIMARY=1;                              (*PRIMARY COUNTING SPECTRUM*)
000003          B=2;                                    (*BACKGROUND COUNT SPECTRUM*)
000003          SB=3;                                   (*STD DEVS FOR 4 WEEK BKG SUMMARY*)
000003          E1=4;                                  (*E1 THRU E4 ARE INDICES FOR *)
000003                                          (*EXTRAPOLATED SPECTRA*)
000003          E2=5;
000003          E3=6;
000003          E4=7;
000003      TYPE
000003          DIAGNOSTIC=(BADRES,NOTROUBLE);
000003          ALPHA=PACKED ARRAY[1..10] OF CHAR;      (*NAME FORMAT*)
000003          ISOTOPE=PACKED ARRAY[1..5] OF CHAR;     (*EXAMPLE PU238*)
000003          COLUMN=RECORD
000003              NAME%ISOTOPE;                        (*NAME OF SPECTRA IN A GIVEN COL*)
000003              DETECTOR%1..SIZE;                   (*DET TO WHICH SPECTRUM BELONGS*)
000003              SPECTRA%1..8;                        (*NO. OF SPEC PRESENTLY ALLOWED*)
000003              END;
000003                                          (*IN THE DATA ARRAY*)
000003          BOUND=RECORD
000003              HIGH%1..SPECTRUMSIZE;               (*HIGH END WINDOW MARKER*)
000003              LOW%1..SPECTRUMSIZE;               (*LOW END WINDOW MARKER*)
000003              END;
000003          INDEX=1..SPECTRUMSIZE;                 (*ARRAY INDEX*)
000003          UNIT=RECORD                             (*DATA STRUCTURE FOR SAMP INFO*)

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000003      ID%PACKED ARRAY[1..10] OF CHAR;      (*LAB NUMBER*)
000003      OWNER%ALFA;      (*SAMP OWN INITIALS (FOR DATA BASE*)
000003      ANALYSIS%ARRAY[1..3] OF ISOTOPE;      (*ALPHA SPEC ANALYSIS REQUESTED*)
000003      TRACER%ISOTOPE;      (*ISOTOPE OF TRACER USED*)
000003      TRACERDPM%REAL;      (*TRACER ACTIVITY*)
000003      TRACERUNCER%REAL;      (*STD DEV OF TRACER ACTIVITY*)
000003      SAMPQUAN%REAL;      (*SAMPLE QUANTITY*)
000003      ALQTFRAC%REAL;      (*ALIQOT FRACTION*)
000003      UNITS%CHAR;      (*UNITS (G,S,F OR L)*)
000003      SEPDATE%ALPHA;      (*SEPARATION DATE (PO210) ONLY*)
000003      RESOLUTION%REAL;      (*FWHM RESOLUTION*)
000003      RECOVERY%REAL;      (*FRACTION OF TRACER RECOVERED*)
000003      END;
000003      COEFFS=RECORD
000003          FCOEFF%REAL;      (*COEFFS FOR Y=A*E**BX*)
000003          A%REAL;
000003          B%REAL;
000003      END;
000003  VAR
000003      BUFFER%ISOTOPE;      (*TEMP FOR STRING VARIABLES*)
000003      WORD%ALFA;      (*ALFA WORD HOLDER*)
000005      SAMPLE%ARRAY[1..SIZE] OF UNIT;      (*SAMPLE INFO ARRAY*)
000705      DATA%ARRAY[1..7,1..SIZE,1..SPECTRUMSIZE] OF INTEGER;      (*COUNTING DATA*)
070705      LNUM%INTEGER;      (*DUMMY FOR LINE NUMBER READ*)
070706      PTR%INTEGER;      (*MCA CHANNEL NUMBER INDICATOR*)
070707      PEAK%ARRAY[1..SIZE,1..NUMANALYSES] OF BOUND;      (*PEAK BOUNDARY TABLE*)
071707      LOCATION%ARRAY[1..NUMANALYSES] OF 1..SPECTRUMSIZE;      (*PEAK LOCATION TABLE*)
071717      CTSEC%INTEGER;      (*MCA COUNT TIME IN SEC*)
071720      CHANNEL%INTEGER;      (*MCA CHANNEL*)
071721      CT%INTEGER;      (*TOTAL TRACER COUNTS*)
071722      CIT%INTEGER;      (*TOT CTS INTERFERING W/TRACER PEAK*)
071723      CBT%REAL;      (*TRACER BACKGROUND*)
071724      CX%INTEGER;      (*TOTAL CTS FOR ANALYSIS PEAK*)
071725      CIX%INTEGER;      (*TOT CTS INTERF W/ANALYSIS PEAK*)
071726      CBX%REAL;      (*ANALYSIS PEAK BKG*)
071727      SCBT%REAL;      (*STD DEV OF TRACER BKG*)
071730      SCBX%REAL;      (*STD DEV OF ANALYSIS BKG*)
071731      TX%REAL;      (*INTERFERENCE RATIO FOR ANALY PEAK*)
071732      STX%REAL;      (*STD DEV OF INTERF RATIO*)
071733      AX%REAL;      (*SAMP ACTIVITY IN PCI/UNIT QUAN*)
071734      SAX%REAL;      (*STD DEV OF SAMPLE ACTIVITY*)
071735      KEVCH%REAL;      (*ALPHA ENERGY SCALE*)
071736      COL%ARRAY[1..11] OF COLUMN;      (*NUMBER OF COLS THAT MAY BE *)
071777      (*LOADED WITH OUTPUT DATA*)
071777      NUMSPEC%INTEGER;      (*INDEXING VARIABLE FOR SPECTRAL=
072000      (*OUTPUT*)
072000      ADDITION%INDEX;      (*NO. OF SPECTRA ADDED AFTER A*)
072001      FIT%ARRAY[1..NUMANALYSES] OF COEFFS;      (*COEFFS FROM EFIT PROCEDURE*)
072031      P%1..SPECTRUMSIZE;      (*CHANNEL POINTER*)
072032      SHIFT%INTEGER;      (*CALIBRATION SHIFT FOR ALPHA DET*)
072033      (*PASS OF THE COLUMN SCHEDULER*)
072033
072033  FUNCTION ISCODE(NAME%ISOTOPE)%INDEX;
000004      (*-----*)
000004      (*RETURNS INDEX FOR TABLE LOOKUP OF ISOTOPE DEPENDENT PARAMETERS*)
000004      (*-----*)
000004  BEGIN      (*ISCODE*)
000004      IF NAME==PU242 THEN ISCODE%=1
000011      ELSE IF NAME==PU239 THEN ISCODE%=2
000015      ELSE IF NAME==PU238 THEN ISCODE%=3
000021      ELSE IF NAME==PU236 THEN ISCODE%=4
000025      ELSE IF NAME==AM243 THEN ISCODE%=5
000031      ELSE IF NAME==AM241 THEN ISCODE%=6
000035      ELSE IF NAME==PO210 THEN ISCODE%=7

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000041     ELSE IF NAME=PO208 THEN ISCODE%=8;
000046     END;  (*ISCODE*)
000063
000063 FUNCTION FINDPEAK(START%INDEX)%INDEX;
000064  (*-----*)
000004  (*FROM THE STARTING POINT %START%, FIND THE HIGHST CHANNEL WITHIN *)
000004  (*THE INTERVAL START-9 TO START+1. IF A CHANNEL THE ESTIMATED *)
000004  (*PEAKCHANNEL IS NOT FOUND THEN FINDPEAK=START ELSE FINDPEAK=THE *)
000004  (*BIGGEST CHANNEL ENCOUNTERED. *)
000004  (*-----*)
000004  VAR
000004      K%1..SPECTRUMSIZE;          (*LOOP VARIABLE*)
000005      PEAKCHAN%1..SPECTRUMSIZE;    (*SWAPPING VARIABLE*)
000006  BEGIN (*FINDPEAK*)
000006      PEAKCHAN%=START-4;
000013      FOR K%=(START-9) TO (START+1) DO
000015          IF DATA[PRIMARY,I,K]>DATA[PRIMARY,I,PEAKCHAN]
000033              THEN PEAKCHAN%=K;
000044          IF (DATA[PRIMARY,I,PEAKCHAN]>DATA[PRIMARY,I,START-4])AND
000064              (DATA[PRIMARY,I,PEAKCHAN]>5)
000073              THEN FINDPEAK%=PEAKCHAN
000073          ELSE FINDPEAK%=START-4;
000102      END;  (*FINDPEAK*)
000115
000115 PROCEDURE EXTRAP(SUBJECT%ISOTOPE; PTR%INTEGER);
000005  (*-----*)
000005  (*CONSTRUCTS EXTRAPOLATED SPECTRUM ON THE SUBJECT ISOTOPE USING *)
000005  (*PREVIOUSLY DETERMINED EXPONENTIAL FITS *)
000005  (*-----*)
000005  VAR  J%INTEGER;          (*INDEX VARIABLE*)
000006      P%INTEGER;          (*CHANNEL POINTER*)
000007      OFFSET%INTEGER;      (*OFFSET TO REFERENCE PEAK*)
000010      AX%REAL;            (*Y=AX*E**B(X)*)
000011      REF%INTEGER;        (*REFERENCE PEAK FOR EXTRAP*)
000012      INDX%1..NUMANALYSES; (*SPECTRUM INDX*)
000013  BEGIN (*EXTRAP*)
000013      (*-----*)
000013      (*BUILD AND STORE EXTRAPOLATED SPECTRA DATA*)
000013      (*-----*)
000013      IF SUBJECT=SAMPLE[1].TRACER
000013      THEN(*SPECTRUM STORED IN E4*) INDX%=E4
000017      ELSE(*SPECTRUM STORED IN E(K) OF ANALYSIS(K)*)
000020          CASE K OF
000025              1%INDX%=E1;
000027              2%INDX%=E2;
000031              3%INDX%=E3;
000033          END;
000036      J%=PEAK[1,ISCODE(SUBJECT)].LOW-1;
000053      P%=FINDPEAK(LOCATION[ISCODE(SUBJECT)]);
000066      REF%=FINDPEAK(LOCATION[PTR]);
000077      AX%=DATA[PRIMARY,I,P]*FIT[PTR].A/DATA[PRIMARY,I,REF];
000126      OFFSET%=REF-P;
000127      WITH FIT[PTR] DO
000134      REPEAT
000134          DATA[INDX,I,J]%=ROUND(AX*EXP(B*(J-OFFSET)));
000174          J%=PRED(J);
000175          UNTIL ((J=1) OR (DATA[INDX,I,J+1]<=1));
000212          (*END OF SPECTRUM RANGE OR EXTRAP CTS<= PRIMARYCTS/100+1*)
000212      END;  (*EXTRAP*)
000234
000234 FUNCTION INTEGRAL(K%INDEX;SUBJECT%ISOTOPE)%INTEGER;

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000005 (*-----*)
000005 (*PERFORMS A SUMMATION ON THE DATA ARRAY BETWEEN TWO LIMITS WHICH ARE*)
000005 (*DEFINED BY THE PEAK WINDOW FOR THE ISOTOPE OF INTEREST. K=PRIMARY=1*)
000005 (*IS THE COUNTING DATA;K=E1,E2,E3=4,5,6 IS THE EXTRAPOLATED DATA *)
000005 (*-----*)
000005 VAR
000005     TOTAL%INTEGER; (*SUMMING VARIABLE*)
000006 BEGIN (*INTEGRAL*)
000006     TOTAL%=0;
000010     FOR J%=PEAK[1,ISCODE(SUBJECT)].LOW TO PEAK[1,ISCODE(SUBJECT)].HIGH DO
000040         TOTAL%=TOTAL+DATA[K,1,J];
000057     INTEGRAL%=TOTAL;
000061     END; (*INTEGRAL*)
000071
000071 FUNCTION POORRES(SUBJECT%ISOTOPE)%BOOLEAN;
000004 (*-----*)
000004 (*CHECKS RESOLVABILITY ON THE SUBJECT PEAK. MUST FIND A CHANNEL OF *)
000004 (*<=PEAKCHANNEL/100+1 WITHIN 130 KEV OF THE PEAKCHANNEL OR THE POOR *)
000004 (*RESOLUTION FLAG IS SET *)
000004 (*-----*)
000004 CONST
000004     KEVCH=16; (*ENERGY SCALE*)
000004 VAR
000004     PEAKCHAN%1..SPECTRUMSIZE; (*PEAK CHANNEL NUMBER*)
000005     K%INDEX; (*INDEXING VARIABLE*)
000006 BEGIN (*POORRES*)
000006     IF SUBJECT<>= = (*THEN CHECK RESOLABILITY*)
000007     THEN BEGIN
000011         POORRES%=TRUE;
000012         PEAKCHAN%=FINDPEAK(LOCATION[ISCODE(SUBJECT)]);
000026         FOR K%=PEAKCHAN TO PEAKCHAN+ROUND(130/KEVCH) DO
000037             (*-----*)
000037             (*COMPARE DATA[PRIMARY,1,K] TO PEACHAN/100+1*)
000037             (*-----*)
000037             IF DATA[PRIMARY,1,K]<=DATA[PRIMARY,1,PEAKCHAN]/100+1
000064             THEN POORRES%=FALSE;
000075         END
000075     ELSE POORRES%=FALSE; (*NO ANALYSIS*)
000077     END; (*POORRES*)
000111
000111 FUNCTION DIAGNOSIS%DIAGNOSTIC;
000003 (*-----*)
000003 (*TROUBLE DETECTOR MODULE. AS OF 10/5/76 IT IS LIMITED TO CHECKING FOR*)
000003 (*POOR RESOLUTION ON THE ALPHA PEAKS; IT SHOULD BE EXPANDED AS ANALYSIS*)
000003 (*FAULTS ARE DETECTED *)
000003 (*-----*)
000003 BEGIN (*DIAGNOSIS*)
000003     WITH SAMPLE[1] DO
000014     BEGIN
000014         IF (POORRES(TRACER)OR(POORRES(ANALYSIS[1]))OR(POORRES(ANALYSIS[2]))OR
000030         (POORRES(ANALYSIS[3])))
000035         THEN DIAGNOSIS%=BADRES
000036         ELSE DIAGNOSIS%=NOTROUBLE;
000040     END;
000040     END; (*DIAGNOSIS*)
000045
000045 PROCEDURE OUTHEADER;
000003 (*-----*)
000003 (*WRITES OUTPUT HEADER IDENTIFICATION *)
000003 (*-----*)
000003 BEGIN (*OUTHEADER*)

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000003 LINE%:=1;
000007 WRITELN(= ALPHA SPECTRA ANALYSES=,
000014 = PAGE =,PAGE%2); L;
000027 WRITELN; L;
000031 WRITELN(= DATE COUNTED=,COUNTDATE%10,
000043 = COUNTING TIME=,CTSEC%7,= SECONDS=); L;
000064 WRITELN; L;
000066 END; (*OUTHEADER*)
000111
000111
000111 PROCEDURE CALCHEADING;
000003 (*-----*)
000003 (*PRODUCES THE HEADING FOR CALCULATED RESULT OUTPUT *)
000003 (*-----*)
000003 BEGIN (*CALCHEADING*)
000003 WRITELN(=DET SAMPLE ISOTOPE GROSS BKGD EXTRAP FIT=,
000013 = SAMPLE ACTIVITY=); L;
000022 WRITELN(= ID COUNT COUNT COUNT COEFF=); L;
000031 WRITELN(=-----=,
000036 = -----=); L;
000045 END; (*CALCHEADING*)
000076
000076 FUNCTION CALCRESOLUTION(SUBJECT%ISOTOPE)%REAL;
000004 (*-----*)
000004 (*CALCULATES THE FWHM RESOLUTION IN KEV FOR THE SUBJECT PEAK. ENERGY*)
000004 (*SCALE IS COPIED FROM THE EXTERNAL FILE DETDATA. RESOLUTION IS *)
000004 (*RETURNED AS 0 IF THE PEAK CHANNEL CONTAINS LESS THAN THE NUMBER OF *)
000004 (*COUNTS SPECIFIED BY THE CONSTANT MINHEIGHT *)
000004 (*-----*)
000004 CONST
000004 MINHEIGHT=25; (*MIN NECESSARY PEAK HEIGHT FOR*)
000004 (*MEANINGFUL RESOLUTION *)
000004 VAR
000004 HALFMAXHIGH%REAL; (*HALFMAX CH ON HIGH SIDE PEAK *)
000005 HALFMAXLOW%REAL; (*HALFMAX CH ON LOW SIDE PEAK *)
000006 J%INDEX; (*CHANNEL INDEXING VARIABLE *)
000007 PEAKCHANNEL%INDEX; (*PEAK CHANNEL FOR THE SUBJ PEAK*)
000010 BEGIN (*CALCRESOLUTION*)
000010 PEAKCHANNEL%=FINDPEAK(LOCATION(ISCODE(SUBJECT)));
000023 IF DATA(PRIMARY,1,PEAKCHANNEL)>MINHEIGHT
000030 THEN BEGIN
000033 (*-----*)
000033 (*FIND HALFMAX ON THE HIGH SIDE*)
000033 (*-----*)
000033 J%=PEAKCHANNEL;
000035 WHILE((DATA(PRIMARY,1,J))>=DATA(PRIMARY,1,PEAKCHANNEL)/2)AND
000062 (J<SPECTRUMSIZE) DO J%=SUCC(J);
000066 HALFMAXHIGH%=(DATA(PRIMARY,1,PEAKCHANNEL)/2-DATA(PRIMARY,1,J-1))/
000111 (DATA(PRIMARY,1,J)-DATA(PRIMARY,1,J-1))*J;
000134 (*-----*)
000134 (*FIND HALFMAX ON THE LOW SIDE*)
000134 (*-----*)
000134 J%=PEAKCHANNEL;
000137 WHILE ((DATA(PRIMARY,1,J))>=DATA(PRIMARY,1,PEAKCHANNEL)/2)AND
000164 (J>1) DO J%=PRED(J);
000170 HALFMAXLOW%=ABS((DATA(PRIMARY,1,J)-DATA(PRIMARY,1,PEAKCHANNEL)/2)/
000213 (DATA(PRIMARY,1,J)-DATA(PRIMARY,1,J+1))*J);
000237 CALCRESOLUTION%=(HALFMAXHIGH-HALFMAXLOW)*KEVCH;
000241 END ELSE CALCRESOLUTION%=0;
000244 END; (*CALCRESOLUTION*)
000261
000261 PROCEDURE INTERFRATIO(SUBJECT%ISOTOPE;VAR TX%REAL;VAR STX%REAL);

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000006 (*-----*)
000006 (*SELECTS THE PROPER TX(TRACER INTERFERENCE RATIO) AND STX(STD DEV OF *)
000006 (*THE TRACER INTERFERENCE RATIO) FOR THE ANALYSIS OF INTREST. *)
000006 (*NOTE THIS PROCEDURE MUST BE UPDATED AS NEW TRACER STOCKS ARE RECEIVED*)
000006 (*-----*)
000006 BEGIN (*INTERFRATIO*)
000006 WITH SAMPLE(1) DO
000015 BEGIN
000015 IF TRACER=PU242 THEN
000020 IF (((TRACERDPM/11.2*10)-TRUNC(TRACERDPM/11.2*10))=0) (*LLL-8*)
000036 THEN BEGIN
000036 CASE ISCODE(SUBJECT) OF
000044 4XBEGIN TX=0; STX=0; END; (*PU236 RATIOS UNKNOWN AT THIS TIME*)
000053 3XBEGIN TX=0.0006; STX=0.0004; END; (*PU238*)
000057 2XBEGIN TX=0.0002; STX=0.0002; END; (*PU239*)
000062 END; (*CASE*)
000065 END ELSE IF (((TRACERDPM/11.8*10)-TRUNC(TRACERDPM/11.8*10))=0)
000104 THEN BEGIN
000104 CASE ISCODE(SUBJECT) OF
000112 4XBEGIN TX=0; STX=0; END; (*PU236 RATIOS UNKNOWN*)
000121 3XBEGIN TX=0.00026; STX=0.00012; END; (*PU238*)
000125 2XBEGIN TX=0.0001; STX=0.0001; END; (*PU239*)
000130 END; (*CASE*)
000133 END ELSE IF (((TRACERDPM/10.8*10)-TRUNC(TRACERDPM/10.8*10))=0)
000151 THEN BEGIN
000151 CASE ISCODE(SUBJECT) OF
000157 4XBEGIN TX=0; STX=0; END; (*PU236 RATIOS UNKNOWN*)
000166 3XBEGIN TX=0.00026; STX=0.00012; END; (*PU238*)
000172 2XBEGIN TX=0.0001; STX=0.0001; END; (*PU239*)
000175 END; (*CASE*)
000200 END ELSE WRITELN(=UNKNOWN TRACER FOR SAMPLE =,ID*10)
000213 ELSE IF (TRACER=AM243) AND (SUBJECT=AM241)
000222 THEN IF (((TRACERDPM/11.3*10)-TRUNC(TRACERDPM/11.3*10))=0) (*LLL-2*)
000244 THEN BEGIN TX=0.0021; STX=0.003; END (*AM241*)
000247 ELSE WRITELN(=UNKNOWN TRACER FOR SAMPLE =,ID*10)
000261 ELSE IF (TRACER=PO208) AND (SUBJECT=PO210)
000267 THEN IF (((TRACERDPM/11.0*10)-TRUNC(TRACERDPM/11.0*10))=0)
000311 THEN BEGIN TX=0.0004; STX=0.0002; END
000314 ELSE WRITELN(=UNKNOWN TRACER FOR SAMPLE =,ID*10)
000326 ELSE (*END OF TRACER TABLE*) BEGIN
000330 WRITELN(=UNKNOWN TRACER FOR SAMPLE =,ID*10);
000343 TX=0; STX=0;
000351 END;
000351 END;
000351 END;
000406
000406 FUNCTION SIGBKG(SUBJECT,ISOTOPE)REAL;
000004 (*-----*)
000004 (*COMPUTES THE STD DEV OF THE BKG COUNTS FOR THE ISOTOPE OF INTEREST*)
000004 (*DATA ARE ASSUMED TO RESIDE IN DATA(SB,I,K) *)
000004 (*-----*)
000004 VAR
000004 SIGMA:REAL; (*TEMP FOR STD DEV OF BKG COMP*)
000005 K:INDEX; (*CHANNEL INDEXING VARIABLE*)
000006 BEGIN (*SIGBKG*)
000006 SIGMA:=0;
000012 FOR K=PEAK[1,ISCODE(SUBJECT)].LOW TO PEAK[1,ISCODE(SUBJECT)].HIGH DO
000041 SIGMA:=SIGMA+SQR(DATA[SB,I,K]);
000060 SIGBKG:=SQRT(SIGMA);
000074 END; (*SIGBKG*)
000104
000104 PROCEDURE EFIT(SUBJECT,ISOTOPE);

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000004      (*-----*)
000004      (*PERFORMS AN EXPONENTIAL FIT ON THE ALPHA PEAK OF THE SUBJECT ISOTOPE.*)
000004      (*THE SEGMENT FITTED IS PEAKCHANNEL DOWNT0 PEAKCHANNEL-N-1. THE *)
000004      (*EXTRAPOLATION ARRAY IS AUTOMATICALLY CREATED AND STORED *)
000004      (*-----*)
000004      CONST
000004          N=10;                                (*0..N IS THE X INTERV OVER WHICH*)
000004                                              (*THE FIT IS TO TAKE PLACE*)
000004      VAR
000004          Y%ARRAY[1..SPECTRUMSIZE] OF INTEGER; (*DATA[PRIMARY,I,J]*)
000004          EX1%REAL;                             (*SUMMATION OF X1 FOR I=1 TO N*)
000205          EX12%REAL;                            (*      SQR(X1)      *)
000206          ELNY1%REAL;                          (*      LN(Y1)      *)
000207          ELNY12%REAL;                         (*      SQR(LN(Y1))  *)
000210          PEAKCHANNEL%INDEX;                  (*PEAKCHANNEL FOR SUBJECT PEAK*)
000211          J%INDEX;                            (*INDEXING VARIABLE*)
000212          INDX%1..NUMANALYSES;                (*      *)
000213          EX1LNY1%REAL;                      (*SUMMATION V%R FOR X1.LN(Y1)*)
000214      BEGIN (*EFIT*)
000214          PEAKCHANNEL%=FINDPEAK(LOCATION[ISCODE(SUBJECT)]);
000023      (*-----*)
000023      (*LOAD J,Y TABLE*)
000023      (*-----*)
000023      FOR J%=PEAKCHANNEL DOWNT0 (PEAKCHANNEL-(N-1)) DO
000025      BEGIN
000031          Y[J]%=DATA[PRIMARY,I,J];
000043          IF Y[J]=0 THEN Y[J]%=1;              (*AVOID LN(0)*)
000051          END;
000054      (*-----*)
000054      (*INITIALIZE ALL SUMMATION VARIABLES*)
000054      (*-----*)
000054          EX1%=0; EX12%=0; ELNY1%=0; ELNY12%=0; EX1LNY1%=0;
000071      (*-----*)
000071      (*GATHER STATISTICS*)
000071      (*-----*)
000071      FOR J%=PEAKCHANNEL DOWNT0 (PEAKCHANNEL-(N-1)) DO
000074      BEGIN
000100          EX1%=EX1+J;
000104          EX12%=EX12+SQR(J);
000107          ELNY1%=ELNY1+LN(Y[J]);
000131          ELNY12%=ELNY12+SQR(LN(Y[J]));
000152          EX1LNY1%=J*LN(Y[J])+EX1LNY1;
000177          END;
000200      (*-----*)
000200      (*COMPUTE FITTING COEFFICIENTS*)
000200      (*-----*)
000200      WITH FIT[ISCODE(SUBJECT)]
000207      DO BEGIN
000210          B%=(EX1LNY1-EX1*ELNY1/(N))/(EX12-SQR(EX1)/(N));
000221          A%=EXP(ELNY1/N-B*EX1/(N));
000246          FCOEFF%=SQR(EX1LNY1-EX1*ELNY1/(N))/((EX12-SQR(EX1)/(N))*
000257              (ELNY12-SQR(ELNY1)/(N)));
000264          END;
000264      END;
000310
000310      FUNCTION BKG(SUBJECT%ISOTOPE)%INTEGER;
000004      (*-----*)
000004      (*SUMS UP THE TOTAL BKG IN THE WINDOW AREA FOR A GIVEN ISOTOPE *)
000004      (*THE BKG INFORMATION IS ASSUMED TO RESIDE IN DATA[B,I,K] *)
000004      (*-----*)
000004      VAR
000004          BKG0%INTEGER;                        (*TEMP HOLDER FOR BKG SUMMATION*)
000005          K%INDEX;                            (*CHANNEL ADDRESSING INDEX*)

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000006 BEGIN (*BKG*)
000006 BKGD%=0;
000007 FOR K%=PEAK[I,ISCODE(SUBJECT)].LOW TO PEAK[I,ISCODE(SUBJECT)].HIGH DO
000037 BKGD%=BKGD+DATA[B,I,K];
000053 BKGD%=ROUND(BKGD+CTSEC/80000);
000067 BKG%=BKGD;
000067 END; (*BKG*)
000077
000077 PROCEDURE WINDOW(SUBJECT%ISOTOPE);
000004 (*-----*)
000004 (* ESTABLISHES BNDRY MARKERS FOR PEAK DEFINITION AROUND THE SUBJECT*)
000004 (* PEAK. WINDOWING METHOD IS P-6 TO P+3 INCLUSIVE. *)
000004 (*-----*)
000004 BEGIN (*WINDOW*)
000004 PEAK[I,ISCODE(SUBJECT)].LOW%=FINDPEAK(LOCATION[ISCODE(SUBJECT)])-6;
000041 PEAK[I,ISCODE(SUBJECT)].HIGH%=FINDPEAK(LOCATION[ISCODE(SUBJECT)])+3;
000074 END; (*WINDOW*)
000077
000077
000077 BEGIN (*ASPEC*)
000077 (*-----*)
000077 (*INITIALIZE*)
000077 (*-----*)
000077 FOR J%=1 TO SIZE DO WITH SAMPLE [J] DO
000016 BEGIN
000016 FOR K%=1 TO 10 DO ID[K]%=≡ ≡;
000032 FOR J%=1 TO 3 DO ANALYSIS[K]%=≡ ≡;
000043 END;
000045 (*-----*)
000045 (*READ ID INFORMATION INTO ARRAY *SAMPLE**)
000045 (*-----*)
000045 RESET(IDENTS);
000046 WRITELN(ENTER DATE COUNTED - EXAMPLE 12/01/76=);
000054 READ(CH); READ(CH);
000066 READWORD(INPUT,COUNTDATE,LENGTH);
000071 J%=1;
000072 WHILE (J<=SIZE) AND (NOT(EOF(IDENTS))) DO WITH SAMPLE[J] DO
000101 BEGIN
000101 K%=1;
000102 SKIPBLANKS(IDENTS);
000103 REPEAT
000103 (*-----*)
000103 (*READ SAMPLE NAME*)
000103 (*-----*)
000103 READ(IDENTS,ID[K]);
000116 K%=SUCC(K);
000120 UNTIL (K>10) OR (IDENTS'=≡ ≡) OR (EOF(IDENTS));
000124 SKIPBLANKS(IDENTS);
000126 IF ((NOT(ID=NO-SAMPLE ≡)) AND (NOT(EOF(IDENTS))))
000132 THEN (*READ REST OF SAMPLE INFORMATION*)
000132 (*-----*)
000132 (*READ ANALYSES*)
000132 (*-----*)
000132 BEGIN
000132 READWORD(IDENTS,OWNER,LENGTH);
000135 IF OWNER[J]=≡0≡ THEN OWNER%=SAMPLE[J-1].OWNER;
000146 J%=1;
000147 REPEAT
000147 K%=1;
000150 REPEAT
000150 READ(IDENTS,BUFFER[K]);

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000163      K%=SUCC(K);
000165      UNTIL (K>5) OR (BUFFER(I)=0=);
000171      IF NOT(IDENTS'= =) THEN GET(IDENTS);
000174      IF BUFFER(I)=0= THEN ANALYSIS(J)%=SAMPLE(PRED(I)).ANALYSIS(J)
000212      ELSE ANALYSIS(J)%=BUFFER;
000220      J%=SUCC(J);
000222      UNTIL (J>3) OR (IDENTS'= =);
000226      SKIPBLANKS(IDENTS);
000227      (*-----*)
000227      (*READ TRACER ISOTOPE*)
000227      (*-----*)
000227      K%=1;
000230      REPEAT
000230      READ(IDENTS,TRACER(K));
000243      K%=SUCC(K);
000245      UNTIL (K>5) OR (TRACER(I)=0=);
000252      IF TRACER(I)=0= THEN TRACER%=SAMPLE(I-1).TRACER;
000261      SKIPBLANKS(IDENTS);
000263      (*-----*)
000263      (*READ REMAINING SAMPLE VALUES*)
000263      (*-----*)
000263      READ(IDENTS,TRACERDPM,SAMPQUAN,ALQTFRAC);
000277      IF TRACERDPM=0 THEN TRACERDPM%=SAMPLE(PRED(I)).TRACERDPM;
000311      IF SAMPQUAN=0 THEN SAMPQUAN%=SAMPLE(PRED(I)).SAMPQUAN;
000323      IF ALQTFRAC=0 THEN ALQTFRAC%=SAMPLE(PRED(I)).ALQTFRAC;
000335      SKIPBLANKS(IDENTS);
000337      READ(IDENTS,UNITS);
000344      IF UNITS=0= THEN UNITS%=SAMPLE(PRED(I)).UNITS;
000357      SKIPBLANKS(IDENTS);
000361      IF TRACER=P0208= THEN (*READ SEPARATION DATE*)
000365      BEGIN
000365      SEPDATE%=
000365      K%=1;
000366      WHILE NOT(EOLN(IDENTS)) AND (K<=8) DO
000367      BEGIN
000372      READ(IDENTS,SEPDATE(K));
000404      K%=SUCC(K);
000406      END;
000406      IF SEPDATE(I)=X= THEN SEPDATE%=SAMPLE(I-1).SEPDATE;
000417      END;
000417      SKIPBLANKS(IDENTS);
000421      IF (NOT(EOF(IDENTS))) THEN READLN(IDENTS);
000423      I%=SUCC(I);
000425      END;
000425
000425      (*-----*)
000425      (*ECHO SAMPLE INPUT INFORMATION TO HARD COPY OUTPUT*)
000425      (*WRITE HEADING *)
000425      (*-----*)
000425      NEWPAGE;
000426      DELIMETER;
000427      WRITELN(= SAMPLE INFORMATION=);
000435      WRITELN; WRITELN;
000437      WRITELN(= ACT =,
000444      = ALQT SEP=);
000452      WRITELN(=DET ID ANALYSES TRACER TRAC QUAN =,
000457      =FRAC UNITS DATE=);
000465      WRITELN(=-----=,
000472      =-----=);
000500      LINE%=7;
000501      (*-----*)
000501      (*WRITE SAMPLE INFORMATION FOR ALL SAMPLES ANALYZED*)

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```

000501      (*-----*)
000501      I%=1;
000502      WHILE I<=SIZE DO
000504      BEGIN
000504          IF (SAMPLE[I].ID<>=          =) THEN WITH SAMPLE[I] DO
000516              BEGIN
000516                  WRITE(I%2,=,ID%10,=,ANALYSIS[I]*6,ANALYSIS[I2]*6,ANALYSIS[I3]*6,
000552                      TRACER*6,TRACERDPM*7*1,SAMPQUAN*9*3,ALQTFRAC*6*3,
000576                      UNITS*4);
000603                  IF TRACER=PO208=
000604                      THEN WRITELN(SEPDATE*11)
000614                      ELSE WRITELN;
000617                      LINE%=SUCC(LINE);
000621                  END;
000621                  I%=SUCC(I);
000623              END;
000623      FILLER;
000624      (*-----*)
000624      (*READ COUNTING DATA FOR SPECTRUMSIZE*SIZE CHANNELS INTO THE DATA*)
000624      (*ARRAY *DATA*. READS AND DISCARDS THE CANBERRA 8100 LINE NUMBER*)
000624      (*FORMATTING. INPUT IS FROM THE EXTERNAL FILE CTDAT. *)
000624      (*DISCARD HEADER,READ CTTIME AND FIRST LINE NUMBER *)
000624      (*-----*)
000624      RESET(CTDAT);
000625      READLN(CTDAT);
000626      READLN(CTDAT,CTSEC);
000632      READLN(CTDAT,LNUM);
000636      (*-----*)
000636      (*INITIALIZE READER*)
000636      (*-----*)
000636      I%=1; CHANNEL%=1; PTR%=1;
000641      (*-----*)
000641      (*READ DATA UNTIL EOF(CTDAT) OR LAST DETECTOR DATA IS FILLED*)
000641      (*-----*)
000641      REPEAT
000641          (*-----*)
000641          (*READ DATA UNTIL EOF(CTDAT) OR CURRENT DETECTOR IS FILLED OR*)
000641          (*A LINE NUMBER IS ENCOUNTERED *)
000641          (*-----*)
000641          REPEAT
000641              READ(CTDAT,DATA[PRIMARY,I,CHANNEL]);
000653              CHANNEL%=SUCC(CHANNEL); PTR%=SUCC(PTR);
000656              UNTIL (EOF(CTDAT) OR (CHANNEL>SPECTRUMSIZE) OR ((PTR MOD 101)=0));
000665          (*-----*)
000665          (*IF LINE NUMBER THEN DISCARD*)
000665          (*-----*)
000665          IF NOT (EOF(CTDAT))
000665              THEN BEGIN
000666              IF (PTR MOD 101)=0
000671                  THEN BEGIN
000672                      READLN(CTDAT,LNUM);
000676                      PTR%=SUCC(PTR);
000700                      END;
000700                      IF CHANNEL>SPECTRUMSIZE
000700                          THEN BEGIN
000702                              I%=SUCC(I);
000704                              CHANNEL%=1;
000704                              END;
000704                          END;
000704                      UNTIL (EOF(CTDAT) OR (I>SIZE));
000707          (*-----*)
000707          (*ECHO COUNTING DATA AS RECIEVED*BY THE DATA[I,CHANNEL] ARRAY*)
000707          (*-----*)
000707      (*NEWPAGE; DELIMETER;

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```

000707      WRITELN(CTSEC%6);
000707      FOR I%=1 TO SIZE DO
000707      BEGIN
000707          CHANNEL%=1;
000707          WHILE CHANNEL<=128 DO
000707          BEGIN
000707              WHILE ((CHANNEL MOD 10<>0) AND (CHANNEL MOD 128<>0)) DO
000707              BEGIN
000707                  WRITE(DATA[I,CHANNEL]%6);
000707                  CHANNEL%=SUCC(CHANNEL);
000707              END;
000707              WRITELN(DATA[I,CHANNEL]%6);
000707              CHANNEL%=SUCC(CHANNEL);
000707          END;
000707      END;
000707      DELIMITER;*
000707      (*-----*)
000707      (*READ BKG INFORMATION FROM FILE BKGDFL*)
000707      (*-----*)
000707      RESET(BKGDFL);
000710      FOR I%=1 TO SIZE DO
000711      FOR K%=1 TO SPECTRUMSIZE DO
000714      READ(BKGDFL,DATA[B,I,K],DATA[SB,I,K]);
000745      (*-----*)
000745      (*CALCULATE AND OUTPUT RESULTS FOR ALL SAMPLES ANALYZED*)
000745      (*-----*)
000745      LINE%=63; RESET(DETDATA);
000747      FOR I%=1 TO SIZE DO WITH SAMPLE[I] DO
000757      BEGIN
000757          (*-----*)
000757          (*PICK UP DETECTOR DEPENDENT INFORMATION*)
000757          (*-----*)
000757          READ(DETDATA,EFFICIENCY,KEYCH);
000765          FOR K%=1 TO NUMANALYSES DO READ(DETDATA,LOCATION[K]);
000777          (*-----*)
000777          (*BEGIN ANALYSES*)
000777          (*-----*)
000777          IF ((ID<>=NO-SAMPLE =)AND(ID<>=                =))
001004      THEN BEGIN
001004          SHIFT%=0;
001005          WINDOW(TRACER);
001007          IF NOT(POORRES(TRACER))
001012      THEN BEGIN
001013              (*-----*)
001013              *FIND LEADING EDGE AND SEARCH FOR CAL SHIFT*
001013              (*-----*)
001013              P%=FINDPEAK(LOCATION[ISCODE(TRACER)]);
001030              J%=P;
001031              REPEAT
001031                  J%=SUCC(J);
001033                  UNTIL ((DATA[PRIMARY,I,J]<=ROUND(DATA[PRIMARY,I,P]/50))
001056                      OR(DATA[PRIMARY,I,J]<5));
001065              SHIFT%=J-LOCATION[ISCODE(TRACER)];
001075              IF ABS(SHIFT)<=2
001076      THEN SHIFT%=0
001077              ELSE FOR K%=1 TO 3 DO
001101                  IF ANALYSIS[K]<>=                =
001106      THEN LOCATION[ISCODE(ANALYSIS[K])]%=
001120                  LOCATION[ISCODE(ANALYSIS[K])]+SHIFT;
001141      END;
001141      (*-----*)
001141      (*WINDOW ALL ANALYSES*)
001141      (*-----*)
001141      FOR K%=1 TO 3 DO

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001142      IF ANALYSIS(K)<>=      =
001147      THEN WINDOW(ANALYSIS(K));
001160      IF LINE>62
001160      THEN BEGIN
001162          (*-----*)
001162          (*START A NEW PAGE*)
001162          (*-----*)
001162          DELIMITER; NEWPAGE; DELIMITER;
001165          PAGE#=SUCC(PAGE);
001167          OUTHEADER;
001170          CALCHEADING;
001172          END;
001172          (*-----*)
001172          (*CLEAR ALL TEMPORARY STORAGE LOCATIONS*)
001172          (*-----*)
001172      FOR K#=1 TO NUMANALYSES DO WITH FIT(K) DO
001202      BEGIN
001202          FCOEFF#=0; A#=0; B#=0;
001211          END;
001213      CASE DIAGNOSIS OF
001221      BADRES#BEGIN
001221          EFIT(Tracer);
001224          FOR K#=1 TO 3 DO IF ANALYSIS(K)<>=      = THEN EFIT(ANALYSIS(K));
001243          (*-----*)
001243          (*FIND BEST CORRELATION. IF NONE >0.80 THEN J=0*)
001243          (*-----*)
001243          J#=1;
001244          FOR K#=1 TO NUMANALYSES DO
001245          IF FIT(K).FCOEFF>FIT(J).FCOEFF THEN J#=K;
001262          IF FIT(J).FCOEFF<=0.80 THEN J#=0;
001271          (*-----*)
001271          (*ATTEMPT TO EXTRAPOLATE PEAK TAILS*)
001271          (*-----*)
001271          IF FIT(ISCODE(Tracer)).FCOEFF>0.90
001300          THEN (*USE IT*) EXTRAP(Tracer,ISCODE(Tracer))
001311          ELSE IF J<>0
001313          THEN EXTRAP(Tracer,J);
001317          (*-----*)
001317          (*USE IT FOR EXTRAPOLATIONS*)
001317          (*-----*)
001317          FOR K#=1 TO 3 DO
001320          IF ANALYSIS(K)<>=      =
001325          THEN IF FIT(ISCODE(ANALYSIS(K))).FCOEFF>0.90
001341          THEN (*USE IT*) EXTRAP(ANALYSIS(K),ISCODE(ANALYSIS(K)))
001360          ELSE IF J<>0
001362          THEN EXTRAP(ANALYSIS(K),J);
001373          END;
001374          NOTROUBLE# (*NO TROUBLE*) BEGIN (*CONTINUE*) END;
001375          END; (*CASE*)
001377          (*-----*)
001377          (*INTEGRATE TRACER AND OUTPUT RESULTS*)
001377          (*-----*)
001377          CT#=INTEGRAL(PRIMARY,Tracer);
001407          CIT#=INTEGRAL(E1,Tracer)+INTEGRAL(E2,Tracer)+INTEGRAL(E3,Tracer)+
001442          INTEGRAL(E4,Tracer);
001454          CBT#=BKG(Tracer);
001463          RECOVERY#=(CT-CIT-CBT)/(TRACERDPM*(CTSEC/60)*EFFICIENCY)*100;
001502          IF TRACER#=AM243=
001502          THEN (*CORRECT EFFICIENCY FOR SMALL PLATE*)
001505          RECOVERY#=RECOVERY*0.89;
001506          RESOLUTION#=CALCRESOLUTION(Tracer);
001515          WRITE(IX2,ID#12,TRACER#7,CT#8,CBT#6#2,CIT#7);
001547          IF (FIT(ISCODE(Tracer)).FCOEFF=0)
001561          THEN WRITE(= -- =)

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001566 ELSE WRITE(FIT[ISCODE(TRACER)].FCOEFF%5%2);
001604 WRITELN(= -----=); L;
001613 (*-----*)
001613 (*COMPUTE AND OUTPUT RESULTS FOR ALL ANALYSES*)
001613 (*-----*)
001613 FOR K%=1 TO 3 DO
001614 IF ANALYSIS(K)<>= =
001621 THEN BEGIN (*PROCESS*)
001624 CX%=INTEGRAL(PRIMARY,ANALYSIS(K));
001633 CIX%=INTEGRAL(E1,ANALYSIS(K))+INTEGRAL(E2,ANALYSIS(K))+
001656 INTEGRAL(E3,ANALYSIS(K))+INTEGRAL(E4,ANALYSIS(K));
001704 CBX%=BKG(ANALYSIS(K));
001714 INTERFRATIO(ANALYSIS(K),TX,STX);
001723 IF ((CX-CBX-CIX)=0) THEN CX%=CX+1;
001736 IF ((CT-CBT-CIT)=0) THEN CT%=CT+1;
001751 IF ((CT-CBT)=0) THEN CT%=CT+1;
001761 AX%= ((CX-CIX-CBX)/(CT-CIT-CBT)-TX)*TRACERDPM/
001774 (SAMPQUAN*2.22*ALQTFRAC);
001777 IF ANALYSIS(K)=P0210=
002002 THEN (*DECAY CORRECT*)
002005 AX%=AX/(EXP(-(0.693/138.4*ET(SEPDATE,0,0,COUNTDATE,0,0))));
002043 (*-----*)
002043 (*COMPUTE STD DEV OF SAMPLE ACTIVITY*)
002043 (*-----*)
002043 SCBX%=SIGBKG(ANALYSIS(K));
002053 SCBT%=SIGBKG(TRACER);
002060 SAX%=ABS(AX*(SQRT(((CX+SQR(SCBX)+CIX)/SQR(CX-CBX-CIX)+
002075 (CT+SQR(SCBT)+CIT)/SQR(CT-CBT-CIT))*
002111 SQR((CX-CBX)/(CT-CBT)) + SQR(STX))/
002121 SQR((CX-CBX)/(CT-CBT)-TX) + SQR(TRACERUNCER/TRACERDPM))));
002145 (*-----*)
002145 (*OUTPUT ANALYSIS RESULT*)
002145 (*-----*)
002145 WRITE(= =,ANALYSIS(K)%6,CX%B,CBX%6%2,CIX%7);
002177 IF FIT[ISCODE(ANALYSIS(K))].FCOEFF=0
002211 THEN WRITE(= -- =)
002221 ELSE WRITE(FIT[ISCODE(ANALYSIS(K))].FCOEFF%5%2);
002242 SIGDIGITS(AX,SAX);
002245 WRITE(= =);
002247 WRITELN(=PC1/=,UNITS); L;
002263 BUFFER%=ANALYSIS(K);
002270 WORD%= =;
002271 WORD(1)%=BUFFER(1); WORD(2)%=BUFFER(2); WORD(3)%=--=;
002305 FOR N%=4 TO 6 DO WORD(N)%=BUFFER(N-1);
002327 SYS2KFORM(AX,SAX,=P=,=C1 =,SAMPQUAN,UNITS,COUNTDATE,1D,
002343 OWNER,WORD);
002346 END;
002350 END;
002350 END;
002352 FILLER;
002353 DELIMITER;
002354 (*-----*)
002354 (*PRINT SPECTRAL DATA(INCLUDING EXTRAPOLATIONS) FOR ALL SAMPLES ANALYZED*)
002354 (*-----*)
002354 I%=1;
002355 WHILE I<=32 DO
002357 BEGIN
002357 NEWPAGE; DELIMITER;
002361 NUMSPEC%=0;
002362 WHILE ((NUMSPEC<8)AND(I<=32)) DO WITH SAMPLE(I) DO
002372 IF (ID<>=NO-SAMPLE =)AND(ID<>= =)
002374 THEN BEGIN
002376 ADDITION%=1;
002377 (*-----*)

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002377      (*LOOK AHEAD AT SPECTRAL OUTPUT FOR NEXT DETECTOR*)
002377      (*-----*)
002377      NUMSPEC%=SUCC(NUMSPEC);
002400      COL(NUMSPEC).NAME%=PRMRY;
002405      COL(NUMSPEC).DETECTOR%=1;
002414      COL(NUMSPEC).SPECTRA%=PRIMARY;
002421      FOR K%=E1 TO E4 DO
002422      BEGIN
002424          M%=1;
002424          WHILE ((M<128)AND(DATA[K,1,M]=0))
002441              DO M%=SUCC(M);
002443              IF M<128
002443                  THEN BEGIN
002444                      NUMSPEC%=SUCC(NUMSPEC);
002446                      ADDITION%=SUCC(ADDITION);
002451                      CASE K OF
002455                          E1%COL(NUMSPEC).NAME%=ANALYSIS(1);
002463                          E2%COL(NUMSPEC).NAME%=ANALYSIS(2);
002471                          E3%COL(NUMSPEC).NAME%=ANALYSIS(3);
002477                          E4%COL(NUMSPEC).NAME%=TRACER;
002505                          END; (*CASE*)
002511                      COL(NUMSPEC).DETECTOR%=1;
002521                      COL(NUMSPEC).SPECTRA%=K;
002530                      END;
002530                  END;
002532                  I%=SUCC(I);
002534                  END ELSE I%=SUCC(I);
002536      IF NUMSPEC<=8
002536      THEN BEGIN (*OK-GO ON TO NEXT DETECTOR*) END
002537      ELSE (*TO MANY SPECTRA-DON'T INCLUDE LAST DETECTOR ON THIS PAGE*)
002540      BEGIN NUMSPEC%=NUMSPEC-ADDITION; I%=PRED(I); END;
002542      (*-----*)
002542      (*WRITE THE PAGE TO OUTPUT*)
002542      (*-----*)
002542      WRITELN(=                               S P E C T R U M=);
002550      WRITE(=CHAN=,COL(1).DETECTOR%6);
002561      FOR K%=2 TO NUMSPEC DO WRITE(COL(K).DETECTOR%8);
002577      WRITELN;
002600      WRITE(= NO.=,COL(1).NAME%8);
002612      FOR J%=2 TO NUMSPEC DO WRITE(COL(J).NAME%8);
002631      WRITELN;
002632      FOR K%=5 TO 110 DO
002633      BEGIN
002635          WRITE(K%3);
002640          FOR J%=1 TO NUMSPEC DO WITH SAMPLE(COL(J).DETECTOR) DO
002655      BEGIN
002655          (*-----*)
002655          (*WRITE CHANNEL VALUES AND WINDOW MARKERS*)
002655          (*-----*)
002655          M%=COL(J).DETECTOR;
002661          WRITE(DATA(COL(J).SPECTRA,COL(J).DETECTOR,K)%7);
002705          IF ((K=PEAK(M,ISCODE(TRACER)).LOW)OR(K=PEAK(M,ISCODE(TRACER)).HIGH))
002740      THEN WRITE(=T=)
002742      ELSE BEGIN
002743          CH%= =;
002744          FOR N%= 1 TO 3 DO
002745              IF ANALYSIS(N)<>= =
002752              THEN IF ((K=PEAK(M,ISCODE(ANALYSIS(N))).LOW) OR
002772                  (K=PEAK(M,ISCODE(ANALYSIS(N))).HIGH))
003014                  THEN CH%=CHR(N);
003021                  WRITE(CH);
003025                  END;
003025      END;
003030      WRITELN;

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003031      END;
003033      DELIMITER;
003034      END;
003035      (*-----*)
003035      (*PRINT RECOVERY AND RESOLUTION DATA FOR ALL SAMPLES ANALYZED*)
003035      (*-----*)
003035      (*FORCE NEW PAGE*)
003035      (*-----*)
003035      LINE%=65;
003036      FOR I%=1 TO SIZE DO WITH SAMPLE{I} DO
003045      BEGIN
003045          IF LINE>62
003045          THEN BEGIN
003047              LINE%=1;
003047              IF I<>1 THEN DELIMITER;
003051              NEWPAGE; DELIMITER; PAGE%=SUCC(PAGE);
003055              OUTHEADER;
003056              WRITELN(=DET    SAMPLE    %    FWHM(KEV)=); L;
003065              WRITELN(=      ID    RECOVERY  RESOLUTION=); L;
003074              WRITELN(=---  -----  -----  -----=); L;
003103              END;
003103              IF ((NOT(ID=NO-SAMPLE =))AND(NOT(ID=      =)))
003110              THEN BEGIN
003110                  WRITELN(I%3,10%11,RECOVERY%8%0,RESOLUTION%10%0); L;
003135                  WRITELN; L;
003137                  END;
003137              END;
003141              FILLER; DELIMITER;
003143              END;
003332
003332      PROCEDURE ALPHABETA;
000003      (*-----*)
000003      (*CALCULATES ALPHA/BETA RESULTS FOR WIDE BETA11 COUNTING DATA*)
000003      (*-----*)
000003      TYPE
000003          DATA=RECORD                                (*SAMPLE INFO SET*)
000003              ID%ALFA;                                (*SAMPLE ID*)
000003              QUAN%REAL;                              (*SAMPLE QUANTITY*)
000003              OWNER%ALFA;                             (*SAMPLE OWNER*)
000003              UNITQUAN%PACKED ARRAY[1..4] OF CHAR;    (*SAMP UNIT QUANTITY*)
000003              TIME%REAL;                              (*COUNT LENGTH IN MIN*)
000003              ALPHACTS,BETACTS%REAL;                  (*TOTAL ALPHA/BETA CTS*)
000003              AX,BX%REAL;                             (*ALPHA/BETA ACTIVITIES*)
000003              SAX,SBX%REAL;                           (*STD DEVS OF A/B ACTIV*)
000003              MASS%REAL;                              (*PLANCHET MASS LOAD IN G*)
000003              END;
000003      VAR
000003          CH%CHAR;                                    (*CHARACTER HOLDER*)
000004          UNITS%PACKED ARRAY[1..6] OF CHAR;          (*ACTIVITY UNITS*)
000005          ALPHABKG,BETABKG%INTEGER;                  (*A/B TOTAL BKG COUNTS*)
000007          NUMSAMP%INTEGER;                           (*NUMB SAMPS TO BE PROCESSED*)
000010          N%INTEGER;                                 (*INDEXING VARIABLE*)
000011          EFFALPHA%REAL;                             (*ALPHA COUNTING EFF*)
000012          SEFFALPHA%REAL;                            (*STD DEV OF ALPHA EFF*)
000013          EFFBETA%REAL;                              (*BETA COUNTING EFF*)
000014          SEFFBETA%REAL;                             (*STD DEV OF BETA EFF*)
000015          TIMBKG%REAL;                               (*BACKGROUND COUNTING TIME*)
000016          SQQUAN%REAL;                              (*STD DEV OF SAMP QUAN*)
000017          DUMMY%REAL;                                (*TEMPORARY VARIABLE*)
000020          PREFIX%CHAR;                              (*ACTIV UNITS PREFIX *)
000021          MEDIUM%ALFA;                              (*SAMPLE MATRIX TYPE*)
000022          SAMPLE%PACKED ARRAY[1..60] OF DATA;       (*SET OF SAMPLES TO CALC*)
001342          XATOB%REAL;                               (*A TO B CROSSTALK*)

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001343          XBTOA%REAL;                                (*B TO A CROSSTALK*)
001344
001344  PROCEDURE GETPARAMETERS;
000003  (*-----*)
000003  (*GETS COUNTING INFORMATION FROM TERMINAL*)
000003  (*-----*)
000003  BEGIN (*GETPARAMETERS*)
000003      WRITELN(ENTER DATE COUNTED - EXAMPLE 12/01/76=);
000014      READ(CH);
000021      READWORD(INPUT,COUNTDATE,LENGTH);
000024      WRITELN(=ALPHA BACKGROUND=);
000032      READ(ALPHABKG);
000036      WRITELN(=BETA BACKGROUND=);
000044      READ(BETABKG);
000050      WRITELN(=BACKGROUND COUNTING TIME=);
000056      READ(TIMBKG);
000062      END; (*GETPARAMETERS*)
000101
000101  PROCEDURE RAWHEADING;
000003  (*-----*)
000003  (*HEADING FOR RAW DATA OUTPUT*)
000003  (*-----*)
000003  BEGIN (*RAWHEADING*)
000003      NEWPAGE; DELIMITER;
000010      WRITELN(=
000022      = GROSS ALPHA AND BETA IN =,MEDIUM%6.
000035      = PAGE=,PAGE%2); WRITELN;
000043      WRITELN(= R A W D A T A=);
000051      WRITELN(= -----=);
000056      = BETA=);
000064      WRITELN(= SAMPLE ID OWNER QUANTITY QUAN TIME COUNTS=,
000071      = COUNTS=);
000077      LINE%:=11;
000100      END; (*RAWHEADING*)
000144
000144  PROCEDURE CALCHEADING;
000003  (*-----*)
000003  (*WRITES HEADER FOR CALCULATED RESULTS*)
000003  (*-----*)
000003  BEGIN (*CALCHEADING*)
000003      NEWPAGE; DELIMITER;
000010      WRITELN(=
000022      = GROSS ALPHA AND BETA IN =,MEDIUM%6.
000035      = PAGE=,PAGE%2); WRITELN;
000052      WRITELN(=DATE COUNTED=,COUNTDATE%10); WRITELN; WRITELN;
000060      WRITELN(= C A L C U L A T E D R E S U L T S=);
000066      WRITELN(= -----=);
000111      = ALPHA=,PREFIX%2,=C1/=,UNITS%6,
000136      BETA=,PREFIX%2,=C1/=,UNITS%6); WRITELN;
000137      LINE%:=11;
000177      END; (*CALCHEADING*)
000177
000177  PROCEDURE RELERROR;
000003  (*-----*)
000003  (*DETERMINE RELATIVE ERROR BASED ON SAMPLE MEDIUM*)
000003  (*-----*)
000003  BEGIN (*RELERROR*)
000003      WITH SAMPLE(1) DO
000014      BEGIN
000014          IF UNITQUAN=EM..3=
000014          THEN SQUAN%=0.08
000017          ELSE IF UNITQUAN=ESAMP=
000021          THEN SQUAN%=0
000024          ELSE SQUAN%=0.01;
000031          IF UNITQUAN=EM..3=

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000032      THEN UNITS $\equiv$ M..3  $\equiv$ 
000035      ELSE IF UNITQUAN $\equiv$ LITE $\equiv$ 
000037      THEN UNITS $\equiv$ LITER  $\equiv$ 
000042      ELSE IF UNITQUAN $\equiv$ SAMP $\equiv$ 
000044      THEN UNITS $\equiv$ SAMPLE $\equiv$ 
000047      ELSE UNITS $\equiv$ GRAM  $\equiv$ ;
000053      END;
000053      END; (*RELEERROR*)
000070
000070      PROCEDURE CALCEFFICIENCY;
000003      (*-----*)
000003      (*CALCULATES EFFICIENCY FROM PROPER FUNCTION FOR THE SAMPLE MATRIX*)
000003      (*-----*)
000003      BEGIN (*CALCEFFICIENCY*)
000003          WITH SAMPLE(1) DO
000014              BEGIN
000014                  IF UNITQUAN $\equiv$ M..3 $\equiv$ 
000014                      THEN BEGIN
000017                      EFFALPHA $\equiv$ 0.210;
000020                      EFFBETA $\equiv$ 0.49;
000022                      XATOB $\equiv$ 0.127;
000023                      XBTOA $\equiv$ 0.003;
000024                      END;
000024                  IF UNITQUAN $\equiv$ LITE $\equiv$ 
000025                      THEN BEGIN
000030                      EFFALPHA $\equiv$ 0.180*(EXP(-2.38*MASS));
000045                      EFFBETA $\equiv$ 0.460*(EXP(-0.56*MASS));
000063                      XATOB $\equiv$ 0.140+0.25*MASS;
000067                      XBTOA $\equiv$ 0.003;
000070                      END;
000070                  IF (UNITQUAN $\equiv$ GRAM $\equiv$ ) OR (UNITQUAN $\equiv$ SAMP $\equiv$ )
000075                      THEN BEGIN
000100                      EFFALPHA $\equiv$ 0.180*(EXP(-2.02*MASS));
000115                      EFFBETA $\equiv$ 0.460*(EXP(-0.56*MASS));
000133                      XATOB $\equiv$ 0.140+0.25*MASS;
000137                      XBTOA $\equiv$ 0.003;
000140                      END;
000140                      SEFFALPHA $\equiv$ EFFALPHA*0.2;
000142                      SEFFBETA $\equiv$ EFFBETA*0.1;
000144                      END;
000144                      END; (*CALCEFFICIENCY*)
000170
000170      PROCEDURE ACTALPHA;
000003      (*-----*)
000003      (*COMPUTE GROSS ALPHA ACTIVITY*)
000003      (*-----*)
000003      BEGIN (*ACTALPHA*)
000003          RELEERROR; CALCEFFICIENCY;
000011          WITH SAMPLE(1) DO
000017              BEGIN
000017                  IF ALPHACTS/TIME=ALPHABKG/TIMBKG
000021                      THEN ALPHACTS $\equiv$ ALPHACTS+0.01*ALPHACTS;
000027                  AX $\equiv$ (ALPHACTS/TIME-ALPHABKG/TIMBKG-XBTOA*(BETACTS/TIME-BETABKG/TIMBKG))/
000043                      (EFFALPHA*QUAN $\wedge$ 2.22);
000045                  SAX $\equiv$ ABS(AX*(SQRT(((ALPHACTS/SQR(TIME)+XBTOA*(BETACTS-BETABKG*TIME/
000054                      TIMBKG)/SQR(TIME)+ALPHABKG/SQR(TIMBKG)))/
000064                      SQR(ALPHACTS/TIME-XBTOA*(BETACTS/TIME-
000066                      BETABKG/TIMBKG)-ALPHABKG/TIMBKG))+
000077                      SQR(SEFFALPHA/EFFALPHA)+SQR(SQUAN))));
000116                  IF UNITQUAN $\equiv$ M..3 $\equiv$ 
000116                      THEN BEGIN
000121                      AX $\equiv$ AX*1000;
000125                      SAX $\equiv$ SAX*1000;
000130                      PREFIX $\equiv$ F $\equiv$ ;

```

```

000131         END
000131         ELSE PREFIX $\neq$ P $\equiv$ ;
000134         END;
000134         END; (*ACTALPHA*)
000143
000143
000143 PROCEDURE ACTBETA;
000003 (*-----*)
000003 (*COMPUTE GROSS BETA ACTIVITY*)
000003 (*-----*)
000003     VAR SIGCTS $\times$ REAL; (*STD DEV OF COUNTING INFO*)
000004 BEGIN (*ACTBETA*)
000004     RELERROR;
000007     WITH SAMPLE(1) DO
000015     BEGIN
000015         IF BETACTS/TIME=BETABKG/TIMBKG
000017         THEN BETACTS $\times$ =BETACTS+0.01*BETACTS;
000025         BX $\times$ =(BETACTS/TIME-BETABKG/TIMBKG-XATOB*(ALPHACTS/TIME-ALPHABKG/TIMBKG))/
000041             (EFFBETA*QUAN*2.22);
000043         SIGCTS $\times$ =SQRT((BETACTS/SQR(TIME)+BETABKG/SQR(TIMBKG)*XATOB*
000052             ((ALPHACTS/TIME-ALPHABKG/TIMBKG)/TIME))/
000061             SQR(BETACTS/TIME-BETABKG/TIMBKG-XATOB*(ALPHACTS/TIME-
000066             ALPHABKG/TIMBKG)));
000105         SBX $\times$ =ABS(BX*SQR(SQR(SIGCTS)+SQR(SEFFBETA/EFFBETA)+SQR(SQUAN)));
000127         IF UNITQUAN $\equiv$ M..3 $\equiv$ 
000127         THEN BEGIN
000132             BX $\times$ =BX*1000; SBX $\times$ =SBX*1000; PREFIX $\times$  $\neq$ F $\equiv$ ; END
000142         ELSE PREFIX $\times$  $\neq$ P $\equiv$ 
000143         END;
000145     END; (*ACTBETA*)
000156
000156 PROCEDURE GETDATA;
000003 (*-----*)
000003 (*GET DATA FROM THE INPUT FILES*)
000003 (*-----*)
000003     VAR ORDER $\times$ REAL; (*DUMMY VAR FOR PAPER TAPE READ*)
000004 BEGIN (*GETDATA*)
000004     READWORD(IDENTS,SAMPLE(1).ID,LENGTH);
000015     IF NOT EOF(IDENTS)
000015     THEN WITH SAMPLE(1) DO
000024     BEGIN
000024         READWORD(IDENTS,OWNER,LENGTH);
000027         READ(IDENTS,QUAN);
000032         IF QUAN=0
000033         THEN QUAN $\times$ =SAMPLE(1-1).QUAN;
000045         READ(IDENTS,MASS);
000051         IF MASS=0
000052         THEN MASS $\times$ =SAMPLE(1-1).MASS;
000064         K $\times$ =1;
000065         REPEAT
000065             READ(IDENTS,UNITQUAN(K));
000100             UNTIL UNITQUAN(K) $\neq$   $\equiv$ ;
000110             FOR K $\times$ =2 TO 4 DO READ(IDENTS,UNITQUAN(K));
000126             READLN(IDENTS);
000127             IF UNITQUAN $\equiv$   $\equiv$ 
000130             THEN UNITQUAN $\times$ =SAMPLE(1-1).UNITQUAN;
000141             READ(CTDAT,ORDER,ORDER,BETACTS,ALPHACTS,TIME);
000163         END;
000163     END; (*GETDATA*)
000172
000172 BEGIN (*MAIN FOR ALPHBET*)
000172     RESET(IDENTS); RESET(CTDAT);
000010     (*-----*)
000010     (*INITIALIZE*)

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000010      (*-----*)
000010      MEDIUM:=  =: COUNTDATE:=MEDIUM;
000013      GETPARAMETERS;
000014      I:=1;
000015      REPEAT
000015          SAMPLE(I).ID:=  =:
000023          GETDATA; NUMSAMP:=1; I:=SUCC(I);
000027          UNTIL EOF(IDENTS) OR EOF(CTDAT);
000031      I:=1;
000031      REPEAT
000031          ACTALPHA; ACTBETA; I:=SUCC(I);
000037          UNTIL I>NUMSAMP;
000040      (*-----*)
000040      (*OUTPUT RESULTS IN 8 1/2 BY 11 PAGE FORMAT*)
000040      (*-----*)
000040      PAGE:=0; I:=1;
000041      IF SAMPLE(I).UNITQUAN=M..3=
000045      THEN MEDIUM:=AIR  =
000050      ELSE IF SAMPLE(I).UNITQUAN=LIVE=
000055      THEN MEDIUM:=WATER  =
000061      ELSE IF SAMPLE(I).UNITQUAN=GRAM=
000067      THEN MEDIUM:=SOIL  =
000072      ELSE MEDIUM:=SAMPLE  =;
000076      REPEAT
000076          PAGE:=SUCC(PAGE);
000100          RAWHEADING;
000101          REPEAT
000101              WITH SAMPLE(I) DO
000107              BEGIN
000107                  WRITELN(= ,ID*10,= ,OWNER*7,QUAN*10*2,UNITS*10,TIME*10*2,ALPHACTS*11*0,
000154                      BETACTS*11*0);
000162              END;
000162              I:=SUCC(I); LINE:=SUCC(LINE);
000165              UNTIL (I>NUMSAMP) OR (LINE=64);
000170              IF LINE=64 THEN BEGIN DELIMETER; PAGE:=SUCC(PAGE); END;
000174              UNTIL I>NUMSAMP;
000176          FILLER; DELIMETER;
000200          I:=1;
000201          REPEAT
000201              PAGE:=SUCC(PAGE);
000203              CALCHEADING;
000204              REPEAT
000204                  WITH SAMPLE(I) DO
000212                  BEGIN
000212                      WRITE(= ,ID*10,= ,OWNER*8,= );
000240                      SIGDIGITS(AX,SAX); WRITE(= );
000250                      SIGDIGITS(BX,SBX); WRITELN;
000254                      SYS2KFORM(AX,SAX,PREFIX,C) =,QUAN,UNITQUAN(I),
000267                      COUNTDATE,ID,OWNER,=ALPHA  =;
000273                      SYS2KFORM(BX,SBX,PREFIX,C) =,QUAN,UNITQUAN(I),
000306                      COUNTDATE,ID,OWNER,=BETA  =;
000312                  END;
000312                  LINE:=SUCC(LINE); I:=SUCC(I);
000315                  UNTIL (I>NUMSAMP) OR (LINE=64);
000320                  IF LINE=64 THEN BEGIN DELIMETER; PAGE:=SUCC(PAGE); END;
000324                  UNTIL I>NUMSAMP;
000326              FILLER; DELIMETER;
000330          END; (*MAIN FOR ALPHBET*)
000407
000407
000407      PROCEDURE CALIBRATE;
000003      (*-----*)
000003      (* THIS PROCEDURE WRITTEN BY BILL GOODE, 12/75 TO ANALYZE CALIBRATION DATA*)
000003      (* COLLECTED WHILE COUNTING KNOWN SOURCES OF PU242,PU239 AND AM241 IN *)

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000003 (* THE H-B ALPHA SPECTROSCOPY SYSTEM. COUNTING DATA ARE READ FROM A FILE *)
000003 (* =CTDAT=. THE PEAKS OF PU242 AND PU239 ARE LOCATED AND COMPU- *)
000003 (* TATIONS FOR ENERGY SCALE, RESOLUTION AND EFFICIENCY ARE MADE. PEAK *)
000003 (* LOCATIONS (LEADING EDGES) FOR PU242,PU239, PU238, PU236, AM243, AM241 *)
000003 (* P0210, P0208 ARE EXTRAPOLATED. THE RAW DATA ARE OUTPUT TO HARD *)
000003 (* COPY. COMPUTED INFORMATION IS PUT ON HARD COPY AND ALSO WRITTEN TO *)
000003 (* FILE =DETDATA= IN PERMANENT STORAGE WHICH IS ACCESSED FROM THE H-B ALPHA *)
000003 (* ANALYSIS PROGRAM. *)
000003 (-----*)
000003 TYPE
000003     SEGMENT=1..128; (*CHANNELS/DETECTOR*)
000003     PARAMETERS=RECORD
000003         OLD%BOOLEAN; (*DATA FROM PREV RUN*)
000003         EFFICIENCY%REAL; (*DET EFF C/D*)
000003         RESOLUTION%REAL; (*DET RESOLUTION FWHM KEV*)
000003         KEVCH%REAL; (*ENERGY SCALE KEV/CH*)
000003         PU242,PU239,PU238,PU236,AM243,AM241,P0210,P0208%SEGMENT; (*PEAK LOC*)
000003     END;
000003 VAR
000003     CH%CHAR; (*CHARACTER HOLDER*)
000004     COUNTDATE%PACKED ARRAY[1..10] OF CHAR; (*COUNTING DATE*)
000005     DETECTOR%ARRAY[1..32] OF PARAMETERS; (*SET OF DET PARAMETERS*)
000605     COUNTSEC%INTEGER; (*CT TIME IN SEC*)
000606     PEAKCHANNEL%SEGMENT; (*PEAK CHAN LOCATION*)
000607     LEADINGEDGE%SEGMENT; (*LEADING EDGE CHAN LOCATION*)
000610     OK%BOOLEAN; (*ERRORS*)
000611     DPM%ARRAY[1..32] OF INTEGER; (*STD ACTIVITY TABLE*)
000651     CHANNEL%ARRAY[1..32,1..128] OF INTEGER;(*40 x CHAN DATA ARRAY*)
010651
010651
010651
000003 PROCEDURE INITIALIZE;
000003 (*-----*)
000003 (* INITIALIZE VARIABLES TO THEIR CURRENT APPROPRIATE VALUE *)
000003 (*-----*)
000003 BEGIN
000003     DPM[1]%:=2955; DPM[9]%:=2564; DPM[17]%:=2955; DPM[25]%:=2564;
000012     DPM[2]%:=3391; DPM[10]%:=3767; DPM[18]%:=3391; DPM[26]%:=3767;
000016     DPM[3]%:=3918; DPM[11]%:=3782; DPM[19]%:=3918; DPM[27]%:=3782;
000022     DPM[4]%:=3857; DPM[12]%:=3194; DPM[20]%:=3857; DPM[28]%:=3194;
000026     DPM[5]%:=2424; DPM[13]%:=2940; DPM[21]%:=2424; DPM[29]%:=2940;
000032     DPM[6]%:=3179; DPM[14]%:=3438; DPM[22]%:=3179; DPM[30]%:=3438;
000036     DPM[7]%:=3742; DPM[15]%:=2170; DPM[23]%:=3742; DPM[31]%:=2170;
000042     DPM[8]%:=3851; DPM[16]%:=4020; DPM[24]%:=3851; DPM[32]%:=4020;
000046     FOR K%:=1 TO 10 DO COUNTDATE[K]%:= ;
000062     END;
000066
000066
000066
000066 PROCEDURE COPYOLDPEAKS;
000003 (*-----*)
000003 (* READ OLD DATA FROM FILE DETDATA INTO ARRAY VARIABLES. *)
000003 (*-----*)
000003 BEGIN
000003     READLN(DETDATA);
000007     FOR I%:=1 TO 32 DO WITH DETECTOR[I] DO
000017         BEGIN
000017             OLD%=TRUE;
000020             KEVCH%=0;
000022             READLN(DETDATA,EFFICIENCY,KEVCH,PU242,PU239,PU238,PU236,AM243,AM241,P0210,P0208)
000072             RESOLUTION%=0;
000076             EFFICIENCY%=0;
000100         END;
000102     END;
000106
000106

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000106  PROCEDURE READCOUNTDATE;
000003  BEGIN
000003      WRITELN(=COUNTDATE=);
000014      READ(CH);
000021      K:=0;
000022      REPEAT
000022          K:=K+1;
000024          READ(COUNTDATE[K]);
000036          UNTIL EOLN;
000037      END;
000044
000044  PROCEDURE READCALDATA;
000003  (*-----*)
000003  (* READ ALPHA SPECTRA FROM FILE CTDAT INTO CHANNEL(32,128) *)
000003  (*-----*)
000003      VAR
000003          DUMMY:INTEGER;
000004          COUNTER:INTEGER;
000005  BEGIN
000005      READLN(CTDAT); (*DISCARD HEADER LINE*)
000007      READ(CTDAT,COUNTSEC);
000013      COUNTER:=101;
000014      I:=1;
000015      REPEAT
000015          J:=1;
000016          REPEAT
000016              IF COUNTER=101 THEN
000020                  BEGIN
000020                      READ(CTDAT,DUMMY);
000023                      COUNTER:=1;
000024                      END ELSE BEGIN
000025                          READ(CTDAT,CHANNEL[I,J]);
000037                          J:=J+1;
000041                          COUNTER:=COUNTER+1;
000042                          END;
000042                      UNTIL (J>128) OR (EOF(CTDAT));
000045                      I:=I+1;
000046                      UNTIL (I>32) OR (EOF(CTDAT));
000047                      I:=I-1;
000050                      IF (EOF(CTDAT)) AND (I<32) THEN
000051                          BEGIN
000051                              OK:=FALSE;
000052                              WRITELN(=ERROR IN READING OF COUNTING DATA - PROGRAM TERMINATED=);
000060                              END ELSE OK:=TRUE;
000063                          END;
000101
000101  PROCEDURE FINDPEAK(START:SEGMENT);
000004  (*-----*)
000004  (* SEARCH DETECTOR[I] AREA BEGINNING AT =START= AND FIND THE PEAK CHANNEL*)
000004  (* DEFINITION: THE #PEAK CHANNEL# IS THAT CHANNEL NUMBER WHICH CONTAINS *)
000004  (* MORE COUNTS THAN ANY OTHER CHANNEL IN THE AREA OF INTREST. CONTENTS *)

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000004      (* OF PEAK CHANNEL MUST BE >100 TO QUALIFY *)
000004      (*-----*)
000004      BEGIN
000004          J%=START;
000010          PEAKCHANNEL%=J;
000014          REPEAT
000014              IF CHANNEL[I,J]>CHANNEL[I,PEAKCHANNEL] THEN PEAKCHANNEL%=J;
000035              J%=J+1;
000037              UNTIL (J>START+25) OR (CHANNEL[I,J-1]<ROUND(CHANNEL[I,PEAKCHANNEL]/100));
000066          LEADINGEDGE%=J-1;
000072          IF (CHANNEL[I,PEAKCHANNEL]<100) OR (NOT(CHANNEL[I,PEAKCHANNEL]>
000106              CHANNEL[I,PEAKCHANNEL-2])) OR (J=128) OR (LEADINGEDGE>PEAKCHANNEL+10) THEN
000122              BEGIN
000122                  OK%=FALSE;
000122                  WRITELN('PEAK IDENTIFICATION PROBLEM AT DETECTOR#,I%3);
000134                  WRITELN;
000135                  END ELSE OK%=TRUE;
000137              END;
000151
000151      FUNCTION CALCEFFICIENCY(VAR I%INTEGER;J%INTEGER)%REAL;
000005      (*-----*)
000005      (* CALCULATE EFFICIENCY BASED ON A TEN CHANNEL WINDOW OVER THE PU242 PEAK *)
000005      (*-----*)
000005      VAR
000005          TOTALCTS%INTEGER;
000006      BEGIN
000006          FINDPEAK(J);
000014          TOTALCTS%=0;
000015          J%=PEAKCHANNEL;
000017          WHILE CHANNEL[I,J]>(ROUND(CHANNEL[I,PEAKCHANNEL]/100)) DO J%=J-1;
000046          FOR K%=J TO LEADINGEDGE DO TOTALCTS%=TOTALCTS+CHANNEL[I,K];
000064          CALCEFFICIENCY%=(TOTALCTS*60)/(COUNTSEC*DPM(I));
000101          END;
000113
000113      FUNCTION CALCRESOLUTION(J%SEGMENT)%REAL;
000004      (*-----*)
000004      (* CALCULATE FWHM RESOLUTION(KEV) FOR THE PEAK OF INTEREST. INTERPOLATION *)
000004      (* BETWEEN CHANNELS IS PROVIDED. *)
000004      (*-----*)
000004      VAR
000004          HALFMAXLEAD,HALFMAXTRAIL%REAL;
000006      BEGIN
000006          FINDPEAK(J);
000013          J%=PEAKCHANNEL;
000020          (*-----*)
000020          (*FIND HALFMAX ON THE LEADING SIDE.*)
000020          (*-----*)
000020          WHILE CHANNEL[I,J]>=CHANNEL[I,PEAKCHANNEL]/2 DO J%=J+1;
000051          HALFMAXLEAD%=(CHANNEL[I,PEAKCHANNEL]/2-CHANNEL[I,J-1])/(CHANNEL[I,J]-
000103              CHANNEL[I,J-1])+(J-1);
000120          (*-----*)
000120          (* FIND HALFMAX ON THE TRAILING SIDE*)
000120          (*-----*)
000120          J%=PEAKCHANNEL;
000123          WHILE CHANNEL[I,J]>=CHANNEL[I,PEAKCHANNEL]/2 DO J%=J-1;
000154          HALFMAXTRAIL%=ABS((CHANNEL[I,J]-CHANNEL[I,PEAKCHANNEL]/2)/(CHANNEL[I,J]
000205              -CHANNEL[I,J+1]))+J;
000223          CALCRESOLUTION%=(HALFMAXLEAD-HALFMAXTRAIL)*DETECTOR[I].KEVCH;

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000230      END;
000242      PROCEDURE RAMEADING;
000242      (* I WILL GIVE HEADING FOR CHANNEL BY CHANNEL WRITE. USES CURRENT VALUE OF *)
000003      (* I FOR COLUMN HEADINGS. *)
000003      (* *)
000003      BEGIN
000003      WRITELN(= DETECTOR NUMBER
000003      DATE=,COUNTDATE%10);
000013      WRITE(= CH =); FOR K%1 TO 1+9 DO WRITE(K%7); WRITELN;
000046      END;
000063      PROCEDURE SUMMARYHEADING;
000003      (* *)
000003      (* * WRITES HEADINGS FOR PERFORMANCE PARAMETERS AND PEAK LOCATIONS. *)
000003      (* *)
000003      BEGIN
000003      WRITELN(=
000003      ALPHA SPECTROMETER CALIBRATION=);
000014      DATE=,COUNTDATE%10);
000027      WRITELN;
000030      WRITELN(=DET OLD RESOL EFFIC KEV/ L E A D I N G E D G E =,
000035      (= CHANNEL S=);
000043      WRITELN(=NO. DATA UTION IENCY CH P U 2 4 2 P U 2 3 9 P U 2 3 8 A M 2 4 3 A M 2 4 1=,
000050      (= P O 2 1 0 P O 2 0 8=);
000056      WRITELN(=-----=);
000063      END;
000141      BEGIN
000141      RESET(DETDATE); RESET(CIDAT);
000010      INITIALIZE;
000012      (* *)
000012      (* * ENTER INPUT SECTOR*)
000012      (* *)
000012      READCOUNT DATE;
000014      READCALDATA;
000016      (*COPYOLDPEAKS;*);
000016      REWRITE(DETDATE);
000017      (* *)
000017      (* * ENTER COMPUTATIONAL SECTOR*)
000017      (* *)
000021      IF OK THEN FOR I%1 TO 32 DO
000030      WITH DETECTOR(I) DO
000030      BEGIN
000030      FINDPEAK(I);
000034      IF OK THEN
000035      BEGIN
000035      P U 2 4 2 = L E A D I N G E D G E ;
000042      FINDPEAK(30);
000046      IF OK THEN
000047      BEGIN
000047      P U 2 3 9 = L E A D I N G E D G E ;
000054      KEVCH%256/(P U 2 3 9 - P U 2 4 2);
000063      (* *)
000063      (* * CALCULATE OTHER LEADING EDGES FROM THE POSITIONS OF P U 2 4 2 AND P U 2 3 9 *)
000063      (* *)
000063      P U 2 3 8 = R O U N D (( 5 4 9 9 - 4 9 0 0 ) / K E V C H ) + P U 2 4 2 ;
000074      P U 2 3 6 = R O U N D (( 5 7 7 0 - 4 9 0 0 ) / K E V C H ) + P U 2 4 2 ;
000106      A M 2 4 3 = R O U N D (( 5 2 8 0 - 4 9 0 0 ) / K E V C H ) + P U 2 4 2 ;
000117      A M 2 4 1 = P U 2 3 8 ;

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000123      PO210%=ROUND((5305-4900)/KEVCH)+PU242;
000134      PO208%=ROUND((5110-4900)/KEVCH)+PU242;
000146      RESOLUTION%=CALCRESOLUTION(PU242-10);
000155      EFFICIENCY%=CALCEFFICIENCY(1,PU242-10);
000162      OLD%=FALSE;
000163      END;
000163      END;
000163      END;
000165      (*-----*)
000165      (* ENTER OUTPUT SECTOR *)
000165      (* WRITE OUT CHANNEL BY CHANNEL INFORMATION IN 10 DETECTOR X 105 CHANNEL *)
000165      (* PAGES *)
000165      (*-----*)
000165      FOR I%=1 TO 32 DO WITH DETECTOR(I) DO
000175      WRITELN(DETDATA,EFFICIENCY%*7%3,KEVCH%8%2,PU242%4,PU239%4,PU238%4,
000225      PU236%4,AM243%4,AM241%4,PO210%4,PO208%4);
000261      I%=1; J%=5;
000263      REPEAT
000263      NEWPAGE; DELIMITER;
000265      RAWHEADING;
000267      FOR J%=10 TO 70 DO
000270      BEGIN
000272      WRITE(J%3,= =); FOR K%=1 TO 1+9 DO WRITE(CHANNEL(K,J)%7); WRITELN;
000323      END;
000325      DELIMITER;
000326      I%=I+10;
000330      UNTIL I>30;
000331      NEWPAGE; DELIMITER;
000333      RAWHEADING;
000335      FOR J%=10 TO 70 DO
000336      BEGIN
000340      WRITE(J%3,= =);
000350      FOR K%=1 TO 1+1 DO WRITE(CHANNEL(K,J)%7);
000367      WRITELN;
000370      END;
000372      DELIMITER;
000373      (*-----*)
000373      (* WRITE OUT SUMMARY INFORMATION*)
000373      (*-----*)
000373      NEWPAGE; DELIMITER;
000375      SUMMARYHEADING;
000377      LINE%=6;
000400      FOR I%=1 TO 32 DO WITH DETECTOR(I) DO
000410      BEGIN
000410      WRITELN(I%3,= =,OLD%5,RESOLUTION%6%1,EFFICIENCY%6%3,KEVCH%6%2,PU242%6,
000446      PU239%6,PU238%6,PU236%6,AM243%6,AM241%6,PO210%6,PO208%6);
000512      LINE%=LINE+1;
000514      END;
000515      FILLER; DELIMITER;
000517      END;
000536
000536      PROCEDURE TRITIUM;
000003      (*-----*)
000003      (*INPUT=FILE IDENTIS; FILE CTDAT; COUNTING PARAMETERS FROM INPUT FILE *)
000003      (*CALCULATES HTO CONCENTRATIONS IN TERMS OF PCI/UNITQUAN. CTDAT READER*)
000003      (*IS WRITTEN TO RECIEVE COUNTING DATA FROM THE PAPER TAPE OUTPUT OF *)
000003      (*THE BECKMAN LSC 200 AFTER IT HAS BEEN REWRITTEN BY THE PROCEDURE *)
000003      (*PERFORM OR ABBREVIATED HAND ENTERED DATA. OUTPUT=HARD COPY TERMINAL *)
000003      (*FORMATTED OUTPUT IN THE RESULTS FILE *)
000003      (*-----*)
000003      TYPE
000003      INFO=RECORD
000003      ID%ALFA;
000003      (*SAMPLE ID*)

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000003      OWNER%ALFA;          (*SAMPLE OWNER*)
000003      QUAN%REAL;          (*SAMPLE QUANTITY*)
000003      UNITQUAN%CHAR;      (*UNIT QUANTITY*)
000003      WATERVOL%REAL;      (*WATER VOL(L) FOR AIR SAMPS*)
000003      AIRVOL%REAL;        (*AIR VOL (M3) FOR AIR SAMPLS*)
000003      COUNTS%REAL;        (*TOTAL H-3 COUNTS*)
000003      TIME%REAL;          (*COUNTING TIME*)
000003      SFACOR%REAL;        (*EXTERNAL STD RATIO*)
000003      END;
000003  VAR
000003      BKG%REAL;              (*TOTAL BKG COUNTS*)
000004      TIMBKG%REAL;         (*BKG COUNTING TIME*)
000005      SAMPLE%ARRAY(1..200) OF INFO;  (*SAMPLE ARRAY*)
003415      NUMSAMP%INTEGER;    (*TOTAL NUMBER OF SAMPLES TO PROCESS*)
003416      BUFFER%ALFA;        (*ALFA WORD HOLDER*)
003417      DUMMY%REAL;         (*READER DUMMY*)
003420      AX%REAL;            (*SAMPLE ACTIVITY*)
003421      SAX%REAL;          (*STD DEV OF SAMPLE ACTIVITY*)
003422      PREFIX%CHAR;       (*UNITS MULTIPLIER*)
003423
003423  PROCEDURE PREFORM;
000003      (*-----*)
000003      (*PREFORMATS THE CTDAT FILE TO BE COMPATIBLE WITH THE PASCAL READ*)
000003      (*PROCEDURES. I.E. REPLACES NON-NUMERIC CHARACTERS WITH BLANKS *)
000003      (*-----*)
000003  BEGIN (*PREFORM*)
000003      RESET(CTDAT); REWRITE(RESULTS);
000010      WHILE NOT(EOF(CTDAT)) DO
000011      BEGIN
000011          IF ((NOT(EOLN(CTDAT)))AND(NOT(CTDAT IN {=0=..=9=,=,=})))
000013          THEN WRITE(RESULTS,=)
000016          ELSE WRITE(RESULTS,CTDAT);
000023          GET(CTDAT);
000024          END;
000025      (*-----*)
000025      (*REWRITE THE CTDAT FILE*)
000025      (*-----*)
000025      REWRITE(CTDAT); RESET(RESULTS);
000027      WHILE NOT(EOF(RESULTS)) DO
000031      BEGIN
000031          WRITE(CTDAT,RESULTS);
000035          GET(RESULTS);
000036          END;
000037      END; (*PREFORM*)
000044
000044  PROCEDURE CALCTITLE;
000003      (*-----*)
000003      (*WRITES COLUMN HEADERS FOR CALCULATED RESULTS OUTPUT*)
000003      (*-----*)
000003  BEGIN (*CALCTITLE*)
000003      WRITELN(= SAMPLE=);
000014      WRITELN(= ID OWNER HTO CONCENTRATION=);
000022      WRITELN(=-----);
000030      LINE%=7;
000031      END;
000051
000051  PROCEDURE HEADER;
000003      (*-----*)
000003      (*WRITES HEADER INFORMATION FOR OUTPUT OF HTO RESULTS*)
000003      (*-----*)
000003  BEGIN (*HEADER*)
000003      WRITELN(= TRITIUM RESULTS=);

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000014      WRITE(=      DATE COUNTED=,COUNTDATE%10);
000026      WRITELN(=      PAGE=,PAGE%3);
000040      WRITELN;
000041      LINE%=4;
000042      END;  (*HEADER*)
000062
000062      PROCEDURE RAWTITLE;
000003      (*-----*)
000003      (*WRITES COLUMN TITLES FOR RAW INFORMATION*)
000003      (*-----*)
000003      BEGIN  (*RAWTITLE*)
000003          WRITELN(=  SAMPLE      SAMPLE  WATER  AIR  H-3      COUNT=);
000014          WRITELN(=  ID          OWNER    (L)    (L)    (M)    COUNTS  TIME    SFACOR=);
000022          WRITELN(=-----);
000030          LINE%=7;
000031          END;  (*RAWTITLE*)
000061
000061      BEGIN  (*TRITIUM*)
000061      (*-----*)
000061      (*GET COUNTING PARAMETERS*)
000061      (*-----*)
000061      WRITELN(=ENTER DATE COUNTED - EXAMPLE 12/01/76=);
000014      READ(CH);
000021      READWORD(INPUT,COUNTDATE,LENGTH);
000024      WRITELN(=ENTER COUNTING EFFICIENCY (C/D)=);
000032      READ(EFFICIENCY);
000035      WRITELN(=ENTER RELATIVE STD OF COUNTING EFFICIENCY=);
000043      READ(SIGEFF);
000046      WRITELN(=ENTER TRITIUM BKG - TOTAL COUNTS=);
000054      READ(BKG);
000057      WRITELN(=ENTER BACKGROUND COUNTING TIME (MIN)=);
000065      READ(TIMBKG);
000070      (*-----*)
000070      (*READ SAMPLE ID INFO*)
000070      (*-----*)
000070      RESET(IDENTS);
000071      FOR I%=1 TO 100 DO WITH SAMPLE[I] DO
000101      BEGIN
000101          AIRVOL%=0;  WATERVOL%=0;
000106          END;
000110          I%=1;
000111      WHILE NOT(EOF(IDENTS)) DO WITH SAMPLE[I] DO
000120      BEGIN
000120          READWORD(IDENTS,ID,LENGTH);
000122          READWORD(IDENTS,OWNER,LENGTH);
000125          READ(IDENTS,QUAN);
000131          SKIPBLANKS(IDENTS);
000133          IF ((NOT(EOF(IDENTS)))AND(NOT(EOLN(IDENTS))))
000134          THEN (*MUST BE AN AIR SAMPLE*)
000135              READLN(IDENTS,AIRVOL,WATERVOL)
000144          ELSE IF(NOT(EOF(IDENTS))) THEN READLN(IDENTS);
000150          NUMSAMP%=I;
000152          I%=SUCC(I);
000153          END;
000153      (*-----*)
000153      (*READ COUNTING DATA*)
000153      (*-----*)
000153      RESET(CTDAT);
000154      WRITELN(=IS THE CTDAT FILE IS LSC 200 PAPER TAPE FORMAT=);
000162      READ(CH);
000167      READWORD(INPUT,BUFFER,LENGTH);
000172      IF BUFFER=YES
000172      THEN BEGIN
000174          PREFORM;  I%=1;

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```

000176      (*-----*)
000176      (*READ COUNTING DATA FROM PAPER TAPE*)
000176      (*-----*)
000176      WHILE I<=NUMSAMP DO WITH SAMPLE[I] DO
000205      BEGIN
000205          READ(CTDAT,DUMMY,TIME,COUNTS,DUMMY,DUMMY,DUMMY,DUMMY,DUMMY,SFACTOR);
000243          I%=SUCC(I);
000245      END;
000245      END
000245      ELSE BEGIN (*READ HAND ENTERED DATA*)
000246          I%=1;
000247          WHILE I<=NUMSAMP DO WITH SAMPLE[I] DO
000256          BEGIN
000256              READ(CTDAT,TIME,COUNTS,SFACTOR);
000271              I%=SUCC(I);
000273          END;
000273      END;
000273      (*-----*)
000273      (*ECHO RAW COUNTING DATA*)
000273      (*-----*)
000273      LINE%=65; PAGE%=0;
000275      FOR I%=1 TO NUMSAMP DO WITH SAMPLE[I] DO
000306      BEGIN
000306          IF LINE>64
000306          THEN BEGIN
000310              PAGE%=SUCC(PAGE);
000311              IF I<>1 THEN DELIMITER;
000313              NEWPAGE; DELIMITER; HEADER; RAWTITLE;
000321              END;
000321              WRITE(10%10,=,=,OWNER%3,QUAN%9%3);
000345              IF WATERVOL<>0
000346              THEN WRITE(WATERVOL%7%4)
000356              ELSE WRITE(= -----=);
000364              IF AIRVOL<>0
000365              THEN WRITE(AIRVOL%6%2)
000375
000375              ELSE WRITE(= -----=);
000403              WRITELN(COUNTS%8%0,TIME%7%2,SFACTOR%8%3); L;
000424              END;
000427          FILLER; DELIMITER;
000431          (*-----*)
000431          (*CALCULATE AND OUTPUT RESULTS*)
000431          (*-----*)
000431          LINE%=65;
000432          REWRITE(RESULTS);
000433          FOR I%=1 TO NUMSAMP DO WITH SAMPLE[I] DO
000444          BEGIN
000444              IF LINE>64
000444              THEN BEGIN
000446                  PAGE%=SUCC(PAGE);
000447                  IF I<>1 THEN DELIMITER;
000451                  NEWPAGE; DELIMITER; HEADER; CALCTITLE;
000457                  END;
000457                  IF COUNTS/TIME=BKG/TIMBKG
000461                  THEN COUNTS%=COUNTS*COUNTS*0.01;
000465                  AX%=(COUNTS/TIME-BKG/TIMBKG)/(EFFICIENCY*QUAN*2.22);
000474                  IF AIRVOL<>0
000474                  THEN BEGIN
000477                      AX%=AX*WATERVOL/AIRVOL;
000501                      SAX%=ABS(AX)*SQRT(((COUNTS/SQR(TIME)+BKG/SQR(TIMBKG))/
000506                      SQR(COUNTS/TIME-BKG/TIMBKG))+SQR(SIGEFF)+SQR(0.16));
000526                      UNITQUAN%=M%;
000530                      END
000530                  ELSE BEGIN

```

```

000530      SAX:=ABS(AX*SQR(((COUNTS/SQR(TIME)+BKG/SQR(TIMBKG))/
000534      SQR(COUNTS/TIME-BKG/TIMBKG))+SQR(SIGEFF)+SQR(0.01)))));
000554      UNITQUAN:=L;
000556      END;
000556      PREFIX:=P;
000557      WRITE(ID*10,=,OWNER*3,=);
000603      SIGDIGITS(AX,SAX);
000606      WRITELN(=,PREFIX,=C/=,UNITQUAN); L;
000630      IF AIRVOL<>0
000631      THEN SYS2KFORM(AX,SAX,PREFIX,=C/=,AIRVOL,UNITQUAN,COUNTDATE,
000646      ID,OWNER,=H-3=);
000651      ELSE SYS2KFORM(AX,SAX,PREFIX,=C/=,QUAN,UNITQUAN,COUNTDATE,
000665      ID,OWNER,=H-3=);
000671      END;
000674      FILLER; DELIMITER;
000676      END; (*TRIITIUM*)
000765
000765      PROCEDURE GROSSGAM;
000003      (*-----*)
000003      (*THIS PROCEDURE PROVIDES GROSS GAMMA CALCULATING CAPABILITY FOR*)
000003      (*THE NAI WELL COUNTER. *)
000003      (*-----*)
000003      VAR
000003      BKG*REAL; (*GROSS GAMMA COUNTING BKG*)
000004      TIMBKG*REAL; (*BACKGROUND COUNTING TIME*)
000005      ID*ALFA; (*SAMPLE ID*)
000006      OWNER*ALFA; (*SAMPLE OWNER*)
000007      QUAN*REAL; (*SAMPLE QUANTIT.*)
000010      UNITQUAN*CHAR; (*UNIT QUANTITY*)
000011      COUNTS*REAL; (*TOTAL GROSS GAMMA COUNTS*)
000012      TIME*REAL; (*COUNTING TIME (MIN)*)
000013      AX*REAL; (*SAMPLE ACTIVITY*)
000014      SAX*REAL; (*STD DEV OF SAMPLE ACTIVITY*)
000015
000015      PROCEDURE TITLE;
000003      (*-----*)
000003      (*WRITES COLUMN TITLE INFORMATION FOR GROSS GAMMA RESULTS*)
000003      (*-----*)
000003      BEGIN (*TITLE*)
000003      WRITELN(= SAMPLE ID OWNER QUAN COUNTS TIME GROSS GAMMA=,
000013      = CONCENTRATION=);
000021      WRITELN(= ----- =);
000026      (=-----=);
000034      LINE:=LINE+2;
000036      END; (*TITLE*)
000061
000061      PROCEDURE HEADER;
000003      (*-----*)
000003      (*WRITES OUTPUT HEADER FOR GROSS GAMMA RESULTS*)
000003      (*-----*)
000003      BEGIN (*HEADER*)
000003      WRITELN(= GROSS GAMMA RESULTS=);
000014      WRITE(= DATE COUNTED-=,COUNTDATE*10);
000026      WRITELN(= PAGE=,PAGE*3);
000040      WRITELN;
000041      LINE:=4;
000042      END; (*HEADER*)
000062
000062      BEGIN (*GROSSGAM*)
000062      WRITELN(=ENTER DATE COUNTED - EXAMPLE 12/01/76=);
000014      READ(CH); READ(CH);
000026      READWORD(INPUT,COUNTDATE,LENGTH);

```

```

000031      WRITELN(=ENTER GROSS GAMMA BKG - TOTAL COUNTS=);
000037      READ(BKG);
000042      WRITELN(=ENTER BKG COUNTING TIME - MIN=);
000050      READ(TIMBKG);
000053      (*-----*)
000053      (*READ INPUT,CALCULATE AND OUTPUT RESULTS ONE SAMPLE AT A TIME*)
000053      (*-----*)
000053      RESET(IDENTS); RESET(CTDAT); REWRITE(RESULTS);
000056      LINE%=67; PAGE%=0;
000060      WHILE ((NOT(EOF(IDENTS)))AND(NOT(EOF(CTDAT))))
000062      DO BEGIN
000062          READWORD(IDENTS,ID,LENGTH);
000065          READWORD(IDENTS,OWNER,LENGTH);
000070          READ(IDENTS,QUAN); SKIPBLANKS(IDENTS); READ(IDENTS,UNITQUAN);
000102          IF NOT(EOF(IDENTS)) THEN READLN(IDENTS);
000104          READ(CTDAT,COUNTS,TIME);
000112          IF NOT(EOF(CTDAT)) THEN READLN(CTDAT);
000114          AX%=(COUNTS/TIME-BKG/TIMBKG)/QUAN;
000120          IF ((COUNTS/TIME)=(BKG/TIMBKG)) THEN COUNTS%=COUNTS+COUNTS*0.00001;
000123          SAX%=ABS(SQRT((COUNTS/SQR(TIME)+BKG/SQR(TIMBKG)))/
000126              SQR(COUNTS/TIME-BKG/TIMBKG)+SQR(0.01))*AX);
000145          (*-----*)
000145          (*OUTPUT RAW AND CALCULATED INFORMATION*)
000145          (*-----*)
000145          IF LINE%>65
000145          THEN BEGIN
000147              PAGE%=SUCC(PAGE); LINE%=1;
000151              DELIMITER; NEWPAGE; DELIMITER; HEADER; TITLE;
000160              END;
000160              WRITE(ID%10,=,=,OWNER%3,QUAN%8%2,COUNTS%8%0,TIME%8%2,=,=);
000220              S(DIGITS(AX,SAX));
000223              WRITELN(= NCPM/=,UNITQUAN); L;
000236              SYSZKFORM(AX,SAX,=,=,= NCPM=,QUAN,UNITQUAN,COUNTDATE,13,
000252                  OWNER,= GAMMA=);
000255          END;
000256          FILLER;
000257          DELIMITER;
000260          END; (*GROSSGAM*)
000325
000325
000325      PROCEDURE SR90;
000003      (*-----*)
000003      (*PROCEDURE FOR HANDLING SR-90 DATA REDUCTION. INPUT DATA ARE MANUALLY*)
000003      (*BUILT INTO A FILE #IDENTS#. OTHER INPUT DATA ARE ENTERED FROM *)
000003      (*THE INPUT FILE. HARD COPY OUTPUT OF THE RAW DATA AND CALCULATED *)
000003      (*RESULTS ARE PROVIDED. RESULTS ARE ALSO FORMED FOR SYSTEM 2000 *)
000003      (*AND WRITTEN TO THE #RESULT# FILE *)
000003      (*-----*)
000003
000003      CONST
000003          ARSIZE=50;
000003          BLANKS==;
000003
000003      TYPE
000003          DATA=RECORD
000003              ID%ALFA; (*SAMPLE ID *)
000003              OWNER%ALFA; (*SAMPLE OWNER *)
000003              QUAN%REAL; (*SAMPLE QUANTITY *)
000003              UNITQUAN%CHAR; (*UNIT QUANTITY *)
000003              CTDUR%REAL; (*COUNT DURATION IN MIN *)
000003              CTS%REAL; (*TOTAL BETA COUNTS *)
000003              SEPDATE%ALFA; (*SEPARATION DATE *)
000003              SEPHR%INTEGER; (*SEPARATION HOUR OF DAY *)
000003              SEPMIN%INTEGER; (*SEPARATION MIN OF HOUR *)

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000003      CTDATE%ALFA;          (*COUNTING DATE          *)
000003      CTHR%INTEGER;         (*COUNTING HOUR OF DAY *)
000003      CTMIN%INTEGER;       (*COUNTING MIN OF HOUR *)
000003      ADDED%REAL;          (*CARRIER ADDED        *)
000003      RECOV%REAL;          (*CARRIER RECOVERED    *)
000003      END;
000003
000003      VAR
000003          BKG%REAL;          (*COUNTER BKG (TOTAL)   *)
000004          TIMBKG%REAL;      (*BACKGROUND COUNTING (MIN) *)
000005          SAMPLE%ARRAY[1..50] OF DATA; (*SAMPLE DATA ARRAY    *)
001301          WORD%ALFA;       (*ALFA WORD HOLDER      *)
001302          AX%REAL;          (*SAMPLE ACTIVITY       *)
001303          SAX%REAL;         (*STD DEV OF SAMPLE ACTIVITY *)
001304          PREFIX%CHAR;      (*UNITS MULTIPLIER      *)
001305          DTIME%REAL;        (*DECAY TIME IN HOURS   *)
001306          Z%REAL;           (*DUMMY FOR VALUE DUPLICATION *)
001307          ABORT%BOOLEAN;    (*RESPONSE FROM DATA SCANNING *)
001310          T%INTEGER;        (*TEMPORARY VARIABLE*)
001311
001311      PROCEDURE SRHEADER;
000003      (*-----*)
000003      (*WRITES HEADER FOR SR-90 ANALYSIS OUTPUT *)
000003      (*-----*)
000003      BEGIN (*SRHEADER*)
000003          WRITE(= SR-90 ANALYSES=);
000013          WRITELN(= PAGE=,PAGE%3);
000025          WRITELN; WRITELN;
000027          LINE%4; PAGE%SUCC(PAGE);
000032          END; (*SRHEADER*)
000045
000045      BEGIN (*SR-90*)
000045      (*-----*)
000045      (*READ COUNTING PARAMETERS*)
000045      (*-----*)
000045      WRITELN(= ENTER REQUESTED INFORMATION=);
000014      WRITELN(= EFFICIENCY(C/D) SIGEFF(RELATIVE) BKG(TOTAL) BKG DURATION(MIN)=);
000022      WRITELN(= -----);
000030      READ(EFFICIENCY,SIGEFF,BKG,TIMBKG);
000044      (*-----*)
000044      (*READ SAMPLE INFORMATION FROM THE IDENTs FILE*)
000044      (*-----*)
000044      RESET(IDENTS);
000045      FOR I%1 TO ARSIZE DO WITH SAMPLE[I] DO ID%=BLANKS;
000057      I%1; PAGE%1; ABORT%FALSE;
000062      WHILE NOT(EOF(IDENTS)) DO WITH SAMPLE[I] DO
000071      BEGIN
000071          READWORD(IDENTS,ID,LENGTH);
000073          READWORD(IDENTS,WORD,LENGTH);
000076          IF WORD[I]=0=
000076          THEN OWNER%=SAMPLE[I-1].OWNER
000106          ELSE IF LENGTH>4
000110          THEN BEGIN
000112              WRITELN(=ERROR IN OWNER FIELD FOR SAMPLE =,ID%10);
000125              ABORT%=TRUE;
000126          END
000126          ELSE OWNER%=WORD;
000131          READ(IDENTS,Z);
000134          IF Z=0
000134          THEN QUAN%=SAMPLE[I-1].QUAN
000145          ELSE QUAN%=Z;
000151          READWORD(IDENTS,WORD,LENGTH);
000154          IF WORD[I]=0= THEN
000157          UNITQUAN%=SAMPLE[I-1].UNITQUAN

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000164      ELSE IF LENGTH>1
000170      THEN BEGIN
000172          WRITELN(=ERROR IN UNIT QUANTITY FIELD FOR SAMPLE =,ID%10);
000205          ABORT%=TRUE;
000206          END
000206      ELSE UNITQUAN%=WORD[1];
000213      READ(IDENTS,CTS,Z);
000222      IF Z=0
000222      THEN CTDUR%=SAMPLE[1-1].CTDUR
000233      ELSE CTDUR%=Z;
000237      READ(IDENTS,Z);
000242      IF Z=0
000242      THEN ADDED%=SAMPLE[1-1].ADDED
000253      ELSE ADDED%=Z;
000257      READ(IDENTS,Z);
000262      IF Z=0
000262      THEN RECOV%=SAMPLE[1-1].RECOV
000273      ELSE RECOV%=Z;
000277      IF RECOV-ADDED>0
000301      THEN BEGIN
000304          WRITELN(=SUPER RECOVERY FOR SAMPLE =,ID%10);
000317          ABORT%=TRUE;
000320          END;
000320      READWORD(IDENTS,WORD,LENGTH);
000323      IF WORD[1]=X=
000323      THEN SEPDATE%=SAMPLE[1-1].SEPDATE
000333      ELSE IF LENGTH<>8
000335      THEN BEGIN
000337          WRITELN(=ERROR IN SEPARATION DATE FIELD FOR SAMPLE =,ID%10);
000352          ABORT%=TRUE;
000353          END
000353      ELSE SEPDATE%=WORD;
000356      READ(IDENTS,Z);
000361      IF Z=0
000361      THEN SEPHR%=SAMPLE[1-1].SEPHR
000372      ELSE IF ((Z>23)OR(Z<0))
000402      THEN BEGIN
000402          WRITELN(=ERROR IN SEPARATION HOUR FIELD FOR SAMPLE =,ID%10);
000415          ABORT%=TRUE;
000416          END
000416      ELSE SEPHR%=ROUND(Z);
000422      READ(IDENTS,Z);
000425      IF Z=0
000425      THEN SEPMIN%=SAMPLE[1-1].SEPMIN
000436      ELSE IF ((SEPMIN<0)OR(SEPMIN>59))
000443      THEN BEGIN
000443          WRITELN(=ERROR IN SEPARATION MINUTE FIELD FOR SAMPLE =,ID%10);
000456          ABORT%=TRUE;
000457          END
000457      ELSE SEPMIN%=ROUND(Z);
000463      READWORD(IDENTS,WORD,LENGTH);
000466      IF WORD[1]=X=
000466      THEN CTDATE%=SAMPLE[1-1].CTDATE
000476      ELSE IF LENGTH<>8
000500      THEN BEGIN
000502          WRITELN(=ERROR IN COUNTING DATE FOR SAMPLE =,ID%10);
000515          ABORT%=TRUE;
000516          END
000516      ELSE CTDATE%=WORD;
000521      READ(IDENTS,Z);
000524      IF Z=0
000524      THEN CTHR%=SAMPLE[1-1].CTHR
000535      ELSE IF ((CTHR<0)OR(CTHR>23))
000542      THEN BEGIN

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```

000542      WRITELN(=ERROR IN COUNTING DATA FIELD FOR SAMPLE =,ID%10);
000555      ABORT%=TRUE;
000556      END
000556      ELSE CTHR%=ROUND(Z);
000562      READ(IDENTS,Z);
000565      IF Z=0
000565      THEN CTMIN%=SAMPLE[1]-1,CTMIN
000576      ELSE IF ((CTMIN<0)OR(CTMIN>59))
000603      THEN BEGIN
000603      WRITELN(=ERROR IN COUNTING MINUTE FIELD FOR SAMPLE =,ID%10);
000616      ABORT%=TRUE;
000617      END
000617      ELSE CTMIN%=ROUND(Z);
000623      IF NOT(EOF(IDENTS)) THEN READLN(IDENTS);
000625      I%=SUCC(1);
000627      END;
000627      IF NOT(ABORT)
000627      THEN BEGIN
000631      (*-----*)
000631      (*ECHO RAW INFORMATION*)
000631      (*-----*)
000631      I%=1;
000632      WHILE NOT(SAMPLE[1].ID=BLANKS) DO
000641      BEGIN
000641      DELIMETER;
000642      SRHEADER;
000644      C 1644      WRITELN(= SAMPLE          UNIT          CNT=);L;
000653      WRITELN(= ID      OWNER    QUAN  QUAN  COUNTS    MIN=);L;
000662      WRITELN(=-----=);L;
000671      WHILE ((LINE<65) AND (SAMPLE[1].ID<>BLANKS)) DO WITH SAMPLE[1] DO
000706      BEGIN
000706      WRITELN(ID%10,OWNER%6,QUAN%8%2,UNITQUAN%5,CTS%8%0,CTDUR%8%2);
000744      L; I%=SUCC(1);
000747      END;
000747      FILLER;
000750      END;
000751      I%=1;
000752      WHILE NOT(SAMPLE[1].ID=BLANKS) DO
000761      BEGIN
000761      DELIMETER;
000762      SRHEADER;
000764      WRITELN(= SAMPLE    CARRIER CARRIER    SEPARATION    COUNTING=);L;
000773      WRITELN(= ID      ADDED  RECOVD    DATE    HR MN    DATE    HR MN=);L;
001001      L;
001002      WRITELN(=-----=);L;
001010      L;
001011      WHILE ((LINE<65)AND(SAMPLE[1].ID<>BLANKS)) DO WITH SAMPLE[1] DO
001026      BEGIN
001026      WRITELN(ID%10,ADDED%7%2,RECOV%7%2,= =,SEPDATE%8,SEPHR%3,SEPMIN%3,
001070      = =,CTDATE%8,CTHR%3,CTMIN%3);L;
001116      I%=SUCC(1);
001120      END;
001120      FILLER;
001121      END;
001122      (*-----*)
001122      (*COMPUTE SAMPLE RESULTS AND OUTPUT ONE SAMPLE AT A TIME TILL DONE*)
001122      (*-----*)
001122      I%=1;
001123      WHILE NOT(SAMPLE[1].ID=BLANKS) DO
001132      BEGIN
001132      DELIMETER;
001133      SRHEADER;
001135      WRITELN(= ID      OWNER          SR-90 CONCENTRATION    =);L;
001144      WRITELN(=-----=);L;

```



```

001153 WHILE ((LINE<65) AND (SAMPLE[1].ID<>BLANKS)) DO WITH SAMPLE[1] DO
001170 BEGIN
001170 T:=CTMIN+ROUND((CTDUR/(60*2)-TRUNC(CTDUR/(60*2)))*60);
001211 DTIME:=ET(SEPDATE,SEPHR,SEPMIN,CTDATE,(CTHR+TRUNC(CTDUR/(60*2)))*
001231 T)*24;
001241 IF DTIME<0
001241 THEN WRITELN(=ERROR IN TIME PARAMETER FOR SAMPLE =,ID*10,
001256 = - NEGATIVE ET=);
001264 AX:=(CTS/CTDUR-BKG/TIMBKG)*ADDED*EXP(0.693/64*DTIME)/
001311 (QUAN*EFFICIENCY*2.22*RECOV));
001315 SAX:=ABS(AX*SQR(((CTS/SQR(CTDUR)+BKG/SQR(TIMBKG))/
001321 SQR(CTS/CTDUR-BKG/TIMBKG))+SQR(SIGEFF))));
001340 PREFIX:=P=;
001341 WRITE(ID*10,=,=,OWNER*3,=); SIGDIGITS(AX,SAX);
001365 WRITELN(PREFIX*2,=C1/=,UNITQUAN);L:
001405 SYS2KFORM(AX,SAX,PREFIX,=C1,=,QUAN,UNITQUAN,CTDATE,
001420 ID,OWNER,=SR-90,=);
001424 I:=SUCC(I);
001426 END;
001426 FILLER;
001427 END;
001430 DELIMITER;
001431 END;
001431 END; (*SR-90*)
001640
001640 BEGIN (*MASTERCALC*)
001640 (*-----*)
001640 (*MAIN DRIVER FOR MASTERCALC *)
001640 (*-----*)
001640 REWRITE(RESULTS);
000054 LINELIMIT(OUTPUT,15000);
000055 WRITELN;
000056 WRITELN(=PLACE AN X UNDER THE DESIRED ANALYSIS=);
000064 WRITELN(= A A A T G S=);
000072 WRITELN(= L L L R R R=);
000100 WRITELN(= P P P I O -=);
000106 WRITELN(= H H H T S 9=);
000114 WRITELN(= A A A I S 0=);
000122 WRITELN(= S B C U G =);
000130 WRITELN(= P E A M A =);
000136 WRITELN(= E T L M =);
000144 WRITELN(= C A =);
000152 READ(CH); K:=0;
000160 REPEAT
000160 READ(CH);
000165 K:=SUCC(K);
000167 UNTIL CH<>= =;
000171 CASE K OF
000175 1*ALPHASPEC;
000177 6*ALPHA BETA;
000201 11*CALIHRATE;
000203 16*TRITIUM;
000205 21*GROSSGAM;
000207 26*SR90;
000211 END;
000243 1000* END.

```

```

PROGRAM BKGD2 (INPUT,OUTPUT,TAPE3,TAPE4,TAPE5)
DIMENSION IDATA(128,32,4), CB(128,32), SDCB(128,32), ICHAN(32)
DIMENSION IREG1(32,4), IREG2(32,4), ITOT(32,4), IGT(4), ITEMP(4096)
1 )

```

```

COMMON LINE, I, J, K, K2, IDATE

```

```

-----
THIS PROGRAM IS A MODIFICATION OF SM LOMBARDO'S PROGRAM TO ANALYZE
ALPHA SPECTROMETRY BACKGROUND INFORMATION WRITTEN BY BILL GOODE
12/75. CURRENT BACKGROUND COUNTING DATA ARE READ FROM A FILE CTDAT
HARD COPY INFORMATION IS GIVEN AND PERFILES ARE MAINTAINED WHICH
KEEP (1) A FOUR WEEK RECORD OF PAST BKGDS (2) A COMPILATION OF AVE
AND STD DEVIATION VALUES FOR EACH CHANNEL OF EACH DETECTOR AREA
BASED ON THE FOUR WEEK PERIOD (FILE BKGDFL). THE FILE BKGDFL
SUPPORTS THE ALPHA ANALYSIS CODE.
-----

```

```

ISIZE=32
CALL GETPF (5HTAPE3,5HCTDAT)
CALL GETPF (5HTAPE4,4HBKGX)
CALL GETPF (5HTAPE5,6HBKGDFL)
REWIND 3
REWIND 4
REWIND 5

```

```

-----
ENTER INPUT SECTOR
-----

```

```

READ NEW BKG DATA
-----

```

```

READ (3,350) I
READ (3,360) CTIME
K=-9
TALLY=11
IEND=ISIZE*128/10+ISIZE*128/100+2
DO 90 I=1,IEND
  K=K+10
  IF (TALLY.EQ.11) 80,10

```

```

-----
READ ELEMENTS INTO ITEMP
-----

```

```

10    IF (I.EQ.IEND) 20,60
20    IF (ISIZE.EQ.32) 30,40
30    K2=K+4
      GO TO 50
40    K2=K+6
      GO TO 70
50    READ (3,370) (ITEMP(J),J=K,K2)
      GO TO 70
60    K2=K+9
      READ (3,380) (ITEMP(J),J=K,K2)
70    TALLY=TALLY+1
      GO TO 90

```

```

-----
READ LINE NUMBER AND DISCARD
-----

```

```

80    READ (3,390) LNUM
      TALLY=1
      K=K-10

```

```

90      CONTINUE
      ITEMP(4096)=0
      K=1
      DO 110 J=1,ISIZE
        DO 100 I=1,128
          IDATA(I,J,4)=ITEMP(K)
          K=K+1
100      CONTINUE
110     CONTINUE
      READ 400, IDATE
      READ (4,410) (((IDATA(I,J,K),I=1,128),J=1,ISIZE),K=1,3)
      REWIND 4

-----
      ENTER COMPUTATIONAL SECTOR
-----

      IDATA(1,1,4)=0
      DO 150 J=1,ISIZE
        DO 140 I=1,128
          CB(I,J)=0
          DO 120 K=1,4
120         CB(I,J)=CB(I,J)+IDATA(I,J,K)
          CB(I,J)=CB(I,J)/4
          SDCB(I,J)=0
          DO 130 K=1,4
130         SDCB(I,J)=SDCB(I,J)+(IDATA(I,J,K)-CB(I,J))*2
140         CONTINUE
140         SDCB(I,J)=SQRT(SDCB(I,J)/3)
150     CONTINUE

-----
      CONVERT TO INTEGER NUMBERS BEFORE WRITE
-----

      DO 170 J=1,ISIZE
        DO 160 I=1,128
          ICB=CB(I,J)+0.5
          ISDCB=SDCB(I,J)+0.5
          WRITE (5,420) (ICB,ISDCB)
160         CONTINUE
170     CONTINUE

-----
      BEGIN OUTPUT SECTOR
-----

      REWIND 5
      CALL REPLACE (5HTAPE5,6HBKGDFL)

-----
      OUTPUT RAW COUNTING DATA IN 60 CHAN X 8 DEFECTOR PAGES
-----

      GO TO 400
      ISTOP=ISIZE/8
      K=-7
      DO 200 N=1,ISTOP
        M=5
        K=K+8
        K2=K+7
180     M2=M+60
        CALL NEWPG
        CALL DELIMTR

```

```

        CALL RAWHEAD
        DO 190 I=M,M2
            PRINT 430, I, (IDATA(I,J,4),J=K,K2)
190      CONTINUE
        CALL DELIMTR
        M=M+60
        IF (M.LT.125) GO TO 180
200      CONTINUE

```

WRITE OUT SUMMARY INFORMATION

```

CALL NEWPG
CALL DELIMTR
PRINT 440, IDATE
PRINT 450
LINE=6
        DO 240 J=1,ISIZE
            DO 230 K=1,4
                IREG1(J,K)=0
                IREG2(J,K)=0
                DO 210 I=54,64
210              IREG1(J,K)=IREG1(J,K)+IDATA(I,J,K)
                DO 220 I=32,42
220              IREG2(J,K)=IREG2(J,K)+IDATA(I,J,K)
230              CONTINUE
240          CONTINUE
            DO 270 J=1,ISIZE
                DO 260 K=1,4
                    ITOT(J,K)=0
                    DO 250 I=1,128
250                  ITOT(J,K)=ITOT(J,K)+IDATA(I,J,K)
260              CONTINUE
                PRINT 460, J, (IREG1(J,K),IREG2(J,K),ITOT(J,K),K=1,4)
                CALL LINEUP
                CONTINUE
                DO 290 K=1,4
                    IGT(K)=0
                    DO 280 J=1,ISIZE
280                  IGT(K)=IGT(K)+ITOT(J,K)
290              CONTINUE
                PRINT 470, (IGT(K),K=1,4)
                CALL LINEUP

```

OPTIONAL LISTING OF ALL CHANNELS AVERAGING 01 COUNT BACKGROUND

```

PRINT 480
CALL LINEUP
CALL LINEUP
        DO 310 J=1,ISIZE
            DO 300 I=1,128
                IF (CB(I,J).LE.1) GO TO 300
                PRINT 490, J,I,CB(I,J)
                CALL LINEUP
300          CONTINUE
310      CONTINUE
        CALL FILLER
        CALL DELIMTR
        GO TO 570
        DO 340 J=1,ISIZE
            DO 330 I=1,128

```

```

DO 320 K=1,3
320      IDATA(I,J,K)=IDATA(I,J,K+1)
330      CONTINUE
340      CONTINUE
      WRITE (4,410) (((IDATA(I,J,K),I=1,128),J=1,ISIZE),K=1,3)
      REWIND 4
      CALL REPLACE (5HTAPE4,4HBKGX)

350 FORMAT (A1)
360 FORMAT (16)
370 FORMAT (16,617)
380 FORMAT (16,917)
390 FORMAT (14)
400 FORMAT (A10)
410 FORMAT (16)
420 FORMAT (216)
430 FORMAT (13,* *,817)
440 FORMAT (21X,*BACKGROUND SUMMARY*,20X,A10,/,/,30X,*WEEK*)
450 FORMAT (11X,*1*,13X,*2*,13X,*3*,13X,*4*,/,*,DET 238 239 TOT 238
1*,* 239 TOT 238 239 TOT 238 239 TOT*)
460 FORMAT (13,3X,13,214,16,214,16,214,16,214)
470 FORMAT (*GRAND TOTAL*,3X,13,3(11X,13))
480 FORMAT (/,*,DET CHAN CB*)
490 FORMAT (13,17,F8.2)
END

```

SUBROUTINE LINEUP

 INCREMENTS THE LINE COUNT

COMMON LINE
 LINE=LINE+1
 RETURN
 END

SUBROUTINE NEWPG

 STARTS A NEW PHYSICAL PAGE

PRINT 10
 RETURN

10 FORMAT (//////)
 END

SUBROUTINE DELIMTR

 WRITES A PAGE DELIMETER

PRINT 10
 RETURN

10 FORMAT (*- -----
 1--*,* -----*)
 END

SUBROUTINE RAWHEAD

WRITES THE HEADING FOR THE OUTPUT OF RAW SPECTRAL INFORMATION

```
DIMENSION M(32)
COMMON LINE, I, J, K, K2, IDATE
PRINT 20, IDATE
      DO 10 N=K,K2
      M(N)=N
10    CONTINUE
PRINT 30, (M(N),N=K,K2)
RETURN

20 FORMAT (32X,*DETECTOR NUMBER*,15X,*DATE=*,A8)
30 FORMAT (* CH *,8I7)
END
```

SUBROUTINE FILLER

MAINTAINS PROPER DIMENSIONS FOR A 8 1/2 BY 11 INCH PAGE

```
COMMON LINE
ISPACE=64-LINE
      DO 10 K=1,ISPACE
      PRINT 20
10    CONTINUE
RETURN

20 FORMAT ( )
END
```