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ANALYSIS AND RETRIEVAL OF
PROCESSED GAMMA SPECTRA DATA

E. L. Wells
W. R. Weissenberger

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ANALYSIS AND RETRIEVAL OF
PROCESSED GAMMA SPECTRA DATA

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PROCESSED GAMMA SPECTRA DATA

ABSTRACT

This report discusses the gamma energy analytical system established for the Containment Systems Experiment and the associated digital computer programs. A general description of components, coding methods, mathematical treatment, and analytical results are given.

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Introduction

In 1963, a program entitled, "The Containment System Experiment," was undertaken by BNW. One of the primary objectives of the CSE program is to evaluate the effectiveness of natural processes and engineering safeguards in limiting the release of fission products from nuclear reactor accidents to the environment.

Associated with this evaluation is the collection and analysis of several thousand chemical samples per individual Containment System Test, with each sample containing a maximum of eight chemical constituents for analysis.

To perform the desired tests, a rapid yet economical method was required for analyzing chemical constituents common to a reactor accident and in the appropriate concentration ranges. Gamma energy analytical techniques were chosen on the basis of detection limit for the prescribed chemical constituents and concentrations and the minimum chemical manipulations required to analyze all components in the chemical mixture.

Two alternative methods of pulse height analysis were considered, (1) the purchase of four complete multichannel analyzer systems with paper-tape output and (2) the interfacing of four analog-to-digital pulse converter-scintillation detector systems to a small digital computer. The latter method was chosen based on advantages of immediate data output, possibilities for further data reduction, and a small differential direct cost for the two systems.

Additional advantages of the on-line system as opposed to a central data processing facility are short turn-around times, the ability to immediately adjust for sampling errors, recheck on samples of questionable

origin or isotopic content, immediate check on goodness of fit of analytical output and above all, paper-tape to cards or magnetic tape conversions are not required. In addition, the mutual sharing of computer memory by four multichannel analyzer systems allows the simultaneous collection of spectra from all systems and immediate data processing on a priority interrupt basis.

A schematic of analyzer and PDP-7 Digital Computer systems is shown in Figure 1.

Procedure

Following a radioactive aerosol release to the containment systems structure, numerous radioactive samples are collected and analyzed for specific radionuclide content. Sampling devices are used to collect fractional amounts of the total airborne and liquid phase content of the containment vessel as a function of time and deposition coupons measure integrated sorption of input activity on materials of construction. Samples of a given type are taken at numerous locations within the containment structure to ensure valid interpretation of collected data.

Samples are gamma counted on any one of the four sodium iodide scintillation detector systems by positioning the samples at a proper distance relationship to the detector to give the best count rate. Counting is then initiated via a teletype command to the computer.^(2,3) Gamma energy pulse height spectra data is converted from analog to digital pulses and stored immediately in the sections of computer core assigned to the given analyzer system. After the preset count cycle is complete, stored spectra data is compared with standard spectra of the radionuclides of interest which are filed on magnetic tape and processed on-line by a modified least squares fitting routine to

give the relative amounts of individual radionuclides in the sample spectra. Included in the processing are decay corrections, volume corrections and conversion to concentration units if desired. A typical output is shown in Table 1.

After the spectroscopist has observed the analytical output he may choose to save or reject this information on the basis of relative error or Chi^2 goodness of fit indicator information presented. If the information is acceptable, it is filed on magnetic tape by a teletype command⁽²⁾

Format for data storage is as follows: block five of the 1100₈ block microtape is used as a master block. This block of data contains the run number identification, (IRUN) and an index to file block (BF) and data block (BS) information. (Table 2)

Blocks 6 - 35₈ are used as file blocks. The file blocks consist of 400₈ 18-bit words. There is identification information for 85 samples stored in each file block with each sample requiring three words. Word one is the first half of the sample ID, word two, the second half of the sample ID, and word three, a packed word which defines the associated data block number and the section within that data block where the particular sample information is stored. (Table 3)

Blocks 36₈ - 1033₈ are used as data blocks. Each of these blocks contains 4 sets of data with each set consisting of 100₈ words. (Table 4) Using this format, it is possible to store a maximum of 2040 data sets on one PDP-7 magnetic tape.

Method

Retrieval of Aerosol, Liquid, and Deposition data will be described separately for clarity.

Aerosol Sampling

Airborne activity is obtained as a function of time by the aerosol sampling train shown in Figure 2. The basic sampling device is a hollow cylinder in which four aerosol segregation media are installed in sequence: glass fibre filters, silver screens, charcoal paper and finally, granular charcoal. These four components are used to differentiate between different forms of iodine with particulate iodide being associated with glass filters, elemental iodine on silver surfaces, high molecular weight organic iodide on charcoal paper, and methyl iodide on the granular charcoal bed.

The importance of the airborne concentration data is to allow predictions of the amount of fission produce elements available for release to the environment as a function of time. Final representation of the data will be in a graphical form as follows:

IODINE GAS PHASE CONCENTRATION VERSUS
TIME ON MAYPACK COMPONENTS

Other isotope data will be presented in the same fashion. In addition, the components within a Maypack (filters, screens, charcoal

paper, and charcoal bed) may be plotted individually to show the function of the various forms of the isotope versus time.

To obtain the concentrations of these elements as a function of time, the program requires the following input data:

Sample ID--6 characters starting with M followed by two numeric digits representing a location and then an A, B, C, or D alphabetic character which corresponds to a filter, screen, charcoal paper, or granular bed charcoal sample respectively followed by an additional two numeric digits to specify the maypack sample in question, i.e.,

M	01	A	01	
				maypack #
				component ID
				location
				aerosol type sample

To obtain the $\mu\text{g}/\text{m}^3$ units, the following equation is used;

$$\mu\text{g}/\text{m}^3 = (X \cdot Y) / m_1^3$$

where $X = \text{d}/\text{m} = \text{disintegrations/minutes}$

$Y = \mu\text{g}/\text{d}/\text{m} = \text{specific activity of the isotope}$

and $m_1^3 = \text{cubic meters of containment volume}$

To obtain containment cubic meters, requires pressure and temperature corrections and conversion from cubic feet to metric units.

Pressure correction for flow is computed using the following equation:

$$\text{actual flow} = (\text{observed flow}) \sqrt{\frac{\text{Rotometer Pressure (psia) (observed)}}{\text{Rotometer Pressure (psia) (calibrated)}}}$$

The observed pressures are read either as pounds per square inch gauge (psig) or as negative inches of mercury (-Hg") which require manipulations to obtain psia.

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So, the two equations are:

$$\text{correct flow} = \text{observed flow} \sqrt{\frac{P(\text{psig}) + 14.3}{14.7}},$$

$$\text{or, } \sqrt{\frac{P(-\text{Hg}'')/29.9 (14.7) + 14.3}{14.7}}$$

Conversion from measured standard m^3 of air removed from containment to geometric m^3 of containment requires a correction coefficient dependent on moles of air present per geometric cubic meter of containment volume at test conditions. For initial tests, this value was $\frac{1.09 \text{ m}^3 (\text{geometric})}{\text{std m}^3 (\text{measured})}$

Combining these equations:

$$\mu\text{g}/\text{m}^3 (\text{geometric}) = \frac{(\text{d}/\text{m}) (\text{g}/\text{d}/\text{m})}{\left(\frac{\text{std ft}^3}{\text{min}}\right) \left(\frac{\text{sampling (min)}}{\text{duration}}\right) \left(\frac{\text{m}^3 (\text{std})}{35.3 \text{ ft}^3}\right) \sqrt{\frac{\text{psig} + 14.3}{14.7}} \frac{1.09 \text{ m}^3 (\text{geo})}{\text{m}^3 (\text{std})}}$$

After the above manipulations the data is automatically typed out in tabled form in terms of concentrations of the various aerosol sampler components as a function of time as illustrated in Table 5 for one location. Averages of components taken at a discrete time at a number of locations are in turn computed and tabled according to the illustrated format in Table 6.

Liquid

The significance of the condensate of liquid sample analysis versus time is to give an estimate of the amount of activity removed by condensing steam and helps to provide an overall inventory of the input aerosol versus time. Since the amount of material introduced to the containment vessel is known and the amount in liquid and gaseous phases is measured as a function of time, the amount of a given material associated with the vessel structural components can be inferred.

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The liquid samples are coded much like the maypack sample.

To obtain μg per sample, disintegrations per minute (d/m) must be multiplied by the specific activity of the specific isotope.

$$\text{i.e.,} \quad \mu\text{g} = (\text{d/m}) \cdot (\mu\text{g/d/m})$$

The result of the output is illustrated in Table 7.

Deposition

There are no provisions for removing deposition coupons from the vessel as a function of time. The main information gained from these samples is an estimate of the amount of activity which will be associated with the vessel structural components.

The coding of the deposition coupons is similar to both the maypack and liquid samples.

The data that is stored on magnetic tape is in terms of disintegration per minute per square centimeter (d/m/cm^2). To convert this value to $\mu\text{g/cm}^2$ requires multiplication by the specific activity of the isotope,

$$\text{i.e.,} \quad \mu\text{g/cm}^2 = (\text{d/m/cm}^2) \cdot (\mu\text{g/d/m})$$

The result of the output is illustrated in Table 8.

Main Program (REPORT)

This Fortran program was written to produce formal reports using the IBM Selectric typewriter. Its main function is to operate on the retrieved data using typed inputs to compute averages, per cent errors, and totals and output the data on an IBM Selectric.

The typed inputs required are:

- (1) IRUN = a three digit run number which must correspond to the run number on the data tape.
- (2) NOI = number of isotopes.
- (3) ID1(I) and ID2(I) for I = 1 to NOI. = These are the first and second three character isotope identification respectively.
- (4) A(I) for I = 1 to NOI. = The specific activity for each isotope.
- (5) NLOC = number of locations (1-40) to be retrieved.
- (6) ISDI(I) for I = 1 to NLOC = The first three alphanumeric characters of the first sample identification to be retrieved.
- (7) INDXS = an index used to indicate at what position within a location the user wishes to start. i.e., if the user wanted the following:

MO4 A06	MO4 B06	MO4 C06	MO4 D06
MO4 A07	MO4 B07	MO4 C07	MO4 D07
.	.	.	.
.	.	.	.
.	.	.	.
MO4 A10	MO4 B10	MO4 C10	MO4 D10
.	.	.	.
.	.	.	.
.	.	.	.

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INDXS would be input as 6. If INDXS were input as 1, the following would occur:

M04 A01	M04 B01	M04 C01	M04 D01
M04 A02	M04 B02	M04 C02	M04 D02
.	.	.	.
.	.	.	.
.	.	.	.
M04 A10	M04 B10	M04 C10	M04 D10
.	.	.	.
.	.	.	.
.	.	.	.

- (8) KFAC = the search factor associated with the sample identification. (1-40). For example, if KFAC = 3 and INDXS = 5, the following would result:

M04 A05	M04 B05	M04 C05	M04 D05
M04 A06	M04 B06	M04 C06	M04 D06
M04 A07	M04 B07	M04 C07	M04 D07

This is all that would be retrieved.

A typical input for the REPORT program can be seen in Table 9.

After the input has been typed in, the appropriate headings are output on the IBM Selectric. Subroutine GET is now called to retrieve the data indicated in the call argument list.

If liquid or deposition sample analyses are retrieved, the amount of the radionuclide is computed as follows:

$$\mu\text{g} = A(I) \cdot \text{DATA}(1)$$

where $A(I)$ = specific activity for isotope I.

and $\text{DATA}(1)$ = disintegrations per minute.

If airborne (Maypack) analyses are reported, the desired output is micrograms per cubic meter of containment vessel ($\mu\text{g}/\text{m}^3$ containment). This calculation is dependent upon cubic meters of vessel, pressure corrections,

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flow meter readings, and the collection time or the duration of sampling.

The following calculation is performed:

$$\mu\text{g}/\text{m}^3 \text{ containment} = (D_1) \cdot (A_1) / (D_5) \cdot (D_6) \cdot (\sqrt{D_4}) \cdot (.008067)$$

where

$$D_1 = \text{DATA (1)} = d/m$$

$$A_1 = A(I) = \mu/d/m = \text{specific activity of isotope I}$$

$$D_5 = \text{DATA (5)} = \text{rotometer reading}$$

$$D_6 = \text{collection time}$$

$$D_4 = \text{DATA (4)} + 14.3 \text{ if DATA (4) is lbs/in}^2$$

$$\text{or } D_4 = \text{DATA (4)} \cdot .4909 + 14.3 \text{ if DATA (4) is -Hg"}$$

and .008067 is a conversion constant.

If an airborne analysis is reported, the data is accumulated and after all locations for a particular isotope have been reported, the average concentration of that isotope is computed and reported. (Table 6)

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Retrieval Program (GET)

The GET subroutine, written in assembly language, is compatible with the PDP-7 FORTRAN operating system. The main program uses the GET subroutine for retrieval of stored analyses sets. The calling program transfers information to GET through the call argument list and GET places the desired data array in a special common area starting at 30_g. The argument list is as follows:

CALL GET (ID, M, IL, IT1, IT2, IM9, I1, I2, IDENT, ITOS, ID3)

ID = First three alphanumeric characters of the six character sample identification.

M = The two digit number (01-40) in the second three alphanumeric characters of the sample identification. The subroutine uses the value of M and the value of IL to construct the last half of the sample identification, i.e., if IL = 1 and M = 06, then the subroutine would construct A06 for the last half of the sample identification.

IL = 1,2...12 indicating an A - L respectively.

IT1 = First three alphanumeric characters of the isotope identification.

IT2 = Second three characters of the six character isotope identification.

IM9 = Flag indicator for the output device. IM9 = 0 indicates KSR-33 teletype of IM9 ≠ 0 indicates IBM Selectric.

I1 = A GET return argument which is zero only if no data is found on data tape.

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12 = A GET return argument which is zero only if no isotope is found on data tape.

IDENT = Flag indicator used by GET. If IDENT $\neq$ 0, GET initializes its search loop and then sets IDENT = 0.

ITOS = Integer time of sample value.

ID3 = A GET return argument used only if deposition data is being retrieved. If search is successful, ID3 = second three characters of sample identification. Used for variable headings on output.

A typical input argument list would be:

ID = M12

M = 4

IL = 3

IT1 = UI-

IT2 = 131

IM9 = 1

IDENT = 5

This would generate the sample identification M12C04. If M were 2 and IL = 1, then GET would construct the sample identification M12A02.

A special procedure was developed which reduces the tape search time by a factor of twenty. Subroutine GET searches file blocks 6-35₈ until it locates the required data. This file block is then stored in memory and GET will operate from this file block until the data information has been exhausted. This means that GET can operate in the data block area (36₈-1033₈) for a longer period of time and not have to rewind the magnetic tape to search the file blocks as often.

Consequently, when IDENT $\neq$ 0, GET initializes a search loop, sets IDENT = 0, and assumes the first of a series of isotopes. As long as the isotope identification (IT1, IT2) does not change, GET, will upon entry, find the sample block and the sample block section and save these in two separate integer arrays--RS(J) and RD(J). When IT1 and IT2 change and as long as IDENT = 0, these two arrays are examined and all file block searching is by-passed. The data array which GET returns is composed as follows:

DATA (1) = Disintegrations per minute (d/m)

DATA (2) = Relative standard error ($\sigma/\bar{x}$)

DATA (3) = Aliquot factor

DATA (4) = Pressure (if airborne sample)

DATA (5) = Rotometer reading (if airborne sample)

DATA (6) = Sample collection time.

These values, plus program inputs, are used to calculate isotopic concentrations in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of containment volume for airborne samples (Maypack), micrograms per liter ($\mu\text{g}/\text{l}$) for liquid samples, and micrograms per square centimeter ($\mu\text{g}/\text{cm}^2$) for deposition samples. Because of the length of the main FORTRAN program, GET uses its own magnetic tape routines. It reads one block of data at a time and stores it in a buffer area beginning at 10400₈.

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Line Feed Subroutine (LFEED)

LFEED subroutine is a small routine written in assembly language. The function of this subroutine is simply to generate a form feed or line feed on the IBM Selectric typer. There is one argument in the calling sequence that must be present when the subroutine is called. This argument represents the number of lines to be skipped and is computed from the maximum number of lines per page minus the number of lines that have been written on a page.

The calling sequence appears as follows:

KOUNT = 52-NLINE

CALL LFEED (KOUNT)

where NLINE is the present number of lines written on a page.

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Operating Instructions for Report Program

1. Mount DSD magnetic tape on any unit with WRITE LOCK.
2. Set ADS = 176000.
3. Set ACO-5 to unit of DSD tape and AC 11-17 to block of Report Program.
4. Read-In DSD paper tape. (This will load the Report Program).
5. Mount Data tape #3 on unit 3 with WRITE LOCK. (This must be the only unit dialed to 3).
6. Program will request a three digit run number, number of isotopes, isotope identifications and specific activities of each isotope, number of locations, the first three characters of the sample identification followed by three blanks, the beginning location index, and the number of searches.

NOMENCLATURE

S = initialized internally

I = input

C = computed internally

<u>Variable</u>	<u>Description</u>	<u>Class</u>
A(I)	Specific activity for isotope I.	I
AVTOT(IY)	The average concentration of the total. Used in Maypack averages only.	C
ERRTOT(IY,IX)	The total error of a particular sample. Used in Maypack averages only.	C
ERRSUM	Used to keep a cumulative sum of the error in the sample at a particular position.	C
ID1(I)	First three alphanumeric characters of the 6 character isotope identification (Dimensioned 8) for isotope I.	I
ID2(I)	Second three alphanumeric characters of the 6 character isotope identification (Dimensioned 8) for isotope I.	I
IDENT	Flag indicator used by subroutine GET. If IDENT $\neq$ 0, GET initializes a search loop.	S
IM9	Output device index. IM9 = 0 indicates KSR-33 teletype (not to be used with this program). IM9 $\neq$ indicates IBM Selectric.	S
IN	Alphabetic character code index of last half of sample identification for Maypack sample, IN = 4 resulting in an A, B, C, and D alphabetic character code being constructed by subroutine GET. For Liquid samples, IN = 3 resulting in an A, B, or C being constructed. For Deposition samples, IN has no significance.	C
IND	Sample analysis index either 1, 2 or 3 indicating Maypack, Liquid, or Deposition sample respectively.	C
INDXS	The initial location index to be retrieved.	I
IRUN	Data Run number.	I

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<u>Variable</u>	<u>Description</u>	<u>Class</u>
ISD1(I)	First three alphanumeric characters of the sample identification for sample location I.	I
KFAC	A search factor index associated with the sample identification. KFAC can take on values 1-40.	I
KOUNT	Line counter for subroutine LFEED.	C
MY(IX)	The second three alphanumeric characters of the sample identification of a deposition sample. Used only when reporting deposition analyses.	C
NLOC	Number of sample locations to be retrieved.	I
NOI	Number of isotopes to be retrieved.	I
PCTTOT(IY,IX)	The total percentage of concentration. Used in Maypack averages only.	C
TOTAL	Used to keep a cumulative sum of the concentrations at a particular position.	C
WTTOT(IY,IX)	The total concentration in micrograms. Used in Maypack averages only.	C
Y	Conversion factor used in computing the $\mu\text{g}/\text{m}^3$ containment for an airborne analyses.	S

IBM FORMAL REPORT PROGRAM

```

2WORD
S      OCTAL
S      XND=17777
S      IRUN.=26
S      DECIMAL
      EXTEND MODE WTTOT,PCTTOT,JUMP1,A,C1,C2,C3,C4
      DIMENSION JUMP1(256)
      DIMENSION A(8),ID1(8),ID2(8),C1(12),C2(12)
      DIMENSION C3(12),C4(12),DATA(15),ISD1(15),AVTOT(12)
      DIMENSION M4(12),WTTOT(12,4),PCTTOT(12,4),ERRTOT(
S      12,4)
4      WRITE 2,900
      READ 1,906,IRUN
      WRITE 2,935
      WRITE 2,930
      READ 1,902,NOI
      WRITE 2,904
      DO 10 I=1,NOI
      READ 1,906,ID1(I),ID2(I)
      READ 1,907,A(I)
      WRITE 2,935
10     CONTINUE
      KOUNT =0
      WRITE 2,935
      WRITE2,910
      READ 1,909,NLOC
20     WRITE 2,908
      DO 11 I=1,NLOC
      READ1,906,ISD1(I),ISD2
11     CONTINUE
      IND=1
      IN=4
      KT=ISD1(1)
S      OCTAL
S      AND (770000
S      SAD (430000
S      JMP .7
S      SAD (640000
S      JMP .8
S      JMP .9
S      DECIMAL
7      CONTINUE
      IND=2
      IN=3
      GO TO 9
8      CONTINUE
      IND=3
      IN=1
9      CONTINUE

```

```

WRITE 2,935
WRITE 2,970
WRITE 2,935
READ 1,909,INDXS
WRITE 2,935
WRITE 2,912
READ 1,905,KFAC
IM9=1
Y=.008067
DO 51 I=1,N0I
  IDENT=5
  DO 17 IY=1,12
    AVTOT(IY)=0.0
    DO 17 IX=1,4
      WTTOT(IY,IX)=0.0
      PCTTOT(IY,IX)=0.0
      ERRTOT(IY,IX)=0.0
17    CONTINUE
    DO 1000 II=1,NLOC
      ID=ISD1(II)
      M=INDXS
      IT1=ID1(I)
      IT2=ID2(I)
      KOUNT =KOUNT+1
      WRITE 9,914,IRUN,ID1(I),ID2(I)
      GO TO (18,19,21),IND
18    CONTINUE
      KOUNT=KOUNT+4
      WRITE9,915,ISD1(II)
      WRITE9,940
      WRITE 9,916
      GO TO 22
19    CONTINUE
      KOUNT=KOUNT+4
      WRITE9,917,ISD1(II)
      WRITE 9,918
      WRITE9,943
      GO TO 22
21    CONTINUE
      KOUNT=KOUNT+1
      WRITE9,919,ISD1(II)
22    CONTINUE
      DO 30 L=1,KFAC
      GO TO (92,92,91),IND
91    DO 6 IX=1,12
      M4(IX)=ISD2
6      CONTINUE
92    CONTINUE
      DO 5 IX=1,IN
      C1(IX)=0.0

```



```
      C2(IX)=0.0
      C3(IX)=0.0
      C4(IX)=0.0
5      CONTINUE
      TOTAL=0.0
      ERRSUM=0.0
      GO TO(24,24,241),IND
241    M=INDXS-1
      KF=KFAC+M
23    CONTINUE
      M=M+1
      IF(M-KF)24,24,26
24    CONTINUE
      DO 25 IL=1,IN
      CALL GET(ID,M,IL,IT1,IT2,IM9,I1,I2,ITOS,IDENT,ID3)
      KK=I1*I2
      IF(KK)47,70,47
47    CONTINUE
      GO TO(49,49,48),IND
48    LL=M
      M4(LL)=ID3
      GO TO 491
49    LL=IL
491    CONTINUE
      R=DATA(1)
      RA=A(I)
      B=R*RA
      GO TO(46,45,45),IND
45    CONTINUE
      R8=B
      GO TO 62
46    IF(DATA(4))50,60,60
50    CONTINUE
      DATA(4)=DATA(4)*0.4909
60    CONTINUE
      DATA(4)=DATA(4)+14.7
61    CONTINUE
      DATA4=DATA(4)
      R5=SQRTF(DATA4)
      R6=DATA(5)*DATA(6)*R5*Y
      R8=B/R6
62    C1(LL)=R8
      C3(LL)=DATA(2)
      ERRSUM=ERRSUM+DATA(2)
      IF(R8)94,93,93
93    TOTAL=TOTAL+R8
94    GO TO (70,70,23),IND
70    CONTINUE
25    CONTINUE
26    CONTINUE
```

```

DO 27 IL=1, IN
IF(C1(IL))27,95,95
95  C2(IL)=(C1(IL)/TOTAL)*100.0
27  CONTINUE
    C11=C1(1)
    C21=C2(1)
    C31=C3(1)
    C12=C1(2)
    C22=C2(2)
    C32=C3(2)
    C13=C1(3)
    C23=C2(3)
    C33=C3(3)
    C14=C1(4)
    C24=C2(4)
    C34=C3(4)
    C15=C1(5)
    C35=C3(5)
    C16=C1(6)
    C36=C3(6)
    C17=C1(7)
    C37=C3(7)
    C18=C1(8)
    C38=C3(8)
    C19=C1(9)
    C39=C3(9)
    C110=C1(10)
    C310=C3(10)
    C111=C1(11)
    C311=C3(11)
    C112=C1(12)
    C312=C3(12)
    GOTO(41,42,43), IND
41  CONTINUE
    LM=L+INDXS-1
    KOUNT=KOUNT+1
    WRITE9,925,LM,ITOS,C11,C21,C31,C12,C22,C32,C13,C23,
S   C33,C14,C24,C34,TOTAL
    DO 44 IX=1,4
    IF(C1(IX))83,84,84
84  IF(C2(IX))85,86,86
86  IF(C3(IX))87,88,88
83  C1(IX)=0.0
    GO TO 84
85  C2(IX)=0.0
    GO TO 86
87  C3(IX)=0.0
88  WTTOT(L,IX)=WTTOT(L,IX)+C1(IX)
    PCTTOT(L,IX)=PCTTOT(L,IX)+C2(IX)
    ERRTOT(L,IX)=ERRTOT(L,IX)+C3(IX)

```

```

44      CONTINUE
      AVTOT(L)=AVTOT(L)+TOTAL
      M4(L)=ITOS
      GO TO 71
42      CONTINUE
      IF(KOUNT*2-50)81,80,80
80      KOUNT=0
81      KOUNT=KOUNT+1
      LX=L+INDXS-1
      WRITE9,927,LX,ITOS,C11,C21,C31,C12,C22,C32,C13,C23,
$      C33,TOTAL
      GO TO 71
43      CONTINUE
      KOUNT=KOUNT+5
      WRITE9,921,(M4(KM),KM=1,6)
      WRITE9,971
      WRITE9,941
      WRITE9,929,C11,C32,C12,C32,C13,C33,C14,C34,C15,C35
$      ,C16,C36
      WRITE9,935
      IF(M4(7)-ISD2)78,71,78
78      KOUNT=KOUNT+5
      WRITE9,942,(M4(KM),KM=7,12)
      WRITE9,971
      WRITE9,941
      WRITE9,929,C17,C37,C18,C38,C19,C39,C110,C310,C111,
$      C311,C112,C312
71      CONTINUE
      GO TO(29,29,33),IND
29      M=M+1
30      CONTINUE
33      KOUNT=32-KOUNT*2
      CALL LFEEED(KOUNT)
      KOUNT=0
1000    CONTINUE
      GO TO (53,51,51),IND
53      CONTINUE
      KOUNT=KOUNT+5
      WRITE9,972
      WRITE9,940
      WRITE9,916
      DIV=NLOC
      DO 55 IY=1,KFAC
      AVTOT(IY)=AVTOT(IY)/DIV
      DO 55 IX=1,4
      WTTOT(IY,IX)=WTTOT(IY,IX)/DIV
      PCTTOT(IY,IX)=PCTTOT(IY,IX)/DIV
      ERRTOT(IY,IX)=ERRTOT(IY,IX)/DIV
55      CONTINUE
      DO 56 IY=1,KFAC

```

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```

W1=WTTOT(IY,1)
P1=PCTTOT(IY,1)
E1=ERRTOT(IY,1)
W2=WTTOT(IY,2)
P2=PCTTOT(IY,2)
E2=ERRTOT(IY,2)
W3=WTTOT(IY,3)
P3=PCTTOT(IY,3)
E3=ERRTOT(IY,3)
W4=WTTOT(IY,4)
P4=PCTTOT(IY,4)
E4=ERRTOT(IY,4)
AV=AVTOT(IY)
MV=M4(IY)
KOUNT=KOUNT+1
KT=INDXS-1+IY
WRITE 9,925,KT,MV,W1,P1,E1,W2,P2,E2,W3,P3,E3,W4,
$ P4,E4,AV
56 CONTINUE
KOUNT=32-KOUNT*2
CALL LFEED(KOUNT)
KOUNT=0
51 CONTINUE
WRITE 2,922
READ 1,902,IG
IF(IG)20,550,20
550 CONTINUE
S HLT
600 GO TO 4
900 FORMAT(9HRUN NO. //)
902 FORMAT(2I3)
904 FORMAT(30H6 LETTER ID AND SPEC. ACTIVITY//)
905 FORMAT(I5)
906 FQRMAT(2A3)
907 FORMAT(E8.3)
908 FQRMAT(10HLOCATION //)
912 FORMAT(34HIF SEARCH,TYPE NUMBER FROM 1 TO 40//)
914 FORMAT(1H@,5HRUN ,2X,A3,9X,9HISOTOPE ,2A3)
915 FORMAT(1H@,12HMAYPACK DATA,5X,12HLOCATION ,A3)
916 FORMAT(10X,3HTOS,3X,9H<UG>/M**3,4X,3HPCT,5X,3HERR,
$ 6X,9H<UG>/M**3,4X,3HPCT,5X,3HERR,6X,9H<UG>/M**3,4X
$ ,3HPCT,5X,3HERR,6X,9H<UG>/M**3,4X,3HPCT,5X,3HERR,6
$ X,9H<UG>/M**3)
917 FORMAT(1H@,11HLIQUID DATA,6X,12HLOCATION ,A3)
918 FORMAT(23X,9HPARTICLES,19X,8HFILIRATE,19X,11HN
$ TREATMENT,19X,5HTOTAL,/16X,23H-----
$ ---,6X,23H-----,6X,23H-----
$ -----,6X,18H-----/)
919 FORMAT(1H@,10HDEPOSITION,7X,12HLOCATION ,A3)
921 FORMAT(2X,11HSAMPLE TYPE,12X,A3,19X,A3,19X,A3,19X,

```

```

$      A3,19X,A3,19X,A3)
971    FORMAT(17X,17H-----,5X,17H-----
$      -----,5X,17H-----,5X,17H-----
$      ---,5X,17H-----,5X,17H-----
$      -/)
925    FORMAT(2X,1HM,I3,I5,3X,E9.4,1X,F7.2,1X,F6.3,4X,
$      E9.4,1X,F7.2,1X,F6.3,4X,E9.4,1X,F7.2,1X,F6.3,4X,E9.
$      4,1X,F7.2,1X,F6.3,4X,E9.4)
927    FORMAT(1HG,I3,1X,I5,3X,E9.4,F7.2,1X,F6.3,6X,E9.4,F
$      7.2,1X,F6.3,6X,E9.4,F7.2,1X,F6.3,10X,E9.4)
929    FORMAT(15X,E9.4,3X,F7.3,3X,E9.4,3X,F7.3,3X,E9.4,3X
$      ,F7.3,3X,E9.4,3X,F7.3,3X,E9.4,3X,F7.3,3X,E9.4,3X,
$      F7.3)
922    FORMAT(26HNEW ID TYPE 1, NO, TYPE 0)
930    FORMAT(17HNO. OF ISOTOPES //)
935    FORMAT(1H //)
940    FORMAT(24X,6HFILTER,23X,7HSCREENS,18X,8HAC PAPER,
$      18X,8HCHARCOAL,17X,5HTOTAL/16X,23H-----
$      -----,4X,25H-----,4X,23H--
$      -----,4X,23H-----
$      --,4X,16H-----/)
941    FORMAT(17X,10H<UG/CM>**2,5X,3HERR,6X,10H<UG/CM>**2
$      ,5X,3HERR,6X,10H<UG/CM>**2,5X,3HERR,6X,10H<UG/CM>*
$      *2,5X,3HERR,6X,10H<UG/CM>**2,5X,3HERR,6X,10H<UG/CM
$      >**2,5X,3HERR)
942    FORMAT(24X,A3,19X,A3,19X,A3,19X,A3,19X,A3,19X,A3)
943    FORMAT(8X,3HTOS,5X,7H <UG> ,4X,3HPCT,4X,3HERR,11X
$      ,7H <UG> ,4X,3HPCT,4X,3HERR,10X,7H <UG> ,4X,3HPCT
$      ,4X,3HERR,13X,7H <UG> )
909    FORMAT(I2)
970    FORMAT(37HAT WHAT LOCATION DO YOU WANT TO START/)
972    FORMAT(/1H0,7X,16HMAYPACK AVERAGES)
910    FORMAT(18HNO. OF LOCATIONS //)
      END

```

```

/MAYSUB = TAPE RETRIEVAL SUBROUTINE
/CALL ARGUMENTS ARE.
/IDENT NOT 0 RESULTS IN GET INITIALIZATION - SWITCH A SET
/ID = FIRST THREE ALPH-NUMERIC CHARACTERS FOR DATA IDENTIFICATION
/IL = 1 TO 12 INDICATING AN A THROUGH L WHICH FORMS THE FIRST
/CHARACTER OF 2ND DATA IDENT. WORD
/M = 1 - 12 (2ND AND 3RD CHARACTER OF 2ND DATA WORD)
/IT1 = ALPH-NUMERIC ISOTOPE ID
/IT2 = 2ND PORTION OF ISOTOPE ID
/IM9=0 -TELETYPE REPORT, IM9 NOT 0, IBM TYPER REPORT
/RETURN ARGUMENTS
/ID3 = SECOND DATA IDENTIFICATION WORD ( GENERATED BY GET )
/I2 = 0 NO ISOTOPE FOUND
/I1 = 0 NO DATA FOUND
/DATA ARRAY IN COMMON FROM OCTAL 30 THRU 46
/ITOS = FIXED POINT TIME OF SAMPLE
/ VEC CONTAINS JMS .IO2 OR JMS .IO9( THE LATTER FOR IBM)
/

```

```

          FIODEC
/PARAMETER ASSIGNMENTS
          EXTERNAL .IO2
BAR 2
          OCTAL
          .DDD=30
          IRUN=26
          .BF1=15565
          .BFF=10400
          .RDD=17100
          .RSS=17160
          DECIMAL
          INTERNAL GET.
GET.,     JMS GTARG
          JMP .AAA
ID.,      0
M.,       0
IL.,      0
IT1.,     0
IT2.,     0
IM9.,     0
I1.,      0
I2.,      0
ITOS.,    0          /TIME OF SAMPLE (INTEGER)
IDENT.,   0
ID3.,     0
.AAA.,    JMP M10
BUFR.,    JMS CALSB
          LAW 1
          .BF1
BUF.,     JMS CALSB
          LAW 1

```

```

DATA,      .BFF
           JMS CALSB
           LAW 2
           .DDD
RD,         JMS CALSB
           LAW 1
           .RDD
RS,         JMS CALSB
           LAW 1
           .RSS
M10,       NOP
           DZM CNT
           LFM
           CLA          /DESELECT ALL TAPES
           MMLC
           MMSE
           JMS OLC
           LAC I IDENT          /SEE IF ID HAS CHANGED
           DAC SID
           SNA
           JMP M11      /NO
           LAW A        /YES, RESET SWITCH
           DAC VAR
M11,       JMP I VAR /GO TO A,B,C
A,         LAC U35
           JMS MTAPE /READ IN BLOCK 5
           LAC BUF+2 /ARGUMENT FOR MTAPE (NOT EXECUTED)
           LAC .BFF
           SAD IRUN  /HAVE WE THE PROPER TAPE
           JMP M20     /YES
/NO, INFORM THE OPERATOR
           WRITE
           JMS .IO2
           2
           FOR .800
           ENDIO      HLT          JMP A
/OK, GO AHEAD
M20,       LAC .BFF+3          /GET FILE BLOCK FROM MASTER TAPE
           CMA
           DAC BF      / -BF ( USED IN SEARCH)
           LAW B
           DAC VAR      /SET NEXT ENTRY
           LAC (1
           DAC J
           LAC I IT1
           DAC IS11  /SAVE ISOTOPE ID PART 1
           LAC I IT2
           DAC IS22  /SAVE PART 2
           DZM I IDENT
/FIX 2-ND PART OF ID AS A FORMAT IF IBM TYPED IS BEING USED

```

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```

      L
A2,   LAC I IM9
      SNA
      JMP A3.20 /TELETYPE BEING USED
      LAC I IL /IL = 1,2,3 .....12
      SAD (10
      JMP A2.8
      SAD (11
      JMP A2.8
      SAD (12
      JMP A2.8
      TAD N60
      JMP A2.9
A2.8, TAD N27
A2.9, CLL
      JMS ALS12 /SHIFT LEFT 12
      DAC TEM
      LAC I M /M= 1,2,3, ..... 12
      AND N70
      SZA
      JMP A3.5
/M = 7 OR LESS
A3.1, LAC BIT7
      TAD I M
A3.2, TAD TEM
A3.3, DAC SVID3
      AND FOR7
      DAC SVNO
      JMP A4
A3.5, LAC I M /M= 8,9,10,11,12
      DAC SM
      ADD (-10
      SMA
      JMP A3.6
      LAC SM
      SAD (8
      JMP A3.1
      SAD (9
      JMP A3.1
      SAD (10
      LAC (80
      JMP A3.2
A3.6, NOP
      ADD (LAC TAB
      DAC .+1
      XX
      JMP A3.2
/TELETYPE BEING USED
A3.20, LAC I M /ID ALREADY IN A FORMAT
      JMP A3.3
/READ INTO BUFFER - THE CURRENT FILE BLOCK

```



```

A4,      LAC SID
          SNA
          JMP .+7
          NOP
          LAC (6
          DAC FB
          TAD U3
          JMS MTAPE
          LAC BUFR +2
          LAC (1
          DAC K
A5,      CAL BUFR
          ARX K
          LAC I TEMAD
          ISZ TEMAD
          SAD I ID /IS BUF(K) = ID
          SKP /YES
          JMP A7 /NO
          NOP
          AND TWO7
          SAD D64
          JMP DEP
          LAC I TEMAD
          DAC ID2
          LAC SVID3
          SAD ID2 /IS BUF(K+1)=ID2
          JMP P /YES

A7,      LAC K
          TAD (3
          DAC K
          SAD (256 /THRU WITH ONE BLOCK
          SKP
          JMP A5 /KEEP SEARCHING

A10,     LAC FB
          TAD (1 /FB=FB+1
          DAC FB
          TAD BF /FB-BF
          SMA
          JMP A12 /NEVER FOUND
          LAC FB
          SAD (30
          SKP /NEVER FOUND
          JMP A4+5 /CONTINUE SEARCH

A12,     DZM I 12
          DZM I 11
          LAC CNT
          SZA
          JMP .+4

```

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```

    LAC (1
    DAC CNT
    JMP A4+4
    RETUR
    HLT

```

```

/SAVE BLOCK SECTION, BD AND STORAGE BLOCK, BS
/IN RD AND RS ARRAYS, RESPECTIVELY

```

```

DEP,    LAC I TEMAD
        DAC ID3SV
        NOP
        AND FOR7
        SAD SVN0
        JMP .+2
        JMP A7
        LAC ID3SV
        DAC I ID3
        JMP P
P,      ISZ TEMAD
        LAC I TEMAD
        DAC TEM

```

```

/TEM CONTAINS BD IN BITS 0, 1, 2 AND BS IN BITS 6 - 17, RIGHT
/ADJUSTED

```

```

    RTL
    RTL
    AND (7
    DAC TEM+1          /BD
    LAC TEM
    OCTAL
    AND (7777
    DAC TEM            /BS
    DECIMA

```

```

    CAL RD    /SAVE BD IN RD(J) ARRAY
    ARX J
    LAC TEM+1
    DAC I TEMAD

```

```

    CAL RS    /SAVE BS IN RS ARRA
    ARX J
    LAC TEM
    DAC I TEMAD

```

```

/READ IN BLOCK RS(J)

```

```

P1,    CAL RS
        ARX J
        LAC I TEMAD

```

TAD U3
JMS MTAPE
LAG BUF+2

/GET PROPER SECTION 1, 2, 3 OR 4
/ADDRESS WILL BE FIRST WORD IN BLOCK,
/65TH, 129TH OR 193RD WORD.
/SUBSCRIPT N (BUF(N)) = 64 * (BD - 1) + 1

GAL RD
ARX J
LAG I TEMAD
TAD MNI
AND (7
GLL
RTL
RTL
RTL /64 * (BD - 1)
TAD (1
DAC N
TAD (15
DAC TEM
ISZ J /J= J+1

/CHECK TO SEE IF ISOTOPE IDENT MATCHES

DZM I 11
DZM I 12
LAG (1
DAC L /DQ P10 L = 1.8

P5, GAL BUF
ARX TEM
LAG I TEMAD
SAD IS11 /FIRST PART OF ID AGREES
SKP /YES
JMP P7 /NO
ISZ TEMAD
LAG I TEMAD
SAD IS22 /DOES 2ND PART COMPARE
JMP P20 /YES

P7, ISZ L /NO

LAC L
SAD (9
JMP A12 /NEVER FOUND
LAG TEM
TAD (6
DAC TEM

P10, JMP P5 /GO SEARCH IN NEXT GROUP

/ISOTOPE FOUND, INDICATE BY SETTING
 /I2 NOT ZERO
 /START TRANSFER OF DATA TO ARGUMENT LIST

P20, DAC I I2
 DAC I I1
 ISZ TEMAD
 LAC TEMAD /ADDRESS OF DISINTEGRATIONS
 DAC TEM
 CAL DATA
 ARX (1

/DATA(1) = DISINTEGRATIONS

EFM
 LAC I TEM
 DAC I TEMAD
 LFM
 ISZ TEM
 ISZ TEM
 ISZ TEMAD
 ISZ TEMAD

/DATA(2) = REL. STD. ERROR

EFM
 LAC I TEM
 DAC I TEMAD
 LFM

/NOW FILL UP REST OF DATA ARRAY

LAC N
 TAD (2
 DAC TEM
 ISZ TEMAD
 ISZ TEMAD
 LAC TEMAD
 DAC TEM+1 /DATA(3) ADDRESS
 CAL BUF
 ARX TEM

/DATA (3) = ALIQUOT

EFM
 LAC I TEMAD
 DAC I TEM+1
 LFM
 ISZ TEM+1
 ISZ TEM+1

```
LAC TEMAD
TAD 4
DAC TEMAD
/ DATA (4) = PRESSURE
EFM
LAC I TEMAD
DAC I TEM+1
LFM
ISZ TEMAD
ISZ TEMAD
ISZ TEM+1
ISZ TEM+1
EFM
```

```
/ DATA(5) = ROTO READING
```

```
LAC I TEMAD
DAC I TEM+1
LFM
ISZ TEMAD
ISZ TEMAD
ISZ TEM+1
ISZ TEM+1
EFM
```

```
/ DATA(6) = COLLECTION TIME
```

```
LAC I TEMAD
DAC I TEM+1
LFM
ISZ TEMAD
ISZ TEMAD
ISZ TEMAD
ISZ TEM+1
ISZ TEM+1
EFM
```

```
LAC I TEMAD
DAC I TEM+1
LFM
```

```
/ CHI**2 INTO DATA(7)
```

```
/ NOW, GET TIME OF SAMPLE
```

```
LAC N
TAD 45
DAC TEM
CAL BUF
ARX TEM
LAC I TEMAD
DAC I ITOS
```

```
/ DATA ARRAY COMPLETE
```

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```

P60,      RETUR
          HLT
          OCTAL
FOR7,      7777
TWO7,      770000
D64,       640000
/B SWITCH - ENTERED AFTER FIRST TIME THRU GET SUBBY
/IS THERE A NEW ISOTOPE REQUEST

B,         JMS REQ
          SNA
          JMP A2                      /NO

/NEW ISOTOPE REQUEST, SET SWITCH C

B1,        LAW C
          DAC VAR

B2,        LAM -0
          TAD J
          CMA
          DAC JAX      /JAX = -( J-1 )
          LAC (1
          DAC J          /J = 1
          LAC I IT1
          DAC IS11
          LAC I IT2
          DAC IS22
          JMP P1

/SWITCH C

C,         LAC J
          TAD JAX
          SMA          /IS THE RS ARRAY EXCEEDED
          JMP A12      /YES
          JMS REQ      /NO, IS THERE A NEW ISOTOPE REQUEST
          SNA
          JMP P1          /NO
          JMP B2          /YES

REQ,       0
          LAC I IT1
          SAD IS11      /NEW REQUEST
          SKP          /NO
          JMP I REQ      /YES

/COMPARE SECOND WORD

          LAC I IT2

```

```

      0
      0
      0
      0
      0
      0
      0
N70,   70
N200,  200
N20,   20
ID2,   0
FB,    0
U3,    030000
K,     0
N,     0
L,     0
BF,    0      /FILE BLOCK FROM MASTER BLOCK 5
/SHIFT 12 LEFT

```

```

ALS12, 0
      RTL
      RTL
      RTL
      RTL
      RTL
      RTL
      RTL
      JMP I ALS12

```

```

/MTAPE ROUTINE - SPECIAL READ ONLY - NOT ON INTERRUPT
/ENTERED WITH UNIT AND BLOCK IN AC
/ADDRESS OF CORE STORAGE FOUND BY XCT OF INST. FOLLOWING
/JMS MTAPE

```

```

      OCTAL
MTAPE, 0
      MMSE
      AND <1777
      DAC BLOCK
S1,    LAW 41
      MMLC
SEARCH, JMS RED
      AND <1777
      SAD BLOCK
      JMP FOUND
      CMA
      TAD BLOCK
      SMA
      JMP SEARCH      /MORE THAN 0
      LAW 61          /LESS THAN 0, GO REVERSE
      MMLC
S2,    JMS RED

```

	AND (1777	
	CMA	
	TAD BLOCK	
	TAD MN2	
	SRA	
	JMP S2	
	JMP S1	
MN2,	777776	
/MTAPE		
FOUND,	XCT I MTAPE	/LAC CORE ADDRESS
	TAD MN1	
	DAC 10	
	LAM -377	
	DAC COUNS	
	LAW 42	
	MMLC	
	JMS RED	/GET FIRST CHECK SUM
	DAC CHECK	
LOAD,	JMS RED	
	DAC I 10	
	ADD CHECK	
	DAC CHECK	
	ISZ COUNS	
	JMP LOAD	
	MMBF	
	JMP --1	
	MMRD	
	ADD CHECK	
	DAC CHECK	
	CLA	
	MMLC	
	MMSE	
	JMS OLC	
	ISZ MTAPE	
	JMP I MTAPE	
RED,	0	
	MMEF	
	SKP	
	JMP ERR	
	MMDF	
	JMP RED+1	
	MMRD	
	JMP I RED	
ERR,	WRITE	
	JMS .102	
	2	


```
FOR .ER
ENDIO
LAC BLOCK
DAC 7
MMRS
HLT
.ER, 320037
TEXT
BAD TAPE, STATUS IN AC, BLOCK IN CELL 7
600000

OLC, 0
LAG TTC
DAC COUNS
ISZ COUNS
JMP .-1
JMP I OLC

JAX, 0
MNI, LAM -0
COUNS, 0
FAIL, LAM -2
BLOCK, 0
CHECK, 0
TTC, 754300

BIT7, 002000
BIT8, 001000
```

START

REFERENCES

1. G. J. Rogers, Program for Containment Systems Experiment, USAEC Report HW-83607, September 1964.
2. L. D. Coffin & N. P. Wilburn, The Combination of On-line Analysis with Collection of Multicomponent Spectra in a PDP-7, BNWL-CC-700, July 1966.
3. L. D. Coffin, On-Line Computer Storage & Retrieval of Processed Gamma Spectra Data, BNWL-506, July 1967.

FIGURE 1

BLOCK DIAGRAM OF HARDWARE

FIGURE 2

AEROSOL SAMPLING TRAIN

REPORT

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PROGRAM FLOW CHART (GET)

TABLE 1

TYPICAL OUTPUT OF ON-LINE PROCESSING

ANALYZER # 1

RUN NO.	SAMPLE ID	SAMPLE TIME (MIN)	LIVE TIME (MIN)
031767	D	1	1

NUCLIDE	COUNTS	REL STD ERROR	DISINTEGRATIONS/MIN
I-131	27454.	.042	.119520 06
CS134	21068.	.107	.465025 05
RU103	27973.	.081	.139154 06
BA140	36920.	.072	.193608 06
TE132	33466.	.067	.181795 06
RU106	39055.	.077	.532874 06
CS137	24823.	.036	.151137 06
RA226	47196.	.088	.112690 06

CHI**2 = -2.433

DEG. F. = 12

TABLE 2

DATA TAPE BLOCK 5 FORMAT

<u>WORD</u>	<u>BLOCK 5</u>	<u>PROGRAM NAME</u>
1	1 1 0 7 0 1	IRUN (Ex: IRUN = 971)
2	0 0 0 0 0 0	BD
3	0 0 0 0 3 6	BS
4	0 0 0 0 0 6	BF
5	7 7 7 7 7 4	W
6	.	WORDS 6-256
.	.	NEVER USED
.	.	
.		
256		

TABLE 3

DATA TAPE FILE BLOCK FORMAT

M 1 1	Sample ID (A3 Format - first part)
A 1 2	Sample ID (Second part)
1 3 6	BD in bits 0-2 BS in bits 12-17*
M 0 6	
B 3 0	
2 3 6	
.	
.	
.	

*BD = The current block (BS) subsection.
 Ranges from 1 to 4.

BS = The current block where the data of the previous
 sample ID is located.

TABLE 4

DATA TAPE DATA BLOCK FORMAT

<u>Block Word</u>	<u>Description</u>
1	Sample ID (A3 format 1st part)
2	Sample ID (second part)
3	Aliquot factor
4	" "
5	Rotometer No.
6	Time of sample
7	Pressure
8	"
9	Rotometer Reading
10	" "
11	Collection time
12	" "
13	Degrees of Freedom
14	χ^2
15	"
16	{ Isotope Ident
17	
18 Isotope #1	
19	
20	{ Calculated disintegrations
21	
22	
23	
24	{ Relative standard error
25	
26	
27	
28	{
29	
30	
31	
32	{
33	
34	
35	
36	{ Isotope Ident
37	
38	
39	
40	{ Calculated disintegrations
41	
42	
43	
44	{ Relative Standard error
45	
46	
47	
48	{
49	
50	
51	
52	{
53	
54	
55	
56	{ Isotope Ident
57	
58	
59	
60	{ Calculated disintegrations
61 Isotope #8	
62	
63	
64	{ Relative Standard error
	not used

TABLE 5

<div> <div>RUN 001</div> <div>ISOTOPE I-131</div> <div>MAYPACK DATA</div> <div>LOCATION M02</div> </div>														
FILTER			SCREENS			AC PAPER			CHARCOAL			TOTAL		
TOS	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3	
M 1 4	.2210 03	84.97	.012	.2972 02	11.42	.011	.8655 01	3.32	.011	.7082 00	.27	.014	.2601 03	
M 2 10	.1290 03	75.83	.012	.3199 02	18.80	.010	.8534 01	5.01	.011	.5900 00	.34	.015	.1701 03	
M 3 25	.5561 02	74.94	.016	.1093 02	14.73	.011	.7163 01	9.65	.011	.4946-00	.66	.016	.7420 02	
M 4 40	.2150 02	59.39	.013	.7927 01	21.89	.012	.6126 01	16.92	.012	.6438 00	1.77	.015	.3620 02	
M 5 60	.1139 02	49.03	.014	.6109 01	26.28	.013	.5309 01	22.84	.012	.4251-00	1.82	.017	.2323 02	
M 6 80	.8639 01	45.24	.015	.4959 01	25.97	.014	.4967 01	26.01	.013	.5267 00	2.75	.016	.1909 02	
M 7 100	.5577 01	39.99	.017	.3658 01	26.22	.010	.4230 01	30.33	.013	.4804-00	3.44	.017	.1394 02	
M 8 120	.4041 01	35.73	.016	.2799 01	24.75	.011	.3800 01	33.60	.014	.6672 00	5.89	.015	.1130 02	
M 9 180	.7608 00	13.24	.016	.1536 01	26.73	.010	.2969 01	51.68	.010	.4792-00	8.34	.017	.5745 01	
M 10 300	.1860-00	4.81	.024	.9728 00	25.17	.010	.2084 01	53.95	.018	.6202 00	16.05	.015	.3864 01	
M 11 1100	.5248-01	4.22	.036	.1884-00	15.16	.019	.4018-00	32.34	.013	.5995 00	48.26	.015	.1242 01	
M 12 2400	.2087-00	47.11	.020	.9654-01	21.79	.026	.1135-00	25.62	.022	.2422-01	5.46	.087	.4430-00	

TABLE 6

MAYPACK AVERAGES														
		FILTER			SCREENS			AC PAPER			CHARCOAL			TOTAL
	TOS	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3	PCT	ERR	ug/M**3
M 1	5	.8649-01	14.39	.365	.8795-01	.07	1.074	.8705-01	.10	.663	.8761-01	.07	.322	.7280 03
M 2	12	.8761-01	14.35	.054	.8761-01	.07	.376	.8817-01	.07	.955	.8872-01	.07	.239	.1142 04
M 3	25	.8872-01	14.39	.016	.8928-01	.07	.315	.8928-01	.07	.588	.8984-01	.07	.360	.6796 03
M 4	48	.8984-01	14.39	.012	.9040-01	.10	.371	.9040-01	.07	.465	.9096-01	.07	4.193	.3153 03
M 5	74	.9130-01	9.51	.013	.8457 01	4.41	.476	.8845 00	.55	.305	.2095-00	.15	.413	.1779 03
M 6	114	.6267 02	14.09	.014	.3156-00	.27	1.308	.2333-00	.14	1.111	.1237-00	.13	.886	.6334 02
M 7	151	.3688 02	14.32	.011	.8031-01	.08	1.167	.6504-01	.10	.367	.3228-01	.13	.907	.3706 02
M 8	210	.1374 02	14.26	.013	.2861-00	.12	1.228	.1165-00	.07	.380	.7956-01	.14	.483	.1423 02
M 9	300	.4709 01	14.26	.096	.1273-01	.13	1.957	.1538-01	.13	1.098	.4776-01	.07	.480	.4785 01
M 10	720	.2883-00	3.23	.172	.2459-01	.07	.394	.6473-02	.10	.507	.3820-01	.07	2.027	.3576-00
M 11	1330	.2221-00	.49	.136	.1733-01	.73	.585	.1415-01	.38	.491	.3673-01	2.46	.815	.2903-00
M 12	0	.5270 01	3.71	.200	.5253-01	3.85	.407	.3857-01	.55	.669	.9585-01	6.51	.327	.5457 01

-49-

BNWL-669

TABLE 7

			RUN 002			ISOTOPE I-131								
			LIQUID DATA			LOCATION L11								
			PARTICLES			FILTRATE			N TREATMENT			TOTAL		
			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	TOS		ug	PCT	ERR	ug	PCT	ERR	ug	PCT	ERR	ug		
C 5	110		.0000 00	.00	.000	.0000 00	.00	.000	.6459 00	100.00	.127	.6459 00		
C 6	105		.0000 00	.00	.000	.0000 00	.00	.000	.4629-00	100.00	.168	.4629-00		
C 7	100		.0000 00	.00	.000	.0000 00	.00	.000	.1085 01	100.00	.108	.1085 01		
C 8	5		.4498 01	13.47	.063	.2888 02	86.52	.099	.0000 00	.00	.000	.3338 02		
C 9	10		.2124 02	1.66	.047	.1252 04	98.33	.037	.0000 00	.00	.000	.1273 04		
C 10	15		.2428 02	.29	.051	.8132 04	99.70	.024	.0000 00	.00	.000	.8156 04		
C 11	20		.6729 02	.33	.101	.2012 05	99.66	.020	.0000 00	.00	.000	.2019 05		
C 12	25		.0000 00	.00	.000	.0000 00	.00	.000	.2866 05	100.00	.018	.2866 05		
C 13	30		.0000 00	.00	.000	.0000 00	.00	.000	.4176 05	100.00	.015	.4176 05		
C 14	35		.0000 00	.00	.000	.0000 00	.00	.000	.4629 05	100.00	.015	.4629 05		
C 15	40		.0000 00	.00	.000	.0000 00	.00	.000	.5104 05	100.00	.015	.5104 05		
C 16	45		.0000 00	.00	.000	.0000 00	.00	.000	.5374 05	100.00	.014	.5374 05		
C 17	50		.0000 00	.00	.000	.0000 00	.00	.000	.4910 05	100.00	.013	.4910 05		
C 18	55		.0000 00	.00	.000	.0000 00	.00	.000	.4989 05	100.00	.013	.4989 05		
C 19	60		.0000 00	.00	.000	.0000 00	.00	.000	.4304 05	100.00	.012	.4304 05		
	20	65	.0000 00	.00	.000	.0000 00	.00	.000	.4372 05	100.00	.013	.4372 05		
	21	75	.0000 00	.00	.000	.0000 00	.00	.000	.3633 05	100.00	.011	.3633 05		

TABLE 8

SAMPLE TYPE		B01		C02		A03		G04		K05		C06	
		ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR
		.8113-02	.013	.1046 01	.013	.1744 02	.010	.5239 01	.014	.9208-01	.011	.1341 01	.030

SAMPLE TYPE		E07		E08		E09		E10		E11		E12	
		ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR	ug/cm**2	ERR
		.2786 01	.018	.1667 01	.011	.2483 01	.010	.2751 01	.010	.1617 01	.011	.2824 01	.010

TABLE 9

TYPICAL INPUT FOR REPORT PROGRAM

RUN NO.?

002

NO. OF ISOTOPES?

2

6 LETTER ID AND SPEC. ACTIVITY

U I-131 (where U represents a space)

.100 E-06

U CS134 (where U represents a space)

.106 E-05

NO. OF LOCATIONS?

1

LOCATION?

M04 U U U (where U represents a space)

AT WHAT LOCATION DO YOU WANT TO START?

01

IF SEARCH, TYPE NUMBER FROM 1 TO 40

03

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