PIONEER - F/G
SPECTRUM PLOT PROGRAM

Prepared by

COMPUTER SCIENCES CORPORATION

For

GODDARD SPACE FLIGHT CENTER

Under

Contract No. NAS 5-11999
Task Assignment No. 247

Prepared by:

Dr. N. Lal — Date

Reviewed by:

P. M. Botting — Date
Section Manager

SECTION 1 - PROGRAM OVERVIEW

1.1 INTRODUCTION

The Spectrum Display Program is used to study the average spectral shape during a given interval, as well as to study the variation of spectral shape over a period of time. Spectral shape (spectrum) is the functional relationship between flux and energy. To determine average spectrum during a time interval, fluxes (averaged over energy range) in several different energy ranges must be known. In the GSFC/CRT experiments onboard Pioneer-F and Pioneer-G satellites, there are two ways of obtaining fluxes: from the PHA data, and from the RATES data. The program to be described operates on the RATES data alone. Each rate equation selects events belonging to some particle and within a specified energy range. (This statement is approximately true for electron and proton rates. For heavier particles, a rate equation may correspond to different particles and thus different energy ranges.)

To determine spectra, then, flux = number of particles/unit time/unit energy interval/area/solid angle must be computed. The number of particles per unit time corresponding to a given energy range is given by the number of counts in a rate counter in relation to the time over which these counts accumulated (i.e., rate). The energy interval is given by the rate equation which defines a threshold and ceiling.

The product of area and solid angle corresponding to the rate equation is given by the "geometry factor." Thus, if the rate corresponding to a given rate equation is known, the flux is given by

$$\frac{\text{Rate}}{(\Delta E)\ (\text{Geometry factor})}$$

The energy range corresponding to a given rate equation is generally large enough that the average flux obtained using the above relationship provides only a coarse measure. To obtain more information, fluxes are obtained for two rate equations which correspond to energy ranges which have a partial overlap with each other. The difference between the corresponding rates corresponds to the rate of events corresponding to the nonoverlapping energy region. It is, of course, a part of the experiment design to provide for enough rate equations such that meaningful information in energy ranges of interest can be obtained.

Hence, if the first rate equation (a) spans the energy range $\left(E_a^{\ell} - E_a^{u}\right)$, if the second rate equation (b) spans the energy range $\left(E_b^{\ell} - E_a^{u}\right)$, and if r_a and r_b are the rates corresponding to the first and second rate equations, respectively, then assuming that the two rate equations have the same geometry factor, the average flux in energy range $E_a^{\ell} - E_b^{\ell}$ is given by

$$\frac{r_b - r_a}{\left(E_a^{\ell} - E_b^{\ell}\right) * g_a}$$

$g_a = g_b = g$ = geometry factor

$E_a^{\ell} > E_b^{\ell}$

The purpose of the Spectrum Display Program is to compute the desired fluxes averaged over a specified time interval, and to produce flux versus energy plots on log-log and semi-log scales.

The data needed to compute rates is obtained from the rate summary data base. In the current version of the program, the rate used to obtain fluxes is provided as input to the program. The geometry factors, thresholds, and ceiling values are maintained in a table. These values can be overridden by providing the program with revised values as input.

1.2 DESIGN CONSIDERATIONS

The Spectrum Display Program was designed with a specific application in mind, i.e., plotting LET-I and LET-II proton fluxes as well as plotting electron fluxes. The speed of development took precedence over a general design. Thus, the plot section has scaling parameters and labels hard-coded via data statements. The design is modular, and the program, as presently constituted, is very efficient. However, it does possess the following limitations:

1. For semi-log plots, the energy range that can be plotted is 0 to 24 MeV. For log-log plots, the energy range is 0.1 to 100 MeV. Thus, the program will have to be modified if, say, expansion of the scale (i.e., to have the entire X-axis object space correspond to 0.1 to 10 MeV) is wanted. Only the routines that perform abscissa scaling would be affected, however.

2. The list facility is not currently implemented.

1.3 INPUT AND OUTPUT

The primary input to the Spectrum Display Program is the rate summary data base and the associated status data set. The former contains one logical record for each summary interval in a span of time. The time of the first record and the time of the last record as well as the length of the summary interval are recorded in the associated status data set. Thus, given a time on summary interval boundary, the ordinal number of the summary record can be computed from the time of the first record and the summary interval.

The time interval over which the fluxes are to be averaged (plot interval), and the plot intervals for which plots are to be generated, are described to the program via input cards. Specification of the particle to which the data belongs such that plots can be appropriately labelled is needed.

Output of the Spectrum Display Program consists of microfilm plots.

SECTION 2 - PROGRAM PFDISP

2.1 MAIN PROGRAM FUNCTIONS

PFDISP is the main program of the Spectrum Display Program and performs the following functions:

1. Initializes one-time constants
2. Calls routines that read and analyze input information
3. Mounts and positions rate summary tape to the data to be extracted
4. Calls routines that compute fluxes and those that plot the flux data
5. Performs end-of-job processing

2.2 PROCEDURE

1. NOSTAE is called in order that in the event of abnormal termination, contents of registers are preserved for analysis of the dump.
2. ECHO is called to read and print all input cards on logical units 5 and 15. ECHO performs no analysis; it simply reads data cards and prints them out on logical unit 4 for easy analysis of any input-related problems. The input data set is rewound before returning control to PFDISP.
3. Logical unit 10 is assigned to the rate summary data set (NUS). That no tapes are currently mounted is indicated by initializing variables DTAPES and DSTPON. The frame counter, IFRAME, is initialized. The logical variable, QOPEN, is set to .FALSE. to indicate that SD4060 output data set (ddname SC406022) is not yet opened.
4. For the specified plot periods, PFDPIA is called to read and analyze the input plot information. PFDPIA reads and analyzes information as to the plot period, scaling of plots, and plot interval.

It determines whether conditions exist such that the program can continue. In the event that the analysis is successful, the following data is returned via COMMON block PLOT.

Variable	Type	Description
NRECB	I*4	Ordinal number of first rate summary record to be processed
DTAPES	R*8	Serial number of volume on which rate summary data resides
HSID	I*2	Identification of satellite whose data is to be processed
QLIST	L*4	Logical variable indicating whether listing of fluxes is desired
QSCALE	L*4	Logical variable indicating whether autoscaling of plots is desired
LOOP	I*4	Number of summary intervals contained in a plot interval
RMAX	R*4	Upper limit of ordinate for plots
RMIN	R*4	Lower limit of ordinate for plots
QSMLOG	L*4	Indicates whether semi-log plots are requested

5. If autoscaling is not in effect (QSCALE = .FALSE.), then the location of the ordinate grid lines and the labels for the ordinate must be calculated only once. This is accomplished by calling PFDCYL, which computes and stores in local variables this information. Alternate return (RETURN 1) from this routine implies that the specified limits, RMAX and RMIN, did not fall in the acceptable range 10^{-9} to 10^{9}. Should this return be executed, the job is terminated.

6. PFDRIA is called if this is the first time (i.e., NGROUP = 0). PFDRIA reads in the rate descriptors to be used in computing

fluxes. If input is faulty (i.e., certain necessary data is not provided), a message to this effect appears on logical unit 4. If insufficient information is provided, such that processing cannot continue, alternate return 1 is taken. This results in limitation of the job. On normal return, the following data is returned via COMMON area PLOT.

Variable	Type	Description
THRESH	R*4	Dimensioned arrays (2,50) THRESH (1, I), energy corresponding to start of energy range for Ith range THRESH (2, I), energy corresponding to end of energy range for Ith range
NGROUP	I*4	Number of energy ranges

7. Information messages data set (logical unit 4) is closed.

8. PFDCXC is called to compute absolute raster coordinates corresponding to start and end of each of the NGROUP energy ranges. PFDCXC returns these coordinates via calling argument arrays ISTART and IEND. ISTART(I) and IEND(I) (I ≤ NGROUP) contain the start abscissa value and end abscissa value, respectively, for the Ith energy range.

9. If the rate summary tape is not yet mounted, the volume specified by DTAPES is mounted with DSNAME appropriate to the satellite as specified by HSID. MOUNT (a part of the FTIO package) is called to accomplish this purpose. The tape is positioned such that the ordinal number of the record which will be read next is NRECB.

10. If the SD4060 data set is not yet open: it is opened and the mode array AMODE initialized by a call to MODESG (part of the SC4060 package); SETSMG is called to inform the SC4060 package that coordinates in calls to routines in this package will be absolute

integer raster coordinates; QOPEN is set to show that the 4060 data set is now open.

11. Until an alternate return is executed from PFDXPD, or an error return executed from PFDCYL, the following sequence is executed:

A. PFDXPD is called to extract data, and to compute fluxes and associated errors for a plot interval. On normal return, array RATE contains (in the first NGROUP four-word entries) the results of computation. Each four-word entry has the following structure:

Word	Type	Description
1	R*4	Flux
2	R*4	Error in flux
3	R*4	0
4	I*4	0 (= 96 if data is missing/padded)

Return 1 - signals that all the data for this plot period has been processed

Return 2 - signals that an end of file was detected (this should not occur)

Return 3 - signals that an I/O error was encountered

B. If a listing of fluxes was required, PFDLG is called to generate listings (the list feature is currently not implemented).

C. PFDCYC is called to compute absolute raster ordinates corresponding to the flux, flux plus error, and flux minus error. PFDCYC returns ordinates via array IRATE. There is a

four-word entry corresponding to each energy range. The structure of the entry is as follows:

Word	Type	Description
1	I*4	Ordinate corresponding to flux plus error
2	I*4	Ordinate corresponding to flux minus error
3	I*4	Ordinate corresponding to flux
4	I*4	0 (= 96 if data is missing/padded)

D. If autoscaling is required, PFDCYL is called to compute the location of ordinate grid lines and the labels for the ordinate. If autoscaling is not in effect, then this has been done already.

E. PFDSDG is called to plot the data, label the axis, and draw the grids.

12. The SD4060 data set is closed by a call to EXITG. A message giving the number of frames generated and signaling end of job is printed.

SECTION 3 - SUBROUTINES FOR INPUT ANALYSIS

3.1 SUBROUTINE PFDPIA

PFPDPIA is called by PFDISP to perform the following functions:

1. Reads in a plot request from logical unit 15 via NAMELIST PLOT.
2. Formats and writes, on logical unit 14, specified or implied values of parameters in NAMELIST PLOT.
3. Reads round trip light times corresponding to desired ID.[1]
4. Reads the status of the rate summary in which data to be plotted will be found.
5. Verifies that requested plots can be produced by the program.
6. If the requested plots (or a subset thereof) can be produced, computes the range of rate summary records to be processed, and determines the number of summary intervals contained in a plot interval.

Calling Sequence

CALL PFDPIA (&ALT1, &ALT2)

Interface

Input

- Via COMMON Area PLOT

Variable	Type	Description
NGROUP	I*4	Number of energy ranges. This variable contains zero on first call to this routine, and a nonzero positive number on all subsequent calls

[1] Round trip light times are not used in the current version of the program.

- Via I/O Operations

Logical Unit	Description
15	NAMELIST PLOT, which describes a plot request, is read from the input data set referenced by FT15F001. Description of NAMELIST variables is provided in User's Guide
20	Referenced if specified ID is 'F'
30	Referenced if specified ID is 'G'

Data sets referenced by these units define round trip light times. This data set contains three records each of length 1820 bytes (RECFM=F, BLKSIZE=1820). If these records are read into contiguous locations in core, following structure obtains

Variable	Type	Description
HSATID	I*2	Satellite ID (EBCDIC)
HDSTAR	I*2	n (described below)
RTLT	R*4	Array of real numbers

Number n is such that round trip light time for relative modified Julian day (RMJD) given by RTLT (MJD-n). Thus, n is (RMJD of satellite launch-1)

8	Referenced if satellite ID is 'F' and special summary data is desired
9	Referenced if satellite ID is 'F' and special summary data is desired
18	Referenced if satellite ID is 'G' and standard summary data is desired (QSPEC=.FALSE.)
19	Referenced if satellite ID is 'G' and special summary data is desired

Data sets defined by these units are rate summary status data sets. These are created by Rate Summary Program or Rate Summary Merge Program. Only first record of these data sets is required. For format of this record, see Rate Summary Program

Output

- Via Alternate Returns

Return	Description
1	Indicates that an end of file was encountered on logical unit 15, and that at least one plot request has been processed
2	Indicates that an error condition exists, which is identified in a message on logical unit 14

- Via COMMON Area PLOT

Variable	Type	Description
DTAPES	A8	Serial number of volume on which rate summary data resides
HSID	A2	Satellite ID of current request
INTHR	I*4	Same as variables in NAMELIST PLOT (see User's Guide)
INTMIN	I*4	
INTSEC	I*4	
QSCALE	L*4	
QLIST	L*4	
RMAX	R*4	Same as variable RHI in NAMELIST PLOT
RMIN	R*4	Same as variable RLO in NAMELIST PLOT
HDPART	I*2	Same as variable IDPART in NAMELIST PLOT
QSMLOG	L*4	Same as variable QSEMI in NAMELIST PLOT
NRECB	I*4	Ordinal number of rate summary record with which processing is to begin
NRECE	I*4	Ordinal number of rate summary record with which processing is to end
LOOP	I*4	Number of summary intervals contained in a plot interval

Variable	Type	Description
JFRAME	I*4	Frame counter for current plot period (set to 0)
NFRAME	I*4	Line count for listing of frame summary (set to 58)

- Via I/O Operations

Logical Unit	Description
14	Processing messages and error messages are written on this unit

Subroutines Called

Subprogram	Description
MSTOT	Called to convert millisecond of day to hour, minute, second, and millisecond
DRMJD	Called to convert year, month, and day to relative modified Julian day (RMJD)
RMJDD	Called to convert RMJD to year, month, and day
FREAD	Called to read a record (FTIO)
UNLOAD	Called to close a data set opened by FTIO routines

Procedure

1. Default values are assigned to NAMELIST variables (for a list of default values, see User's Guide), and variables JFRAME and NFRAME are assigned values to reflect the beginning of a new plot period.
2. A plot request is read via NAMELIST PLOT from logical unit 15.
3. If read was successful, the following processes take place:
   A. Specified or implied description of the request is decoded, formatted, and written on logical unit 14.

B. Round trip light times are read from the logical unit appropriate to the satellite ID. If an unexpected end of file or an I/O error is detected, error return (RETURN 2) is taken.

C. Status of the rate summary is read, and it is verified that the requested plot interval is an integral multiple of the summary interval. If it is not, the current request is ignored.

D. Ordinal number of the first record (on the rate summary tape) on plot interval boundary and the ordinal number of the last record that completes a plot interval are computed.

E. Requested begin time is examined. If this time is earlier than the first record on plot interval boundary, begin time is set equal to the time of this record. The ordinal number of the first record to be processed is computed and stored in NRECB.

F. Requested end time is examined. If this time is later than the last record that completes a plot interval, the end time is set equal to the time of this record. The ordinal number of the last record to be processed is computed and stored in NRECE.

G. A RETURN is executed.

4. If variable NGROUP is zero, indicating that this is the first time the routine was called, error return (RETURN2) is taken; otherwise, RETURN1 is taken. Note that other error conditions resulting in RETURN2 are:

A. Round trip light time data set not appropriate to ID.

B. End of file on round trip light time data set.

C. I/O error on round trip light time data set.

D. Status data set not appropriate to ID.

E. End of file on status data set.

F. I/O error on status data set.

G. Begin time or end time not specified.

H. No overlap between plot period and the data on the summary tape.

3.2 SUBROUTINE PFDRIA

PFDRIA is called once during an execution of PFDISP. PFDRIA reads and verifies the input rates informaion, stores the location of rates requested by energy range, and computes certain quantities for use by PFDXPD.

Calling Sequence

CALL PFDRIA (&ALT1)

Interface

Input

- Via Logical Unit 50

  One record is read from logical unit 50 into COMMON area TABLE. The format of this record is as follows:

Variable	Type	Description
TTAB	R*4	Array containing threshold energy for each of 157 rates
CTAB	R*4	Array containing ceiling energy for each of 157 rates
FTAB	R*4	Array containing geometry factors for each of 157 rates

- Via Logical Unit 5

  Records are read from this unit under format control. The format of a record (card) is as follows:

Column	Format	Variable	Description
1-8	(A8)	D1	Rate mnemonic for first rate
11-18	(A8)	D2	Rate mnemonic for second rate (blank)
21-30	(F10.0)	T1	Threshold for first rate

Column	Format	Variable	Description
31-40	(F10.0)	T2	Threshold for second rate; ceiling for first rate
41-50	(F10.0)	FACT	Geometry factor

Values T1, T2, and FACT need not be specified if they are present in the COMMON area TABLE.

- Via COMMON Area RTAB

  This table contains rate mnemonics (Section).

Output

- Via Alternate Return

Return	Description
1	Signals that either only two energy ranges were specified, or more than three input cards were ignored because insufficient information was available

- Via COMMON Area PLOT

Variable	Type	Description
D	R*8	Dimensioned array (2, 50) D(1, J), rate mnemonic corresponding to first rate D(2, J), rate mnemonic corresponding to second rate
THRESH	R*4	Dimensioned array (2, 50) THRESH(1, J), threshold of Jth energy range THRESH(2, J), ceiling of Jth energy range
GFACTR	R*4	GFACTR(J) is geometry factor for Jth energy range

Variable	Type	Description
INDEX	I*4	Dimensioned array (2, 50) INDEX(1, J), index in array DREG (COMMON area RTAB) corresponding to first rate that defines Jth energy range INDEX(2, J), index in array DREG corresponding to second rate, if any; zero if only one rate
FDIV	R*4	FDW(J) = (THRESH(1, J) - THRESH(2, J) * GFACTR(J)
NGROUP	I*4	Number of energy ranges defined by input data
QCHAR	L*1	Character array QCHAR(J) contains character associated with Jth energy range

Procedure

1. The table containing thresholds and ceiling energy values is read from logical unit 50 into COMMON area TABLE. If read is unsuccessful, it is assumed the table does not exist. Each entry in the table is set equal to -1 to reflect this situation.

2. IGNORE, the variable that contains the number of input cards ignored due to error, or insufficient information is initialized to 0. NGROUP is initialized to 0.

3. Until an end of file is detected on logical unit 5, the following processing is performed:

   A. A card is read from logical unit 5. If D1 is blank, the card is ignored; otherwise, array DREG is searched until D1 is found in the table. If D1 is not found, a message is written on logical unit 4, and the card is ignored; otherwise, the index corresponding to D1 is stored in local variable I1. If the threshold (T1) is either specified or available in the table,

processing continues; otherwise, an appropriate message is written, and the card is ignored.

B. When the second rate mnemonic (D2) is blank, then if the ceiling energy T2 is either specified or available in the table, the card is accepted; otherwise, it is ignored.

C. When the second rate mnemonic is not blank, then:

(1) If the rate is not in the table DREG, the card is ignored.

(2) If the rate is in the table, and the threshold (T2) is either specified or available in table TTAB, the card is accepted.

D. If the geometry factor (FACT) is neither specified nor available in the table FTAB, then the card is ignored.

E. In case there are two rates, but they do not belong to the same telescope, the card is ignored. Whether or not they belong to the same telescope is determined by comparing the character codes corresponding to the two rates. The character codes are stored in the local array CHART.

F. The counter NGROUP is updated, and the verified data regarding this energy range is stored in arrays in COMMON area PLOT.

4. If more than two cards are ignored, or less than three cards are accepted, alternate return 1 is taken; otherwise, verified information is formatted and written are on logical unit 14, and a normal return is taken.

Data Constants

Variable	Type	Description
CHART	L*1	Character array dimensioned 157. CHART(I) array contains: Character □, rate corresponding to Ith mnemonic in table DREG belongs to LET-II Character ×, rate corresponding to Ith mnemonic in table DREG belong to LET-I Character +, rate corresponding to Ith mnemonic in table DREG belongs to HET

3.3 SUBROUTINE PFDXPD

PFDXPD is called by PFDISP to extract data from the rate summary data set for all the energy ranges for the current plot interval, and to compute fluxes and associated errors.

Calling Sequence

CALL PFDXPD (RATE, &ALT1, &ALT2, &ALT3)

Interface

Input (on Call)

- Via COMMON Area PLOT

Variable	Type	Description
MSINT	I*4	Summary interval (milliseconds)
NRECE	I*4	Ordinal number of last summary record to be processed
JREC	I*4	Ordinal number of last summary record processed
NLOOP	I*4	Number one less than number of summary intervals in a plot interval
INDEX	I*2	Dimensioned array (2, 50) INDEX(1, J), index in array ICOUNT (COMMON area SUMREC) corresponding to first or only rate that defines Jth energy range INDEX(2, J), index in array ICOUNT corresponding to second rate that defines Jth energy range. If a single rate defines energy range, INDEX(2, J) = 0
FDIV	R*4	Array Jth element of which is product of energy range and geometry factor for Jth energy range
NGROUP	I*4	Number of energy ranges

Input (Via I/O Operations)

Logical unit 10--Rate summary records are read into COMMON area SUMREC. For a description of various fields in COMMON area SUMREC, see Section .

Output

- Via Calling Parameters

Variable	Type	Description
RATE	R*4	Array which contains NGROUP four-word entries, one entry for each energy range. Array can be considered to be dimensioned (4, 50) RATE(1, J), flux for Jth energy range RATE(2, J), error associated with flux for Jth energy range RATE(3, J), 0 RATE(4, J), 0 if data is not padded or missing; Z60 if data is padded or missing

Subroutines Called

Subroutine	Description
ADDREC	Called to add counts and accumulation times for rates from NLOOP summary records to counts and accumulation times in area SUMREC
FINIT	Called to initialize array RATE

- Via Alternate Returns

Return	Description
1	Signals end of plot period
2	Signals that unexpected end of file was detected while reading rate summary data
3	Signals that I/O error was encountered while reading rate summary data

- Via COMMON Area SUMREC

  This area contains the description of the plot interval as well as accumulated counts and accumulation times. Only the description of the plot interval is used after return from this routine, however.

Procedure

1. JREC is incremented by 1, and it is determined whether the record to be read next is to be processed. If this record is not to be processed, alternate return 1 is executed.

2. A rate summary record is read into COMMON area SUMREC.

3. Variable NLOOP is examined to determine whether data from more summary records is needed to complete this plot interval. If more data is needed, ADDREC is called to accumulate counts and accumulation times from NLOOP records for each of the 157 counters.

4. FINIT is called to initialize the array RATE. FINIT sets each element of the array equal to true zero.

5. For each of the NGROUP energy ranges, the following processes are performed:

   A. Index corresponding to the first (or only) rate is obtained from array INDEX. The counts and accumulation times are obtained from the arrays ICOUNT and ACTIME, respectively. If the count is nonzero, the rate and error are computed. If the count is zero, but the accumulation time is nonzero, then the entry in array RATE need not be altered. If both count and accumulation time are zero, this is the case of missing or padded data. In this case, the fourth word of the entry in the array RATE is set equal to variable BLANK (Z60).

B. If the index corresponding to the second rate is nonzero, step A is repeated for this rate, except when the count is zero, but accumulation time is nonzero. This case is treated like the case of one rate only.

C. If the first rate is less than the second rate, the difference between them is made zero. The entry for this energy range need not be modified in this case. Otherwise, the flux is computed by dividing the difference between the two rates by the appropriate element of array FDIV (COMMON area PLOT), and the error in the flux is obtained by dividing square root of the sum of squares of the errors in the two rates by the appropriate element of FDIV.

D. In this case, the flux is obtained by dividing the rate by the appropriate element of FDIV, and the error is obtained by dividing the error by the same element of FDIV.

Data Constants

Flag	Description
Z60	Indicates missing or padded data

SECTION 4 - SUBROUTINES FOR DATA PLOTTING

4.1 SUBROUTINE PFDCXC

PFDCXC is called by PFDISP to compute the absolute raster abscissa of the start and end of each of the energy ranges.

Interface

Input

- Via Arguments in Call

Variable	Type	Description
THRESH	R*4	Array containing start and end of each NGROUP energy range
NGROUP	I*4	Number of energy ranges
QSMLG	L*4	Logical variable indicating whether semi-log scaling is to be performed

Output

- Via Arguments in Call

Variable	Type	Description
ISTART	I*4	Array ISTART(I) is integer absolute raster abscissa corresponding to start of Ith energy range
IEND	I*4	Array IEND(I) is integer absolute raster coordinate corresponding to end of Ith energy range

Subroutines Called

ALOG10

Procedure

1. For logarithmic scaling (QSMLG = .FALSE.)--The energy range 0.1 to 100 MeV is mapped onto the abscissa region (236, 3836). Thus, the abscissa corresponding to energy E $(0.1 \leq E \leq 100)$ is given by

$$236 + \log_{10}\left(\frac{E}{0.1}\right) * \frac{(3836 - 236)}{\log_{10}\left(\frac{100}{0.1}\right)}$$

$$= 236 + (\log_{10}(E) - (-1) * 1200$$

$$= 1436 + \log_{10}(E) * 1200$$

2. For linear scaling (QSMLG = .TRUE.)--The energy range 0 to 24 MeV is mapped onto the abscissa region (236, 3836). Thus, the abscissa corresponding to energy E $(0 \leq E \leq 24)$ is given by

$$236 + \frac{3600}{24} E = 236 + 150 E$$

4.2 SUBROUTINE PFDCYC

PFDCYC is called by PFDISP to obtain from the given flux and error the absolute integer raster ordinate of flux plus error, flux minus error, and flux.

Calling Sequence

CALL PFDCYC (RATE, IRATE, RHIGH, RZERO, QSCALE, NGROUP)

Interface

Input

- Via Call

Variable	Type	Description
RATE	R*4	Array containing flux and error in first two words of each four-word entry. There is one four-word entry for each energy range
RHIGH	R*4	Upper limit of ordinate
RZERO	R*4	Lower limit of ordinate
QSCALE	L*4	QSCALE = .TRUE., scaling according to maximum and minimum value of data received QSCALE = .FALSE., scaling according to RHIGH and RZERO
NGROUP	I*4	Number of energy ranges for which array RATE contains fluxes and errors

Output

- Via Arguments in Call

Variable	Type	Description
IRATE	I*4	Array containing NGROUP four-word entries in following format: Word 1--ordinate (raster) of flux plus error Word 2--ordinate (raster) of flux minus error Word 3--ordinate (raster) of flux Word 4--not used
RHIGH	R*4	Upper limit of ordinate (QSCALE = .TRUE.) unchanged from initial value (QSCALE = .FALSE.)
RZERO	R*4	Lower limit of ordinate (QSCALE = .TRUE.) unchanged from initial value (QSCALE = .FALSE.)

Procedure

This subroutine performs essentially the same function as PRDCYC described in Section . The decisions having to do with QPRNTR do not apply here.

4.3 SUBROUTINE RESET

Given RMAX and RMIN, RESET determines IRMAX and IRMIN such that:

1. If RMAX(RMIN) < 1 , then IRMAX(IRMIN) is the largest integer; thus, $10^{IRMAX(IRMIN)} \leq RMAX(RMIN)$

2. If RMAX(RMIN) ≥ 1 , then IRMAX(IRMIN) is the smallest integer; thus, $RMAX(RMIN) \leq 10^{IRMAX(IRMIN)}$

The given values of RMAX and RMIN are replaced by 10^{IRMAX} and 10^{IRMIN}, respectively.

Calling Sequence

CALL RESET (RMAX, RMIN, IRMAX, IRMIN)

Interface

Received From Calling Program

RMAX, RMIN R*4

Returned to Calling Program

IRMAX, IRMIN I*4

RMAX, RMIN R*4

4.4 SUBROUTINE PFDSDG

PFDSDG is called by PFDISP to plot data for the current plot interval. It calls routines that generate the grid and label the axes, generates title for the plot, and plots the data.

Calling Sequence

CALL PFDSDG (AMODE, IRATE, ISTART, IEND)

Interface

Input (on Call)

- Via Arguments in Call

Variable	Type	Description
AMODE	R*4	Mode set array used for calls to 4060 routines
IRATE	I*4	Array containing ordinates in format described under PFDCYC
ISTART	I*4	Array of which Ith element contains abscissa corresponding to start of Ith energy range
IEND	I*4	Array of which Ith element contains abscissa corresponding to end of Ith energy range

- Via COMMON Area PLOT

Variable	Type	Description
HSID	I*2	Satellite ID used to label plot
INTHR	I*4	Describe plot interval; used to label plot
INTMIN	I*4	
INTSEC	I*4	
IFRAME	I*4	Frame counter for job; contains number of frames generated so far in this job

Variable	Type	Description
JFRAME	I*4	Frame counter for current plot period
NGROUP	I*4	Number of energy ranges to be plotted
QCHAR	I*1	Character array of which Ith element contains character that identifies source of data (i.e., LET-I, LET-II, or HET) for Ith energy range
HDPART	I*2	Index associated with particle
QSEMI	L*4	Determines whether semi-log or log-log plot is to be generated

Output

- Via COMMON Area PLOT

Variable	Type	Description
IFRAME	I*4	Updated aggregated frame count
JFRAME	I*4	Updated count of number of frames for this period

- Via I/O Operations

Calls to subroutines PFDLAY, PFDXLL (or PFDXSL), SETSMG, SEGMTG, LEGNDG, LINESG, TEXTG, and PAGEG result in meta-language instructions being written to the SD4060 output data set.

- Via COMMON Area SUMREC

Variable	Type	Description
HYRC	I*2	Year
HMONC	I*2	Month
HDAYC	I*2	Day
HHRC	I*2	Hour
HMINC	I*2	Minute
HSECC	I*2	Second

Define current plot interval

Procedure

1. Call PFDXSL if semi-log plots are indicated (QSEM1 = . TRUE.); otherwise, call PFDXLL to draw vertical grid lines and abscissa labels.

2. Call PFDLAY to draw horizontal grid lines and ordinate labels.

3. Convert the time of the plot interval (fields HYRC through HSECC in COMMON area SUMREC) into EBCDIC characters; convert plot interval description INTHR, INTMIN, and INTSEC to EBCDIC character, and write the title.

4. Write legends along the abscissa and ordinate.

5. For each of the NGROUP energy ranges, perform the following processes:

   A. If the padded data is indicated by the fourth word of entry corresponding to this energy range in the array IRATE, skip this energy range.

   B. If the data is not padded, plot the character appropriate to the range (obtained from array QCHAR) at the coordinate

$$\left(\frac{\text{ISTART(I)} + \text{IEND(I)}}{2}\ ,\ \text{IRATE(3, I)}\right)$$

   C. If the energy range > 60 rasters, draw a line from (ISTART(I), IRATE(3, I)) to

$$\left(\frac{\text{ISTART(I)} + \text{IEND(I)}}{2} - 30\ ,\ \text{IRATE(3, I)}\right)$$

and from

$$\left(\frac{\text{ISTART(I)} + \text{IEND(I)}}{2} + 30 \ , \ \text{IRATE(3, I)}\right)$$

to (IEND(I) , IRATE(3, I)) .

6. Draw all error bars; the error bar is the line drawn from

$$\left(\frac{\text{ISTART(I)} + \text{IEND(I)}}{2} \ , \ \text{IRATE(2, I)}\right)$$

to

$$\left(\frac{\text{ISTART(I)} + \text{IEND(I)}}{2} \ , \ \text{IRATE(1, I)}\right)$$

7. Increment frame counters and advance the frame.

4.5 SUBROUTINE PFDXSL

PFDXSL is called by PFDSDG to draw vertical grid lines and to label the abscissa.

Interface

Input

- Via Call

Variable	Type	Description
AMODE	R*4	Mode set array

Output

- Via Arguments

Variable	Type	Description
AMODE	R*4	Mode set array (not altered)

- Via I/O Operations

Routines SETSMG, SEGMTG, and LEGNDG are called to write meta-language instructions for drawing grid lines and plotting labels on the SC4060 output data set.

Data Constants

Variable	Type	Description
LABEL	I*4	Array containing labels to be written along abscissa
LABX	I*4	Array containing locations of labels (raster coordinates)
LIGHT	I*4	Abscissa of light internal grid lines
LDARK	I*4	Abscissa of accented grid lines

Variable	Type	Description
ISTART	I*4	Array of which all elements equal ordinate of orgin of plot (raster coordinates)
IEND	I*4	Array of which all elements equal to ordinate of topmost horizontal grid line

Literals

Literal	Description
13	Number of accented grid lines
36	Number of light grid lines
170	Ordinate of horizontal line where labels are written
18	Number of abscissa labels
30	In call to SETSMG; mode set for changing line thickness
0.5	In call to SETSMG; to set line thickness to one-half normal
94	In call to SETSMG; mode set for changing line density
1.0	In call to SETSMG; to set line density to light

4.6 SUBROUTINE PFDXLL

PFDXLL is called by PFDSDG to draw vertical grid lines and to label abscissa for log-log plots. This subroutine is very similar to PFDXSL, the only differences being in data constants and literals. The differences are as follows:

4--Number of accented grid lines

24--Number of light grid lines

22--Number of abscissa labels

4.7 SUBROUTINE PFDCYL

PFDCYL is called by PFDISP, and performs the following functions:

1. Verifies that the ordinate limits provided by arguments in the call be between 10^{-9} and 10^{9}.
2. Computes ordinates where grid lines are to be drawn.
3. Computes ordinates where labels are to be written.

Interface

Input

- Via Parameters

Variable	Type	Description
RMAX	R*4	Upper limit of ordinate
RMIN	R*4	Lower limit of ordinate

- Via Call

Variable	Description
RMAX	Upper limit of ordinate adjusted to decade boundary
RMIN	Lower limit of ordinate adjusted to decade boundary
IRMAX	Log_{10} (RMAX)
IRMIN	Log_{10} (RMIN)

Output

- Via Internal Variables for Use by Entry Point PFDLAY

Variable	Type	Description
NCYCLE	I*4	Number of cycles along ordinate
NYLAB	I*4	Integer array dimensioned (20, 20) NYLAB(1, I), ordinate of labels $1 \leq I \leq$ NCYCLE + 1 and accented lines NYLAB(J, I), ordinate of light interval grid lines $2 \leq J \leq 9$, $1 \leq I \leq$ NCYCLE
IRMIN	I*4	Log_{10} (RMIN)

Note that RMAX and RMIN are not altered if they are already on decade boundary.

4.8 SUBROUTINE PFDLAY

PFDLAY is an entry point in subroutine PFDCYL. PFDLAY is called by PFDSDG to label the Y-axis of the plot and to draw horizontal grid lines.

Interface

Input

- Via Calling Program

Variable	Type	Description
AMODE	R*4	Mode set array for calls to 4060 routines

- Via Internal Variables

Variable	Type	Description
NCYCLE	I*4	For description, see PFDCYL
NYLAB	I*4	
IRMIN	I*3	

Output

- Via I/O Operations

Subroutines SETSMG, SEGMTG, LINESG, and TEXTG are called to write meta-language instructions for drawing grid lines and plotting labels on the SC4060 output data set.

Data Constants and Literals

Variable	Type	Description
DXLAB	R*8	Array containing labels which are coded for raising and lowering of carriage by use of control character '$+'. DXLAB(I) contains label corresponding to 10^{I-10}

Variable	Type	Description
NCHAR	I*4	Array of which Ith element contains number of characters in label DXLAB(I)
NX	I*4	Array of which Ith element contains abscissa where DXLAB(I) is to be written
ISTART	-	Abscissa of leftmost vertical grid line (set to 236)
IEND	-	Abscissa of rightmost vertical grid line (set to 2836)
200.	R*4	Ordinate of origin (rasters)
2700.	R*4	Extent of ordinate (rasters)
1. E09	-	Maximum value of RMAX allowed
1. E-9	-	Minimum value of RMIN allowed

SECTION 5 - PIONEER FLUX DISPLAY PROGRAM

The Pioneer Flux Display Program is designed to produce averaged flux versus energy plots. The fluxes are computed by obtaining from the rates summary data counts per second for specified rates (or rate pairs) and dividing the counts per second (or difference between the counts per second corresponding to each rate in the pair) by the energy range and the geometry factor. The flux may be averaged over an integral number of summary intervals.

As presently available, the rate or pairs of rates to be used to compute fluxes must be specified to the program. A parameter that identifies the particle whose flux is to be plotted is also required. In the current version, no checks are made to ensure that the rates specified are compatible with the particle. The plots may be made on the log-log or semi-log scale. Further, one may either have a fixed scale along the ordinate, or have the program scale the ordinate based on values of fluxes encountered. In the present version of the program, neither listings of fluxes nor printer plots can be generated.

The current version of this program references a table to find the threshold, ceiling energy (cut off energy), or geometry factor that was not specified as input. If the value is not available in the table, a message is printed and the input card is ignored. Suffice it to say here that the values specified on the parameter cards override the values in the table.

5.1 LOCATION AND RESOURCE REQUIREMENTS

The main control section for this program resides in the library K3. ZBMTW. SB001. OPIOMISC. Other load modules (nonexecutable) can be obtained from the following libraries:

K3. ZBMTW. SB001. OPIOMISC

K3. ZB2NL. SB001. PIORDISP

SYS2.SC4060

SYS1.FORTLIB

SYS2.FORTLIB

An executable load module currently exists on the data set MMLOAD under the member name ZB2NLPFD.

The program requires approximately 200K of main storage, a 9-track tape unit, and a 7-track tape unit. It requires approximately one-half minute of CPU and 1 minute of I/O time (when executed from the executable load module).

5.2 DATA SETS REFERENCED

Data Set	Description
FT04F001	Defines output data set containing informational messages regarding rate thresholds and geometry factors. This is usually directed to a line printer (SYSOUT = A). If printout is not desired a DD DUMMY statement may be used
FT08F001	Defines rate summary status data set, whose satellite ID attribute is F. This data set is referenced when there is at least one request for plots from standard summary for Pioneer-F. This data set must have been created by Rates Summary Program or Rates Summary Tape Merge Program. If data set is cataloged, only data set name and DISP = OLD or DISP = SHR need be specified. Otherwise, UNIT and VOL parameters are required (INPUT)
FT09F001	Defines rate summary status data set, whose satellite ID attribute is F. This data set is referenced when there is at least one request for plots from special summary for Pioneer F. Comments made under FT08F001, regarding creation and information required to define this data set, apply here also (INPUT)

Data Set	Description
DT10F001	Defines rate summary data set. Following information should be specified: UNIT = (9TRACK,,DEFER), DSNAME = anyname1, VOL = SER = anyname2, DISP = SHR, DCB = BUFNO = 1 Anyname1 and anyname2 are overridden by program and replaced by names appropriate to plot requests (INPUT)
FT14F001	Defines output message data sets, normally directed to line printer (SYSOUT = A). Program processing and error messages appear on this data set. Following DCB parameters should be specified: RECFM = VBA, LRECL = 137, BLKSIZE = 1100, BUFNO = 1 (A larger block size may be specified, if core is available)
FT15F001	Defines input data set, which contains plot requests. This is usually included in input stream (DD *). For a description of input formats, see Section 5.3.1
FT18F001	Defines rate summary status data set, whose satellite ID attribute is G. This data set is referenced when there is at least one request for plots from standard summary for Pioneer-G (see also description of FT08F001)
FT19F001	Defines rate summary status data set whose satellite ID attribute is G. This data set is referenced when there is at least one request for plots from special summary for Pioneer-G (see also description of FT08F001)
FT20F001	Defines round trip light times data set for Pioneer-F. This data set is created by Pioneer Round Trip Light Times Generator Program
FT30F001	Defines round trip light times data set for Pioneer-G. This data set is created by Pioneer Round Trip Light Times Generator Program

Data Set	Description
SC4060ZZ	Defines output tape data set that contains plots coded for representation on SD4060 microfilm plot apparatus. This data set is not required if no 4060 plots are requested. In this event, code: DUMMY If 4060 plots are requested, following information is needed: UNIT = 7TRACK, LABEL, DISP = (NEW,KEEP), DCB = (DEN = 1, TRTCH = C, RECFM = F, BLKSIZE = 240), VOL. Volume specified should be nonlabeled (NL) and LABEL parameter should specify NL or BLP
FT05F001	Defines input data set which describes rates associated thresholds to be plotted and/or listed in this execution of program. This is usually included in input stream (DD *). See Section 5.3.2
FT50F001	Defines data set containing tables of threshold energy, ceiling energy, and geometry factors. If cataloged, only DSNAME and DISP parameters need be specified; otherwise, VOL and UNIT should also be input. This may be defined as a dummy data set (DD DUMMY) if all required threshold and geometry factors are input in FT05F001

5.3 PARAMETER CARDS

5.3.1 Describing Required Plots

The plot period, plot interval, and attributes of the rates summary where data to be plotted resides, as well as the scaling parameters for the plots required, are described to the Pioneer Flux Display Program via NAMELIST PLOT on FORTRAN logical unit 15 (ddname FT15F001).

The first column of each card in this data set must be blank. Specification of each request begins on a new card which must contain the sequence of characters &PLOT in columns 2 through 6. This sequence of characters must be followed by at least one blank, followed by data items separated by commas.

As many cards as are necessary to specify a request may be used. The end of a request specification is indicated by the character string &END. The form of data items is given below. The underlined keywords and equal signs (=) must be written as shown.

5.3.1.1 Plot Interval

The plot interval (averaging time) is specified by the following data items:

INTHR = inthr, where inthr is an integer equal to number of whole hours contained in a plot interval (defaults to 1).

INTMIN = intmin, where intmin is an integer equal to number of whole minutes in plot interval-inthr (defaults to 0).

INTSEC = intsec, where intsec is an integer equal to number of seconds in plot interval-inthr hours-intmin minutes (defaults to 0).

The interval specified must be an exact multiple of the summary interval of the summary specified by the HID and QSPEC parameters.

5.3.1.2 Plot Period

The plot period, or the time span for which plots are to be produced, is specified by the following data items:

HTB = { iyr, imon, iday
iyr, imon, iday, ihr
iyr, imon, iday, ihr, imin
iyr, imon, iday, ihr, imin, isec

where iyr = two-digit year of first plot interval to be processed

imon = integer equal to month of first plot interval to be processed

iday = integer equal to day of month of first plot interval to be processed

ihr = integer equal to hour of day corresponding to first plot interval to be processed

imin = integer equal to minute of hour corresponding to first plot interval to be processed

isec = integer equal to second of hour corresponding to first plot interval to be processed

Anyone of the four forms above can be used to specify begin time. ihr, imin, and isec default to 0.

The following data items specify the time of the plot interval up to which processing is to continue, i.e., the processing is to stop after the plot interval immediately preceding the processed time specified by HTE:

$$\underline{\text{HTE}} = \begin{cases} \text{iyr, imon, iday} \\ \text{iyr, imon, iday, ihr} \\ \text{iyr, imon, iday, ihr, imin} \\ \text{iyr, imon, iday, ihr, imin, isec} \end{cases}$$

where the definitions of iyr, imon, iday, ihr, imin, and isec are identical to those described above.

5.3.1.3 Summary Attributes

The following data items describe the attributes of the summary from which summary data is to be obtained. These attributes point to a status data set which points to the summary from which data is to be obtained:

HID = 'F', QSPEC = .TRUE. points to status data set defined by ddname FT09F001. (Pioneer-F data from special summary required.)

HID = 'F' or HID = 'F', QSPEC = .FALSE. points to status data set defined by ddname FT08F001. (Pioneer-F data from standard summary required.)

HID = 'G', QSPEC = .TRUE. points to status data set defined by ddname FT19F001. (Pioneer-G data from special summary required.)

HID = 'G' or HID = 'G', QSPEC = .FALSE. points to status data set defined by ddname FT18F001. (Pioneer-G data from standard summary required.)

NOTE: If HID is omitted, it defaults to 'F' for the first request and to the HID specified or assumed for the request immediately preceding this request.

5.3.1.4 Displays

Formatted Listings--If formatted listings of rates are desired, specify QLIST = .TRUE.. If QLIST specification is omitted, no listings are produced.

5.3.1.5 Plot Ordinate Scaling

The ordinate scaling of plots can be specified by the following data items:

QSCALE = .TRUE.	Specifies that autoscaling is to be in effect for this plot period. Ordinate scale will be determined from maximum and minimum values in each frame.
QSCALE = .FALSE.	Specifies that plots will be scaled along ordinate according to maximum and minimum values specified by data items RHI and RLO, respectively; this is default
RHI = r_1	r_1 is maximum value of ordinate for scaling, and must be specified if QSCALE = .FALSE.
RLO = r_2	r_2 is minimum value of ordinate for scaling, and must be specified. If QSCALE = .TRUE., and an entire frame is padded, all fluxes are set equal to this value

5.3.1.6 Plot Abscissa Scaling

QSEMI = .TRUE. Implies that abscissa is to be scaled linearly

QSEMI = .FALSE. Implies that abscissa is to be scaled logarithmically

5.3.1.7 Particle Identification

The following data item defines the particle whose flux is to be plotted for this plot period. This input is for labeling purposes only, since the program makes no checks for consistency.

IDPART = 1 Plots will be labeled as electron fluxes

IDPART = 2 Plots will be labeled as proton fluxes

5.3.2 Describing Energy Ranges for Which Fluxes Are To Be Plotted

The energy ranges are described to the program via logical unit 5. Each energy range is described on a separate input card. The format of the input card is as follows:

Column	Description
1-8	Mnemonic of first rate that defines energy range (A8)
11-18	Mnemonic of second rate that defines energy range (A8). Blank if a single rate defines energy range
21-30	Threshold of first rate (F10.0) (blank)
31-40	Threshold of second rate (F10.0) if columns 11-18 are nonblank. Ceiling of first rate if columns 11-18 are blank (blank)
41-50	Geometry factor corresponding to first rate (F10.0) (blank)

Except for rate mnemonics, data not provided is obtained from the table described by logical unit 50.

SECTION 6 - PROGRAM ERROR MESSAGES

Following is a brief description of error messages from the Spectrum Plot Program, with likely causes and appropriate corrective measures listed:

1. END OF FILE DETECTED WHILE SKIPPING SUMMARY RECORDS OF SUMMARY TAPE xxxxxx. PROGRAM ERROR INDICATED.

   Cause: As stated.

   User Response: Save program output. Consult with a programmer.

2. AN I/O ERROR DETECTED WHILE SKIPPING RECORDS OF SUMMARY TAPE xxxxxx RUN TERMINATED. MESSAGE FOLLOWS, (message from FTIO printed here).

   Cause: As stated.

   User Response: Run job again. If error recurs, check FTIO manual and message printed to locate error. Tape will have to be copied replacing lost data.

3. NO RATE DESCRIPTIONS ON THE INPUT DATA SET - OR THREE OR MORE RATE CARDS WERE IN ERROR - OR TWO OR LESS CARDS WERE ACCEPTED.

   Cause: As stated.

   User Response: Check printout on logical unit 4 (FT04F001) for details of why cards were rejected. Make corrections indicated.

4. RTLT DATASET (UNIT xx) SHOULD HAVE BEEN APPROPRIATE TO THE ID x, BUT INSTEAD CORRESPONDS TO ID x. JOB TERMINATED.

   Cause: As stated.

User Response: Make sure that FT20F001 is F RTLT data set, and/or that FT30F001 is G RTLT data set.

5. END OF FILE DETECTED WHILE READING RTLT DATASET (UNIT xx). JOB TERMINATED.

   Cause: Data set specified on DD card has not been written to.

   User Response: Make corrections to DD card for specified unit. Make sure data set specified has been written to.

6. I/O ERROR DETECTED WHILE READING RTLT DATASET (UNIT xx). JOB TERMINATED.

   Cause: As stated.

   User Response: Rerun job. If error recurs, RTLT data set must be recreated.

7. STATUS DATASET DOES NOT CORRESPOND TO DESIRED S/C I.D. DESIRED I.D. WAS x, WHILE THE STATUS DATASET CORRESPONDS TO x. JOB TERMINATED.

   Cause: As stated.

   User Response: If desired ID was F, make corrections to FT08F001 and/or FT09F001 so that they define status data sets for data sets for Pioneer-F. If desired ID was G, make corrections to FT18F001 and/or FT19F001 so that they define status data sets for Pioneer-G.

8. BEGIN YEAR WAS NOT SPECIFIED. RUN IS TERMINATED.

   Cause: As stated.

   User Response: Correct period NAMELIST input card to specify HTB (start time).

9. END YEAR WAS NOT SPECIFIED. RUN IS TERMINATED.

Cause: As stated.

User Response: Correct period NAMELIST input card to specify HTE (end time).

10. BEGIN TIME IS LATER THAN END TIME. RUN IS TERMINATED.

Cause: As stated.

User Response: Make corrections to plot card.

11. AN I/O ERROR WAS DETECTED WHILE READING THE STATUS DATASET ON UNIT xx. RUN TERMINATED. (Message from FTIO printed here.)

Cause: As stated.

User Response: Rerun job. If data set was correctly specified and error recurs, status data must be recreated.

12. NO PERIOD CARD. JOB TERMINATED.

Cause: As stated.

User Response: Use NAMELIST PLOT to supply plot types desired and plot period to program.

13. THE GIVEN INTERVAL IS NOT AN EXACT MULTIPLE OF THE INTERVAL ON THE SUMMARY TAPE. REQUEST IGNORED.

Cause: The requested plot interval (the time between data points on the plot grid) is not an integral multiple of the summary intervals; or QSPEC = T was desired but not specified on the PLOT card or was specified when not desired and hence the wrong status data set was referenced.

User Response: Make corrections to requested plot interval, or, if already correct, change rates summary data set to one appropriate for this interval. The plot interval as specified on the NAMELIST PLOT card (INTHR, INTMIN, INTSEC) must be an exact multiple of the summary interval on the rates summary tape. For example, if the summary interval is 1 hour, the plot period specified must be at least 1 hour and may be any integral number of hours. Conversely, if the desired plot interval is 1 hour, the summary interval can be no greater than 1 hour, and must divide 1 hour.

14. END OF TAPE WHILE READING THE SUMMARY TAPE. PROBABLE PROGRAM ERROR, OR AN ERROR ON TAPE INDICATED. EXECUTION CONTINUING.

Cause: As stated.

User Response: Make sure JCL has a card saying //GO.SYSUDUMP DD SYSOUT = A. Adjust program jobname to obtain a dump and consult with a programmer.

15. I/O ERROR (message from FTIO printed here).

Cause: An I/O error was detected while reading the rates summary tape. Job is terminated.

User Response: Run job again. If error recurs, check FTIO manual for location of error and recreate bad record on tape.

16. END OF FILE DETECTED WHILE READING THE STATUS DATA-SET ON UNIT xx. RUN TERMINATED.

Cause: As stated.

User Response: If data set name is in error on DD card, correct it. Otherwise, status data set must be recreated.