1620
NODE NUMBERING PROGRAM

Author: Lou J. Granato
IBM Corporation
631 Cooper Street
Camden 2,
New Jersey

DECK KEY

1. Program Deck
2. Sample Data- 9 cards

1620 Node Numbering

Direct Inquiries to: Lou J. Granato
IBM Corporation
631 Cooper Street
Camden 2, New Jersey

Purpose/Description: Program accepts an arbitrarily numbered system of nodes and proceeds to number them correctly such that the network is consecutively numbered and satisfies the condition that each arrow tail node (I) is less than the corresponding arrow head node (J).

Method: N/A

Restrictions/Range: The network must have only one origin (start point) and one terminal (end point). Each node is assigned a four (4) digit number in the range 0002 to 9998. Program can handle a maximum of 1500 jobs (arrows).

Equipment Specs: 1620 with 20K memory and 1622 Card Reader/Punch.

Execution Time: A network with 374 jobs (arrows) will be renumbered in about 12 minutes which includes final Punch-out.

Accuracy: N/A

Source Language: SPS II

Check-out Status: Several networks of various sizes have been run successfully to date. Largest network had about 600 jobs.

COMMENTS

This program and its documentation were written by an IBM employee. It was developed for a specific purpose and submitted for general distribution to interested parties in the hope that it might prove helpful to other members of the data processing community. The program and its documentation are essentially in the author's original form. IBM serves as the distribution agency in supplying this program. Questions concerning the use of the program should be directed to the author's attention.

TABLE OF CONTENTS

This write-up is for the 1620 Node Numbering Program and can be considered Part I of the 1620 LESS Package. The I/O design is compatible with Part II of the LESS package which is Critical Path Scheduling.

The program accepts an arbitrarily numbered system of nodes and proceeds to number them correctly such that the network is consecutively numbered, starting with the initial node of 1, and satisfies the condition that each arrow tail node (I) is less than the corresponding arrow head node (J).

PROGRAM RESTRAINTS

1. The network must have only one origin or initial start point. This node must be assigned the number 1.

2. The network must have only one terminal or end point. This node must be assigned the number 9999.

3. With the exception of the start point and end point, numbers may be assigned at random to the other nodes in the network. However, no two nodes may be assigned the same number. Thus, each node is assigned a four digit number in the range 0002 to 9998.

4. The program can handle a maximum of 1500 jobs.

Key to Notations

1. IIII - Starting or generating node of a job.
2. JJJJ - Ending node of a job.
3. DDD - Duration of a job.

In order to explain the technique used in this program, consider the following:

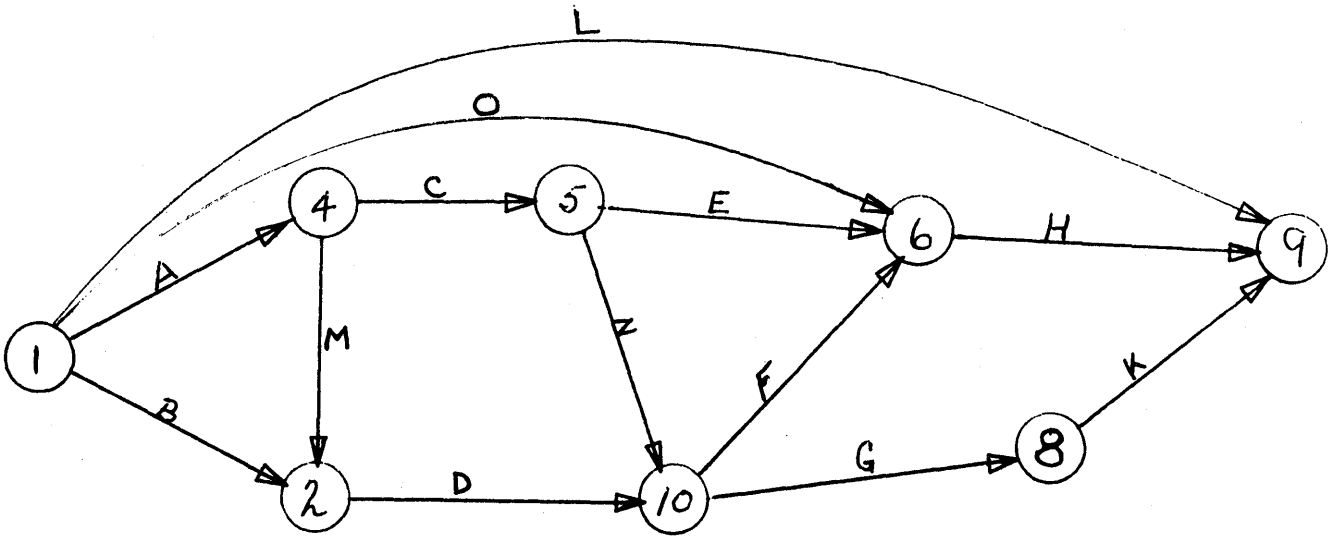
Take any node, say #6 in Example 1. This node can be reached in many ways:

O	or 1 job
A, C, E	or 3 jobs
A, M, D, F	or 4 jobs
A, C, N, F	or 4 jobs
B, D, F	or 3 jobs

If we define the "distance" of a node from the origin (node 1) as the maximum number of jobs by which the node can be reached, then node #6 is a "distance" of 4 from the origin.

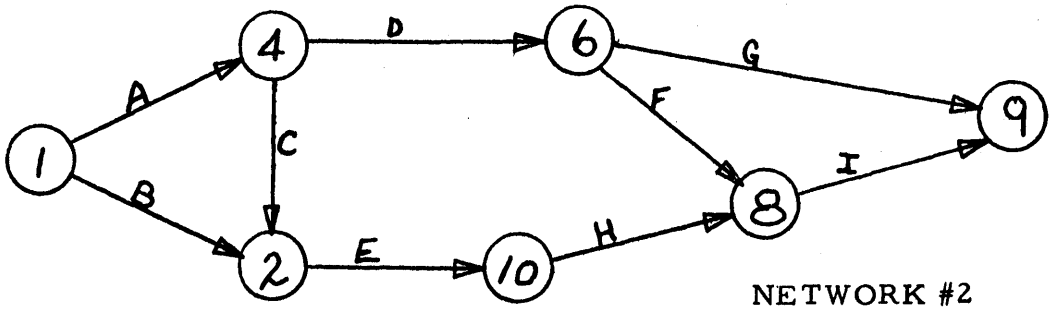
Further, from this definition, it can be seen that the distance from the origin of the head node (J) of any job (I, J) is at least one more than the distance of the tail node (I) of the corresponding job. Examine job (4, 5).

Therefore, by numbering all nodes of distance 1 before those of distance 2, before those of distance 3 etc., we can satisfy the condition that I be less than J.



EXAMPLE #1

In any network, there are various chains of jobs by which one can proceed from the start point to the end point. Assume the following network:



NETWORK #2

The list of chains would be as follows:

CHAIN							
a)	1	4	6	9			
b)	1	4	6	8	9		
c)	1	4	2	10	8	9	
d)	1	2	10	8	9		
	0	1	2	3	4	5	DISTANCE ALONG CHAIN

Using our definition of "distance", we can now construct the following table:

NODE NUMBER	NODE DISTANCE
1	0
2	2
4	1
6	2
8	4
9	5
10	3

Rearrangement of the list to have the node distances in sequence produces the following:

NODE DISTANCE	NODE NUMBER
0	1
1	4
2	2
2	6
3	10
4	8
5	9

It should be noted here that within nodes of a given "distance" from the origin (such as nodes 2 and 6 in the previous example which are both of distance 2 from the origin) the choice of consecutive numbering is immaterial since by the previous definition of "distance" any of these nodes cannot be connected by jobs.

With this in mind, we can now number easily and our final list will appear thusly:

NODE DISTANCE	NODE NUMBER	CORRECTED NODE NUMBER
0	1	1
1	4	2
2	2	3
2	6	4
3	10	5
4	8	6
5	9	7

INPUT DATA FOR SAMPLE PROBLEM

JOB IDENTIFICATION	NODE NUMBERS
B	1, 2
A	1, 4
E	2, 10
C	4, 2
D	4, 6
F	6, 8
G	6, 9
I	8, 9
H	10, 8

EXAMPLE #3

Input Data

B	00010002002
A	00010004001
E	00020010005
C	00040002003
D	00040006004
F	00060008006
G	00069999007
I	00089999009
H	00100008008

6A

Test Output 6/12/62

SW 1 Off

00010002
00010004
00020010
00040002
00040006
00060008
00069999
00089999
00100008

0001000 3002
0001000 2001
0003000 5005
0002000 3003
0002000 4004
0004000 6006
0004000 7007
0006000 7009
0005000 6008

B
A
E
C
D
F
G
I
H

Test Output 6/12/63

SW 1 On

B 00010003002
A 00010002001
E 00030005005
C 00020003003
D 00020004004
F 00040006006
G 00040007007
I 00060007009
H 00050006008

6c

The method used by the 1620 program assuming input data in proper sequence and using network #2, shown in Example #3, is as follows:

Generate the "distance" 1 list: Since the origin node number has been selected as 1, then "distance" 1 nodes will be generated only by jobs of the form (I, J).

DISTANCE	GENERATING NODE	ENDING NODE
1	1	2
	1	4

This list shows that nodes 2 and 4 are the only nodes of "distance" 1 from the origin. However, it can be seen from the network that node 2 is not of "distance" 1 but of "distance" 2 from the origin. This fact will be shown later when node 2 appears as a higher "distance" node in the list.

We now continue to "distance" 2 nodes, that is, all nodes that will be generated by nodes of "distance" 1, namely nodes 2 and 4.

DISTANCE	GENERATING NODE	ENDING NODE
1	1	2
	1	4
2	2	10
	4	2
	4	6

When job (4, 2) is listed, note that node 2 already had appeared previously in the ENDING NODE column. This emphasizes the previous statement that although node 2 appeared in the "distance" 1 group, it would reappear again in a higher "distance" group. Since by definition, "distance" is a maximum of several "distances", one need keep only the latest entry. With this idea, one can save many program steps as well as a substantial number of core storage positions.

The complete list, using the above example, would appear as follows:

DISTANCE	GENERATING NODE	ENDING NODE
1	1	~~2~~
	1	4
2	2	~~10~~
	4	2
	4	6
3	10	~~8~~
	2	10
	6	~~8~~
	6	~~9~~
4	10	8
	9	-
5	8	9
	9	-

The blank in the Ending Node column opposite Generating Node 9 merely points out that node 9 is the end node and therefore can generate no additional nodes. When the Ending Node column has been exhausted, this implies no additional nodes can be generated. Therefore, the only thing left is to assign the Corrected Node Numbers. The final list will appear thusly:

DISTANCE	GENERATING NODE	ENDING NODE	CORRECTED NODE NUMBER
1	1	~~2~~	
	1	4	2
2	2	~~10~~	
	4	2	3
	4	6	4
3	10	~~8~~	
	2	10	5
	6	~~8~~	
	6	~~9~~	
4	10	8	6
	9	-	
5	8	9	7
	9	-	

INPUT DATA

Card Columns 1-25 - Alpha description
" " 26-29 - IIII
30-33 - JJJJ
34-36 - DDD
37-79 - Utilized at the descretion of the user

The input cards must be sorted J within I, that is, sorted on card columns 33 through 26. Column 80 of the input cards must be blank except for the last card. The last card must have any digit, other than zero, punched in column 80.

OUTPUT

Card output will be similar to card input with card columns 26-33 containing the new IIII and JJJJ assigned by the program. The old IIII and JJJJ, depending on the setting of Console Switch #1, may or may not be punched in card columns 72-79. Information punched in all other columns of the input cards will be punched in the output cards so that these columns may be utilized at the option of the user.

OPERATING INSTRUCTIONS

1. Clear memory to zeros as follows:
   A. All console switches off
   B. Depress the Insert Key
   C. Type in 16 00010 00000
   D. Depress the Release Key, then the Start Key
   E. After approximately 1.5 seconds, depress the Instant Stop Key, the Release Key, and the Reset Key in that order.

2. Set Console Switches as follows:
   Parity Check Switch - STOP Position
   I/O Check Switch - STOP Position
   Overflow Switch - PROGRAM Position
   Console Switch #1
      a) OFF - Output with original IIII and JJJJ in card columns 72-79.
      b) ON - Output without original IIII and JJJJ
   Console Switch #2 - Not interrogated
   Console Switch #3 - Not interrogated
   Console Switch #4 - Not interrogated

3. Place the Program Deck followed by the Data Deck into the 1622 Read Hopper and depress the LOAD KEY.

4. When the program has been loaded, it will immediately start reading the data cards. When the last data card has been fed, depress the START KEY on the 1622 Card Reader.

5. When the last data card has been processed, the total number of jobs in the network will be typed out in the form:

   $\overline{X}$XXX JOBS

6. If no errors are found and the program has generated the new node numbers, the following message will appear:

   RELOAD DATA

7. Ready the 1622 Punch side with blank cards.

8. Place the Data Deck back into the Read Hopper and depress the Start Key on the Reader.

9. When the last data card has been fed, depress the Start Key on the Card Reader.

10. If there were no errors, the following message will be typed out

indicating the completion of the program:

END OF PROGRAM

11. Due to the nature of the program, it must be reloaded for each network processed.

ERROR INDICATIONS

ERROR 1: Sequence error has been found. That is, IIII is not in ascending sequence. The following message will be typed:

SEQUENCE ERROR, RELOAD PROGRAM AND RESTART

RESTART PROCEDURE: Remove the cards from the stacker. The card out of sequence will be the second card from the back. Put the card in proper sequence and restart the program.

ERROR 2: Cards with duplicate IIII and JJJJ have been found. This may be due to an error in punching or they may be exact duplicates. The following message will be typed:

DUPLICATE JOB CARDS EXIST

RESTART PROCEDURE: Remove the cards from the stacker. The duplicate cards will be the second (2nd) and third (3rd) cards from the back. If the cards are merely exact duplicates, discard one of them and push the START KEY on the 1620 console. If there was an error in punching, correct the card, put it in proper sequence, reload the program and start again.

ERROR 3: An attempt has been made to number a network that contains more than 1500 jobs. The following message will be typed:

TOO MANY JOBS, PROGRAM CANNOT BE CONTINUED

RESTART PROCEDURE: Program cannot be continued with this network.

ERROR 4: Job card has been found that has identical IIII and JJJJ on same card. The following message will be typed:

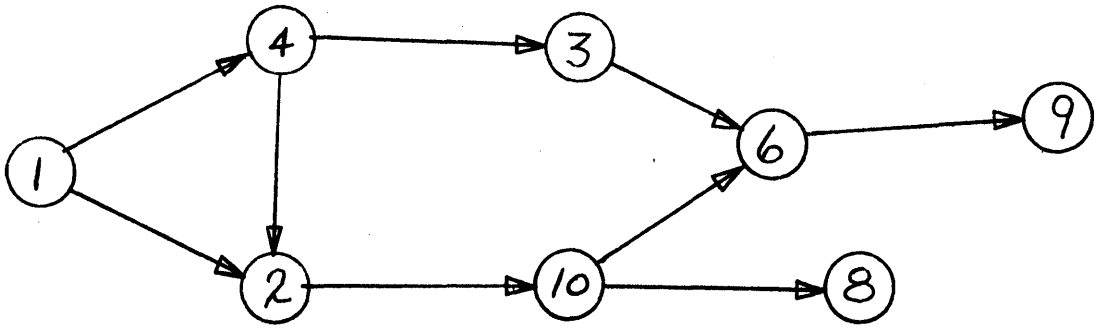
ERROR, JOB CARD HAS SAME IIII AND JJJJ

RESTART PROCEDURE: Remove cards from the stacker. The error card will be the second card from the back. Correct the card, put in proper sequence, reload the program and start again.

ERROR 5: A node, other than the terminal node, 9999, has been detected that has no job exit. The following will be typed:

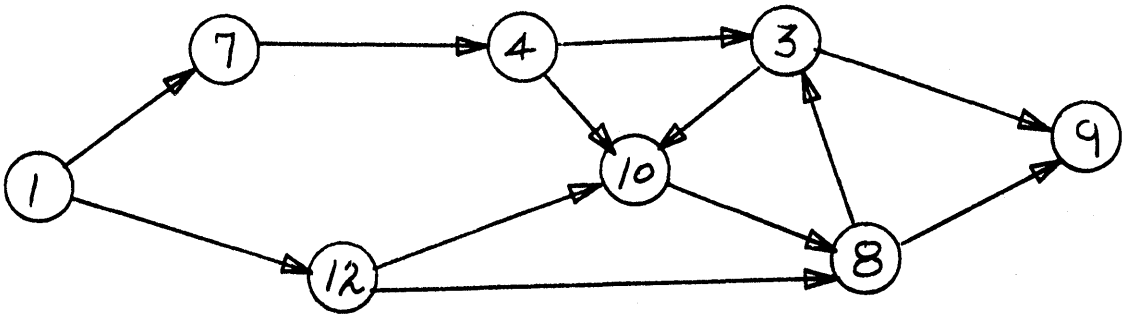
ERROR 5 $\overline{X}$XXX

Where $\overline{X}$XXX is the detected node without a job exit, the following network shows this type of error. Job (10, 8) is in error.



RESTART PROCEDURE: Program cannot be continued. Proper corrections should be made to the data deck and/or the arrow diagram before attempting to re-run the problem.

ERROR 6: Somewhere within the network a "loop" has been found. Consider the following example:



The above network represents a project that is impossible to complete since the loop 10-8, 3 says that "you cannot start job (10, 8) until job (10, 8) is complete." This represents an error in arrow diagram logic. The following will be typed:

ERROR 6 $\overline{X}$XXX $\overline{X}$XXX $\overline{X}$XXX.....

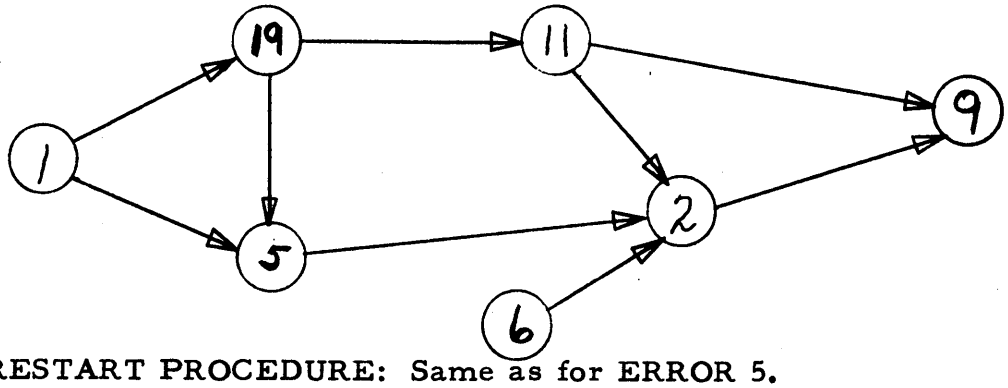
Where $\bar{X}XXX\bar{X}XXX.....$ represents the list of generating nodes among which are contained the nodes that make up the "loop".

RESTART PROCEDURE: Same as for ERROR 5.

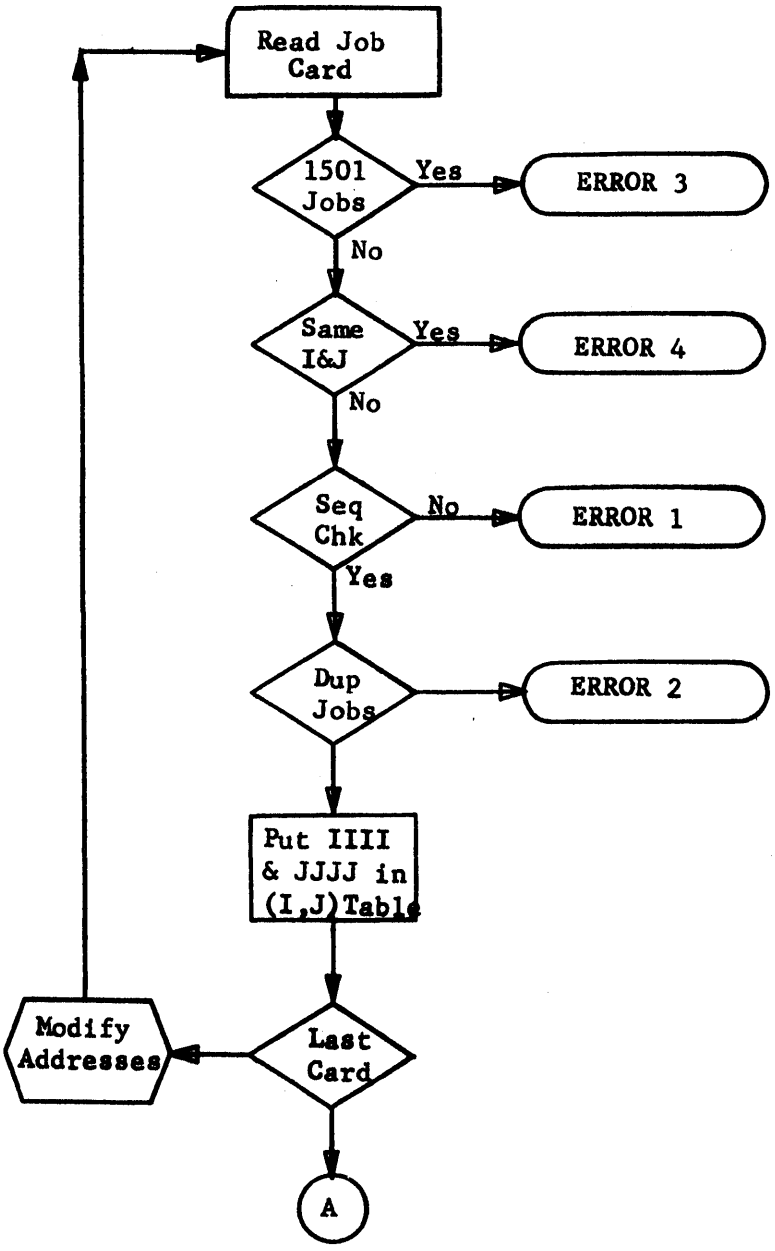
ERROR 7: A node, other than the initial node 0001, has been detected that has no job predecessor. The following will be typed:

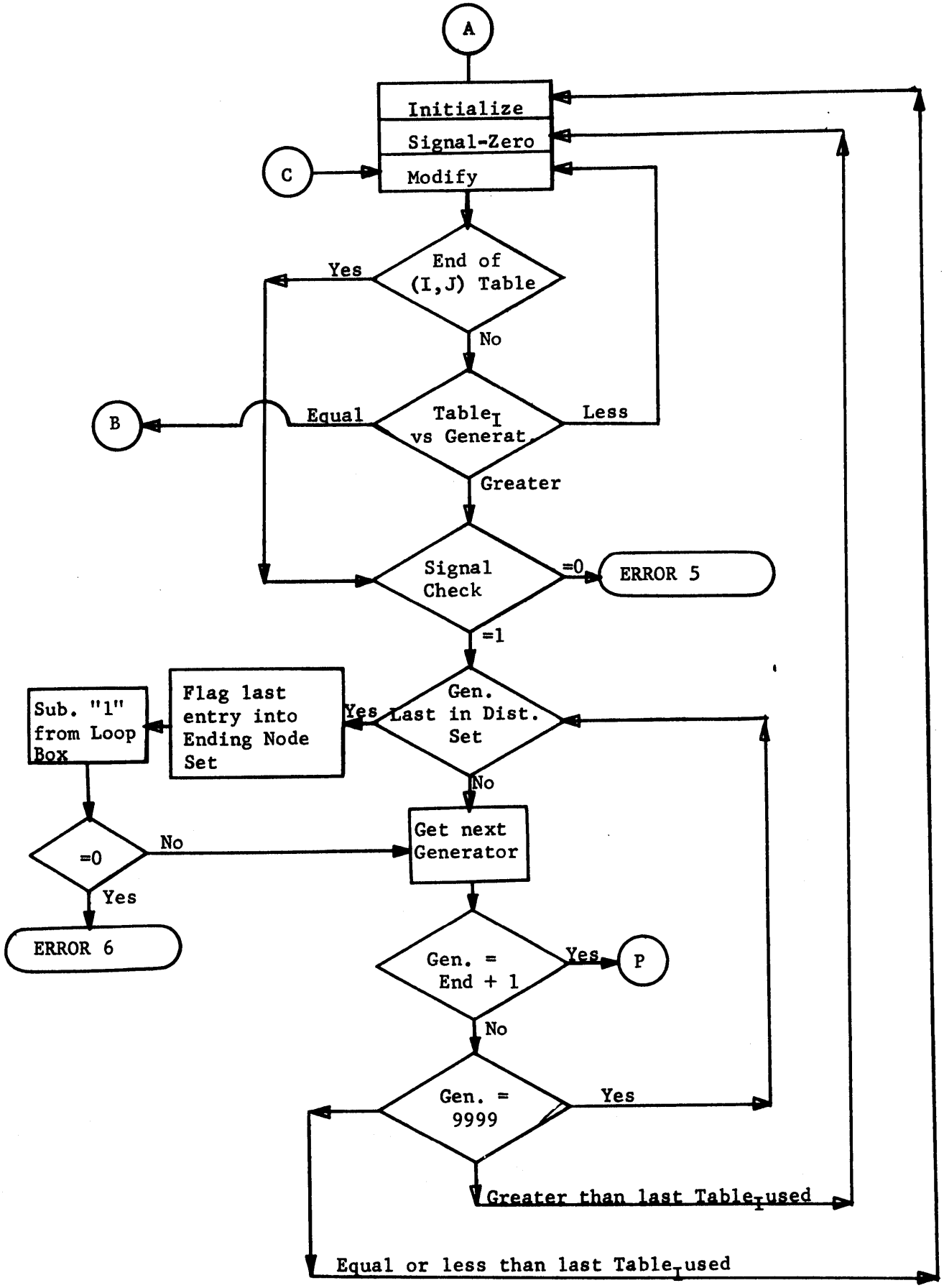
$\bar{X}XXX$ ERROR 7

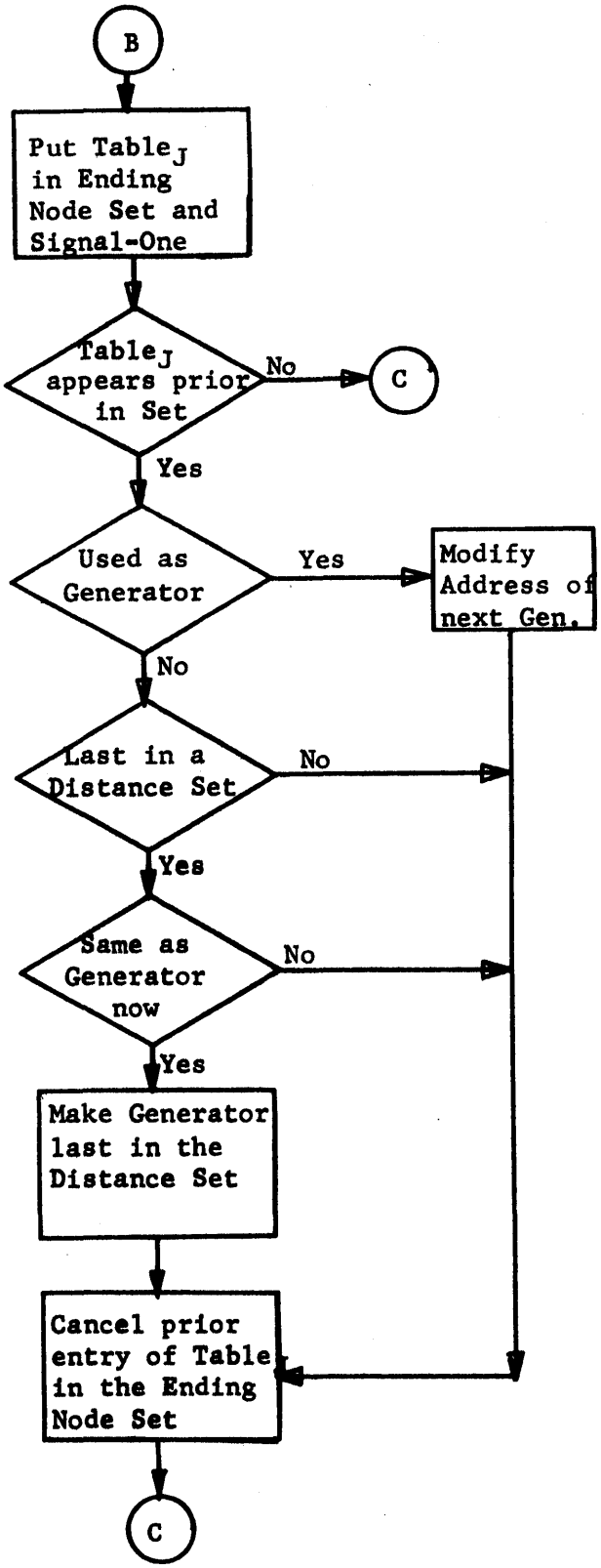
$\bar{X}XXX$ is the detected node without a job predecessor. This error will be detected during the punching phase of the program. The following network shows this type of error. Job (6, 2) is in error.

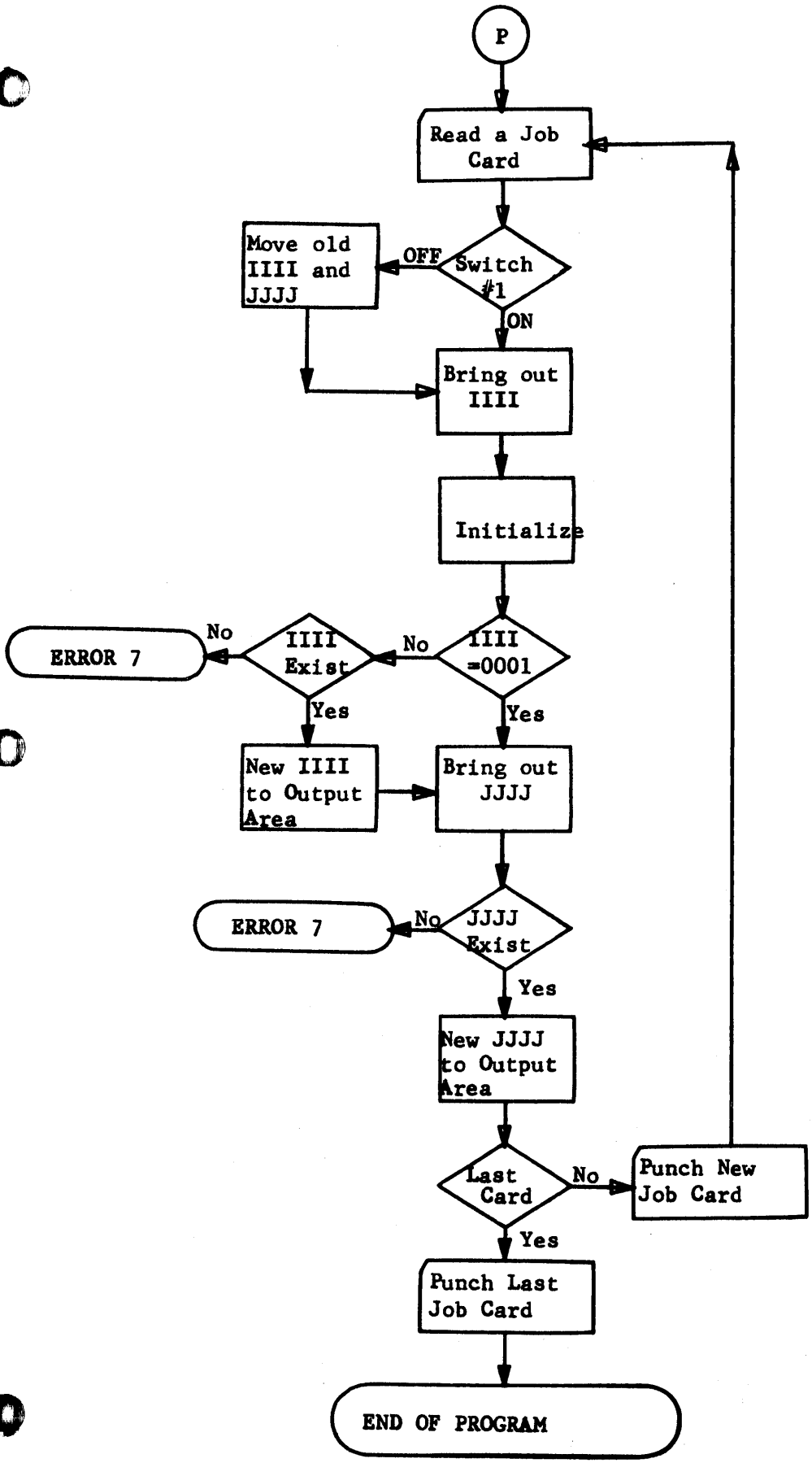


RESTART PROCEDURE: Same as for ERROR 5.


Read Job Card
1501 Jobs
Yes
ERROR 3
No
Same I&J
Yes
ERROR 4
No
Seq Chk
No
ERROR 1
Yes
Dup Jobs
ERROR 2
Put IIII & JJJJ in (I,J) Table
Last Card
Modify Addresses
A


A
Initialize
Signal-Zero
Modify
C
End of (I,J) Table
Yes
No
B
Equal
Table$_I$ vs Generat.
Less
Greater
Signal Check
=0
ERROR 5
=1
Gen. Last in Dist. Set
Yes
Flag last entry into Ending Node Set
Sub. "1" from Loop Box
No
Get next Generator
=0
No
Yes
ERROR 6
Gen. = End + 1
Yes
P
No
Gen. = 9999
Yes
Greater than last Table$_I$ used
Equal or less than last Table$_I$ used


B
Put Table$_J$ in Ending Node Set and Signal-One
Table$_J$ appears prior in Set
No
C
Yes
Used as Generator
Yes
Modify Address of next Gen.
No
Last in a Distance Set
No
Yes
Same as Generator now
No
Yes
Make Generator last in the Distance Set
Cancel prior entry of Table$_J$ in the Ending Node Set
C


P
Read a Job Card
Move old IIII and JJJJ
OFF
Switch #1
ON
Bring out IIII
Initialize
No
ERROR 7
IIII Exist
No
IIII =0001
Yes
Yes
New IIII to Output Area
Bring out JJJJ
ERROR 7
No
JJJJ Exist
Yes
New JJJJ to Output Area
Last Card
No
Punch New Job Card
Yes
Punch Last Job Card
END OF PROGRAM

```
14000                                          DORG  14000Z
14000 34 00000 00102  1010                     RCTY   Z
14012 36 00001 00500  1015 START               RNCD  JOB-25Z
14024 11 00508 0-001  1020                     AM    N,1,8Z
14036 46 14360 01200  1025                     BZ    OVERZ
14048 32 00026 00000  1035 S                   SF    JOBZ
14060 32 00030 00000  1040                     SF    JOB&4Z
14072 24 00029 00033  1041                     C     JOB&3,JOB&7Z
14084 46 14708 01200  1042                     BE    SAMEZ
14096 24 14059 00029  1045                     C     PREV,JOB&3Z
14108 46 14396 01100  1050                     BH    SEKERZ
14120 46 14324 01200  1051                     BE    CKDUPZ
14132 26 14707 00033  1052                     TF    PREV1,JOB&7Z
14144 26 14059 00029  1055 RET                 TF    PREV,JOB&3Z
14156 15 00034 00000  1060                     TDM   JOB&8Z
14167        1 00000  1065                     DC    1,@,*Z
14168 31 -1999 00026  1070                     TR    TABLE-3,JOB,2Z
14180 11 14174 -0008  1075                     AM    *-6,8Z
14192 43 14216 00080  1080                     BD    GOA1,JOB&54Z
14204 49 14012 00000  1085                     B     STARTZ
14216 11 00508 0J501  1180 GOA1                AM    N,1501,8Z
14228 38 00505 00100  1185                     WNTY  N-3Z
14240 39 01955 00100  1190                     WATY  RESTZ
14252 34 00000 00102  1195                     RCTY   Z
14264 13 00508 000-8  2005 GOA                 MM    N,8,10Z
14276 21 00449 00099  2010                     A     MEND&11,99Z
14288 11 00508 000-1  2011                     AM    N,1,10Z
14300 32 00150 00000                           SF    150Z
14312 49 00402 00000  2012                     B     GOZ
14324 24 14707 00033  1200 CKDUP               C     PREV1,JOB&7Z
14336 46 14420 01200  1205                     BE    DUPERRZ
14348 49 14132 00000  1215                     B     RET-12Z
14360 39 14481 00100  1220 OVER                WATY  OVERLDZ
14372 48 00000 00000  1225                     H      Z
14384 49 14372 00000  1230                     B     *-12Z
14396 39 14567 00100  1235 SEKER               WATY  SKMESSZ
14408 49 14372 00000  1240                     B     OVER&12Z
14420 39 14653 00100  1245 DUPERR              WATY  PAIRZ
14432 34 00000 00102  1250                     RCTY   Z
14444 48 00000 00000  1265                     H      Z
14456 12 00508 0-001  1270                     SM    N,1,8Z
14468 49 14012 00000  1275                     B     STARTZ
```


19

```
14481         43 00000   1345 OVERLD DAC  43,TOO MANY JOBS, PROGRAM CANNOT BE CONTINUED@Z
14567         43 00000   1350 SKMESS DAC  43,SEQUENCE ERROR, RELOAD PROGRAM AND RESTART@Z
14653         26 00000   1355 PAIR   DAC  26,DUPLICATE JOB CARDS EXIST@Z
14707          4 00000   1365 PREV1  DC   4,0Z
14708 39 14769 00100     1400 SAME   WATY SAMEYZ
14720 34 00000 00102     1410        RCTY  Z
14732 39 14599 00100     1420        WATY SKMESS&32Z
14744 34 00000 00102     1430        RCTY  Z
14756 48 00000 00000     1440        H     Z
14769         39 00000   1450 SAMEY  DAC  39,ERROR, JOB CARD HAS SAME IIII AND JJJJ@Z
00402                    1005        DORG 402Z
00402 16 00468 -1994     2015 GO     TFM  A&6,TABLE-8Z
00414 15 01607 00000     2020        TDM  SIGNALZ
00426 11 00468 -0008     2025        AM   A&6,8Z
00438 14 00468 -2002     2030 MEND   CM   A&6,TABLEZ
00450 46 01300 01200     2035        BE   CHECKZ
00462 24 00000 01970     2040 A      C    ,GENZ
00474 46 01456 01200     2045        BE   EQUALZ
00486 46 01300 01100     2050        BH   CHECKZ
00498 49 00426 00000     2055        B    GO&24Z
00505                    2060        DORG *-4Z
00508          4 00000   2065 N      DC   4,-1501Z
00509          1 00000   2075        DC   1,@Z
00510 43 01220 01966     2080 A1     BD   FLAG,GEN-4Z
00522 11 00545 -0004     2080        AM   *&23,4Z
00534 26 01970 J3998     2085 A2     TF   GEN,ENODE-4,7Z
00546 45 01080 01967     2090        BNR  B,GEN-3Z
00558 39 01881 00100     2091        WATY DATAZ
00570 34 00000 00102                 RCTY  Z
00582 16 00508 0-002     2092 PUNCH  TFM  N,2,8Z
00594 37 00101 00500     3005        RACD 101Z
00606 46 00654 00100                 BC1  *&48Z
00618 33 00151 00000     3006        CF   151Z
00630 33 00159 00000     3007        CF   159Z
00642 26 00257 00165     3008        TF   257,165Z
00654 16 01380 -0151     3010        TFM  ZY&6,SAYZ
00666 16 00949 J4002     3015        TFM  ZC&11,ENODEZ
00678 16 00863 -0151     3020        TFM  ZX&11,SAYZ
00690 17 00840 000-4     3025        BTM  ZXA,4,10Z
00702 14 00797 -0001     3030        CM   N1,1Z
00714 46 01436 01200     3035        BE   P1Z
00726 27 00914 00913     3040        BT   ZCA,ZCA-1Z
00738 17 00840 000-4     3045 KA     BTM  ZXA,4,10Z
```

```
00750 27 00914 00913  3050          BT    ZCA,ZCA-1Z
00762 43 00800 00259  3055          BD    K,259Z
00774 39 00101 00400  3060          WACD  101Z
00786 49 00582 00000  3065          B     PUNCHZ
00793                 3070          DORG  *-4Z
00797       5 00000   3072 N1       DC    5,0Z
00798       1 00000   3073          DC    1,@Z
00800 16 00259 000-0  3075 K        TFM   259,,10Z
00812 39 00101 00400  3080          WACD  101Z
00824 39 01905 00100  3085          WATY  ENDZ
00836 48 00000 00000  3090          H      Z
00838                 3095          DORG  *-9Z
00839       2 00000   3100          DS    2Z
00840 16 00858 -0794  3105 ZXA      TFM   ZX&6,N1-3Z
00852 25 00000 00000  3110 ZX       TD     Z
00864 11 00858 -0001  3115          AM    ZX&6,1Z
00876 11 00863 -0002  3120          AM    ZX&11,2Z
00888 12 00839 000-1  3125          SM    ZXA-1,1,10Z
00900 47 00852 01200  3130          BNE   ZXZ
00912 M2 00000 00000  3135          BB    ,,0Z
00914                 3140          DORG  *-9Z
00914 26 00932 00949  3150 ZCA      TF    *&18,ZC&11Z
00926 33 00000 00000  3155          CF     Z
00938 24 00797 00000  3160 ZC       C     N1Z
00950 46 01350 01200  3165          BE    OKAYZ
00962 11 00949 -0001  3170          AM    ZC&11,1Z
00974 26 00997 00949  3175          TF    *&23,ZC&11Z
00986 45 01048 00000  3180          BNR   ZC1Z
00998 15 01947 00007  3185 NONE     TDM   ERROR&12,7Z
01010 38 00794 00100  3186          WNTY  N1-3Z
01022 39 01935 00100  1095 SEQERR   WATY  ERRORZ
01034 48 13999 00100  1100          H     ENODE-3,100Z
01046 48 00000 00000  1105          H      Z
01048                 1110          DORG  *-9Z
01048 11 00949 -0003  3200 ZC1      AM    ZC&11,3Z
01060 11 00508 0-001  3205          AM    N,1,8Z
01072 49 00914 00000  3210          B     ZCAZ
01080                 3215          DORG  *-3Z
00151                 3220 SAY      DS    ,151Z
01080 15 01966 00000  4005 B        TDM   GEN-4Z
01092 44 01128 01970  4010          BNF   B1,GENZ
01104 33 01970 00000  4015          CF    GENZ
01116 15 01966 00001  4020          TDM   GEN-4,1Z
```

```
01128 14 01970 0R999  4025 B1      CM    GEN,9999,8Z
01140 46 00510 01200  4030         BE    A1Z
01152 24 00468 00449                C     A&6,MEND&11Z
01164 46 00402 01200                BE    GOZ
01176 26 01199 00468  4031         TF    *&23,A&6Z
01188 24 01970 00000  4032         C     GENZ
01200 46 00414 01100  4033         BH    GO&12Z
01212 49 00402 00000  4034         B     GOZ
01220                 4040         DORG  *-3Z
01220 26 01238 01498  4045 FLAG    TF    *&18,E1&6Z
01232 32 00000 00000  4050         SF     Z
01244 12 00508 -0001  4055         SM    N,1Z
01256 46 00522 01100  4060         BH    A2-12Z
01268 15 01947 00006  4065         TDM   ERROR&12,6Z
01280 15 01034 00003  4070         TDM   SEQERR&12,3Z
01292 49 01022 00000  4075         B     SEQERRZ
01300                 4080         DORG  *-3Z
01300 43 00510 01607  4085 CHECK   BD    A1,SIGNALZ
01312 15 01947 00005    9          TDM   ERROR&12,5Z
01324 39 01935 00100  4095         WATY  ERRORZ
01336 38 01967 00100  4100         WNTY  GEN-3Z
01348 48 00000 00000  4110         H      Z
01350                 4115         DORG  *-9Z
01350 16 01385 -0505  5005 OKAY    TFM   ZY&11,N-3Z
01362 16 01243 000-4  5010         TFM   CNT,4,10Z
01374 25 00000 00000  5015 ZY      TD     Z
01386 11 01380 -0002  5020         AM    ZY&6,2Z
01398 11 01385 -0001  5025         AM    ZY&11,1Z
01410 12 01243 000-1  5030         SM    CNT,1,10Z
01422 47 01374 01200  5035         BNE   ZYZ
01434 42 00000 00000  5040         BB     Z
01436                 5045         DORG  *-9Z
01436 11 01380 -0008  5050 P1      AM    ZY&6,8Z
01448 49 00738 00000  5055         B     KAZ
01456                 5060         DORG  *-3Z
01243          2 00000  5065 CNT     DS    2,FLAG&23Z
01456 11 01498 -0004  6005 EQUAL   AM    E1&6,4Z
01468 26 01503 00468  6010         TF    E1&11,A&6Z
01480 11 01503 -0004  6015         AM    E1&11,4Z
01492 26 J3998 00000  6020 E1      TF    ENODE-4,,2Z
01504 26 01534 01498  6025         TF    *&30,E1&6Z
01516 11 01534 -0001  6030         AM    *&18,1Z
01528 15 00000 00000  6035         TDM    Z
```

```
01539          1 00000  6040          DC    1,@,*Z
01540 15 01607 00001  6045          TDM   SIGNAL,1Z
01552 16 01599 J3998  6050          TFM   Z&11,ENODE-4Z
01564 26 01647 01498  6055          TF    X&11,E1&6Z
01576 11 01599 -0004  6060          AM    Z&11,4Z
01588 26 00629 00000  6065 Z        TF    WORKZ
01600 33 00629 00000  6070          CF    WORKZ
01612 24 01599 01647  6075 Y1       C     Z&11,X&11Z
01624 46 00426 01200  6080          BE    MEND-12Z
01636 24 00629 00000  6085 X        C     WORKZ
01648 47 01576 01200  6090          BNE   Z-12Z
01660 24 01599 00545  6095 Y        C     Z&11,A2&11Z
01672 47 01860 01300  6100          BL    MINUSZ
01684 26 01707 01599  6105          TF    *&23,Z&11Z
01696 44 01780 00000  6110          BNF   CANCELZ
01708 26 01738 01707  6115          TF    X1&6,*-1Z
01720 12 01738 -0004  6120          SM    X1&6,4Z
01732 32 00000 00000  6125 X1       SF     Z
01744 24 01738 00545  6130          C     X1&6,A2&11Z
01756 47 01780 01200  6135          BNE   CANCELZ
01768 15 01966 00001  6140          TDM   GEN-4,1Z
01780 26 01834 01599  6150 CANCEL   TF    CAN1&6,Z&11Z
01792 12 01834 -0003  6155          SM    CAN1&6,3Z
01804 26 01839 01599  6160          TF    CAN1&11,Z&11Z
01816 11 01839 -0001  6165          AM    CAN1&11,1Z
01828 31 00000 00000  6170 CAN1     TR     Z
01840 12 01498 -0004  6175          SM    E1&6,4Z
01852 49 00426 00000  6180          B     MEND-12Z
01860                 6185          DORG  *-3Z
01860 12 00545 -0004  6186 MINUS    SM    A2&11,4Z
01872 49 01780 00000  6187          B     CANCELZ
01880                 6188          DORG  *-3Z
01607                 6190 SIGNAL   DS    ,Z&19Z
01881         12 00000        DATA   DAC   12,RELOAD DATA@Z
00629                         WORK   DS    ,PUNCH&47Z
01905         15 00000        END    DAC   15,END OF PROGRAM@Z
01935         10 00000  1130  ERROR  DAC   10,ERROR 1  @Z
00026                 1135  JOB    DS    ,26Z
14059          4 00000  1150  PREV   DC    4,0,S&11Z
01955          6 00000        REST   DAC   6, JOBS@Z
01966          1 00000  1155         DC    1,1Z
01970          4 00000  1160  GEN    DC    4,1Z
01971          1 00000  1165         DC    1,@Z
14002                   1170  ENODE  DS    ,14002Z
14000                         DEND  14000Z
```