10.3.011-C

1620 GENERAL PROGRAM LIBRARY

Miss Less

C-19

COMMON USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter, ink or pencil)

Program No.____________________ Date________________

Program Name:____

1. Does the abstract adequately describe what the program is and what it does? Yes____ No____
   Comment____
2. Does the program do what the abstract says? Yes____ No____
   Comment____
3. Is the description clear, understandable, and adequate? Yes____ No____
   Comment____
4. Are the Operating Instructions understandable and in sufficient detail? Yes____ No____
   Comment____
   Are the Sense Switch options adequately described (if applicable)? Yes____ No____
   Are the mnemonic labels identified or sufficiently understandable? Yes____ No____
   Comment____
5. Does the source program compile satisfactorily (if applicable)? Yes____ No____
   Comment____
6. Does the object program run satisfactorily? Yes____ No____
   Comment____
7. Number of test cases run_____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes____ No____
   Comment____
8. Does the Program meet the minimal standards of COMMON? Yes____ No____
   Comment____
9. Were all necessary parts of the program received? Yes____ No____
   Comment____
10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

Mr. Richard L. Pratt
Data Corporation
7500 Old Xenia Pike
Dayton, Ohio 45432

Your Name ____________________
Company ____________________
____
Address ____________________
____
Users Group Code ____________________

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11/1/65

MISS LESS

Management Information Scheduling - A Segment Of Least Cost Estimating And Scheduling

An SPS Program For The
IBM 1620 Card System

Ray N. Sauer
IBM
2601 South Main
Houston 2, Texas

June , 1962

Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for IBM Data Processing Systems. When such an announcement occurs, users should order a complete new program from the Program Information Department.

TABLE OF CONTENTS

PART I - INTRODUCTION

Least Cost Estimating and Scheduling (LESS) refers to a management science technique for analyzing certain business projects. The three phases of this analysis are (1) planning, (2) scheduling, and (3) determining project cost to completion time relationships. The first two phases, termed here as MISS LESS and commonly called arrow diagram planning and critical path scheduling, are also the basis of many similar business management methods such as the Program Evaluation and Review Technique (PERT).

This report states the rules for constructing an arrow diagram, and describes an IBM 1620 program for scheduling. There are no restrictions on numbering of jobs (except all numbers are less than 2000) or on the order of input. For a 20K computer, the sum of jobs and nodes may be as high as 1614. The program will run on basic paper tape or card systems.

This program should be considered a major revision of program file 10.3.002 for the 1620 paper tape system and a minor revision of program file number 10.3.003 for the 1620 card system. For paper tape systems, this program introduces the use of random node numbering with variable storage of jobs and nodes. For both systems the input format has been made compatible, the maximum node number has been increased to 1999 and typed output is available.

PART II - ARROW DIAGRAM PLANNING

Fundamental to the technique being described is a graphical representation of any project by an arrow diagram which defines all jobs in the project and the order in which they must be done. Figure 1 is such a diagram, which represents the sequence of jobs necessary to replace a pipe line. This diagram will be used to illustrate several facts concerning arrow diagramming.

(1) Every job is represented by an arrow, and denoted by the numbers at the tail and head of the arrow. This set of numbers need not be unique.
ex. Job (12, 14) is a pressure test.

(2) Jobs whose heads bear the same number as the tail of a given job must immediately preceed the given job.
ex. Job (11, 12) preceeds job (12, 14). That is (12, 14) cannot be started until (11, 12) is finished.

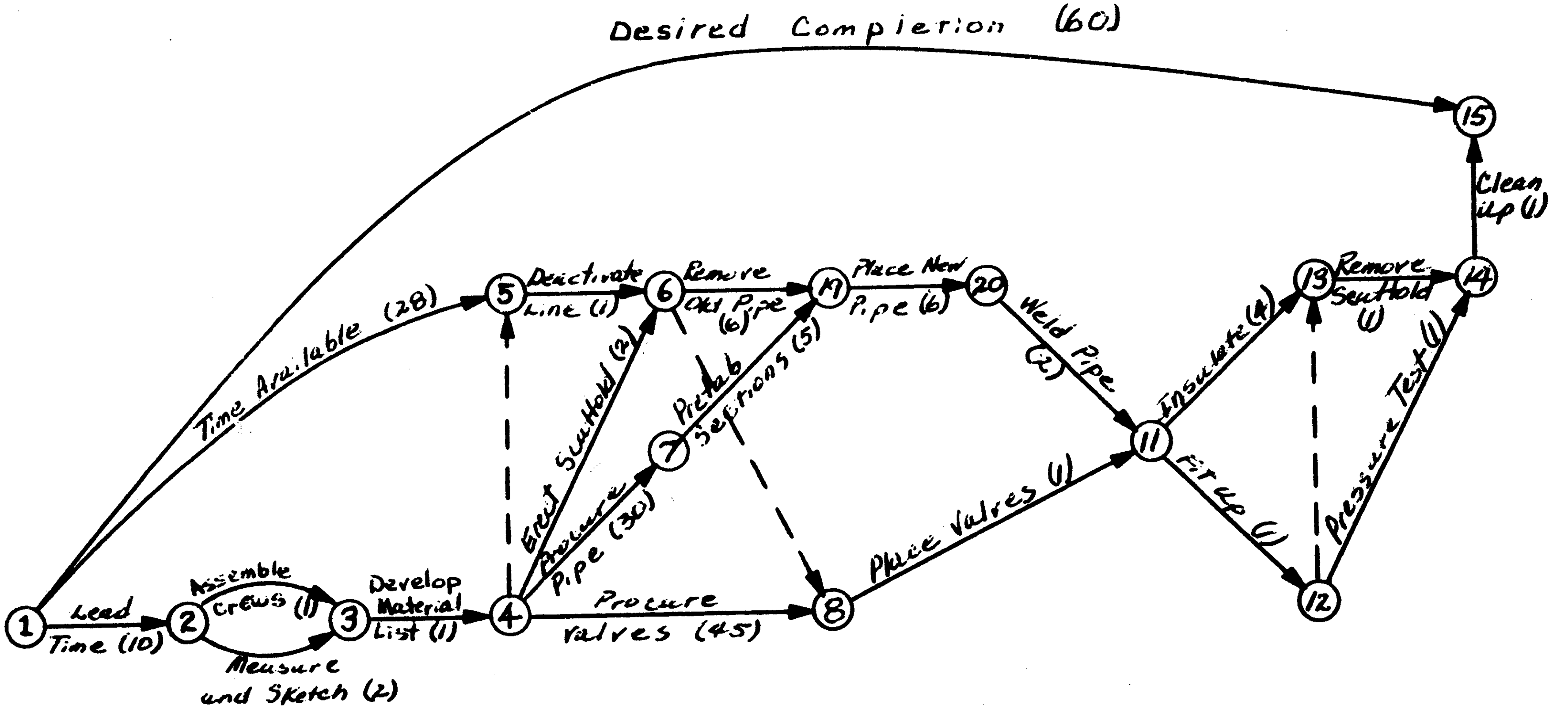
(3) Jobs whose tails bear the same number as the head of a given job must immediately succeed the given job.
ex. Job (14, 15) succeeds job (12, 14) and may not be started until (12, 14) and (13, 14) are finished.

(4) Jobs whose tails bear the same number may be done concurrently.
ex. Jobs (11, 12) and (11, 13) may be done concurrently.

(5) Dummy jobs (denoted by dotted line arrows) are inserted to complete the logic of an arrow diagram.
ex. Dummy (6, 8) shows that the jobs immediately preceeding job (8, 11) have heads numbered 6 as well as 8. That is jobs (5, 6), (4, 6), and (4, 8) preceed job (8, 11).

The rules presented thus far allow descriptions of the technological sequence of jobs within a project. Actually, this planning should include a time estimate of each diagrammed job. A few additional rules will now be given that allow the injection of the time element.

(6) Every job has an estimated elapsed time associated with it. In the case of dummy jobs, this time is zero. This time may be used along with arrow head and tail to denote a job.
ex. The time estimated to complete the pressure test (12, 14, 1) is one day.



Schedule Replacement of a Pipe Line - Figure 1

(7) In order to later calculate start and finish dates for each job, the first job is usually designated as lead time.
ex. Job (1, 2, 10) states that the project may begin on the 10th day of a particular calendar (or 10th hour of a clock). That is the first actual jobs (2, 3, 2) and (2, 3, 1) may begin on the 10th day.

(8) Time restraints on the execution of certain jobs may be described by the use of arrows with associated times.
ex. Restraint (1, 5, 28) means that the old pipe line must not be deactivated until the 28th day.

(9) Material delivery restraints do not always have to be tied to the calendar as in (8), but may be in elapsed time.
ex. Restraint (4, 7, 30) means that the pipe will be delivered 30 days after the completion of job (3, 4).

PART III - CRITICAL PATH SCHEDULING

The fact that scheduling has not yet been mentioned is a unique advantage of this technique - planning and scheduling are recognized as two separate functions. After completing the arrow diagram and estimating the duration of each job, a schedule (in the form of a detailed time table) is easily obtained by a few simple calculations. The following nomenclature is used.

I	Tail of a job, dummy, or restraint arrow.
J	Head of a job, dummy, or restraint arrow.
N	A Node. Either the head or tail of an arrow.
D (I, J)	Estimated elapsed time for job (I, J).
TI (N)	The earliest time that a job whose tail is N may start and assure minimum project completion time.
TJ (N)	The latest time that a job whose head is N may finish and assure minimum project completion time.
ES	Earliest start time. Same as TI (N)
EF	Earliest finish time.
LS	Latest start time.
LF	Latest finish time. Same as TJ (N)
TF	Total float time. The length of time that the start of a job may be delayed without changing the minimum project completion time.
FF	Free float time. The length of time that the start of a job may be delayed without changing ES for another job.
λ	Minimum project completion time.

The following steps are followed to calculate a time table for the project diagrammed in Figure 2.

(1) Place the planning results in a table like Table 1A.

(2) Set up a row in Table 2 for each node in the diagram.

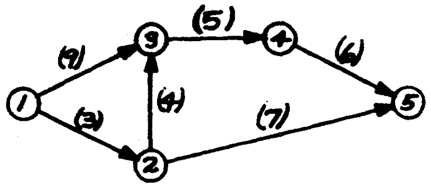


Figure 2

Table 1A

I	J	D(I,J)
1	2	3
1	3	9
2	3	4
2	5	7
3	4	5
4	5	6

Table 1B

ES	EF	LS	LF	TF	FF	
0	3	2	5	2	0	
0	9	0	9	0	0	*
3	7	5	9	2	2	
3	10	13	20	10	10	
9	14	9	14	0	0	*
14	20	14	20	0	0	*

Table 2

N	TI(N)	TJ(N)
1	0	0 ~~2~~
2	3	~~13~~ 5
3	9 ~~7~~	9
4	14	14
5	~~10~~ 20	20

(3) Compute the TI (N) value in Table 2 by first setting TI (First Node) = 0 and then generating possible values of TI (J) = TI (I) + D (I, J). The largest such value of TI (J) is the correct value for a given node.

ex. TI (1) = 0

$$TI(2) \overset{?}{=} TI(1) + D(1,2) = 0 + 3 = 3 = TI(2)$$

$$TI(3) \overset{?}{=} TI(1) + D(1,3) = 0 + 9 = 9 = TI(3)$$

$$TI(3) \overset{?}{=} TI(2) + D(2,3) = 3 + 4 = 7$$

$$TI(5) \overset{?}{=} TI(2) + D(2,5) = 3 + 7 = 10$$

$$TI(4) \overset{?}{=} TI(3) + D(3,4) = 9 + 5 = 14 = TI(4)$$

$$TI(5) \overset{?}{=} TI(4) + D(4,5) = 14 + 6 = 20 = TI(5)$$

(4) The TI value for the last node will be the minimum completion time for the project.

ex. λ = TI (Last Node) = TI (5) = 20

(5) Compute TJ (N) values by setting TJ (Last Node) = λ and generating possible values of TJ (I) = TJ (J) - D (I, J). The smallest such value of TJ (I) is the correct value for a given node.

ex. TJ (Last Node) = λ = TJ (5) = 20

$TJ(4) \overset{?}{=} TJ(5) - D(4,5) = 20 - 6 = 14$, etc.

(6) With Table 2 complete, Table 1 B can be constructed by use of the following relationships.

ex. For job (1, 2)

ES = TI (I) = TI (1) = 0

EF = ES + D (I, J) = 0 + 3 = 3

LF = TJ (J) = TJ (2) = 5

LS = LF - D (I, J) = 5 - 3 = 2

TF = LS - ES = 2 - 0 = 2

FF = TI (J) - EF = TI (2) - EF = 3 - 3 = 0

The longest chain of jobs through a project is termed the "critical path." The jobs along this path have zero total float times and are marked by an asterisk in Table 1 B. Any delay in the starting or completion of these jobs will delay completion of the project by a like amount of time. On the other hand some of the jobs are floaters and may be delayed a limited amount without effecting the project completion date.

PART IV - NOTES ON THIS PROGRAM

A. Node Numbering

In many previous programs of this sort the jobs had to be numbered so that the head of an arrow (J) was always greater than the tail (I) of that arrow. In addition input cards had to be in J sequence within I sequence with no missing I values. These restrictions allowed checking arrow diagram logic by a sequence check of I values and a test of I against J. In this program another method is used for checking logic that removes these restrictions.

As long as none of the restrictions of Part II are violated, I and J may be any four digit numbers less than 2000. However, the restrictions on maximum project size are in terms of the highest numbered node and not in terms of the total number of nodes, so it is sometimes necessary to use the smallest numbers available for I and J. There is also a slight speed advantage in putting the jobs in approximately the same order as the previous restrictions required.

B. Program Capacity

For a 20,000 digit core memory machine, the sum of the number of the highest numbered node and the number of jobs must be 1614 or less. For 40,000 digits of storage this restriction is 3614 and for 60,000 digits it is 5614. The highest possible numbered node is 1999.

C. Machine Requirements

1620 Data Processing System

1622 Card Read Punch or 1621 Paper Tape Reader

1623 Additional Core Memory is optional

No special features

PART V - INPUT

The input to this program contains three types of data cards or card images on paper tape. Type 1 and 2 cards may be arranged in any desired order. See Appendix A for sample problem input.

Type 1 - Heading or description cards

These are identified by some character in column 1, other than a blank or numeric digit. The remainder of the card may be punched with any information desired. The identifying character in column 1 may be different for each type 1 card. These may be any length up to 80 characters long for tape records.

Type 2 - Job description cards

There is one of these for every job in the project. Blanks in numeric fields are taken as zeros. Tape records must be at least 50 characters long, but not over 80 characters.

Columns	
1 - 4	Tail of the job arrow - I (1999 or less)
5 - 8	Head of the job arrow - J (1999 or less)
9 - 12	Time duration of the job - D (I, J)
13 - 17	Cost of the job
18 - 50	Description of the job and miscellaneous data
51 - 80	Not used - may contain anything

Type 3 - End of the project

This is the last card in the input deck and should be blank. Tape record should be at least 8 characters long.

PART VI - OPERATING INSTRUCTIONS

A. Program Deck

The SPS listing of this program is in Appendix C. The condensed program deck (listing in Appendix D) consists of 90 cards numbered 00 through 89 in columns 79 - 80. The program tape was formed by putting these cards on tape with a slightly different load routine.

B. Console Settings

PARITY	Switch	-	STOP
O FLOW	Switch	-	STOP
I/O	Switch	-	STOP
Program	Switch 1	-	ON Typed Output
		-	OFF Card Output
Program	Switch 2	-	ON Tape Input
		-	OFF Card Input

C. Card Procedure

Load Program Deck - Depress RESET, place program deck in read hopper, depress LOAD. To read final program card, depress READER START. Computer then halts when program is loaded.

Data Pass I - Place data deck in read hopper, press READER START and computer START. To read the final data card, depress READER START. Computer reads jobs, does error analysis, and either halts or prints an error message and halts.

Data Pass II - If no errors were discovered, place data deck in read hopper and blank cards in punch hopper. Press READER START, PUNCH START, and computer START. To read the final data card, depress READER START.

D. ~~Tape Procedure~~

~~Load Program Tape - Ready program tape in reader, RESET, INSERT, 36 00000 00300, RELEASE, START. Computer halts when program is loaded.~~

Tapes deleted 4/1/65

~~Data Pass I - Ready data tape in reader, press START. Computer reads jobs, does error analysis, and either halts or prints an error message and halts.~~

~~Data Pass II - If no errors were discovered, ready data tape in reader, turn typewriter to a clean sheet, and press START. Computer prints report and halts. Press START to work next problem.~~

E. Error Messages and Actions

Error 1 - Available storage has been exceeded. The number of the highest numbered arrow plus the number of jobs is greater than 1614 (for 20,000 positions of storage). Typewriter prints four fields - the highest numbered node, 2 four digit fields with no meaning, and the number of jobs - and halts. To work the next project remove remainder of data from reader and press START.

Error 2 - More than one "last" node (a node which is not the tail of some arrow) has been found. Typewriter prints 3 fields - the "first" node, the previous "last" node, and the last "last" node discovered - and halts. To work the next project INSERT 16 01327 000$\overline{1}$6 49 00402, RELEASE, START.

Error 3 - More than one "first" node (a node which is not the head of some arrow) has been found. Typewriter prints 3 fields - the previous "first" node, the "last" node, and the last "first" node discovered - and halts. To work the next project INSERT 16 01327 000$\overline{1}$6 49 00402, RELEASE, START.

Error 4 - A loop has been found in the arrow diagram. For example a series of jobs (1,2), (2,3), and (3,1) would be a loop. Typewriter prints I, J, and D for the first job where the error may be detected. (i.e. The earliest start fot this job exceeds the sum of all job times.) This job need not be on the loop itself, but may be on a chain of jobs which passes through one of the nodes on the loop. To work the next project press START.

Error 5 - Available storage has been exceeded. The storing of jobs has destroyed the temporary table used to find "first" and "last" nodes. Typewriter prints 4 fields - the highest numbered node, 2 four digit fields with no meaning, and the number of jobs - and halts. To work the next project remove remainder of data from reader and press START.

PART VII - OUTPUT

With program switch 1 off, a deck of cards similar to the pass II data deck is produced. The type 1 output cards are unchanged. The type 2 output cards are identical to input in columns 1 - 50, and contain the following calculated quantities in columns 51 - 80.

Columns	
51 - 55	Earliest start date
56 - 60	Earliest finish date
61 - 65	Latest start date
66 - 70	Latest finish date
71 - 75	Total float time
76 - 80	Free float time
75	Contains * if this is a critical job

There are no type 3 cards in the output deck. The last output card is a type 1 card containing project cost and completion date. By letting the first column of the output cards be a printer format control, any desired listing may be developed.

With program switch 1 on, this same information is typed out.

PART VIII - SUGGESTIONS

A. Additional or Special Output

The second pass of data controls the amount of output. For example if you do not wish to include dummy jobs in the printed report, omit them from the data deck in the second data pass. If you wish to prepare several reports on one project, it is possible to make several second passes. Prepare a transfer card with 49 02030 0000 in columns 1 - 12, and place it on top of the pass 2 deck. Press RESET and LOAD to execute another second pass.

B. Least Cost Estimating

Repeated applications of this program will give an idea of how project completion time varies with cost. First schedule the project with normal job time and normal costs, then compress the schedule along the critical path, which shortens the overall project time at the expense of increasing some job costs. Running the schedule again will show the new project time and cost and the new critical path. If the assumption is made that cost of a job varies linearly with completion time between the limits of normal job time and crash time, this estimating may be done automatically by means of a specialized parametric linear programming algorithm. In either case a series of project durations are obtained as a function of direct job costs. By combining these with the indirect costs for overhead, penalties, etc., the least cost may be estimated.

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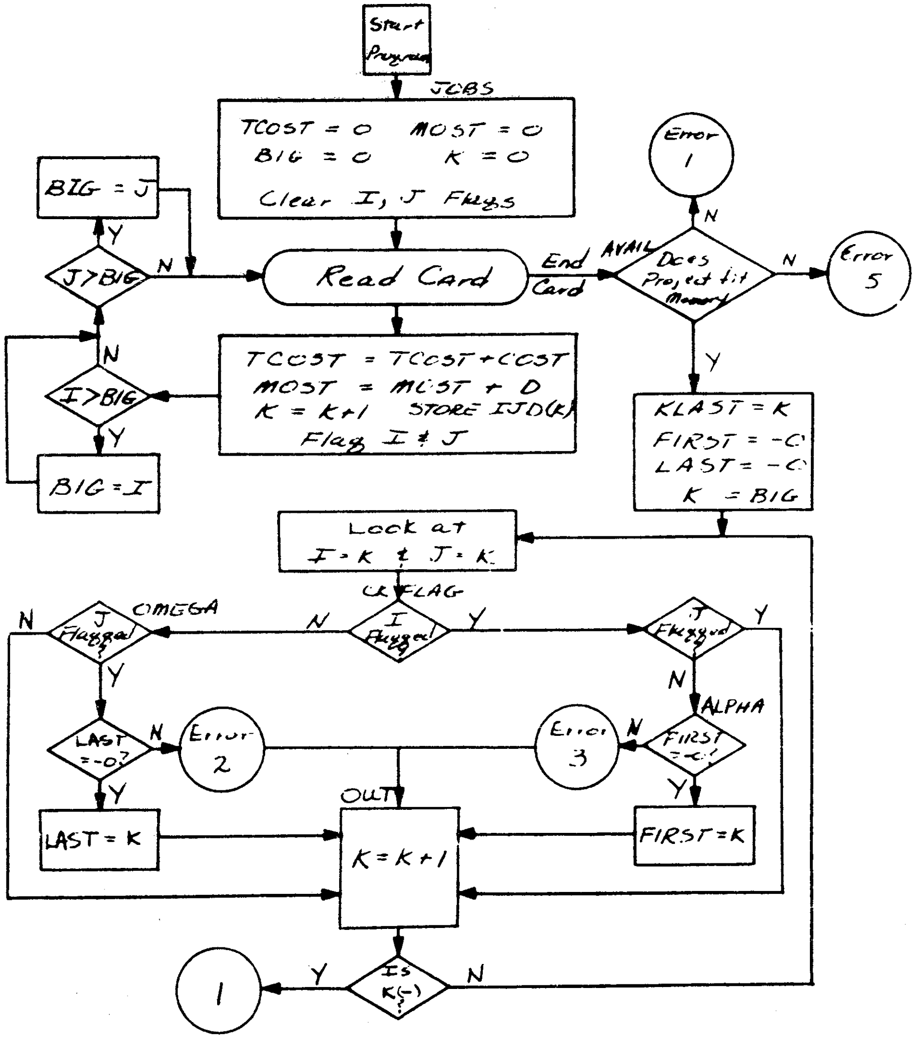
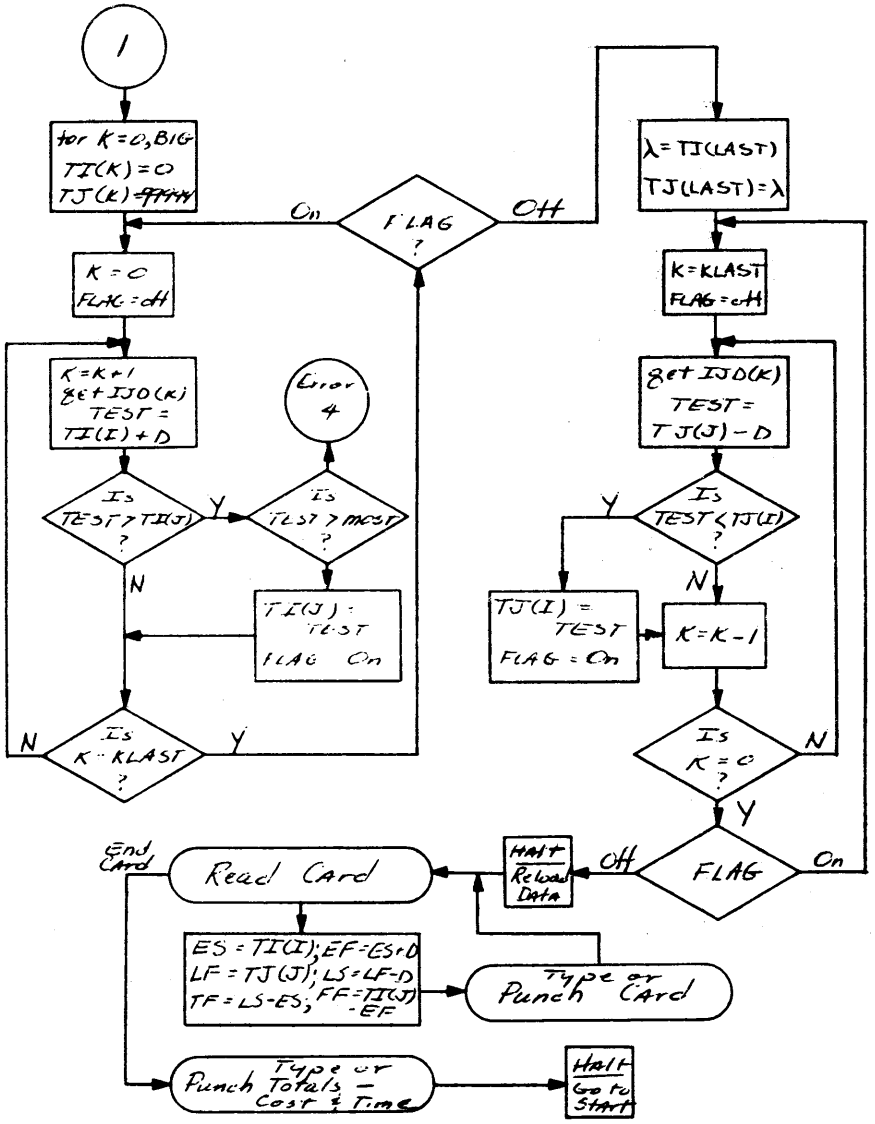
APPENDIX

```
     LISTING OF SAMPLE DATA FOR CRITICAL PATH SCHEDULING


         1         2         3         4         5         6         7         8
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789
-           SCHEDULE REPLACEMENT OF A PIPE LINE  -  FIGURE 1
-
-  I    J    D COST    DESCRIPTION OF JOBS                ES    EF    LS    LF    TF    FF
-
   1    2  10          LEAD TIME
   1    5  28          TIME AVAILABLE
   1   15  60          DESIRED COMPLETION
   2    3   1   25     ASSEMBLE CREWS
   2    3   2  300     MEASURE AND SKETCH
   3    4   1  100     DEVELOP MATERIAL LIST
   4    5
   4    6   2  300     ERECT SCAFFOLD
   4    7  30  850     PROCURE PIPE
   4    8  45  300     PROCURE VALVES
   5    6   1  100     DEACTIVATE LINE
   6    8
   6   19   6  400     REMOVE OLD PIPE
   7   19   5 1200     PREFAB SECTIONS
   8   11   1  100     PLACE VALVES
  19   20   6  800     PLACE NEW PIPE
  20   11   2  100     WELD PIPE
  11   12   1  100     FIT UP
  11   13   4  300     INSULATE
  12   13
  12   14   1   50     PRESSURE TEST
  13   14   1  100     REMOVE SCAFFOLD
  14   15   1  100     CLEAN UP
-


-           SAMPLE PROBLEM - FIGURE 2
-
-  I    J    D COST    DESCRIPTION OF JOBS                ES    EF    LS    LF    TF    FF
-
   1    2   3
   1    3   9
   2    3   4
   2    5   7
   3    4   5
   4    5   6
-


         1         2         3         4         5         6         7         8
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789
```

```
-           SCHEDULE REPLACEMENT OF A PIPE LINE  -  FIGURE 1
-
-  I    J    D COST    DESCRIPTION OF JOBS                ES    EF    LS    LF    TF    FF
-
   1    2  10          LEAD TIME                                10          10     *
   1    5  28          TIME AVAILABLE                           28    16    44    16
   1   15  60          DESIRED COMPLETION                       60     5    65     5     5
   2    3   1   25     ASSEMBLE CREWS                     10    11    11    12     1     1
   2    3   2  300     MEASURE AND SKETCH                 10    12    10    12     *
   3    4   1  100     DEVELOP MATERIAL LIST              12    13    12    13     *
   4    5                                                 13    13    44    44    31    15
   4    6   2  300     ERECT SCAFFOLD                     13    15    43    45    30    14
   4    7  30  850     PROCURE PIPE                       13    43    16    46     3
   4    8  45  300     PROCURE VALVES                     13    58    13    58     *
   5    6   1  100     DEACTIVATE LINE                    28    29    44    45    16
   6    8                                                 29    29    58    58    29    29
   6   19   6  400     REMOVE OLD PIPE                    29    35    45    51    16    13
   7   19   5 1200     PREFAB SECTIONS                    43    48    46    51     3
   8   11   1  100     PLACE VALVES                       58    59    58    59     *
  19   20   6  800     PLACE NEW PIPE                     48    54    51    57     3
  20   11   2  100     WELD PIPE                          54    56    57    59     3     3
  11   12   1  100     FIT UP                             59    60    62    63     3
  11   13   4  300     INSULATE                           59    63    59    63     *
  12   13                                                 60    60    63    63     3     3
  12   14   1   50     PRESSURE TEST                      60    61    63    64     3     3
  13   14   1  100     REMOVE SCAFFOLD                    63    64    63    64     *
  14   15   1  100     CLEAN UP                           64    65    64    65     *
-
-  PROJECT COST        5225              PROJECT COMPLETION        65



-           SAMPLE PROBLEM - FIGURE 2
-
-  I    J    D COST    DESCRIPTION OF JOBS                ES    EF    LS    LF    TF    FF
-
   1    2   3                                                  3     2     5     2
   1    3   9                                                  9           9     *
   2    3   4                                              3   7     5     9     2     2
   2    5   7                                              3  10    13    20    10    10
   3    4   5                                              9  14     9    14     *
   4    5   6                                             14  20    14    20     *
-
-  PROJECT COST                          PROJECT COMPLETION        20
```


Start Program
JOBS
TCOST = 0 MOST = 0
BIG = 0 K = 0
Clear I, J Flags
BIG = J
Y
J>BIG
N
Read Card
End Card
AVAIL
Does Project fit Memory
N
Error 1
Error 5
Y
TCOST = TCOST + COST
MOST = MOST + D
K = K+1 STORE IJD(K)
Flag I & J
I>BIG
BIG = I
KLAST = K
FIRST = -0
LAST = -0
K = BIG
Look at I = K & J = K
OK FLAG
I Flagged?
J Flagged?
OMEGA
J Flagged?
ALPHA
LAST = -0?
Error 2
Error 3
FIRST = -0?
OUT
LAST = K
K = K+1
FIRST = K
Is K(-)?
1


1
for K = 0, BIG
TI(K) = 0
TJ(K) = 9999
K = 0
FLAG = off
K = K+1
get IJD(K)
TEST = TI(I) + D
Is TEST > TI(J)?
Y
N
Error 4
Is TEST > MOST?
TI(J) = TEST
FLAG On
Is K = KLAST?
FLAG?
On
Off
λ = TJ(LAST)
TJ(LAST) = λ
K = KLAST
FLAG = off
get IJD(K)
TEST = TJ(J) - D
Is TEST < TJ(I)?
TJ(I) = TEST
FLAG = On
K = K-1
Is K = 0?
FLAG
Halt Reload Data
End Card
Read Card
ES = TI(I); EF = ES+D
LF = TJ(J); LS = LF-D
TF = LS-ES; FF = TI(J) - EF
Type or Punch Card
Type or Punch Totals — Cost & Time
Halt Go to Start

```
        SAMPLE PROBLEM - FIGURE 2

 I    J    D COST    DESCRIPTION OF JOBS                     ES     EF     LS     LF     TF     FF

 1    2    3                                                         3      2      5      2
 1    3    9                                                         9             9      *
 2    3    4                                                  3      7      5      9      2      2
 2    5    7                                                  3     10     13     20     10     10
 3    4    5                                                  9     14      9     14      *
 4    5    6                                                 14     20     14     20      *

PROJECT COST                             PROJECT COMPLETION          20
```

```
  16000 10000003600000003
SWITCH 1 ON FOR TYPED OUTPUT
SWITCH 2 ON IF USING TAPE INPUT
          SAMPLE PROBLEM   FIGURE 2

    I    J    D COST    DESCRIPTION OF JOBS                ES     EF     LS     LF     TF     FF

    1    2    3                                                    3      7     10      7      7
    1    3    9                                                    9      3     12      3      3
    2    3    4                                            10     14      8     12
    2    5    7                                            10     17     37     44     27     11
    3    4    5                                            12     17      8     13
    4    5    6                                            13     19     38     44     25      9

49038641600010000003600000003
SWITCH 1 ON FOR TYPED OUTPUT
SWITCH 2 ON IF USING TAPE INPUT
          SCHEDULE REPLACEMENT OF A PIPE LINE      FIGURE 1

    I    J    D COST    DESCRIPTION OF JOBS                ES     EF     LS     LF     TF     FF

    1    2   10            LEAD TIME                              10            10      *
    1    5   28            TIME AVAILABLE                         28     16     44     16

 1  15  60           DESIRED COMPLETION                    60      5     65      5      5
 2   3   1    25     ASSEMBLE CREWS                 10     11     11     12      1      1
 2   3   2   300     MEASURE AND SKETCH             10     12     10     12      *
 3   4   1   100     DEVELOP MATERIAL LIST          12     13     12     13      *
 4   5                                              13     13     44     44     31     15
 4   6   2   300     ERECT SCAFFOLD                 13     15     43     45     30     14
 4   7  30   850     PROCURE PIPE                   13     43     16     46      3
 4   8  45   300     PROCURE VALVES                 13     58     13     58      *
 5   6   1   100     DEACTIVATE LINE                28     29     44     45     16
 6   8                                              29     29     58     58     29     29
 6  19   6   400     REMOVE OLD PIPE                29     35     45     51     16     13
 7  19   5  1200     PREFAB SECTIONS                43     48     46     51      3
 8  11   1   100     PLACE VALVES                   58     59     58     59      *
19  20   6   800     PLACE NEW PIPE                 48     54     51     57      3
20  11   2   100     WELD PIPE                      54     56     57     59      3      3
11  12   1   100     FIT UP                         59     60     62     63      3
11  13   4   300     INSULATE                       59     63     59     63      *
12  13                                              60     60     63     63      3      3
12  14   1    50     PRESSURE TEST                  60     61     63     64      3      3
13  14   1   100     REMOVE SCAFFOLD                63     64     63     64      *
14  15   1   100     CLEAN UP                       64     65     64     65      *

  PROJECT COST        5225               PROJECT COMPLETION        65
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                              [illegible]00275260005900274250001100000260000900026900C 0000
                              [illegible]0002645300000000200260011400274250000000114900012000000000
                         00010*        CRITICAL PATH SCHEDULING FOR PROJECTSZ
                         00020*        PLANNED BY THE ARROW DIAGRAMMING TECHNIQUEZ
                         00030*         Z
                         00040*        RAY N. SAUERZ
                         000[illegible]*        IBM - [illegible]
                         000[illegible]*        JUNE, [illegible]
                         00060*         Z
                         00070*        INPUT DATA - ANY NUMBER OF TYPE 1 AND TYPE 2 CARDS, WHICHZ
                         00080*                  MAY BE INTERSPERSED AND IN ANY ORDER.  THESEZ
                         00090*                  ARE FOLLOWED BY A TYPE*3 CARD.Z
                         00100*          1.  HEADING CARDS - THE CHARACTER*IN COLUMN 1 MUST NOTZ
                         00110*                             BE BLANK OR NUMERIC.  THE REMAINDERZ
                         00120*                             OF THE CARD MAY CONTAIN ANYTHING.Z
                         00130*          2.  JOB DESCRIPTORS - ONE FOR EVERY JOB IN THE PROJECT.Z
                         00140*                   COLUMNS          LEADING ZEROS ARE NOT NECESSARY.Z
                         00150*                      1-4     TAIL OF THE JOB*ARROW - IZ
                         00160*                      [illegible]     HEAD OF THE JOB*ARROW - JZ
                         00170*                      [illegible]     TIME DURATION OF THE JOB - DZ
                         00180*                      13-17   COST OF THE JOBZ
                         00190*                      18-50   DESCRIPTION OF*THE JOB & MISC DATAZ
                         00200*                      51-80   NOT USED - MAY*CONTAIN ANYTHINGZ
                         00210*                                 - I MAY BE GREATER OR LESS THAN JZ
                         00220*          3.  END OF [illegible] - COLUMNS 1-4*ARE BLANK.Z
                         00230*         Z
                         00240*        OUTPUT CARDS - SAME AS INPUT WITH THE CALCULATED SCHEDULE
                         00250*                     IN COLUMNS 51-80 OF*TYPE 2 CARDS.  A TYPE 1Z
                         00260*                     CARD IS PUNCHED WITH*PROJECT TIME AND COST.Z
                         00270*                     THE TYPE 3 CARD IS NOT PUNCHED.Z
                         01010*         Z
                         01020*        READ AND [illegible] INFORMATION
                         01030*        FIND [illegible]
                         01040*         Z
00402                    01050         DORG  402Z
00402  16 00432 -3862     1130 JOBS    TFM   *630,TJZ
00414  11 00432 000-1    01140         AM    *618,1,10Z
00426  3[illegible] 00000 00000    01150         CF     Z
00438  1[illegible]2 -7[illegible]2     1160         CM    *-6,TJ[illegible]Z
00450  47 00414 01200    01170         BNE   JOBS612Z
00462  22 03790 03790    01180         S     TCOST,TCOSTZ
00474  22 03798 03798    01190         S     MOST,MOSTZ
00486  16 03818 0-000     1200         TFM   BIG,0,8Z
00498  16 03830 0-000    01210         TFM   K,0,8Z
                         01240*         Z
00510  17 03394 000-0    02010 READ1   BTM   READ,0,10,      READ AND STORE IJD%K¤Z
00522  44 00942 03392    02020         BNF   AVAIL,READ-2,,  FLAG I AND J NODESZ
00534  11 03830 0-001    02030         AM    K,1,8Z
00546  17 03058 000-0    02040         BTM   TNS,0,10Z
00558  21 03790 03796    02110         A     TCOST,COSTZ
00570  21 03798 03731    02120         A     MOST,[illegible]
00582  16 00636 -3863     2122         TFM   FLAGIJ66,TJ61Z
00594  16 00648 -5863     2124         TFM   FLAGIJ618,TJ62001Z
00606  21 00636 03723     2130         A     FLAGIJ66,IZ
00618  21 00648 03727     2140         A     FLAGIJ6[illegible]
00630  32 00000 00000    02150 FLAGIJ  SF     Z
00642  32 00000 00000    02160         SF     Z
                         02170*         Z
00654  24 03723 03818    02180         C     I,BIG,,         FIND HIGHEST NODE ANDZ
00666  47 00690 01100    02190         BNH   *624,,,         DETERMINE STORAGE AVAILABILITYZ
00678  26 03818 03723    02200         TF    BIG,IZ
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00690  24 03727 03818    02210         C     J,BIGZ
00702  47 00726 01100    02220         BNH   *624Z
00714  26 03818 03727    02230         TF    BIG,JZ
00726  43 00746 03724     2240         BD    *620,J-3Z
00738  49 00758 00000     2250         B     *620Z
00746                     2260         DORG  *-3Z
00746  32 03727 00000     2270         SF    JZ
00758  43 00778 03720     2280         BD    *620,I-3Z
00770  49 00790 00000     2290         B     *620Z
00778                     2300         DORG  *-3Z
00778  32 03723 00000     2310         SF    IZ
00790  32 03721 00000     2320         SF    I-2Z
00802  32 03725 00000    02330         SF    J-2Z
00814  26 03724 03723     2340         TF    I61,IZ
00826  25 03732 03737     2350         TD    D61,RECMRKZ
00838  26 00873 03847     2360         TF    *635,SIZEZ
00850  22 00872 03830     2370         S     *622,KZ
00862  25 03841 00000     2380 SAVE    TD    FLAGZ
00874  26 00904 00873     2400         TF    *630,SAVE611Z
00886  12 00904 000J0     2410         SM    *618,10,10Z
00898  31 00000 03722     2420         TR    ,D-9Z
00910  26 00928 00873     2430         TF    *618,SAVE611Z
00922  25 00000 03841     2440         TD    ,FLAGZ
00934  49 00510 00000     2450         B     READ1Z
00942                     2460         DORG  *-3Z
00942  16 03840 -3863    03010 AVAIL   TFM   TEST,TJ61Z
00954  21 03839 03818    03020         A     TEST-1,BIGZ
00966  21 03839 03830    03030         A     TEST-1,KZ
00978  24 03840 03847    03040         C     TEST,SIZEZ
00990  46 02557 01100    03050         BH    ERROR1Z
01002  16 03840 -5874    03051         TFM   TEST,TJ62012Z
01014  21 03840 03818     3052         A     TEST,[illegible]
01026  21 03839 03830    03053         A     TEST-[illegible]
01038  24 03840 03847     3054         C     TEST,SIZEZ
01050  46 02714 01100     3055         BH    ERROR5Z
                         03060*          Z
                         03070*        FIND STARTING AND ENDING NODESZ
                         03080*        CHECK FOR MORE THAN ONE OF EACHZ
                         03090*          Z
01062  26 03835 03830    03095         TF    KLAST,KZ
01074  16 03822 0-000     3100         TFM   FIRST,0,811Z
01086  16 03826 0-000     3110         TFM   LAST,0,811Z
01098  26 03830 03818    03120         TF    K,BIGZ
01110  16 01181 -3863     3121         TFM   CKFLAG611,TJ61Z
01122  16 01193 -5863     3122         TFM   CKFLAG623,TJ62001Z
01134  21 01181 03830     3130         A     CKFLAG611,KZ
01146  21 01193 03830     3140         A     CKFLAG623,KZ
01158  26 01281 01193     3150         TF    OMEGA611,CKFLAG623Z
01170  44 01270 00000    03160 CKFLAG  BNF   OMEGAZ
01[illegible]  44 01226 00000    03170         BNF   ALPHAZ
01[illegible]  12 03830 00-01    03180 OUT     SM    K,1,[illegible]
01206  47 01326 01300    03190         BN    TICALCZ
 1218  49 01110 00000    03200         B     CKFLAG-60Z
 1226                    03210         DORG  *-3Z
 12[illegible]  14 03822 0-000    03220 ALPHA   CM    FIRST,0,811Z
 12[illegible]  47 02590 01200    03230         BNE   ERRO[illegible]
 12[illegible]  26 03822 03830    03240         TF    FI[illegible]
  262  49 01194 00000    03250         B     OUTZ
  270                    03260         DORG  *-3Z
  270  44 01194 00000    04010 OMEGA   BNF   OUTZ
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[illegible]                                 TF      [illegible]
01318  49 01194 00000   04050           B       OUTZ
01326                   04060           DORG    *-3Z
                        04070*            Z
                        04080*          COMPUTE EARLIEST STARTING TIMES - TI[illegible]Z
                        04090*          CHECK FOR A LOOP IN THE ARROW DIAGRAMZ
                        04100*            Z
01326  16 01356 -3857   04110 TICALC TFM     *630,TIZ
01338  16 01380 -3862   04120           TFM     *642,TJZ
01350  16 00000 -0000   04130           TFM     ,0Z
01362  11 01356 00030   04140           AM      *-6,10,10Z
01374  16 00000 [illegible]   04150           TFM     [illegible]
01386  11 01380 00030   04160           AM      [illegible]
01398  12 03818 00-01   04170           SM      BIG,1,9Z
01410  46 01350 01300   04180           BNN     TICALC&24Z
01422  16 03830 0-000   04190 TILOOP TFM     K,0,8Z
01434  33 03841 00000   04200           CF      FLAGZ
01446  11 03830 0-001   04210           AM      K,1,8Z
01458  17 02772 000-0   04220           BTM     GETIJ[illegible],10Z
01470  16 01505 -3857   04230           TFM     *635,TIZ
01482  21 01504 03723   04240           A-      *622,IZ
01494  26 03840 00000   04250           TF      TESTZ
01506  21 [illegible] [illegible]   04260           A       [illegible]
01518  16 01553 [illegible]   05010           TFM     [illegible]
01530  21 01552 03727   05020           A       [illegible]
01542  26 03777 00000   05030           TF      TIJZ
01554  24 03777 03840   05040           C       TIJ,TESTZ
01566  47 01622 01300   05050           BL      ONIZ
01578  24 03830 03835   05060 BACKI  C       K,KLASTZ
01590  47 [illegible] 01200   05070           BNE     TILOOP[illegible]
01602  44 01702 03841   05080           BNF     TJCALC,FLAGZ
01614  49 01422 00000   05090           B       TILOOPZ
01622                   05100           DORG    *-3Z
01622  24 03798 03840   05110 ONI    C       MOST,TESTZ
01634  47 02658 01100   05120           BNH     ERROR4Z
01646  16 01676 -3857   05130           TFM     *630,TIZ
01658  21 01675 03727   05140           A       *617,JZ
01670  26 00000 03840   05150           TF      ,TESTZ
01682  32 03841 00000   05160           SF      FLAGZ
01694  49 01578 00000   05170           B       BACKIZ
01702                   05185           DORG    *-3Z
                        05180*            Z
                        05190*          COMPUTE LATEST STARTING TIMES - TJ%J¤Z
                        05200*            Z
01702  16 01737 -3857   05210 TJCALC TFM     *635,TIZ
01714  21 01736 03826   05220           A       *622,LASTZ
01726  26 03742 00000   05230           TF      LAMDAZ
01738  16 01768 -3862   05240           TFM     *630[illegible]
01750  21 01767 03826   05250           A       *617[illegible]TZ
01762  26 00000 03742   05260           TF      ,LAMDAZ
01774  26 03830 03835   06010 TJLOOP TF      K,KLASTZ
01786  33 03841 00000   06020           CF      FLAGZ
01798  17 02772 000-0   06030           BTM     GETIJ[illegible],10Z
01810  16 01845 -3862   06040           TFM     *635,[illegible]
01822  21 01844 03727   06050           A       *622,[illegible]
01834  26 03840 00000   06060           TF      TESTZ
01846  22 03840 03731   06070           S       TEST,DZ
01858  16 01893 -3862   06080           TFM     *635,TJZ
01870  21 01892 03723   06090           A       *622,IZ
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01882  26 03782 00000   06100           TF      TJIZ
01894  24 03782 03840   06110           C       TJI,TESTZ
01906  46 01962 01100   06120           BH      ONJZ
01918  12 03830 0-001   06130 BACKJ  SM      K,1,8Z
01930  47 01798 01200   06140           BNZ     TJLOOP&24Z
01942  44 02018 03841   06150           BNF     OUTPUT,FLAGZ
01954  49 01774 00000   06160           B       TJLOOPZ
01962                   06170           DORG    *-3Z
01962  16 01992 -3862   06180 ONJ    TFM     *630,TJZ
01974  21 01991 03723   06190           A       *617,IZ
01986  26 00000 03840   06200           TF      ,TESTZ
01998  32 03841 00000   06205           SF      FLAGZ
02010  49 01918 00000   06210           B       BACKJZ
02018                   06220           DORG    *-3Z
                        06230*            Z
                        06240*          CALCULATE AND PUNCH START, FINISH,*AN. FLOAT TIMESZ
                        06250*            Z
02018  48 11111 11111   07010 OUTPUT H       11111,11111Z
02030  17 03394 000-J   07020 READ2  BTM     READ,-1,10Z
02042  44 02446 03392   07030           BNF     EOJ,READ-2Z
02054  33 03842 00000   07125           CF      CRITZ
02066  17 03058 000-0   07130           BTM     TNS,0,10Z
02078  16 02113 -3857   07160           TFM     *635,TIZ
02090  21 02112 03723   07170           A       *622,IZ
02102  26 03747 00000   07180           TF      TIIZ
02114  16 02149 -3857   07190           TFM     *635,TIZ
02126  21 02148 03727   07200           A       *622,JZ
02138  26 03777 00000   07210           TF      TIJZ
02150  16 02185 -3862   07220           TFM     *635,TJZ
02162  21 02184 03727   07230           A       *622,JZ
02174  26 03762 00000   07240           TF      TJJZ
02186  26 03752 03747   07250           TF      EF,TIIZ
02198  21 03752 03731   07260           A       EF,DZ
02210  26 03757 03762   08010           TF      LS,TJJZ
02222  22 03757 03731   08020           S       LS,DZ
02234  26 03767 03757   08030           TF      TF,LSZ
02246  22 03767 03747   08040           S       TF,TIIZ
02258  47 02282 01200   08050           BNZ     *624Z
02270  32 03842 00000   08060           SF      CRITZ
02282  26 03772 03777   08070           TF      FF,TIJZ
02294  22 03772 03752   08080           S       FF,EFZ
02306  16 03852 -0201   08090           TFM     STRIP,RECORD&100Z
02318  17 03200 -3743   08100           BTM     EDIT,TII-4Z
02330  17 03200 -3748   08110           BTM     EDIT,EF-4Z
02342  17 03200 -3753   08120           BTM     EDIT,LS-4Z
02354  17 03200 -3758   08130           BTM     EDIT,TJJ-4Z
02366  17 03200 -3763   08140           BTM     EDIT,TF-4Z
02378  17 03200 -3768   08150           BTM     EDIT,FF-4Z
02390  44 02414 03842   08160           BNF     *624,CRITZ
02402  16 00249 000J4   08170           TFM     RECORD&148,14,10Z
02414  34 00000 00102   08180 WRITE1 RCTY     Z
02426  39 00101 00100   08185           WATY    RECORDZ
02438  49 02030 00000   08190           B       READ2Z
02446                   08200           DORG    *-3Z
                        09010*            Z
                        09020*          PUNCH TOTAL COST AND COMPLETION TIMEZ
                        09030*            Z
02446  31 00100 03538   09040 EOJ    TR      RECORD-1,TITLE-1Z
02458  16 03852 -0137   09050           TFM     STRIP,RECORD&36Z
02470  17 03200 -3783   09060           BTM     EDIT,TCOST-7Z
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[illegible]
02518   39 00101 00100   09115          WATY   RECORDZ
02530   48 22222 22222   09120 GOBACK   H      22222,222222
02542   49 00402 00000   09130          B      JOBSZ
[illegible]                             [illegible]
                         [illegible]
                         [illegible]
                         [illegible]
                         09170*           Z
02550   15 03713 00001   09180 ERROR1   TDM    ER612,1Z
02562   49 02726 00000   09190          B      ER15Z
[illegible]              09200          [illegible]
[illegible] 15 03713 00002 [illegible]  [illegible]
02582   49 02602 00000   [illegible]    [illegible]
02590                    09230          DORG   *-3Z
02590   15 03713 00003   09240 ERROR3   TDM    ER612,3Z
02602   16 01327 000M8   09250 ER23     TFM    TICALC61,48,10Z
02614   34 00000 00102   09251          RCTY   [illegible]
02626   39 03701 00100   09252          WATY   [illegible]
02638   38 [illegible] 00100 09253      WNTY   [illegible]
02650   49 01194 00000   09254          B      OUTZ
02658                    09260          DORG   *-3Z
02658   15 03713 00004   10010 ERROR4   TDM    ER612,4Z
02670   34 00000 00102   10020          RCTY    Z
02682   39 03701 00100   10030          WATY   [illegible]
02694   38 03720 00100   10032          WNTY   [illegible]
02706   49 02530 00000   10040          B      GOBACKZ
02714                    10050          DORG   *-3Z
02714   15 03713 00005   10060 ERROR5   TDM    ER612,5Z
02726   34 00000 00102   10070 ER15     RCTY    Z
02738   39 03701 00100   10072          WATY   [illegible]
02750   38 03815 00100   10074          WNTY   [illegible]
02762   49 02530 00000   10076          B      GOBACKZ
02770                    10080          DORG   *-3Z
                         11010*           Z
                         11020*         SUBROUTINE TO GET IJ[illegible] FROM STORAGEZ
                         11030*           Z
02771      00002         11040          DS     2Z
02772   26 02807 03847   11050 GETIJD   TF     *635,SIZEZ
02784   22 02806 03830   11060          S      *622,KZ
02796   25 03842 00000   11070 DAGIT    TD     CRITZ
02808   26 02826 02807   11071          TF     *618,DAGIT611Z
02820   25 00000 03737   11072          TD     ,RECM[illegible]Z
02832   26 02867 02807   11073          TF     *635,DAGIT611Z
02844   12 02867 -0010   11074          SM     *623,10Z
02856   31 03721 00000   11075          TR     D-10Z
02868   26 02686 02807   11076          TF     *618,DAGIT611Z
02880   25 00000 03842   11077          TD     ,CRITZ
02892   26 03731 03730   11078          TF     D,D-1Z
02904   26 03727 03726   11079          TF     J,J-1Z
02916   44 02960 03723   11080          BNF    *644,IZ
02928   33 03723 00000   11081          CF     IZ
02940   15 03720 0000J   11082          TDM    I-3,1,11Z
02952   49 02972 00000   11083          B      *620Z
02960                    11084          DORG   *-3Z
02960   15 03720 00000   11085          TDM    I-3,0,11Z
02972   33 03721 00000   11086          CF     I-2Z
02984   44 03028 03727   11087          BNF    *644,JZ
02996   33 03727 00000   11088          CF     JZ
03008   15 03724 0000J   11089          TDM    J-3,1,11Z
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03020   49 03040 00000   11090          B      *620Z
03028                    11091          DORG   *-3Z
03028   15 03724 00000   11092          TDM    J-3,0,11Z
03040   33 03725 00000   11093          CF     J-2Z
03052   42 00000 00000   11094          BB      Z
03056                    11110          DORG   *-7Z
                         11120*           Z
                         11130*         SUBROUTINE TO TRANSFER NUMERIC STRIPZ
                         11040*         FOR INPUT FIELDS I, J, D, AND COSTZ*
                         11150*           Z
03057      00002         11160          DS     2Z
03058   16 03088 -3720   11170 TNS      TFM    *630,I-3Z
03070   16 03093 -0101   11180          TFM    *623,RECORDZ
03082   25 00000 00000   11190          TD      Z
03094   11 03093 000-2   11200          AM     *-1,2,10Z
03106   11 03088 000-1   11210          AM     *-18,1,10Z
03118   14 03088 -3737   11220          CM     *-30,COST61Z
03130   47 03082 01200   11230          BNE    *-48Z
03142   32 03720 00000   11240          SF     I-3Z
03154   32 03724 00000   11241          SF     J-3Z
03166   32 03728 00000   11242          SF     D-3Z
03178   32 03732 00000   11243          SF     COST-4Z
03190   42 00000 00000   11250          BB      Z
03194                    11260          DORG   *-7Z
                         12010*           Z
                         12020*         SUBROUTINE TO TRANSFER NUMERIC FILLZ
                         12030*         AND ELIMINATE LEADING ZEROSZ
                         12040*         HIGH ORDER ADDRESS OF NUMERIC IS IN*EDIT-1Z
                         12050*         HIGH ORDER ADDRESS OF ALPHAMERIC IS*IN STRIPZ
                         12060*           Z
03198      00005         12070          DS     5Z
03200   32 03841 00000   12080 EDIT     SF     FLAGZ
03212   26 03283 03199   12090          TF     ZERO-1,EDIT-1Z
03224   26 03290 03852   12100          TF     ZERO66,STRIPZ
03236   26 03327 03199   12110          TF     DIGIT623,EDIT-1Z
03248   26 03334 03852   12120          TF     DIGIT630,STRIPZ
03260   44 03304 03841   12130          BNF    DIGIT,FLAGZ
03272   43 03304 00000   12140          BD     DIGITZ
03284   16 00000 000-0   12150 ZERO     TFM    0,0,10Z
03296   49 03340 00000   12160          B      DIGIT636Z
03304                    12170          DORG   *-3Z
03304   33 03841 00000   12180 DIGIT    CF     FLAGZ
03316   25 03339 00000   12190          TD     *623Z
03328   16 00000 000P0   12200          TFM    ,70,10Z
03340   11 03199 000-1   12210          AM     EDIT-1,1,10Z
03352   11 03852 000-2   12220          AM     STRIP,2,10Z
03364   26 03387 03199   12230          TF     *623,EDIT-1Z
03376   44 03212 00000   12240          BNF    EDIT612Z
03388   42 00000 00000   12250          BB      Z
03392                    12260          DORG   *-1Z
                         12310*
                         12311*         READ ROUTINE.  TITLE CARDS MAY BE INTERSPERSED WITH JOBSZ
                         12320*           Z
03393      00002         12330          DS     2Z
03394   37 00101 00300   12340 READ     RAPT   RECORDZ
03406   14 00101 [illegible] 12370      CM     [illegible]
03418   46 [illegible]   [illegible]    [illegible]
03430   24 00115 03814   12390          C      RECORD614,Z16Z
03442   46 03922 01200   12400          BE     ENDZ
03454   14 00101 000-0   12401          CM     RECORD,0,10Z
```

03454   14 00101 000-0   12401   CM   RECORD,0,10Z

```
[illegible]
[illegible]
[illegible]   34 [illegible]   12430 WRITE3 RCTY    [illegible]
03502  39 00101 00100   12455              WATY   RECORDZ
03514  49 03394 00000   12460              B      READZ
03522                   12470              DORG   *-3Z
03522  33 03392 00000   12480 END          CF     READ-2Z
03534  42 00000 00000   12490              BB      Z
03538                   12500              DORG   [illegible]
                        13010*              Z
                        13020*            AREA AND STORAGE DEFINITIONSZ
                        13030*              Z
00101       00080       13040 RECORD DAS    [illegible]
03539       00040       13050 TITLE  DAC    [illegible]
                        13050K000001789565[illegible]                        [illegible]
                        130500000000000                  Z                 0603588036160
03619       00041       13060        DAC    41, PROJECT COMPLETION          @,,Z
                        130600057595651454363004356545753456349565500000000000000Z  0603618036680
                        130600000000000                  Z                 [illegible]037000
03701       00010       13070 ER     DAC    [illegible] @,,Z
                        13070M559595659007[illegible]Z                     [illegible]037200
03723       00004       13080 I      DS     4Z
03727       00004       13090 J      DS     4Z
03731       00004       13100 D      DS      4Z
03736       00005       13110 COST   DS      [illegible]
03737       00001       13111 RECMRK DC      [illegible]
                        13111Z                                             0603737037380
03742       00005       13112 LAMDA  DS      5Z
03747       00005       13120 TII    DS      5Z
03752       00005       13130 EF     DS      5Z
03757       00005       13140 LS     DS      5Z
03762       00005       13150 TJJ    DS      5Z
03767       00005       13160 TF     DS      5Z
03772       00005       13170 FF     DS      5Z
03777       00005       13180 TIJ    DS      5Z
03782       00005       13190 TJI    DS      5Z
03790       00008       13200 TCOST  DC      [illegible]
                        13200000000002                                     0603783037910
03798       00008       13210 MOST   DC      [illegible]
                        1321000000000Z                                     0603791037990
03814       00016       13211 Z16    DC     16,0Z
                        132110000000000000000Z                             0603799038150
03818       00004       13220 BIG    DS     4Z
03822       00004       13230 FIRST  DS     4Z
03826       00004       13240 LAST   DS     4Z
03830       00004       13250 K      DS      4Z
03831       00001       13251        DC      1,@,,Z
                        13251Z                                             0603831038320
03835       00004       13260 KLAST  DS      4Z
03840       00005       14010 TEST   DS     5Z
03841       00001       14020 FLAG   DS     1Z
03842       00001       14030 CRIT   DS     1Z
03847       00005       14040 SIZE   DS     5Z
03852       00005       14046 STRIP  DS      5Z
03857       00005       14050 TI     DS      5Z
03862       00005       14060 TJ     DS      5Z
                        14061*              Z
                        14062*             FIND MEMORY SIZE AND CONVERT FOR CARDS IF NEEDEDZ
                        14063*              Z
03864  31 J9999 00399   14070 MEMORY TR     19999,399,2Z
03876  45 03924 00000   14080        BNR    *648,0Z
```

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03888  11 03870 -0010   14090           AM     *+18,10Z
03900  26 03847 03870   14100           TF     SIZE,*-30Z
03912  49 03948 00000   14110           B      *636Z
03924  11 03870 K0000   14120           AM     MEMORY66,20000Z
03936  49 03864 00000   14130           B      MEMORYZ
03948  34 00000 00102   14131           RCTY    Z
03960  39 04141 00100   14132           WATY   MESS1Z
03972  34 00000 00102   14133           RCTY    Z
03984  39 04199 00100   14134           WATY   MESS2Z
03996  48 00000 00000   14135           H       Z
04008  46 04080 00200   14140           BC2    *672Z
04020  46 04068 00100   14150           BC1    *648Z
04032  31 02414 04116   14160           TR     WRITE1,CDOUTZ
04044  31 02506 04116   14170           TR     WRITE2,CDOUTZ
04056  31 03490 04116   14180           TR     WRITE3,CDOUTZ
04068  15 03403 00005   14190           TDM    READ69,5Z
04080  31 00100 03538   14200           TR     RECORD-1,TITLE-1Z
04092  32 00100 00000   14210           SF     RECORD-1Z
04104  49 00402 00000   14220           B      JOBSZ
04116  41 12345 67890   14230 CDOUT     NOP    12345,67890Z
04128  39 00101 00400   14240           WACD   RECORDZ
04139        00001      14250           DC     1,@,CDOUT623Z
                        14250Z                                             0604139041400
04141        00029      14251 MESS1  DAC    29,SWITCH 1 ON FOR TYPED OUTPUT@Z
                        14251026649634348007100565500465659006366574544005664632   0604140041900
                        1425157646302                                      0604190041980
04199        00032      14252 MESS2  DAC    32,SWITCH 2 ON IF USING TAPE INPUT@Z
                        142520266496343480072005655004946006464955470063415745Z   0604198042480
                        1425200495557646302                                0604248042620
03864                   14260           DEND   MEMORYZ
                        14260  L600000005004900000Z                        0800096001150
                        36001000050036001720050036002440050036003160050036000000050000000000     -
                                     10203040002040608000306090210040802161005001510200602181420OZ 0
                        7041128200806142230090817263000000000005060708090012141618151811242720242Z 0
                        8223635203530454036324844553249465360484654627544536271801234567891234562 0
                        7890234567890J34567890JK4567890JKL567890JKLM67890JKLMN7890JKLMN0890JKLMNZ 0
                        M800000000000490386400890JKLMNOPQZ     L1003880001 9M9000000000M90003600000000
                                                                                            362
                                                                                            898*
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32037320000042000000000 0Z                                  00103178032020 0057
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4403304003841450335040000016000000000049033400000 0Z          00103260033080 0059
3303841000002503339000001600000000P011031990000111038520000 2Z00103304033640 0060
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260338703199440321200000420000000000Z                       00103364034000 0061
37001010030014001010000P0460353401300240011503814460352201200Z00103394034540 0062
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                          Z                                 10103588036180 0067
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                           Z                                10103668037000 0069
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Z                                                           10103737037380 0071
                            Z                               10103783038150 0072
Z                                                           10103831038320 0073
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Z                                                           10104139041400 0079
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