A COMPUTER PROGRAM
TO IMPROVE STADAN
STATION SCHEDULING

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ABSTRACT $2 3 5 5^6$

As a first step toward automatic STADAN station scheduling, a computer program is developed to: (1) relieve the STADAN station scheduler from sifting through volumes of predicted satellite operations (i.e., Operational Predictions for Satellites) data to obtain the data necessary for station scheduling; (2) save the STADAN station scheduler the time, labor, and perhaps human errors of transferring the scheduling data to a station scheduling sheet or chart; and (3) place the scheduling data in a format more suitable for scheduling. The computer program is described in sufficient detail to permit its operation by anyone with a minimal understanding of general computer programming.

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INTRODUCTION

Scheduling of STADAN stations has become increasingly more difficult because of the volume and complexity of predicted satellite data which the scheduler must use. A computer program has been developed that takes the data calculated by the revised Goddard Space Flight Center (GSFC) orbital program and: (1) edits the predicted satellite operations data, extracting only pertinent scheduling data; (2) generates or calculates new predicted satellite operations data when the time interval (during a station pass†) of any two successive predicted satellite operations data points equals or exceeds two minutes; and (3) places the results of (1) and (2) in a suitable format for station scheduling. (It should be noted that all satellite and STADAN station conflicts, at any arbitrary time, will be immediately apparent on "first sight" inspection).

During the initiation of the study, the plans were made to develop, in addition to the aforementioned computer program (Phase I), a second computer program (Phase II) which would resolve all scheduling conflicts and make all station scheduling decisions. Heretofore, the Phase II operation has been manual. After Phase I is put into operation and proven, an effort can be made to develop a Phase II-type computer program.

The Phase I computer program is written mostly in the FORTRAN IV language. However, several control cards of the IBM 7090/7094 IBSYS Operating System Generalized Sorting System are utilized along with several MAP routines for multireel output; the END OF FILE (EOF) mark is written automatically when the END OF TAPE (EOT) reflective spot is sensed during writing. Reel switching occurs after the EOF is written. The listed "deck names", FRWB, FRWD, FSLI, FXEM, NOSYS, and GOSYS, within the Phase I computer program (Appendix A) represent binary program decks constituting modified IBM FORTRAN IV subroutines (written in MAP). These binary decks are utilized to enable the IBM 7094 to read the next file, if desired by the programmer, after encountering the EOF mark on an input tape and to use the record, as read the 100th time, if the "permanent read redundancy" error condition is encountered.

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*STADAN is the denotation of *Space Tracking And Data Acquisition Network*. Station scheduling is defined to be the allocation of the service time of a STADAN station to the satellites which pass through the station's field of tracking and data acquisition.
†Station pass is defined to be a passing of the satellite through the station's field of tracking and data acquisition.

The FORTRAN statements, SORT control cards or instructions, MAP routines, and the aforementioned deck names of the Phase I computer program are given in Appendix A.

SUBPROGRAMS OF PHASE I

The computer program of Phase I consists of three subprograms:

Subprogram 1 edits the predicted satellite operations data, extracting only pertinent scheduling data; generates or calculates new predicted satellite operations data when the time interval (during a station pass) of any two successive predicted satellite operations data points equals or exceeds two minutes; and places the results in a format suitable for sorting internally on the IBM 7090/7094.

Subprogram 2 sorts the results of subprogram 1 on the IBM 7090/7094 with respect to date, time, station, and satellite.

Subprogram 3 places the results of subprogram 2 in the final format as illustrated in Figure 1 (see page 13).

Subprogram 1

Input Data Cards

For a run of subprogram 1, (n + 1) + c data cards are input for n satellites of input data, where c is the total number of continuation cards. That is, excluding the continuation cards, one data card is input for each satellite of input data plus a data card which contains the total number of satellites, n, whose data are input into the computer for the run of subprogram 1.

The parameters on the input data cards of subprogram 1 are:

TNSATL = total number of satellites whose data are input into the computer for a run of subprogram 1.

Z = an alphabetic or non-numerical character assigned to the satellite, whose data are input into the computer for a run of subprogram 1, to indicate, in the final output, that the satellite is in the field of tracking and data acquisition of a STADAN station but is not in the sunlight; and to identify the satellite and its column of data, in the final output, when TNSATL does not exceed the total number of alphabetic and "usable" special characters. (If TNSATL exceeds the total number of alphabetic (26) and usable special characters, it is suggested that numbers or numerical characters, assigned to the satellites by subprogram 1, be used to identify the satellites and their columns of data in the final output with Z = A for all satellites whose data are input into the computer for the run of subprogram 1. (These numerical characters, obtainable from the on-line print-out of subprogram 1, would be inserted with the input data of subprogram 3 as the values of the parameter (NOT(I).)

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'JPSI = An assigned elevation angle such that the subprogram 1 input data of any pass of the satellite through the field of tracking and data acquisition of any STADAN station will be deleted if the maximum elevation angle of the satellite during the pass does not equal or exceed it. (With a minor modification in the subprogram 1 computer program, JPSI can be varied for each STADAN station which is scheduled to track and/or acquire data from the satellite.)

KEY = Number (0, 1, or 2) which enables the program operator to "inform" the computer of the number of files and their arrangement on the subprogram 1 input reel(s) of predicted operations data for a satellite.

KEY = 0 => every input reel of predicted operations data for the satellite has only one file.

KEY = 1 => first input reel of predicted operations data for the satellite has only two files while each of the other input reels, if any, has only one.

KEY = 2 => a second input reel of predicted operations data for the satellite has only two files while each of the other input reels including the first (i.e., the reel which contains identifications and World Map data) has only one. (Due to the format revision of the predicted satellite operations data and the subsequent modification of subprogram 1, it is not necessary to use "KEY = 2". When, due to identification and World Map data, two files appear on any input reel except the first, eliminate and don't input the reel(s) of identification and World Map data which precede the "two file reel." Then, treat the two file reel as the first input reel of predicted operations data for the satellite, and set K = 1. It is assumed, based on past operations, that the identification and World Map data will precede, on the input reels of predicted operations data for the satellite, the predicted operations data.)

NOS = total number of STADAN stations whose data are to be deleted during the run of subprogram 1.

NOSTAT = six character name of STADAN station whose data are to be deleted during the run of subprogram 1. (The order of the names of the NOSTAT stations on the input data card(s) is not important.)

NOSTAT(L) = NOSTAT in the Lth position of the linear array of NOSTAT(S) on the input data card (where L = 1, 2, ..., NOS).

It may be worthwhile to note that, in order to delete all the predicted satellite operations data of a satellite, the program operator merely does not input the data of that satellite. The above statement assumes, based on past operations, that the predicted satellite operations data of two or more satellites are not contained on the same reel.

One hundred core memory locations have been allocated for the STADAN stations (see the parameter JSTAT in the Dimension statement of subprogram 1, Appendix A). If necessary, the program operator may allocate additional (up to or beyond several thousand on the IBM 7094) core memory locations for the STADAN stations. The core memory allocations of the parameter NOSTAT may be adjusted accordingly. Due to one or two adjustment "gimmicks" in the computer program, it will never be necessary to allocate additional core memory locations for any of the other parameters in the DIMENSION statement. In fact, the core memory allocations of JTIM, MINS, JEL, JCHAR, JDAY, JDATE, NTIM, NEL, NCHAR, NDAY, and NDATE, respectively, may be decreased if several FORTRAN statements are adjusted accordingly. (The core memory allocations of each of the aforementioned parameters may be decreased to, but not less than, *two* locations.) If, however, within the predicted satellite operations data, there exists a large number of station passes such that the number of minutes in the duration of each station pass is greater than the core memory allocations of the parameters, subprogram 1 would cause the computer to increase its "looping" and, hence, its running time.

Subprogram 2

Information on the control cards of this subprogram may be obtained from any up-to-date manual on the IBM 7090/7094 IBSYS Operating System Generalized Sorting System. For normal non-stop runs, the subprogram 2 computer program, as shown in Appendix A, may remain unchanged with the possible exception of the "REEL/n" field of the INPUT FILE control card. The number of reels of data input into the computer for a run of subprogram 2 is denoted by n in the "REELS/n" field. It is necessary to update the value of n for each run of subprogram 2. For example, suppose that the number of reels of subprogram 2 input data is 3 for a particular run, then n is 3 and the INPUT FILE control card can be written as

FILE, INPUT/1, REELS/3, MODE/D, DENSITY/H, BLOCKSIZE/5.

The "REELS/n" field may be omitted for a one-reel file, i.e., the number of reels of subprogram 2 input data is one.

Subprogram 3

Input Data Cards

For a run of subprogram 3, (n + m + 3) + c data cards, where c is the total number of continuation cards, are input for n satellites and m stations of input data. The parameters on these data cards are:

DOTS 2 = two special characters which are used to separate, on the final print-out sheet, the data of a STADAN station from the data of the STADAN station(s) adjacent to it. (The character "●" followed by the blank character were used in the simulated runs and Figure 1.)

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DASH = two special characters used to indicate that the satellite or spacecraft is not in the field of tracking and data acquisition of the STADAN station. (Two blank characters were used in the simulated runs and Figure 1.)

TNSTAT = total number of distinct stations whose names are printed on-line during the computer run of subprogram 1.

TNSATL = same definition as TNSATL of subprogram 1. (TNSATL of subprogram 3 is also equivalent to the total number of distinct satellites whose identifications are printed on-line during the computer run of subprogram 1, unless the program operator inputs the data of a satellite whose data are subsequently deleted because every STADAN station, through whose field of tracking and data acquisition the satellite is predicted to pass, is a NOSTAT station. (See the definition of NOSTAT, page 3))

REELS = total number of reels of data which are output during the computer run of subprogram 2.

KSTAT = six (or less) character name of STADAN station. (BPOINT is an example.)

JK = station count or number assigned to KSTAT by the computer during the run of subprogram 1. (All distinct KSTATs or names of STADAN stations whose data are input into the computer during a run of subprogram 1 are assigned numbers by the computer in ascending order, beginning with number 1, as they are input into the computer in a non-NOSTAT status. (If KSTAT is a NOSTAT station for a satellite, it is neither assigned a number nor printed on-line during that computer "satellite loop." However, KSTAT could be assigned a number and printed on-line during succeeding computer satellite loops.).)

NSATL = total number of distinct satellites whose identifications are printed on-line, during the computer run of subprogram 1, within the same record (the same line) as KSTAT. (NSATL is also equivalent to the total number of distinct satellites which pass through the field of tracking and data acquisition of the KSTAT station and whose predicted data are input into the computer for the run of subprogram 1, unless the KSTAT station is a NOSTAT station to one or more of the distinct satellites.)

NUM = satellite count or number assigned to the satellite by the computer during the run of subprogram 1. (All distinct satellites whose predicted data are input into the computer during a run of subprogram 1 are assigned numbers by the computer in ascending order, beginning with the number 1, as their predicted data are input into the computer. If every STADAN station, through whose field of tracking and data acquisition the satellite

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is predicted to pass, is a NOSTAT station, the NUM of the satellite is not printed on-line, even though a number is assigned to that satellite by the computer during the run of subprogram 1.)

NUM (JK, I) = NUM (satellite count) of the satellite whose identification number is
(I = 1, 2, ..., NSATL) printed on-line, during the computer run of subprogram 1, within the same record as the KSTAT station whose station count is JK and which has the Ith smallest NUM of all NUM(JK, I)I = 1, 2, . . . NSATL.

NOT(I) = Z of the satellite, whose NUM or satellite count is NUM(JK, I), followed by the blank character. (NOT(I) is also printed on-line, during the computer run of subprogram 1, within the same record as the identification of the above satellite and, hence, NUM(JK, I).)

FDATE = the smallest (or earliest) Start-Date of all the Start-Dates of the satellites whose predicted operations data are input into the computer for the run of subprogram 1.

FTIME = the smallest (or earliest) Start-Time of all the Start-Times of the satellites whose predicted operations data are input into the computer for the run of subprogram 1.

LDATE = the largest (or oldest) Stop-Date of all the Stop-Dates of the satellites whose predicted operations data are input into the computer for the run of subprogram 1.

LTIME = the largest (or oldest) Stop-Time of all the Stop-Times of the satellites whose predicted operations data are input into the computer for the run of subprogram 1.

Z = Z of subprogram 1.

IDENT = identification number of the satellite. (The identification number consists presently of five numerical characters.)

JSATL = partial or full name of the satellite. (JSATL = partial name of the satellite if the name of the satellite consists of seven or more characters. For example, if EXPLORER is the name of the satellite, JSATL = EXPLOR.)

NOS = partial name of the satellite if the name of the satellite consists of seven or more characters. Using the example from above, if EXPLORER is the name of the satellite, then NOS = ER followed by two blank characters.

JSDAT = Start-Date of the satellite.

JSTIM = Start-Time of the satellite.

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JXDAT = Stop-Date of the satellite.

JXTIM = Stop-Time of the satellite.

JPSI = JPSI of subprogram 1. (In the format, exterior location 74, of subprogram 3 in Appendix A, space has been alloted to enable the program operator to insert a "decimal" character within the value of JPSI of subprogram 1.)

On the second input data card of subprogram 3, the values of the parameters TNSTAT, TNSATL, and REELS may be predetermined before the computer runs. The values of the parameters TNSTAT and TNSATL can also be easily determined from the subprogram 1 on-line print-out. However, as we indicated above, the value of TNSATL input into the computer for the run of subprogram 1 is different from the value of TNSATL determined from the subprogram 1 on-line print-out if the program operator inputs the data of a satellite subsequently deleted because every STADAN station through whose field of tracking and data acquisition the satellite is predicted to pass is a NOSTAT station. In this event, either value of TNSATL may be used (for the subprogram 3 input) since the predicted operational data of that satellite will not be processed or even considered during the computer run. (If the subprogram 1 input value of TNSATL is used, the set of input data cards whose parameters are Z, IDENT, JSATL, NOS, JSDAT, JSTIM, JXDAT, JXTIM, and JPSI should contain an input data card on every satellite whose predicted operational data are input for the computer run of subprogram 1. If the subprogram 1 on-line print-out value of TNSATL is used, the set of input data cards should contain an input data card on every satellite *except* the satellites whose predicted operational data are deleted.) In order to eliminate any possible variation of the value of TNSATL during the computer runs of subprograms 1, 2, and 3, the program operator should pre-check the station listing of each satellite, whose predicted operational data are input for the computer "run" of subprogram 1, and *not* input the data of any satellite whose predicted operational data would be deleted.

On the set of input data cards whose parameters are JK, KSTAT, NSATL, NUM(JK, I), and NOT(I), I = 1, 2, ..., NSATL, the values of the aforementioned parameters should be obtained and determined from the subprogram 1 on-line print-out since the relationship of the values of JK, KSTAT, NUM(JK, I) and NOT(I), I = 1, 2, ..., NSATL, on each member (input data card) of the aforementioned set depends on the order in which the predicted operational data of the satellites are input into the computer for a run of subprogram 1.

Records of data consisting of the values of JK, KSTAT, NUM(JK, I), NOT(I), and IDENT, for some I, I = 1, 2, ..., NSATL, are printed on-line by the computer during the run of subprogram 1. The following is an example of an on-line print-out of a subprogram 1 computer run.

1	BPOINT	1	A	62681
2	FTMYRS	1	A	62681
1	BPOINT	2	B	72798
3	JOBURG	2	B	72798

```
2  FTMYRS              3  C  92671
3  JOBURG              4  D  42013
```

From the example above, it is easy to see that TNSTAT = 3 and TNSATL = 4. The set of input data cards whose parameters are JK, KSTAT, NSATL, NUM(JK, I), and NOT(I), I = 1,2,..., NSATL, consist of three members.

First Input Card: JK = 1; KSTAT = BPOINT; NSATL = 2; NUM(1, 1) = 1;
                    NOT(1) = A; NUM(1, 2,) = 2; and NOT(2) = B.

Second Input Card: JK = 2; KSTAT = FTMYRS; NSATL = 2; NUM(2, 1) = 1;
                    NOT(1) = A; NUM(2, 2) = 3; and NOT(2) = C.

Third Input Card: JK = 3; KSTAT = JOBURG; NSATL = 2; NUM(3, 1) = 2;
                    NOT(1) = B; NUM(3, 2) = 4; and NOT(2) = D.

For a more automatic and perhaps faster operation from subprogram 1 through subprogram 3, subprogram 1 may be modified so that the array of input data whose parameters are TNSTAT, TNSATL, JK, KSTAT, NSATL, NUM(JK, I), and NOT(I), I = 1, 2, ..., NSATL, are either card punched on-line by the computer or written on a magnetic tape separate from the other output data tapes. (The operation of punching cards on-line should be avoided on T&DS' IBM 7094 computers at GSFC.) The on-line punched cards or magnetic tape are/is input into the computer later for the run of subprogram 3. The subprogram 1 on-line print-out would no longer be vital to the operation of subprogram 3.

Memory Allocations

As in subprogram 1, one hundred core memory locations have been allocated for the STADAN stations or, more specifically, for the values (names of the STADAN stations) of the parameter JSTAT. The core memory allocations for the parameters JSTAT and MSATL are and should always be the same. (See the DIMENSION statement of subprogram 3.) The core memory allocations for each of the parameters NUM, NOT, MOT, NSU, and JEL were allocated as a function of ten physical tape units (tape drives) for output and/or 150 character-wide print-out paper or sheets for the final results.

Let x be the number of core memory locations which are allocated for the names of the STADAN stations; y be the maximum number of tape drives, attached to the computer, which can be utilized for output during the run of subprogram 3; and Z be the total number of characters which can be written width-wise across the print-out paper which will be utilized for the final results. Then, the DIMENSION statement of subprogram 3 can be formulated, using FORTRAN language notations, as

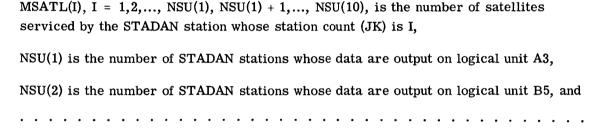$$\text{DIMENSION NUM}\left(x, \frac{Z-6}{2}\right), \text{ NOT}\left(y*\left(\frac{Z-6}{2}\right)\right), \text{ MOT}\left(y*\left(\frac{Z-6}{2}\right)\right), \text{ JSTAT}(x), \text{ MSATL}(x),$$

$$\text{NSU}(y), \text{ JEL}\left(\frac{Z-6}{2}\right)$$

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•Subprogram 3, Appendix A, is written to print the final results on 132 or more character-wide print-out paper. However, if the additional width on the "greater than 132" character-wide print-out paper is to be utilized, two FORTRAN statements must be adjusted according to the increase.

Format Updating

In Figure 1, the number of satellites serviced by a STADAN station is the same for all the stations. However, this is not always the case because the number of satellites serviced by two or more distinct STADAN stations may vary. Hence, in order to output the scheduling data in the final format without wasting spaces on the print-out sheet between the data of two stations, it is necessary to update the output formats (exterior statement numbers 98, 99, 100, 101, 102, 103, 104, 105, 106, and 107) of subprogram 3.

The output formats of subprogram 3 are generalized and formulated in Appendix B where,

MSATL(I), I = 1,2,..., NSU(1), NSU(1) + 1,..., NSU(10), is the number of satellites serviced by the STADAN station whose station count (JK) is I,

NSU(1) is the number of STADAN stations whose data are output on logical unit A3,

NSU(2) is the number of STADAN stations whose data are output on logical unit B5, and

. . . .

NSU(10) is the number of STADAN stations whose data are output on logical unit A8.

If MSATL(I), I = 1,2,..., NSU(10), is 2, it is suggested that the name, KSTAT, of the STADAN station, whose station count is I, be input on the input data cards of subprogram 3 as a four-character name instead of a six-character name followed by two blank characters. Otherwise, the six-character names of at least two STADAN stations will be written together in the heading of the final print-out with no space between them.

If MSATL(I), I = 1,2,..., NSU(10), is 1, the formulated formats of Appendix B do not hold true. In order to rectify this, it is suggested that the name, KSTAT, of the STADAN station, whose station count is I, be input on the input data cards of subprogram 3 as a two character name followed by four blank characters; the A6 (of the aforementioned formats), which precede the expression which contains MSATL(I), be changed to A2; and set (2* MSATL(I) - 4), the expression which contains MSATL(I), equal to 2.

Elimination of Computer Hang-Up and Unnecessary Dumps

If a logical tape unit referenced in subprogram 3 is not used during a run of subprogram 3, the 7094 computer system of T&DS at GSFC will still select and unload that unit after the run. This may often result in a computer hang-up and an unnecessary dump of core storage. To avoid this, appropriate $NAME card(s) should be inserted into the subprogram 3 deck after the $IBJOB

card, along with the proper instruction on the instruction card. For example, in a short simulated run of subprogram 3, only logical units A5 and A3 were utilized during the computer run. In order to stop the computer from selecting and attempting to unload logical units A6, B5, B6, C1, C2, A7, B7, B8, B9, and A8 (all of subprogram 3), nine $NAME cards were inserted into the subprogram 3 deck after the $IBJOB card in the form

COLUMN 1 16

$NAME .UNI . = .UN19.

where I = 06, 15, 16, 21, 22, 07, 17, 18, 08. Then an output reel for logical unit B9 (.UN19.) was requested on the instruction card.

The MAP routine for multireel output on a particular logical tape unit should be inserted into the subprogram 3 deck for a computer run if and only if that logical unit will be utilized during that run (or all MAP routines for multireel output on the logical tape units which will not be utilized during a computer run should be removed from the subprogram 3 computer program of Appendix A for that run). If a MAP routine for multireel output on a logical tape unit is inserted into the subprogram 3 deck for a computer run, the computer will select and attempt to unload the logical tape unit after that run.

Output

If the data at some time t, as illustrated in Figure 1, exceed 132 characters, two or more physical tape units (tape drives) are used for output during the run of subprogram 3. If the data at some time t, as illustrated in Figure 1, exceed 1320 characters (132 characters times 10 tape drives), or if more than ten tape drives are needed for output, the computer will stop its execution of subprogram 3 after printing an "informative" message on-line and return control to the Basic Monitor. (If ten tape drives are used for output during the computer run of subprogram 3, logical tape unit A2 (SYSIN1, the system input tape unit for the T&DS IBM 7094 computers at GSFC) is eliminated by subprogram 3, and the computer "hangs-up" *after* the subprogram 3 computer run.)

The output tapes of subprogram 3 are printed off-line, by the IBM 1401 computer, on 132 character-wide paper or sheets. The print-out sheets of the output tape(s) of each tape drive used for output during the subprogram 3 computer run are decollated and then bound into a book. Within each book of scheduling data, there exists no unused character space between the data of two adjacent STADAN stations even though the number of satellites serviced by one of the stations is not the same as the number of satellites serviced by the other. However, an unused character space or spaces may exist at the end, width-wise, of each page or sheet of a book of scheduling data, since all the scheduling data of each STADAN station are contained within one book of scheduling data. (Subprogram 3 can be modified or revised so that unused character spaces cannot exist when the station count (JK) of each STADAN station within the book is less than the station count of any STADAN station within another book of the same run. The result would be

that the data of some STADAN stations would be divided or broken-up and placed into two separate books. This might appear to be bad human engineering from the viewpoint of the STADAN station scheduler.)

PASS-CHAINS OF FINAL OUTPUT

In the final print-out or books of scheduling data, it is easy to recognize the station passes of each satellite by observing the vertical chains of data, at one minute intervals, under the satellite's notation or identification character(s). Henceforth, a vertical chain of data at one minute intervals will be called a pass-chain.

Regardless of the time increment variations of successive data points of predicted satellite operations, no break(s) will ever occur in a pass-chain except when, during a station pass of more than 1 day, the day count increment (disregarding the 365 or 366 days/year) of two successive data points of predicted satellite operations exceeds 1 day. Scheduling data are not generated for the date or dates on which no data point of predicted satellite operations is computed. If at least 1 data point of predicted satellite operations for a station pass of any duration is computed for a date, additional scheduling data will be generated to complete the pass-chain for that date. To guard against breaks in the pass-chain, the time increment of any two successive data points of predicted satellite operations for a station pass should never exceed 24 hours or 1440 minutes. (While it is recognized that the above case is remote, the situation could be encountered with Syncom-type satellites and deep space probe vehicles.)

METHODS FOR HANDLING EXTRAORDINARILY LARGE NUMBERS
OF STATIONS AND SATELLITES

Each of the T&DS IBM 7094 computers (A, B, and C) at GSFC has a maximum of 14 physical tape units (tape drives), even though each has 30 logical tape units. Subprogram 3 can use up to 12 of the 14 physical tape units, 2 for input and 10 for output. The 7094 computer system will not allow subprogram 3 to use the remaining 2 physical tape units.

The 10 output tape units used in subprogram 3 with 132 character-wide print-out sheets are presently adequate for all normal operations. However, in an abnormal operation and with the number of satellites in orbit steadily increasing, the 10 output tape units, as used in subprogram 3 with 132 character-wide print-out sheets, may or will soon be inadequate. In order to make the 10 output tape units adequate for all present and future operations, including extra large numbers of stations and satellites, it is necessary to devise methods or techniques to overcome the above limitations. Three such methods are given here.

Method 1: The names of the STADAN stations, which are listed in the predicted satellite operations data and are not NOSTAT stations, are separated into two or more sets (set A, set B, etc.). Then,

(a) The members of all of the above sets except, say, the set A are punched on subprogram 1 input data cards as NOSTAT stations. Now, the above input data

cards, other appropriate data cards, and all of the predicted satellite operations data are input, in the usual manner, into the computer for a run of subprogram 1. Using the output of subprogram 1, subprograms 2 and 3 are run in the usual manner, also. The final result of these three runs is a set of books of scheduling data whose STADAN stations are members of set A.

(b) The members of all the sets except set B are punched on subprogram 1 input data cards as NOSTAT stations. These input data cards, other appropriate data cards and, again, all of the predicted satellite operations data are input, in the usual manner, into the computer for a run of subprogram 1. Using the output of subprogram 1, subprograms 2 and 3 are run in the usual manner. The final result is a set of books of scheduling data whose STADAN stations are members of set B.

(c) This method may be continued for any number of sets. Of course, the method increases the computer time; however, the placement of the scheduling data within the books is virtually unaffected.

Method 2: The names of the satellites, each of which is predicted to pass through the field of tracking and data acquisition of at least one non-NOSTAT station and whose predicted operations data are to be input into the computer for the run of subprogram 1, are separated into two or more sets (set G, set H, etc.). Then,

(a) The predicted operations data of the satellites whose names are members of one and only one of the above sets, say set G, are input for a run of subprogram 1. The input data cards of subprogram 1 are appropriately adjusted for the run. Using the output of subprogram 1, subprograms 2 and 3 are run in the usual manner. The final result of these three runs is a set of books of scheduling data whose satellites are members of set G.

(b) The predicted operations data of the satellites whose names are members of set H are input into the computer for another run of subprogram 1. The input data cards of subprogram 1 are appropriately adjusted, again. Using the output of subprogram 1, subprograms 2 and 3 are then run in the usual manner. The final result is a set of books of scheduling data whose satellites are members of set H.

(c) Method 2 may also be continued for any number of sets. The computer executing time, excluding compiler time, is not significantly increased by this latter method. However, the placement of the scheduling data within the book is affected.

Method 3: An appropriate combination of methods 1 and 2, above.
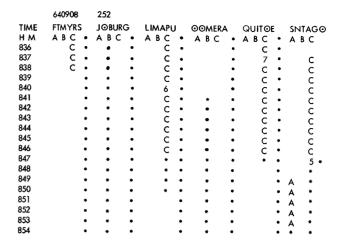
EXPLANATION OF THE EXAMPLE OF THE FINAL OUTPUT FORMAT

A blank at time t in column A, B, or C under a particular station indicates that RELAY 1, RELAY 2, or ECHO 2 is not in the field of tracking and data acquisition of that station at time t.

For example, at time 0836, RELAY 1 and RELAY 2 are not in the field of tracking and data acquisition of FTMYRS.

A, B, or C at time t in column A, B, or C under a particular station indicates that RELAY 1, RELAY 2, or ECHO 2 is in the field of tracking and data acquisition of that station but is not in sunlight at time t. For example, at time 0836, ECHO 2 is in the field of tracking and data acquisition of FTMYRS, LIMAPU, and QUITOE but is not in the sunlight.

An asterisk at time t in column A, B, or C under a particular station indicates that RELAY 1, RELAY 2, or ECHO 2 is in the field of tracking and data acquisition of that station and is in sunlight at time t. For example, at time 0836, RELAY 2 is in the field of tracking and data acquisition of JOBURG and is in the sunlight.

At time 0837, 7 in column C under station QUITOE indicates that ECHO 2 is at maximum elevation angle in the field of tracking and data acquisition of QUITOE, but is not in sunlight, and that the maximum elevation angle ranges from 70-79 degrees.

At time 0847, 5* in column C under station SNTAGO indicates that ECHO 2 is at maximum elevation angle in the field of tracking and data acquisition of SNTAGO, is in sunlight, and that the maximum elevation angle ranges from 50-59 degrees.

The character ●, followed by the blank character, was used to separate the data of the stations (see the parameter DOTS2 of the INPUT DATA CARDS of SUBPROGRAM 3).

640908   252

TIME H M	FTMYRS A	B	C	JOBURG A	B	C	LIMAPU A	B	C	OOMERA A	B	C	QUITOE A	B	C	SNTAGO A	B	C
836			C		*				C						C			
837			C		*				C						7			C
838			C		*				C						C			C
839					*				C						C			C
840					*				6						C			C
841					*				C		*				C			C
842					*				C		*				C			C
843					*				C		*				C			C
844					*				C		*				C			C
845									C		*				C			C
846									C		*				C			C
847					*			*			*			*				5 *
848					*			*			*							*
849								*			*		A					*
850								*			*		A					
851											*		A					
852													A					
853													A					
854																	*	

IDENTIFICATION

A - RELAY 1
B - RELAY 2
C - ECHO 2

Figure 1—An example of the final output format.

CONCLUSION

The computer program is capable of deleting, from the predicted satellite operations data (as calculated by the revised GSFC orbital programs), the data of any orbital parameter, station pass, STADAN station, and/or satellite; handling or processing the predicted operations data of any satellite, including Syncom or a Syncom-type satellite (which would have a single continuous pass from Start-Date to Stop-Date); imposing no limits on the duration of any pass (that is to say, the computer program can handle a station pass of any duration); generating or calculating new predicted satellite operations data when the time interval (during a station pass) of successive predicted satellite operations data points equals or exceeds two minutes; and processing, by

methods 1, 2, and 3 as described above, the predicted operations data of extraordinarily large numbers of satellites and stations.

In addition to improving STADAN station scheduling, the computer program may also serve as a catalyst to a Phase II-type computer program for more automated station scheduling.

The utilization of this computer program will result in a significant saving in manpower and a faster and more efficient operation.

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Appendix A

Computer Program Statements

<u>SUBPROGRAM 1</u>

```
$IBSYS
$ID RO2T       WDD521A, X4189
$*             DEAR OPERATOR, PLEASE MOUNT THE TAPES,AS DESIGNATED ON
$*             INSTRUCTION CARD,ON A5,A6,AND B5. A3 AND B6 ARE MY OUTPUT
$*             UNITS. SAVE MY B6 OUTPUT TAPES.
$*             RESTART MACHINE. THE MACHINE WILL READ AND REWIND A5,A6,
$*             AND B5,SEQUENTIALLY AND CYCLICALLY,UNTIL ALL TAPES ARE
$*             READ. AFTER A5,A6,OR B5 IS REWOUND, MOUNT,IMMEDIATELY,THE
$*             NEXT TAPE AS SHOWN ON INSTRUCTION CARD.
$PAUSE
$DATE          052065
$EXECUTE       IBJOB
$IBJOB         GO
$IBFTC MAIN
C      STATION SCHEDULING,SUBPROGRAM 1 OF PHASE 1
       LOGICAL EOF
       COMMON/SYSF0F/EOF
       FOF=.FALSE.
       CALL SYSGO(34)
       CALL SYSGO(35)
       INTEGER X,OP,EN,STA,TIME,Z,TNSATL
      0DATA OP/6HOP    /,EN/6HEN     /,STA/6H(STATI/,TIME/6H(TIME /,ICHAR/
      16H*       /
      0DIMENSION NOSTAT(99),JSTAT(100),KTIM(4),JTIM(900),MINS(900),JEL(90
      10),JCHAR(900),JDAY(900),JDATE(900),NTIM(900),NEL(900),NCHAR(900),N
      2DAY(900),NDATE(900)
       READ (2,3)TNSATL
    3 FORMAT (I3)
       K=0
       J=1
       DO 4 I=1,TNSATL
       READ (2,5)Z,JPSI,KEY,NOS,(NOSTAT(L),L=1,NOS)
    5 FORMAT (A1,A4,I1,I2,99A6)
       IF (KEY)16,17,16
   16 GOTO (18,19,20),J
   18 READ (5,21)KSKIP
       IF (EOF)GOTO 22
       GOTO 18
   19 READ (6,21)KSKIP
       IF (EOF)GOTO 22
       GOTO 19
   20 READ (15,21)KSKIP
       IF (FOF)GOTO 22
       GOTO 20
   21 FORMAT (I1)
   22 EOF=.FALSE.
       IF (KEY-1)232,17,23
   23 KEY=1
       GOTO (24,25,26),J
   24 REWIND 5
       J=2
       GOTO 19
   25 REWIND 6
       J=3
       GOTO 20
   26 REWIND 15
       J=1
       GOTO 18
```

16

```
   17 GOTO (27,28,29),J
   27 READ (5,30)IDENT,X
      IF (EOF)GOTO 31
      IF (X-STA)32,33,32
   32 IF (X-TIME)27,34,27
   28 READ (6,30)IDENT,X
      IF (EOF)GOTO 31
      IF (X-STA)35,33,35
   35 IF (X-TIME)28,34,28
   29 READ (15,30)IDENT,X
      IF (EOF)GOTO 31
      IF (X-STA)36,33,36
   36 IF (X-TIME)29,34,29
   30 FORMAT (29X,A5,1X,A6)
   34 PRINT 37,IDENT
   370FORMAT (1H0,50HSTOPPING----PREDIXS ARE TIME SORTED FOR SATELLITE ,
      1A5,35H , USE ONLY STATION SORTED PREDIXS.)
      GOTO 232
   31 EOF=.FALSE.
      IF (KEY-1)38,17,38
   38 GOTO (39,40,41),J
   39 REWIND 5
      J=2
      GOTO 28
   40 REWIND 6
      J=3
      GOTO 29
   41 REWIND 15
      J=1
      GOTO 27
   33 GOTO (42,43,44),J
   42 READ (5,21)KSKIP
      IF (EOF)GOTO 45
      GOTO 46
   43 READ (6,21)KSKIP
      IF (EOF)GOTO 45
      GOTO 46
   44 READ (15,21)KSKIP
      IF (EOF)GOTO 45
      GOTO 46
   45 EOF=.FALSE.
      GOTO (47,48,49),J
   47 REWIND 5
      J=2
      GOTO 43
   48 REWIND 6
      J=3
      GOTO 44
   49 REWIND 15
      J=1
      GOTO 42
   46 GOTO (50,51,52),J
   50 READ (5,53)KSTC,KSTAT,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
      IF (EOF)GOTO 54
      GOTO 55
   51 READ (6,53)KSTC,KSTAT,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
      IF (EOF)GOTO 54
      GOTO 55
   52 READ (15,53)KSTC,KSTAT,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
      IF (EOF)GOTO 54
```

```
          GOTO 55
   53 FORMAT (1X,A2,1X,A6,A1,6X,A3,1X,A6,1X,4A1,14X,A4,16X,A1)
   54 FOF=.FALSE.
          GOTO (56,57,58),J
   56 REWIND 5
          J=2
          GOTO 51
   57 REWIND 6
          J=3
          GOTO 52
   58 REWIND 15
          J=1
          GOTO 50
   55 DO 59 M=1,NOS
          IF (KSTAT-NOSTAT(M))59,60,59
   59 CONTINUE
          JSTC=KSTC
          IF (K)61,62,61
   61 DO 63 JK=1,K
          IF (JSTAT(JK)-KSTAT)63,64,63
   63 CONTINUE
   62 K=K+1
          JK=K
          JSTAT(JK)=KSTAT
   64 NBIG=0
  196 NPASS=0
   65 DO 66 N=1,900
          DO 67 M=1,4
          KTIM(M)=KTIM(M)/(2**30)
   67 CONTINUE
          JTIM(N)=KTIM(1)*(10**3)+KTIM(2)*(10**2)+KTIM(3)*10+KTIM(4)
          MINS(N)=KTIM(3)*10+KTIM(4)
          JFL(N)=KFL
          JCHAR(N)=KCHAR
          JDAY(N)=KDAY
          JDATE(N)=KDATE
   80 GOTO (68,69,70),J
   68 READ (5,153)KSTC,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
          IF (FOF)GOTO 71
          GOTO 72
   69 READ (6,153)KSTC,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
          IF (FOF)GOTO 71
          GOTO 72
   70 READ (15,153)KSTC,KPASS,KDAY,KDATE,KTIM,KEL,KCHAR
          IF (FOF)GOTO 71
          GOTO 72
  153 FORMAT (1X,A2,7X,A1,6X,A3,1X,A6,1X,4A1,14X,A4,16X,A1)
   71 FOF=.FALSE.
          GOTO (73,74,75),J
   73 REWIND 5
          J=2
          GOTO 69
   74 REWIND 6
          J=3
          GOTO 70
   75 REWIND 15
          J=1
          GOTO 68
   72 IF (JSTC-KSTC)77,76,77
   76 IF (KPASS-ICHAR)66,78,66
```

```
77 GOTO (81,82,83),J
81 READ (5,21)KSKIP
   IF (EOF)GOTO 84
   GOTO 85
82 READ (6,21)KSKIP
   IF (EOF)GOTO 84
   GOTO 85
83 READ (15,21)KSKIP
   IF (EOF)GOTO 84
   GOTO 85
84 EOF=.FALSE.
   GOTO (86,87,88),J
86 REWIND 5
   J=2
   GOTO 82
87 REWIND 6
   J=3
   GOTO 83
88 REWIND 15
   J=1
   GOTO 81
85 IF (KSTC-OP)79,80,79
66 CONTINUE
   NPASS=900
   N=900
79 GOTO (89,90,91),J
89 READ (5,92)KSTC
   IF (EOF)GOTO 93
   GOTO 78
90 READ (6,92)KSTC
   IF (EOF)GOTO 93
   GOTO 78
91 READ (15,92)KSTC
   IF (EOF)GOTO 93
   GOTO 78
92 FORMAT (1X,A2)
93 EOF=.FALSE.
   GOTO (94,95,96),J
94 REWIND 5
   J=2
   GOTO 90
95 REWIND 6
   J=3
   GOTO 91
96 REWIND 15
   J=1
   GOTO 89
78 IF (NBIG)97,98,97
98 JFLM=0
97 DO 99 M=1,N
   JELM=MAXO(JFL(M),JELM)
99 CONTINUE
   IF (JELM-JPSI)100,101,101
101 IN=1
   MX=1
   IX=1
   J630=2
   J624=2
   J612=2
   J632=2
```

```
          J130=2
          J121=2
          J132=2
          J133=2
          IF (NRIG)102,645,102
  645 IF (N-1)601,634,601
  601 IN=IN+1
  103 IF (JDATE(IN)-JDATE(MX))106,625,106
  625 IF (MINS(MX)-000059)611,622,611
  622 IF (JTIM(IN)-JTIM(MX)-000041)603,604,623
  623 NTIM(IX)=JTIM(MX)
      NFL(IX)=JFL(MX)
      NCHAR(IX)=JCHAR(MX)
      NDAY(IX)=JDAY(MX)
      NDATE(IX)=JDATE(MX)
      IF (IX-900)624,613,613
  624 IF (JFL(MX)-JFLM)627,628,628
  628 JFL(MX)=JFL(IN)
  627 IX=IX+1
      JTIM(MX)=JTIM(MX)+000041
      MINS(MX)=0
      IF (JDATE(IN)-JDATE(MX))605,611,605
  611 IF (JTIM(IN)-JTIM(MX)-000001)603,604,605
  603 IF (JFL(IN)-JFLM)606,607,607
  607 JFL(MX)=JFL(IN)
      JCHAR(MX)=JCHAR(IN)
  606 IF (IN-N)601,608,601
  604 NTIM(IX)=JTIM(MX)
      NFL(IX)=JFL(MX)
      NCHAR(IX)=JCHAR(MX)
      NDAY(IX)=JDAY(MX)
      NDATE(IX)=JDATE(MX)
      MX=IN
      IF (IX-900)630,609,609
  630 IX=IX+1
      IF (IN-N)601,608,601
  605 NTIM(IX)=JTIM(MX)
      NFL(IX)=JFL(MX)
      NCHAR(IX)=JCHAR(MX)
      NDAY(IX)=JDAY(MX)
      NDATE(IX)=JDATE(MX)
      IF (IX-900)612,631,631
  612 IF (JFL(MX)-JFLM)629,626,626
  626 JFL(MX)=JFL(IN)
  629 IX=IX+1
      JTIM(MX)=JTIM(MX)+000001
      MINS(MX)=MINS(MX)+000001
      IF (JDATE(IN)-JDATE(MX))107,625,107
  107 IF (MINS(MX)-000059)605,106,106
  609 J630=0
      GOTO 108
  613 J624=0
      GOTO 108
  631 J612=0
      GOTO 108
  608 IF (NPASS)640,634,640
  634 NTIM(IX)=JTIM(MX)
      NFL(IX)=JFL(MX)
      NCHAR(IX)=JCHAR(MX)
      NDAY(IX)=JDAY(MX)
```

```
      NDATE(IX)=JDATE(MX)
      GOTO 108
  640 NJTIM=JTIM(MX)
      NJFL=JFL(MX)
      NJCHAR=JCHAR(MX)
      NJDAY=JDAY(MX)
      NJDATE=JDATE(MX)
      NMINS=MINS(MX)
      IX=IX-1
      GOTO 108
  106 IF (JTIM(MX)-002359)110,111,111
  110 IF (MINS(MX)-000059)605,623,605
  111 NTIM(IX)=JTIM(MX)
      NFL(IX)=JFL(MX)
      NCHAR(IX)=JCHAR(MX)
      NDAY(IX)=JDAY(MX)
      NDATE(IX)=JDATE(MX)
      IF (IX-900)632,633,633
  632 IF (JEL(MX)-JELM)112,113,113
  113 JFL(MX)=JFL(IN)
  112 IX=IX+1
      JTIM(MX)=0
      MINS(MX)=0
      JDAY(MX)=JDAY(IN)
      JDATE(MX)=JDATE(IN)
      GOTO 611
  633 J632=0
      GOTO 108
  102 IF (JDATE(IN)-NJDATE)114,115,114
  115 IF (NMINS-000059)116,117,116
  117 IF (JTIM(IN)-NJTIM-000041)118,119,120
  120 NTIM(IX)=NJTIM
      NFL(IX)=NJFL
      NCHAR(IX)=NJCHAR
      NDAY(IX)=NJDAY
      NDATE(IX)=NJDATE
      IF (IX-900)121,122,122
  121 IF (NJFL-JFLM)123,124,124
  124 NJFL=JFL(IN)
  123 IX=IX+1
      NJTIM=NJTIM+000041
      NMINS=0
      IF (JDATE(IN)-NJDATE)125,116,125
  116 IF (JTIM(IN)-NJTIM-000001)118,119,125
  118 IF (JFL(IN)-JFLM)126,127,127
  127 NJFL=JFL(IN)
      NJCHAR=JCHAR(IN)
  126 IF (IN-N)128,129,128
  129 IF (NPASS)196,301,196
  301 NTIM(IX)=NJTIM
      NFL(IX)=NJFL
      NCHAR(IX)=NJCHAR
      NDAY(IX)=NJDAY
      NDATE(IX)=NJDATE
      GOTO 108
  128 IN=IN+1
      GOTO 102
  119 NTIM(IX)=NJTIM
      NFL(IX)=NJFL
      NCHAR(IX)=NJCHAR
```

```
      NDAY(IX)=NJDAY
      NDATE(IX)=NJDATE
      MX=IN
      IF (IX-900)130,131,131
  130 IX=IX+1
      IF (IN-N)601,608,601
  125 NTIM(IX)=NJTIM
      NFL(IX)=NJFL
      NCHAR(IX)=NJCHAR
      NDAY(IX)=NJDAY
      NDATE(IX)=NJDATE
      IF (IX-900)132,133,133
  132 IF (NJFL-JFLM)134,135,135
  135 NJFL=JFL(IN)
  134 IX=IX+1
      NJTIM=NJTIM+000001
      NMINS=NMINS+000001
      IF (JDATE(IN)-NJDATE)136,115,136
  136 IF (NMINS-000059)125,114,114
  131 J130=0
      GOTO 108
  122 J121=0
      GOTO 108
  133 J132=0
      GOTO 108
  114 IF (NJTIM-002359)137,138,138
  137 IF (NMINS-000059)125,120,125
  138 NTIM(IX)=NJTIM
      NFL(IX)=NJFL
      NCHAR(IX)=NJCHAR
      NDAY(IX)=NJDAY
      NDATE(IX)=NJDATE
      IF (IX-900)139,140,140
  139 IF (NJFL-JFLM)141,142,142
  142 NJFL=JFL(IN)
  141 IX=IX+1
      NJTIM=0
      NMINS=0
      NJDAY=JDAY(IN)
      NJDATE=JDATE(IN)
      GOTO 116
  140 J139=0
  108 DO 167 M=1,IX
      IF (NFL(M)-JFLM)168,169,169
  169 IF (NCHAR(M)-ICHAR)170,171,170
  171 WRITE (16,172)NDATE(M),NTIM(M),JK,I,NDAY(M),NEL(M),NCHAR(M)
  172 FORMAT (2HCC,1X,A6,1X,I4,1X,I3,1X,I3,1X,A3,2X,A1,A1)
      GOTO 167
  168 IF (NCHAR(M)-ICHAR)173,174,173
  174 NEL(M)=NCHAR(M)
      GOTO 170
  173 NEL(M)=7
  170 WRITE (16,175)NDATE(M),NTIM(M),JK,I,NDAY(M),NEL(M)
  175 FORMAT (2HCC,1X,A6,1X,I4,1X,I3,1X,I3,1X,A3,2X,A1,1H )
  167 CONTINUE
      IF (IX-900)176,177,176
  177 IF (J630)178,179,178
  178 IF (J624)180,181,180
  180 IF (J612)182,183,182
  182 IF (J632)184,185,184
```

```
184 IF (J130)186,187,186
186 IF (J121)188,189,188
188 IF (J132)190,191,190
190 IF (J139)176,193,176
179 J630=2
    IX=0
    GOTO 630
181 J624=2
    IX=0
    GOTO 624
183 J612=2
    IX=0
    GOTO 612
185 J632=2
    IX=0
    GOTO 632
187 J130=2
    IX=0
    GOTO 130
189 J121=2
    IX=0
    GOTO 121
191 J132=2
    IX=0
    GOTO 132
193 J139=2
    IX=0
    GOTO 139
176 IF (NPASS)194,100,194
194 NBIG=4
    GOTO 196
100 IF (JSTC-KSTC)197,64,197
197 PRINT 199,JK,JSTAT(JK),I,Z,IDENT
199 FORMAT (7X,I3,3X,A6,8X,I3,3X,A1,3X,A5)
223 IF (KSTC-FN)46,227,46
 60 JSTC=KSTC
218 GOTO (200,201,202),J
200 READ (5,92)KSTC
    IF (EOF)GOTO 204
    IF (JSTC-KSTC)205,200,205
201 READ (6,92)KSTC
    IF (EOF)GOTO 204
    IF (JSTC-KSTC)205,201,205
202 READ (15,92)KSTC
    IF (EOF)GOTO 204
    IF (JSTC-KSTC)205,202,205
204 EOF=.FALSE.
    GOTO (206,207,208),J
206 REWIND 5
    J=2
    GOTO 201
207 REWIND 6
    J=3
    GOTO 202
208 REWIND 15
    J=1
    GOTO 200
205 GOTO (209,210,211),J
209 READ (5,21)KSKIP
    IF (EOF)GOTO 212
    GOTO 213
```

```
  210 READ (6,21)KSKIP
      IF (EOF)GOTO 212
      GOTO 213
  211 READ (15,21)KSKIP
      IF (EOF)GOTO 212
      GOTO 213
  212 EOF=.FALSE.
      GOTO (214,215,216),J
  214 REWIND 5
      J=2
      GOTO 210
  215 REWIND 6
      J=3
      GOTO 211
  216 REWIND 15
      J=1
      GOTO 209
  213 IF (KSTC-OP)217,218,217
  217 GOTO (219,220,221),J
  219 READ (5,92)KSTC
      IF (EOF)GOTO 222
      GOTO 223
  220 READ (6,92)KSTC
      IF (EOF)GOTO 222
      GOTO 223
  221 READ (15,92)KSTC
      IF (EOF)GOTO 222
      GOTO 223
  222 EOF=.FALSE.
      GOTO (224,225,226),J
  224 REWIND 5
      J=2
      GOTO 220
  225 REWIND 6
      J=3
      GOTO 221
  226 REWIND 15
      J=1
      GOTO 219
  227 GOTO (228,229,230),J
  228 REWIND 5
      J=2
      GOTO 4
  229 REWIND 6
      J=3
      GOTO 4
  230 REWIND 15
      J=1
    4 CONTINUE
      PRINT 231
  231 FORMAT (1H0,10HEND OF RUN)
      END FILE 16
  232 STOP
      END
$IBMAP UN16
      ENTRY    .UN16.
.UN16. PZE      UNIT16
UNIT16 FILE     ,B(2),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
      END
```

```
$IBLDP FRWB
(RELOCATABLE BINARY DECK FOR SUBROUTINE FRWB)

$IBLDP FRWD
(RELOCATABLE BINARY DECK FOR SUBROUTINE FRWD)

$IBLDP FSLI
(RELOCATABLE BINARY DECK FOR SUBROUTINE FSLI)

$IBLDP FXEM
(RELOCATABLE BINARY DECK FOR SUBROUTINE FXEM)

$IBLDP NOSYS
(RELOCATABLE BINARY DECK FOR SUBROUTINE NOSYS)

$IBLDP GOSYS
(RELOCATABLE BINARY DECK FOR SUBROUTINE GOSYS)

(END-OF-FILE CARD)

(DATA CARDS)

(END-OF-FILE CARD)
$EMCSY
(END-OF-FILE CARD)
```

SUBPROGRAM 2

```
$IBSYS
$ID PO2T          WDD521A, X4189
$RELEASE          SYSPP1
$RELEASE          SYSUT1
$RELEASE          SYSUT2
$RELEASE          SYSUT3
$RELEASE          SYSUT4
$ATTACH           PDA
$AS               SYSIN1
$EXECUTE          SORT
        OPTION,MAP,HISTORY,CARDS,TAPES,NOCKPT
        CHANNEL,INPUT/2,MERGE/(A,B)
        FILE,INPUT/1,REELS/1,MODE/D,DENSITY/H,BLOCKSIZE/5
        FILE,OUTPUT,MODE/D,DENSITY/H,BLOCKSIZE/5
        RECORD,TYPE/F,LENGTH/5,FIELD/(3,6,1,4,1,3,1,3)
        SORT,SEQUENCE/C,ORDER/3,FIELD/(2,4,6,8),FILE/1
        END
$IBSYS
$STOP
```

SUBPROGRAM 3

```
$IBSYS
$ID PO2T          WDD521A, X4189
$*                DEAR OPERATOR, PLEASE MOUNT THE TAPES,AS DESIGNATED ON
$*                INSTRUCTION CARD,ON A5 AND A6. MY OUTPUT UNITS ARE SHOWN
$*                ON THE INSTRUCTION CARD AND,WHEN NUMBER OF OUTPUT UNITS
$*                EXCEEDS 5, THE ON-LINE PRINTER.
```

```
$*                SAVE MY OUTPUT TAPES.
$*                RESTART MACHINE. THE MACHINE WILL READ AND REWIND A5 AND
$*                A6,SEQUENTIALLY AND CYCLICALLY,UNTIL ALL TAPES ARE READ.
$*                AFTER A5 OR A6 IS REWOUND,MOUNT,IMMEDIATELY,THE NEXT TAPE
$*                AS SHOWN ON INSTRUCTION CARD.
$PAUSE
$DATE             061065
$EXECUTE          IBJOB
$IBJOB            GO
C     STATION SCHEDULING,SUBPROGRAM 3 OF PHASE 1
      LOGICAL FOF
      COMMON/SYSFOF/FOF
      FOF=.FALSE.
      CALL SYSGO(34)
      CALL SYSGO(35)
      INTEGER REELS,Z,DOTS2,DASH,TNSTAT,TNSATL
      DATA IEND/6HEND OF/,JWORD/6HOC    /
     ODIMENSION NUM(100,72),NOT(720),MOT(720),JSTAT(100),MSATL(100),NSU(
     110),JFL(72)
      READ 2,DOTS2,DASH
    2 FORMAT (2A2)
      READ 3,TNSTAT,TNSATL,REELS
    3 FORMAT (3I3)
      L=1
      DO 4 NS=1,TNSTAT
      READ 5,JK,KSTAT,NSATL,(NUM(JK,I),NOT(I),I=1,NSATL)
    5 FORMAT (I3,1X,A6,1X,I2,1X,72(I2,A2))
      IF (JK-NS)6,7,6
    6 PRINT 8
    8OFORMAT (1H0,118HSTOPPING----DATA CARDS OF STATIONS ARE DISORDERED.
     1 CLEAR MACHINE AND PLACE DATA CARDS IN CORRECT ORDER. RERUN PROGRA
     2M.)
      GOTO 9
    7 JSTAT(NS)=KSTAT
      MSATL(NS)=NSATL
      DO 10 K=1,NSATL
      MOT(L)=NOT(K)
      L=L+1
   10 CONTINUE
    4 CONTINUE
      NS=1
      NU=1
   11 NSPU=1
      MANY=0
   12 MANY=MANY+2*MSATL(NS)+2
      IF (MANY-126)13,14,15
   13 IF (NS-TNSTAT)16,14,16
   16 NSPU=NSPU+1
      NS=NS+1
      GOTO 12
   15 NSPU=NSPU-1
      NS=NS-1
      IF (NSPU)14,17,14
   17 PRINT 18
  18OFORMAT (1H0,87HSTOPPING----NSPU = 0 . 132 CHARACTER-WIDE PRINT-OUT
     1 SHEET IS INSUFFICIENT FOR THIS JOB.)
      GOTO 9
   14 NSU(NU)=NSPU
      IF (NS-TNSTAT)19,20,19
   19 NS=NS+1
```

```
      NU=NU+1
      GOTO 11
20    JXX=NU
      IF (JXX-6)21,22,23
23    IF (JXX-7)22,24,25
25    IF (JXX-8)24,26,27
27    IF (JXX-9)26,28,29
29    IF (JXX-10)28,30,31
22    PRINT 32
320FORMAT (1H0,67HOPERATOR ACTION PAUSE----DIAL TAPE UNIT A4 TO A7.
     1RESTART MACHINE.)
      PAUSE
      REWIND 7
      GOTO 21
24    PRINT 33
330FORMAT (1H0,70HOPERATOR ACTION PAUSE----DIAL A4 TO A7 AND B4 TO B7
     1.  RESTART MACHINE.)
      PAUSE
      REWIND 7
      REWIND 17
      GOTO 21
26    PRINT 34
340FORMAT (1H0,80HOPERATOR ACTION PAUSE----DIAL A4 TO A7, B4 TO B7 AN
     1D B2 TO B8.  RESTART MACHINE.)
      PAUSE

      REWIND 7
      REWIND 17
      REWIND 18
      GOTO 21
28    PRINT 35
350FORMAT (1H0,90HOPERATOR ACTION PAUSE----DIAL A4 TO A7, B4 TO B7, B
     12 TO B8 AND B1 TO B9.  RESTART MACHINE.)
      PAUSE
      REWIND 7
      REWIND 17
      REWIND 18
      REWIND 19
      GOTO 21
30    PRINT 36
360FORMAT (1H0,119HOPERATOR ACTION PAUSE----REPLACE REEL ON A2 WITH A
     1N OUTPUT REEL. DIAL A2 TO A8,A4 TO A7,B4 TO B7,B2 TO B8 AND B1 TO
     2B9./1H0,25X,16HRESTART MACHINE.)
      PAUSE
      REWIND 7
      REWIND 17
      REWIND 18
      REWIND 19
      GOTO 21
31    PRINT 37
370FORMAT (1H0,65HSTOPPING----INSUFFICIENT NO. OF PHYSICAL TAPE UNITS
     1 FOR THIS JOB.)
      GOTO 9
21    READ 38,FDATE,FTIME,LDATE,LTIME
38    FORMAT (4A6)
      DO 49 J=1,JXX
      GOTO (50,51,52,53,54,55,56,57,58,59),J
50    WRITE (3,60)FDATE,FTIME,LDATE,LTIME,J,JXX
      GOTO 49
51    WRITE (15,60)FDATE,FTIME,LDATE,LTIME,J,JXX
      GOTO 49
```

```
 52 WRITE (16,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 53 WRITE (21,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 54 WRITE (22,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 55 WRITE (7,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 56 WRITE (17,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 57 WRITE (18,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 58 WRITE (19,60)FDATE,FTIME,LDATE,LTIME,J,JXX
    GOTO 49
 59 WRITE (8,60)FDATE,FTIME,LDATE,LTIME,J,JXX
600FORMAT (1H1/1H0/1H0/1H0/1H0/1H0/1H0/1H0/1H0/1H0/1H0,49X,27HOPE
   1RATIONAL PREDICTIONS FOR/1H ,53X,18HSTATION SCHEDULING/1H0,49X,4HF
   2ROM,2X,A6,1X,A6/1H ,51X,2HTO,2X,A6,1X,A6/1H0,56X,5H(PART,1X,I2,1X,
   32HOF,1X,I2,1H)/1H1/1H0,77HID. ID.NO. SATELLITE  START-DATE  STAR
   4T-TIME  STOP-DATE  STOP-TIME  MIN.EL./1H ,24X,50HY M D      H M S
   5          Y M D      H M S       DEG.)
 49 CONTINUE
    JRF=1
    JJ2=1
    DO 61 JT=1,TNSATL
    READ 62,Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
 62 FORMAT (A1,1X,A5,1X,A6,A4,1X,A6,1X,A6,1X,A6,1X,A6,1X,A5)
    DO 63 J=1,JXX
    GOTO (64,65,66,67,68,69,70,71,72,73),J
 64 WRITE (3,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 65 WRITE (15,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 66 WRITE (16,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 67 WRITE (21,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 68 WRITE (22,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 69 WRITE (7,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 70 WRITE (17,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 71 WRITE (18,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 72 WRITE (19,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
    GOTO 63
 73 WRITE (8,74)Z,IDENT,JSATL,NOS,JSDAT,JSTIM,JXDAT,JXTIM,JPSI
 74 FORMAT (1H ,A1,4X,A5,3X,A6,A4,1X,A6,6X,A6,6X,A6,5X,A6,5X,A5)
 63 CONTINUE
 61 CONTINUE
    NU=1
    NS=0
    L=0
    K=0
 75 NX=1
 81 NS=NS+1
    JT=1
 76 L=L+1
    K=K+1
```

```
      NOT(L)=MOT(K)
      IF (JT-MSATL(NS))77,78,77
   77 JT=JT+1
      GOTO 76
   78 IF (NX-NSU(NU))79,80,79
   79 NX=NX+1
      L=L+1
      NOT(L)=DOTS2
      GOTO 81
   80 IF (NU-JXX)82,83,82
   82 NU=NU+1
      GOTO 75
   83 READ (5,84)KWORD,KDATE,KTIM,JK,I,KDAY,KFL
   84 FORMAT (A2,1X,I6,1X,A4,1X,I3,1X,I3,1X,I3,2X,A2)
      IF (KWORD-JWORD))83,85,83
   85 JDATE=KDATE
  191 LXX=0
      LSU=0
      NX=0
      DO 86 J=1,JXX
      MXX=NSU(J)
      LSU=LSU+MXX
      DO 87 MN=1,MXX
      NX=NX+1
      LXX=LXX+MSATL(NX)
   87 CONTINUE
      LXX=LXX+MXX-1
      GOTO (88,89,90,91,92,93,94,95,96,97),J
   88 WRITE (3,98)KDATE,KDAY,(JSTAT(NS),NS=1,LSU),(NOT(L),L=1,LXX)
      GOTO 108
   89 WRITE (15,99)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   90 WRITE (16,100)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   91 WRITE (21,101)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   92 WRITE (22,102)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   93 WRITE (7,103)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   94 WRITE (17,104)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   95 WRITE (18,105)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   96 WRITE (19,106)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
      GOTO 108
   97 WRITE (8,107)KDATE,KDAY,(JSTAT(NS),NS=N1,LSU),(NOT(L),L=N2,LXX)
  108 N1=LSU+1
      N2=LXX+1
   86 CONTINUE
      JSKIP=1
  109 JTIM=KTIM
      MJK=1
      NX=1
      J=1
  168 N=1
      NS=1
  110 K=JK
      M=1
  111 IF (MJK-K)112,113,112
```

29

```
112 NSATL=MSATL(NX)
    DO 114 M=1,NSATL
    JFL(N)=DASH
    N=N+1
114 CONTINUE
    NX=NX+1
    IF (NS-NSU(J))115,116,115
115 NS=NS+1
    JFL(N)=DOTS2
    N=N+1
    GOTO 129
116 N=N-1
    GOTO (117,118,119,120,121,122,123,124,125,126),J
117 WRITE (3,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
118 WRITE (15,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
119 WRITE (16,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
120 WRITE (21,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
121 WRITE (22,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
122 WRITE (7,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 128
123 WRITE (17,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
124 WRITE (18,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 128
125 WRITE (19,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 128
126 WRITE (8,127)JTIM,(JEL(IN),IN=1,N)
127 FORMAT (1H ,A4,3X,72A2)
128 J=J+1
    N=1
    NS=1
129 MJK=MJK+1
    M=1
    GOTO 111
113 IF (NUM(K,M)-I)130,131,130
130 JFL(N)=DASH
132 M=M+1
    N=N+1
    GOTO 113
131 JFL(N)=KEL
133 GOTO (134,135),JJ2
134 READ (5,136)KDATE,KTIM,JK,I,KDAY,KEL
    IF (EOF)GOTO 137
    GOTO 138
135 READ (6,136)KDATE,KTIM,JK,I,KDAY,KEL
    IF (EOF)GOTO 137
    GOTO 138
136 FORMAT (3X,I6,1X,A4,1X,I3,1X,I3,1X,I3,2X,A2)
137 EOF=.FALSE.
    IF (JRE-REELS)139,140,139
139 JRE=JRE+1
    GOTO (141,142),JJ2
141 REWIND 5
    JJ2=2
    GOTO 135
```

```
142 REWIND 6
    JJ2=1
    GOTO 134
140 JRF=IFND
    GOTO (143,144),JJ2
143 REWIND 5
    GOTO 145
144 REWIND 6
    GOTO 145
138 IF (JDATE-KDATE)145,146,145
146 IF (JTIM-KTIM)145,147,145
147 IF (K-JK)148,149,148
149 IF (NUM(K,M)-I)132,133,150
150 PRINT 151
151 FORMAT (1HO,36HSTOPPING----SORT ERROR ON INPUT TAPE)
    GOTO 9
148 IF (M-MSATL(NX))152,153,152
152 M=M+1
    N=N+1
    JFL(N)=DASH
    GOTO 148
153 NX=NX+1
    IF (NS-NSU(J))154,155,154
154 N=N+1
    NS=NS+1
    JFL(N)=DOTS2
156 N=N+1
    MJK=MJK+1
    GOTO 110
155 GOTO (157,158,159,160,161,162,163,164,165,166),J
157 WRITE (3,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 167
158 WRITE (15,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 167
159 WRITE (16,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 167
160 WRITE (21,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 167
161 WRITE (22,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 167
162 WRITE (7,127)JTIM,(JFL(IN),IN=1,N)
    GOTO 167
163 WRITE (17,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 167
164 WRITE (18,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 167
165 WRITE (19,127)JTIM,(JEL(IN),IN=1,N)
    GOTO 167
166 WRITE (8,127)JTIM,(JEL(IN),IN=1,N)
167 J=J+1
    MJK=MJK+1
    GOTO 168
145 IF (M-MSATL(NX))169,170,169
169 M=M+1
    N=N+1
    JFL(N)=DASH
    GOTO 145
170 NX=NX+1
    IF (NS-NSU(J))171,172,171
171 N=N+1
    NS=NS+1
```

```
      JFL(N)=DOTS2
      M=0
      GOTO 169
172   GOTO (173,174,175,176,177,178,179,180,181,182),J
173   WRITE (3,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
174   WRITE (15,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
175   WRITE (16,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
176   WRITE (21,127)JTIM,(JFL(IN),IN=1,N)
      GOTO 183
177   WRITE (22,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
178   WRITE (7,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
179   WRITE (17,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
180   WRITE (18,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
181   WRITE (19,127)JTIM,(JEL(IN),IN=1,N)
      GOTO 183
182   WRITE (8,127)JTIM,(JFL(IN),IN=1,N)
183   IF (J-JXX)184,185,184
184   J=J+1
      N=0
      NS=1
      M=0
      GOTO 169
185   IF (JRF-IFND)186,187,186
186   IF (JDATF-KDATF)188,189,188
188   DO 192 J=1,JXX
      GOTO (193,194,195,196,197,198,199,200,201,202),J
193   WRITE (3,203)
      GOTO 192
194   WRITE (15,203)
      GOTO 192
195   WRITE (16,203)
      GOTO 192
196   WRITE (21,203)
      GOTO 192
197   WRITE (22,203)
      GOTO 192
198   WRITE (7,203)
      GOTO 192
199   WRITE (17,203)
      GOTO 192
200   WRITE (18,203)
      GOTO 192
201   WRITE (19,203)
      GOTO 192
202   WRITE (8,203)
203   FORMAT (1H ,3HEND)
192   CONTINUF
      GOTO 85
189   IF (JSKIP-57)190,191,190
190   JSKIP=JSKIP+1
      GOTO 109
187   DO 204 J=1,JXX
      GOTO (205,206,207,208,209,210,211,212,213,214),J
```

```
  205 WRITE (3,215)JRE
      GOTO 204
  206 WRITE (15,215)JRE
      GOTO 204
  207 WRITE (16,215)JRE
      GOTO 204
  208 WRITE (21,215)JRE
      GOTO 204
  209 WRITE (22,215)JRE
      GOTO 204
  210 WRITE (7,215)JRE
      GOTO 204
  211 WRITE (17,215)JRE
      GOTO 204
  212 WRITE (18,215)JRE
      GOTO 204
  213 WRITE (19,215)JRE
      GOTO 204
  214 WRITE (8,215)JRE
  215 FORMAT (1H ,3HEND/1H ,A6,4H RUN)
  204 CONTINUE

   98 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

   99 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  100 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  101 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  102 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  103 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  104 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  105 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  106 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

  107 FORMAT
(FORMAT MUST BE UPDATED FOR EACH RUN. SEE APPENDIX B)

    9 STOP
      END
$IBMAP UN15
      ENTRY    .UN15.
.UN15.  PZE      UNIT15
UNIT15 FILE     ,B(1),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
      END
```

```
$IBMAP UN16
        ENTRY    .UN16.
.UN16.  PZE      UNIT16
UNIT16  FILE     ,B(2),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN21
        ENTRY    .UN21.
.UN21.  PZE      UNIT21
UNIT21  FILE     ,C(1),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN22
        ENTRY    .UN22.
.UN22.  PZE      UNIT22
UNIT22  FILE     ,C(2),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN07
        ENTRY    .UN07.
.UN07.  PZE      UNIT07
UNIT07  FILE     ,A(3),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN17
        ENTRY    .UN17.
.UN17.  PZE      UNIT17
UNIT17  FILE     ,B(3),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN18
        ENTRY    .UN18.
.UN18.  PZE      UNIT18
UNIT18  FILE     ,B(4),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN19
        ENTRY    .UN19.
.UN19.  PZE      UNIT19
UNIT19  FILE     ,B(5),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END
$IBMAP UN08
        ENTRY    .UN08.
.UN08.  PZE      UNIT08
UNIT08  FILE     ,A(4),READY,INOUT,BLK=22,MULTIREEL,BCD,HOLD,NOLIST
        END


$IBLDR FRWB
(RELOCATABLE BINARY DECK FOR SUBROUTINE FRWB)


$IBLDR FRWD
(RELOCATABLE BINARY DECK FOR SUBROUTINE FRWD)


$IBLDR FSLI
(RELOCATABLE BINARY DECK FOR SUBROUTINE FSLI)


$IBLDR FXEM
(RELOCATABLE BINARY DECK FOR SUBROUTINE FXEM)


$IBLDR NOSYS
(RELOCATABLE BINARY DECK FOR SUBROUTINE NOSYS)


$IBLDR GOSYS
(RELOCATABLE BINARY DECK FOR SUBROUTINE GOSYS)


(END-OF-FILE CARD)
$EMSYS
(END-OF-FILE CARD)
```

Appendix B

Formulated Formats of Subprogram 3

FORMULATED FORMATS OF SUBPROGRAM 3

```
 980FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(1)-4)X,A6,(2*MSA
   1TL(2)-4)X,A6,------,A6,(2*MSATL(NSU(1))-4)X,A6/1H ,3HH M,4X,72A2)

 990FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(1)+1)-4)X,A6
   1,(2*MSATL(NSU(1)+2)-4)X,A6,------,A6,(2*MSATL(NSU(2))-4)X,A6/1H ,3
   2HH M,4X72A2)

1000FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(2)+1)-4)X,A6
   1,(2*MSATL(NSU(2)+2)-4)X,A6,------,A6,(2*MSATL(NSU(3))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1010FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIMF,3X,A6,(2*MSATL(NSU(3)+1)-4)X,A6
   1,(2*MSATL(NSU(3)+2)-4)X,A6,------,A6,(2*MSATL(NSU(4))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1020FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(4)+1)-4)X,A6
   1,(2*MSATL(NSU(4)+2)-4)X,A6,------,A6,(2*MSATL(NSU(5))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1030FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIMF,3X,A6,(2*MSATL(NSU(5)+1)-4)X,A6
   1,(2*MSATL(NSU(5)+2)-4)X,A6,------,A6,(2*MSATL(NSU(6))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1040FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(6)+1)-4)X,A6
   1,(2*MSATL(NSU(6)+2)-4)X,A6,------,A6,(2*MSATL(NSU(7))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1050FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(7)+1)-4)X,A6
   1,(2*MSATL(NSU(7)+2)-4)X,A6,------,A6,(2*MSATL(NSU(8))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1060FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIME,3X,A6,(2*MSATL(NSU(8)+1)-4)X,A6
   1,(2*MSATL(NSU(8)+2)-4)X,A6,------,A6,(2*MSATL(NSU(9))-4)X,A6/1H ,3
   2HH M,4X,72A2)

1070FORMAT (1H1,7X,I6,2X,I3/1H ,4HTIMF,3X,A6,(2*MSATL(NSU(9)+1)-4)X,A6
   1,(2*MSATL(NSU(9)+2)-4)X,A6,------,A6,(2*MSATL(NSU(10))-4)X,A6/1H ,
   23HH M,4X,72A2)
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