An MS-DOS-Based Program for Analyzing Plutonium Gamma-Ray Spectra

Volume 2

System Operation, Software Installation, and Maintenance of the Data-Transfer, Data-Analysis, and Quality-Assurance Applications

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Manuscript date: September 7, 1989

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Volume 2 System Operation, Software Installation, and Maintenance of the Data-Transfer, Data-Analysis, and Quality-Assurance Applications

Abstract

A plutonium gamma-ray analysis system that operates on MS-DOS-based computers has been developed for the International Atomic Energy Agency (IAEA) to perform in-field analysis of plutonium gamma-ray spectra for plutonium isotopics. The program titled IAEAPU consists of three separate applications: (1) a data-transfer application for transferring spectral data from a CICERO multichannel analyzer to a binary data file, (2) a data-analysis application to analyze plutonium gamma-ray spectra for plutonium isotopic ratios and weight percents of total plutonium, (3) and a data-quality assurance application to check spectral data for proper data-acquisition setup and performance. Volume 2 describes the operations of these applications and the installation and maintenance of the software.

Introduction

The IAEA Plutonium Isotopics Analysis System is comprised of a Microsoft FORTRAN-77(c) application, a Clipper(c)-compiled dBASE III(c) menu, and a forms front-end program with on-line help implemented using Flashup(c). The two modules are coordinated by MS-DOS "BAT" procedures and communicate via dBASE III files.

It is intended to help provide a portable, accurate, and automated inspection capability for the International Atomic Energy Agency.

Data Transfer

This application transfers data from a Silena CICERO 8K multichannel analyzer via an RS-232c link and writes a binary spectral data file to disk along with dBASE III compatible descriptive information.

Data Analysis

This application is an extension of the IAEA "Blue Box" software. It analyzes plutonium gamma-ray spectra for plutonium isotopic ratios and weight percents of total plutonium. The program is

capable of analyzing gamma-ray spectra of mixed uranium and plutonium samples for plutonium isotopics and ^{235}U to total plutonium ratio.

The program analyzes gamma-ray peaks beginning at 123 keV up to 383 keV. For a complete analysis, the spectrum must start at or below 121.5 keV and include the ^{237}U 208.0-keV peak. The only input required for the program are the positions of the ^{241}Pu 148-keV and ^{237}U 208-keV peaks. This information is often made available by the dBASE III files written by the data-transfer application.

Quality Assurance

This application performs peak-shape analysis on peaks specified and provides the user with full-width-half-maximum values (FWHM) at 122 and 208 keV. It also examines the high-energy side of the high-energy peak for pileup. If it is significant, it warns the user. It also checks the gain to determine if it is appropriate for plutonium isotopic measurements.

Operating Instructions

The following instructions assume that the IAEA programs for spectral data transfer, analysis, and quality-assurance checking have been installed according to the instructions given in the installation section of this document or the README.TXT file.

- The disk files referred to in this document for alternate reading will be found on the PROGRAM diskette.
- Most of the material in this manual can be found in the OPINSTR.TXT file.
- Responses from the computer are shown in courier typeface throughout this document.
- Instructions to press specific keys on the keypad are placed in angle brackets. Some examples are as follows:

<A>	press the 'A' key
<esc>	press the esc (escape) key
<PgDn>	press the PgDn (page down) key

Navigating the Menus and Forms

Operations are chosen by pressing an appropriate key and then <enter>. Each operation is shown on a menu with the associated key for that operation. To choose an operation, press the indicated key once and <enter>. This will select that operation.

When entering or editing information on a screen, <PgDn> exits a screen and saves the new information. If you make a mistake and do not want to save the new information, <esc> [or alternatively, <Q> (quit) available in most menus] will exit you from that screen and not save the new information.

Starting the Program

On a floppy-based system (Toshiba 1100 or 2100 without a hard-disk drive), place the PROGRAM diskette in drive A. If the system prompt is not A: >, then type

```
A:<enter>
IA<enter>
```

Otherwise, just type
IA<enter>

On a hard-disk-based system, simply type

IA<enter>

The Title screen (Fig. 1) will appear, followed by the top-level menu (Fig. 2).

IAEA Plutonium Isotopics Analysis
by
The Lawrence Livermore National Laboratory
and
Compuchem, Inc.
Version 4.2
July 1989

Written by:

W. Ruhter R. Fleming R. Gunnink W.M. Buckley R. Wenning

Figure 1. Title screen.

IAEA Plutonium Analysis System
88.07.27

02:04:51

International Atomic Energy Agency Plutonium Analysis
Menu Options: T) Transfer Data from Cicero Analyzer A) Analyze Data from Gamma-Ray Spectra on disk C) Check Quality Assurance D) Change Default Settings Q) Quit this menu and return to system Enter Choice: T

• <Enter the appropriate key or use the arrow keys then press enter>

Figure 2. Top-level menu.

The top-level menu provides access to all other menus and options in the program. The user may transfer a spectrum from the CICERO analyzer by <T>, analyze spectral data by <A>, perform a quality-assurance test on spectral data by <C>, change the default settings by <D>, or exit the program by <Q> or <esc>.

Explanation of Figures in this Manual

Figures that represent forms in the program have "pictures" that represent the type of data that can be entered into a field. A description of these pictures follows:

- YY.MM.DD is a date, where YY is 2 digits for the year
MM is 2 digits for the month
DD is 2 digits for the day;
- HH:MM:SS is a time, where HH is 2 digits for the hour
MM is 2 digits for the minute
SS is 2 digits for the seconds;
- 9999 is a numeric field 4 digits wide;
- ZZZZZZ is an alphabetic field (A-Z,a-z) 6 characters wide;
- Z9Z9Z9 is an alphanumeric field (A-Z,a-z,0-9) 6 characters wide.

Changing System Defaults

The fourth option of the main menu allows the user to change default settings (Fig. 3). The plutonium analysis default abundances (Fig. 4) and batch sample information (Fig. 5) can be changed, as can the default drive and the path (Fig. 6) where the data bases can be found.

Plutonium Analysis System
88.07.27

02:04:51

Change Default Settings	
A)	Change Analysis Defaults
D)	Change Default Drive and Path
E)	Exit This Menu
Enter Choice: A	

<Enter the appropriate key or use the arrow keys, then press enter>

Figure 3. Change default settings.

Change Default Abundances

For each analysis, a comparison is made between the measured isotopic abundances and the declared isotopic abundances, if the latter are provided. Default declared isotopic abundances may be entered here so that they are used for each subsequent analysis until changed. The isotopic abundances may also be entered in the Plutonium Abundance form under the Data Analysis option, but these entries are overwritten by the default abundances on subsequent analyses.

IAEA Plutonium Analysis System

88.08.01

12:06:30

[illegible]

Type In Value	↑, ↓ and ↵	PgDn	Esc
	Move Field Cursor	Exit Screen	Abort Screen

Figure 4. Change default abundances.

Change Batch Sample Information

Default batch sample information may be entered here. This information is used on all subsequent analyses until changed. Batch sample information may also be entered under the Data Analysis option, but this information is overwritten by the default information on subsequent analyses.

IAEA Plutonium Analysis System

88-08-01

12:06:30

[illegible]

Type In Value	↑, ↓ and ↵	PgDn	Esc
	Move Field Cursor	Exit Screen	Abort Screen

Figure 5. Change batch sample information.

Change Default Drive and Path	
Enter New Drive	Z:
Enter New Path	Z929Z929Z929Z929Z929Z929Z929Z929

Figure 6. Change default drive and path.

Change Default Drive and Path

The initial default setting is for the data bases to be found on the root directory of drive B. By setting a drive and path for the data bases, the user may put them anywhere on the disk, and the IAEA system will find them. If the data bases are not where the default drive and path specify, an error message will be displayed when that data base is needed. The user may then either exit the system and move the data bases to the appropriate subdirectory or change the default drive and path to where the data bases actually are. When entering the default drive and path, the user must make sure to give a valid drive letter and path. If an invalid drive or path is entered, an error message will be displayed when the database is needed.

Data Transfer

To transfer data from a CICERO analyzer to a Toshiba personal computer, a cable must be connected from the COMM port on the computer (DB-9 connector) to the J2 RS-232c port on the CICERO (DB-25 connector). See the section on cabling for information on the appropriate cable. The model 8500/RSIO interface board for RS-232c communications must be set to 9600 baud and data format type A. For data format type A, switches 1 to 3 on the dip switch assembly at the rear of the 8500/RSIO board are set to ON, and switches 4 and 5 are set to OFF.

Data transfer is initiated by the computer, but before data transfer can occur, the CICERO must be set up for data transfer to the computer. This is done by pressing the DATA OUT pushbutton on the CICERO and selecting the appropriate options. There are three data-out options on the CICERO that must be set correctly for data to be transferred to the computer.

The first option, MEM. RANGE, must be set to the size of the spectrum to be sent. To transfer a 4096-channel spectrum from the first half of the analyzer memory, MEM. RANGE must be set to HALF 1 by <1> on the CICERO numeric keypad, followed by <2> and then <1>.

The second option, **PERIPHERALS**, must be set to **COMPUTER**. Selecting **COMPUTER** is done by <2> and then <4> on the CICERO numeric keypad. The **OUT. MODE** option must be set to **TOTAL**, which is done by <3> on the keypad, after which **TOTAL** is displayed.

When the correct DATA OUT options have been selected, the DATA OUT pushbutton is pressed again, followed by the STOP pushbutton. The CICERO is now ready for data transfer to the computer.

To start the data transfer program on the computer, the data transfer option is selected from the top menu option list by <T> on the computer keyboard, followed by <enter>. The Sample/Spectrum Information form (Fig. 7) will appear on the screen. This form contains fields for the sample number, the 148- and 208-keV peak positions, and the spectrum filename. (The drive and patl. are not required if the data are stored under the default drive and path.) If a drive and path are specified, they will take priority over the default specification.

At the bottom of each form, instructions are displayed to aid the user in completing the fields in the form. In the lower left-hand corner of the screen, a message is displayed, which tells the user whether to "type in value" or to "toggle choice" by <F2>. To move from field to field, the user may use

the UP or DOWN arrow keys or <enter>. Exiting the form is done by <PgDn>, and aborting the form is done by <esc>.

IAEA Plutonium Analysis System
88.08.01

12:50:20

Sample/Spectrum Information
Sample Number: Z9Z9Z9Z9
148 KeV Peak Position: 9999.999
208 KeV Peak Position: 9999.999
Spectrum File Name: Z9Z9.bZ9

Type In Value ↑, ↓ and ↵ PgDn Esc
Move Field Cursor Exit Screen Abort Screen

Figure 7. Sample/spectrum information form

Sample/Spectrum Information Form

The spectrum number and peak positions are stored in a data-base file along with the spectrum filename. The spectrum filename must be given in order to store the data transferred from the CICERO. When the spectrum filename is entered, the program checks for duplicate filenames and warns the user if a duplicate filename exists. The user is given the option of writing over the old data file or entering a new filename. When the form is complete, the user may exit the form by <PgDn>. This form is then replaced by the CICERO Data Transfer menu (Fig. 8).

IAEA Plutonium Analysis System
88.08.01

12:46:36

Cicero Data Transfer
S) System Setup
I) Inspection Identification
F) File and Peak Information
T) Transfer Data from Analyzer
A) Abort Data Entry and Exit
Enter Choice: Z

Cicero Data Out Instructions

1. Memory Range : Half 1
2. Peripheral : Computer
3. Out. Mode : Total

<Enter the appropriate key or use the arrow keys then press enter>

Figure 8. Data-transfer menu.

Default values are initially read into the Inspection Identification form (Fig. 10). New information entered in the form is retained after each spectrum transfer until it is changed or until the main control program is exited. Thus, only an initial setup of the form is required for a series of measurements in which the Inspection ID information is the same. The Date and Time of Measurement fields, which contain the current date and time, are automatically filled in by the program. The date and time information is used to decay-correct the declared isotopic abundances, if given in the Plutonium Abundance form (Fig. 13), to the time of the measurement. Please note that if the data was acquired at a time and date other than the present, then the correct date and time must be entered. <PgD> exits the form and returns the program to the CICERO Data Transfer selection menu.

[illegible]

Figure 10. Inspection Identification.

indicating that the transferred data is being written to disk. The spectrum ID number assigned by the CICERO analyzer and the spectrum livetime are also displayed. <Enter> returns the program to the top-level menu.

Error Messages

If there is a problem in communicating with the analyzer, the following messages will appear on the screen:

Error in issuing commands to analyzer

The computer is unable to send commands to the analyzer.
Check the cabling connecting the computer and analyzer.

Press an 'R' to retry the transfer or any other key to abort transfer.

If these messages occur, the user should check to make sure that the correct cable IS CONNECTED between the computer and the analyzer. If there is a problem with the cable, the user should correct it and try again by <R>. If the problem has been corrected, the message

Now receiving data

is displayed almost immediately. If the problem cannot be corrected, typing any key other than an "R" will abort the transfer.

Data Analysis

The DATA ANALYSIS option is selected from the top-level menu option list by <A>, followed by <enter>. The File and Peak Information form (Fig. 11) is displayed initially when this option is selected. This form obtains the spectrum filename and the channel positions of the 148- and 208-keV peaks.

Plutonium Analysis System
88.07.27

13:01:35

IAEA Plutonium Analysis
Spectral File Name: 2929.b29
148 KeV Position: 9999.999
208 KeV Position: 9999.999
Output Report File Name: 29292929
Direct Report Output {S,P,D}: S {Screen,Printer,Disk}
Include Peak Areas in Report {Y,N}: N

Type In Value	↑, ↓ and ↵	PgDn	Esc
	Move Field Cursor	Exit Screen	Abort Screen

Figure 11. IAEA Plutonium Analysis form.

After the spectrum filename is entered, the program searches a data-base file for the filename and, if found, retrieves the 148- and 208-keV peak position information and loads it into the appropriate fields in the form. If the spectrum filename cannot be found in the MCAPAR.DBF data-base file, the system searches the IAEA.DBF for the spectrum filename, and if the search is unsuccessful, the following message appears at the bottom of the computer screen:

```
<filename> peak information is not found
Press enter to continue . . .
```

This message warns the user that the peak position information is not available from a data-base file and must be provided by the user. Once any key is pressed in response to this message, the program returns to these fields for completion by the user.

The 148- and 208-keV peak position fields must be completed for an analysis to be done. So that the analysis results can be stored in a data-base file, the user is also asked for a sample number, if the spectrum filename was not found in the data base.

If the analysis output is directed to a disk file, the output report filename is used. If the output is directed to a printer or the computer screen, the report file name is not required. If the spectrum filename starts with "S," then the report filename defaults to a filename starting with "R," and the remaining characters and file extension are the same as the spectrum filename. The user may change the name of the output report, if desired.

Several options are available for the device to be used for output of the analysis. Initially, a default setting is provided that may be changed by editing the IADEFAULT data-base file. The analysis may be sent to an attached printer by <P>. It may also be sent to the computer screen by <S> or to the disk by <D>. Finally, on this form the user has the option of including the peak areas in the analysis report. If the peak areas are not included in the report, the analysis report is contained on one page. The default setting for this option is not (N) to include the peak areas in the report. This form is exited by <PgDn> to save the values, or by <esc> to abort the entries.

The File and Peak Information form is then replaced by the Plutonium Analysis menu shown in Fig. 12. This is the only form that must be completed in order to do a spectrum analysis. The first option selects the form described above (Fig. 11). The <P> or options select forms that obtain information regarding the sample and store this information into a data-base file.

Plutonium Analysis System
88.08.03

13:01:35

IAEA Plutonium Analysis
F) File and Peak Information
P) Plutonium Abundances
B) Batch Sample Information
A) Analyze Data
Q) Quit and Return to Main Menu
Enter Choice: Z

<Enter the appropriate key or use the arrow keys, then press enter>

Figure 12. IAEA Plutonium Analysis menu.

The Plutonium Abundances form (Fig. 13) is used to obtain the sample's declared isotopic abundances, their errors, and the plutonium and americium analysis dates. The isotopic abundances and the analysis dates are required only if a comparison between measured and declared isotopic

abundances (T^*2 statistical test) is desired. This form is also used for entering the ^{242}Pu abundance and its percentage error, if a known value is to be used in calculating the abundances of the other plutonium isotopes. If the ^{242}Pu abundance is set to zero in this form, the ^{242}Pu abundance and its error are calculated by the analysis program. Note: the analysis dates are entered as year, month, and day.

Default values for the isotopic abundances are read from the IADEFALT database file, when the program is first started. NOTE: It is recommended that the default values in the data-base file be set to zero, if the user does not intend to use this form for the T^*2 statistical test. If isotopic abundances are entered, the values are kept for each subsequent analysis until they are changed or the main control program is exited. For the isotopic abundance errors a default value of 10.% is provided only for ^{242}Pu . When the Plutonium Abundances form is selected, the user is first queried with

Are the abundances known (Y,N)?

Either <Y> or <enter> will indicate that the abundances are known and the user wishes to enter the values. <N> indicates that the abundances are not known or that it is desired to set all the abundances to zero and have the ^{242}Pu abundance calculated by the program. If 'N' is entered, the form displays a query for the plutonium cooling time (years) with a default value of 4 years provided. The cooling time is used in the calculation of the ^{242}Pu abundance. If the cooling time is known, the user enters the value in place of the default value.

IAEA Plutonium Analysis System
88.08.03

12:35:35

Enter Plutonium Abundances			
Pu Analysis Date: YY.MM.DD		Am Analysis Date: YY.MM.DD	
%Pu-238 Abundance: 99.9999		Pu-238 % Error: 99.9999	
%Pu-239 Abundance: 99.9999		Pu-239 % Error: 99.9999	
%Pu-240 Abundance: 99.9999		Pu-240 % Error: 99.9999	
%Pu-241 Abundance: 99.9999		Pu-241 % Error: 99.9999	
%Pu-242 Abundance: 99.9999		Pu-242 % Error: 99.9999	
%Am-241 Abundance: 99.9999		Am-241 % Error: 99.9999	

Type In Value ↑, ↓ and ↵ PgDn Esc
Move Field Cursor Exit Screen Abort Screen

Figure 13. Enter Plutonium Abundances form.

The Batch Sample information form (Fig. 14) is provided only for recording sample information. It is not necessary to complete this form to perform an analysis. The form needs to be completed only once for a series of measurements on samples from the same batch. When all of the necessary or desired information has been entered, <PgDn> exits the form and returns to the Plutonium Analysis menu option list.

Batch Sample Information			
Batch Name: 292929		Canning Materials: 292929	
Number of Items: 99999		292929	
Material Description: 29Z			
Plutonium Mass: 9.999		Uranium Mass: 9.999	
Plutonium Analysis Method: 292929			
Uranium Enrichment: 292929			

Type In Value ↑, ↓ and ↵ PgDn Esc
 Move Field Cursor Exit Screen Abort Screen

Figure 14. Batch Sample Information form.

When the user is in the Plutonium Analysis option menu, <A> followed by <enter> starts the analysis. If the analysis output is directed to the screen, the output begins with a listing of information regarding the spectrum (see Fig. 15). The last four lines appear only if peak areas are requested in the report.

```
IAEAPU VERSION 4.2
ANALYSIS OF : sdata.bin
Spectrum Date: 87.06.24
Spectrum Time: 10:19:51
Spectrum Livetime: 118. seconds
Spectrum total counts: 250759656.

148-KeV peak position entered: 1393
208-KeV peak position entered: 1951
GAIN = .1068
ZERO = -.467
FWHM(208 KEV)= .655
SHAPC(1) = .02664
SHAPC(2) = .00190
ATAIL = .022
BTAIL = .160
```

Figure 15. Analysis report header.

Next, the message

Press enter to continue . . .

is displayed to prevent the output from "rolling off" the top of the screen before the user has a chance to examine it. To permit the output to continue, the user must press the 'enter' key. If the peak area information is not requested, the screen will display the message

Working on Group #

to indicate that the computer is working on the analysis. This message is also displayed if the output is directed to the printer or a disk file. The final part of the output gives the plutonium isotopic ratios and weight percent abundances.

If the output is directed to a disk file, the following message will appear at the beginning of the analysis:

```
Report is going to disk.  
Make sure drive is ready and there is free disk space.  
Press Enter to Continue.
```

<Enter> will cause

```
Working on Group <#>
```

to appear on the screen.

Working on Group <#> will not appear unless the printer is enabled. If the printer is not available, the message

```
No paper error writing device PRN  
Abort, Retry, Ignore?
```

will be displayed, and the user should take appropriate action.

The last question on the form in Fig. 11:

```
Include Peak Areas in Report {Y,N}:
```

enables the output of peak areas for diagnostic purposes. An example of this output is shown in Fig. 16.

When output is to the screen, only one "screenful" of the peak-area information is output to the screen at a time. When continuation of the report is desired, <enter> is done to continue, as is requested at the bottom of the screen.

----- Plutonium Analysis Diagnostics -----

GROUP # 1
 REDUCED CHI-SQUARE = 775.8
 PEAK EN. COUNTS %ER
 122.80 503325. .18
 123.49 4442. FIXD
 124.38 14043. FIXD
 125.08 13084. FIXD
 125.16 2113398. .08
 129.16 1436506. .09

GROUP # 2
 REDUCED CHI-SQUARE = 100.5
 PEAK EN. COUNTS %ER
 141.57 0. 34.66
 143.35 0. 30.93
 143.77 0.100.00
 144.21 128954. 5.22
 146.08 54457. FIXD
 146.56 495098. 1.84
 148.57 6095808. .42
 150.11 80279. FIXD

GROUP # 3
 PEAK EN. COUNTS %ER
 152.68 508134. .26

Figure 16. Analysis report diagnostic output.

IAEAPU ANALYSIS OF SPECTRUM:sdata.bin
 Pu238/Pu239 = .004713 +- .000030
 Pu240/Pu239 = .209061 +- .001604
 Pu241/Pu239 = .049705 +- .000213
 Am241/Pu241 = .944704 +- .004144
 U235/Pu239 = .000000 +- .000000

PLUTONIUM AGE = 5072.46 +- 16.37 DAYS
 = 13.89 +- .04 YEARS

	MEAS. WT.PCT.	ABS. ERR	DECAY CORR. OPERATOR WT.PCT.	(M-O) %
PU238	= .3687 +- .0022		.3650	1.0000
PU239	=78.2332 +- .1408		77.9210	.0000
PU240	=16.3555 +- .1055		16.6830	-1.9608
PU241	= 3.8886 +- .0143		3.8500	1.0000
PU242	= 1.1540 +- .1154		1.1540	.0000
AM241	= 3.6736 +- .0068		3.5666	3.0000

U235/PU RATIO = .0000 +- .0000

PU240 EFFECTIVE =19.0855 +- .2185

SPECIFIC POWER (mW/g) = 9.0888 +- .0123

VALUE OF T**2 = 27.699

Figure 17. Analysis Report—results.

The Analysis Report includes the decay corrected operator weight percent abundances and (M-O)% (measured - operator percent difference) columns, if the declared operator plutonium abundances are provided. Note: the declared abundances are decay-corrected only if the spectrum measurement date exists in the MC/PAAR.DBF file. For the measurement date to exist in this file, the spectrum must have been transferred with the Data Transfer option.

If the measurement date does not exist, then the isotopic abundances must be decay-corrected before they are entered into the Plutonium Abundance form.

When the analysis is completed, the program returns to the top-level menu. If the analysis output is directed to a disk file, the user must exit the control program (<PgDn>) to type or print the contents of the output report file.

Analysis Error Messages

BAD PEAK POSITION FOR REFERENCE PEAK
 Press Enter to continue

If the position for the 148- or 208-keV peak is incorrect, and statistically insignificant data exists at the position given, this message will be displayed. This message may also indicate that the data stored in the data file is bad and cannot be analyzed. First, the user should check positions of peaks given and, if okay, check the data in the disk file.

BAD PEAK-WIDTH PARAMETER; CHANNEL OVERFLOW?

If the peak-width parameter has the wrong sign, this message is displayed. The most likely cause is a channel overflow in the reference peak. The user should check the spectrum. The spectrum cannot be analyzed if channel overflows exist.

BAD GAIN; CHECK PEAK POSITIONS

If the product of the spectrum gain and the maximum number of channels in the spectrum, plus the zero-channel energy is less than 210 keV, this message is displayed. The 208-keV peak must be included in the spectrum for the analysis to be completed. Adjust the amplifier gain to include the 208-keV peak in the spectrum.

BAD ZERO; CHECK PEAK POSITIONS

If the channel-zero energy is greater than 121.5 keV, this message is displayed. A channel-zero energy greater than 121.5 keV precludes analysis of the 120-keV peak grouping, which is required by the analysis program. This condition may occur because of an incorrect peak-position entry or an improper energy calibration.

POOR RESOLUTION

If the FWHM of the 208-keV peak exceeds 1.15 keV, a warning message is displayed to warn the user that the spectral resolution is not good and that the results are questionable. Although the data will be analyzed, the user should take action to improve the energy resolution. This action may involve simply reducing the count rate, or it may involve adjusting the amplifier pole zero and shaping time constant (consult the IMI for more details).

CHECK REFERENCE PEAK POSITION

This error message will occur if incorrect peak positions were given for the 148- and 208-keV peaks. The calculated gain and zero may satisfy the necessary conditions and will be printed out; however, the program will check to make sure that the 129.3-keV peak is found in the correct position. The analysis program will not continue. Check and verify that the correct reference peak positions were given.

BAD 375.0 keV PEAK

If the 300-keV peak regions are included in the spectrum, the analysis program uses the 375.0-keV peak as a reference to adjust the gain. If the 375.0-keV peak is nonexistent or the data in the spectrum disk file is bad, this error will be displayed.

<Energy>-keV peak area is <=0. Analysis aborted

If any of the peak areas used for establishing the relative detection efficiency for the measurement are 0, this error message is displayed. These peaks must exist for the analysis to be completed. If the displayed spectrum shows significant peaks, the user should check the spectrum disk file for bad data.

Significant pileup effects found in spectrum.
Results may be suspect. Check count rate and pole zero.

The high-energy side of the 208-keV peak is checked for pileup effects. If the pileup effects are significant, this message is displayed. The reason for the pileup should be found and eliminated, because it may bias the results.

Large scattering peaks observed in spectrum.
Analysis will be performed, but results may be suspect
Check measurement setup. Remove objects causing scattering.

Gamma-rays scattering off of objects surrounding the detector may cause broad sloping distributions in the spectrum that make determination of background and peak areas less accurate. The user should locate sources of scattering and modify the counting setup or remove objects.

Output of Data-Base Records

If the user performs analysis on the same spectrum more than once, the application will keep only the most recent values in the data base. This is to say that multiple records for the same spectrum and sample number will NOT be kept. If multiple analyses need to be kept, then changing the spectrum name or sample number will be required.

Quality-Assurance Analysis

This program is selected from the top-level menu by <C> and <enter>. The purpose of the quality-assurance program is to check certain parameters determined from a gamma-ray spectrum for system setup and performance. The parameters are determined by analyzing low- and high-energy gamma-ray peaks in the spectrum. The program may be applied to a gamma-ray spectrum of any gamma-ray emitter (i.e., it does not have to be a plutonium gamma-ray spectrum).

Inputs to the program are the energies and channel positions of the low- and high-energy gamma-ray peaks and the spectrum filename. The two peaks should be well isolated (free from interferences) and should contain a minimum of 10^5 counts (or 2×10^4 peak height) to ensure a good determination of the gamma-ray peak shape. Outputs from the program are the gain and channel-zero energy of the spectrum, as well as the calculated spectral resolution at 122 and 208 keV.

The gain and zero are checked to determine if they are appropriate for plutonium gamma-ray isotopic analysis. If the gain of the system is greater than 0.15 keV/channel, the message

Gain MUST BE LESS than 0.15 keV/channel

is displayed on the screen. Plutonium isotopic results may be compromised if the gain is higher than 0.15 keV/channel. This is because of requirements by the analysis program that the channel spacing between peaks not be below a minimum value. It is recommended that the gain be approximately 0.11 keV/channel. The zero-channel energy (zero) is checked and the message

CHECK ZERO; Zero CANNOT BE GREATER than 121.5 keV

is displayed if the zero-channel energy is greater than 121.5 keV. A zero-channel energy greater than 121.5 keV precludes analysis of the 120-keV peak grouping, which is required by the isotopic analysis program. The energy range of the spectrum is also checked. If the product of the spectrum gain and maximum channel in the spectrum plus the zero-channel energy is less than 210 keV, then the message

CHECK GAIN; Upper energy range MUST BE AT LEAST 210 keV

is displayed. The isotopic analysis program cannot analyze a plutonium gamma-ray spectrum, if the 208-keV peak region is not included. The above requirements on the gain and zero must be met by plutonium gamma-ray spectra that are to be analyzed for plutonium isotopics.

If the quality assurance program is used to check the quality of spectra other than plutonium spectra, these conditions may be ignored. The isotopic analysis program also performs the checks described above.

The program also checks the resolution performance of the system at 208 keV. If the resolution is greater than 1.15 keV, then the message

PCOR RESOLUTION -- CHECK SYSTEM AND COUNT RATE

is displayed. It is recommended that resolution at 208 keV for a plutonium gamma-ray spectrum be no greater than 800 eV for the best results. The high-energy peak is also inspected for high-energy tailing caused by pulse pileup. The following message is displayed if high-energy tailing is significant:

**HIGH-ENERGY TAILING IS SIGNIFICANT,
CHECK SYSTEM POLE-ZERO SETTING AND INPUT COUNT RATE.**

High-energy tailing may be a symptom of improper pole-zero adjustment or high input count rate. The measurement situation should be checked for both of these conditions. High-energy tailing may also be an indication of poor detector performance (slow risetime pulses). In such cases the detector should be replaced or refurbished.

When the quality assurance program is completed, it returns to the main option menu.

IAEA Plutonium Analysis System
88.08.03

12:16:08

Quality Assurance Check	
Low Energy Peak Position:	9999
Peak Energy:	9999.99999
High Energy Peak Position:	9999
Peak Energy:	9999.99999
Binary Data File Name: Z9Z9.BZ9	

Type In Value	↑, ↓ and ↵	PgDn	Esc
	Move Field Cursor	Exit Screen	Abort Screen

Figure 18. Quality Assurance Check form)

Ending the Program

Exiting the main option menu is done by <esc> or <Q> when the main option menu is displayed. The main control program displays the message

Ending IAEA Plutonium Acquisition and Analysis Program

and returns the system to the MS-DOS prompt. To restart the main control program and display the main option menu, the user types '1A' after the MS-DOS prompt, as shown in the beginning of the operating instructions.

Installation

Distribution Media

There are five diskettes supplied: four 3.5-in. diskettes and one 5.25-in. diskette.

1. Master Program Diskette :	ia.bat
iaea.exe
panal.win
cictrans.win	master.exe
defaults.dbf
defchang.win
tempinfo.dbf	unflash.exe
flrun.exe
mainwind.win
filename.cic
2. Master Data Diskette :	iadefalt.dbf
mcapar.dbf	anresult.dbf
iaea.dbf	dcheck.dbf
filename.dbf
3. Maintenance Diskette :
FORTRAN sources :	ave.for
diaea.for
bkgrd.for
ncnts.for
ctail.for
diags.for
idpmy.for
testbin for	c2jdat.for
dsave.for
maxval.for
rdsf.for
gfit2.for
more.for
ttest.for
rdbin.for	decay.for
bwf.for
strip1.for
bkgrd.for
pufity.for
matinv.for
dchdat.for
ia.for
dcheck.for
master.for
cicero.for
getd.for
anresult.for
sppow.for
FORTRAN include files :	iaea.cmn	iaeadb.cmn	top.cmn
FORTRAN libraries :	commsub.lib
grafsub.lib	iaeafor.lib
acssub.lib	filesub.lib
dbsubs.lib
dBASE sources :	iaea.prg
cicdata.prg
dch.prg
decfnum.prg
getstrg.prg
getnum.prg	funkey.prg
getiadat.prg
enditall.prg
inputban.prg
getdate.prg	getkey.prg
getcool.prg
chdefalt.prg
getwhnum.prg
gettime.prg
dBASE libraries :	prgs.lib	compchem.lib	
MAKE files :	prg.mak	for.inak	
Installation files :	installh.bat		
FLASHCODE window libraries :	panal.win
defchang.win	cictrans.win	mainwind.win
4. Documentation Diskette :			
ASCII text files :	readme.txt
data.fmt	opinstr.txt	login.cc
Volkswriter 3 format files :	iaearef.doc		
5. Data Structures Diskette:
(5.25")	iadefalt.dbf
mcapar.dbf	anresult.dbf
iaea.dbf	dcheck.dbf
filename.dbf

Systems with Two 720-KB Disks

(Installations on systems without hard disks cannot support maintenance of the program.)

(Installation will NOT be successful on systems with 360KB floppy disk drives and NO hard disk.)

Generating a Program Diskette can be done by simply copying the disk labeled "Master Program Disk." Generating a Data Diskette can be done by simply copying the disk labeled "Master Data Disk." Installation is done by simply placing the program disk in drive A and the data disk in drive B. In order to use the IAEA system on a floppy-based system, the only disks needed are the PROGRAM and DATA disks. The PROGRAM disk must go in drive A and the DATA disk in B. The Change Defaults option from the main menu is used to change the drive to B. If the user has a path on the disk for data files and wants to use that as the default, the path should be entered at the path prompt.

Systems with Hard Disks

To use this system on a computer with a hard disk, the user must copy all the files on the "Master Program Disk" to a subdirectory on the hard drive. We suggest the "c:\iaea" subdirectory, but the spectral data files may be placed anywhere, as long as the user either enters the drive and path for the data files in the filename prompt or enters the drive and path in the Set Defaults option. Additional files need to be loaded on the hard disk if maintenance is to be performed on the program.

Use of the INSTALLH.BAT will set up the hard disk so that maintenance can be performed.

Maintenance

The IAEA Plutonium Isotopics Analysis Program is comprised of a Microsoft(c) FORTRAN application, a Clipper(c)-compiled dBASE III(c) front-end program, and some MS-DOS(c) "BAT" command files.

If maintenance needs to be performed, it is necessary that this activity take place on a system with a hard disk.

System software required for use:

- Microsoft or IBM MS-DOS or PC-DOS, Revs. 2.1 to 3.3
- Ashton-Tate dBASE III (optional, for viewing data-base files)
- Software Bottling of N.Y. FLASHCODE run-time files.

System software required for maintenance:

- Microsoft or IBM MS-DOS or PC-DOS, Revs. 2.1 to 3.3
- Ashton-Tate dBASE III (optional, for viewing data-base files)
- Microsoft FORTRAN-77, Rev. 4.01 (other revision levels might necessitate recompilation and source-code modification)
- Microsoft LINK, Rev. 3.55
- Microsoft LIB, Rev. 3.06
- Microsoft MAKE, Rev. 4.05
- Nantucket CLIPPER compiler, Summer 87 Revision or later
- A text editor appropriate for source-code modification.
- Software Bottling of N.Y. FLASHCODE

Hardware required for maintenance:

- IBM-PC/XT/AT compatible system with hard disk if the system does not have a 3.5-in., 720-KB floppy disk drive, the user will need cabling and software to transfer software to the Toshiba 1100/2100 for use. The system software mentioned previously needs to be installed on the system on which maintenance will be performed. The source code is supplied and is loaded onto the system by

using the INSTALLH.BAT command procedure. In order to recompile the code, we use a Make file to automate the process. First, the appropriate compiler needs to be installed on the hard disk. The user will not be able to recompile the application from a floppy-based system. IAEA.EXE is the user interface, and MASTER.EXE performs the data transfer, analysis, and quality assurance. The sources with PRG extensions are compiled with Clipper and create IAEA.EXE. The sources with FOR extensions are the FORTRAN sources and are compiled with the FORTRAN compiler.

To Rebuild IAEA.EXE

Type MAKE PRG.MAK <Enter>. This will run the program MAKE.EXE. Make will read the file PRG.MAK and compile the sources that have been changed since the last compile. (See the section in the FORTRAN manual about Make and make files for a detailed description of Make.)

Make will call the compiler specified in the top of the Make file PRG.MAK. The compiler must be installed properly and be available along the DOS Path. The source files must be in the current disk directory. This process is completely automated, and if the compiler is installed properly and there are no errors in the new code, the new IAEA.EXE will be generated. It is now ready to use.

To Rebuild MASTER.EXE

Type MAKE FOR.MAK <cr>. This process is the same as rebuilding IAEA.EXE. The FORTRAN compiler must be available along the DOS path, and the source files must be in the current directory.

If the compilation and linking goes properly, a new MASTER.EXE is now created and is ready for use.

For the FORTRAN program, certain libraries must be available for linking. These can be in the current directory or available along the path specified by the LIB environment variable.

These libraries are as follows:

COMMSUB.LIB
GRAFSUB.LIB
ACSSUB.LIB
FILESUB.LIB
DBSUBS.LIB
IAEAFOR.LIB

A user who has systems with and without 80x87 math coprocessors will need to use the "emulator" library LLIBFORE and the appropriate command switches when compiling. Otherwise, the "alternative" library LLIBFORA should be used along with the appropriate command switches for the compiler.

Spectral Data-File Formats

The analysis application understands two formats: binary and ASCII. The ASCII format is easily read or edited by a person, but it requires twice the space on disk and takes more than twice as long for a computer to read or write as binary. It is expected that most catalogued spectra will be stored in the binary format.

In ASCII, all values are written/read in FORTRAN F8.0 format. In binary, all values are written/read as 1*4 variables by using FORTRAN binary WRITES or READS. In either format, values are as follows:

1 value	-	spectra id
1 value	-	livetime
n values	-	n channels of count values

dBASE III Data Structures

The following are descriptions of the dBASE III data structures for the files used by the IAEA plutonium application suite:

FIELD	The number of the field within the file FIELD
NAME	The name of the indicated field, used for referencing that field
TYP	The type of the field : C is character N is numeric D is date
WIDTH	The width of the field, in bytes (characters or digits)
DEC	The number of decimals in a numeric field.

(A **WIDTH** of 8 and a **DEC** of 4 indicate numbers formatted and stored as 999.9999.)

File Description : Analysis defaults

File Name : IADefault.DBF
 Record Length : 345
 Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC	
1	CMAT3	C	15	0	Third canning material
2	CMAT2	C	15	0	Second canning material
3	PU238ERR	N	8	4	Error in Pu-238 abundance
4	PU239ERR	N	8	4	Error in Pu-239 abundance
5	PU240ERR	N	8	4	Error in Pu-240 abundance
6	PU241ERR	N	8	4	Error in Pu-241 abundance
7	PU242ERR	N	8	4	Error in Pu-242 abundance
8	AM241ERR	N	8	4	Error in Am-241 abundance
9	COOLING	N	5	0	Cooling time, in years
10	AM241	N	10	4	Am-241 abundance
11	PU242	N	10	4	Pu-242 abundance
12	PU241	N	10	4	Pu-241 abundance
13	PU240	N	10	4	Pu-240 abundance
14	PU239	N	10	4	Pu-239 abundance
15	PU238	N	10	4	Pu-238 abundance
16	POS148	C	10	0	Channel position of 148 KeV
17	POS208	C	10	0	Channel position of 208 KeV
18	SPECFILENAME	C	30	0	Spectrum filename
19	REPFILENAME	C	30	0	Report filename
20	OUTPUT	C	1	0	Output mode
21	BATCH	C	15	0	Batch identification
22	NOITEM	C	5	0	Number of items
23	TPUMAS	N	12	3	Total plutonium mass
24	PUDATE	D	8	0	Plutonium analysis date
25	AMDATE	D	8	0	Americium analysis date
26	METHOD	C	20	0	method of Pu analysis
27	TUMAS	N	12	3	Total uranium mass
28	ENRICH	C	10	0	Uranium enrichment
29	MDC	C	15	0	Material description code
30	CMAT	C	15	0	First canning material

File Description : Temporary Storage
 File Name : FILENAME.DBF
 Record Length : 31
 Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC
1	FILENAME	C	30	0

File Description : Temporary Storage
 File Name : TMP.DBF
 Record Length : 181
 Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC
1	STUFF	C	180	0

File Description : Transfer Parameters

File Name : MCAPAR.DBF
 Record Length : 362
 Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC	
1	SAMPLENUM	C	10	0	sample number
2	POS208	N	8	3	channel position of 208 KeV
3	POS148	N	8	3	channel position of 143 KeV
4	FNAME	C	30	0	spectrum filename
5	PUR	C	4	0	pile-up rejection setting
6	RATE	C	4	0	pile-up rate setting
7	PZA	C	20	0	pole-zero adjustment
8	INPOL	C	6	0	Input switch polarity
9	BLRL	C	4	0	baseline restore(BLR) adjustment
10	BLRS	C	4	0	BLR shape setting
11	DTS	C	4	0	dead time setting
12	INPMD	C	5	0	input mode setting
13	BASE	C	20	0	base line comment

FIELD	NAME	TYP	WIDTH	DEC	
14	RTPS	C	4	0	rise time protection
15	HVPOL	C	3	0	high-voltage polarity
16	SHAPET	N	12	2	shaping time
17	CGAIN	N	12	2	coarse gain
18	FGAIN	N	12	2	fine gain
19	RTPT	N	12	2	rise time protection(usec)
20	HVOLT	N	12	2	detector bias high-voltage
21	DISCR	N	12	2	discriminator setting
22	CNTRY	C	8	0	country
23	FCLTY	C	6	0	facility
24	MBA	C	6	0	material balance area code
25	KM	C	6	0	key measurement point code
26	REPORT	C	12	0	inspection report number
27	DATE	D	8	0	date of inspection
28	INSPTR	C	24	0	inspector identification
29	RMRKS	C	69	0	remarks
30	MEASDATE	D	8	0	date of measurement
31	MEASTIME	C	8	0	time of measurement

File Description : Analysis Parameters

File Name : IAEA.DBF
 Record Length : 371
 Current Date : 6 SEP 1988

FIELD	NAME	TYP	WIDTH	DEC	
1	CMAT3	C	15	0	Third canning material
2	CMAT2	C	15	0	Second canning material
3	PU238ERR	N	8	4	Error in Pu-238 abundance
4	PU239ERR	N	8	4	Error in Pu-239 abundance
5	PU240ERR	N	8	4	Error in Pu-240 abundance
6	PU241ERR	N	8	4	Error in Pu-241 abundance
7	PU242ERR	N	8	4	Error in Pu-242 abundance
8	AM241ERR	N	8	4	Error in Am-241 abundance
9	COOLING	N	5	0	Cooling time, in years
10	AM241	N	10	4	Am-241 abundance
11	PU242	N	10	4	Pu-242 abundance
12	PU241	N	10	4	Pu-241 abundance
13	PU240	N	10	4	Pu-240 abundance
14	PU239	N	10	4	Pu-239 abundance
15	PU238	N	10	4	Pu-238 abundance
16	POS148	C	10	0	Channel position of 148 KeV
17	POS208	C	10	0	Channel position of 208 KeV
18	SPECFNAME	C	30	0	Spectrum filename
19	REFPNAME	C	30	0	Report filename
20	OUTPUT	C	1	0	Output mode
21	BATCH	C	15	0	Batch identification
22	NOITEM	C	5	0	Number of items
23	TPUMAS	N	12	3	Total plutonium mass
24	PUDATE	D	8	0	Plutonium analysis date
25	AMDATE	D	8	0	Americium analysis date
26	METHOD	C	20	0	Plutonium analysis method
27	TUMAS	N	12	3	Total uranium mass
28	ENRICH	C	10	0	Uranium enrichment
29	MDC	C	15	0	Material description code
30	CMAT	C	15	0	First canning material
31	Samplenum	C	10	0	Sample number
32	Measdate	D	8	0	Date of measurement
33	Measstime	C	8	0	Time of measurement

File Description : Analysis Results

File Name : ANRESULT.DBF
 Record Length : 641
 Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC	
1	SPECFNAME	C	30	0	Spectrum Filename
2	SAMPLE	C	10	0	Sample Number
3	PU238	N	8	4	Pu-238 abundance
4	PU239	N	8	4	Pu-239 abundance
5	PU240	N	8	4	Pu-240 abundance
6	PU241	N	8	4	Pu-241 abundance
7	PU242	N	8	4	Pu-242 abundance
8	PE238	N	8	4	Error in Pu-238 abundance
9	PE239	N	8	4	Error in Pu-239 abundance
10	PE240	N	8	4	Error in Pu-240 abundance
11	PE241	N	8	4	Error in Pu-241 abundance
12	PE242	N	8	4	Error in Pu-242 abundance
13	POW	N	8	4	Specific power
14	POWE	N	8	4	Error in specific power
15	E240	N	8	4	Effective Pu-240
16	E240E	N	8	4	Error in effective Pu-240
17	ALPHA11	N	15	8	INVERTED MATRIX ELEMENTS
18	APLHA12	N	15	8	
19	ALPHA13	N	15	8	

FIELD	NAME	TYP	WIDTH	DEC	
20	ALPHA14	N	15	8	
21	ALPHA22	N	15	8	
22	ALPHA23	N	15	8	
23	ALPHA24	N	15	8	
24	ALPHA33	N	15	8	
25	ALPHA34	N	15	8	
26	ALPHA44	N	15	8	
27	Z4849	N	15	8	Pu238/Pu239 ratio
28	EZ4849	N	15	8	Abs. error in Pu238/Pu239
29	Z4049	N	15	8	Pu240/Pu239 ratio
30	EZ4049	N	15	8	Abs. error in Pu240/Pu239
31	Z4149	N	15	8	Pu241/Pu239 ratio
32	EZ4149	N	15	8	Abs. error in Pu241/Pu239
33	Z5149	N	15	8	Am241/Pu239 ratio
34	EZ5149	N	15	8	Abs. error in Am241/Pu239
35	Z2549	N	15	8	U235/Pu239 ratio
36	EZ2549	N	15	8	Abs. error in U235/Pu239
37	NUMCOUNTS	N	15	8	Total spectrum counts
38	A241	N	15	8	Am-241 abundance
39	AE241	N	15	8	Error in Am-241 abundance
40	U235	N	15	8	U-235 abundance
41	UE235	N	15	8	Error in U-235 abundance
42	FWHM	N	15	8	FWHM of 208-keV peak

File Description : Quality Assurance

File Name : DCHECK.DBF
Record Length : 236
Current Date : 5 NOV 1987

FIELD	NAME	TYP	WIDTH	DEC	
1	FNAME	C	30	0	Spectrum filename
2	NREF1	N	11	0	Position of reference peak 1
3	STD1	N	11	5	Energy of reference peak 1
4	NREF2	N	11	0	Position of reference peak 2
5	STD2	N	11	5	Energy of reference peak 2
6	LIVTIM	N	11	0	Livetime
7	CRATE	N	11	5	Count rate
8	ZERO	N	11	5	Channel zero energy
9	GAIN	N	11	5	Spectrum gain (keV/channel)
10	FWHM1	N	11	5	Full-width-half-max peak 1
11	SFWHM1	N	11	5	Standard deviation of FWHM1
12	SHAPC2	N	11	5	Peak shape parameter
13	SHAPC1	N	11	5	Peak shape parameter
14	PAREA1	N	13	5	Area of peak 1
15	SPAREA1	N	11	5	Standard deviation of AREA1
16	FWHM2	N	11	5	FWHM of peak 2
17	SFWHM2	N	11	5	Standard deviation of FWHM2
18	PAREA2	N	13	5	Area of peak 2
19	SPAREA2	N	11	5	Standard deviation of AREA2
20	PUFLG	C	3	0	File-up flag

Disk File Index

Batch Files

IA BAT Invokes entire system. Use this to run it all.
MF BAT Calls 'make' for FORTRAN sources
MP BAT Calls 'make' for dBASE sources
MOVELIB BAT moves libraries to supplied directory or drive
LPRG BAT prints dBASE sources to laserjet
LFOR BAT prints FORTRAN sources to laserjet
PRODUCT BAT copies files to distribution disks
MOVEFOR BAT copies FORTRAN sources to specified drive or sub-dir
MOVEPRG BAT copies dBASE sources to specified drive or sub-dir
INSTALLH BAT installs files off distribution disk to hard disk
UPDATE BAT updates IAEA.ARC with sources and support files

Information Files

FILENAME CIC written by CICERO.FOR, read by GETIADAT.PRG. spectra file name

Common Files

IAEA	CMN	main common block for FORTRAN sources
IAEADB	CMN	DBSAVE common block, used in DIAEA.FOR, ANRESULT.FOR and IA.FOR
TOP	CMN	holds drive and path for FORTRAN sources

Data-Base Files

DCHECK	DBF	holds DCHECK results
DEFAULTS	DBF	dBASE source defaults
IAEA	DBF	info entered for analysis
IADEFALT	DBF	analysis defaults
ANRESULT	DBF	results of analysis
FILENAME	DBF	holds new spectra file name
TEMPINFO	DBF	reads in SWITCH.PRM to decide if should call CHECKIA in IAEA
MCAPAR	DBF	info entered in CICDATA.PRG

Executables

MASTER	EXE	FORTRAN executable
IAEA	EXE	dBASE executable
FLRUN	EXE	Flashcode executable
UNFLASH	EXE	Flashcode executable

FORTRAN Sources

NCNTS	FOR	determines net counts in a specified region
DIAEA	FOR	writes results of analysis to TMP.PRM for dBASE saving
BKGD	FOR	calculate background continuum beneath peak
PUFITY	FOR	calculate relative detection efficiency curve for specified peaks
SPPOW	FOR	calculates specific power
DCHDAT	FOR	reads DCHECK.PRM for DCHECK FORTRAN routine
CTAIL	FOR	determines tail parameters for a gamma-ray peak
GFIT2	FOR	determines peak position, height, and width from given peak data
STRLEN	FOR	finds string-length function
DECAY	FOR	calculates decay correction
CICERO	FOR	data-acquisition routine from CICERO to spectra data file
IA	FOR	master plutonium-analysis routine
ANRESULT	FOR	writes analysis results to IAEA.DBF
MASTER	FOR	controlling FORTRAN program, calls CICERO, IA or DCHECK
MAXVAL	FOR	determines channel with maximum count in a given region
MATINV	FOR	performs matrix inversion on a symmetric matrix
RDSK	FOR	reads ASCII spectra data file
DSAVE	FOR	saves DCHECK results to DCHECK.DBF
DIAGS	FOR	prints analysis diagnostics (routine WRTEMP)
BKGRD	FOR	calculates background continuum beneath peak, allows sloping background
TTEST	FOR	performs t**2 statistical test
IDPMY	FOR	calculates relative detection efficiency for a given energy
STRIP1	FOR	subtracts out a peak from spectral data in a specified region
DCHECK	FOR	quality-assurance routine, called by MASTER.FOR
GETD	FOR	reads OUT_IA.PRM, gets info from GETIADAT
RDBIN	FOR	reads binary spectra-data file
C2JDAT	FOR	converts date to Julian date
MORE	FOR	displays 'more' message for print to screens in analysis
TESTBIN	FOR	tests data file if it is binary or ASCII
AVE	FOR	calculates average counts in specified region

Libraries

FILESUB	LIB	needed support library (part of FORLIB PLUS)
PRGS	LIB	dBASE routines
COMPCHEM	LIB	dBASE routines
GRAFSUB	LIB	needed support library (part of FORLIB PLUS)
IAEAFOR	LIB	FORTRAN routines
ACSSUB	LIB	needed support library (part of FORLIB PLUS)
COMMSUB	LIB	needed support library (part of FORLIB PLUS)
DBSUBS	LIB	dBASE-FORTRAN routines

Text Files

FOR	LST	Text file with info on making FORTRAN application
PRG	LST	Text file with info on making dBASE application

Make Files

PRG	MAK	make file for dBASE code
FOR	MAK	make file for FORTRAN code

dBASE Sources

CHECKIA	PRG	checks last entry of IAEA.DBF for duplicates earlier in file
CICDATA	PRG	CICERO front end. Full screen entry routine
DCH	PRG	DCHECK front end
ENDITALL	PRG	displays ending banner when exiting system
GETIADAT	PRG	analysis front end
GETCOOL	PRG	gets cooling time for analysis
CHDEFAULT	PRG	changes defaults for dBASE system
DECNUM	PRG	decrements field number for CICDATA.PRG
INPUTBAN	PRG	displays bottom banner for analysis front end
IAEA	PRG	top-level dBASE source file
FUNKEY	PRG	gets a function key input
GETKEY	PRG	gets certain keys
GETDATE	PRG	gets a valid date
GETNUM	PRG	gets floating-point numbers
GETTIME	PRG	gets a valid time
GETSTRG	PRG	gets a string

Information Files

OUT_IA	PRM	written by GETIADAT, read by GETD.FOR. Info for analysis
TMP	PRM	written by DIAEA, holds results of analysis
CICERO	PRM	holds data-file name for use by CICERO.FOR
DCHECK	PRM	holds DCHECK results
STATUS	IA	holds information for flags used in GETIADAT.PRG

Help Window Files

PANAL	WIN
DEFCHANG	WIN
MAINWIND	WIN
CICTRANS	WIN

Special Notes

Because of FORLIB PLUS, there must be a library named FORTRAN.LIB. The LLIBFORE.LIB file should be copied to FORTRAN.LIB in the library subdirectory for the FORTRAN compiler.

IAEA Routine-Calling Hierarchies

IAEA dBASE routine calling hierarchy

IAEA FORTRAN routine calling hierarchy

* Part of the FORLIB PLUS library package.

Part of the FORTRAN-dBASE library in DBSUBS.LIB.

All source files not marked '#' or '*' are in IAEA FOR.LIB except for MASTER, IA, CICERO, and DCHECK.

Cabling

Specifications for cabling between Silena CICERO 8K and IBM PC (or compatible) computer systems.

"PC" type cables (for IBM PC/XT and "clones")

Connectors: female DB-25 to male DB-25.

Description: pins 5, 6, 8, and 20 jumpered at both ends.

Diagram:

"AT" type cables (for IBM AT and most "laptops"*)

Connectors: female DB-9 to male DB-25.

Description: pins 1, 4, 6, and 8 jumpered at the DB-9 end; pins 1 and 7 and 5, 6, 8, and 20 jumpered at the DB-25 end.

Diagram:

* Toshiba 1100/2100/3100/3200/5100.

Acknowledgments

The data-transfer, data-analysis, and quality-assurance applications were developed jointly by the Lawrence Livermore National Laboratory Nuclear Chemistry Division, Livermore, Calif. 94551 USA and Compuchem, Inc., 30998 Huntwood Avenue, Suite 107 Hayward, Calif. 94544-7033 USA.

IAEA Plutonium Isotopics Analysis System for IBM PC and compatible computers developed for the International Atomic Energy Agency by W. D. Ruhler, W. M. Buckley and R. Gunnink, Lawrence Livermore National Laboratory, under ISPO Task A.140 and by R. Fleming, Compuchem, Inc., under LLNL Personal Services Agreements 9107605 and 5541100.

Software Revision Level: 4.2, Reference Manual Revision: 4.2, release date: 24 July 1989.