A GENERAL FORTRAN COMPUTER PROGRAM FOR USE WITH THE IBM 2250 DISPLAY UNIT

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THESIS

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ABSTRACT

A General computer program was designed, using the FORTRAN IV language, to utilize the IBM 2250 Display Unit in conjunction with the IBM System/360 Operating System. The user may adapt an associated program so that it may be an integral part of this general program. The general program provides the user with the ability to display a static information array and an input data array. The user may insert input data, for his associated program, from on-line input devices or directly through the IBM 2250 alphameric keyboard and may change this data from the keyboard. The associated program may be executed repeatedly, subject to system time constraints, and both alphameric and graphical output data from the associated program may be displayed after each execution.

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I. INTRODUCTION

The use of visual display units associated with present generation computer systems creates a man-machine interface which allows the user to communicate directly with the computer, during the execution of his program. As a teaching aid, the use of a visual display unit affords the visual presentation of information to the student as it is being discussed and computational results may be graphically displayed immediately, while the information is fresh in his mind. In addition, with the ability to change data or alter sequences of operations, comparisons may be rapidly made between various options in a problem to determine which may be relevant or where further investigation is warranted.

The purpose of this thesis was to construct a general graphic display program for the IBM 2250 Display Unit. This equipment is associated with the IBM System/360 Operating System. This program is not limited in use as a teaching aid; its applicability may be extended to all situations where graphic display is desired.

This thesis presents one method of utilizing the IBM 2250 Display Unit through a General FORTRAN Program called GFP. The GFP was designed such that another associated computer program may be incorporated, through appropriate modifications, as an integral part of the GFP. The input and output data from the associated program and the associated program may then be displayed on the screen of the display unit and changes to the input data may be made using the graphic display unit keyboard.

The use of the GFP does not require that the user have previous practical experience with the IBM designed Graphic Subroutine Package; however, it is expected that he be familar with the general information concerning graphic programming services and the IBM 2250 as described in Ref. 2. It is to be remembered that this GFP is not a unique method for using the display unit, but only one possible aid for using this equipment. A person familar with graphic subroutines and functions could develop a graphic program suited exactly to the specific requirements of his problem, thereby making the best use of the capabilities of the display unit. This program, however, allows the relatively inexperienced user to take advantage of some of the capa-. bilities of the display unit, rather than none at all.

The associated program which was used during the development of the GFP, and is included in the GFP listing in Appendix C, is a minesweeper simulation program, written by Professor A. F. Andrus and Miss P. R. Hoang of the Naval Postgraduate School. The complete description of this example associated program is provided in Ref. 1. This associated program was modified both for use with the IBM System/360 Operating System and the GFP.

Chapter II provides a general description of the capabilities of the GFP, the graphic data sets, arrays, and the program function keyboard keys used. Chapter III presents the detailed instructions, using the GFP listing in Appendix C, for making an associated program compatible with the GFP. Chapter IV provides a possible chain of events during the execution of the GFP and describes the physical operations which occur.

II. DESCRIPTION OF THE GENERAL FORTRAN PROGRAM

The General Fortran Program was written in accordance with the instructions as specified in Refs. 2 and 3. The design of the IBM 2250 allows only for EBCDIC characters to be displayed on and read into the program from the screen of the Display Unit. Therefore, all data displayed on the screen must be in the A format. To overcome the obstacle of the input of numerical data and the display of numerical output data, computed by the associated program, a direct access disc storage device was utilized. This allows, with the use of input and output arrays, for an alphameric/numerical interface through appropriate read and write statements formatted for use with a direct access disc storage device. The DEFINE FILE statement in the GFP specifies direct access disc storage for this purpose.

A. CAPABILITIES OF THE GFP

In conjunction with an associated program, the GFP will allow the user to perform the following operations.

1. A specified array of information may be read into the GFP and displayed on the screen in 25-line pages.

2. The input data to be used by an associated program may be read into the GFP and displayed. This data will be displayed in 20-line pages. The user may also enter this data directly from the alphameric keyboard or modify data which was previously read.

3. The associated program may be executed and re-executed as desired, subject to system restrictions on total allowable execution time of the GFP.

4. A rectangular coordinate system grid may be displayed and labeled. The graphical data limits of the lines to be drawn on this graph must be specified by the user.

5. Output data, both tabular and graphical, from the associated program may be displayed. The tabular data is displayed in 25-line pages. The two line graphs, labeled "1" and "2," may be displayed simultaneously.

6. The input and output data, which was used and produced by the associated program, may be printed on the line printer.

B. GRAPHIC DATA SETS

The GFP utilizes three graphic data sets named IGDS1, IGDS2, and IGDS3. IGDS1 encompasses the lower half of the screen and is used for all alphameric input and output displays. IGDS2 encompasses the upper half of the screen and is used to display rectangular coordinate graph axes and the desired numerical scales and labels for these axes. The data for the line graphs is generated by the associated program. The axes are permanently displayed in the center of the IGDS2 area, the length of each axis being four tenths of the length of the entire screen. IGDS3 encompasses that square screen area bordered on the left and bottom by the permanently displayed axes which were initialized in IGDS2. The intersection of the two axes is the lower left corner of IGDS3. The data limits for IGDS3 are variable and detailed instructions for setting these limits are discussed in Chapter III. Figure 1 shows the locations of the graphic data sets on the display screen.

C. DATA ARRAYS

The GFP uses eight arrays for storage of the user's input data and the output data from the associated program. These arrays are named

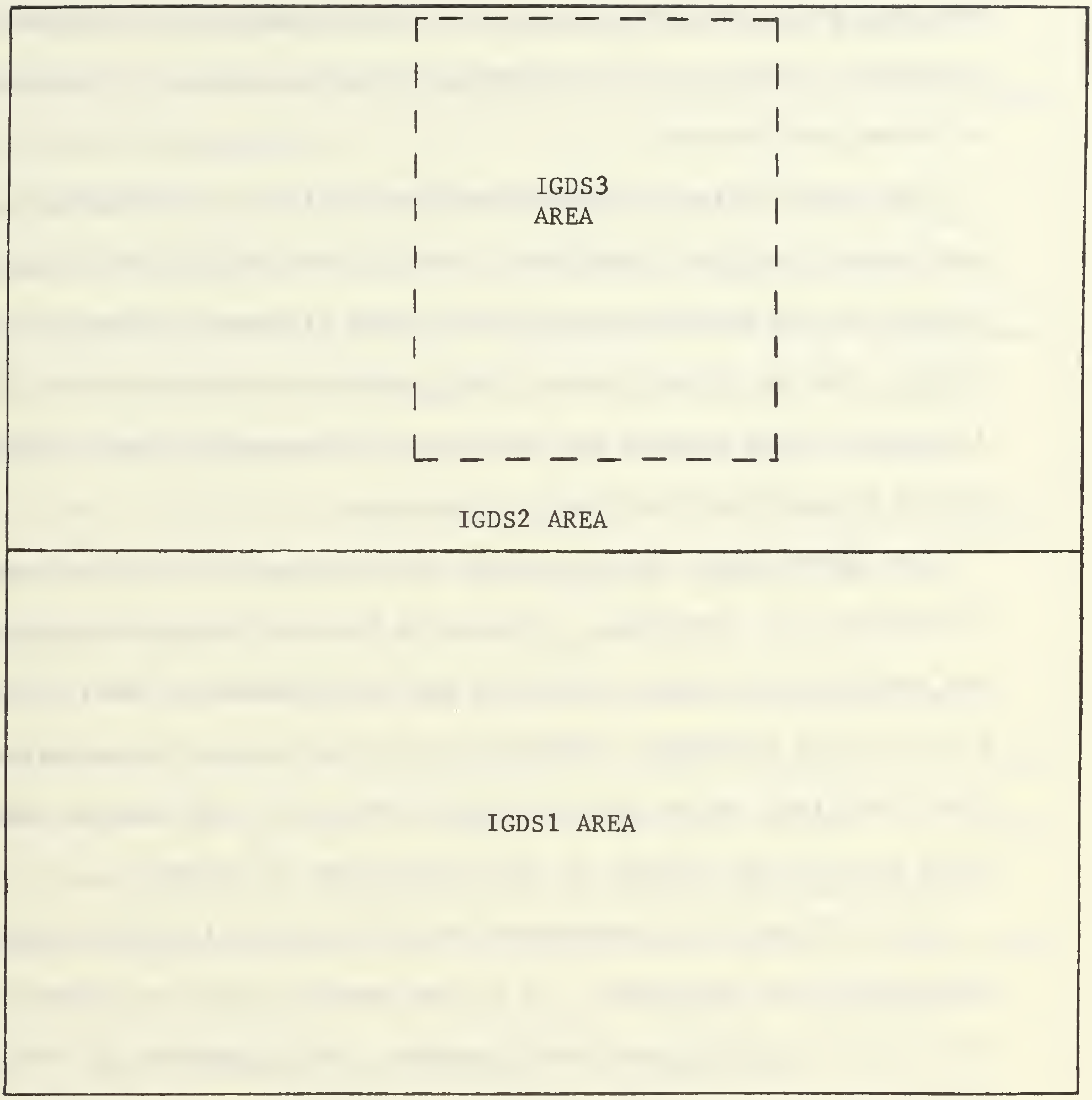


Figure 1

Location of Graphic Data Sets on Screen

INPUT1, INPUT2, OUT1, OUT2, OUT3, OUT4, OUT5, and OUT6. INPUT1, INPUT2, and OUT1 arrays are blanked out by a data statement upon initial execution of the GFP. The following paragraphs present a description of these eight arrays.

The INPUT1 array is dimensioned for 500 lines of 18 words, each word containing four characters. The user may utilize this array for display of the associated program or other alphameric information in IGDS1. This is a static array; the information must be read in at the beginning of the program and stored for subsequent display. INPUT1 cannot be used for other than this purpose.

The INPUT2 array is dimensioned for 50 lines of 18 words, each word containing four characters. Its use is to store input data utilized by the associated program. This data may be displayed in IGDS1, changed by use of the alphameric keyboard if desired, and may be transferred into the direct access storage disc by the user. The data in this array may also be printed on the line printer if desired.

The OUT1 array is dimensioned for 350 lines of 18 words, each word containing four characters. It is the storage array for alphameric data output from the associated program. The information in this array may be displayed in IGDS1, printed on the line printer, or blanked out as desired by the user. Blanking out of this array after an execution of the associated program would erase all previous data, and would preclude the possibility of displaying or printing erroneous output data after the next execution of the associated program.

The OUT2 array is dimensioned for one line of 18 words, each word containing four characters. It is the storage array for one line of data from the INPUT2 array which is determined to be in error by the associated program. The associated program must have a method to check input data for correctness, as in the example associated program in Appendix C, and to read that line of data into the array, if this array is to serve any purpose.

The OUT3 array is dimensioned for ten words and is the storage array for the dependent variable for graphical display in IGDS3. The array is filled directly during the execution of the associated program.

The OUT4 array is dimensioned for ten words and is the storage array for the independent variable for graphical display in IGDS3. The array is filled directly during execution of the associated program. This array, in conjunction with the OUT4 array, provides the data points for display of the line graph labeled "1."

The OUT5 and OUT6 arrays are dimensioned for ten words and are used to store the data in the OUT3 and OUT4 arrays respectively. These arrays provide data points for display of the graph labeled "2." Since the values in OUT3 and OUT4 arrays are set during execution of the associated program, arrays OUT5 and OUT6 provide storage for data points from a previous execution of the associated program. Both graphs "1" and "2" may be displayed simultaneously for comparison.

D. DISPLAY IN IGDS1 AREA

The INPUT1 or OUT2 array data may be displayed on the screen in 25-line increments, and the INPUT2 array data may be displayed on the screen in 20-line increments. These increments will be referred to as pages. Through the use of the applicable keys on the program function keyboard, these pages may be advanced or rewound to allow for display of the entire contents of any of the three arrays. The advance and rewind operations may be accomplished in ten or one page increments or ten and five line increments. The display of the last set of data in an array will occupy less than a full page when the number of lines of data in this set is less than the number of lines on a page. For example, in the example associated program there are 34 lines of data in the INPUT2 array. The first page displayed will include the first 20 lines, but after advancing the display one page, only 14 lines will be displayed, lines 21 through 34. If, while advancing the pages in an array, the number of the first line to be displayed is advanced beyond the specified limits of that array, a message will be displayed indicating the end of the input/output array.

E. PROGRAM FUNCTION KEYBOARD

The GFP uses 29 function keys. The use of each key is described below.

Key 1 has two uses. Its primary use is to display the first 25 lines of data, stored in the INPUT1 array, in the IGDS1 area. In addition, when used immediately after any of keys 2 through 9 or 11, the specified 25 lines data in the INPUT1 array is displayed in IGDS1.

Key 2 has two uses. Its primary use is to advance the line counters, which determine the next array segment to be displayed in IGDS1, ten 25-line pages beyond their present positions. When used immediately after any of keys 2 through 9 or 11, the specified 20 lines of data in the INPUT2 array is displayed in IGDS1.

Key 3 has two uses. Its primary use is to reset the line counters, which determine the next array segment to be displayed in IGDS1, ten 25-line pages back from their present positions. When used immediately after any of keys 2 through 9 or 11, the specified 25 lines of data in the OUT1 array is displayed in IGDS1.

Key 4 advances the line counters, which determine the next array segment to be displayed in IGDS1, one 25-line page beyond their present positions.

Key 5 resets the line counters, which determine the next array segment to be displayed in IGDS1, one 25-line page back from their present positions.

Key 6 advances the line counters, which determine the next array segment to be displayed in IGDS1, ten lines beyond their present positions.

Key 7 resets the line counters, which determine the next array segment to be displayed in IGDS1, ten lines back from their present positions.

Key 8 advances the line counters, which determine the next array segment to be displayed in IGDS1, five lines beyond their present positions.

Key 9 resets the line counters, which determine the next array segment to be displayed in IGDS1, five lines back from their present positions.

Key 10 displays in IGDS1 the first 20 lines of the input data stored in the INPUT2 array. It also displays the instructions for changing the data in the INPUT2 array.

Key 11 advances the line counters, which determine the next array segment to be displayed in IGDS1, 20 lines beyond their present positions. This key is designed to assist in advancing the data in the INPUT2 array by one page increments because the specified page length for INPUT2 array data is 20 lines rather than 25 lines.

Key 12 displays a cursor under the first character position in the first line of displayed INPUT2 data. This key is only used when INPUT2 data is displayed.

Key 13 advances the cursor one line and displays the cursor under the first character of the next line.

Key 14 removes the cursor from the display.

Key 15 transmits the page of displayed INPUT2 data into the INPUT2 array. If this data has been changed on the display screen with the alphameric keyboard, the new data is stored in the INPUT2 array. This data must be read into the INPUT2 array before the next page of data is displayed.

Key 16 transfers the data in the INPUT2 array to the direct access disc storage area. The associated program reads its input data from this intermediate disc storage space.

Key 17 blanks out the OUT1 designated section on the direct access storage disc. This key should be used only after using key 18 to prevent the loss of output data produced during execution of the associated program.

Key 18 transfers the alphameric data output from the direct access disc storage to the OUT1 array.

Key 19 displays the first 25 lines of data, stored in the OUT1 array, in IGDS1.

Key 20 displays the axes and labeling for the graphical output in IGDS2, and displays a cursor under the top zero in the column of zeros alongside the vertical axis. This zero may be changed by use of the alphameric keyboard.

Key 21 advances the cursor to the next designated line in IGDS2, and displays the cursor under the first character in that line.

Key 22 blanks out IGDS3. Keys 23 or 25 must be used to display a line in IGDS3. At the beginning of execution of the GFP an initialization line is displayed diagonally across IGDS3. The use of this key will remove that line when it is desired to display a graph.

Key 23 displays a line graph in IGDS3, utilizing data in OUT3 and OUT4 arrays, and labels this graph "1."

Key 24 transfers data stored in the OUT3 and OUT4 arrays to the OUT5 and OUT6 arrays respectively.

Key 25 displays a line graph in IGDS3, utilizing the data in OUT5 and OUT6 arrays, and labels this graph "2." The two line graphs, labeled "1" and "2" may be displayed simultaneously. Additional graphs may be simultaneously displayed but will be labeled "1" or "2." Therefore, to display more than two graphs, the user will need to use a mechanical method to determine which data produced the additional line graphs. If the user uses key 22, only the data stored in the OUT3/OUT4 and OUT5/OUT6 arrays will be available to produce line graphs until another execution of the associated program is completed.

Key 26 transfers to the line printer, the current contents of the input data stored in the INPUT2 array.

Key 27 transfers to the line printer, the current contents of the output data stored in the OUT1 array.

Key 28 initializes the execution of the associated program.

Key 29 terminates the GFP.

III. ASSOCIATED PROGRAM COMPATABILITY REQUIREMENTS

This chapter describes, in detail, the requirements to make an associated program compatable with the GFP. The GFP program is contained in Appendix C and direct referral will be made to this program using the line index numbers.

A. GENERAL

The GFP manipulates and displays the data to and from the associated program. It provides intermediate direct access disc storage space of 800 lines, each of 72 characters in length. This disc space is used to temporarily store INPUT2, OUT1, and OUT2 data during execution of the GFP. The GFP transfers the input data in the INPUT2 array to disc storage. The associated program, then, must read this data from the disc storage in a manner similar to that in the INPUT SUBROUTINE, line 462, in the example associated program. The associated program must store alphameric output data, for later transfer by GFP to the OUT1 array, on intermediate disc space in a manner similar to that in the TITLE SUBROUTINE, line 587, in the example associated program. The associated program must store the line of improper input data, if any, on intermediate disc storage space and transfer this to the OUT2 array in a manner similar to that in the INPUT SUBROUTINE, lines 576 through 579, in the example associated program. The associated program must also store numerical data in the OUT3 and OUT4 arrays for use in the display of line graphs.

The user must always set the variables NMAX, NDATA, MAXOUT, N1, GR1, GR2, GR3, and GR4, described in section C of this chapter, to correspond to the requirements of his associated program. The GFP may be utilized without further modifications if the user reads external data into GFP for the INPUT1 and INPUT2 arrays and the total number of 72-character lines of data stored in the INPUT1, INPUT2, OUT1, and OUT2 arrays are less than or equal to 500, 50, 350, and 1 respectively. In addition, the number of data point sets to be utilized for any line graph must not be greater than ten.

B. DIMENSIONING OF ARRAYS

The GFP utilizes the arrays described in this paragraph exclusively and their dimensions must not be changed. The one word array NULL is required for use as the null variable. The one word array IBIT is required for storage of light pen attention or end-order-sequence information by the Request Attention Information subroutine. The one word array IT is required for storage of information related to the completion of the read operation in the Read Text subroutine. The array IKEY is required for identification of elements associated with the Plot Text, Insert Cursor, and Read Text subroutines and must be dimensioned for 25 words, the maximum number of lines displayed in IGDS1 at any time.

It may be necessary for the user to modify the dimensions of the INPUT and OUT arrays, either by decreasing some of them to reduce total core requirements for the GFP with an integrated associated program, or by increasing some of them to provide sufficient storage space for the desired input and output data. If this situation occurs, the following changes to the arrays and associated program variables are necessary to ensure associated program compatability.

If the sum of the second dimensions of INPUT2 and OUT1, and OUT2 arrays are greater than 800, the second dimension of the DEFINE FILE statement, line 36, must be appropriately increased. Because of the format of the read and write statements in the GFP, the first dimension of INPUT1, INPUT2, OUT1, and OUT2 arrays should not be changed from 18 and the second dimensions must be at least one. If the second dimension of the INPUT2 array is increased beyond 50 and/or the second dimension of OUT1 array is increased beyond 350, it will be necessary to insure that no intermediate disc storage records are inadvertantly overwritten. In line 379 of the example associated program, the variable W defines the first location for storing the OUT1 array on the disc. The user must specify the value of the corresponding variable in his associated program such that it is one greater than the value of the second dimension of the INPUT2 array. In lines 249 and 260, the variable I values must also range from one more than the value of the second dimension of the INPUT2 array to the sum of the second dimensions of INPUT2 and OUT1 arrays, to ensure proper blanking out or reading in of data. Also, as in lines 576 and 579 in the example associated program, the user must specify in the corresponding statement in his associated program that the initial location for storing the data for the OUT2 array be one greater than the sum of the second dimensions of the INPUT2 and OUT1 arrays. If the dimensions of INPUT1, INPUT2, or OUT1 arrays are changed, corresponding changes will be required for initial blanking out of these arrays by the DATA statement, line 32.

The dimensions of OUT3, OUT4, OUT5, and OUT6 arrays are determined by the number of points to be used for displaying each line graph in

IGDS3. The dimensions of these arrays should be increased, if necessary, and they should all be dimensioned the same value.

C. SPECIFIC VARIABLE INITIALIZATION

In lines 43 through 50, initialization variables are specified. NMAX specifies the actual number of lines of data used in the INPUT1 array. NDATA is the actual number of lines of data in the INPUT2 array and MAXOUT is the actual number of lines in the OUT1 array. These three variables determine the operations to be performed in lines 80, 86, 115, 182, 241, 269, 362, and 370. It is also necessary that the second dimensions in INPUT1, INPUT2, and OUT1 arrays be greater than or equal to the values of NMAX, NDATA, and MAXOUT respectively.

N1 is the variable designating the number of lines to be drawn on each line graph. The number of points to be stored in OUT3, OUT4, OUT5, and OUT6 arrays must be one more than this number. The first point in these arrays will be the initial starting positions for the line graphs.

The variables GR1 and GR2 designate the X and Y values respectively at the lower left corner of IGDS3, which is the intersection of the line graph axes. GR3 and GR4 designate the maximum X and Y values respectively of the data range of the line graphs, and is the upper right corner of IGDS3. GR1, GR2, GR3, and GR4 must be chosen by the user according to the specific requirements of his associated program. The GFP automatically scales the graph area for these values, line 65.

D. EXTERNAL INSERTION OF INPUT DATA

The reading of data into INPUT1 and INPUT2 arrays, lines 80 through 88, is optional and these statements may be left out of the GFP. If they are removed, then function keyboard key number one will have no use and the INPUT2 data will have to be inserted from the alphameric keyboard with the use of the cursor.

IV. SAMPLE GFP EXECUTION CHAIN OF EVENTS

This chapter describes one complete chain of events during execution of the GFP. This description will assume that all of the capabilities of the GFP will be utilized. It is to be remembered that the user is not required to follow this sequence exactly to utilize the GFP, and that multiple sequences of events may be utilized for multiple executions of the associated program. This chapter will also indicate faulty sequences which will prevent the user from obtaining his desired graphical display. Reference to the GFP program listing in appendix C will be made by line index number.

Upon initial execution of the GFP the INPUT1, INPUT2, and OUT1 arrays are blanked out, intermediate disc storage is defined and basic parameter variables are initialized, lines 32 through 50. The 2250 is initialized and the statement "GENERAL FORTRAN PROGRAM" is displayed in the center of IGDS1. A horizontal line is displayed across the bottom edge of IGDS2 and a diagonal line is displayed from the lower left corner to the upper right corner of IGDS3 for initialization. Data is read into INPUT1 and INPUT2 arrays. These reading operations are optional. The alarm, which is a short duration tone, is sounded. The keys 1 through 29 are enabled and the lights in these keys are lighted to indicate theyare enabled. The program waits at this point for attention information provided by the user with the program function keyboard. Unless otherwise specified during the remainder of the discussion in this chapter, the program will return to line 92 and wait for the next attention information, at the completion of each operation.

A. DISPLAY OF INPUT1 ARRAY

The sequence of events for displaying INPUT1 information is listed below. A complete explanation of all of the computer operations for this process is described below the list.

1. Push key 1
2. Push one of keys 2 through 9
3. Repeat steps 1 and 2 as desired

Key 1 is pushed by the user and the first 25 lines of information, or the number specified in the variable NMAX, if it is less than 25, stored in INPUT1 array is displayed in IGDS1. The user then pushes any of keys 2 through 9 to reset the page to be displayed. The use of keys 2 through 9 resets the values of the variables NA and NB and the program goes to line 104 and disables all keys except 1, 2, and 3. The previous display will remain and the lights in the disabled keys will be turned off. Since the INPUT1 information is being displayed, key 1 will be pushed next and the new 25-line segment of INPUT1 information will be displayed. The program will go to line 92, enable and light all keys 1 through 29 again, and wait for the next attention information. It should be noted at this time that when only keys 1, 2, and 3 are enabled, any of these keys may be pushed. If key 2 is pushed, only the 20-line segment in the INPUT2 array with the first line corresponding to the present value of NA will be displayed. If key 3 is pressed, the 25-line segment in the OUT1 array corresponding to the present values of the variables NA and NB will be displayed. Therefore, the user must push the proper key to display the desired information. The procedure of displaying successive pages of INPUT1 information may be continued by repeating the two-step procedure described above. When the value of the variable NA is incremented to a value greater than the specified value of NMAX, the program control is transferred to line 408 and the statement, "END OF INPUT/OUTPUT ARRAY USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIRED PORTION OF PROGRAM," is displayed. Program control then returns to line 92 and waits for the next attention information.

B. DISPLAY, CHANGING AND STORING OF INPUT2 DATA

The next sequence is to display, change, and store INPUT2 data as follows:

1. Push key 10
2. Push key 12
3. Push key 13
4. Repeat steps 2 and 3 as desired
5. Push key 14
6. Push key 15
7. Push key 11 if additional pages of INPUT2 data are to be inserted
8. Push key 2
9. Repeat steps 2 through 6 as desired
10. Push key 16

The user pushes key 10 to display the first 20 lines, or the number of lines specified by the value of the variable NDATA if it is less than 20, in IGDS1. In addition, the statements, "TO MODIFY OR ENTER DATA INSERT CURSOR." and "REMOVE CURSOR WHEN EDITING IS COMPLETED," are displayed at the top and bottom respectively of IGDS1. If no INPUT2 data is read in initially, the IGDS1 area will be blank except for the above statements. By pushing key 12, the cursor will be displayed under the first character position in the first line of INPUT2 data. The use of key 13 advances the cursor one line. The user may change the input data by proceding to the desired line and, by use of the advance key on the alphameric keyboard, position the cursor under the desired character to be changed. After typing in the new character from the alphameric keyboard, the cursor will advance one space. If no initial INPUT2 data was read, the user will type in his complete page of data. Upon completion of the desired changes on a page of INPUT2 data, the user pushes key 14. This is not necessary but will prevent the user from inadvertantly striking a key on the alphameric keyboard which would change the character where the cursor was positioned. The user then pushes key 15 which reads the displayed data into the INPUT2 array and sounds the alarm. This key must be pushed before the display is advanced or the changed data will not be entered into the INPUT2 array. If no changes had been made to the data previously read, this operation would not affect the data already in the array. The above sequence of operations may be repeated to change or insert additional pages of INPUT2 data by pushing key 11 which advances NA and NB by 20-line increments, pushing key 2, and making desired changes or insertions. If the value of the variable NA is increased to a value greater than the value of the variable NDATA, the end of input/output array message will be displayed in IGDS1. Upon the completion of all input changes or the typing of all INPUT2 data, key 16 is pushed to transfer this data to intermediate disc storage from which it may be utilized by the associated program. The alarm is again sounded to indicate completion of this operation.

Key 28 is pressed to execute the associated program. The user may utilize an input data checking procedure in his associated program which places a line of improper data into the OUT2 array and returns control to GFP. If this checking procedure is used and the input data is in error, the program will return to line 432, print the following statements, "FOLLOWING DATA CARD CONTAINS ILLEGAL NAME," the line of improper data from the OUT2 array, and "USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIRED PORTION OF PROGRAM," in IGDS1, and sound the alarm. If the data is correct or no data checking procedure is used and the associated program completes execution, the program will return to line 420, display the following statement in IGDS1, "ASSOCIATED PROGRAM EXECUTION COMPLETED USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIRED PORTION OF PROGRAM," and sound the alarm.

C. DISPLAY OF OUT1 DATA

Upon completion of the execution of the associated program, the user may utilize the following sequence of keys to display OUT1 data.

1. Push key 18
2. Push key 17 if desired
3. Push key 19
4. Push one of keys 2 through 9
5. Push key 3
6. Repeat steps 4 and 5 as desired

The user pushes key 18 to transfer the alphameric output from the intermediate disc storage to the OUT1 array. The alarm will sound to indicate completion of this operation. This data may be displayed in IGDS1 in a similar manner as stated previously for the display of INPUT1 information. Key 19 is pushed to display the first 25 lines of data in the OUT1 array in IGDS1, or the value of the variable MAXOUT if it is less that 25. Any of keys 2 through 9 may now be pushed to reset the values of the variables NA and NB and will disable all program function keys except 1, 2, and 3. Key 3 must be pushed next to display the desired segment of the OUT1 array. When the value of the variable NA is incremented to a value greater than the specified value of the variable MAXOUT, the end of input/output array message will be displayed in IGDS1. It should be noted that if key 17 is pushed after the completion of execution of the associated program and before pushing key 18, the alphameric output data from that execution will be lost by the blanking out of that portion of the intermediate disc storage reserved for the output data. Therefore, key 17 should be used only after key 18 is pushed.

D. GRAPH LABELING

The user may label the graph to correspond to the associated program data by the following sequence.

1. Push key 20
2. Push key 21
3. Repeat step 2 as desired

Key 20 is pushed to display the line graph axes and general labeling. The labels consists of the following characters. Immediately to the left of the vertical axis is a column of 11 equally spaced zeros. To the left of the column of zeros are two lines with the words, "DEPENDENT" and "VARIABLE." Below the horizontal axis are two lines of characters; first is a row of 11 equally spaced zeros and below this line another line with the words, "INDEPENDENT VARIABLE." In addition to the display of axes and labeling, a cursor is inserted beneath the uppermost zero in the column of zeros. Key 21 may be pushed to advance the cursor to the next designated line. The specific labeling of the graph may be accomplished through the use of the alphameric keyboard, in the following sequence.

1. The 11 zeros to the left of the vertical axis are changed individually be selecting the desired characters from the keyboard to replace the zero indicated by the cursor. Key 21 is then pushed which places the cursor under the next zero. This procedure is repeated until all 11 zeros are changed to the desired values. Two characters may be placed on each of these lines.

2. At the completion of (1) push key 21, which places the cursor under the first zero below the horizontal axis, and change this entire line as desired to scale the horizontal axis.

3. At the completion of (2) push key 21, which places the cursor under the first character in the line "DEPENDENT", which is to the left of the vertical axis. The characters of this line may now be changed as desired.

4. At the completion of (3) push key 21, which places the cursor under the first character in the line "VARIABLE," which is directly under the line in (3) above. This line may now be changed as desired.

5. At the completion of (4) push key 21, which places the cursor under the first character in the line "INDEPENDENT VARIABLE" below the horizontal axis. This line may now be changed as desired.

The use of key 20 after the graph has been labeled by the user will reset the labels to the original characters displayed when key 20 was originally pushed.

E. DISPLAY OF LINE GRAPHS

The user may display a line graph in the following sequence.

1. Push key 22

2. Push key 23

3. Push key 24 if desired

4. Push key 22 if associated program is executed two or more times

5. Push key 23

6. Push key 25

Key 22 is pushed to remove the diagonal line from IGDS3. Key 23 is pushed to display line graph labeled "1" in IGDS3. If it is desired to save the data for this line graph for comparison with data from future executions of the associated program, key 24 must be pushed to transfer the data to the OUT5 and OUT6 arrays. The alarm will sound to indicate completion of this operation. The line graph labeled "2," using the data in OUT5 and OUT6 arrays may be displayed by using key 25.

F. PRINTING OF INPUT2 AND OUT1 ARRAYS ON LINE PRINTER

The data in INPUT2 and OUT1 arrays may be written on the line printer by pushing keys 26 and 27 respectively. The alarm will sound after each of these operations to indicate their completion.

This essentially completes the sequence of events in the execution of the GFP. If additional executions of the associated program are desired, the above sequences may be repeated.

When all desired operations are completed, the user will push key 29 which will completely terminate the execution of the GFP and the use of the 2250 for that program.

It should be remembered that this sample chain of events is only an aid to understanding the operations performed by the GFP. The user may utilize these operations in the order which satisfies his needs, limited by the few sequences indicated in this chapter which would prevent him from obtaining his desired output.

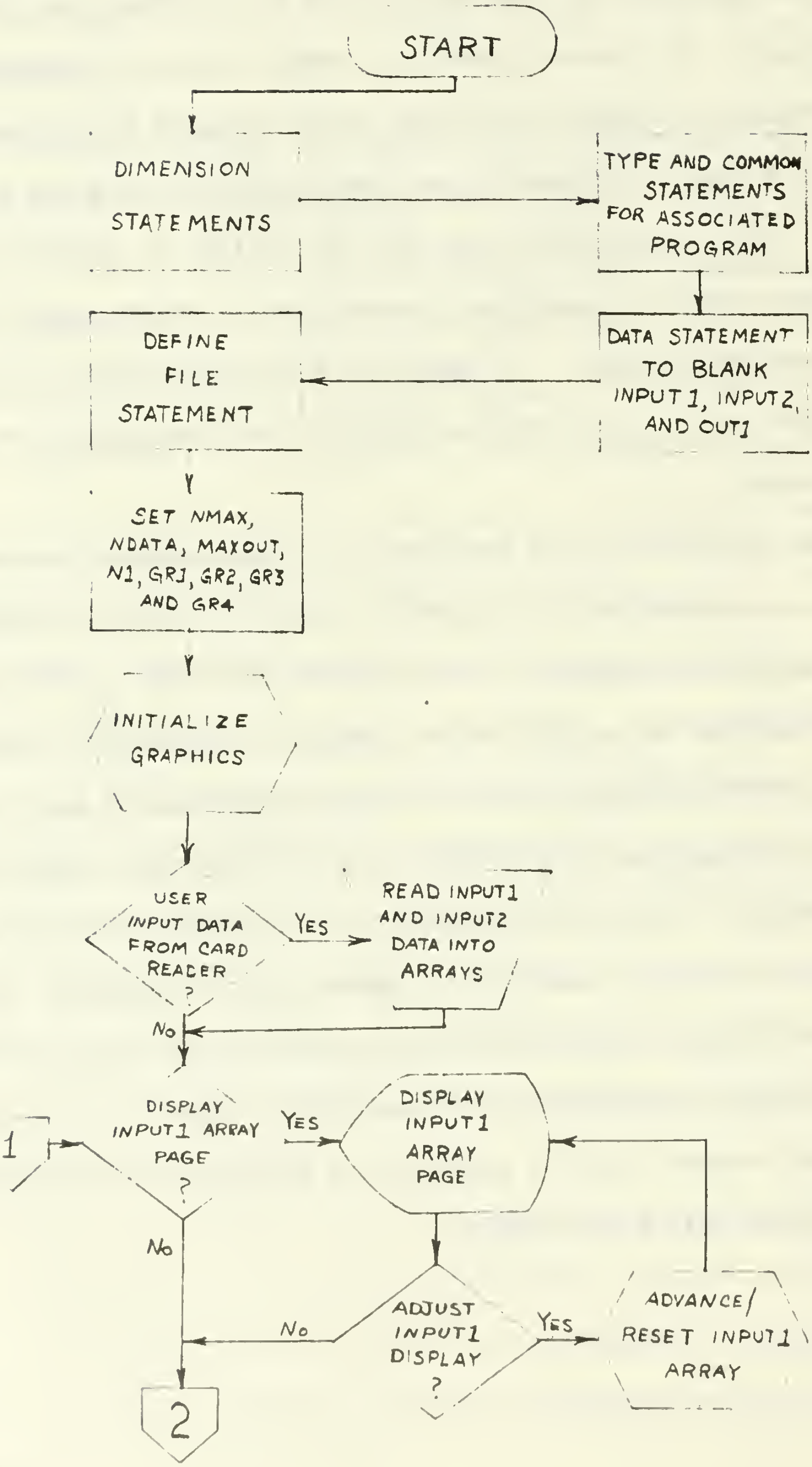
V. SUMMARY AND RECOMMENDATIONS

The GFP provides the user with an aid to utilizing the IBM 2250 Display Unit. The user may display a static array of information, enter, display and change input data to be utilized by the associated program and display alphameric and line graph data from the associated program. This provides the user with the ability to utilize the GFP with a wide range of associated programs and to obtain rapid display of computational results. In additionl the GFP may assist the inexperienced user to gain familiarity with the display unit and its capabilities.

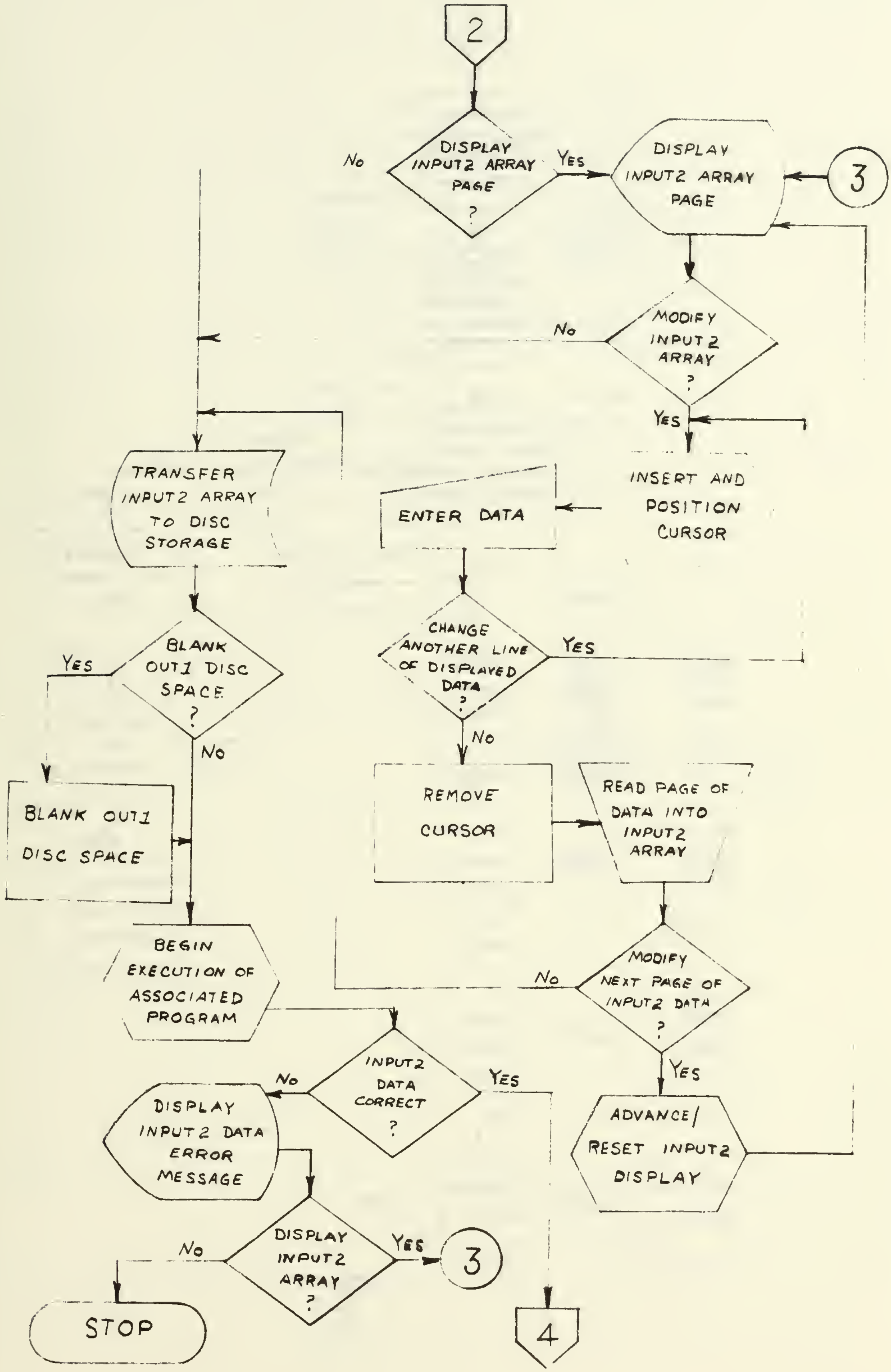
It was noted during the development of this program that many variables and arrays had to be preset in the GFP and could not be changed during its execution. One possible solution to this problem may be to develop an initialization computer program which could read the desired GFP variable values and array dimensions as data, calculate necessary intermediate disc storage locations and then compile and execute the GFP. With this capability, the GFP would require no changes for individual associated programs and, in addition, could be modified to include additional variables which would automatically specify storage locations for the associated program. It is recommended that further study be conducted in this area to determine the feasibility of this type program.

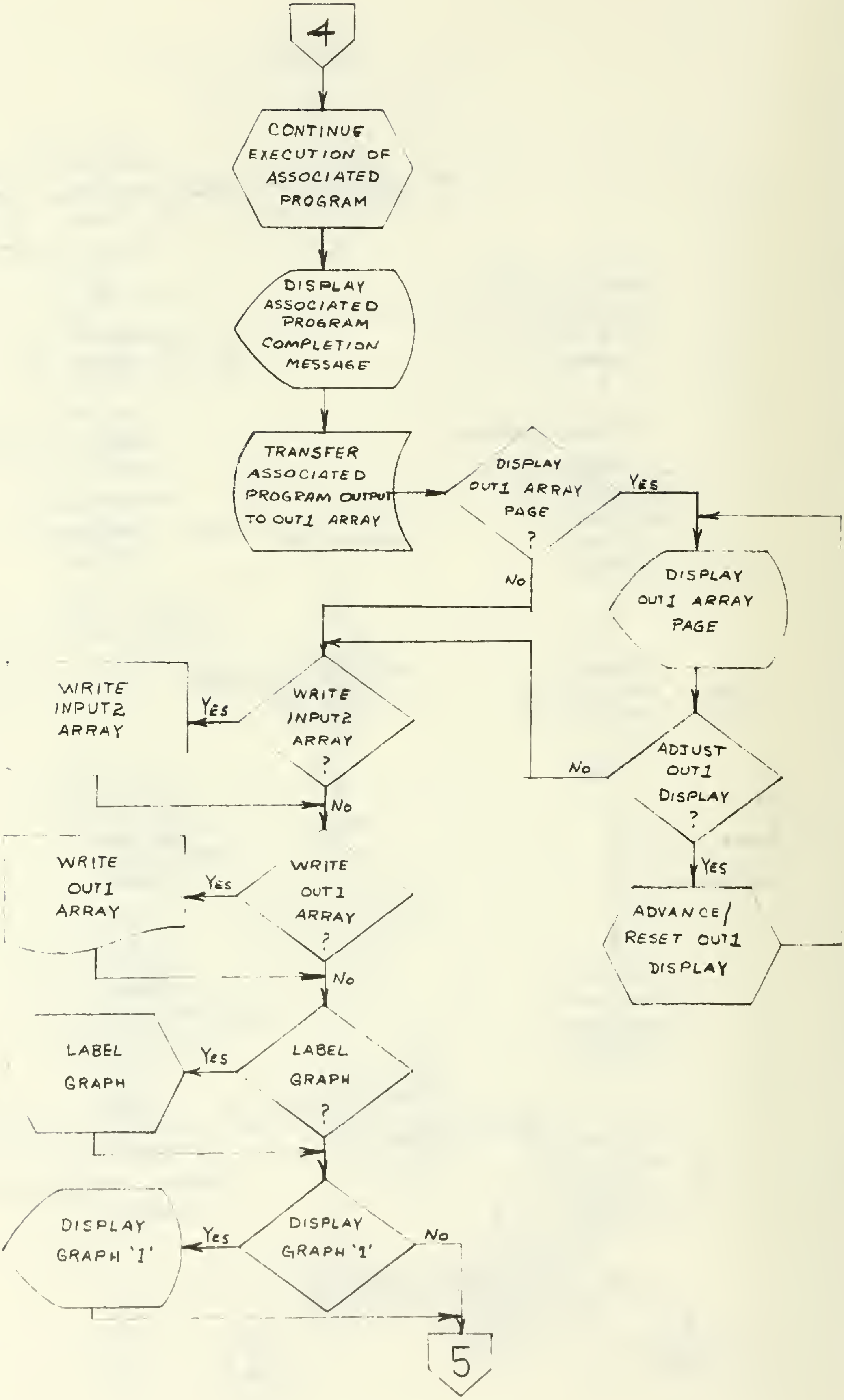
APPENDIX A

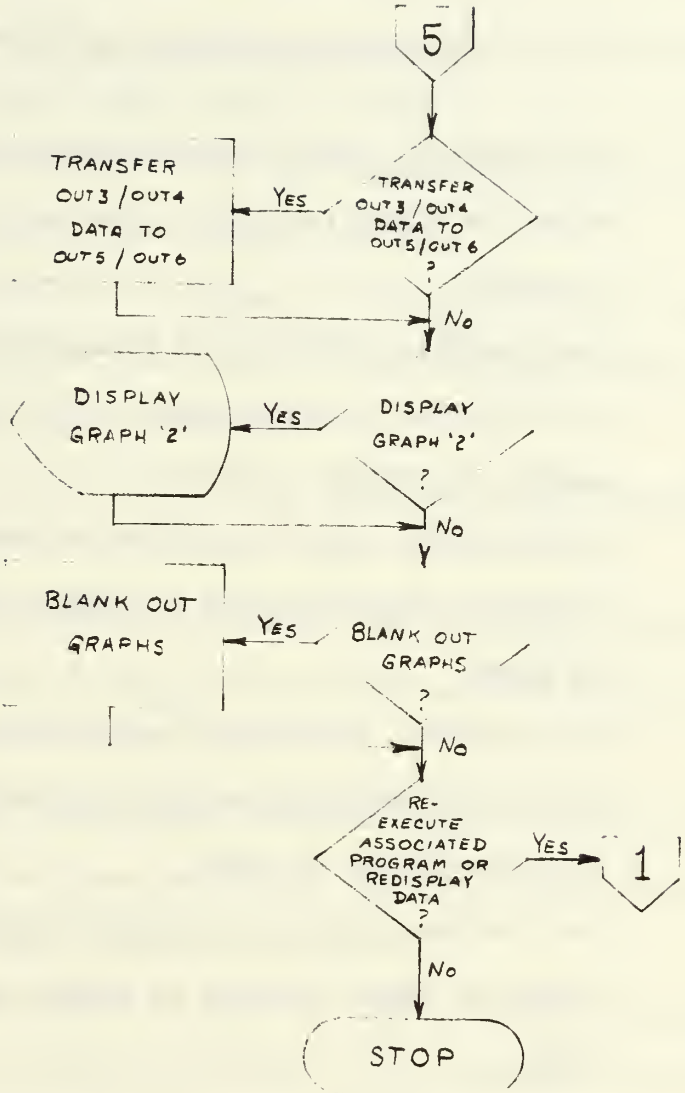
FLOW CHART OF GFP



START
DIMENSION STATEMENTS
TYPE AND COMMON STATEMENTS FOR ASSOCIATED PROGRAM
DATA STATEMENT TO BLANK INPUT1, INPUT2, AND OUT1
DEFINE FILE STATEMENT
SET NMAX, NDATA, MAXOUT, N1, GR1, GR2, GR3 AND GR4
INITIALIZE GRAPHICS
USER INPUT DATA FROM CARD READER ?
YES
READ INPUT1 AND INPUT2 DATA INTO ARRAYS
No
1
DISPLAY INPUT1 ARRAY PAGE ?
YES
DISPLAY INPUT1 ARRAY PAGE
No
ADJUST INPUT1 DISPLAY ?
No
YES
ADVANCE/ RESET INPUT1 ARRAY
2


2
DISPLAY INPUT2 ARRAY PAGE ?
No
YES
DISPLAY INPUT2 ARRAY PAGE
3
MODIFY INPUT 2 ARRAY ?
No
YES
INSERT AND POSITION CURSOR
ENTER DATA
CHANGE ANOTHER LINE OF DISPLAYED DATA ?
YES
No
REMOVE CURSOR
READ PAGE OF DATA INTO INPUT2 ARRAY
MODIFY NEXT PAGE OF INPUT2 DATA ?
No
YES
ADVANCE/ RESET INPUT2 DISPLAY
TRANSFER INPUT2 ARRAY TO DISC STORAGE
BLANK OUT1 DISC SPACE ?
YES
No
BLANK OUT1 DISC SPACE
BEGIN EXECUTION OF ASSOCIATED PROGRAM
INPUT2 DATA CORRECT ?
No
YES
DISPLAY INPUT2 DATA ERROR MESSAGE
DISPLAY INPUT2 ARRAY ?
No
YES
3
STOP
4


4
CONTINUE EXECUTION OF ASSOCIATED PROGRAM
DISPLAY ASSOCIATED PROGRAM COMPLETION MESSAGE
TRANSFER ASSOCIATED PROGRAM OUTPUT TO OUT1 ARRAY
DISPLAY OUT1 ARRAY PAGE ?
YES
NO
DISPLAY OUT1 ARRAY PAGE
ADJUST OUT1 DISPLAY ?
No
Yes
ADVANCE/ RESET OUT1 DISPLAY
WRITE INPUT2 ARRAY ?
Yes
WRITE INPUT2 ARRAY
No
WRITE OUT1 ARRAY ?
Yes
WRITE OUT1 ARRAY
No
LABEL GRAPH ?
Yes
LABEL GRAPH
DISPLAY GRAPH '1'
Yes
DISPLAY GRAPH '1'
No
5


5
TRANSFER OUT3 / OUT4 DATA TO OUT5 / OUT6 ?
YES
TRANSFER OUT3 / OUT4 DATA TO OUT5 / OUT6
No
DISPLAY GRAPH '2' ?
YES
DISPLAY GRAPH '2'
No
BLANK OUT GRAPHS ?
YES
BLANK OUT GRAPHS
No
RE-EXECUTE ASSOCIATED PROGRAM OR REDISPLAY DATA ?
YES
1
No
STOP

APPENDIX B

LIST OF VARIABLES USED BY GFP

A Real variable used in conjunction with the variable B to alter the screen position to display a line of INPUT1 data in IGDS1.

B Real variable, the value of which denotes the Y-coordinate of the initial starting position to display a line of information from INPUT1 in IGDS1.

C Real variable, used in conjunction with the variable D to alter the screen position to display a line of INPUT2 data in IGDS1.

D Real variable, the value of which denotes the Y-coordinate of the initial starting position to display a line of information from INPUT2 in IGDS1.

E Real variable used in conjunction with the variable F to alter the screen position to display a line of OUT1 data in IGDS1.

F Real variable, the value of which denotes the Y-coordinate of the initial starting position to display a line of information from OUT1 in IGDS1.

G Real variable used in conjunction with the variable H to alter the screen position to display a zero on the vertical axis in IGDS2.

GR1 Real variable, the value of which denotes the X-coordinate of the lower left corner of IGDS3.

GR2 Real variable, the value of which denotes the Y-coordinate of the lower left corner of IGDS3.

GR3 Real variable, the value of which denotes the X-coordinate of the upper right corner of IGDS3.

GR4 Real variable, the value of which denotes the Y-coordinate of the upper right corner of IGDS3.

H Real variable, the value of which denotes the Y-coordinate of the initial starting position to display a zero on the vertical axis in IGDS2.

I Dummy integer variable for temporary storage throughout the program.

IATL Integer variable to which a value is assigned by the CRATL Subroutine to identify the attention level created by this call.

IBIT Variable identifying a ten-word array into which the RQATN Subroutine places additional information about light pen or end-of-order sequence attentions.

IBUTT Integer variable to which the RQATN Subroutine assigns a value to identify the source of the attention information being returned.

IGDS1 Integer variable to which a value is assigned by the INGDS Subroutine to identify the graphic data set to be created by this call.

IGDS2 Integer variable to which a value is assigned by the INGDS Subroutine to identify the graphic data set to be created by this call.

IGDS3 Integer variable to which a value is assigned by the INGDS Subroutine to identify the graphic data set to be created by this call.

IGSP Integer variable to which a value is assigned by the INGSP Subroutine for initialization of the graphic subroutine package.

IT Integer variable to which a value is assigned by the GSPRD Subroutine to identify the reason why the subroutine was terminated.

I2250 Integer variable to which a value is assigned by the INDEV Subroutine to identify the 2250 initialized by this call.

J Dummy integer variable for temporary storage throughout the program.

K Dummy variable for temporary storage.

L Integer variable to which is assigned a value by GSP, to specify the key value in the PTEXT or GSPRD Subroutines, of a particular line of data displayed in IGDS1 or read into INPUT2 array.

M Integer variable, the value of which is used by GSP to determine the particular line under which to display the cursor by the ICURS Subroutine.

MAXOUT Integer variable, the value of which denotes the actual number of lines used in OUT1 array.

NA Integer variable, the value of which denotes the first line in a sequence of information from a desired array, to be displayed in IGDS1.

NB Integer variable, used in conjunction with NA and the value of which denotes the last line in a sequence of information from a desired array, to be displayed in IGDS1.

NDATA Integer variable, the value of which denotes the actual number of lines used in INPUT2 array.

NMAX Integer variable, the value of which denotes the actual number of lines used in INPUT1 array.

N1 Integer variable, the value of which denotes the number of lines drawn for each line graph in IGDS3.

N2 Integer variable, the value of which denotes the number of points utilized to draw a line graph in IGDS3.

X Real variable, the value of which denotes the X-coordinate of a particular point for displaying a line graph in IGDS3.

Y Real variable, the value of which denotes the Y-coordinate of a particular point for displaying a line graph in IGDS3.

APPENDIX C

GFP COMPUTER PROGRAM LISTING

This appendix provides a complete listing of the GFP and includes the example associated program.

```
C                                                                       GFP00001
C GENERAL FORTRAN PROGRAM FOR USE WITH IBM 2250 DISPLAY UNIT            GFP00002
C                                                                       GFP00003
C DIMENSION VARIABLES FOR GFP                                           GFP00004
C                                                                       GFP00005
      DIMENSION NULL(1),INPUT1(18,500),INPUT2(18,50),OUT1(18,350),IBIT(1GFP00006
     1),IKEY(25),IT(1),OUT2(18,1),OUT3(10),OUT4(10),OUT5(10),OUT6(10)   GFP00007
C                                                                       GFP00008
C DIMENSION VARIABLES FOR ASSOCIATED PROGRAM                            GFP00009
C                                                                       GFP00010
      DIMENSION NRMPAC(50),NACEPT(50),MINED(300),MINENR(300),MINEX(300),GFP00011
     1MINEY(300),MWEP(50),NSAMSZ(100),FSAMSZ(100),SAMPLE(100)           GFP00012
C                                                                       GFP00013
C DECLARE INTEGER VARIABLES FOR ASSOCIATED PROGRAM                      GFP00014
C                                                                       GFP00015
      INTEGER Z,W                                                       GFP00016
C                                                                       GFP00017
C DECLARE VARIABLES IN COMMON FOR ASSOCIATED PROGRAM                    GFP00018
C                                                                       GFP00019
      COMMON MSWP1,MSWP2,NSP1,NSP2,NSMP,NSAMSZ,FSAMSZ                   GFP00020
      COMMON XMSWP,XNSP,NSAFE                                           GFP00021
      COMMON NAIR,NRMPAC,NACEPT,MINED,NRMINE,MINENR,MINEX,MINEY,NMSP,   GFP00022
     1MWEP,MSWD,NRSH,NSW,NSXL,NCHW,NCHL,NXERR1,NYERR1,NXERRS,NYERRS,    GFP00023
     2NCHANW,NCHANL,FSPSE                                               GFP00024
      COMMON NRNC,NXIN,NRND                                             GFP00025
      COMMON NDSC,Z,W                                                   GFP00026
      COMMON OUT2                                                       GFP00027
      COMMON DUMY                                                       GFP00028
C                                                                       GFP00029
C BLANK INPUT1, INPUT2, AND OUT1 ARRAYS                                 GFP00030
C                                                                       GFP00031
      DATA INPUT1,INPUT2,OUT1/9000*'    ',900*'    ',6300*'    '/       GFP00032
C                                                                       GFP00033
C DEFINE INTERMEDIATE DISC STORAGE AND GO TO FIRST RECORD               GFP00034
C                                                                       GFP00035
      DEFINE FILE 8(800,72,E,IV1)                                       GFP00036
      FIND(8'1)                                                         GFP00037
C                                                                       GFP00038
C INITIALIZE LENGTH OF INPUT1, INPUT2, AND OUT1 ARRAYS.  INITIALIZE,    GFP00039
C FOR GRAPH OUTPUT, THE NUMBER OF LINES TO BE DRAWN FOR ANY GRAPH       GFP00040
C AND THE DATA RANGE OF THE GRAPHS                                      GFP00041
C                                                                       GFP00042
      NMAX=475                                                          GFP00043
      NDATA=34                                                          GFP00044
      MAXOUT=350                                                        GFP00045
      N1=5                                                              GFP00046
      GR1=0.0                                                           GFP00047
      GR2=0.0                                                           GFP00048
      GR3=25.0                                                          GFP00049
      GR4=50.0                                                          GFP00050
C                                                                       GFP00051
C  INITIALIZE 2250 AND DISPLAY INITIAL MESSAGE                          GFP00052
C                                                                       GFP00053
      NULL(1)=-5                                                        GFP00054
      CALL INGSP(IGSP,NULL)                                             GFP00055
      CALL INDEV(IGSP,10,I2250)                                         GFP00056
      CALL INGDS(I2250,IGDS1,2816)                                      GFP00057
      CALL SGDSL(IGDS1,0.0,0.0,10.0,5.0,0.0,0.0,10.0,10.0)              GFP00058
      CALL SDATL(IGDS1,0.0,0.0,1000.0,500.0)                            GFP00059
      CALL INGDS(I2250,IGDS2,512)                                       GFP00060
      CALL SGDSL(IGDS2,0.0,5.0,10.0,10.0,0.0,0.0,10.0,10.0)             GFP00061
      CALL SDATL(IGDS2,0.0,500.0,1000.0,1000.0)                         GFP00062
      CALL INGDS(I2250,IGDS3,512)                                       GFP00063
      CALL SGDSL(IGDS3,300.0,580.0,700.0,980.0,0.0,0.0,1000.0,1000.0)   GFP00064
      CALL SDATL(IGDS3,GR1,GR2,GR3,GR4)                                 GFP00065
      CALL CRATL(I2250,IATL)                                            GFP00066
      CALL SCHAM(IGDS1,2)                                               GFP00067
      CALL PTEXT(IGDS1,'GENERAL FORTRAN PROGRAM',23,1,NULL,1,300.0,300.0GFP00068
     1)                                                                 GFP00069
      CALL EXEC(IGDS1)                                                  GFP00070
      CALL MVPOS(IGDS2,0.0,500.0)                                       GFP00071
      CALL PLINE(IGDS2,1000.0,500.0)                                    GFP00072
      CALL EXEC(IGDS2)                                                  GFP00073
      CALL MVPOS(IGDS3,GR1,GR2)                                         GFP00074
      CALL PLINE(IGDS3,GR3,GR4)                                         GFP00075
      CALL EXEC(IGDS3)                                                  GFP00076
C                                                                       GFP00077
C   READ ASSOCIATED PROGRAM INTO INPUT1 ARRAY FROM CARD READER          GFP00078
C                                                                       GFP00079
      DO 32 I=1,NMAX                                                    GFP00080
   32 READ(5,33)(INPUT1(J,I),J=1,18)                                    GFP00081
   33 FORMAT(18A4)                                                      GFP00082
C                                                                       GFP00083
C   READ ASSOCIATED PROGRAM DATA INTO INPUT2 ARRAY FROM CARD READER     GFP00084
C                                                                       GFP00085
      DO 34 I=1,NDATA                                                   GFP00086
   34 READ(5,33)(INPUT2(J,I),J=1,18)                                    GFP00087
      CALL SALRM(I2250)                                                 GFP00088
C                                                                       GFP00089
C  ENABLE AND LIGHT ATTENTION SOURCES AND REQUEST ATTENTION INFORMATION GFP00090
C                                                                       GFP00091
   35 CALL ENATN(IATL,1,-29)                                            GFP00092
      CALL MLITS(I2250,3)                                               GFP00093
      CALL RQATN(IATL,IBUTT,2,IBIT,1,-29)                               GFP00094
C                                                                       GFP00095
C  BRANCH TO ATTENTION HANDLING ROUTINES                                GFP00096
```

```
C                                                                       GFP00097
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23GFP00098
     1,24,25,26,27,28,29),IBUTT                                         GFP00099
C                                                                       GFP00100
C DISABLE AND TURN OFF LIGHTS ON ALL ATTENTION SOURCES EXCEPT 1-3       GFP00101
C AND REQUEST ATTENTION INFORMATION                                     GFP00102
C                                                                       GFP00103
   36 CALL DSATN(IATL,4,-29)                                            GFP00104
      CALL MLITS(I2250,3)                                               GFP00105
      CALL RQATN(IATL,IBUTT,2,IBIT,1,-3)                                GFP00106
C                                                                       GFP00107
C BRANCH TO ATTENTION HANDLING ROUTINES                                 GFP00108
C                                                                       GFP00109
      GO TO(37,39,46),IBUTT                                             GFP00110
C                                                                       GFP00111
C   DISPLAY INPUT1 DATA  ( FIRST 25 LINES OR ENTIRE ARRAY)              GFP00112
C                                                                       GFP00113
    1 NA=1                                                              GFP00114
      NB=MIN0(25,NMAX)                                                  GFP00115
   37 CALL RESET(IGDS1)                                                 GFP00116
      CALL SCHAM(IGDS1,1)                                               GFP00117
      IF(NB.GT.NMAX)NB=NMAX                                             GFP00118
      IF(NA.GT.NMAX) GO TO 58                                           GFP00119
      IF (NA.LT.1) GO TO 1                                              GFP00120
      IF(NA.LT.NMAX-24) NB=NA+24                                        GFP00121
      IF(NA.GT.NMAX-24) NB=NMAX                                         GFP00122
      A=0.0                                                             GFP00123
      DO 38 I=NA,NB                                                     GFP00124
      A=A+20.0                                                          GFP00125
      B=500.0-A                                                         GFP00126
   38 CALL PTEXT(IGDS1,INPUT1(1,I),72,NULL,NULL,1,0.0,B)                GFP00127
      CALL EXEC(IGDS1)                                                  GFP00128
      GO TO 35                                                          GFP00129
C                                                                       GFP00130
C  ADVANCE INPUT/OUTPUT DISPLAY 10 PAGES (250 LINES)                    GFP00131
C                                                                       GFP00132
    2 NA=NA +250                                                        GFP00133
      NB=NB+250                                                         GFP00134
      GO TO 36                                                          GFP00135
C                                                                       GFP00136
C  REWIND INPUT/OUTPUT DISPLAY 10 PAGES (250 LINES)                     GFP00137
C                                                                       GFP00138
    3 NA=NA-250                                                         GFP00139
      NB=NB-250                                                         GFP00140
      GO TO 36                                                          GFP00141
C                                                                       GFP00142
C  ADVANCE INPUT/OUTPUT DISPLAY 1 PAGE (25 LINES)                       GFP00143
C                                                                       GFP00144
```

```
    4 NA=NA+25                                                          GFP00145
      NB=NB+25                                                          GFP00146
      GO TO 36                                                          GFP00147
C                                                                       GFP00148
C  REWIND INPUT/OUTPUT DISPLAY 1 PAGE (25 LINES)                        GFP00149
C                                                                       GFP00150
    5 NA=NA-25                                                          GFP00151
      NB=NB-25                                                          GFP00152
      GO TO 36                                                          GFP00153
C                                                                       GFP00154
C  ADVANCE INPUT/OUTPUT DISPLAY 10 LINES                                GFP00155
C                                                                       GFP00156
    6 NA=NA+10                                                          GFP00157
      NB=NB+10                                                          GFP00158
      GO TO 36                                                          GFP00159
C                                                                       GFP00160
C  REWIND INPUT/OUTPUT DISPLAY 10 LINES                                 GFP00161
C                                                                       GFP00162
    7 NA=NA-10                                                          GFP00163
      NB=NB-10                                                          GFP00164
      GO TO 36                                                          GFP00165
C                                                                       GFP00166
C  ADVANCE INPUT/OUTPUT DISPLAY 5 LINES                                 GFP00167
C                                                                       GFP00168
    8 NA=NA+5                                                           GFP00169
      NB=NB+5                                                           GFP00170
      GO TO 36                                                          GFP00171
C                                                                       GFP00172
C  REWIND INPUT/OUTPUT DISPLAY 5 LINES                                  GFP00173
C                                                                       GFP00174
    9 NA=NA-5                                                           GFP00175
      NB=NB-5                                                           GFP00176
      GO TO 36                                                          GFP00177
C                                                                       GFP00178
C  DISPLAY ASSOCIATED PROGRAM INPUT2 DATA AND CURSOR INSTRUCTIONS       GFP00179
C                                                                       GFP00180
   10 NA=1                                                              GFP00181
      NB=MIN0(20,NDATA)                                                 GFP00182
   39 IF(NB.GT.NDATA)NB=NDATA                                           GFP00183
      IF(NA.GT.NDATA)GO TO 58                                           GFP00184
      IF(NA.LT.1) GO TO 10                                              GFP00185
      IF(NA.LT.NDATA-19) NB=NA+19                                       GFP00186
      IF(NA.GT.NDATA-19)NB=NDATA                                        GFP00187
      CALL RESET(IGDS1)                                                 GFP00188
      CALL SCHAM(IGDS1,2)                                               GFP00189
      CALL PTEXT(IGDS1,'TO MODIFY OR ENTER DATA INSERT CURSOR',37,1,NULLGFP00190
     1,1,20.0,470.0)                                                    GFP00191
      CALL PTEXT(IGDS1,'REMOVE CURSOR WHEN EDITING IS COMPLETED',39,2,NUGFP00192
     1LL,1,20.0,5.0)                                                    GFP00193
      CALL EXEC(IGDS1)                                                  GFP00194
      CALL SCHAM(IGDS1,3)                                               GFP00195
      C=0.0                                                             GFP00196
      L=0                                                               GFP00197
      DO 40 I=NA,NB                                                     GFP00198
      C=C+20.0                                                          GFP00199
      D=470.0-C                                                         GFP00200
      L=L+1                                                             GFP00201
   40 CALL PTEXT(IGDS1,INPUT2(1,I),72,NULL,IKEY(L),1,0.0,D)             GFP00202
      CALL EXEC(IGDS1)                                                  GFP00203
      GO TO 35                                                          GFP00204
C                                                                       GFP00205
C ADVANCE INPUT2  DATA DISPLAY 1 PAGE (20 LINES)                        GFP00206
C                                                                       GFP00207
   11 NA=NA+20                                                          GFP00208
      NB=NB+20                                                          GFP00209
      GO TO 36                                                          GFP00210
C                                                                       GFP00211
C  INSERT CURSOR UNDER FIRST LINE OF INPUT DATA                         GFP00212
C                                                                       GFP00213
   12 M=1                                                               GFP00214
      CALL ICURS(IGDS1,NULL,IKEY(M),1)                                  GFP00215
      GO TO 35                                                          GFP00216
C                                                                       GFP00217
C  ADVANCE CURSOR 1 LINE                                                GFP00218
C                                                                       GFP00219
   13 CALL RCURS(IGDS1)                                                 GFP00220
      M=M+1                                                             GFP00221
      CALL ICURS(IGDS1,NULL,IKEY(M),1)                                  GFP00222
      GO TO 35                                                          GFP00223
C                                                                       GFP00224
C  REMOVE CURSOR                                                        GFP00225
C                                                                       GFP00226
   14 CALL RCURS(IGDS1)                                                 GFP00227
      GO TO 35                                                          GFP00228
C                                                                       GFP00229
C  READ GRAPHICS INTO INPUT2 DATA ARRAY                                 GFP00230
C                                                                       GFP00231
   15 L=0                                                               GFP00232
      DO 41 M=NA,NB                                                     GFP00233
      L=L+1                                                             GFP00234
   41 CALL GSPRD(IGDS1,INPUT2(1,M),72,1,IT,NULL,IKEY(L))                GFP00235
      CALL SALRM(I2250)                                                 GFP00236
      GO TO 35                                                          GFP00237
C                                                                       GFP00238
C  TRANSFER INPUT2 DATA TO INTERMEDIATE DISC STORAGE                    GFP00239
C                                                                       GFP00240
```

```
   16 DO 42 I=1,NDATA                                                      GFP00241
   42 WRITE(8'I,33)(INPUT2(J,I),J=1,18)                                   GFP00242
      FIND(8'1)                                                            GFP00243
      CALL SALRM(I2250)                                                    GFP00244
      GO TO 35                                                             GFP00245
C                                                                          GFP00246
C BLANK OUT1 OUTPUT SECTION ON INTERMEDIATE DISC STORAGE AREA              GFP00247
C                                                                          GFP00248
   17 DO 43 I=51,400                                                       GFP00249
   43 WRITE(8'I,44)                                                        GFP00250
   44 FORMAT(72H                                                           GFP00251
     1                          )                                          GFP00252
      FIND(8'1)                                                            GFP00253
      CALL SALRM(I2250)                                                    GFP00254
      GO TO 35                                                             GFP00255
C                                                                          GFP00256
C XFER ASSOCIATED PROGRAM OUTPUT TO OUTPUT DISPLAY ARRAY OUT1              GFP00257
C                                                                          GFP00258
   18 K=0                                                                  GFP00259
      DO 45 I=51,400                                                       GFP00260
      K=K+1                                                                GFP00261
   45 READ(8'I,33)(OUT1(J,K),J=1,18)                                       GFP00262
      CALL SALRM(I2250)                                                    GFP00263
      GO TO 35                                                             GFP00264
C                                                                          GFP00265
C DISPLAY ASSOCIATED PROGRAM OUT1 DATA                                     GFP00266
C                                                                          GFP00267
   19 NA=1                                                                 GFP00268
      NB=MINO(25,MAXOUT)                                                   GFP00269
   46 IF(NB.GT.MAXOUT)NB=MAXOUT                                            GFP00270
      IF(NA.GT.MAXOUT)GO TO 58                                             GFP00271
      IF(NA.LT.1)GO TO 19                                                  GFP00272
      IF(NA.LT.MAXOUT-24)NB=NA+24                                          GFP00273
      IF(NA.GT.MAXOUT-24)NB=MAXOUT                                         GFP00274
      CALL RESET(IGDS1)                                                    GFP00275
      CALL SCHAM(IGDS1,3)                                                  GFP00276
      E=0.0                                                                GFP00277
      L=0                                                                  GFP00278
      DO 47 I=NA,NB                                                        GFP00279
      E=E+20.0                                                             GFP00280
      F=500.0-E                                                            GFP00281
      L=L+1                                                                GFP00282
   47 CALL PTEXT(IGDS1,OUT1(1,I),72,NULL,IKEY(L),1,0.0,F)                  GFP00283
      CALL EXEC(IGDS1)                                                     GFP00284
      GO TO 35                                                             GFP00285
C                                                                          GFP00286
C  DISPLAY GRAPH AXES  --  INSERT CURSOR TO LABEL GRAPH                    GFP00287
C                                                                          GFP00288
```

```
   20 CALL RFSET(IGDS2)                                                      GFP00289
      CALL SCHAM(IGDS2,3)                                                    GFP00290
      G=0.0                                                                  GFP00291
      DO 48 I=1,11                                                           GFP00292
      G=G+36.3                                                               GFP00293
      H=1000.0-G                                                             GFP00294
   48 CALL PTEXT(IGDS2,'0',1,I,NULL,1,260.0,H)                              GFP00295
      CALL PTEXT(IGDS2,'0  0  0  0  0  0  0  0  0  0  0',31,12,NULL,1,30GFP00296
     10.0,560.0)                                                             GFP00297
      CALL PTEXT(IGDS2,'DEPENDENT',9,13,NULL,1,10.0,800.0)                   GFP00298
      CALL PTEXT(IGDS2,'VARIABLF',8,14,NULL,1,10.0,750.0)                    GFP00299
      CALL PTEXT(IGDS2,'INDEPENDENT VARIABLE',20,15,NULL,1,400.0,525.0) GFP00300
      CALL MVPOS(IGDS2,0.0,500.0)                                            GFP00301
      CALL PLINE(IGDS2,1000.0,500.0)                                         GFP00302
      CALL MVPOS(IGDS2,700.0,580.0)                                          GFP00303
      CALL PLINE(IGDS2,300.0,580.0)                                          GFP00304
      CALL PLINE(IGDS2,300.0,980.0)                                          GFP00305
      CALL EXEC(IGDS2)                                                       GFP00306
      M=1                                                                    GFP00307
      CALL ICURS(IGDS2,M,NULL,1)                                             GFP00308
      GO TO 35                                                               GFP00309
C                                                                            GFP00310
C  ADVANCE CURSOR 1 LINE(TO CHANGE GRAPH LABELING)                           GFP00311
C                                                                            GFP00312
   21 CALL RCURS(IGDS2)                                                      GFP00313
      M=M+1                                                                  GFP00314
      CALL ICURS(IGDS2,M,NULL,1)                                             GFP00315
      GO TO 35                                                               GFP00316
C                                                                            GFP00317
C BLANK OUT IGDS3                                                            GFP00318
C                                                                            GFP00319
   22 CALL RESET(IGDS3)                                                      GFP00320
      GO TO 35                                                               GFP00321
C                                                                            GFP00322
C DISPLAY LINE GRAPH 1                                                       GFP00323
C                                                                            GFP00324
   23 X=OUT4(1)                                                              GFP00325
      Y=OUT3(1)                                                              GFP00326
      CALL STPOS(IGDS3,X,Y)                                                  GFP00327
      N2=N1+1                                                                GFP00328
      DO 49 I=2,N2                                                           GFP00329
      X=OUT4(I)                                                              GFP00330
      Y=OUT3(I)                                                              GFP00331
   49 CALL PLINE(IGDS3,X,Y)                                                  GFP00332
      CALL PTEXT(IGDS3,'1',1,1,NULL,1,X,Y)                                   GFP00333
      CALL EXEC(IGDS3)                                                       GFP00334
      GO TO 35                                                               GFP00335
C                                                                            GFP00336
```

```
C TRANSFER OUT3/OUT4 DATA TO OUT5/OUT6                                  GFP00337
C                                                                       GFP00338
   24 N2=N1+1                                                           GFP00339
      DO 50 I=1,N2                                                      GFP00340
      OUT5(I)=OUT3(I)                                                   GFP00341
   50 OUT6(I)=OUT4(I)                                                   GFP00342
      CALL SALRM(I2250)                                                 GFP00343
      GO TO 35                                                          GFP00344
C                                                                       GFP00345
C DISPLAY LINE GRAPH 2                                                  GFP00346
C                                                                       GFP00347
   25 X=OUT6(1)                                                         GFP00348
      Y=OUT5(1)                                                         GFP00349
      CALL STPOS(IGDS3,X,Y)                                             GFP00350
      N2=N1+1                                                           GFP00351
      DO 51 I=2,N2                                                      GFP00352
      X=OUT6(I)                                                         GFP00353
      Y=OUT5(I)                                                         GFP00354
   51 CALL PLINE(IGDS3,X,Y)                                             GFP00355
      CALL PTEXT(IGDS3,'2',1,2,NULL,1,X,Y)                              GFP00356
      CALL EXEC(IGDS3)                                                  GFP00357
      GO TO 35                                                          GFP00358
C                                                                       GFP00359
C WRITE CURRENT CONTENTS OF INPUT2 ARRAY ON LINE PRINTER                GFP00360
C                                                                       GFP00361
   26 DO 52 I=1,NDATA                                                   GFP00362
   52 WRITE(6,53)(INPUT2(J,I),J=1,18)                                   GFP00363
   53 FORMAT(' ',18A4)                                                  GFP00364
      CALL SALRM(I2250)                                                 GFP00365
      GO TO 35                                                          GFP00366
C                                                                       GFP00367
C WRITE CURRENT CONTENTS OF OUT1 ARRAY ON LINE PRINTER                  GFP00368
C                                                                       GFP00369
   27 DO 54 I=1,MAXOUT                                                  GFP00370
   54 WRITE(6,53)(OUT1(J,I),J=1,18)                                     GFP00371
      CALL SALRM(I2250)                                                 GFP00372
      GO TO 35                                                          GFP00373
C                                                                       GFP00374
C INSERT USER ASSOCIATED PROGRAM                                        GFP00375
C                                                                       GFP00376
C     PROGRAM MSF                                                       GFP00377
   28 Z=1                                                               GFP00378
      W=51                                                              GFP00379
      IDUM=0                                                            GFP00380
   55 CALL RNG(0,RN)                                                    GFP00381
      CALL INPUT(&56,&57)                                               GFP00382
      CALL RNG(NRND,RN)                                                 GFP00383
      CALL TITLE                                                        GFP00384
      CALL MS2
      IDUM=IDUM+1
      OUT3(IDUM)=DUMY
      OUT4(IDUM)=NMSP
      GO TO 55
C
C END OF ASSOCIATED PROGRAM
C
C
C RETURN TO GFP AT COMPLETION OF EXECUTION OF ASSOCIATED PROGRAM
C
   56 GO TO 59
C
C RETURN TO GFP IF ILLEGAL DATA CARD ENCOUNTERED
C
   57 GO TO 60
C
C  TERMINATE PROGRAM
C
   29 CALL TMGSP(IGSP)
      CALL EXIT
C
C DISPLAY END OF INPUT/OUTPUT ARRAY MESSAGE
C
   58 CALL RESET(IGDS1)
      CALL SCHAM(IGDS1,1)
      CALL PTEXT(IGDS1,'END OF INPUT/OUTPUT ARRAY',25,1,NULL,1,100.0,400
     1.0)
      CALL PTEXT(IGDS1,'USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIR
     1ED PORTION OF PROGRAM',69,2,NULL,1,20.0,300,0)
      CALL EXEC(IGDS1)
      GO TO 35
C
C DISPLAY ASSOCIATED PROGRAM EXECUTION COMPLETED MESSAGE
C
   59 CALL RESET(IGDS1)
      CALL SCHAM(IGDS1,1)
      CALL PTEXT(IGDS1,'ASSOCIATED PROGRAM EXECUTION COMPLETED',38,1,NUL
     1L,1,50,0,400.0)
      CALL PTEXT(IGDS1,'USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIR
     1ED PORTION OF PROGRAM',69,2,NULL,1,20,0,300.0)
      CALL EXEC(IGDS1)
      CALL SALRM(I2250)
      GO TO 35
C
C DISPLAY ILLEGAL DATA MESSAGE
C
   60 CALL RESET(IGDS1)
```

```
      CALL SCHAM(IGDS1,1)                                               GFP00433
      CALL PTEXT(IGDS1,'FOLLOWING DATA CARD CONTAINS ILLEGAL NAME',41,1,GFP00434
     1NULL,1,50.0,400.0)                                                GFP00435
      CALL PTEXT(IGDS1,OUT2(1,1),72,2,NULL,1,10.0,300.0)                GFP00436
      CALL PTEXT(IGDS1,'USE PROGRAM FUNCTION KEYBOARD TO RETURN TO DESIRGFP00437
    1ED PORTION OF PROGRAM',69,3,NULL,1,20.0,200.0)                     GFP00438
      CALL EXEC(IGDS1)                                                  GFP00439
      CALL SALRM(I2250)                                                 GFP00440
      GO TO 35                                                          GFP00441
      END                                                               GFP00442
C                                                                       GFP00443
C INSERT SUBROUTINES, IF ANY, FOR ASSOCIATED PROGRAM                    GFP00444
C                                                                       GFP00445


      SUBROUTINE RNG(N,RN)                                              GFP00446
      NR=N                                                              GFP00447
      IF(NR)10,10,20                                                    GFP00448
   10 IX=12133                                                          GFP00449
      NR=NR+1                                                           GFP00450
   20 DO 50 I=1,NR                                                      GFP00451
      IY=IX*65539                                                       GFP00452
      IF(IY)5,6,6                                                       GFP00453
    5 IY=IY+2147483647+1                                                GFP00454
    6 RN=IY                                                             GFP00455
      RN=RN*.4656613E-9                                                 GFP00456
   50 IX=IY                                                             GFP00457
      RETURN                                                            GFP00458
      END                                                               GFP00459
C                                                                       GFP00460
C                                                                       GFP00461


      SUBROUTINE INPUT(*,*)                                             GFP00462
      DIMENSION NRMPAC(50),NACEPT(50),MINED(300),MINENR(300),MINEX(300),GFP00463
     1MINEY(300),MWEP(50),NSAMSZ(100),FSAMSZ(100),SAMPLE(100),OUT2(18,1)GFP00464
C                                                                       GFP00465
      INTEGER NAME,     A/4HNAIR/,B/4HNMSP/,C/4HMWEP/,D/4HMSWD/,E/4HSHWDGFP00466
     1/,F/4HXERR/,G/4HYERR/,H/4HNSMP/,XI/4HXCHW/,J/4HXCHL/,K/4HERUN/,   GFP00467
     2L/4HNRND/,M/4HNDSC/,N/4HNRSH/,O/4HPMSW/,P/4HXPSH/,Q/4HXXGO/,      GFP00468
     3V,W,X,Y,Z                                                         GFP00469
      COMMON MSWP1,MSWP2,NSP1,NSP2,NSMP,NSAMSZ,FSAMSZ                   GFP00470
      COMMON XMSWP,XNSP,NSAFE                                           GFP00471
      COMMON NAIR,NRMPAC,NACEPT,MINED,NRMINE,MINENR,MINEX,MINEY,NMSP,   GFP00472
     1MWEP,MSWD,NRSH,NSW,NSXL,NCHW,NCHL,NXERR1,NYERR1,NXERRS,NYERRS,    GFP00473
     2NCHANW,NCHANL,FSPSE                                               GFP00474
      COMMON NRNC,NXIN,NRND                                             GFP00475
      COMMON NDSC,Z,W                                                   GFP00476
      COMMON OUT2                                                       GFP00477
   10 READ(8'Z,1000)NAME,N1,N2                                          GFP00478
 1000 FORMAT (A4,2I6)                                                   GFP00479
      Z=Z+1                                                             GFP00480
C                                                                       GFP00481
      IF(NAME-A) 40,20,40                                               GFP00482
   20 NAIR=N1                                                           GFP00483
      READ(8'Z,1001)(NRMPAC(I),NACEPT(I),I=1,NAIR)                      GFP00484
 1001 FORMAT (12I6)                                                     GFP00485
      Y=(NAIR-1)/12+1                                                   GFP00486
      Z=Z+Y                                                             GFP00487
      NRMINE=0                                                          GFP00488
      DO 30 I=1, NAIR                                                   GFP00489
   30 NRMINE=NRMINE+NRMPAC(I)                                           GFP00490
      READ(8'Z,1001)(MINED(I),I=1,NRMINE)                               GFP00491
      Y=(NRMINE-1)/12+1                                                 GFP00492
      Z=Z+Y                                                             GFP00493
      GO TO 10                                                          GFP00494
C                                                                       GFP00495
   40 IF (NAME-B) 52,50,52                                              GFP00496
   50 NMSP=N1                                                           GFP00497
      GO TO 10                                                          GFP00498
C                                                                       GFP00499
   52 IF (NAME-C) 58,54,58                                              GFP00500
   54 READ(8'Z,1001)(MWEP(I),I=1,NMSP)                                  GFP00501
      Y=(NMSP-1)/12+1                                                   GFP00502
      Z=Z+Y                                                             GFP00503
      GO TO 10                                                          GFP00504
C                                                                       GFP00505
   58 IF (NAME-D) 70,60,70                                              GFP00506
   60 MSWD=N1                                                           GFP00507
      GO TO 10                                                          GFP00508
C                                                                       GFP00509
   70 IF (NAME-E ) 90,80,90                                             GFP00510
   80 NSW=N1                                                            GFP00511
      NSXL=N2                                                           GFP00512
      GO TO 10                                                          GFP00513
C                                                                       GFP00514
   90 IF (NAME-F) 110,100,110                                           GFP00515
  100 NXERR1=N1                                                         GFP00516
      NXERRS=N2                                                         GFP00517
      GO TO 10                                                          GFP00518
C                                                                       GFP00519
  110 IF (NAME-G) 130,120,130                                           GFP00520
  120 NYERR1=N1                                                         GFP00521
      NYERRS=N2                                                         GFP00522
      GO TO 10                                                          GFP00523
C                                                                       GFP00524
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  130 IF (NAME-H) 160,140,160                                           GFP00525
  140 NSMP=N1                                                           GFP00526
      READ(8'Z,1001)(NSAMSZ(I),I=1,NSMP)                                GFP00527
      Y=(NSMP-1)/12+1                                                   GFP00528
      Z=Z+Y                                                             GFP00529
      DO 150 I=1,NSMP                                                   GFP00530
  150 FSAMSZ(I)=NSAMSZ(I)                                               GFP00531
      GO TO 10                                                          GFP00532
C                                                                       GFP00533
  160 IF (NAME-XI) 180,170,180                                          GFP00534
  170 NCHW=N1                                                           GFP00535
      NCHANW=NCHW+1                                                     GFP00536
      GO TO 10                                                          GFP00537
C                                                                       GFP00538
  180 IF (NAME-J) 200,190,200                                           GFP00539
  190 NCHL=N1                                                           GFP00540
      NCHANL=NCHL+1                                                     GFP00541
      GO TO 10                                                          GFP00542
C                                                                       GFP00543
  200 IF (NAME-K) 220,210,220                                           GFP00544
  210 RETURN 1                                                          GFP00545
C                                                                       GFP00546
  220 IF (NAME-L) 235,230,235                                           GFP00547
  230 NRND=N1                                                           GFP00548
      GO TO 10                                                          GFP00549
C                                                                       GFP00550
  235 IF (NAME-M) 240,236,240                                           GFP00551
  236 NDSC=N1                                                           GFP00552
      GO TO 10                                                          GFP00553
C                                                                       GFP00554
  240 IF (NAME-N) 260,250,260                                           GFP00555
  250 NRSH=N1                                                           GFP00556
      GO TO 10                                                          GFP00557
C                                                                       GFP00558
  260 IF (NAME-O) 280,270,280                                           GFP00559
  270 MSWP1=N1                                                          GFP00560
      MSWP2=N2                                                          GFP00561
      TEMP1=N1                                                          GFP00562
      TEMP2=N2                                                          GFP00563
  275 XMSWP=TEMP1/TEMP2                                                 GFP00564
      GO TO 10                                                          GFP00565
C                                                                       GFP00566
  280 IF (NAME-P) 300,290,300                                           GFP00567
  290 NSP1=N1                                                           GFP00568
      NSP2=N2                                                           GFP00569
      TEMP3=N1                                                          GFP00570
      TEMP4=N2                                                          GFP00571
  295 XNSP=TEMP3/TEMP4                                                  GFP00572
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      GO TO 10                                                          GFP00573
C                                                                       GFP00574
  300 IF (NAME-Q) 310,500,310                                           GFP00575
  310 WRITE(8'401,1002)NAME,N1,N2                                       GFP00576
 1002 FORMAT(12H                A4,I6,I6,41H                            GFP00577
     1                           )                                      GFP00578
      READ(8'401,1003)(OUT2(I,1),I=1,18)                                GFP00579
 1003 FORMAT(18A4)                                                      GFP00580
      RETURN 2                                                          GFP00581
C                                                                       GFP00582
  500 RETURN                                                            GFP00583
      END                                                               GFP00584
C                                                                       GFP00585
C                                                                       GFP00586


      SUBROUTINE TITLE                                                  GFP00587
      DIMENSION NRMPAC(50),NACEPT(50),MINED(300),MINENR(300),MINEX(300),GFP00588
     1MINEY(300),MWEP(50),NSAMSZ(100),FSAMSZ(100),SAMPLE(100)           GFP00589
C                                                                       GFP00590
      COMMON MSWP1,MSWP2,NSP1,NSP2,NSMP,NSAMSZ,FSAMSZ                   GFP00591
      COMMON XMSWP,XNSP,NSAFE                                           GFP00592
      COMMON NAIR,NRMPAC,NACEPT,MINED,NRMINE,MINENR,MINEX,MINEY,NMSP,   GFP00593
     1MWEP,MSWD,NRSH,NSW,NSXL,NCHW,NCHL,NXERR1,NYERR1,NXERRS,NYERRS,    GFP00594
     2NCHANW,NCHANL,FSPSE                                               GFP00595
      COMMON NRNC,NXIN,NRND                                             GFP00596
      COMMON NDSC,Z,W                                                   GFP00597
C                                                                       GFP00598
      INTEGER Z,W                                                       GFP00599
      WRITE(8'W,2000)                                                   GFP00600
 2000 FORMAT(72H                                                        GFP00601
     1                    )                                             GFP00602
      W=W+1                                                             GFP00603
      WRITE(8'W,2001)                                                   GFP00604
 2001 FORMAT(72H                        A PROBLEM IN MINE FIELD SIMULATION  GFP00605
     1                    )                                             GFP00606
      W=W+1                                                             GFP00607
      WRITE(8'W,2000)                                                   GFP00608
      W=W+1                                                             GFP00609
      WRITE(8'W,2002)NRSH,NRMINE                                        GFP00610
 2002 FORMAT(28H      NUMBER OF SHIPS SCORED (I3,26H SHIPS THROUGH A FIELDGFP00611
     1 OF I3,12H MINES      ))                                          GFP00612
      W=W+1                                                             GFP00613
      WRITE(8'W,2000)                                                   GFP00614
      W=W+1                                                             GFP00615
      WRITE(8'W,2003)NMSP,MSWD                                          GFP00616
 2003 FORMAT(5H     I2,61H MINE SWEEPER PASSES          EFFECTIVE MINE SGFP00617
     1WEEPER WIDTH = I3,1H )                                            GFP00618
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      W=W+1                                                             GFP00619
      WRITE(8'W,2004)MSWP1,MSWP2                                        GFP00620
 2004 FORMAT(52H     PROBABILITY OF MINE SWEEPER ELIMINATING MINE = I4,1GFP00621
     1H/I4,11H           )                                              GFP00622
      W=W+1                                                             GFP00623
      WRITE(8'W,2000)                                                   GFP00624
      W=W+1                                                             GFP00625
      WRITE(8'W,2000)                                                   GFP00626
      W=W+1                                                             GFP00627
      IF(NMSP)3,5,3                                                     GFP00628
    3 WRITE(8'W,2005)                                                   GFP00629
 2005 FORMAT(72H                       MINE SWEEPER ENTRY POINTS        GFP00630
     1                )                                                 GFP00631
      W=W+1                                                             GFP00632
      WRITE(8'W,2000)                                                   GFP00633
      W=W+1                                                             GFP00634
      WRITE(8'W,2006)(MWFP(I),I=1,NMSP)                                 GFP00635
 2006 FORMAT(3(6H      ,10I6,6H      /))                                GFP00636
      K=(NMSP-1)/10+1                                                   GFP00637
      W=W+K                                                             GFP00638
      WRITE(8'W,2000)                                                   GFP00639
      W=W+1                                                             GFP00640
    5 WRITE(8'W,2007)                                                   GFP00641
 2007 FORMAT(72H         DELIVERY VEHICLE         ENTRY ERROR          MGFP00642
     1INE RANGE ERROR )                                                 GFP00643
      W=W+1                                                             GFP00644
      WRITE(8'W,2000)                                                   GFP00645
      W=W+1                                                             GFP00646
      WRITE(8'W,2008)NXERR1,NXERRS                                      GFP00647
 2008 FORMAT(37H           X-COORDINATE              I4,20H             GFP00648
     1       I4,7H       )                                              GFP00649
      W=W+1                                                             GFP00650
      WRITE(8'W,2009)NYERR1,NYERRS                                      GFP00651
 2009 FORMAT(37H           Y-COORDINATE              I4,20H             GFP00652
     1       I4,7H       )                                              GFP00653
      W=W+1                                                             GFP00654
      WRITE(8'W,2000)                                                   GFP00655
      W=W+1                                                             GFP00656
      WRITE(8'W,2000)                                                   GFP00657
      W=W+1                                                             GFP00658
      WRITE(8'W,2010)                                                   GFP00659
 2010 FORMAT(72H  DELIVERY VEHICLE   NUMBER   ENTRY            MINE DISTGFP00660
     1RIBUTION        )                                                 GFP00661
      W=W+1                                                             GFP00662
      WRITE(8'W,2011)                                                   GFP00663
 2011 FORMAT(72H       NUMBER       OF MINES  POINT                     GFP00664
     1                )                                                 GFP00665
      W=W+1                                                             GFP00666
      J1=1                                                              GFP00667
      DO 10 I=1,NAIR                                                    GFP00668
      J2=J1+NRMPAC(I)-1                                                 GFP00669
      J3=MIN0(J1+4,J2)                                                  GFP00670
      WRITE(8'W,2012)I,NRMPAC(I),NACEPT(I),(MINED(J),J=J1,J3)           GFP00671
 2012 FORMAT(9H         I2,12H            I2,5H     I4,2H  I7,I7,I7,I7,IGFP00672
     17,1H )                                                            GFP00673
      W=W+1                                                             GFP00674
      IF(J2-J3)10,10,9                                                  GFP00675
    9 J3=J3+1                                                           GFP00676
      WRITE(8'W,2013)(MINED(J),J=J3,J2)                                 GFP00677
 2013 FORMAT(36H                                    I7,I7,I7,I7,I7,1H ) GFP00678
      W=W+1                                                             GFP00679
   10 J1=J2+1                                                           GFP00680
      WRITE(8'W,2000)                                                   GFP00681
      W=W+1                                                             GFP00682
      WRITE(8'W,2000)                                                   GFP00683
      W=W+1                                                             GFP00684
      WRITE(8'W,2014)NSW                                                GFP00685
 2014 FORMAT(28H     FFFECTIVE SHIP WIDTH = I3)                         GFP00686
      W=W+1                                                             GFP00687
      WRITE(8'W,2015)NSXL                                               GFP00688
 2015 FORMAT(56H     MINIMUM DISTANCE BETWEEN CHANNEL AND SHIP CENTER = GFP00689
     1I3,13H             )                                              GFP00690
      W=W+1                                                             GFP00691
      WRITE(8'W,2016)NSP1,NSP2                                          GFP00692
 2016 FORMAT(46H     PROBABILITY OF A SHIP EXPLODING A MINE = I4,1H/I4,1GFP00693
     17H                 )                                              GFP00694
      W=W+1                                                             GFP00695
      WRITE(8'W,2017)NCHW,NCHL                                          GFP00696
 2017 FORMAT(21H     CHANNEL WIDTH = I5,27H          CHANNEL LENGTH = I5GFP00697
     1,14H              )                                               GFP00698
      W=W+1                                                             GFP00699
      WRITE(8'W,2000)                                                   GFP00700
      W=W+1                                                             GFP00701
      WRITE(8'W,2000)                                                   GFP00702
      W=W+1                                                             GFP00703
      WRITE(8'W,2018)                                                   GFP00704
 2018 FORMAT(72H      SAMPLE    SAMPLE    SAMPLE     SAMPLE      MINIMUMGFP00705
     1       MAXIMUM  )                                                 GFP00706
      W=W+1                                                             GFP00707
      WRITE(8'W,2019)                                                   GFP00708
 2019 FORMAT(72H      NUMBER     SIZE      MEAN     VARIANCE    SHIPS SAGFP00709
     1FE    SHIPS SAFE)                                                 GFP00710
      W=W+1                                                             GFP00711
      WRITE(8'W,2000)                                                   GFP00712
      W=W+1                                                             GFP00713
      WRITE(8'W,2000)                                                   GFP00714
      W=W+1                                                             GFP00715
      RETURN                                                            GFP00716
      END                                                               GFP00717
C                                                                       GFP00718
C                                                                       GFP00719
      SUBROUTINE MS2                                                    GFP00720
C                                                                       GFP00721
C     FORTRAN VERSION OF MINESWEEP PROB.                RHS 7-12-62     GFP00722
C                                                                       GFP00723
      DIMENSION NRMPAC(50),NACEPT(50),MINED(300),MINENR(300),MINEX(300),GFP00724
     1MINEY(300),MWEP(50),NSAMSZ(100),FSAMSZ(100),SAMPLE(100),OUT2(18,1)GFP00725
      INTEGER Z,W                                                       GFP00726
C                                                                       GFP00727
      COMMON MSWP1,MSWP2,NSP1,NSP2,NSMP,NSAMSZ,FSAMSZ                   GFP00728
      COMMON XMSWP,XNSP,NSAFE                                           GFP00729
      COMMON NAIR,NRMPAC,NACEPT,MINED,NRMINE,MINENR,MINEX,MINEY,NMSP,   GFP00730
     1MWEP,MSWD,NRSH,NSW,NSXL,NCHW,NCHL,NXERR1,NYERR1,NXERRS,NYERRS,    GFP00731
     2NCHANW,NCHANL,FSPSE                                               GFP00732
      COMMON NRNC,NXIN,NRND                                             GFP00733
      COMMON NDSC,Z,W                                                   GFP00734
      COMMON OUT2                                                       GFP00735
      COMMON DUMY                                                       GFP00736
C                                                                       GFP00737
C                                                                       GFP00738
      NCHANW=NCHW+1                                                     GFP00739
      NCHANL=NCHL+1                                                     GFP00740
C                                                                       GFP00741
      DUMY1=0.0                                                         GFP00742
      DO 40 I=1,NSMP                                                    GFP00743
      MING=1000                                                         GFP00744
      MAXG=0                                                            GFP00745
      NOUT1=I                                                           GFP00746
      NOUT2=NSAMSZ(I)                                                   GFP00747
      FSPSM=0                                                           GFP00748
      DO 20 J=1,NOUT2                                                   GFP00749
      CALL MINSIM                                                       GFP00750
      FSPSE=NSAFE                                                       GFP00751
      SAMPLE(J)=FSPSE                                                   GFP00752
      MING=MINO(MING,NSAFE)                                             GFP00753
      MAXG=MAXO(MAXG,NSAFE)                                             GFP00754
   13 FMAXG=FSPSE                                                       GFP00755
   20 FSPSM=FSPSM+FSPSE                                                 GFP00756
      OUT30=FSPSM/FSAMSZ(I)                                             GFP00757
      DUMY1=DUMY1+OUT30                                                 GFP00758
      SAMAVE=OUT30                                                      GFP00759
      STORE=0                                                           GFP00760
      DO 30 K=1,NOUT2                                                   GFP00761
      TEMP=SAMPLE(K)-SAMAVE                                             GFP00762
   30 STORE=STORE+TEMP**2                                               GFP00763
      OUT40=STORE/(FSAMSZ(I)-1.)                                        GFP00764
      WRITE(8'W,2001)NOUT1,NOUT2,OUT30,OUT40,MING,MAXG                  GFP00765
 2001 FORMAT(7H        I3,8H          I3,5H     F5.2,5H     F7.4,8H     GFP00766
     1I3,11H          I3,4H     )                                       GFP00767
   40 W=W+1                                                             GFP00768
      DUMY=DUMY1/NSMP                                                   GFP00769
      RETURN                                                            GFP00770
      END                                                               GFP00771
C                                                                       GFP00772
C                                                                       GFP00773


      SUBROUTINE MINSIM                                                 GFP00774
C                                                                       GFP00775
      DIMENSION NRMPAC(50),NACEPT(50),MINED(300),MINENR(300),MINEX(300),GFP00776
     1MINEY(300),MWEP(50),NSAMSZ(100),FSAMSZ(100),SAMPLE(100)           GFP00777
C                                                                       GFP00778
      COMMON MSWP1,MSWP2,NSP1,NSP2,NSMP,NSAMSZ,FSAMSZ                   GFP00779
      COMMON XMSWP,XNSP,NSAFE                                           GFP00780
      COMMON NAIR,NRMPAC,NACEPT,MINED,NRMINE,MINENR,MINEX,MINEY,NMSP,   GFP00781
     1MWEP,MSWD,NRSH,NSW,NSXL,NCHW,NCHL,NXERR1,NYERR1,NXERRS,NYERRS,    GFP00782
     2NCHANW,NCHANL,FSPSE                                               GFP00783
      COMMON NRNC,NXIN,NRND                                             GFP00784
      COMMON NDSC                                                       GFP00785
      NULL=2147483647                                                   GFP00786
      DO 10 I=1,NRMINE                                                  GFP00787
      MINENR(I)=0                                                       GFP00788
      MINEX(I)=NULL                                                     GFP00789
   10 MINEY(I)=NULL                                                     GFP00790
      J=1                                                               GFP00791
      DO 20 I=1,NAIR                                                    GFP00792
      CALL RNG(NDSC,RN)                                                 GFP00793
      NXIN=NYERR1*RN                                                    GFP00794
      MINEY(J)=NXIN+MINED(J)-NYERR1/2                                   GFP00795
      CALL RNG(NDSC,RN)                                                 GFP00796
      NXIN=NXERR1*RN                                                    GFP00797
      MINEX(J)=NXIN+NACEPT(I)-NXERR1/2                                  GFP00798
      MINENR(J)=J                                                       GFP00799
   20 J=J+NRMPAC(I)                                                     GFP00800
      DO 30 J=1,NRMINE                                                  GFP00801
   21 IF (MINEY(J)-NULL) 30,22,30                                       GFP00802
   22 CALL RNG(NDSC,RN)                                                 GFP00803
      NXIN=NYERRS*RN                                                    GFP00804
      MINEY(J)=NXIN+MINED(J)+MINEY(J-1)-NYERRS/2                        GFP00805
C                                                                       GFP00806
```

```
      CALL RNG(NDSC,RN)                                                 GFP00807
      NXIN=NXERRS*RN                                                    GFP00808
      MINEX(J)=NXIN+MINEX(J-1)-NXERRS/2                                 GFP00809
      MINENR(J)=J                                                       GFP00810
   30 CONTINUE                                                          GFP00811
C                                                                       GFP00812
C     LIMIT                                                             GFP00813
C                                                                       GFP00814
      DO 40 I=1,NRMINE                                                  GFP00815
      IF (MINEX(I)) 39,38,38                                            GFP00816
   38 IF (MINEY(I))39,37,37                                             GFP00817
   39 MINEX(I) = NULL-7                                                 GFP00818
      MINEY(I) = MINEX(I)                                               GFP00819
   37 IF (MINEY(I)-NCHANL) 31,33,33                                     GFP00820
   31 IF (MINEX(I)-NCHANW) 40,33,33                                     GFP00821
   33 MINEY(I)=NULL-1                                                   GFP00822
      MINEX(I)=MINEY(I)                                                 GFP00823
   40 CONTINUE                                                          GFP00824
C                                                                       GFP00825
C     SORT MINE TABLE                                                   GFP00826
C                                                                       GFP00827
      J=NRMINE                                                          GFP00828
   50 K=J                                                               GFP00829
      J1=J-1                                                            GFP00830
      DO 60 I=1,J1                                                      GFP00831
      IF (MINEY(I)-MINEY(K)) 55,60,60                                   GFP00832
   55 K=I                                                               GFP00833
   60 CONTINUE                                                          GFP00834
      NT1=MINENR(J)                                                     GFP00835
      MINENR(J)=MINENR(K)                                               GFP00836
      MINENR(K)=NT1                                                     GFP00837
      NT1=MINEX(J)                                                      GFP00838
      MINEX(J)=MINEX(K)                                                 GFP00839
      MINEX(K)=NT1                                                      GFP00840
      NT1=MINEY(J)                                                      GFP00841
      MINEY(J)=MINEY(K)                                                 GFP00842
      MINEY(K)=NT1                                                      GFP00843
      J=J-1                                                             GFP00844
      IF (J-1) 70,70,50                                                 GFP00845
C                                                                       GFP00846
C     MINE SWEEPER PASS                                                 GFP00847
C                                                                       GFP00848
   70 IF(NMSP) 140,140,85                                               GFP00849
   85 DO 130 I=1,NMSP                                                   GFP00850
      NLOLIM=MWEP(I)-MSWD/2-1                                           GFP00851
      NUPLIM=NLOLIM+MSWD+2                                              GFP00852
      DO 120 J=1,NRMINE                                                 GFP00853
      IF (NLOLIM-MINEX(J)) 90,120,120                                   GFP00854
   90 IF (MINEX(J)-NUPLIM) 100,120,120                                    GFP00855
  100 CALL RNG(NDSC,RN)                                                   GFP00856
      IF (RN-XMSWP) 110,120,120                                           GFP00857
  110 MINEX(J)=NULL-2                                                     GFP00858
      MINEY(J)=MINEX(J)                                                   GFP00859
  120 CONTINUE                                                            GFP00860
  130 CONTINUE                                                            GFP00861
C                                                                         GFP00862
C     SHIP START                                                          GFP00863
C                                                                         GFP00864
  140 NSAFE=0                                                             GFP00865
      NSUNK=0                                                             GFP00866
      NRNC=NCHW-NSXL*2                                                    GFP00867
      DO 190 I=1,NRSH                                                     GFP00868
      CALL RNG(NDSC,RN)                                                   GFP00869
      NXIN=RN*NRNC                                                        GFP00870
      NT1=NXIN                                                            GFP00871
      CALL RNG(NDSC,RN)                                                   GFP00872
      NXIN=RN*NRNC                                                        GFP00873
      NLOLIM=(NXIN+NT1)/2+NSXL-NSW/2-1                                    GFP00874
      NUPLIM=NLOLIM+NSW+2                                                 GFP00875
      DO 185 N=1,NRMINE                                                   GFP00876
      IF (NLOLIM-MINEX(N)) 150,185,185                                    GFP00877
  150 IF (MINEX(N)-NUPLIM) 160,185,185                                    GFP00878
  160 CALL RNG(NDSC,RN)                                                   GFP00879
      IF (RN-XNSP) 170,180,180                                            GFP00880
  170 MINEX(N)=NULL-3                                                     GFP00881
      MINEY(N)=MINEX(N)                                                   GFP00882
      NSUNK=NSUNK+1                                                       GFP00883
      GO TO 190                                                           GFP00884
  180 MINEX(N)=NULL-4                                                     GFP00885
      MINEY(N)=MINEX(N)                                                   GFP00886
  185 CONTINUE                                                            GFP00887
C                                                                         GFP00888
      NSAFE=NSAFE+1                                                       GFP00889
  190 CONTINUE                                                            GFP00890
  200 RETURN                                                              GFP00891
      END                                                                 GFP00892
```

LIST OF REFERENCES

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13. ABSTRACT

A General computer program was designed, using the FORTRAN IV language, to utilize the IBM 2250 Display Unit in conjunction with the IBM System/360 Operating System. The user may adapt an associated program so that it may be an integral part of this general program. The general program provides the user with the ability to display a static information array and an input data array. The user may insert input data, for his associated program, from on-line input devices or directly through the IBM 2250 alphameric keyboard and may change this data from the keyboard. The associated program may be executed repeatedly, subject to system time constraints, and both alphameric and graphical output data from the associated program may be displayed after each execution.

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