1620 PERT

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DECK KEY

	1.	Condensed SPS Object Deck for Phase 1.
	2.	Sample Problem Input Data.
	3.	Condensed SPS Object Deck for Phases 2-5.
*	4.	Phase 1 Source Program Deck
*	5.	Phase 2 Source Program Deck
*	6.	Phase 3 Source Program Deck
*	7.	Phase 4 Source Program Deck
*	8.	Phase 5 Source Program Deck

* These Decks will be forwarded only when specifically requested.

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1. Program Abstract

Title: 1620 PERT

Subject Classification: 10.3

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Purpose/Description: 1620 PERT solves the basic critical path problem involving time. The program features random event numbering and allows for more than one event without a predecessor event as well as more than one event without a successor event. Options foreither one or three time estimates are available under program switch control.

Mathematical Method: Ranking is accomplished by topoligical threading; the remaining computations are similar to other PERT programs.

Restrictions, Range: Activity times are given in XX.X weeks. Total project time cannot exceed 199.8 weeks. The 20K 1620 will handle 695 activities; for larger memory, the maximum number of activities allowed is 999. Event numbers are 4 digits XXXX.

Storage Requirements: 4000 + 23N where N is the number of activities.

Equipment Specification: The minimum 1620 configuration is a 20K card 1620 with Indirect Addressing. Automatic divide hardware is required when it is desired to compute the probability of meeting a scheduled completion date.

Additional Remarks: 1620 PERT is written in SPS using fixed point arithmetic. The program uses the TOPTHREAD routine for ranking the activities. This technique allows random event identification and multiple originating and terminating events. Throughout input, processing, and output, the activity records (1 activity per card) remain in the same (collating) sequence. Statistical computations and conversion of times to dates are included. Suggestions are included in the write-up for modifying the input and / or output routines to handle different formats.

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. Questions concerning the use of the program should be directed to the author's attention.

I I. Description of 1620 PERT

A. An Overall Look at the Program

One of the most popular management tools available today is known to civilian groups as Critical Path Scheduling and to persons associated with military projects as PERT. The purpose of this management tool is to help plan, evaluate and control large scale projects with many interrelated activities.

1620 PERT is designed primarily to solve the problem of Critical Path Scheduling in a way conforming to most of the basic input/output specifications of PERT programs currently in use in military projects. The most important difference between PERT and Critical Path Scheduling (CPS) is that PERT requires three time estimates for each activity (job) instead of a single estimate. Therefore statistical computations measuring the uncertainty of estimates of future action are included in the PERT PROGRAM. The author is assuming the user has a familiarity with CPS and PERT. The terminology of PERT will be used in this discussion. There are many fine articles available to provide the user with a more thorough background to PERT including the IBM General Information Manual "PERT... a Dynamic Project Planning and Control Method", Form No. E20-8067. Under program switch control (Switch 1) the user can elect to use only one time estimate and forego the statistical computations. Section VI discusses the requirements for modifying the input routine and/or the output routine for other input/output formats.

To use 1620 PERT the project must be described by a network (arrow diagram, baloon chart). Events (nodes) are the milestones of the project and are usually represented by circles. Events may be randomly numbered. Activities (jobs) are actions which are carried on between events and are designated by arrows. Each activity is defined by its predecessor event (EP) and successor event (ES). Associated with each activity are three time estimates; optimistic, most likely, and pessimistic. Consideration has <u>not</u> been given to extend 1620 PERT to include cost, man-scheduling, or other computations.

Input to 1620 PERT requires one card to describe each activity. In addition, a header card and an END card are needed. Essential to the description of each activity is its predecessor event number (four digits), successor event number (four digits), three time estimates (xx.x weeks) and an optional 31 character alphabetic description of the activity. Optionally a scheduled completion date for any activity may be included. Activities may also be coded C for "complete" in which case they are not included in the computations, but are incorporated in the output listing.

II. Description of 1620 PERT (Cont'd.)

The output consists of one card for each activity. In addition to the duplication of the information which is contained in the input card, each activity card includes the expected time required to perform each activity (xx.x weeks), the slack (total float) time (xx.x weeks), the cumulative variance (xxx.x weeks) of the time estimates of all activities up to the completion of that activity along the longest path to that successor event, the probability (x.xx) of meeting the scheduled completion date if one is specified, the expected completion date (month/day/year - xx/xx/xx), and the latest allowable completion date (xx/xx/xx) which will still not delay the completion of the entire project.

1620 PERT consists of five separate programs. The activity cards are sorted in ascending collating sequence by successor event within predecessor event (eight columns). The activity cards are placed behind the first program (the Input Routine) and the other four programs are placed behind the activity cards. The Input Routine calls in the activity cards, edits them and stores the pertinent information in 23 digit records beginning at location 04000. When an END card is reached signifying that all activity cards have been read and stored, the next program (TOP THREAD) is read in over the Input Routine and ranks the activities. The Backward Pass program is read in over TOPTHREAD and determines the latest allowable completion dates for each activity. Next the Forward Pass program is called in and computes expected completion dates and variances. Finally the Output Routine is called in followed by the input activity cards which must be retrieved from their place behind the Input Routine. As the Output Routine reads each input activity card, the input data is merged with the computed data in storage to produce the output activity card for that activity. The activities remain in collating sequence throughout input, processing and output.

B. Phase I - Input Routine

The function of the Input Routine is to edit the input data, compute the expected time and variance for each activity, and set up a 23 digit record in core storage for each activity.

Five different types of cards are recognized and handled by the Input Routine. These are distinguished by a status code in column 18 of each card. The codes are:

H - Header card - must be the first data card of each network.

Blank - A normal activity card. Columns 18-24 and 50-80 will be blank.

S - An activity card for which a scheduled completion date is specified in columns 19-24.

C - A completed activity whose date of completion can be specified in columns 19-24.

E - An END card. This card with END punched in columns 18-20 is the last card in the network data deck.

The input routine edits for the following erroneous conditions.

1. NO HEADER CARD, START AGAIN

   The first (and only the first) data card must contain an "H" in column 18.

2. CARD OUT OF SEQUENCE

   The activity cards must be in ascending collating sequence, successor event within predecessor event (sort on columns 1 through 8 in reverse order, i.e., 8, 7, 6, 5, 4, 3, 2, 1.) The number N before the message indicates the card in error is the Nth activity card.

3. DUPLICATE ACTIVITY

   Two cards define the same activity. This condition is not permissible. The number N before the message indicates the Nth card is in error.

4. CHECK ESTIMATES

   This message indicates that the three time estimates (optimistic, most likely, pessimistic) do not progress from smaller to larger.

B. Phase I - Input Routine (Cont'd.)

It is allowable to have all three the same. The first 17 numbers in the activity card precede the message for identification purposes. Processing continues using the given time estimates.

5. EXTRA CARD(S)

   This message appears after the END card is read if the number of activity cards exceeds the number specified in columns 5-8 of the header card.

   All cards with status codes C, S, and "blank" will be included in the count of the number of data cards.

6. CARD(S) MISSING

   This message occurs after the END card is read if the number of activity cards is less than the number of activities specified in the header card.

7. ERROR, START NEXT NETWORK

   If program switch 4 is ON and if message 2, 3, 5 or 6 is typed out, message 7 will also appear. Processing is stopped. Depressing START will read in activity cards for another network.

8. NETWORK EXCEEDS MEMORY CAPACITY

   This message indicates that the number of activities in the project is more than 695 for 20K or more than 999 for 40K or 60K.

(Additional restart information is contained in Section V C, "Programmed Stops and Restarts").

As each activity card is read and approved by the edit the expected time and variance are computed. The formulae, derived from the Beta distribution, are

$$\text{Expected time } D = \frac{a + 4m + b}{6}$$

$$\text{Variance} = \left(\frac{b-a}{6}\right)^2$$

where a = optimistic time
m = most likely time
b = pessimistic time

Note: These statistical computations are not made if only one time estimate is used.

B. Phase I - Input Routine (Cont'd.)

After these values are calculated, a 23 digit record is constructed for each activity.

These records appear in the same sequence in memory as the input activity cards.

The first activity record is in memory locations 04000 to 04022, the next in 04023 to 04045, and so on. With proper care these records as well as the rest of the program are relocatable by reassembling the SPS program. (See Section VI A)

The form of each activity record upon completion of the Input Routine is

Positions	Format	Symbol	Description
1-4	$\overline{\text{XXXX}}$	EP	Predecessor event
5-8	$\overline{\text{XXXX}}$	ES	Successor event
9-11	$\overline{\text{XXX}}$		Variance, XX.X weeks.
			$\overline{\text{(}}$000 if only one time estimate is used.)
12-14	$\overline{\text{XXX}}$		Expected time, XX.X Weeks
15-17	$\overline{\text{000}}$	AP	Initially reserved for the number of the activity preceding this one in topological order.*
18-20	$\overline{\text{000}}$	AS	Reserved for the number of the activity succeeding this one in topological order.*
21-23	$\overline{\text{000}}$	M	Initially reserved for a count of the number of times the activity is "moved" during the ranking (TOP THREAD) phase of the program.

NOTE: Activity records are set up in memory only for activities whose status is scheduled (S) or not scheduled (blank), not for completed (C) activities.

* See Section II C for a brief explanation of topological ordering.

II.

C. Phase II - TOPTHREAD

The purpose of this phase is to sequence the activities in the order which is necessary for the subsequent PERT computations, specifically for the Backward Pass and the Forward Pass to determine the earliest and latest completion dates. The method is described by Lasser in "Communications of the ACM", April, 1961, and by the author in the paper "TOPTHREAD" contained in the published papers of the First IBM Systems Engineering Symposium (1961).

Briefly, the TOPTHREAD phase arranges the activities in topological order which is the order essential to further computation. For this purpose, topological order is defined by these two requirements.

1. All activities beginning at the same event will be listed consecutively.

2. Each activity will be listed before all the activities which follow it either directly or indirectly in the network.

Instead of actually rearranging the activity records in memory two "threaded lists" are used. First the activities are numbered sequentially by the program from one to N, the number of activities. This number is conceptual only and does not appear in the activity record. The TOPTHREAD program then places two "tags" in each activity record. One tag (AS) is the number of the activity succeeding this one in topological order. The other tag (AP) is the number of the activity preceding this one in topological order. Thus beginning with an activity in the network it is possible to thread through all the remaining activities to the last activity by "chaining" from activity to activity by using the AS tag. Similarly one can thread backwards from any activity to the first activity using the AP tag. Both the Backward Pass and the Forward Pass make use of the threaded lists.

This method of ranking allows the events to be numbered at random (theoretically the events could be alphanumerically identified). The method also allows more than one event without a predecessor event as well as more than one event without a successor event. These facts may facilitate 1) partitioning of large networks into smaller ones, 2) grouping of sub-networks into larger ones and 3) the processing of multi-project networks. The technique can actually handle several independent networks simultaneously.

Upon completion of TOPTHREAD the 23 digit activity records contain new data in the AP, AS, and M fields. AP (positions 15-17) contains the number of the preceding activity in topological order. AP of the

II C.

Phase II - TOPTHREAD (Cont'd.)

first activity is zero. AS (positions 18-20) contains the number of the succeeding activity in topological order. AS of the last activity is N+1. M (positions 21-23) is a count of the number of times an activity is "moved" in setting up the topological order.

If an activity is moved more than N times (N is the number of activities in the network) during the TOPTHREAD phase it is in a "closed loop", that is, the activity is its own direct or indirect successor. This may result from 1) improperly punched data, 2) an improperly defined network, or 3) more than one event defined by the same number. If this situation arises, the message IN CLOSED LOOP will be printed preceded by the EP and ESof the activity in the closed loop. Processing stops with a complete restart required when the situation has been corrected.

II D. Phase III - The Backward Pass

The purpose of the Backward Pass is to determine the latest allowable finish time (AFT). It does this by starting with the last activity and working its way back along each path until it reaches the first activity.

Before proceeding with the Backward Pass, the program determines the total number of weeks allowed for the entire network by converting the start and finish dates supplied on the header card to weeks and taking the difference. The message PROJECT EXCEEDS 199.8 WEEKS indicates the project is too long and must be reduced to 199.8 weeks or less. The latest allowable finish time of the last activity and the AFT's of all preceding activities are determined starting with 99.9 weeks as the AFT of the last activity and all activities without successor activities.

Starting with this last activity the program threads its way backward through the activities in topological order. As it encounters each activity for the first time, it starts at that activity and threads its way forward through the activity list topoligically until it finds a group of one or more activities all beginning at the successor event of the activity which it has encountered for the first time. (In the Fortran program the index K refers to the activity being encountered the first time in the backward thread. The index I refers to the activities which are checked each time the list is scanned with a forward thread. Thus we seek the group of consecutive activities whose $EP_i = ES_k$.) If no such group is found, i.e., the activity has no successor, the activity is assigned the same AFT as the last activity in the project. If such a group of activities is found (as is normally the case) the activity (K) is assigned an AFT which is the minimum time TMIN of the differences of each AFT in the group and its corresponding expected time D (duration time).

$$AFT_k = \min_{\text{all } i} (AFT_i - D_i)$$

where i is defined by

$$EP_i = ES_k \text{ for each activity } k$$

Upon completion of the Backward Pass the last three digits of each activity record (previously occupied by the move count M) now contain the AFT's of each activity in weeks (XX.X) relative to 99.9 weeks.

After completing the Backward Pass the total number of events without direct successor events is indicated by the message XXX TERMINAL EVENTS.

II

E. Phase IV - The Forward Pass

The purpose of the Forward Pass is to determine the earliest start time EST of each activity. From this the output routine will add the expected time D to the EST to establish the earliest finish time; i.e., the expected completion date. In addition, the Forward Pass determines the sum of the variances of all the activities along the longest path through and including each activity. The message CUMULATIVE VARIANCE EXCEEDS 999.9 WEEKS will type out if the variance along any path exceeds 999.9 weeks.

After finding the first group of activities with the same predecessor event in the list in the topological ordering and assigning them an EST of -99.9, the Forward Pass threads through the topological list in a forward direction (on index K). As each activity group is encountered for the first time, the program again returns to the first activity topologically and searches through the topological list of every activity (using index I) from the first to the group being encountered for the first time seeking all activities whose successor events ES_i are equal to the predecessor event EP_k of the group. The maximum value of the individual sums of the EST plus the D of each activity satisfying this condition is assigned as the EST of each activity in the group.

Thus

$$EST_k = \text{Max}\ (EST_i + D_i)$$

where i is defined to satisfy the relation

$$EP_k = ES_i$$

for any activity k.

Upon completion of the Forward Pass, the record for each activity has two new entries. The value of EST in weeks (XX.X) relative to the start of the project at time -99.9 weeks is in positions 15-17, replacing the backward threaded list AS. The value of the cumulative variance along the longest path to the end of that activity is in positions 1-4 expressed in weeks XXX.X. The variance replaces the predecessor event number EP.

The total number of events without predecessor events is indicated by the message XXX ORIGINATING EVENTS.

F. Phase V - The Output Routine

The purpose of the output routine is to punch or type the output in a form which includes for each activity the values of the

1) Input data
2) Expected time in weeks (XX.X)
3) Slack time in weeks (XX.X)
4) Cumulative variance in weeks (XXX.X)
5) Expected completion date (Mo/day/yr) i.e., the earliest finish time
6) Latest allowable completion date (mo/day/hr), i.e., latest finish time.
7) Probability (X.XX) of meeting the scheduled completion date if one is specified.

In the case of completed activities (status C) only the input information is included in the output.

Program switches 1 and 2 affect the output routine. Switch 1 OFF is normal when three time estimates are used. With Switch 1 ON only one time estimate is used and hence the probability calculation is ignored. With Switch 2 OFF the 80 character output record will be punched; with Switch 2 ON the output record will be typed.

The initialization portion of the output routine checks for the header card and punches it if Switch 2 is OFF. If a typed report is desired, the headings are printed. The base addresses of the fields in the activity records are set up for sequential output of the activity information.

Expected completion date for each activity is determined by adding the earliest start time EST to the expected duration time D (plus 99.9) to compute the earliest finish time EXPTIM. This value, relative to a "time now" of zero, is made relative to the project start date and then converted to a date by the MODAYR subroutine.

II

F. Phase V - The Output Routine (Cont'd.)

The slack time SLACK is derived by subtracting the EXPTIM from the latest finish time AFT. The slack time may be negative since the AFT is determined from the project finish date. A negative slack time implies that that activity is behind schedule if we expect to meet the project finish date. Similarly all slacks may be greater than zero. This implies the entire project is ahead of schedule. All activities which have the minimum value of all the slacks for that network are on the critical path.

The cumulative variance is the sum of all variances along the longest path up to and including that activity. The significance of the cumulative variance is, first, a measure of the uncertainty of completing the activity on the expected completion date. The larger the valve of the variance, the less certain one is of meeting the expected completion date. Second, the cumulative variance is needed because the completion of the activity is dependent on previous activities.

The probability of meeting the scheduled completion date is calculated by PSCHED only when an activity with status S having three time estimates is encountered. The formula used is the familiar one:

$$\text{Probability} = \bar{\emptyset}\ \left(\frac{Ts - Te}{\sigma}\right) = \bar{\emptyset}\ (Z)$$

$$\text{where } \sigma = \sqrt{\text{Cumulative Variance}}$$

The square root of the variance is taken by PSQRT. PSIG computes the standardized variable Z. The routine beginning at label P 12 determines the probability using a Hastings approximation.

II

G. Miscellaneous Subroutines

Incorporated into the preceding programs which make up 1620 PERT are a number of routines which are either written in subroutine form suitable for use with a BT of BTM linkage or are written in a form separate from the rest of the program which might be adapted to subroutine form.

Except for the MO/DA/YR TO DAYS sequence which may be found immediately following the TOPTHREAD routine, all the subroutines are in the Output Routine.

Specifically, these include:

1. MO/DA/YR TO DAYS
   Conversion of a calendar date from Month/day/year to the number of days from the base date January 1, 1960 to that date based on a 7 day week. The entry is at MBEGIN p.20, 1.030.

2. DAYS TO MO/DA/YR
   Conversion of a number of days with base date January 1, 1960 to the corresponding calendar date based on a seven day week. Entry instruction is BT MODAYR, DAYSFIELD. Routine starts at MODAYR p.47, 1.020.

3. Numeric to alpha conversion
   Changes numeric field to double digit form suitable for alphabetic output. Entry instruction is BT NTOA, NFIELD. Routine starts on p.40,1.010.

4. Alpha to numeric conversion
   Changes a numeric field in double digit alphabetic form to single digit numeric form suitable for arithmetic use. Entry instruction is BT ATON, AFIELD. Routine begins on p.40, 1.250.

5. Fixed point square root
   Routine begins at PSQRT with argument at XO in the form XX.XXXX. Square root is placed in XO in same form.

6. Fixed point probability calculation using normal curve
   This routine begins on p.45, 1.070 with the argument in Z in the form X.XXXX. Probability at exit (p.45,1.374) is placed in Z in same form X.XXXX.

III Input/Output

A. Input Formats

The input includes a header card (status H), one activity card (status C, S, or "blank") for each activity, and an END (status E) card in that order. The formats are:

1. Header Card - Status H

Cols.	Description
1 - 4	Network number - 4 digits XXXX
5 - 8	Number of activities - 4 digits XXXX or blank
9 - 11	Case number of network to identify the run.
18	H - Status Code
19 - 24	Date of computer run XX/XX/XX
25 - 55	Network Title
69 - 74	Network start date - "Time now" XX/XX/XX
75 - 80	Network finish date - XX/XX/XX

If the number of activities are specified, it must be the total count of all status C, S, and "Blank" cards. Any discrepancy with this count is detected by the Input Routine and processing is stopped. If an activity count check by the Input Routine is not desired, this field may be left blank or filled with zeros.

2. Activity Cards - status "blank"

Cols.	Description
1 - 4	Predecessor event number XXXX
5 - 8	Successor event number XXXX
9 - 11	Optimistic time estimate XX.X Weeks

III

A. Input Formats (Cont'd.)

Cols.	Description
12 - 14	Most likely time estimate XX.X Weeks
15 - 17	Pessimistic time estimate XX.X Weeks
18	"Blank"
19 - 24	Blank
25 - 55	Activity Description
56 - 80	Anything - This area ignored by the program.

3. Scheduled activity cards - Status S

These are the same as status "blank" activity cards except that Column 18 contains an S and the scheduled date for completing the activity is punched in columns 19 - 24 in the form mo/day/yr XX/XX/XX.

4. Completed activity cards - Status C

These are the same as status "blank" activity cards except that column 18 contains a C and the date the activity was completed is punched in columns 19 - 24 in the form mo/day/yr XX/XX/XX. Completed activity cards are included only so that they may be readily incorporated in the output listing.

5. END CARD

This must be the last card of the data and must have an E in Column 18. It is recommended that the word END be punched in columns 13 - 20 although an E in column 18 is sufficient.

III Input/Output

B. Output Formats

1. Card output - Program Switch 2 OFF.

The header card is duplicated and becomes the first output card. There is one output activity card punched for each input activity card.

Activities will be in the same order for both input and output, namely ascending numeric sequence sorting on columns 1 to 8. Columns 1 through 55 of the output activity cards contain the information duplicated from columns 1 - 55 of the input activity cards. The remaining columns in the output cards include:

Cols.	Description
56 - 58	Expected time in XX.X weeks. This is the weighted average of the three time estimates.
59 - 61	Slack time in XX.X weeks
62 - 65	Cumulative variance along the longest path to the completion of that activity in XX.X weeks.
66 - 68	Probability X.XX of meeting the scheduled completion date for scheduled activities only (status S). Blank for all others.
69 - 74	Expected completion date mo/day/yr XX/XX/XX.
75 - 80	Latest allowable completion date mo/da/yr XX/XX/XX.

The END card is not included in the output.

2. Typed Output - Program Switch 2 ON

The progress of computation is monitored by the typewriter. Header card data is printed to indicate the start of computation. Any error messages are printed following this and are explained elsewhere in this write-up. Following this the operator has the option to punch or type the output data (controlled by Switch 2). With Switch 2 ON two lines of heading will be printed followed by the 80 character activity records which have the identical form as the card output formats.

If the slack is negative the units position of the slack field will be an alphabetic character since output is typed in the alphabetic mode. Upon satisfactory completion of the program, the message THE END will type.

III

Input/Output

C. I/O Formats for a Single Time Estimate

The user has the option to use only one time estimate instead of three. Naturally all statistical calculations are bypassed then by the program. If Program Switch 1 is ON 1620 PERT uses only one time estimate; with Switch 1 OFF, 1620 PERT uses three estimates.

1. Input formats for one time estimate

The input is the same as for three time estimates except:

The single time estimate is punched in columns 12 - 14 (where the Most Likely estimate is usually punched. The other time estimate fields (Columns 9 - 11 and 15 - 17) are ignored by the program and may contain anything.

2. Output formats for one time estimate:

The output is identical to that when three estimates are used except:

a. The single time estimate is punched in cols. 56 - 58 (which contained the Expected Time otherwise).

b. For scheduled activities (Status S) the probability is always left blank since it is not computed.

IV. Operating Instructions

A. Console Switch Settings

Set PARITY and I/O switches to STOP

Set OFLOW to PROGRAM

	OFF	ON
PS1	Three time estimates used	Only one time estimate used
PS2	Output on Punched cards	Output on typewriter
PS3	Not used	Not used
PS4	Stops on input error	Edits all input data
	Proceeds if no errors	Proceeds with computations if no errors occur.

B. Operating Procedure

1. Clear Memory
2. Set console switches.
3. Ready typewriter for 80 character line. No tabs required.
4. Ready card punch with blank cards if punched output is desired.
5. Place program and data cards in read hopper in the following order:
   a. Input Routine program deck
   b. Data deck in this order:
      1) Header card - "H" in column 18
      2) All activity cards sorted in ascending sequence on columns 1 through 8, succeeding event ES within preceding event EP.
      3) END Card - "E" in column 18
   c. The remaining program decks in this order.
      1) TOPTHREAD
      2) Backward Pass
      3) Forward Pass
      4) Output Routine
6. Depress RESET on the console; then press the LOAD key on the Card Reader.
7. Anytime after all the data cards have been read remove them from their place behind the Input Routine and put them in the read hopper behind the last card in the Output Routine program deck.
8. Press READER START on the Card Read Punch to process remaining data cards. THE END should print on the typewriter to signify completion of the processing.

IV. Operating Instructions

C. Programmed Stops and Restarts.

In general all programmed stops should be referred to the PERT analyst for appropriate action as described in Section II.

With Switch 4 on the input data will be edited. If the data is all satisfactory processing will continue with no messages printed out. If the input data is not satisfactory, appropriate error messages will be printed out and editing will continue until all the data cards have been read at which time the message ERROR, START NEXT NETWORK will appear calling for the next network.

With Switch 4 OFF the program halts as soon as the error is detected. If the situation can be corrected without affecting any data cards prior to the one in which the error was discovered (the second from last in the normal read stacker) the remaining data cards beginning with the one in error may be placed back in the read hopper after making the necessary correction. Follow Restart Procedure 3.

Four restart procedures are possible.

1. Complete restart at beginning after making corrections.
2. Restart by reloading complete data deck.
   a. Run the remaining cards out of the read hopper, with the Non-Process Runout key.
   b. Clear the punch feed of cards.
   c. Place the complete data deck (either the present network with corrections or an entirely new network) in the read hopper followed as usual by the rest of the 1620 PERT program deck (if any program cards remain in the read hopper).
   d. Press READER START and console START to continue processing.
3. Restart by loading remaining data deck after corrections are made.
   a. Run the remaining cards out of the read hopper.
   b. The second from last card in the normal read stacker is the card which caused the error. Starting with this card be sure there are no duplicate activities defined and all activity cards must be in sequence.

IV.

C. Programmed Stops and Restarts (Cont'd.)

c. Place these cards back in the reader hopper then press READER START AND console START

4. No restart, processing continues.

Some messages are for monitoring the progress of the program or indicate possible error conditions. Processing continues automatically after the message types out.

Here is a list of programmed messages, the phase in which they can occur, the appropriate restart procedure to be used (describer above) and the Section elsewhere in the write-up where they are more fully described.

PHASE	MESSAGE	RESTART	REFERENCE SECTION
1	NO HEADER CARD, START AGAIN	2	II B
1	CARD OUT OF SEQUENCE (SWITCH 4 OFF)	3 or 1	II B
1	CARD OUT OF SEQUENCE (SWITCH 4 ON)	2	
1	DUPLICATE ACTIVITY (SWITCH 4 OFF)	3 or 1	II B
1	DUPLICATE ACTIVITY (SWITCH 4 ON)	2	
1	CHECK ESTIMATES	4	II B
1	EXTRA CARD(S)	2	II B
1	CARD(S) MISSING	2	II B
1	ERROR, START NEXT NETWORK	2	II B
1	NETWORK EXCEEDS MEMORY CAPACITY	1	II B
2	IN CLOSED LOOP	1	II C
3	XXX TERMINAL EVENTS	4	II D
3	PROJECT EXCEEDS 199.8 WEEKS	1	II D
4	XXX ORIGINATING EVENTS	4	II E
4	CUMULATIVE VARIANCE EXCEEDS 999.9 WEEKS	1	II E
5	CD SEQ ERR	2	
5	THE END	4	

IV. Operating Instructions

D. Off-Line Processing Procedures

The basic procedure for processing cards is:

1. Sort the input activity cards numerically in ascending order on the first 8 card columns. A digit sort beginning in columns 8, 7, 6, 5, 4, 3, 2, 1 is required. The header card should be placed at the beginning of the deck and the END card at the end of the deck after the sort.

2. Process the input activity cards through the 1620 by the procedure described above, in IV.A and IV.B.

3. Using a sorter and a printer (a 407 printer control panel wiring diagram is described in Section VIII) a variety of reports can be made from the output activity cards by sorting in different orders. The most important is usually the listing of the activities from the most critical activity to the least critical activity. Another useful report lists the output activity cards in order of Latest Allowable Completion Date. Still other reports may prove useful to the user. In each case the header card should be removed before the output deck is sorted. After sorting, replace the header card at the beginning of the deck. If additional heading information is desired, an unlimited number of heading cards may be placed in front of the header card. The format for these heading cards is

col. 18 - the letter "H"

cols. 25 - 55 - the heading information

all other columns must be blank.

The sorting procedures for the two reports mentioned are as follows:

a. Activity Listing by Latest Allowable Completion Date.

1) Select all the Completed Activity cards from the deck by sorting out those cards with a "C" in column 18. You may wish to eliminate these activities from the listing or place them behind the sorted deck so they appear at the bottom of the listing.

IV.

D. Off-Line Processing Procedures (Cont'd.)

2) The Latest Allowable Completion Date is in mo/day/yr order in columns 75 - 80. Sort this date in ascending numeric order with day as the minor field (cols 77 - 78), month as the intermediate field (cols 75 - 76) and year as the major field (cols. 79 - 80). In other words, a digit sort in column sequence 78-77-76-75-80-79 is required.

b. Activity Listing by Most Critical Activity to Least Critical Activity will be listed in critical path.

This Listing is made by sorting from least slack time to most slack time. The 3 digit slack field is located in card columns 59 - 61. Remember that in 1620 PERT slack may be negative. This is indicated by an x-punch in column 61.

It is recommended that the sort on slack time be made after the sort or Latest Allowable Completion Date. If this is done activities will be listed in path sequence on the Criticality Report.

1) Separate the activity cards with an x-punch in column 61 from those with no x-punch in 61. The cards with an x-punch have negative slack.

2) Sort the cards with x-punch in 61 in reverse (descending) numeric sequence on the field in cols. 59 - 61.

3) Sort the remaining cards in normal (ascending) numeric sequence, on the field in columns 59 - 61 and place this sorted deck behind the sorted negative slack cards.

4) List the entire deck on the printer after placing the desired heading cards at the front of the deck.

V. Sample Problem

The card deck which you have received from the Program Library includes:

1. Deck 1 - Phase 1 - (Condensed SPS Object Program)
2. Sample Problem Input Date
3. DECK II - Phases 2, 3, 4, 5 (condensed SPS object programs)
4. Source Programs - Phases 1 - 5

A. A PERT Network - The Complete Project

Figure V.1 is an example of a small PERT network patterned after a similar network described in "Critical-Path Planning and Scheduling" by J. E. Kelly, Jr., and M R. Walker, Mauchly Associates, Inc. Note that events have been numbered randomly without regard for missing numbers. Associated with each activity is three time estimates--optimistic, most likely, and pessimistic, in that order--which are expressed in weeks. Figure V.2 is a 1620 PERT data sheet as it might be filled in by the PERT analyst. In Figure V.3 is a 407 listing of the input data in proper (ascending) sequence. Figure V.4 is the output as it would be typed on the typewriter. Figure V.5 shows the same output arranged in order from most critical activity to least critical activity (output cards sorted on SLACK cols. 59-61). The first three lines of the output listing are created by three cards which have the corresponding information punched in columns 25-55 and on H in column 18. These three cards (or any other appropriate ones) may be inserted ahead of the output data deck to improve the report.

In output is on punched cards other sequences may be chosen by sorting on the appropriate columns. Figure V.6 is a listing of the same output data listed by latest allowable completion time.

B. The Project Partially Completed

In figure V.7 we see the PERT network as it may appear shortly after the project has begun. Activities 5, 13, and 17 are now complete and activity 16 has new time estimates because it is partially complete. Figure V.8 is a listing in criticality order. The cards for the completed activities have been included in the listing.

C. A Partitioned Network

In some instances it may become necessary to process a network which is really a part of a larger network. An example of such a partitioned network is illustrated in Figure V.9. It is a reduced form of the network of Figure V.I with Activities 1, 2, 3, 10, 11, 12, 14, and 15 omitted. Figure V.10 shows the output of 1620 PERT using the same data cards as in the previous network except for the omission of those we have mentioned.

VI Maintenance

A. Comments on Making Changes to 1620 PERT

The objective in programming 1620 PERT was to provide the user with a program which would handle randomly numbered events and would provide a variety of PERT management reports comparable to those currently in use in most government projects. For this reason 1620 PERT was written for the card 1620 using the TOP-THREAD technique for ranking with sole concern for handling the time factor only, not cost, manpower scheduling, reliability indexes or other resource factors.

Both new and old uses of the PERT method may demand modifications to be made to 1620 PERT. Some changes may be readily incorporated; others will require a major program revision. The following remarks are given to provide the user who desires to modify the program some insight into the scope of effort required for certain changes and into the considerations inherent in these changes. Note that these remarks are not necessarily complete.

Most changes will probably occur in input/output requirements. These will involve only the Input Routine and the Output Routine and are described in this and the other two parts of this section.

Most other changes, that is, those affecting Phases II, III, and IV (TOPTHREAD, the Backward Pass, and the Forward Pass) will require a major change in the program. Specifically any change involving the lengthening of a field (e.g. event numbers greater than 4 digits, time estimates greater than 3 digits, total project time greater than 199.9 weeks, or more than 999 activities) will cause a major change in these three phases and will not be discussed here.

Each of the five phases is a completely separate program and can be assembled separately in SPS. The provisions for making a change in one phase without affecting the others are:

1. The activity records as they appear at the completion of the previous Phase must remain in memory (location 04000 ff.) since the Phase being changed depends on the output format of the previous Phase which is given in Section II.

A. Comments on Making Changes to 1620 PERT (Cont'd.)

2. Similarly the succeeding Phase requires the output of the Phase being changed (the updated activity records) to be in the same format as specified in Section II.

3. The same remarks that apply to the activity records also apply to the data area which occupies locations 03943 to 03998 in all five Phases. That is, the fields in this area are common to all phases and must be included in each phase.

4. Be careful not to use the symbols referring to the activity records and data area in the Phase being changed for other uses.

5. No one Phase may exceed position 03999 exclusive of activity records. If a modification of any Phase requires that Phase to occupy more than 4000 positions, all the Phases should be reassembled separately after the following changes are made to the SPS source program:

    1) The operand of the last DORG card in each Phase should be changed from 4000 to the address of the beginning of the first activity record after the change. For example, if a change in Phase V (the Output Routine) requires Phase V to occupy positions 00000 through 04499, then the card with page and line number 99029 in each Phase should have the operand changed from 4000 4500. Similarly, the DORG card 98100 in each Phase should have its operand incremented from 3948 by the same amount. In our example, where the program was expanded by 500 positions, this change would be from 3948 to 4448.

6. After reassembling and condensing, be sure columns 1 and 2 of the last card in each Phase contain "41" not "48". Otherwise a programmed halt will occur at the end of each Phase.

To modify 1620 PERT for 40K and 60K machines, change the operand in card number 91140 in Phase I (the Input Routine) from 20000 to 26077. Although the capacity of the machine is larger, the nature of the program prohibits a larger number from being used. This allows for a maximum of 999 activities. (This change can be made to the Phase I condensed SPS deck by changing columns 33-37 in card 00022 from 19988 to 26054 .

VI.

B. Incorporating Changes into the Input Routine

Changes should be made in accordance with the requirements listed above in Section VI A. Be sure the activity records are set up by the Input Routine in the form described in Section II B.

If a change is made in the format of the input activity cards, remember that the Ouput Routine is based on the same format since the activity cards are passed through the 1620 a second time to obtain descriptive information from them. Actually the event numbers (cols. 1-8), the status code (col. 18), the scheduled or completion date (cols. 19-24) and the activity description (col. 25-55) are the only card fields which the Output Routine requires. Other columns may be used as desired without affecting anything but the Input Routine.

Columns 56 through 80 of the input activity cards are not used by the Input Routine and may be used for other identification purposes.

If a major revision in card input format is required carefully consider writing a program to convert to the format required by 1620 PERT rather than modifying both the Input Routine and Output Routine. This would likely be the simplest way of obtaining compatibility with the two-card format frequently used by programs written for larger computers.

VI.

C. Incorporating Changes in the Output Routine

Many of the remarks in Sections VI A and VI B also apply here and should be reviewed before modifying the Output Routine. 1620 PERT emphasises completion dates. Normal output includes the Earliest Expected Completion Date (Earliest Finish Time EFT when refering to Critical Path Scheduling or LESS programs) and the Latest Allowable Completion Date (Latest Finish Time LFT in LESS programs). LESS programs also include the Earliest Start Time EST and the Latest Start Time LST. Both of these times can be calculated in the Output Routine. The EST is immediately available in positions 15 - 17 of each activity record. The LST can be calculated by subtracting the Expected Time (average of the three time estimates) from the Latest Allowable Completion time. This calculation may be made by incorporating the proper instructions in the SPS source program after the instruction at PCALC + 36. Conversion of both the EST and LST to a date in 1620 double digit form suitable for output should be made after the instruction at PNOTSC + 60 following the 3-instruction method used for the Expected Completion Date (EXPTIM) and the Latest Allowable Completion Date (AFTADD) in the first six instructions of PNOTSC. The Output Routine works on only one activity record at a time. When the completed record for an activity is punched it begins processing the next activity. The addresses of the fields in question for an activity at any given time are located at the following symbolic locations:

ESTADD	address of EST
DADD	address of the expected time (duration time D)
AFTADD	address of Latest Allowable Completion time (AFT or LFT)
EXPTIM	Expected Completion Time
MODAYR	entry to the MODAYR subroutine to convert to a date
NTOA	entry to a Numeric to Alpha subroutine.
PRINT + 2	Corresponds to the first column of the output activity card.

VIII A 407 Panel for Listing 1620 Input and Output Data.

The 407 PERT BOARD assumes that all non-activity cards (i.e. Header Cards) have an "H" in Card Col. 18.

If there are no header cards it will be necessary to place a blank card with an "H" in cc. 18 ahead of the other cards.

Alter SW #1 Off: Gives the Pre List

On: Gives the Post List

Alter SW #2 Off: Single Space

On: Double Space

A Carriage tape must contain a one punch for the first printing line and a twelve punch for overflow.

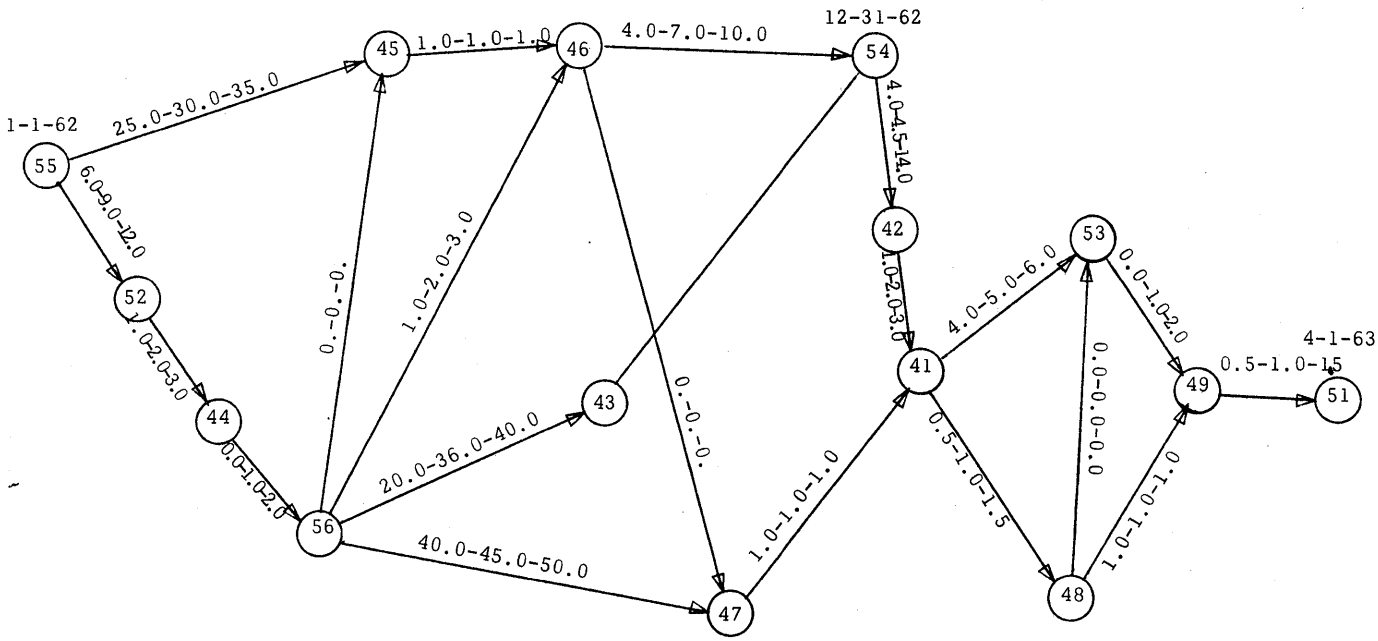

Figure V.1 A Small PERT Network - Complete Project

1620 PERT

NETWORK NO. 7777 NO. OF ACTIVITIES 21 CASE NO. 001 PAGE 1 OF 1

NETWORK TITLE TEST NETWORK ANALYST

RUN DATE (M-D-Y) 12161 START DATE (M-D-Y) 101621 FINISH DATE (M-D-Y) 041663

STATUS CODES (COL. 18) C-COMPLETED ACTIVITY S-SCHEDULED ACTIVITY BLANK-NON-SCHEDULED ACTIVITY

EVENTS BEGIN	EVENTS END	TIMES (WEEKS) OPT	TIMES (WEEKS) Likely	TIMES (WEEKS) Pess	Status	Sched. or completion date (M-D-Y)	ACTIVITY DESCRIPTION	COMMENTS (not punched)
0055	0045	2.5	3.0	3.5			ACT 16	
0045	0046	0.1	0.1	0.1			ACT 6	
0046	0054	0.4	0.7	1.0	S	123162	ACT 8	
0054	0042	0.4	0.45	1.4			ACT 15	
0042	0041	0.1	0.2	0.3			ACT 3	
0055	0052	0.6	0.9	1.2			ACT 17	
0052	0044	0.1	0.2	0.3			ACT 13	
0044	0056	0.0	0.1	0.2			ACT 5	
0056	0045	0.0	0.0	0.0			ACT 19	
0056	0046	0.1	0.2	0.3			ACT 20	
0046	0047	0.0	0.0	0.0			ACT 7	
0056	0043	2.0	3.6	4.0			ACT 18	
0043	0054	0.2	0.8	0.8			ACT 4	
0056	0047	4.0	4.5	5.0			ACT 14	
0047	0041	0.1	0.1	0.1			ACT 9	
0041	0053	0.4	0.5	0.6			ACT 2	
0041	0048	0.05	0.1	0.15			ACT 1 VITY 1	
0048	0053	0.0	0.0	0.0			ACT 11	
0048	0049	0.1	0.1	0.1			ACT 10	
0049	0051	0.05	0.1	0.15	S	061663	ACT 12	

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FIGURE V.2

1620 PERT

Network No. ____ No. of Activities ____ Case No. ____ Page ____ of ____

Network Title ____ Analyst ____

Run Date (M-D-Y) ____ Start Date (M-D-Y) ____ Finish Date (M-D-Y) ____

Status Codes (Col. 18) C-Completed Activity S-Scheduled Activity blank-Non-Scheduled Activity

Events Begin	Events End	Times (Weeks) Opt	Likely	Pess	Sched. or completion date (M-D-Y)	Activity Description	Comments (Not Punched)

34

7777 21 TEST NETWORK 1 4 01 63 1 01 62 3 15 62

1620 PERT PAGE 1

EVENT PREC	EVENT SUCC	ACTIVITY	OPTIM	LIKELY	PESS	STS	SCHED
41	48	ACTIVITY 1	.5	1.0	1.5		
41	53	ACT 2	4.0	5.0	6.0		
42	47	ACT 3	1.0	2.0	3.0		
43	54	ACT 4	2.0	8.0	8.0		
44	55	ACT 5	.0	1.0	2.0		
45	46	ACT 6	1.0	1.0	1.0		
45	47	ACT 7	.0	.0	.0		
46	54	ACT 8	4.0	7.0	10.0	S	12 31 62
47	41	ACT 9	1.0	1.0	1.0		
48	49	ACT 10	1.0	1.0	1.0		
48	53	ACT 11	.0	.0	.0		
49	51	ACT 12	.5	1.0	1.5	S	4 01 63
52	44	ACT 13	1.0	2.0	3.0		
53	49	ACT 14	.0	1.0	2.0		
54	42	ACT 15	4.0	4.5	14.0		
55	45	ACT 16	25.0	30.0	35.0		
55	52	ACT 17	6.0	9.0	12.0		
56	43	ACT 18	20.0	36.0	40.0		
56	45	ACT 19	.0	.0	.0		
56	46	ACT 20	1.0	2.0	3.0		
56	47	ACT 21	40.0	45.0	50.0		
						F	END

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Figure V.3


```
NETWORK  CASE  TITLE                              NO. OF ACT.  RUN     START   FINISH
 7777     001  TEST NETWORK                            21     031562  010162  040163

Ō01 TERMINAL EVENTS     Ō01 ORIGINATING EVENTS

 EVENTS   TIMES   S OR C   ACTIVITY DESCRIPTION        EXPSLKTOT PRBXPECTDLATEST
PREDSUCCOPTLIKPES MODAYR                               TIM    VAR   MODAYRMODAYR

00410048005010015        ACTIVITY 1                    0100100162    031163031863
00410053040050060        ACT 2                         05003-0163    040863031863
00420041010020030        ACT 3                         02003-0162    030463021163
00430054020080080        ACT 4                         07003-0133    010763121762
00440056000010020        ACT 5                         01003-0012    032662030562
00450046010010010        ACT 6                         0101200028    080662102962
00460047000000000        ACT 7                         0002600028    080662020463
00460054040070100S123162 ACT 8                         0701200038100092462121762
00470041010010010        ACT 9                         0100000040    021163021163
00480049010010010        ACT 10                        0100100162    031863032563
00480053000000000        ACT 11                        0000100162    031163031863
00490051005010015S040163 ACT 12                        01003-0164023 042263040163
00520044010020030        ACT 13                        02003-0011    031962022662
00530049000010020        ACT 14                        01003-0164    041563032563
00540042040045140        ACT 15                        06003-0161    021863012863
00550045250300350        ACT 16                        3001200028    073062102262
00550052060090120        ACT 17                        09003-0010    030562021262
00560043200360400        ACT 18                        34003-0123    111962102962
00560045000000000        ACT 19                        0003000012    032662102262
00560046010020030        ACT 20                        0202900013    040962102962
00560047400450500        ACT 21                        4500000040    020463020463
THE END
```

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 21 TEST NETWORK 1 01 62 4 01 63 3 15 62

1620 PERT PAGE 1

EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PROB
55	52	ACT 17	9.0	3.0-	1.0		3 05 62	2 12 62		
52	44	ACT 15	2.0	3.0-	1.1		3 19 62	2 26 62		
44	56	ACT 5	1.0	3.0-	1.2		3 26 62	3 05 62		
55	45	ACT 16	30.0	12.0	2.8		7 30 62	10 22 62		
45	43	ACT 19	.0	30.0	1.2		3 26 62	10 22 62		
56	43	ACT 18	34.0	3.0-	12.3		11 19 62	10 29 62		
45	46	ACT 6	1.0	12.0	2.8		8 06 62	10 29 62		
56	46	ACT 20	2.0	29.0	1.3		4 09 62	10 29 62		
43	54	ACT 4	7.0	3.0-	13.3		1 07 63	12 17 62		
46	54	ACT 8	7.0	12.0	3.8	S	9 24 62	12 17 62	12 31 62	1.00
44	42	ACT 15	6.0	3.0-	16.1		2 18 63	1 28 63		
56	47	ACT 21	45.0	.0	4.0		2 04 63	2 04 63		
46	47	ACT 7	.0	26.0	2.8		8 06 62	2 04 63		
42	41	ACT 3	2.0	3.0-	16.2		3 04 63	2 11 63		
47	41	ACT 9	1.0	.0	4.0		2 11 63	2 11 63		
41	53	ACT 2	5.0	3.0-	16.3		4 08 63	3 18 63		
41	48	ACTIVITY 1	1.0	1.0	16.2		3 11 63	3 18 63		
48	53	ACT 11	.0	1.0	16.2		3 11 63	3 18 63		
48	49	ACT 10	1.0	1.0	16.2		3 18 63	3 25 63		
49	51	ACT 12	1.0	3.0-	16.4	S	4 22 63	4 01 63	4 01 63	.23

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Figure V.5

ACTIVITY LISTING BY
LATEST ALLOWABLE
COMPLETION DATE

777 21 TEST NETWORK 1 01 62 4 01 63 3 15 62

1620 PERT PAGE 1

EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PROB
55	52	ACT 17	9.0	3.0-	1.0		3 05 62	2 12 62		
52	44	ACT 15	2.0	3.0-	1.1		3 19 62	2 26 62		
44	56	ACT 5	1.0	3.0-	1.2		3 26 62	3 05 62		
55	45	ACT 16	30.0	12.0	2.8		7 30 62	10 22 62		
45	43	ACT 19	.0	30.0	1.2		3 26 62	10 22 62		
56	43	ACT 18	34.0	3.0-	12.3		11 19 62	10 29 62		
45	46	ACT 6	1.0	12.0	2.8		8 06 62	10 29 62		
56	46	ACT 20	2.0	29.0	1.3		4 09 62	10 29 62		
43	54	ACT 4	7.0	3.0-	13.3		1 07 63	12 17 62		
46	54	ACT 8	7.0	12.0	3.8	S	9 24 62	12 17 62	12 31 62	1.00
44	42	ACT 15	6.0	3.0-	16.1		2 18 63	1 28 63		
56	47	ACT 21	45.0	.0	4.0		2 04 63	2 04 63		
46	47	ACT 7	.0	26.0	2.8		8 06 62	2 04 63		
42	41	ACT 3	2.0	3.0-	16.2		3 04 63	2 11 63		
47	41	ACT 9	1.0	.0	4.0		2 11 63	2 11 63		
41	53	ACT 2	5.0	3.0-	16.3		4 08 63	3 18 63		
41	48	ACTIVITY 1	1.0	1.0	16.2		3 11 63	3 18 63		
48	53	ACT 11	.0	1.0	16.2		3 11 63	3 18 63		
48	49	ACT 10	1.0	1.0	16.2		3 18 63	3 25 63		
49	51	ACT 12	1.0	3.0-	16.4	S	4 22 63	4 01 63	4 01 63	.23

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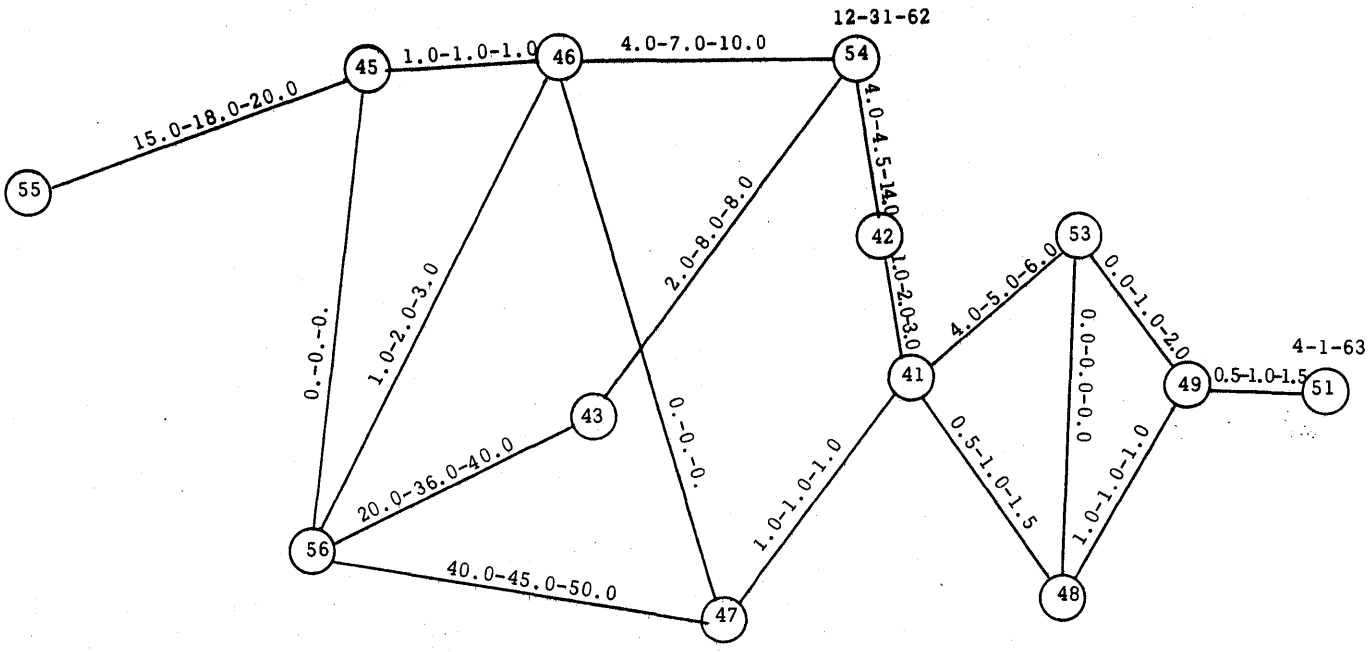

FIGURE V.7 THE PROJECT PARTIALLY COMPLETED

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 TEST NETWORK 3 15 62 4 01 63 3 15 62

1620 PERT PAGE 1

EVENT PRED	EVENT SUCC	ACTIVITY	TIME	SLACK	VAR	STS	EXPECTED	LATEST	SCHED	PROB
56	43	ACT 18	14.0	1.4-	11.1		11 05 62	10 29 62		
43	54	ACT 4	7.0	1.4-	12.1		12 27 62	12 17 62		
54	42	ACT 15	6.0	1.4-	14.0		2 07 63	1 28 63		
42	41	ACT 3	2.0	1.4-	15.0		2 21 63	2 11 63		
41	53	ACT 2	5.0	1.4-	15.1		3 28 63	3 18 63		
53	49	ACT 14	1.0	1.4-	15.2		4 04 63	3 25 63		
49	51	ACT 12	1.0	1.4-	15.2	S	4 11 63	4 01 63	4 01 63	.33
55	45	ACT 16	30.0	1.6	2.8		10 11 62	10 22 62		
45	46	ACT 6	1.0	1.6	2.8		10 18 62	10 29 62		
46	54	ACT 8	7.0	1.6	2.8	S	12 06 62	12 17 62	12 31 62	.97
56	47	ACT 21	45.0	1.6	2.8		1 24 63	2 04 63		
47	41	ACT 9	1.0	1.6	2.8		1 31 63	2 11 63		
41	48	ACTIVITY 1	1.0	2.6	15.0		2 28 63	3 18 63		
48	53	ACT 11	.0	2.6	15.0		2 28 63	3 18 63		
48	49	ACT 10	1.0	2.6	15.0		3 07 63	3 25 63		
46	47	ACT 7	.0	15.6	2.8		10 18 62	2 04 63		
55	45	ACT 20	2.0	30.6	.1		3 29 62	10 29 62		
56	45	ACT 19	.0	31.6	.0		3 15 62	10 22 62		
44	56	ACT 5	.	.	.	C			3 15 62	
52	44	ACT 13	.	.	.	C			3 15 62	
55	52	ACT 17	.	.	.	C			3 15 62	

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Figure V.8

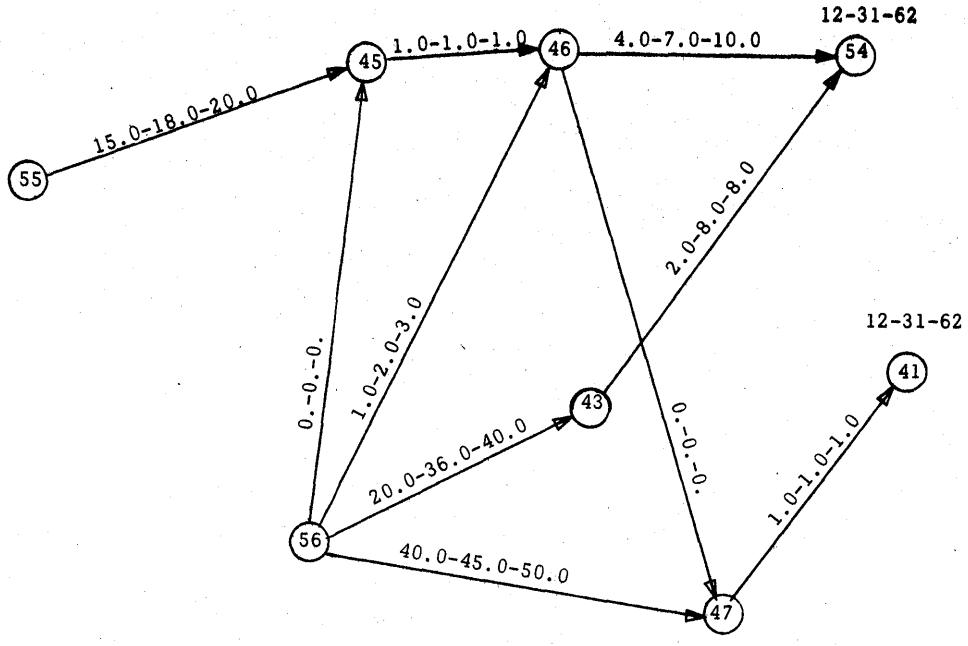

FIGURE V.9 A PARTITIONED NETWORK

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 TEST NETWORK 3 15 62 1 01 63 3 15 62

1620 PERT PAGE 1

EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PROB
56	47	ACT 21	45.0	4.3-	2.8		1 24 63	12 25 62		
47	41	ACT 9	1.0	4.3-	2.8		1 31 63	1 01 63		
56	43	ACT 18	34.0	.7	11.1		11 08 62	11 13 62		
43	54	ACT 4	7.0	.7	12.1		12 27 62	1 01 63		
55	45	ACT 15	30.0	3.7	2.8		10 11 62	11 06 62		
45	46	ACT 6	1.0	3.7	2.8		10 18 62	11 13 62		
46	54	ACT 8	7.0	3.7	3.8	S	12 06 62	1 01 63	12 31 62	.97
46	47	ACT 7	.0	9.7	2.8		10 18 62	12 25 62		
56	46	ACT 20	2.0	32.7	.1		3 29 62	11 13 62		
56	45	ACT 19	.0	33.7	.0		3 15 62	11 06 62		
44	56	ACT 5	.	.	.	C			3 15 62	
52	44	ACT 13	.	.	.	C			3 15 62	
50	52	ACT 17	.	.	.	C			3 15 62	

13

Figure V.10

```
LOAD SOURCE DECK
THEN PUSH START
C  BEGIN INPUT CONVERSION
      DIMENSION  NEP(25),NES(25),NAP(25),NAS(25),M(25)
      DIMENSION D(25),VAR(25),EST(25),AFT(25)
      DIMENSION CUM(12)
      CUM(1)=31.
      CUM(2)=59.
      CUM(3)=90.
      CUM(4)=120.
      CUM(5)=151.
      CUM(6)=181.
      CUM(7)=212.
      CUM(8)=243.
      CUM(9)=273.
      CUM(10)=304.
      CUM(11)=334.
      CUM(12)=365.
  200 READ 1,N,STAMO,STADA,STAYR,SCHMO,SCHDA,SCHYR
      DO 210 I=1,N
      NAP(I)=0
      NAS(I)=0
      M(I)=0
      READ 2,NEP(I),NES(I),A,AB,B
      IF(AB-A)205,201,201
  201 IF(B-AB)205,202,202
  205 PRINT,NEP(I),NES(I),A,AB,B
  202 D(I)=(A+4.*AB+B)/6.
      VAR(I)=((B-A)/6.)**2
      IF(SENSE SWITCH 1)209,210
  209 PRINT,NEP(I),NES(I),D(I),VAR(I)
  210 CONTINUE
C     BEGIN TOPTHREAD
      JSW1=1
      LAST=N+1
   20 DO 21 I=1,N
      IF(M(I))21,25,25
   21 CONTINUE
   22 GO TO 100
   25 NFRST=1
      L=1
      JSW2=1
   30 K=1
      M(K)=M(K)+1
      IF(M(K)  -N)32,32,31
   31 PRINT,N,K,NEP(K),NES(K)
      STOP CLOSED LOOP ERROR
   32 IF(K-N)34,50,50
   34 IF(NEP(K+1)-NEP(K))35,40,50
   35 PRINT,  K,NEP(K),NES(K)
      STOP OUT OF SEQUENCE
   40 I=I+1
      GO TO (41,30),JSW1
   41 IF(NAP(I))42,43,42
   42 NASI=NAS(I)
      NAPI=NAP(I)
      NAP(NASI)=NAP(I)
      NAS(NAPI)=NAS(I)
   43 NAP(I)=K
      NAS(K)=I
      GO TO 30
```

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```
   50 GO TO(52,51),JSW2
   51 L=NAS(L)
      GO TO 53
   52 JSW2=2
   53 JSW1=1
      DO 55 I=1,N
      IF(M(I))55,54,54
   54 IF(NEP(I)-NES(L))55,57,55
   55 CONTINUE
   56 GO TO 60
   57 IF(NEP(I)-NEP(K))41,58,41
   58 JSW1=2
      GO TO 30
   60 NASL=NAS(L)
      IF(K-L)62,61,62
   62 L=NASL
      GO TO 53
   61 NAP(NFRST)=0
      NAS(L)=LAST
      IF(LAST-(N+1))64,63,63
   64 NAP(LAST)=L
   63 LAST=NFRST
      DO 69 I=1,N
      IF(M(I))69,65,65
   65 IF(NAS(I))66,69,66
   66 M(I)=-M(I)
   69 CONTINUE
      GO TO 20
  100 DO 101 I=1,N
  101 PUNCH,NEP(I),NES(I),NAP(I),NAS(I),D(I),VAR(I)
      GO TO 200
      END

END OF COMPILATION
LOAD SUBROUTINE DECK
THEN PUSH START
```

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```
LOAD SOURCE DECK
THEN PUSH START
      DIMENSION NEP(22),NES(22),NAP(22),NAS(22)
      DIMENSION D(22),VAR(22),EST(22),AFT(22)
      DIMENSION CUM(12)
      CUM(1)=31.
      CUM(2)=59.
      CUM(3)=90.
      CUM(4)=120.
      CUM(5)=151.
      CUM(6)=181.
      CUM(7)=212.
      CUM(8)=243.
      CUM(9)=273.
      CUM(10)=304.
      CUM(11)=334.
      CUM(12)=365.
  200 READ 1,N,STAMO,STADA,STAYR,SCHMO,SCHDA,SCHYR
      DO 201 I=1,N
  201 READ, NEP(I),NES(I),NAP(I),NAS(I),D(I),VAR(I)
C     BEGIN MO/DA/YR TO DAYS FO START, SCHEDULE
      YR=STAYR
      DA=STADA
      MO=STAMO
      JSW1=1
  301 YRS=YR-60.
      DAYS=365.*YRS
      IYR=YRS/4.
      ENTYR=IYR
      DAYS=DAYS+1.+ENTYR
      IF(MO-1)305,304,305
  304 DAYS=DAYS+DA
      GO TO 306
  305 DAYS=DAYS+CUM(MO-1)+DA
  306 GO TO (302,303),JSW1
  302 START=DAYS
      YR=SCHYR
      DA=SCHDA
      MO=SCHMO
      JSW1=2
      GO TO 301
  303 SCHED=DAYS
C     BEGIN BACKWARD PASS
      DO 401 I=1,N
      IF(NAS(I)-N-1)401,402,401
  401 CONTINUE
  402 KN=I
      K=I
      AFT(K)=SCHED-START
  410 K=NAP(K)
      I=K
      IF(K)420,501,420
  420 I=NAS(I)
      IF(I-N-1)422,421,422
  421 AFT(K)=SCHED-START
      GO TO 410
  422 IF(NEP(I)-NES(K))420,430,420
  430 TMIN=AFT(I)-D(I)
  440 IF (I-N)444,441,444
  444 IF(NEP(I+1)-NEP(I))441,442,441
  441 AFT(K)=TMIN
      GO TO 410
```

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```
  442 I=I+1
      TIME=AFT(I)-D(I)
      IF(TIME-TMIN)443,440,440
  443 TMIN=TIME
      GO TO 440
C     BEGIN FORWARD PASS
  501 TIME=0.
      VANCE=0.
      DO 502 I=1,N
      IF(NAP(I))502,503,502
  502 CONTINUE
  503 K1=I
      K=K1
  510 EST(K)=TIME
      VAR(K)=VANCE+VAR(K)
      IF(K-N)511,515,515
  511 IF(NEP(K+1)-NEP(K))515,512,515
  512 K=K+1
      GO TO 510
  515 IF(NAS(K)-(N+1))520,600,600
  520 K=NAS(K)
      I=K1
      TIME=0.
      VANCE=0.
  530 IF(NES(I)-NEP(K))540,531,540
  531 IF((D(I)+EST(I))-TIME)540,532,534
  532 IF(VAR(I)-VANCE)540,540,535
  534 TIME=D(I)+EST(I)
  535 VANCE=VAR(I)
  540 IF(I-NAP(K))541,510,541
  541 I=NAS(I)
      GO TO 530
C      BEGIN OUTPUT ROUTINE
  600 IF(SENSE SWITCH 1)605,606
  605 DO 601 I=1,N
      PRINT,NEP(I),NES(I),EST(I),AFT(I),VAR(I)
  601 CONTINUE
  606 IF(SENSE SWITCH 2)602,200
  602 DO 650 I=1,N
  603 JSW2=1
      DAYS=EST(I)+START
  604 INDEX=0
      IYR=60
  610 IF(INDEX)612,611,612
  611 IF(DAYS-366.)621,621,613
  613 DAYS=DAYS-366.
      GO TO 614
  612 IF (DAYS - 365.)626,626,615
  615 DAYS=DAYS-365.
      IF (INDEX-3)614,616,614
  614 INDEX=INDEX+1
      GO TO 617
  616 INDEX=0
  617 IYR=IYR+1
      GO TO 610
  621 IF(DAYS-60.)626,623,624
  623 MO =2
      IDAY=29
      GO TO 645
  624 DAYS=DAYS-1.
  626 IF(DAYS-31.)625,625,630
  625 MO=1
      IDAY=DAYS
      GO TO 645
  630 DO 631 J=2,12
      IF(DAYS-CUM(J))640,640,631
```

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```
 631 CONTINUE
 640 MO=J
     IDAY=DAYS-SUM(J-1)
     GO TO (645,646),JSW2
 645 IMO=MO
     IIDAY=IDAY
     IIYR=IYR
 646 DAYS=AFT(I)+START
     JSW2=2
     GO TO 604
 649 PRINT,NEP(I),NES(I),IMO,IIDAY,IIYR,MO,IDAY,IYR
 650 CONTINUE
     PAUSE
     GO TO 200
     END

END OF COMPILATION
LOAD SUBROUTINE DECK
THEN PUSH START
```

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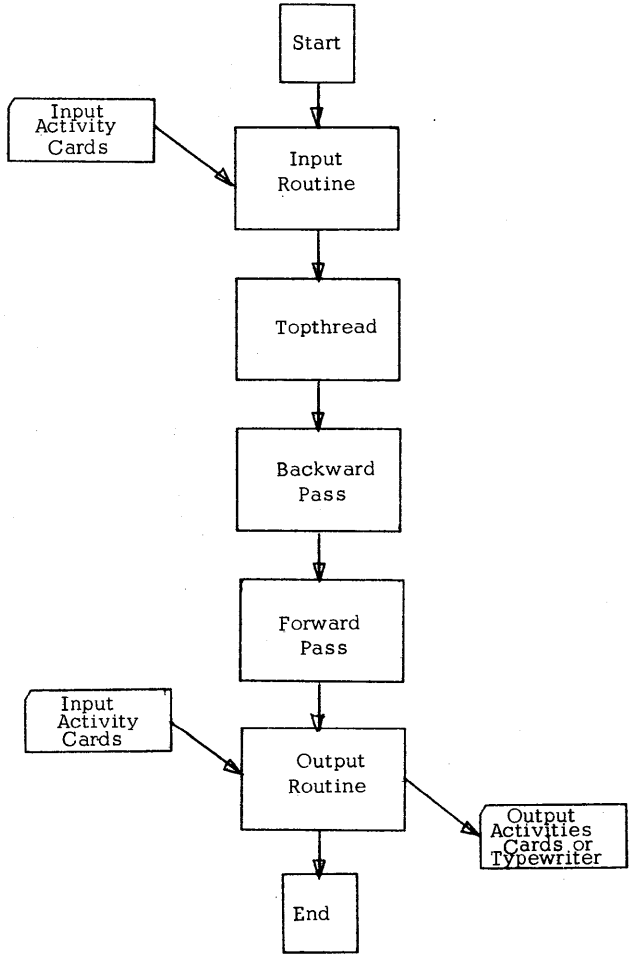


Diagram 1
General Block Diagram

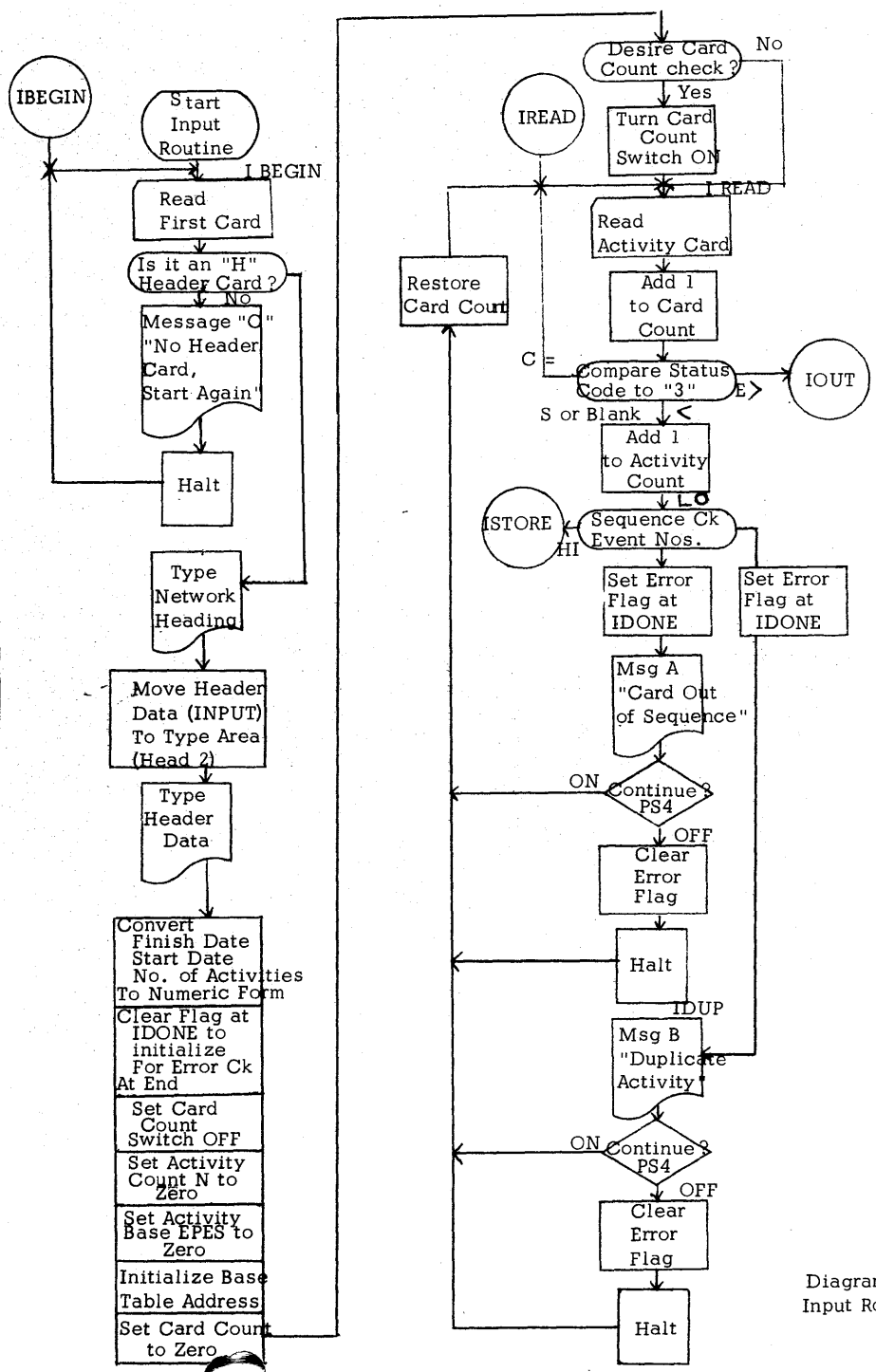


Diagram 2
Input Routine I

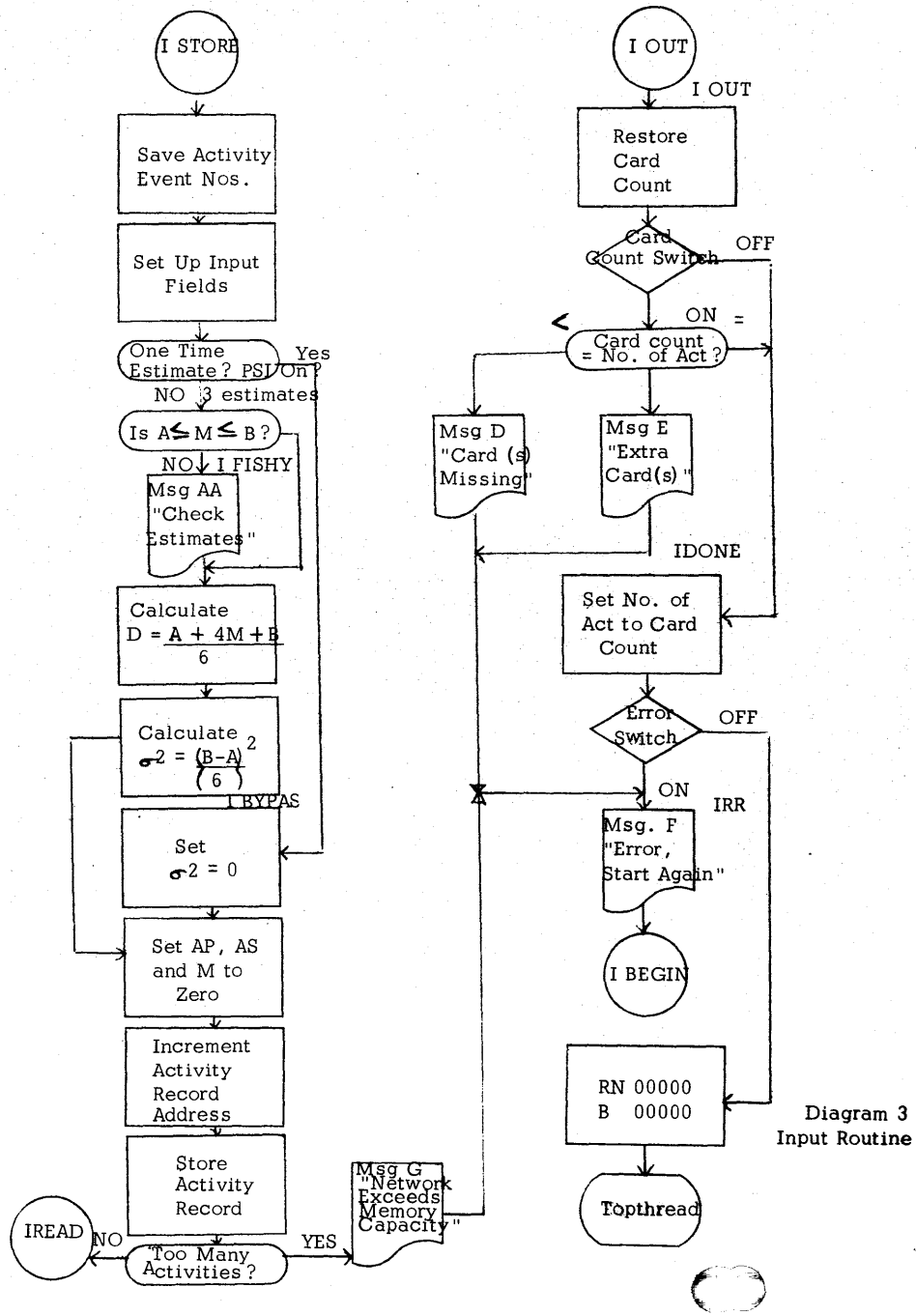


Diagram 3
Input Routine

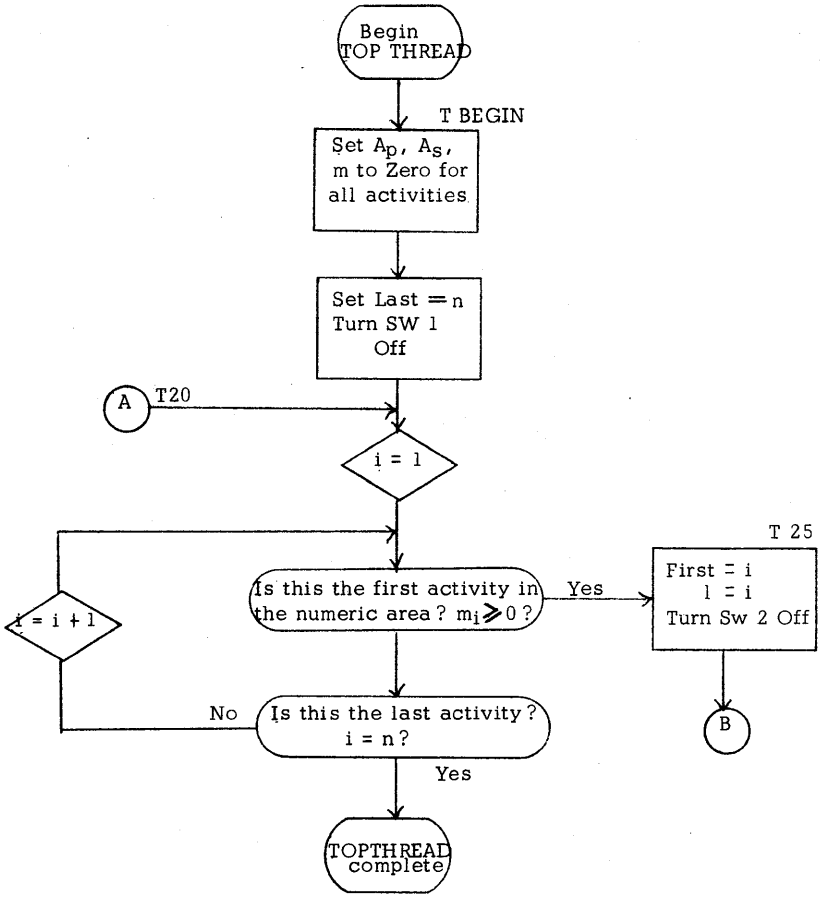


Diagram 4
TOPTHREAD I

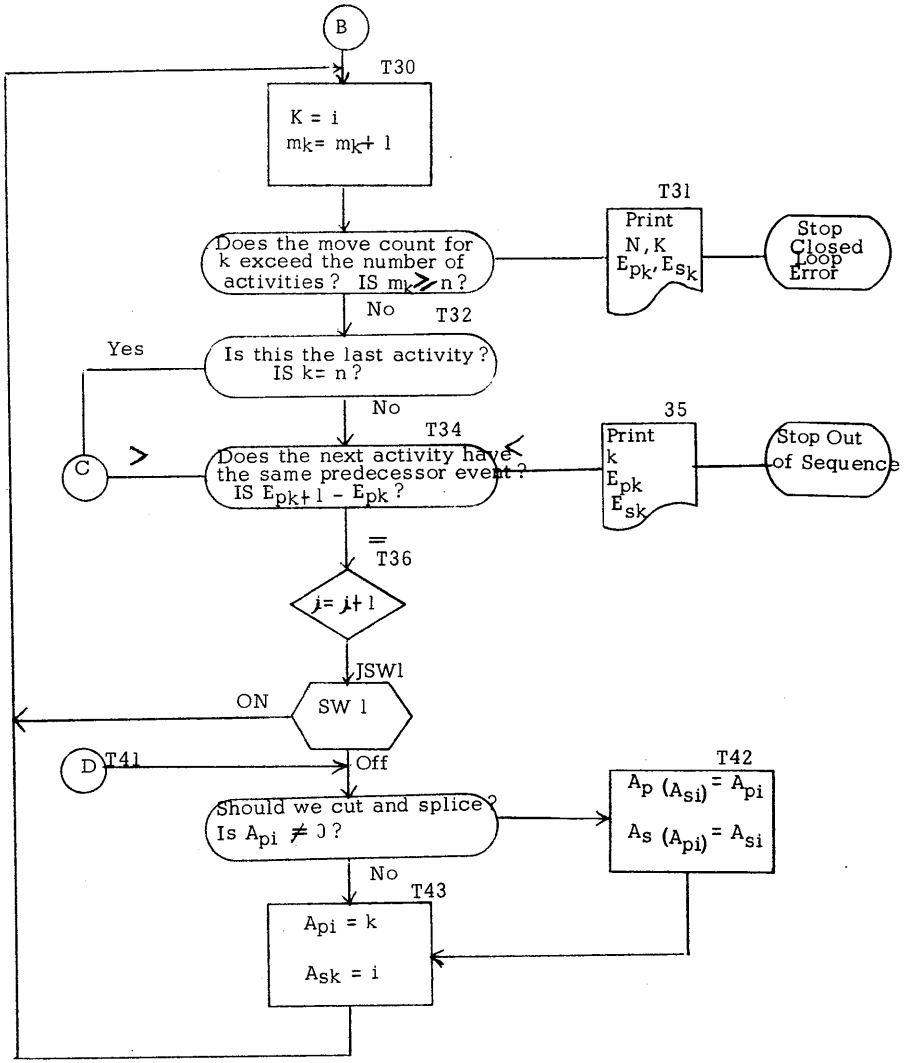


Diagram 5
TOPTHREAD II

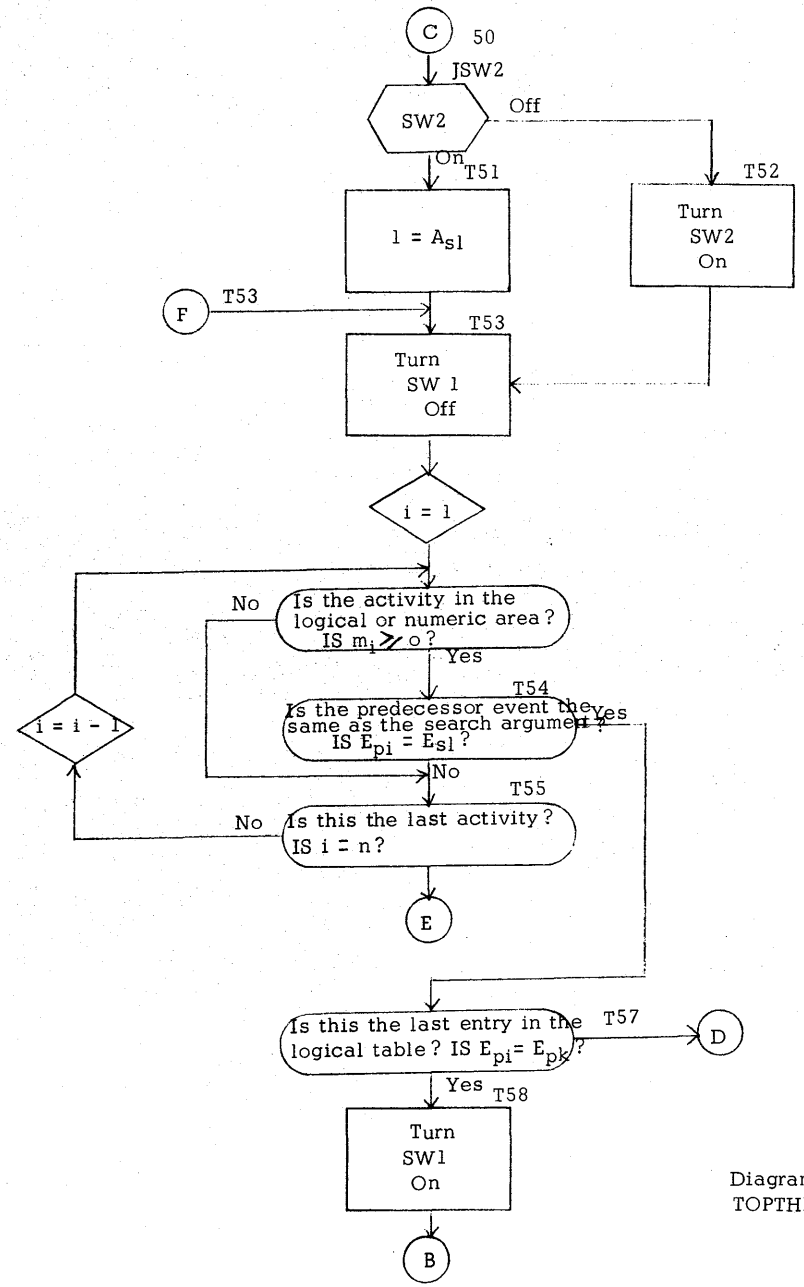
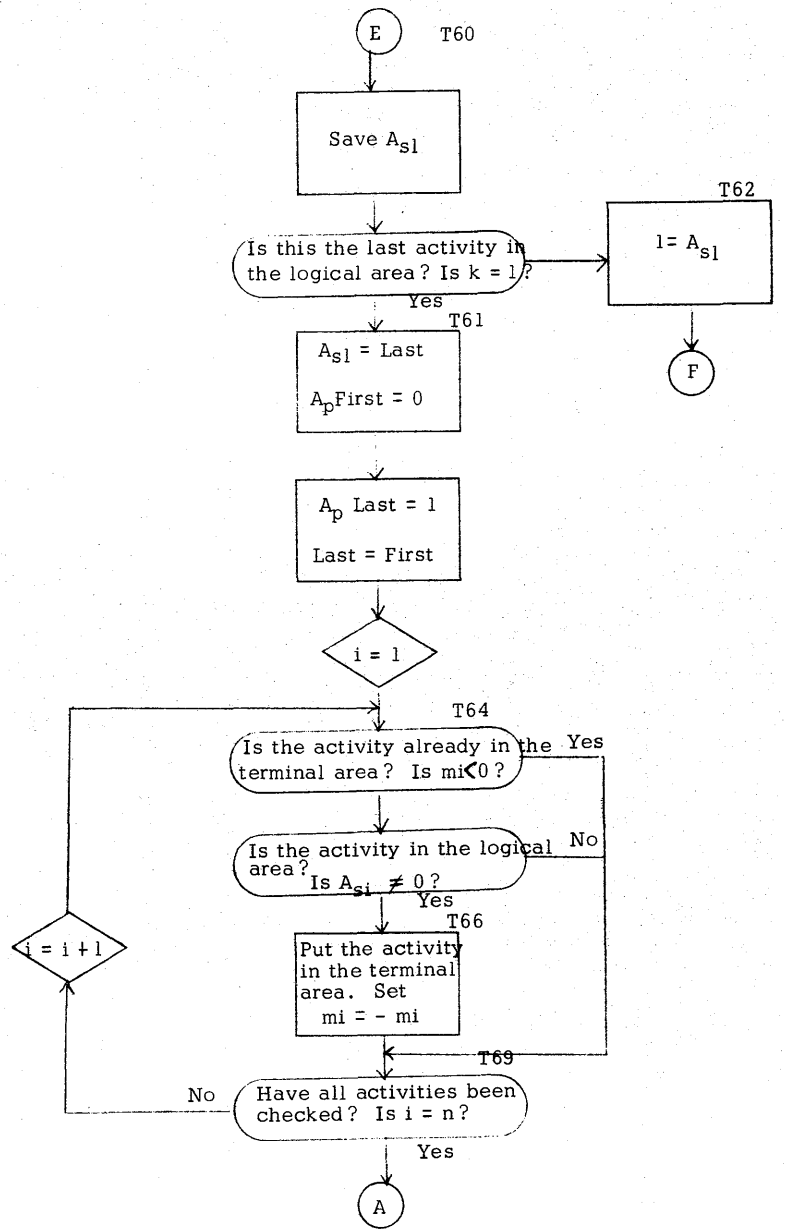


Diagram 6
TOPTHREAD III



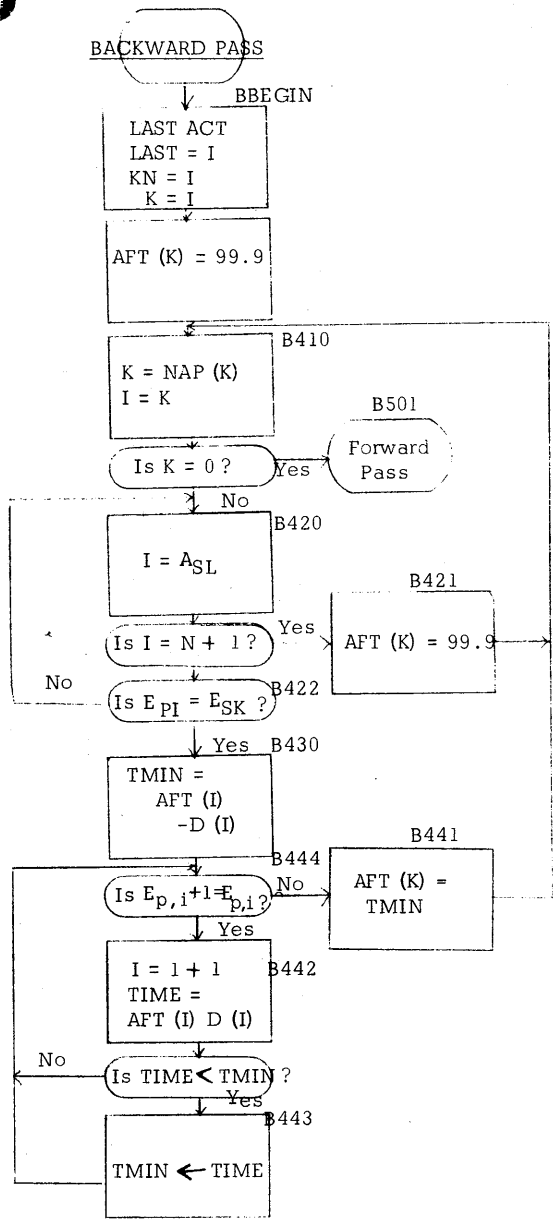


Diagram 8
Backward Pass

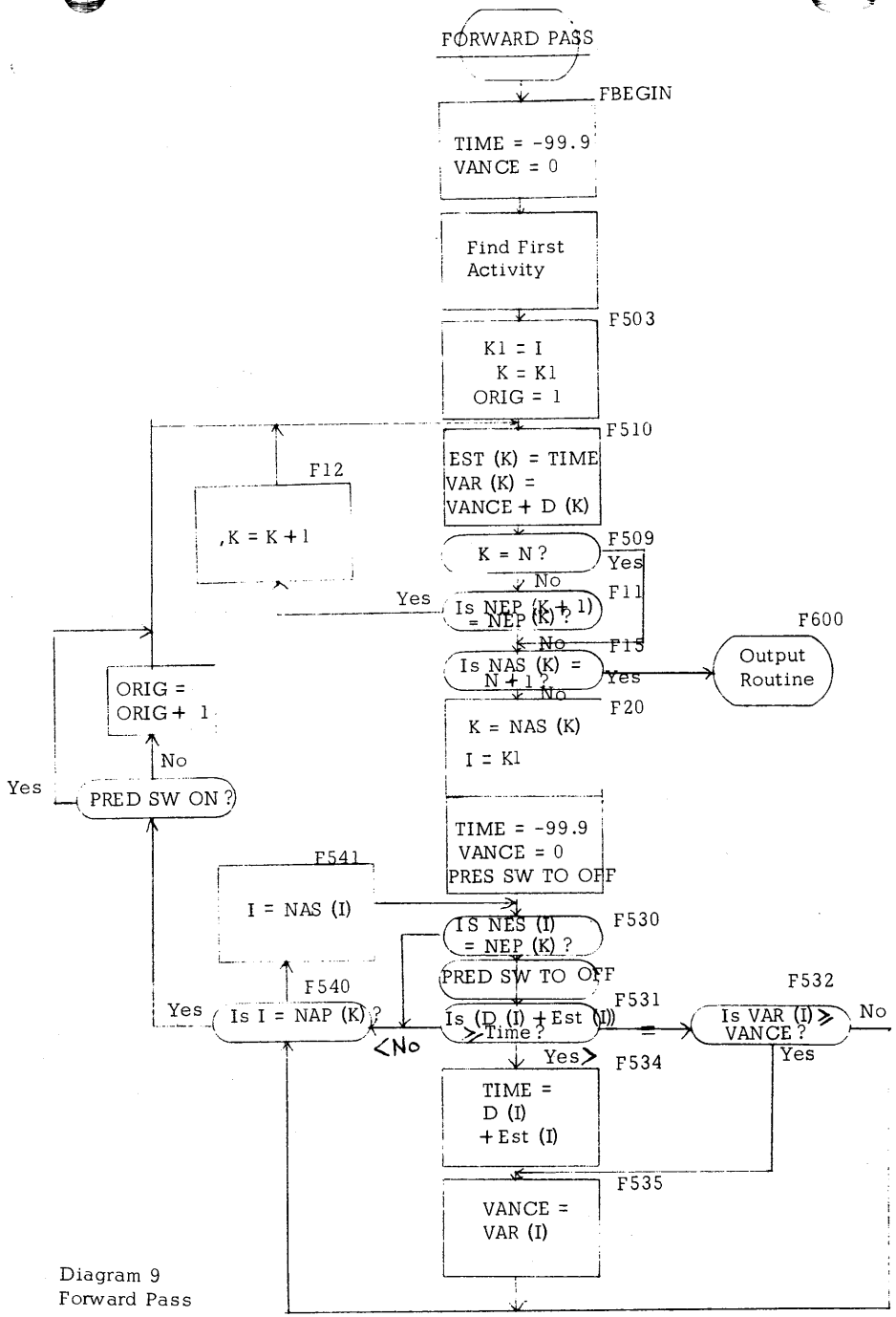


Diagram 9
Forward Pass

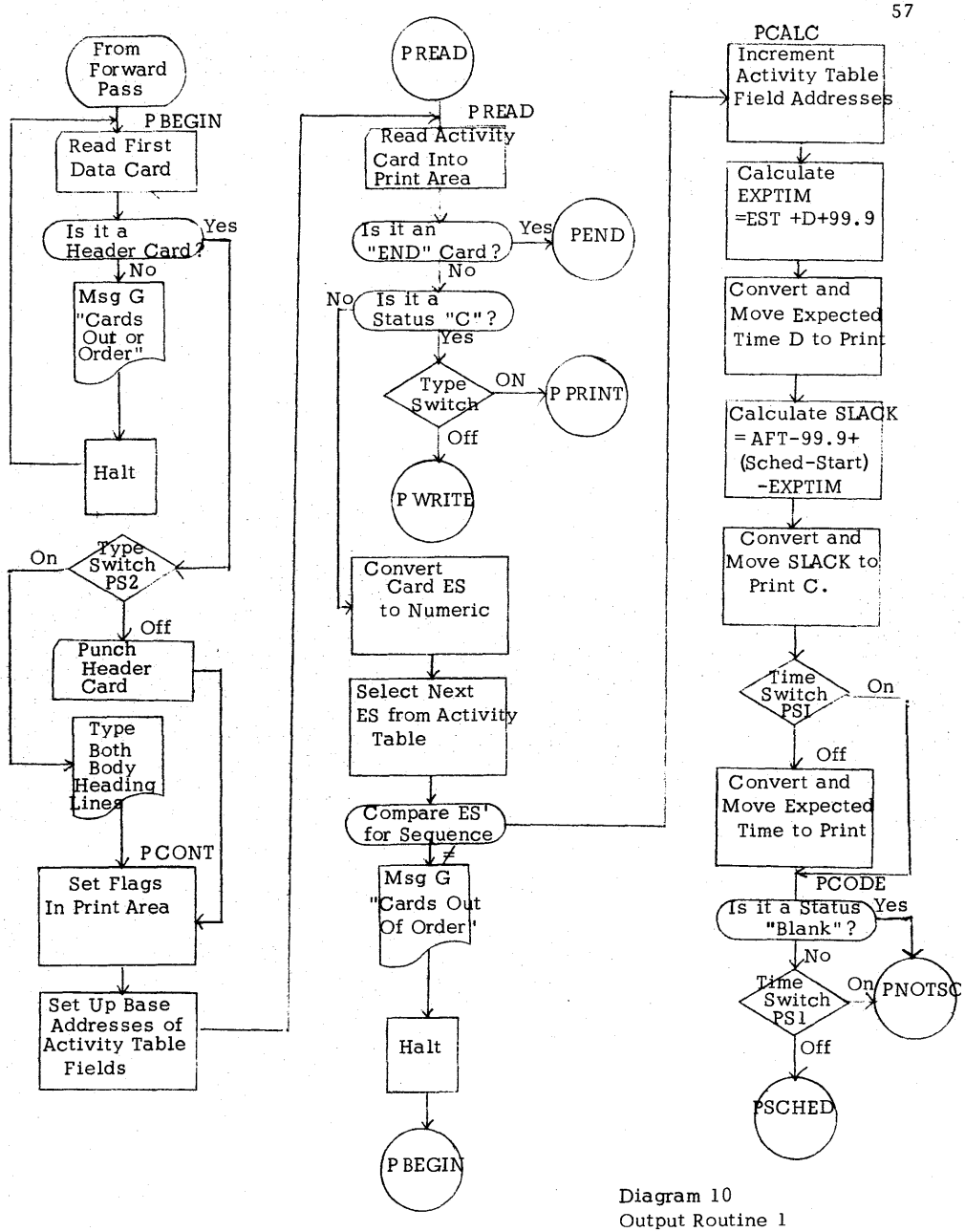


Diagram 10
Output Routine 1

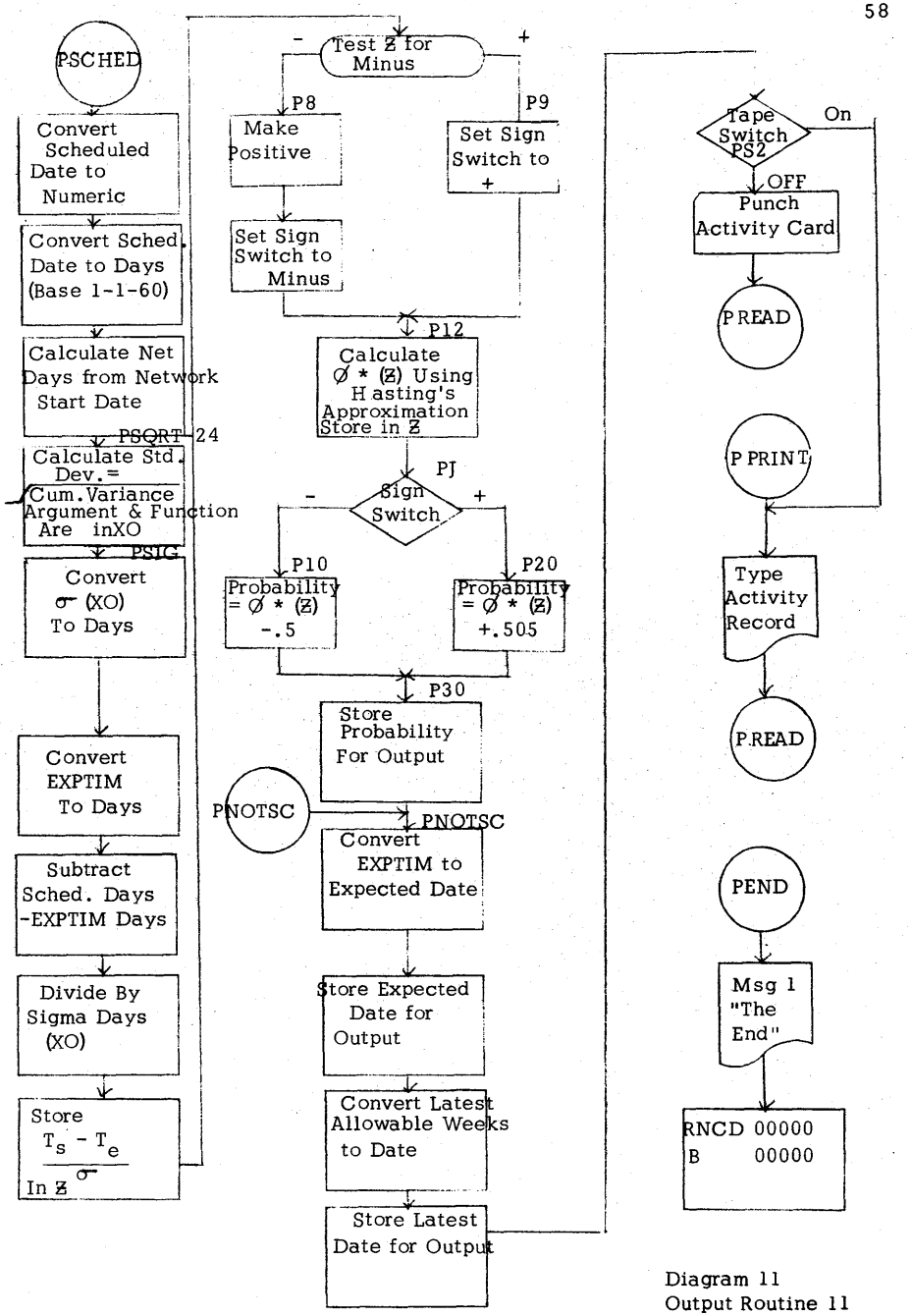


Diagram 11
Output Routine 11

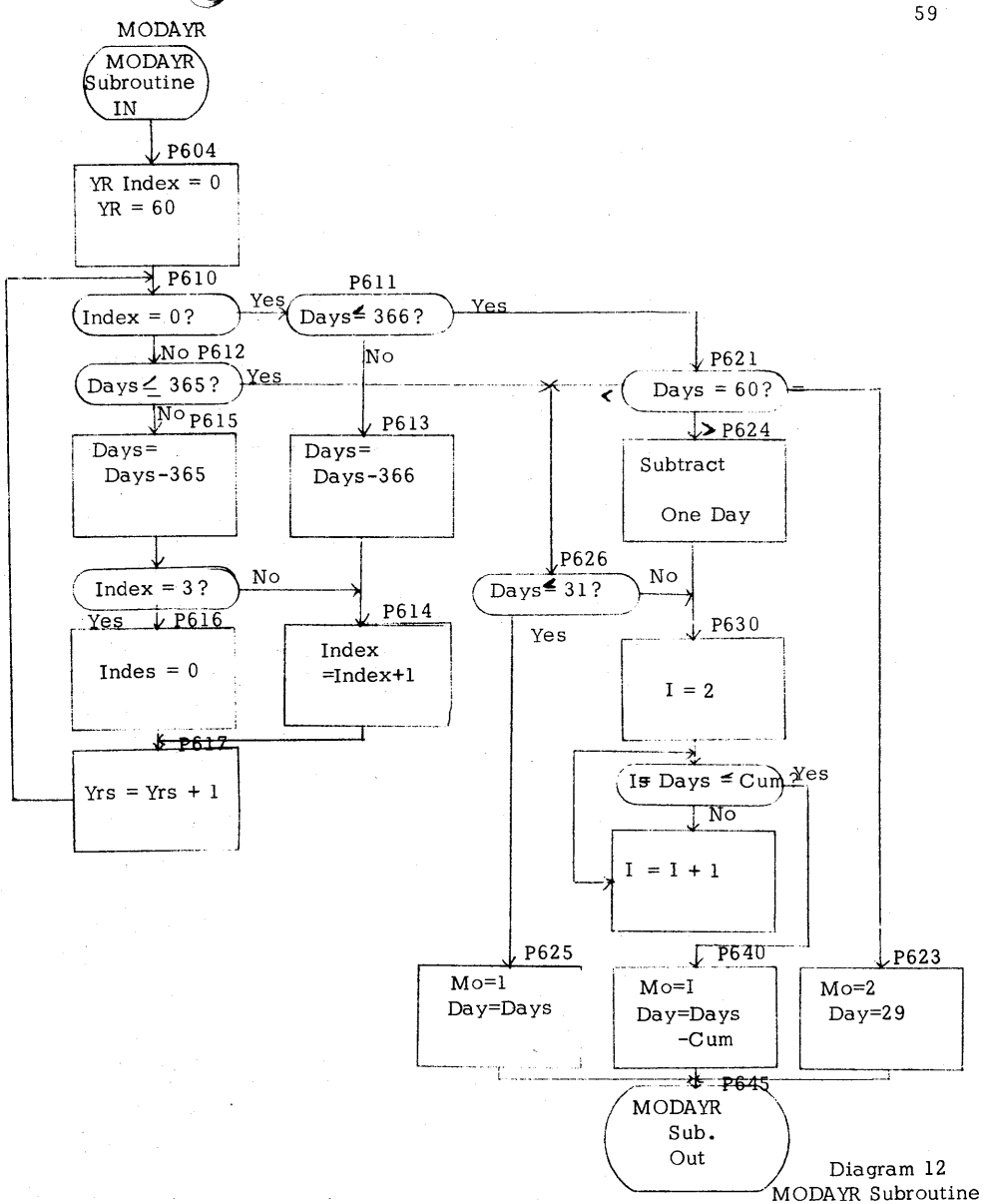
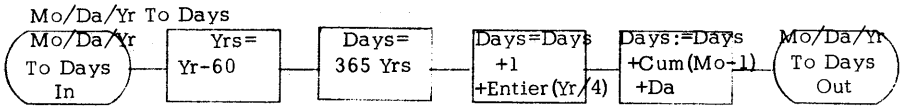


Diagram 12
MODAYR Subroutine




```
                                    1 *       BEGI N INPUT CONVERSIONZ
00402                               10        DORG 402Z
00402 37 02113 00500                20 IBEGIN RACD INPUT&2Z
00414 32 02146 00000                21        SF   INPUT&35Z
00426 14 02147 000M8                22        CM   INPUT&36,48,10Z
00438 46 00498 01200                23        BE   *&60Z
00450 34 00000 00102                24        RCTY  Z
00462 39 02753 00100                25        WATY MSGCZ
00474 48 00000 00000                26        H     7
00486 49 00402 00000                27        B    IBEGINZ
00498 34 00000 00102                30        RCTY  7
00510 39 01947 00100                40        WATY HEAD1AZ
00522 39 02041 00100                50        WATY HEAD1BZ
00534 32 02112 00000                60        SF   INPUT&1Z
00546 26 02283 02119                70        TF   HEAD2&10,INPUT&8Z
00558 32 02128 00000                80        SF   INPUT&17Z
00570 26 02299 02133                90        TF   HEAD2&26,INPUT&22Z
00582 32 02160 00000               100        SF   INPUT&49Z
00594 26 02365 02221               110        TF   HEAD2&92,INPUT&110Z
00606 32 02120 00000               120        SF   INPUT&9Z
00618 26 02381 02127               130        TF   HEAD2&108,INPUT&16Z
00630 32 02148 00000               140        SF   INPUT&37Z
00642 26 02401 02159               150        TF   HEAD2&128,INPUT&48Z
00654 32 02248 00000               160        SF   INPUT&137Z
00666 26 02417 02259               170        TF   HEAD2&144,INPUT&148Z
00678 32 02260 00000               180        SF   INPUT&149Z
00690 26 02433 02271               190        TF   HEAD2&160,INPUT&160Z
00702 34 00000 00102               193        RCTY  Z
00714 39 02275 00100               195        WATY HEAD2&2Z
00726 27 02464 02271               210        RT   ATON,INPUT&160Z
00738 26 03996 02441               220        TF   DATES,NUMZ
00750 27 02464 02259               230        RT   ATON,INPUT&148Z
00762 26 03990 02441               240        TF   DATES-6,NUMZ
00774 27 02464 02127               250        RT   ATON,INPUT&16Z
00786 26 02811 02441               260        TF   NUMB,NUMZ
00798 33 01850 00000 01 79         CE   IDONEZ
00810 15 01719 00009 01 78         TDM  IOUT&13,9Z
00822 16 03984 00-00 01 80         TEM  N,0,9Z
00834 26 02671 02661 01 81         TF   EPES,ZEROESZ
00846 16 01656  3977 01 82         TEM  IPUT&6,ACT-2*SIZE  &17
00858 16 02815 0 000 01 87         TEM  TOTAL,0,8Z
00870 14 02811 0 000 01 88         CM   NUMB,0,8Z
00882 46 00930 01200 01 89         BE   IREADZ
00894 15 01719 00001 01 90         TDM  IOUT&13,1Z
00906 49 00930 00000 01 91         B    IREADZ
00918 12 02815 0 001 01 94         SM   TOTAL,1,8Z
00930 36 02112 00500 01 95 IREAD   RNCD INPUT&1Z
00942 11 02815 0 001 01 99         AM   TOTAL,1,8Z
00954 25 02663 02129 01100         TD   CODE,INPUT&18Z
00966 14 02663 000-3 01110         CM   CODE,3,10Z
00978 46 01706 01100 01120         BH   IOUTZ
00990 46 00930 01200 01130         BE   IREADZ
01002 11 03984 00-01 01140         AM   N,1,9Z
01014 32 02112 00000 01150         SF   INPUT&1Z
01026 24 02119 02671 01160         C    INPUT&8,EPESZ
01038 46 01230 01100 01170         BH   ISTOREZ
01050 32 01850 00000 01175         SF   IDONEZ
01062 34 00000 00102 01180         RCTY  Z
```

```
01074 46 01158 01200 01190          BE    !DUPZ
01086 38 02812 00100 01199          WNTY  TOTAL-3Z
01098 39 02673 00100 01200          WATY  MSGAZ
01110 46 00930 00400 02  5          BC4   !READZ
01122 33 01850 00000 02  6          CE    !DONEZ
01134 48 00000 00000 02 10          H      Z
01146 49 00918 00000 02 20          B     !READ-12Z
01158 38 02812 00100 02 42 !DUP     WNTY  TOTAL-3Z
01170 39 02715 00100 02 43          WATY  MSGBZ
01182 46 01218 00400 02 44          BC4   *&36Z
01194 33 01850 00000 02 46          CE    !DONEZ
01206 48 00000 00000 02 50          H      Z
01218 49 00918 00000 02 60          B     !READ-12Z
01230 26 02671 02119 02 61 !STORE   TE    EDES,INPUT& 8Z
01242 32 02116 00000 02 62          SE    !NPUT&5Z
01254 32 02120 00000 02 70          SE    !NPUT&9Z
01266 32 02123 00000 02 80          SE    !NPUT&12Z
01278 32 02126 00000 02 90          SE    !NPUT&15Z
01290 46 01590 00100 02 91          BC1   !BYPASZ
01302 24 02122 02125 02100          C     OPT,LIKELYZ
01314 46 01350 01100 02110          BH    !EISHYZ
01326 24 02125 02128 02120          C     LIKELY,DESSZ
01338 47 01398 01100 02130          BNH   !CALCZ
01350 25 02129 00400 02140 !EISHY   TD    !NPUT&18,400Z
01362 34 00000 00102 02150          RCTY   Z
01374 38 02112 00100 02160          WNTY  !NPUT&1Z
01386 39 02879 00100 02162          WATY  MSGAAZ
01398 13 02125 000-4 02170 !CALC    MM    LIKELY,4,10Z
01410 26 02914 00099 02180          TE    WA1,PRODZ
01422 21 02914 02122 02190          A     WA1,OPTZ
01434 21 02914 02128 02200          A     WA1,DESSZ
01446 13 02914 16667 03 10          MM    WA1,16667Z
01458 32 00092 00000 03 20          SE    92Z
01470 11 00095 000-5 03 30          AM    95,5,10Z
01482 26 02125 00094 03 40          TE    LIKELY,94Z
01494 22 02128 02122 03 50          S     DESS,OPTZ
01506 13 02128 16667 03 60          MM    DESS,16667Z
01518 26 02914 00096 03 70          TE    WA1,96Z
01530 23 02914 02914 03 80          M     WA1,WA1Z
01542 32 00092 00000 03 90          SE    92Z
01554 11 00095 000-5 03100          AM    95,5,10Z
01566 26 02122 00094 03110          TE    OPT,94Z
01578 49 01602 00000 03115          B     *&24Z
01590 16 02122 00-00 03120 !BYPAS   TEM   !NPUT&11,0,9Z
01602 31 02126 02644 03125          TR    !NPUT&15,ZERO-2Z
01614 21 01656 03998 03130          A     !PUT&6,RECSIZZ
01626 14 01656 19977 03135          CM    !PUT&6,MEMSIZ-SIZEZ
01638 46 01674 01100 03136          BH    *&36Z
01650 31 00000 02112 03140 !PUT     TR    ,!NPUT&1Z
01662 49 00930 00000 03150          B     !READZ
01674 34 00000 00102 03154          RCTY   Z
01686 39 02969 00100 03156          WATY  MSGGZ
01698 49 01874 00000 03158          B     !ERRZ
01706                03160          DORG  *-3Z
01706 12 02815 0 001 03170 !OUT     SM    TOTAL,1,8Z
01718 49 01850 00000 03180          B     !DONEZ
01730 24 02815 02811 03190          C     TOTAL,NUMBZ
```



```
01742 46 01850 01200 03200          BE    !DONEZ
01754 34 00000 00102 03210          RCTY   Z
01766 47 01814 01300 03220          BL    !MISSZ
01778 38 02812 00100 03228          WNTY  TOTAL-3Z
01790 39 02819 00100 03230          WATY  MSGDZ
01802 49 01874 00000 03242          B     !DONE&24Z
01814 38 02812 00100 03248 !MISS    WNTY  TOTAL-3Z
01826 39 02847 00100 03250          WATY  MSGEZ
01838 49 01874 00000 03262          B     !DONE&24Z
01850 26 02811 02815 03270 !DONE    TE    NUMB,TOTALZ
01862 44 01922 01850 03272          BNE   !LOAD,!DONEZ
01874 34 00000 00102 03273 !ERR     RCTY   Z
01886 39 02917 00100 03274          WATY  MSGFZ
01898 48 00000 00000 03275          H      Z
01910 49 00402 00000 03276          B     !BEGINZ
01922 36 00000 00500 03280 !LOAD    RNCD   Z
01934 49 00000 00000 03290          B      Z
01947          47          04 10 HEAD1A DAC   47,NETWORK  CASE  TITLE
02041          35          04 20 HEAD1B DAC   35,NO. OF ACT.  RUN     START
02111           1          04 30 INPUT  DAS   1Z
02113          80          04 40        DAS   80Z
02271          50          04 42        DC    50,0,INPUT&160Z
02222          50          04 44        DC    50,0,INPUT&111Z
02173          50          04 46        DC    50,0,INPUT&62Z
02124          15          04 48        DC    15,0,INPUT&13Z
02273           1          04 50 HEAD2  DAS   1Z
02275          80          04 60        DAS   80Z
02435           1          04 70        DAC   1,@Z
02433          50          04 72        DC    50,0,HEAD2&160Z
02384          50          04 74        DC    50,0,HEAD2&111Z
02335          50          04 76        DC    50,0,HEAD2&62Z
02286          15          04 78        DC    15,0,HEAD2&13Z
02441           6          40 60 NUM    DS    6Z
02446           5          40250 NADD   DS    5Z
02451           5          40260 AADD   DS    5Z
                           41 10 *  ALP HA T O NUMERIC CONVERSIONZ
                           41 20 *  CAL LING  SEQUENCEZ
                           41 30 *        RT    ATON,AFIELDZ
                           41 40 *        TE    NFIELD,NUMZ
02463          12          41 60 ALPHA  DS    12Z
02464 25 02441 02463 41 70 ATON     TD    NUM,ALPHAZ
02476 32 02462 00000 41 80          SE    ALPHA-1Z
02488 12 02463 000N0 41 90          SM    ALPHA,50,10Z
02500 43 02524 02462 41100          BD    *&24,ALPHA-1Z
02512 32 02441 00000 41110          SE    NUMZ
02524 16 02446  2440 41120          TEM   NADD,NUM-1Z
02536 16 02451  2461 41130          TEM   AADD,ALPHA-2Z
02548 25 02446 0245J 41140 ATON1    TD    NADD,AADD,611Z
02560 12 02451  0001 41150          SM    AADD,1Z
02572 44 02608 0245J 41160          BNE   *&36,AADD,11Z
02584 32 02446 00000 41170          SE    NADD,,6Z
02596 42 00000 00000 41180          BB     Z
02608 12 02446  0001 41190          SM    NADD,1Z
02620 12 02451  0001 41200          SM    AADD,1Z
02632 49 02548 00000 41210          B     ATON1Z
                           90 10 *  ARE A RE SERVATIONZ
02646           3          90190 ZERO   DC    3,0Z
```

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02649     3          90191          DC    3,0Z
02652     3          90192          DC    3,0Z
02655     1          90193          DC    1,@Z
02661     8          90194 ZEROES   DC    8,0Z
02663     2          90200 CODE     DC    2,0Z
02671     8          91 10 ERES     DS    8Z
02673    21          91 20 MSGA     DAC   21,CARD OUT OF SEQUENCE@Z
02715    19          91 30 MSGB     DAC   19,DUPLICATE ACTIVITY@Z
02753    28          91 35 MSGC     DAC   28,NO HEADER CARD, START AGAIN'
03011     4          91 40 NUMR     DS    4Z
03015     4          91 50 TOTAL    DS    4Z
03016     1          90 51          DC    1,@Z
03019    14          91 60 MSGD     DAC   14,EXTRA CARD%SH@Z
03047    16          91 70 MSGE     DAC   16,CARD%SH MISSING@Z
03079    16          91 72 MSGAA    DAC   16,CHECK ESTIMATES@Z
03122     3          91 80 OPT      DS    3,INPUT&11Z
03125     3          91 90 LIKELY   DS    3,INPUT&14Z
03128     3          91100 RESS     DS    3,INPUT&17Z
03914     5          91120 WA1      DS    5Z
03917    26          91130 MSGF     DAC   26,ERROR, START NEXT NETWORK@Z
20000                 91140 MEMSIZ   DS    ,20000Z
02969    32          91150 MSGG     DAC   32,NETWORK EXCEEDS MEMORY CAPAC
03948                 98100          DORG  3948Z
03952     5          98110 DI       DS    5Z
03955     3          98120 NPONE    DS    3Z
03960     5          98130 START    DS    5Z
03965     5          98140 DAYS     DS    5Z
03968     3          98150 K        DS    3Z
03973     5          98160 KADD     DS    5Z
03976     3          98170 I        DS    3Z
03981     5          98180 IADD     DS    5Z
03984     3          98190 N        DS    3Z
00099    20          98200 PROD     DS    20,99Z
03996    12          99 20 DATES    DS    12Z
03998     2          99 21 RECSIZ   DC    2,29Z
00029                 99 22 SIZE     DS    ,29Z
04000                 99 29          DORG  4000Z
04022    23 00700     99 30 ACT      DSR   SIZE,700Z
04003     4          99 40 EP       DS    4,ACT-19Z
04007     4          99 50 ES       DS    4,ACT-15Z
04010     3          99 60 VAR      DS    3,ACT-12Z
04013     3          99 70 D        DS    3,ACT-9Z
04016     3          99 80 AP       DS    3,ACT-6Z
04019     3          99 90 AS       DS    3,ACT-3Z
04022     3          99100 M        DS    3,ACTZ
04016     3          99110 EST      DS    3,ACT-6Z
04022     3          99120 AET      DS    3,ACTZ
00402                 99998          DEND  TBEGINZ
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                      99999 *        ENDT  OPTHREADZ
                      10 10 *    BEGIN  TOPTHREADZ
00402                 10 20          DORG  402Z
00402 32 00870 00000  10 30 TBEGIN   SF    JSW1Z
00414 26 01844 03984  10 40          TF    LAST,NZ
00426 11 01844 00-01  10 50          AM    LAST,1,9Z
00438 23 01844 03998  10 60          M     LAST,RECSIZZ
00450 26 01849 00099  10 61          TF    LIMIT,PRODZ
00462 11 01849  3999  10 62          AM    LIMIT,ACT-SIZEZ
00474 16 00509  4022  10 70          TFM   T20&11,MZ
00486 16 03976 00-01  10 80          TFM   I,1,9Z
00498 44 00570 04022  10 90 T20      BNF   T25,MZ
00510 11 03976 00-01  10 99          AM    I,1,9Z
00522 21 00509 03998  10100          A     T20&11,RECSIZZ
00534 24 00509 01849  10120          C     T20&11,LIMITZ
00546 47 00498 01200  10130          BNF   T20Z
00558 49 01818 00000  10140          B     T100Z
00570 26 01852 03976  10150 T25      TF    NERST,IZ
00582 26 01855 03976  10160          TF    L,IZ
00594 32 01122 00000  10170          SF    JSW2Z
00606 26 03968 03976  10180 T30      TF    K,IZ
00618 23 03968 03998  10190          M     K,RECSIZZ
00630 11 00099  3999  10191          AM    PROD,ACT-SIZEZ
00642 26 03973 00099  10200          TF    KADD,PRODZ
00654 11 00099 00-01  11 20          AM    PROD,1,69Z
00666 24 00099 03984  11 30          C     PROD,N,6Z
00678 47 00774 01100  10 40          BNH   T32Z
00690 12 00099  0014  11 50 T31      SM    PROD,14Z
00702 25 00099 00400  11 60          TD    PROD,400,6Z
00714 12 00099  0008  11 70          SM    PROD,8Z
00726 34 00000 00102  11 80          RCTY  Z
00738 38 00099 00100  11 90          WNTY  PROD,,6Z
00750 39 01857 00100  11100          WATY  MSGC7
00762 48 00000 00000  11110          H     Z
00774 24 03968 03984  11120 T32      C     K,NZ
00786 46 01122 01300  11130          BNL   JSW2Z
00798 12 00099  0010  11150 T34      SM    PROD,19Z
00810 26 00094 00099  11160          TF    PROD-5,PRODZ
00822 21 00094 03998  11170          A     PROD-5,RECSIZZ
00834 24 00094 0009R  11180          C     PROD-5,PROD,611Z
00846 46 01122 01100  11190          BH    JSW2Z
00858 11 03976 00-01  12 10 T40      AM    I,1,9Z
00870 44 00606 00870  12 20 JSW1     BNF   T30,JSW1Z
00882 23 03976 03998  12 30 T41      M     I,RECSIZZ
00894 11 00099  3999  12 31          AM    PROD,ACT-SIZEZ
00906 26 03981 00099  12 40          TF    IADD,PRODZ
00918 12 00099  0006  12 50          SM    PROD,6Z
00930 26 01890 00099  12 51          TF    APADD ,PRODZ
00942 14 0189  00-00  12 60          CM    APADD,0,69Z
00954 46 01062 01200  12 70          BE    T43Z
00966 26 01895 00099  12 90 T42      TF    ASADD,PRODZ
00978 11 01895  0003  12100          AM    ASADD,3Z
00990 23 0189  03998  12110          M     APADD,RECSIZ,6Z
01002 11 00099  3996  12120          AM    PROD,AS-SIZEZ
01014 26 00099 0189N  12130          TF    PROD,ASADD,611Z
01026 23 01895 03998  12140          M     ASADD,RECSIZ,6Z
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01038 11 00099  3993 12150        AM   PROD,AP-SIZEZ
01050 26 00099 0189- 12160        TF   PROD,APADD,611Z
01062 26 0189  03968 12170 T43    TF   APADD,K,6Z
01074 26 00099 03973 12180        TF   PROD,KADDZ
01086 12 00099  0003 12190        SM   PROD,3Z
01098 26 00099 03976 12200        TF   PROD,I,6Z
01110 49 00606 00000 12210        B    T30Z
01122 44 01158 01122 13 10 JSW2   BNF  T51,JSW2Z
01134 33 01122 00000 13 20 T52    CF   JSW2Z
01146 49 01194 00000 13 30        B    T53Z
01158 23 01855 03998 13 40 T51    M    L,RECSIZZ
01170 11 00099  3996 13 50        AM   PROD,AS-SIZEZ
01182 26 01855 0009R 13 60        TF   L,PROD,11Z
01194 32 00870 00000 13 70 T53    SF   JSW1Z
01206 23 01855 03998 13 71        M    L,RECSIZZ
01218 11 00099  3984 13 73        AM   PROD,ES-SIZEZ
01230 26 01900 00099 13 75        TF   LADD,PRODZ
01242 16 03981  4022 13 80        TFM  IADD,ACTZ
01254 16 03976 00-01 13 81        TFM  I,1,9Z
01266 44 01290 0398J 13 90 T54    BNF  *&24,IADD,11Z
01278 49 01338 00000 13100        B    T55Z
01290 12 03981  0019 13110        SM   IADD,19Z
01302 24 03981 0190- 13120        C    IADD,LADD,611Z
01314 46 01398 01200 13130        BF   T57Z
01326 11 03981  0019 13140        AM   IADD,19Z
01338 11 03981  0023 13150 T55    AM   IADD,23Z
01350 11 03976 00-01 13151        AM   I,1,9Z
01362 24 03981 01849 13160        C    IADD,LIMITZ
01374 47 01266 01300 13170        BL   T54Z
01386 49 01470 00000 13180        B    T60Z
01398 26 00099 03973 13190 T57    TF   PROD,KADDZ
01410 12 00099  0019 13195        SM   PROD,19Z
01422 24 03981 0009R 13200        C    IADD,PROD,611Z
01434 47 00882 01200 14 10        BNF  T41Z
01446 33 00870 00000 14 20 T58    CF   JSW1Z
01458 49 00606 00000 14 30        B    T30Z
01470 11 01900  0012 14 40 T60    AM   LADD,12Z
01482 26 01903 0190- 14 50        TF   NASL,LADD,11Z
01494 24 03968 01855 14 60        C    K,LZ
01506 46 01542 01200 14 70        BF   T61Z
01518 26 01855 01903 14 80 T62    TF   L,NASLZ
01530 49 01194 00000 14 90        B    T53Z
01542 23 01852 03998 14100 T61    M    NERST,RECSIZZ
01554 11 00099  3993 14110        AM   PROD,AP-SIZEZ
01566 16 00099 00-00 14120        TFM  PROD,0,69Z
01578 26 0190  01844 14130        TF   LADD,LAST,6Z
01590 23 01844 03998 14139        M    LAST,RECSIZZ
01602 11 00099  3999 14140        AM   PROD,ACT-SIZEZ
01614 24 00099 01849 14141        C    PROD,LIMITZ
01626 46 01662 01200 14142        BF   *&36Z
01638 12 00099  0006 14150        SM   PROD,6Z
01650 26 00099 01855 14160        TF   PROD,L,6Z
01662 26 01844 01852 14161        TF   LAST,NERSTZ
01674 16 03981  4022 14170        TFM  IADD,ACTZ
01686 44 01710 0398J 14180 T64    BNF  T65,IADD,11Z
01698 49 01770 00000 14190        B    T69Z
01710 26 00099 03981 15 10 T65    TF   PROD,IADDZ
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01722 12 00099  0003 15 20        SM   PROD,3Z
01734 14 00099 00-00 15 30        CM   PROD,0,69Z
01746 46 01770 01200 15 40        BF   T69Z
01758 32 03981 00000 15 50 T66    SF   IADD,,6Z
01770 11 03981  0023 15 60 T69    AM   IADD,23Z
01782 24 03981 01849 15 70        C    IADD,LIMITZ
01794 47 01686 01300 15 80        BL   T64Z
01806 46 00474 01300 15 90        BNL  T20-247
01818 36 00000 00500 15100 T100   RNCD  7
01830 49 00000 00000 15110        B    Z
                     92 10 *  TOP THRE AD AREASZ
01844        3       92 20 LAST   DS   3Z
01849        5       92 30 LIMIT  DS   5Z
01852        3       92 40 NERST  DS   3Z
01855        3       92 50 L      DS   3Z
01857       15       92 60 MSGC   DAC  15,IN CLOSED LOOP@Z
01890        5       92 70 APADD  DS   5Z
01895        5       92 80 ASADD  DS   5Z
01900        5       92 90 LADD   DS   5Z
01903        3       92100 NASL   DS   3Z
03948                98100        DORG 3948Z
03952        5       98110 DI     DS   5Z
03955        3       98120 NPONE  DS   3Z
03960        5       98130 START  DS   5Z
03965        5       98140 DAYS   DS   5Z
03968        3       98150 K      DS   3Z
03973        5       98160 KADD   DS   5Z
03976        3       98170 I      DS   3Z
03981        5       98180 IADD   DS   5Z
03984        3       98190 N      DS   3Z
00099       20       98200 PROD   DS   20,99Z
03996       12       99 20 DATES  DS   12Z
03998        2       99 21 RECSIZ DC   2,23Z
00023                99 22 SIZE   DS   ,23Z
04000                99 29        DORG 4000Z
04022       23 00700 99 30 ACT    DSR  SIZE,700Z
04003        4       99 40 EP     DS   4,ACT-19Z
04007        4       99 50 ES     DS   4,ACT-15Z
04010        3       99 60 VAR    DS   3,ACT-12Z
04013        3       99 70 D      DS   3,ACT-9Z
04016        3       99 80 AP     DS   3,ACT-6Z
04019        3       99 90 AS     DS   3,ACT-3Z
04022        3       99100 M      DS   3,ACTZ
04016        3       99110 EST    DS   3,ACT-6Z
04022        3       99120 AET    DS   3,ACTZ
00402                99998        DEND TBEGINZ
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                                20010 *  BEG IN M D/DA/YR TO DAYS FOR START, SCHE
00402                           20020          DORG 402Z
00402 32 00666 00000            20030 MBEGIN   SF   JSWZ                    *
00414 32 03989 00000            20040 M301     SF   DATES-7Z                *
00426 32 03987 00000            20050          SF   DATES-9Z                *
00438 12 03990 00000            20060          SM   DATES-6,60,10Z          *
00450 13 03990 00L65            20070          MM   DATES-6,365,9Z          *
00462 26 03965 00099            20080          TF   DAYS,PRODZ              *
00474 11 03965 000-1            20100          AM   DAYS,1,10Z              *
00486 13 03990 000K5            20090          MM   DATES-6,25,10Z          *
00498 21 03965 00097            20110          A    DAYS,PROD-2Z            *
00510 14 03986 000-2            21111          CM   DATES-10,2,10Z          *
00522 46 00606 01100            21112          BH   M305Z                   *
00534 32 00098 00000            21113          SF   PROD-1Z                *
00546 14 00099 000-0            21114          CM   PROD,0,10Z             *
00558 47 00582 01200            21115          BNE  *&24Z                   *
00570 12 03965 000-1            21116          SM   DAYS,1,10Z             *
00582 14 03986 000-1            20120 M304     CM   DATES-10,1,10Z          *
00594 46 00654 01200            20130          BE   M306Z                  *
00606 13 03986 000-3            20160 M305     MM   DATES-10,3,10Z          *
00618 16 00653  1862            20170          TFM  *&35,CUM-6Z            *
00630 21 00653 00099            20180          A    *&23,PRODZ             *
00642 21 03965 00000            20190          A    DAYSZ                  *
00654 21 03965 03988            20200 M306     A    DAYS,DATES-8Z          *
00666 44 00738 00666            21010 JSW      BNF  M303,JSWZ              *
00678 26 03960 03965            21020 M302     TF   START,DAYSZ            *
00690 32 03991 00000            21030          SF   DATES-5Z               *
00702 26 03990 03996            21040          TF   DATES-6,DATESZ         *
00714 33 00666 00000            21050          CF   JSWZ                   *
00726 49 00414 00000            21060          B    M301Z                  *
00738 26 01906 03965            21070 M303     TF   SCHED,DAYSZ            *
                                21090 * BEGI N BA CKWARD PASSZ
00750 26 03955 03984            21100 BBEGIN   TF   NPONE,NZ               *
00762 11 03955 00-01            21110          AM   NPONE,1,9Z             *
00774 16 03976 00-01            21115          TFM  I,1,9Z                 *
00786 24  4019 03955            21120 B401     C    ACT-3,NPONE,2Z         *
00798 46 00846 01200            21130          BE   B402Z                  *
00810 21 00792 03998            21140          A    B401&6,RECSIZZ         *
00822 11 03976 00-01            21145          AM   I,1,9Z                 *
00834 49 00786 00000            21150          B    B401Z                  *
00846 26 02004 03976            21160 B402     TF   KN,IZ                  *
00858 26 03968 03976            21170          TF   K,IZ                   *
00870 26 03947 01906            21180          TF   SCMST,SCHEDZ           *
00882 22 03947 03960            21190          S    SCMST,STARTZ           *
00894 13 03947 14286            21192          MM   SCMST,14286Z           *
00906 32 00091 00000            21194          SF   PROD-8Z                *
00918 11 00096 00-05            21196          AM   PROD-3,5,9Z            *
00930 26 03947 00095            21198          TF   SCMST,PROD-4Z          *
00942 23 03968 03998            21200          M    K,RECSIZZ              *
00954 26 02032 00099            22010          TF   AFTK,PRODZ             *
00966 11 00099  3984            22012          AM   PROD,ES-SIZEZ          *
00978 26 02009 0009R            22013          TF   ESKN,PROD,11Z          *
00990 11 02032  3999            22015          AM   AFTK,AFT-SIZEZ         *
01002 16 02032 00R99            22020          TFM  AFTK,999,69Z           *
01014 16 02000 00-01            22025          TFM  TERM,1,9Z              *
01026 23 03968 03998            22030 B410     M    K,RECSIZZ              *
01038 11 00099  3993            22040          AM   PROD,AP-SIZEZ          *
01050 26 03968 0009R            22050          TF   K,PROD,11Z             *
01062 23 03968 03998            22052          M    K,RECSIZZ              *
                                22054          TF   AFTK,PRODZ
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01074 26 02032 00099                                                    *
01086 26 02014 00099 22056          TF   ESK,PRODZ                      *
01098 26 03976 03968 22060          TF   I,KZ                           *
01110 11 02032  3999 22063          AM   AFTK,AFT-SIZEZ                 *
01122 11 02014  3984 22065          AM   ESK,ES-SIZEZ                   *
01134 14 03968 00-00 22070          CM   K,0,9Z                         *
01146 46 01794 01200 22080          BE   B501Z                          *
01158 23 03976 03998 22090 B420     M    I,RECSIZZ                      *
01170 11 00099  3996 22100          AM   PROD,AS-SIZEZ                  *
01182 26 03976 0009R 22105          TF   I,PROD,11Z                     *
01194 24 03976 03955 22110          C    I,NPONEZ                       *
01206 47 01242 01200 22120          BNE  B422Z                          *
01218 16 02032 00R99 22150 B421     TFM  AFTK,999,69Z                   *
01230 49 01650 00000 22160          B    B5014Z                         *
01242 23 03976 03998 22170 B422     M    I,RECSIZZ                      *
01254 26 03981 00099 22180          TF   IADD,PRODZ                     *
01266 26 02019 00099 22190          TF   EPI,PRODZ                      *
01278 11 02019  3990 22200          AM   EPI,EP-SIZEZ                   *
01290 24 02019 0201M 23010          C    EPI,ESK,611Z                   *
01302 47 01158 01200 23020          BNE  B420Z                          *
01314 26 02027 03981 23030 B430     TF   AFTI,IADDZ                     *
01326 11 02027  3999 23040          AM   AFTI,AFT-SIZEZ                 *
01338 26 03952 03981 23050          TF   DI,IADDZ                       *
01350 11 03952  3990 23060          AM   DI,D-SIZEZ                     *
01362 26 02022 0202P 23070          TF   TMIN,AFTI,11Z                  *
01374 22 02022 0395K 23080          S    TMIN,DI,11Z                    *
01386 47 01446 01400 23081          BNV  B440Z                          *
01398 34 00000 00102 23082          RCTY  Z                             *
01410 39 01909 00100 23083          WATY MSGJZ                          *
01422 48 00000 00000 23084          H     Z                             *
01434 49 01398 00000 23085          B    *-36Z                          *
01446 24 03976 03984 23090 B440     C    I,NZ                           *
01458 46 01518 01200 23100          BE   B441Z                          *
01470 26 00099 02019 23110 B444     TF   PROD,EPIZ                      *
01482 21 02019 03998 23120          A    EPI,RECSIZZ                    *
01494 24 02019 0009R 23130          C    EPI,PROD,611Z                  *
01506 46 01542 01200 23140          BE   B442Z                          *
01518 26 02032 02022 23150 B441     TF   AFTK,TMIN,6Z                   *
01530 49 01026 00000 23160          B    B410Z                          *
01542 21 02027 03998 23170 B442     A    AFTI,RECSIZZ                   *
01554 21 03952 03998 23180          A    DI,RECSIZZ                     *
01566 11 03976 00-01 23181          AM   I,1,9Z                         *
01578 26 00099 0202P 23190          TF   PROD,AFTI,11Z                  *
01590 22 00099 0395K 23200          S    PROD,DI,11Z                    *
01602 24 00099 02022 24010          C    PROD,TMINZ                     *
01614 46 01446 01300 24020          BNL  B440Z                          *
01626 26 02022 00099 24030 B443     TF   TMIN,PRODZ                     *
01638 49 01446 00000 24040          B    B440Z                          *
01650 24 02009 0201M 24110 B5014    C    ESKN,ESK,11Z                   *
01662 46 01026 01200 24120          BE   B410Z                          *
01674 16 03981  4007 24130          TFM  IADD,ESZ                       *
01686 16 03976 00-01 24140          TFM  I,1,9Z                         *
01698 24 03981 0201M 24170          C    IADD,ESK ,611Z                 *
01710 46 01026 01200 24180          BE   B410Z                          *
01722 11 03981  0023 24190          AM   IADD,SIZEZ                     *
01734 11 03976 00-01 24200          AM   I,1,9Z                         *
01746 24 03976 03968 25010          C    I,KZ                           *
01758 47 01698 01300 25020 B5015    BL   B5014&48Z                      *
01770 11 02000 00-01 25030          AM   TERM,1,9Z                      *
01782 49 01026 00000 25040          B    B410Z                          *
                     25070 B501     RCTY  Z
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01794 34 00000 00102                                                *
01806 34 00000 00102 25080          RCTY  Z                         *
01818 38 01998 00100 25090          WNTY TERM-2Z                    *
01830 39 01965 00100 25100          WATY MSGKZ                      *
01842 36 00000 00500 25110          RNCD  Z                         *
01854 49 00000 00000 25120          B     Z                         *
                     93010 *     M O/DA /YR FIELDSZ
01868          3     93030 CUM     DC   3,31Z
01871          3     93040         DC   3,59Z
01874          3     93050         DC   3,90Z
01877          3     93060         DC   3,120Z
01880          3     93070         DC   3,151Z
01883          3     93080         DC   3,181Z
01886          3     93090         DC   3,212Z
01889          3     93100         DC   3,243Z
01892          3     93110         DC   3,273Z
01895          3     93120         DC   3,304Z
01898          3     93130         DC   3,334Z
01901          3     93140         DC   3,365Z
01906          5     93150 SCHED   DS   5Z
                     94010 *  BAC KWAR D PASS FIELDSZ
01909         28   *  94015 MSGJ    DAC  28,PROJECT EXCEEDS 199.8 WEEKS@Z
01965         17   *  94016 MSGK    DAC  17, TERMINAL EVENTS@Z
02000          3     94017 TERM    DS   3Z
02001          1     94018         DC   1,@Z
02004          3     94020 KN      DS   3Z
02009          5     94030 FSKN    DS   5Z
02014          5     94050 ESK     DS   5Z
02019          5     94060 FPI     DS   5Z
02022          3     94070 TMIN    DS   3Z
02027          5     94080 AFTI    DS   5Z
02032          5     94090 AFTK    DS   5Z
03943                98080         DORG 3943Z
03947          5     98090 SCMST   DS   5Z
03948                98100         DORG 3948Z
03952          5     98110 DI      DS   5Z
03955          3     98120 NPONE   DS   3Z
03960          5     98130 START   DS   5Z
03965          5     98140 DAYS    DS   5Z
03968          3     98150 K       DS   3Z
03973          5     98160 KADD    DS   5Z
03976          3     98170 I       DS   3Z
03981          5     98180 IADD    DS   5Z
03984          3     98190 N       DS   3Z
00099         20     98200 PROD    DS   20,99Z
03996         12     99020 DATES   DS   12Z
03998          2     99021 RECSIZ  DC   2,23Z
00023                99022 SIZE    DS   ,23Z
04000                99029         DORG 4000Z
04022         23 00700 99030 ACT   DSB  SIZE,700Z                    *
04003          4     99040 EP      DS   4,ACT-19Z
04007          4     99050 ES      DS   4,ACT-15Z
04010          3     99060 VAR     DS   3,ACT-12Z
04013          3     99070 D       DS   3,ACT-9Z
04016          3     99080 AP      DS   3,ACT-6Z
04019          3     99090 AS      DS   3,ACT-3Z
04022          3     99100 M       DS   3,ACTZ
04016          3     99110 EST     DS   3,ACT-6Z
04022          3     99120 AFT     DS   3,ACTZ
00402                99999         DEND MBEGINZ
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                     30010 * BEGI N FO RWARD PASSZ
00402                30015         DORG 402Z
00402 16 01704 00R9R 30020 FBEGIN  TFM  TIME,999,911Z              *
00414 16 01708 0 000 30030         TFM  VANCE,0,8Z                 *
00426 16 03976 00-00 30031         TFM  I,0,9Z                     *
00438 16 00480  3993 30040         TFM  *&42,AP-SIZEZ              *
00450 21 00480 03998 30050         A    *&30,RECSIZZ               *
00462 11 03976 00-01 30051         AM   I,1,9Z                     *
00474 14 00000 00-00 30060         CM   ,0,9Z                      *
00486 47 00450 01200 30070         BNE  *-36Z                      *
00498 26 01711 03976 30080 F503    TF   KONE,IZ                    *
00510 26 03968 01711 30090         TF   K,KONEZ                    *
00522 23 03968 03998 30100         M    K,RECSIZZ                  *
00534 16 01648 00-01 30115         TFM  ORIG,1,9Z                  *
00546 26 03973 00099 30110         TF   KADD,PRODZ                 *
00558 16 00099  3993 30120 F510    TFM  PROD,EST-SIZEZ             *
00570 21 00099 03973 30130         A    PROD,KADDZ                 *
00582 26 00099 01704 30140         TF   PROD,TIME,6Z               *
00594 16 00094  3987 30150         TFM  PROD-5,VAR-SIZEZ           *
00606 21 00094 03973 30160         A    PROD-5,KADDZ               *
00618 16 00099  3980 30170         TFM  PROD,EP-SIZEZ              *
00630 21 00099 03973 30180         A    PROD,KADDZ                 *
00642 26 01726 0009R 30190         TF   EPK,PROD,11Z               *
00654 26 00099 01708 31010         TF   PROD,VANCE,6Z              *
00666 22 00099 0009M 31015         S    PROD,PROD-5,611,MAKE CUM VAR NEGA
00678 47 00738 01400 31016         BNV  F509Z                      *
00690 34 00000 00102 31017         RCTY  Z                         *
00702 39 01567 00100 31018         WATY MSGLZ                      *
00714 48 00000 00000 31019         H     Z                         *
00726 49 00690 00000 31020         B    *-36Z                      *
00738 24 03968 03984 31021 F509    C    K,NZ                       *
00750 46 00834 01300 31030         BNL  F515Z                      *
00762 21 00099 03998 31050 F511    A    PROD,RECSIZZ               *
00774 24 00099 01726 31060         C    PROD,EPK,6Z                *
00786 47 00834 01200 31070         BNE  F515Z                      *
00798 11 03968 00-01 31080 F512    AM   K,1,9Z                     *
00810 21 03973 03998 31090         A    KADD,RECSIZZ               *
00822 49 00558 00000 31100         B    F510Z                      *
00834 16 00099  3996 31110 F515    TFM  PROD,AS-SIZEZ              *
00846 21 00099 03973 31120         A    PROD,KADDZ                 *
00858 24 00099 03955 31130         C    PROD,NPONE,6Z              *
00870 46 01470 01300 31140         BNL  F550,,,FORWARD PASS*COMPUTATION C
00882 26 03968 0009R 31150 F520    TF   K,PROD,11Z                 *
00894 26 03976 01711 31160         TF   I,KONEZ                    *
00906 23 03968 03998 31162         M    K,RECSIZZ                  *
00918 26 03973 00099 31164         TF   KADD,PRODZ                 *
00930 11 00099  3980 31166         AM   PROD,EP-SIZEZ              *
00942 26 01726 0009R 31168         TF   EPK,PROD,11Z               *
00954 16 01704 00R9R 31170         TFM  TIME,999,911Z              *
00966 16 01708 0 000 31180         TFM  VANCE,0,8Z                 *
00978 32 01326 00000 31185         SF   PREDSWZ                    *
00990 23 03976 03998 31190 F530    M    I,RECSIZZ                  *
01002 26 03981 00099 31200         TF   IADD,PRODZ                 *
01014 11 00099  3984 32010         AM   PROD,ES-SIZEZ              *
01026 24 00099 01726 32030         C    PROD,EPK,6Z                *
01038 47 01278 01200 32040         BNE  F540Z                      *
01050 33 01326 00000 32045         CF   PREDSWZ                    *
01062 16 03952  3990 32050 F531    TFM  DI,D-SIZEZ                 *
01074 21 03952 03981 32060         A    DI,IADDZ                   *
                     32070         TFM  ESTI,EST-SIZEZ
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01086 16 01716  3993                                          *
01098 21 01716 03981 32080          A    ESTI,IADDZ           *
01110 26 00099 0395K 32090          TF   PROD,DI,11Z          *
01122 21 00099 01710 32100          A    PROD,ESTI,11Z        *
01134 24 00099 01704 32110          C    PROD,TIMEZ           *
01146 47 01278 01300 32120          BL   F540Z                *
01158 46 01230 01100 32130          BH   F534Z                *
01170 16 01721  3980 32140 F532     TFM  VARI,EP -SIZEZ       *
01182 21 01721 03981 32150          A    VARI,IADDZ           *
01194 24 01721 01708 32160          C    VARI,VANCE,6Z        *
01206 47 01242 01100 32170          BNH  F535Z                *
01218 49 01278 00000 32180          B    F540Z                *
01230 26 01704 00099 32190 F534     TF   TIME,PRODZ           *
01242 16 01721  3980 33010 F535     TFM  VARI,EP -SIZEZ       *
01254 21 01721 03981 33020          A    VARI,IADDZ           *
01266 26 01708 0172J 33040          TF   VANCE,VARI,11Z       *
01278 16 00099  3993 33050 F540     TFM  PROD,AP-SIZEZ        *
01290 21 00099 03973 33060          A    PROD,KADDZ           *
01302 24 03976 0009R 33070          C    I,PROD,11Z           *
01314 47 01362 01200 33080          BNE  F541Z                *
01326 44 01350 01326 33083 PREDSW   BNF  *&24,PREDSWZ         *
01338 11 01648 00-01 33084          AM   ORIG,1,9Z            *
01350 49 00558 00000 33086          B    F510Z                *
01362 16 00099  3996 33090 F541     TFM  PROD,AS-SIZEZ        *
01374 21 00099 03981 33100          A    PROD,IADDZ           *
01386 26 03976 0009R 33110          TF   I,PROD,11Z           *
01398 49 00990 00000 33120          B    F530Z                *
01410 39 01651 00100 33122 F600     WATY MSGMZ                *
01422 38 01646 00100 33124          WNTY ORIG-2Z              *
01434 39 01663 00100 33126          WATY MSGNZ                *
01446 36 00000 00500 33130          RNCD  Z                   *
01458 49 00000 00000 33140          B     Z                   *
01470 16 01512  3980 34100 F550     TFM  FCF66,EP-SIZE,,ROUTINE TO CLEARZ
01482 23 03984 03998 34110          M    N,RECSIZ,,      FLAGS FROM CUMZ
01494 21 01512 00099 34120          A    FCF66,PROD,,    VARIANCE WHICHZ
01506 33 00000 00000 34130 FCF      CF   ,,,             IS STORED WHEREZ
01518 14 01512  4003 34140          CM   FCF66,EP,,      EP WAS STOREDZ
01530 46 01410 01200 34150          BE   F600Z                *
01542 22 01512 03998 34160          S    FCF66,RECSIZZ        *
01554 49 01506 00000 34170          B    FCFZ                 *
                     95010 *  FOR WARD  PASS FIELDSZ
01567       40     * 95012 MSGL   DAC  40,CUMULATIVE VARIANCE EXCEEDS 99
01648        3       95014 ORIG   DS   3Z
01649        1       95016        DC   1,@Z
01651        6       95017 MSGM   DAC  6,    @Z
01663       20     * 95018 MSGN   DAC  20, ORIGINATING EVENTS@Z
01704        3       95020 TIME   DS   3Z
01708        4       95030 VANCE  DS   4Z
01711        3       95040 KONE   DS   3Z
01716        5       95050 ESTI   DS   5Z
01721        5       95060 VARI   DS   5Z
01726        5       95070 EPK    DS   5Z
03943                98080        DORG 3943Z
03947        5       98090 SCMST  DS   5Z
03948                98100        DORG 3948Z
03952        5       98110 DI     DS   5Z
03955        3       98120 NPONE  DS   3Z
03960        5       98130 START  DS   5Z
03965        5       98140 DAYS   DS   5Z
03968        3       98150 K      DS   3Z
                     98160 KADD   DS   5Z
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03973        5
03976        3       98170 I      DS   3Z
03981        5       98180 IADD   DS   5Z
03984        3       98190 N      DS   3Z
03999       20       98200 PROD   DS   20,99Z
03996       12       99020 DATES  DS   12Z
03998        2       99021 RECSIZ DC   2,23Z
04023                99022 SIZE   DS   ,23Z
04000                99029        DORG 4000Z
04022       23 00700 99030 ACT    DSB  SIZE,700Z                *
04003        4       99040 EP     DS   4,ACT-19Z
04007        4       99050 ES     DS   4,ACT-15Z
04010        3       99060 VAR    DS   3,ACT-12Z
04013        3       99070 D      DS   3,ACT-9Z
04016        3       99080 AP     DS   3,ACT-6Z
04019        3       99090 AS     DS   3,ACT-3Z
04022        3       99100 V      DS   3,ACTZ
04016        3       99110 EST    DS   3,ACT-6Z
04022        3       99120 AFT    DS   3,ACTZ
04002                99999        DEND FBEGINZ
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                        40000 *  OUT PUT  ROUTINEZ
00402                   40001    DORG 402Z
                        40010 *  NUM ERIC  TO ALPHA CONVERSIONZ
                        40020 *  CAL LING  SEQUENCEZ
                        40030 *       BT   NTOA,NFIELDZ
                        40050 *       TF   AFIELD,ALPHAZ
00407          6        40060 NUM     DS   6Z
00408 44    440 00407   40080 NTOA    BNF  *&32,NUMZ
00420 15    614 00005   40090         TDM  ALPHA-1,5Z
00432 49    452 00000   40100         B    *&20Z
00440                   40105         DORG *-3Z
00440 15    614 00007   40110         TDM  ALPHA-1,7Z
00452 25    615 00407   40111         TD   ALPHA,NUMZ
00464 16    603  0613   40120         TFM  AADD,ALPHA-2Z
00476 16    598  0406   40130         TFM  NADD,NUM-1Z
00488 25    603 0059Q   40140 NTOA1   TD   AADD,NADD,611Z
00500 33    603 00000   40145         CF   AADD,,6Z
00512 12    603  0001   40150         SM   AADD,1Z
00524 15    603 00007   40160         TDM  AADD,7,6Z
00536 44    562 0059Q   40170         BNF  *&26,NADD,11Z
00548 32    603 00000   40180         SF   AADD,,6Z
00560 42                40190         BB    7
00562                   40195         DORG *-9Z
00562 12    598  0001   40200         SM   NADD,1Z
00574 12    603  0001   40210         SM   AADD,1Z
00586 49    488 00000   40220         B    NTOA1Z
00594                   40230         DORG *-3Z
00598          5        40250 NADD    DS   5Z
00603          5        40260 AADD    DS   5Z
                        41010 *  ALP HA T O NUMERIC CONVERSIONZ
                        41020 *  CAL LING  SEQUENCEZ
                        41030 *       BT   ATON,AFIELDZ
                        41040 *       TF   NFIELD,NUMZ
00615          12       41060 ALPHA   DS   12Z
00616 25    407 00615   41070 ATON    TD   NUM,ALPHAZ
00628 32    614 00000   41080         SF   ALPHA-1Z
00640 12    615 00000   41090         SM   ALPHA,50,10Z
00652 43    676 00614   41100         BD   *&24,ALPHA-1Z
00664 32    407 00000   41110         SF   NUMZ
00676 16    598  0406   41120         TFM  NADD,NUM-1Z
00688 16    603  0619   41130         TFM  AADD,ALPHA-2Z
00700 25    598 0060L   41140 ATON1   TD   NADD,AADD,611Z
00712 12    603  0001   41150         SM   AADD,1Z
00724 44    750 0060L   41160         BNF  *&26,AADD,11Z
00736 32    598 00000   41170         SF   NADD,,6Z
00748 42                41180         BB    Z
00750                   41185         DORG *-9Z
00750 12    598  0001   41190         SM   NADD,1Z
00762 12    603  0001   41200         SM   AADD,1Z
00774 49    700 00000   41210         B    ATON1Z
00782                   42080         DORG *-3Z
00782 37   3409 00500   42090 PREGIN  RACD PRINT&2Z
00794 32   3442 00000   42091         SF   PRINT&35,,,,Z STORED HERE IN Q7
00806 14   3443 000M8   42092         CM   PRINT&36,48,10Z
00818 46    874 01200   42093         BF   *&56Z
00830 34        102     42094 PMSGG   RCTY ,,,CUMADD STORED HERE IN P7
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00842 39   3899 00100   42095         WATY MSGGZ
00854 48               42096         H    ,,,IYR AND XO STORED HEREZ
00866 49    782 00000   42097         B    PREGINZ
00874                  42098         DORG *-3Z
00874 46    906 00200   42100         BC2  *&32Z
00886 39   3409 00400   42105         WACD PRINT&2Z
00898 49   1002 00000   42120         B    PCONTZ
00906                  42130         DORG *-3Z
00906 34        102     42132 PHEAD   RCTY ,,,ESADD STORED HERE IN P7
00918 34        102     42133         RCTY ,,,DADD STORED HERE IN P7
00930 39   3571 00100   42134         WATY HEAD5AZ
00942 39   3671 00100   42135         WATY HEAD5BZ
00954 34        102     42136         RCTY  ,,,AFTADD STORED HERE IN P7
00966 39   3735 00100   42137         WATY HEAD6AZ
00978 39   3835 00100   42138         WATY HEAD6BZ
00990 34        102     42139         RCTY ,,,EPADD STORED HERE IN P7
01002 32   3416 00000   42140 PCONT   SF   PRINT&9,,,,ESTADD STORED HERE IN Q
01014 32   3442 00000   42150         SF   PRINT&35,,,,EXPTIM STORED HERE IN
01026 32   3444 00000   42160         SF   PRINT&37,,,,SLACK STORED HERE IN Q
01038 16    912  3984   42190         TFM  ESADD,ES-SIZEZ
01050 16   1013  3993   42200         TFM  ESTADD,EST-SIZEZ
01062 16    924  3990   42210         TFM  DADD,D-SIZEZ
01074 16    960  3999   42220         TFM  AFTADD,AFT-SIZEZ
01086 16    996  3980   42230         TFM  EPADD,EP-SIZEZ
01098 37   3409 00500   43010 PREAD   RACD PRINT&2Z
01110 14   3443 000M5   43020         CM   PRINT&36,45,10Z
01122 46   2726 01200   43030         BE   PENDZ
01134 14   3443 000M3   43040         CM   PRINT&36,43,10Z
01146 47   1178 00200   43042         BNC2 *&32Z
01158 46   2694 01200   43044         BE   PPRINTZ
01170 49   1190 00000   43046         B    *&20Z
01178                  43048         DORG *-3Z
01178 46   2674 01200   43050         BE   PWRITEZ
01190 27    616 03423   43060         BT   ATON,PRINT&16Z
01202 21    912 03998   43070         A    ESADD,RECSIZZ
01214 24    407 0091K   43080         C    NUM,ESADD,11Z
01226 47    830 01200   43090         BNF  PMSGGZ
01238 21   1013 03998   43280 PCALC   A    ESTADD,RECSIZZ
01250 21    924 03998   43290         A    DADD,RECSIZZ
01262 21    996 03998   43291         A    EPADD,RECSIZZ
01274 21    960 03998   43292         A    AFTADD,RECSIZZ
01286 16   1025  0999   43294         TFM  EXPTIM,999Z
01298 21   1025 0101L   43300         A    EXPTIM,ESTADD,11Z
01310 21   1025 0092M   43310         A    EXPTIM,DADD,11Z
01322 27    408 0092M   43320         BT   NTOA,DADD,11Z
01334 26   3523 00615   43330         TF   PRINT&116,ALPHAZ
01346 16   1037  099R   43336         TFM  SLACK,-999Z
01358 21   1037 03947   43338         A    SLACK,SCMSTZ
01370 21   1037 0096-   43340         A    SLACK,AFTADD,11Z
01382 26   3973 01037   43345         TF   KADD,SLACKZ
01394 22   1037 01025   43350         S    SLACK,EXPTIMZ
01406 32   1035 00000   43355         SF   SLACK-2Z
01418 27    408 01037   43360         BT   NTOA,SLACKZ
01430 26   3529 00615   43370         TF   PRINT&122,ALPHAZ
01442 46   1478 00100   43371         BC1  PCONDZ
01454 27    408 00990   43380         BT   NTOA,EPADD,11Z
01466 26   3537 00615   43390         TF   PRINT&130,ALPHAZ
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01478 14  3443 000-0 43400 PCODE  CM   PRINT&36,00,10Z
01490 46  2590 01200 43450        BE   PNOTSCZ
01502 46  2590 00100 43451        BC1  PNOTSCZ
01514 27   616 03455 43460 PSCHED BT   ATON,PRINT&48Z
01526 26  3006 00407 43461        TF   DATES,NUMZ
01538 32  3005 00000 43470        SF   DATES-1Z
01550 32  3003 00000 43480        SF   DATES-3Z
01562 12  3006 00000 43490        SM   DATES,60,10Z
01574 13  3006 00L65 43500        MM   DATES,365,97
01586 26  3065 00099 44010        TF   DAYS,PRODZ
01598 13  3006 00065 44020        MM   DATES,25,10Z
01610 11  3065 000-1 44030        AM   DAYS,1,10Z
01622 21  3065 00097 44040        A    DAYS,PROD-2Z
01634 14  3002 000-1 44050        CM   DATES-4,1,10Z
01646 46  1706 01200 44060        BE   P306Z
01658 13  3002 000-3 44070 P305   MM   DATES-4,3,10Z
01670 16  1705  3366 44080        TEM  P306-1,CUM-6Z
01682 21  1705 00099 44090        A    P306-1,PRODZ
01694 21  3065 00000 44100        A    DAYSZ
01706 21  3065 03994 44110 P306   A    DAYS,DATES-2Z
01718 22  3065 03960 44111        S    DAYS,START2
01730 16   865  0000 44130        TEM  X0,0Z
01742 16   861 000-3 44140        TEM  X0-4,3,10Z
01754 28    92 00000 44150 PSQRT  LD   PROD-7,FPADD,11Z
01766 29    89 00865 44160        D    PROD&1-11,X0Z
01778 32    87 00000 44170        SF   PROD-12Z
01790 26    79 00093 44180        TF   PROD-20,PROD-6Z
01802 21    79 00865 44185        A    PROD-20,X0Z
01814 13    79 000-5 44190        MM   PROD-20,5,10Z
01826 11    99 000-5 44200        AM   PROD,5,10Z
01838 32    93 00000 44210        SF   PROD-6Z
01850 22   865 00098 44220        S    X0,PROD-1Z
01862 33   865 00000 44230        CF   X0Z
01874 14   865  0001 44240        CM   X0,1Z
01886 26   865 00098 44250        TF   X0,PROD-1Z
01898 47  1918 01300 44260        BL   PSIGZ
01910 49  1754 00000 44270        B    PSQRTZ
01918               44271        DORG *-3Z
01918 13   865 000-7 44272 PSIG   MM   X0,7,10Z
01930 32    93 00000 44274        SF   PROD-6Z
01942 11    99 000-5 44276        AM   PROD,5,10Z
01954 26   865 00098 44278        TF   X0,PROD-1Z
01966 32  1022 00000 44280        SF   EXPTIM-3Z
01978 13  1025 000-7 44290        MM   EXPTIM,7,10Z
01990 11    99 000-5 45010        AM   PROD,5,10Z
02002 22  3065 00098 45020        S    DAYS,PROD-1Z
02014 28    92 03965 45030        LD   PROD-7,DAYS7
02026 29    88 00865 45040        D    PROD&1-12,X0Z
02038 43  2070 00088 45042        BD   *&32,PROD-11Z
02050 43  2070 00087 45044        BD   *&20,PROD-12Z
02062 49  2082 00000 45046        B    *&20Z
02070               45047        DORG *-3Z
02070 16    92 09999 45048        TEM  PROD-7,9999,8Z
02082 32    89 00000 45050        SF   PROD-10Z
02094 26   805 00093 45060        TF   Z,PROD-6Z
02106 44  2150 00805 45070        BNE  P9,7Z
02118 33   805 00000 45080 P8     CF   7Z
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02130 33  2486 00000 45090        CF   PJ7
02142 49  2162 00000 45100        B    P12Z
02150               45105        DORG *-3Z
02150 32  2486 00000 45110 P9     SF   PJZ
                     45115 *  THE  FOL LOWING FORMULA MAY BE FOUND7
                     45116 *  IN   HAST INGS APPROXIMATIONS PAGE 185Z
02162 13   805 70711 45117 P12    MM   7,70711Z
02174 26   805 00084 45118        TF   7,PROD-5Z
02186 13   805 78108 45120        MM   7,78108,,FORM 5.4 * FORM 5.6Z
02198 26    79 00095 45130        TF   PROD-20,PROD-4Z
02210 11    79  0972 45140        AM   PROD-20,972Z
02222 23    79 00805 45150        M    PROD-20,ZZ
02234 26    79 00094 45160        TF   PROD-20,PROD-5Z
02246 11    79 23038 45170        AM   PROD-20,23039Z
02258 23    79 00805 45180        M    PROD-20,ZZ
02270 26    79 00095 45190        TF   PROD-20,PROD-4Z
02282 11    79 27839 45200        AM   PROD-20,27839Z
02294 23    79 00805 45210        M    PROD-20,ZZ
02306 11    90 000-1 45220        AM   PROD-9,1,10Z
02318 26    79 00093 45230        TF   PROD-20,PROD-6,,FORM 6.3Z
02330 23    79 00079 45231        M    PROD-20,PROD-20,,FORM 12.6Z
02342 26    79 00097 45232        TF   PROD-20,PROD-2 ,,FORM 10.4Z
02354 23    79 00079 45233        M    PROD-20,PROD-20 ,,FORM 12.8Z
02366 26    74 00094 45235        TF   PROD-25,PROD-5,,FORM 12.3Z
02378 16    79  0000 45238        TEM  PROD-20,0Z
02390 18    96 10000 45240        LDM  PROD-3,10000 ,,FORM 8.7Z
02402 29    92 00074 45250        D    PROD&1-8,PROD-25,,QUOTIENT 8.4Z
02414 32    80 00000 45260        SF   PROD-19,,,FORM 5.4Z
02426 16   805 10000 45270        TEM  7,10000Z
02438 22   805 00084 45280        S    Z,PROD-15Z
02450 13   805 000-5 45290        MM   7,5,10Z
02462 32    94 00000 45300        SF   PROD-5Z
02474 26   805 00098 45310        TF   Z,PROD-1Z
02486 44  2522 02486 45340 PJ     BNE  P10,PJ7
02498 11   805  5050 45350 P20    AM   7,5050Z
02510 49  2558 00000 45360        B    P30Z
02522 16    99  5000 45370 P10    TEM  PROD,5000Z
02534 22    99 00805 45372        S    PROD,ZZ
02546 26   805 00099 45374        TF   Z,PRODZ
02558 27   408 00803 45390 P30    BT   NTOA,Z-2Z
02570 26  3543 00615 45400        TF   PRINT&136,ALPHAZ
02582 49  2590 00000 45410        B    PNOTSCZ
02590               46010        DORG *-3Z
02590 27  2756 01025 46020 PNOTSC BT   MODAYR,EXPTIMZ
02602 27   408 02755 46030        BT   NTOA,MODAYR-1Z
02614 26  3555 00615 46040        TF   PRINT&148,ALPHAZ
02626 27  2756 03973 46050        BT   MODAYR,KADDZ
02638 27   408 02755 46060        BT   NTOA,MODAYR-1Z
02650 26  3567 00615 46070        TF   PRINT&160,ALPHAZ
02662 46  2594 00200 46075        BC2  PPRINTZ
02674 39  3409 00400 46080 PWRITE WACD PRINT&2Z
02686 49  1098 00000 46089        B    PREADZ
02694               46090        DORG *-3Z
02694 34       102  46091 PPRINT RCTY  7
02706 39  3409 00100 46092        WATV PRINT&2Z
02718 49  1098 00000 46093        B    PREADZ
02726               46095        DORG *-3Z
```

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02726 16   848  3921 46140 PEND   TFM   PMSGG&18,MSGIZ
02748 49   830 00000 46150        B     PMSGGZ
02755                47010        DORG  *&6Z
02756 13  2755 00-07 47020 MODAYR MM    MODAYR-1,7,9Z
02768 32    94 00000 47025        SF    PROD-5Z
02780 44  2824 00099 47026        BNF   *&44,PRODZ
02792 12    99  0005 47027        SM    99,5Z
02804 32    98 00000 47028        SF    98Z
02816 49  2836 00000 47029        B     *&20Z
02824                47030        DORG  *-3Z
02824 11    99 000-5 47031        AM    PROD,5,10Z
02836 26    99 00098 47040        TF    PROD,PROD-1Z
02848 21    99 03960 47050        A     PROD,STARTZ
02860 16  3407 000=0 47060 P604   TFM   INDEX,0,10Z
02872 16   859 00000 47070        TFM   IYR,60,10Z
02884 14  3407 000-0 47080 P610   CM    INDEX,0,10Z
02896 47  2952 01200 47090        BNE   P612Z
02908 14    99  0366 47100 P611   CM    PROD,366Z
02920 47  3064 01100 47110        BNH   P621Z
02932 12    99  0366 47120 P613   SM    PROD,366Z
02944 49  3012 00000 47130        B     P614Z
02952                47135        DORG  *-3Z
02952 14    99  0365 47140 P612   CM    PROD,365Z
02964 47  3144 01100 47150        BNH   P626Z
02976 12    99  0365 47160 P615   SM    PROD,365Z
02988 14  3407 000-3 47170        CM    INDEX,3,10Z
03000 46  3032 01200 47180        BE    P616Z
03012 11  3407 000-1 47190 P614   AM    INDEX,1,10Z
03024 49  3044 00000 47200        B     P617Z
03032                47210        DORG  *-3Z
03032 16  3407 000-0 48010 P616   TFM   INDEX,0,10Z
03044 11   859 000-1 48020 P617   AM    IYR,1,10Z
03056 49  2884 00000 48030        B     P610Z
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03064 14    99  0060 48040 P621   CM    PROD,60Z
03076 47  3144 01300 48050        BL    P626Z
03088 46  3132 01100 48060        BH    P624Z
03100 16  2751 000-2 48070 P623   TFM   MODAYR-5,2,10Z
03112 16  2753 00099 48080        TFM   MODAYR-3,29,10Z
03124 49  3332 00000 48090        B     P645Z
03132                48095        DORG  *-3Z
03132 12    99  0001 48100 P624   SM    PROD,1Z
03144 14    99  0031 48110 P626   CM    PROD,31Z
03156 46  3212 01100 48120        BH    P630Z
03168 16  2751 000-1 48130 P625   TFM   MODAYR-5,1,10Z
03180 32    98 00000 48140        SF    PROD-1Z
03192 26  2753 00099 48150        TF    MODAYR-3,PRODZ
03204 49  3332 00000 48159        B     P645Z
03212                48160        DORG  *-3Z
03212 16  2751 000-1 48161 P630   TFM   MODAYR-5,1,10Z
03224 16   836  3372 48170        TFM   CUMADD,CUMZ
03236 11  2751 000-1 48171        AM    MODAYR-5,1,10Z
03248 11   836  0003 48180        AM    CUMADD,3Z
03260 24    99 00830 48190        C     PROD,CUMADD,11Z
03272 46  3236 01100 48200        BH    *-36Z
03284 12   836  0003 48210        SM    CUMADD,3Z
03296 22    99 00830 48220        S     PROD,CUMADD,11Z
```



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03308 32    98 00000 48230        SF    PROD-1Z
03320 26  2753 00099 48240        TF    MODAYR-3,PRODZ
03332 26  2755 00859 48250 P645   TF    MODAYR-1,IYRZ
03344 33  2754 00000 48260        CF    MODAYR-2Z
03356 33  2752 00000 48270        CF    MODAYR-4Z
03368 42             48480        BR    7
03370                48490        DORG  *-9Z
                     03010 *  OUT PUT  AREASZ
03372         3      93030 CUM    DC    3,31Z
03375         3      93040        DC    3,59Z
03378         3      93050        DC    3,90Z
03381         3      93060        DC    3,120Z
03384         3      93070        DC    3,151Z
03387         3      93080        DC    3,181Z
03390         3      93090        DC    3,212Z
03393         3      93100        DC    3,243Z
03396         3      93110        DC    3,273Z
03399         3      93120        DC    3,304Z
03402         3      93130        DC    3,334Z
03405         3      93140        DC    3,365Z
03407        81      96030 PRINT  DAS   81Z
03569         1      96031        DAC   1,@Z
03567        50      96032        DC    50,0,PRINT&160Z
03518        50      96033        DC    50,0,PRINT&111Z
03469        50      96034        DC    50,0,PRINT&62Z
03420        15      96035        DC    15,0,PRINT&13Z
03571        50      96040 HEAD5A DAC   50, EVENTS   TIMES   S OR C   ACT
03671        32      96045 HEAD5B DAC   32,       EXPSLKTOT PRBXPECTDLATE
03735        50      96050 HEAD6A DAC   50,PREDSUCCOPTLIKPFS MODAYR
03835        32      96055 HEAD6B DAC   32,      TIM    VAR   MODAYRMODAY
03899        11      96060 MSGG   DAC   11,CD SEQ ERR@Z
01013         5      96070 ESTADD DS    5,PCONT &11Z
01025         5      96090 EXPTIM DS    5  ,PCONT&237
01037         5      96100 SLACK  DS    5,PCONT&357
03921         8      96110 MSGI   DAC   8,THE END@Z
03407         2      96120 INDEX  DS    2,PRINTZ
00865         6      96130 XO     DS    6,PMSGG&357
00805         5      96140 Z      DS    5,PREGIN&23Z
00912         5      96150 ESADD  DS    5,PHEAD&6Z
00974         5      96160 DADD   DS    5,PHEAD&187
00960         5      96170 AETADD DS    5,PHEAD&547
00996         5      96180 EPADD  DS    5,PHEAD&907
00859         2      96200 IYR    DS    2,PMSGG&297
00836         5      96210 CUMADD DS    5, PMSGG&6Z
03943                98080        DORG  39437
03947         5      98090 SCMST  DS    5Z
03948                98100        DORG  39487
03952         5      98110 DI     DS    5Z
03955         3      98120 NPONE  DS    3Z
03960         5      98130 START  DS    5Z
03965         5      98140 DAYS   DS    5Z
03968         3      98150 K      DS    3Z
03973         5      98160 KADD   DS    5Z
03976         3      98170 I      DS    3Z
03981         5      98180 IADD   DS    5Z
03984         3      98190 N      DS    3Z
00099        20      98200 PROD   DS    20,99Z
```

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03996          12          99020 DATES   DS    12Z
03998           2          99021 RECSIZ  DC    2,23Z
00023                      99022 SIZE    DS    ,23Z
04000                      99029         DORG  4000Z
04022          23 00700    99030 ACT     DSB   SIZE,700Z
04003           4          99040 EP      DS    4,ACT-19Z
04007           4          99050 ES      DS    4,ACT-15Z
04010           3          99060 VAR     DS    3,ACT-12Z
04013           3          99070 D       DS    3,ACT-9Z
04016           3          99080 AP      DS    3,ACT-6Z
04019           3          99090 AS      DS    3,ACT-3Z
04022           3          99100 M       DS    3,ACTZ
04016           3          99110 EST     DS    3,ACT-6Z
04022           3          99120 AFT     DS    3,ACTZ
00782                      99999         DEND  PREGINZ
```



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  430054 20080080       ACT  4
  440056     10020      ACT  5
  450046 10010010       ACT  6
  460047                ACT  7
  460054 40070100S123162ACT  8
  470041 10010010       ACT  9
  480049 10010010       ACT  10
  480053                ACT  11
  490051  5010015S040163ACT  12
  520044 10020030       ACT  13
  530049     10020      ACT  14
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  550052 60090120       ACT  17
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36000720 5003600201005004400012002752600059002742500011000002600090002690000000 0
26000950 26431000000020026001140027425000000 0 1149000120000000 0            -    1
44004400 4071500614000054900452000000Z00000000 0.                           1004080044400000 2
15006140   72500615004071600603006131600598004062 5006 L0059QZ0010044000500000003
330060L0    12006030000115006 0L000074400562005 9Q32006 L00000Z0010050000560000004
42000000    Z0000000                                                    1005600057200000 5
12005980   112006030000149004880 0000Z00000000 0                         1005620059800000 6
25004070 61532006140000012006150 00N04300676006143200 4 700000Z0010061600676000007.
16005980 40616006030061325005 9Q0060L120060300   14400750006 0LZ001006760073600000 8
32005 9Q0    420000000000Z0000000  0 0                                  1007360076000000 9
12005980   112006030000149007000000 0Z00000000 0                         1007500078600001 0
37034090 50032034420000 01403443000M846008740120034000     102Z001007820084200001 1
39038990 10048000000000004900782 0000 0Z00000000 0                      1008420087800001 2
46009060 20039034090040049010020000 0Z00000000 0                        1008740091000001 3
34000000 10234000000010239035710010039036710010034000     102Z001009060096600001 4
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32000930    22008650009833008650000014008650 0   12600865000 98Z0010183801898000030
470191801300490175400000Z00000000 0 0                                   1018980192200003 1
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13010250   71100099000052203965000982800092039652900088008 65Z0010197802038000033
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33024860    4902162000 00Z00000000 0 0                                   1021300215400003 6
32024860    I300805P07II260080500094I300805P8108260007900095Z0010215002210000037
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49025580    160009905000220009900805260080500  9927004  800803Z0010251002570000043
26035430 615490259000000Z00000000 0 0                                   1025700259400004 4
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```



```
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14000990 36547031440110012000990036514034070 0   346030320120 0Z0010295203012000054
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460323601100120083500003220009900830320009800    260275300099Z0010327203332000062
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 Z000000                                                               1010335680357000065
-                                                        Z00           1010351803568000066
-                                                        Z00           1010346903519000067
-                                                        Z00           1010342003470000068
-                    Z00000000                                         1010340603421000069
  45654555636200000063495445620000000620056590 4300Z00                 1010357003620000070
     41436349654963680044456243594957634956550     Z000                1010362003670000071
-             4567576253526356630057594267574543634 4Z00               1010367003720000072
5341634562630Z0000000                                                  1010372003734000073
N759454462644343565763534952574562005456444168590 0Z00                 1010373403784000074
                                                   Z000                1010378403834000075
-             6349540000000065415900000054564441685 9Z00               1010383403884000076
545644416859 0Z0000000                                                 1010388403898000077
M3440062455800455959 0Z00000000 0                                      1010389803920000078
034845004555440Z00000000 0                                             1010392003936000079
K3Z00000                                                               1010399703999000080
L6000000 5004900000Z00000000 0                                          100096001150000 81
36001000 5003600172005003600244005003600316005 0036000     50000000000    -   82
             1020304000204060800030609021 00408 2161005   1510200602181420 0Z0000083
70411282  80614223009081726300000000005060708 900121416181518112427202 42Z0000084
82236352 35304540363248445532249465360484654627544536271801234567891234 56Z0000085
7890234567890J34567890JK4567890JKL567890JKLM67890JKLMN7890JKLMN0890JKLMNZ0000086
M1000000    4900782OP90JKLMNOPQZ0000L10038800 19M9000        M9000360000000000
```

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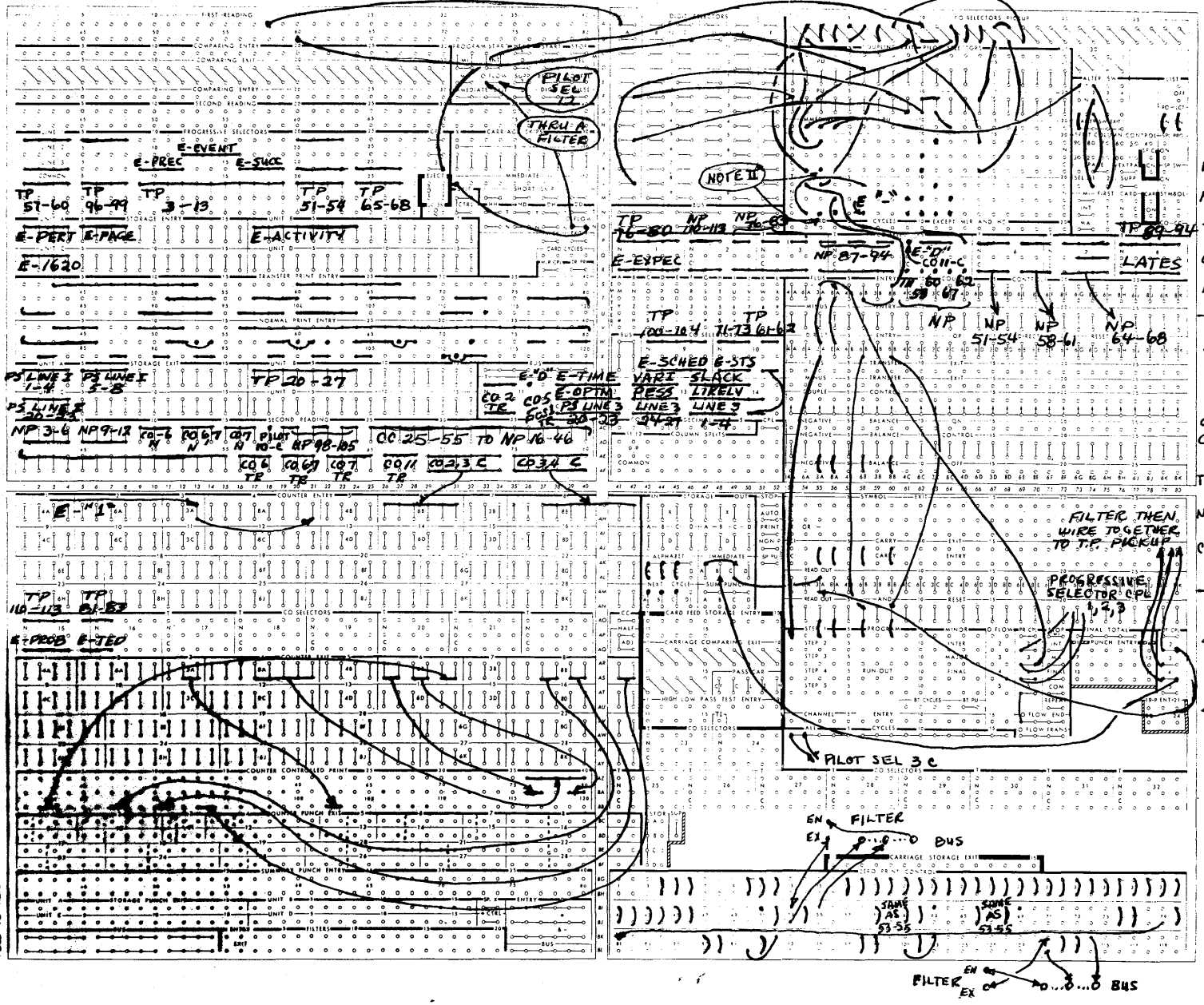
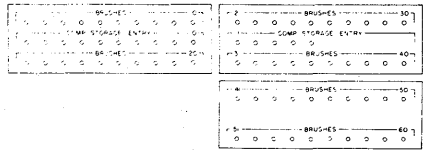
Printed in U.S.A.

IBM 407, 408, 409 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM



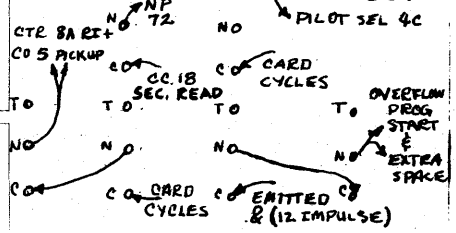
FOLD TO FILE

FIXED 408, 409 CARRIAGE CONTROL PANEL



RI - READ IN	CC - CARD COLUMN
NP - NORMAL PRINT	TR - TRANSFERRED
TP - TRANSFER PRINT	D - EMITTED DECIMAL PT.
CO - CO-SELECTOR	E - EMITTED WORD FOLLOWS
N - NORMAL	PS - PROGRESSIVE SELECTOR

PILOT SELECTORS



NOTES

I A "T" SPLIT-WIRED FROM CO 8 TO TP 91 AND 94 WILL FILL IN THE WORD "LATEST"

II USE TWO ALL CYCLES IMPULSES WIRED THRU PILOT SELECTOR 3 TR WHICH IS TRANSFERRED FOR ALTER SW 1 TRANSFERRED.

REPORT 1620 PERT LISTING

ALTER SW 1 < OFF - INPUT LISTING
ALTER SW 1 < ON - OUTPUT LISTING
ALTER SW 1 < OFF - SINGLE SPACE
ALTER SW 1 < ON - DOUBLE SPACE

DIAGRAM NO.

DATE

(9-61:20M-S)

1620 PERT

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Detroit 2, Michigan

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.

DECK KEY

1. Condensed SPS Object Deck for Phase 1.
2. Sample Problem Input Data.
3. Condensed SPS Object Deck for Phases 2-5.
* 4. Phase 1 Source Program Deck
* 5. Phase 2 Source Program Deck
* 6. Phase 3 Source Program Deck
* 7. Phase 4 Source Program Deck
* 8. Phase 5 Source Program Deck

* These Decks will be forwarded only when specifically requested.

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1. **Program Abstract**

Title: 1620 PERT

Subject Classification: 10.3

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Purpose/Description: 1620 PERT solves the basic critical path problem involving time. The program features random event numbering and allows for more than one event without a predecessor event as well as more than one event without a successor event. Options foreither one or three time estimates are available under program switch control.

Mathematical Method: Ranking is accomplished by topoligical threading; the remaining computations are similar to other PERT programs.

Restrictions, Range: Activity times are given in XX.X weeks. Total project time cannot exceed 199.8 weeks. The 20K 1620 will handle 695 activities; for larger memory, the maximum number of activities allowed is 999. Event numbers are 4 digits XXXX.

Storage Requirements: 4000 + 23N where N is the number of activities.

Equipment Specification: The minimum 1620 configuration is a 20K card 1620 with Indirect Addressing. Automatic divide hardware is required when it is desired to compute the probability of meeting a scheduled completion date.

Additional Remarks: 1620 PERT is written in SPS using fixed point arithmetic. The program uses the TOPTHREAD routine for ranking the activities. This technique allows random event identification and multiple originating and terminating events. Throughout input, processing, and output, the activity records (1 activity per card) remain in the same (collating) sequence. Statistical computations and conversion of times to dates are included. Suggestions are included in the write-up for modifying the input and / or output routines to handle different formats.

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. Questions concerning the use of the program should be directed to the author's attention.

I I. Description of 1620 PERT

A. An Overall Look at the Program

One of the most popular management tools available today is known to civilian groups as Critical Path Scheduling and to persons associated with military projects as PERT. The purpose of this management tool is to help plan, evaluate and control large scale projects with many interrelated activities.

1620 PERT is designed primarily to solve the problem of Critical Path Scheduling in a way conforming to most of the basic input/output specifications of PERT programs currently in use in military projects. The most important difference between PERT and Critical Path Scheduling (CPS) is that PERT requires three time estimates for each activity (job) instead of a single estimate. Therefore statistical computations measuring the uncertainty of estimates of future action are included in the PERT PROGRAM. The author is assuming the user has a familiarity with CPS and PERT. The terminology of PERT will be used in this discussion. There are many fine articles available to provide the user with a more thorough background to PERT including the IBM General Information Manual "PERT... a Dynamic Project Planning and Control Method", Form No. E20-8067. Under program switch control (Switch 1) the user can elect to use only one time estimate and forego the statistical computations. Section VI discusses the requirements for modifying the input routine and/or the output routine for other input/output formats.

To use 1620 PERT the project must be described by a network (arrow diagram, baloon chart). Events (nodes) are the milestones of the project and are usually represented by circles. Events may be randomly numbered. Activities (jobs) are actions which are carried on between events and are designated by arrows. Each activity is defined by its predecessor event (EP) and successor event (ES). Associated with each activity are three time estimates; optimistic, most likely, and pessimistic. Consideration has <u>not</u> been given to extend 1620 PERT to include cost, man-scheduling, or other computations.

Input to 1620 PERT requires one card to describe each activity. In addition, a header card and an END card are needed. Essential to the description of each activity is its predecessor event number (four digits), successor event number (four digits), three time estimates (xx.x weeks) and an optional 31 character alphabetic description of the activity. Optionally a scheduled completion date for any activity may be included. Activities may also be coded C for "complete" in which case they are not included in the computations, but are incorporated in the output listing.

II. Description of 1620 PERT (Cont'd.)

The output consists of one card for each activity. In addition to the duplication of the information which is contained in the input card, each activity card includes the expected time required to perform each activity (xx.x weeks), the slack (total float) time (xx.x weeks), the cumulative variance (xxx.x weeks) of the time estimates of all activities up to the completion of that activity along the longest path to that successor event, the probability (x.xx) of meeting the scheduled completion date if one is specified, the expected completion date (month/day/year - xx/xx/xx), and the latest allowable completion date (xx/xx/xx) which will still not delay the completion of the entire project.

1620 PERT consists of five separate programs. The activity cards are sorted in ascending collating sequence by successor event within predecessor event (eight columns). The activity cards are placed behind the first program (the Input Routine) and the other four programs are placed behind the activity cards. The Input Routine calls in the activity cards, edits them and stores the pertinent information in 23 digit records beginning at location 04000. When an END card is reached signifying that all activity cards have been read and stored, the next program (TOP THREAD) is read in over the Input Routine and ranks the activities. The Backward Pass program is read in over TOPTHREAD and determines the latest allowable completion dates for each activity. Next the Forward Pass program is called in and computes expected completion dates and variances. Finally the Output Routine is called in followed by the input activity cards which must be retrieved from their place behind the Input Routine. As the Output Routine reads each input activity card, the input data is merged with the computed data in storage to produce the output activity card for that activity. The activities remain in collating sequence throughout input, processing and output.

B. Phase I - Input Routine

The function of the Input Routine is to edit the input data, compute the expected time and variance for each activity, and set up a 23 digit record in core storage for each activity.

Five different types of cards are recognized and handled by the Input Routine. These are distinguished by a status code in column 18 of each card. The codes are:

H - Header card - must be the first data card of each network.

Blank - A normal activity card. Columns 18-24 and 56-80 will be blank.

S - An activity card for which a scheduled completion date is specified in columns 19-24.

C - A completed activity whose date of completion can be specified in columns 19-24.

E - An END card. This card with END punched in columns 18-20 is the last card in the network data deck.

The input routine edits for the following erroneous conditions.

1. NO HEADER CARD, START AGAIN

   The first (and only the first) data card must contain an "H" in column 18.

2. CARD OUT OF SEQUENCE

   The activity cards must be in ascending collating sequence, successor event within predecessor event (sort on columns 1 through 8 in reverse order, i.e., 8, 7, 6, 5, 4, 3, 2, 1.) The number N before the message indicates the card in error is the Nth activity card.

3. DUPLICATE ACTIVITY

   Two cards define the same activity. This condition is not permissible. The number N before the message indicates the Nth card is in error.

4. CHECK ESTIMATES

   This message indicates that the three time estimates (optimistic, most likely, pessimistic) do not progress from smaller to larger.

B. Phase I - Input Routine (Cont'd.)

   It is allowable to have all three the same. The first 17 numbers in the activity card precede the message for identification purposes. Processing continues using the given time estimates.

5. EXTRA CARD(S)

   This message appears after the END card is read if the number of activity cards exceeds the number specified in columns 5-8 of the header card.

   All cards with status codes C, S, and "blank" will be included in the count of the number of data cards.

6. CARD(S) MISSING

   This message occurs after the END card is read if the number of activity cards is less than the number of activities specified in the header card.

7. ERROR, START NEXT NETWORK

   If program switch 4 is ON and if message 2, 3, 5 or 6 is typed out, message 7 will also appear. Processing is stopped. Depressing START will read in activity cards for another network.

8. NETWORK EXCEEDS MEMORY CAPACITY

   This message indicates that the number of activities in the project is more than 695 for 20K or more than 999 for 40K or 60K.

(Additional restart information is contained in Section V C, "Programmed Stops and Restarts").

As each activity card is read and approved by the edit the expected time and variance are computed. The formulae, derived from the Beta distribution, are

$$\text{Expected time } D = \frac{a + 4m + b}{6}$$

$$\text{Variance} = \left(\frac{b-a}{6}\right)^2$$

where a = optimistic time
m = most likely time
b = pessimistic time

Note: These statistical computations are not made if only one time estimate is used.

B. Phase I - Input Routine (Cont'd.)

After these values are calculated, a 23 digit record is constructed for each activity.

These records appear in the same sequence in memory as the input activity cards.

The first activity record is in memory locations 04000 to 04022, the next in 04023 to 04045, and so on. With proper care these records as well as the rest of the program are relocatable by reassembling the SPS program. (See Section VI A)

The form of each activity record upon completion of the Input Routine is

Positions	Format	Symbol	Description
1-4	$\overline{X}XXX$	EP	Predecessor event
5-8	$\overline{X}XXX$	ES	Successor event
9-11	$\overline{X}XX$		Variance, XX.X weeks. $\overline{0}$00 if only one time estimate is used.)
12-14	$\overline{X}XX$		Expected time, XX.X Weeks
15-17	$\overline{0}$00	AP	Initially reserved for the number of the activity preceding this one in topological order.*
18-20	$\overline{0}$00	AS	Reserved for the number of the activity succeeding this one in topological order.*
21-23	$\overline{0}$00	M	Initially reserved for a count of the number of times the activity is "moved" during the ranking (TOP THREAD) phase of the program.

NOTE: Activity records are set up in memory only for activities whose status is scheduled (S) or not scheduled (blank), not for completed (C) activities.

* See Section II C for a brief explanation of topological ordering.

II.

C. Phase II - TOPTHREAD

The purpose of this phase is to sequence the activities in the order which is necessary for the subsequent PERT computations, specifically for the Backward Pass and the Forward Pass to determine the earliest and latest completion dates. The method is described by Lasser in "Communications of the ACM", April, 1961, and by the author in the paper "TOPTHREAD" contained in the published papers of the First IBM Systems Engineering Symposium (1961).

Briefly, the TOPTHREAD phase arranges the activities in topological order which is the order essential to further computation. For this purpose, topological order is defined by these two requirements.

1. All activities beginning at the same event will be listed consecutively.

2. Each activity will be listed before all the activities which follow it either directly or indirectly in the network.

Instead of actually rearranging the activity records in memory two "threaded lists" are used. First the activities are numbered sequentially by the program from one to N, the number of activities. This number is conceptual only and does not appear in the activity record. The TOPTHREAD program then places two "tags" in each activity record. One tag (AS) is the number of the activity succeeding this one in topological order. The other tag (AP) is the number of the activity preceding this one in topological order. Thus beginning with an activity in the network it is possible to thread through all the remaining activities to the last activity by "chaining" from activity to activity by using the AS tag. Similarly one can thread backwards from any activity to the first activity using the AP tag. Both the Backward Pass and the Forward Pass make use of the threaded lists.

This method of ranking allows the events to be numbered at random (theoretically the events could be alphanumerically identified). The method also allows more than one event without a predecessor event as well as more than one event without a successor event. These facts may facilitate 1) partitioning of large networks into smaller ones, 2) grouping of sub-networks into larger ones and 3) the processing of multi-project networks. The technique can actually handle several independent networks simultaneously.

Upon completion of TOPTHREAD the 23 digit activity records contain new data in the AP, AS, and M fields. AP (positions 15-17) contains the number of the preceding activity in topological order. AP of the

II C.

Phase II - TOPTHREAD (Cont'd.)

first activity is zero. AS (positions 18-20) contains the number of the succeeding activity in topological order. AS of the last activity is N+1. M (positions 21-23) is a count of the number of times an activity is "moved" in setting up the topological order.

If an activity is moved more than N times (N is the number of activities in the network) during the TOPTHREAD phase it is in a "closed loop", that is, the activity is its own direct or indirect successor. This may result from 1) improperly punched data, 2) an improperly defined network, or 3) more than one event defined by the same number. If this situation arises, the message IN CLOSED LOOP will be printed preceded by the EP and ESof the activity in the closed loop. Processing stops with a complete restart required when the situation has been corrected.

II D. Phase III - The Backward Pass

The purpose of the Backward Pass is to determine the latest allowable finish time (AFT). It does this by starting with the last activity and working its way back along each path until it reaches the first activity.

Before proceeding with the Backward Pass, the program determines the total number of weeks allowed for the entire network by converting the start and finish dates supplied on the header card to weeks and taking the difference. The message PROJECT EXCEEDS 199.8 WEEKS indicates the project is too long and must be reduced to 199.8 weeks or less. The latest allowable finish time of the last activity and the AFT's of all preceding activities are determined starting with 99.9 weeks as the AFT of the last activity and all activities without successor activities.

Starting with this last activity the program threads its way backward through the activities in topological order. As it encounters each activity for the first time, it starts at that activity and threads its way forward through the activity list topoligically until it finds a group of one or more activities all beginning at the successor event of the activity which it has encountered for the first time. (In the Fortran program the index K refers to the activity being encountered the first time in the backward thread. The index I refers to the activities which are checked each time the list is scanned with a forward thread. Thus we seek the group of consecutive activities whose $EP_i = ES_k$.) If no such group is found, i.e., the activity has no successor, the activity is assigned the same AFT as the last activity in the project. If such a group of activities is found (as is normally the case) the activity (K) is assigned an AFT which is the minimum time TMIN of the differences of each AFT in the group and its corresponding expected time D (duration time).

$$AFT_k = \min_{\text{all } i} (AFT_i - D_i)$$

where i is defined by

$$EP_i = ES_k \text{ for each activity } k$$

Upon completion of the Backward Pass the last three digits of each activity record (previously occupied by the move count M) now contain the AFT's of each activity in weeks (XX.X) relative to 99.9 weeks.

After completing the Backward Pass the total number of events without direct successor events is indicated by the message XXX TERMINAL EVENTS.

II

E. Phase IV - The Forward Pass

The purpose of the Forward Pass is to determine the earliest start time EST of each activity. From this the output routine will add the expected time D to the EST to establish the earliest finish time; i.e., the expected completion date. In addition, the Forward Pass determines the sum of the variances of all the activities along the longest path through and including each activity. The message CUMULATIVE VARIANCE EXCEEDS 999.9 WEEKS will type out if the variance along any path exceeds 999.9 weeks.

After finding the first group of activities with the same predecessor event in the list in the topological ordering and assigning them an EST of -99.9, the Forward Pass threads through the topological list in a forward direction (on index K). As each activity group is encountered for the first time, the program again returns to the first activity topologically and searches through the topological list of every activity (using index I) from the first to the group being encountered for the first time seeking all activities whose successor events ES_i are equal to the predecessor event EP_k of the group. The maximum value of the individual sums of the EST plus the D of each activity satisfying this condition is assigned as the EST of each activity in the group.

Thus

$$EST_k = \text{Max}\ (EST_i + D_i)$$

where i is defined to satisfy the relation

$$EP_k = ES_i$$

for any activity k.

Upon completion of the Forward Pass, the record for each activity has two new entries. The value of EST in weeks (XX.X) relative to the start of the project at time -99.9 weeks is in positions 15-17, replacing the backward threaded list AS. The value of the cumulative variance along the longest path to the end of that activity is in positions 1-4 expressed in weeks XXX.X. The variance replaces the predecessor event number EP.

The total number of events without predecessor events is indicated by the message XXX ORIGINATING EVENTS.

II

F. Phase V - The Output Routine

The purpose of the output routine is to punch or type the output in a form which includes for each activity the values of the

1) Input data
2) Expected time in weeks (XX.X)
3) Slack time in weeks (XX.X)
4) Cumulative variance in weeks (XXX.X)
5) Expected completion date (Mo/day/yr) i.e., the earliest finish time
6) Latest allowable completion date (mo/day/hr), i.e., latest finish time.
7) Probability (X.XX) of meeting the scheduled completion date if one is specified.

In the case of completed activities (status C) only the input information is included in the output.

Program switches 1 and 2 affect the output routine. Switch 1 OFF is normal when three time estimates are used. With Switch 1 ON only one time estimate is used and hence the probability calculation is ignored. With Switch 2 OFF the 80 character output record will be punched; with Switch 2 ON the output record will be typed.

The initialization portion of the output routine checks for the header card and punches it if Switch 2 is OFF. If a typed report is desired, the headings are printed. The base addresses of the fields in the activity records are set up for sequential output of the activity information.

Expected completion date for each activity is determined by adding the earliest start time EST to the expected duration time D (plus 99.9) to compute the earliest finish time EXPTIM. This value, relative to a "time now" of zero, is made relative to the project start date and then converted to a date by the MODAYR subroutine.

II

F. Phase V - The Output Routine (Cont'd.)

The slack time SLACK is derived by subtracting the EXPTIM from the latest finish time AFT. The slack time may be negative since the AFT is determined from the project finish date. A negative slack time implies that that activity is behind schedule if we expect to meet the project finish date. Similarly all slacks may be greater than zero. This implies the entire project is ahead of schedule. All activities which have the minimum value of all the slacks for that network are on the critical path.

The cumulative variance is the sum of all variances along the longest path up to and including that activity. The significance of the cumulative variance is, first, a measure of the uncertainty of completing the activity on the expected completion date. The larger the valve of the variance, the less certain one is of meeting the expected completion date. Second, the cumulative variance is needed because the completion of the activity is dependent on previous activities.

The probability of meeting the scheduled completion date is calculated by PSCHED only when an activity with status S having three time estimates is encountered. The formula used is the familiar one:

$$\text{Probability} = \not{\emptyset}\ \left(\frac{Ts - Te}{\sigma}\right) = \not{\emptyset}\ (Z)$$

where $\sigma = \sqrt{\text{Cumulative Variance}}$

The square root of the variance is taken by PSQRT. PSIG computes the standardized variable Z. The routine beginning at label P 12 determines the probability using a Hastings approximation.

II

G. Miscellaneous Subroutines

Incorporated into the preceding programs which make up 1620 PERT are a number of routines which are either written in subroutine form suitable for use with a BT of BTM linkage or are written in a form separate from the rest of the program which might be adapted to subroutine form.

Except for the MO/DA/YR TO DAYS sequence which may be found immediately following the TOPTHREAD routine, all the subroutines are in the Output Routine.

Specifically, these include:

1. MO/DA/YR TO DAYS
   Conversion of a calendar date from Month/day/year to the number of days from the base date January 1, 1960 to that date based on a 7 day week. The entry is at MBEGIN p.20, 1.030.

2. DAYS TO MO/DA/YR
   Conversion of a number of days with base date January 1, 1960 to the corresponding calendar date based on a seven day week. Entry instruction is BT MODAYR, DAYSFIELD. Routine starts at MODAYR p.47, 1.020.

3. Numeric to alpha conversion
   Changes numeric field to double digit form suitable for alphabetic output. Entry instruction is BT NTOA, NFIELD. Routine starts on p.40,1.010.

4. Alpha to numeric conversion
   Changes a numeric field in double digit alphabetic form to single digit numeric form suitable for arithmetic use. Entry instruction is BT ATON, AFIELD. Routine begins on p.40, 1.250.

5. Fixed point square root
   Routine begins at PSQRT with argument at XO in the form XX.XXXX. Square root is placed in XO in same form.

6. Fixed point probability calculation using normal curve
   This routine begins on p.45, 1.070 with the argument in Z in the form X.XXXX. Probability at exit (p.45,1.374) is placed in Z in same form X.XXXX.

III Input/Output

A. Input Formats

The input includes a header card (status H), one activity card (status C, S, or "blank") for each activity, and an END (status E) card in that order. The formats are:

1. Header Card - Status H

Cols.	Description
1 - 4	Network number - 4 digits XXXX
5 - 8	Number of activities - 4 digits XXXX or blank
9 - 11	Case number of network to identify the run.
18	H - Status Code
19 - 24	Date of computer run XX/XX/XX
25 - 55	Network Title
69 - 74	Network start date - "Time now" XX/XX/XX
75 - 80	Network finish date - XX/XX/XX

If the number of activities are specified, it must be the total count of all status C, S, and "Blank" cards. Any discrepancy with this count is detected by the Input Routine and processing is stopped. If an activity count check by the Input Routine is not desired, this field may be left blank or filled with zeros.

2. Activity Cards - status "blank"

Cols.	Description
1 - 4	Predecessor event number XXXX
5 - 8	Successor event number XXXX
9 - 11	Optimistic time estimate XX.X Weeks

III

A. Input Formats (Cont'd.)

Cols.	Description
12 - 14	Most likely time estimate XX.X Weeks
15 - 17	Pessimistic time estimate XX.X Weeks
18	"Blank"
19 - 24	Blank
25 - 55	Activity Description
56 - 80	Anything - This area ignored by the program.

3. Scheduled activity cards - Status S

These are the same as status "blank" activity cards except that Column 18 contains an S and the scheduled date for completing the activity is punched in columns 19 - 24 in the form mo/day/yr XX/XX/XX.

4. Completed activity cards - Status C

These are the same as status "blank" activity cards except that column 18 contains a C and the date the activity was completed is punched in columns 19 - 24 in the form mo/day/yr XX/XX/XX. Completed activity cards are included only so that they may be readily incorporated in the output listing.

5. END CARD

This must be the last card of the data and must have an E in Column 18. It is recommended that the word END be punched in columns 18 - 20 although an E in column 18 is sufficient.

III Input/Output

B. Output Formats

1. Card output - Program Switch 2 OFF.

The header card is duplicated and becomes the first output card. There is one output activity card punched for each input activity card.

Activities will be in the same order for both input and output, namely ascending numeric sequence sorting on columns 1 to 8. Columns 1 through 55 of the output activity cards contain the information duplicated from columns 1 - 55 of the input activity cards. The remaining columns in the output cards include:

Cols.	Description
56 - 58	Expected time in XX.X weeks. This is the weighted average of the three time estimates.
59 - 61	Slack time in XX.X weeks
62 - 65	Cumulative variance along the longest path to the completion of that activity in XX.X weeks.
66 - 68	Probability X.XX of meeting the scheduled completion date for scheduled activities only (status S). Blank for all others.
69 - 74	Expected completion date mo/day/yr XX/XX/XX.
75 - 80	Latest allowable completion date mo/da/yr XX/XX/XX.

The END card is not included in the output.

2. Typed Output - Program Switch 2 ON

The progress of computation is monitored by the typewriter. Header card data is printed to indicate the start of computation. Any error messages are printed following this and are explained elsewhere in this write-up. Following this the operator has the option to punch or type the output data (controlled by Switch 2). With Switch 2 ON two lines of heading will be printed followed by the 80 character activity records which have the identical form as the card output formats.

If the slack is negative the units position of the slack field will be an alphabetic character since output is typed in the alphabetic mode. Upon satisfactory completion of the program, the message THE END will type.

III

Input/Output

C. I/O Formats for a Single Time Estimate

The user has the option to use only one time estimate instead of three. Naturally all statistical calculations are bypassed then by the program. If Program Switch 1 is ON 1620 PERT uses only one time estimate; with Switch 1 OFF, 1620 PERT uses three estimates.

1. Input formats for one time estimate

The input is the same as for three time estimates except:

The single time estimate is punched in columns 12 - 14 (where the Most Likely estimate is usually punched. The other time estimate fields (Columns 9 - 11 and 15 - 17) are ignored by the program and may contain anything.

2. Output formats for one time estimate:

The output is identical to that when three estimates are used except:

a. The single time estimate is punched in cols. 56 - 58 (which contained the Expected Time otherwise).

b. For scheduled activities (Status S) the probability is always left blank since it is not computed.

IV. Operating Instructions

A. Console Switch Settings

Set PARITY and I/O switches to STOP

Set OFLOW to PROGRAM

	OFF	ON
PS1	Three time estimates used	Only one time estimate used
PS2	Output on Punched cards	Output on typewriter
PS3	Not used	Not used
PS4	Stops on input error	Edits all input data
	Proceeds if no errors	Proceeds with computations if no errors occur.

B. Operating Procedure

1. Clear Memory
2. Set console switches.
3. Ready typewriter for 80 character line. No tabs required.
4. Ready card punch with blank cards if punched output is desired.
5. Place program and data cards in read hopper in the following order:
   a. Input Routine program deck
   b. Data deck in this order:
      1) Header card - "H" in column 18
      2) All activity cards sorted in ascending sequence on columns 1 through 8, succeeding event ES within preceding event EP.
      3) END Card - "E" in column 18
   c. The remaining program decks in this order.
      1) TOPTHREAD
      2) Backward Pass
      3) Forward Pass
      4) Output Routine
6. Depress RESET on the console; then press the LOAD key on the Card Reader.
7. Anytime after all the data cards have been read remove them from their place behind the Input Routine and put them in the read hopper behind the last card in the Output Routine program deck.
8. Press READER START on the Card Read Punch to process remaining data cards. THE END should print on the typewriter to signify completion of the processing.

IV. Operating Instructions

C. Programmed Stops and Restarts.

In general all programmed stops should be referred to the PERT analyst for appropriate action as described in Section II.

With Switch 4 on the input data will be edited. If the data is all satisfactory processing will continue with no messages printed out. If the input data is not satisfactory, appropriate error messages will be printed out and editing will continue until all the data cards have been read at which time the message ERROR, START NEXT NETWORK will appear calling for the next network.

With Switch 4 OFF the program halts as soon as the error is detected. If the situation can be corrected without affecting any data cards prior to the one in which the error was discovered (the second from last in the normal read stacker) the remaining data cards beginning with the one in error may be placed back in the read hopper after making the necessary correction. Follow Restart Procedure 3.

Four restart procedures are possible.

1. Complete restart at beginning after making corrections.
2. Restart by reloading complete data deck.
   a. Run the remaining cards out of the read hopper, with the Non-Process Runout key.
   b. Clear the punch feed of cards.
   c. Place the complete data deck (either the present network with corrections or an entirely new network) in the read hopper followed as usual by the rest of the 1620 PERT program deck (if any program cards remain in the read hopper).
   d. Press READER START and console START to continue processing.
3. Restart by loading remaining data deck after corrections are made.
   a. Run the remaining cards out of the read hopper.
   b. The second from last card in the normal read stacker is the card which caused the error. Starting with this card be sure there are no duplicate activities defined and all activity cards must be in sequence.

IV.

C. Programmed Stops and Restarts (Cont'd.)

c. Place these cards back in the reader hopper then press READER START AND console START

4. No restart, processing continues.

Some messages are for monitoring the progress of the program or indicate possible error conditions. Processing continues automatically after the message types out.

Here is a list of programmed messages, the phase in which they can occur, the appropriate restart procedure to be used (describer above) and the Section elsewhere in the write-up where they are more fully described.

PHASE	MESSAGE	RESTART	REFERENCE SECTION
1	NO HEADER CARD, START AGAIN	2	II B
1	CARD OUT OF SEQUENCE (SWITCH 4 OFF)	3 or 1	II B
1	CARD OUT OF SEQUENCE (SWITCH 4 ON)	2	
1	DUPLICATE ACTIVITY (SWITCH 4 OFF)	3 or 1	II B
1	DUPLICATE ACTIVITY (SWITCH 4 ON)	2	
1	CHECK ESTIMATES	4	II B
1	EXTRA CARD(S)	2	II B
1	CARD(S) MISSING	2	II B
1	ERROR, START NEXT NETWORK	2	II B
1	NETWORK EXCEEDS MEMORY CAPACITY	1	II B
2	IN CLOSED LOOP	1	II C
3	XXX TERMINAL EVENTS	4	II D
3	PROJECT EXCEEDS 199.8 WEEKS	1	II D
4	XXX ORIGINATING EVENTS	4	II E
4	CUMULATIVE VARIANCE EXCEEDS 999.9 WEEKS	1	II E
5	CD SEQ ERR	2	
5	THE END	4	

IV. Operating Instructions

D. Off-Line Processing Procedures

The basic procedure for processing cards is:

1. Sort the input activity cards numerically in ascending order on the first 8 card columns. A digit sort beginning in columns 8, 7, 6, 5, 4, 3, 2, 1 is required. The header card should be placed at the beginning of the deck and the END card at the end of the deck after the sort.

2. Process the input activity cards through the 1620 by the procedure described above, in IV.A and IV.B.

3. Using a sorter and a printer (a 407 printer control panel wiring diagram is described in Section VIII) a variety of reports can be made from the output activity cards by sorting in different orders. The most important is usually the listing of the activities from the most critical activity to the least critical activity. Another useful report lists the output activity cards in order of Latest Allowable Completion Date. Still other reports may prove useful to the user. In each case the header card should be removed before the output deck is sorted. After sorting, replace the header card at the beginning of the deck. If additional heading information is desired, an unlimited number of heading cards may be placed in front of the header card. The format for these heading cards is

col. 18 - the letter "H"

cols. 25 - 55 - the heading information

all other columns must be blank.

The sorting procedures for the two reports mentioned are as follows:

a. Activity Listing by Latest Allowable Completion Date.

1) Select all the Completed Activity cards from the deck by sorting out those cards with a "C" in column 18. You may wish to eliminate these activities from the listing or place them behind the sorted deck so they appear at the bottom of the listing.

IV.

D. Off-Line Processing Procedures (Cont'd.)

2) The Latest Allowable Completion Date is in mo/day/yr order in columns 75 - 80. Sort this date in ascending numeric order with day as the minor field (cols 77 - 78), month as the intermediate field (cols 75 - 76) and year as the major field (cols. 79 - 80). In other words, a digit sort in column sequence 78-77-76-75-80-79 is required.

b. Activity Listing by Most Critical Activity to Least Critical Activity will be listed in critical path.

This Listing is made by sorting from least slack time to most slack time. The 3 digit slack field is located in card columns 59 - 61. Remember that in 1620 PERT slack may be negative. This is indicated by an x-punch in column 61.

It is recommended that the sort on slack time be made after the sort or Latest Allowable Completion Date. If this is done activities will be listed in path sequence on the Criticality Report.

1) Separate the activity cards with an x-punch in column 61 from those with no x-punch in 61. The cards with an x-punch have negative slack.

2) Sort the cards with x-punch in 61 in reverse (descending) numeric sequence on the field in cols. 59 - 61.

3) Sort the remaining cards in normal (ascending) numeric sequence, on the field in columns 59 - 61 and place this sorted deck behind the sorted negative slack cards.

4) List the entire deck on the printer after placing the desired heading cards at the front of the deck.

V. Sample Problem

The card deck which you have received from the Program Library includes:

1. Deck 1 - Phase 1 - (Condensed SPS Object Program)
2. Sample Problem Input Date
3. DECK II - Phases 2, 3, 4, 5 (condensed SPS object programs)
4. Source Programs - Phases 1 - 5

A. A PERT Network - The Complete Project

Figure V.1 is an example of a small PERT network patterned after a similar network described in "Critical-Path Planning and Scheduling" by J. E. Kelly, Jr., and M R. Walker, Mauchly Associates, Inc. Note that events have been numbered randomly without regard for missing numbers. Associated with each activity is three time estimates--optimistic, most likely, and pessimistic, in that order--which are expressed in weeks. Figure V.2 is a 1620 PERT data sheet as it might be filled in by the PERT analyst. In Figure V.3 is a 407 listing of the input data in proper (ascending) sequence. Figure V.4 is the output as it would be typed on the typewriter. Figure V.5 shows the same output arranged in order from most critical activity to least critical activity (output cards sorted on SLACK cols. 59-61). The first three lines of the output listing are created by three cards which have the corresponding information punched in columns 25-55 and on H in column 18. These three cards (or any other appropriate ones) may be inserted ahead of the output data deck to improve the report.

In output is on punched cards other sequences may be chosen by sorting on the appropriate columns. Figure V.6 is a listing of the same output data listed by latest allowable completion time.

B. The Project Partially Completed

In figure V.7 we see the PERT network as it may appear shortly after the project has begun. Activities 5, 13, and 17 are now complete and activity 16 has new time estimates because it is partially complete. Figure V.8 is a listing in criticality order. The cards for the completed activities have been included in the listing.

C. A Partitioned Network

In some instances it may become necessary to process a network which is really a part of a larger network. An example of such a partitioned network is illustrated in Figure V.9. It is a reduced form of the network of Figure V.I with Activities 1, 2, 3, 10, 11, 12, 14, and 15 omitted. Figure V.10 shows the output of 1620 PERT using the same data cards as in the previous network except for the omission of those we have mentioned.

VI Maintenance

A. Comments on Making Changes to 1620 PERT

The objective in programming 1620 PERT was to provide the user with a program which would handle randomly numbered events and would provide a variety of PERT management reports comparable to those currently in use in most government projects. For this reason 1620 PERT was written for the card 1620 using the TOP-THREAD technique for ranking with sole concern for handling the time factor only, not cost, manpower scheduling, reliability indexes or other resource factors.

Both new and old uses of the PERT method may demand modifications to be made to 1620 PERT. Some changes may be readily incorporated; others will require a major program revision. The following remarks are given to provide the user who desires to modify the program some insight into the scope of effort required for certain changes and into the considerations inherent in these changes. Note that these remarks are not necessarily complete.

Most changes will probably occur in input/output requirements. These will involve only the Input Routine and the Output Routine and are described in this and the other two parts of this section.

Most other changes, that is, those affecting Phases II, III, and IV (TOPTHREAD, the Backward Pass, and the Forward Pass) will require a major change in the program. Specifically any change involving the lengthening of a field (e.g. event numbers greater than 4 digits, time estimates greater than 3 digits, total project time greater than 199.9 weeks, or more than 999 activities) will cause a major change in these three phases and will not be discussed here.

Each of the five phases is a completely separate program and can be assembled separately in SPS. The provisions for making a change in one phase without affecting the others are:

1. The activity records as they appear at the completion of the previous Phase must remain in memory (location 04000 ff.) since the Phase being changed depends on the output format of the previous Phase which is given in Section II.

A. Comments on Making Changes to 1620 PERT (Cont'd.)

2. Similarly the succeeding Phase requires the output of the Phase being changed (the updated activity records) to be in the same format as specified in Section II.

3. The same remarks that apply to the activity records also apply to the data area which occupies locations 03943 to 03998 in all five Phases. That is, the fields in this area are common to all phases and must be included in each phase.

4. Be careful not to use the symbols referring to the activity records and data area in the Phase being changed for other uses.

5. No one Phase may exceed position 03999 exclusive of activity records. If a modification of any Phase requires that Phase to occupy more than 4000 positions, all the Phases should be reassembled separately after the following changes are made to the SPS source program:

   l) The operand of the last DORG card in each Phase should be changed from 4000 to the address of the beginning of the first activity record after the change. For example, if a change in Phase V (the Output Routine) requires Phase V to occupy positions 00000 through 04499, then the card with page and line number 99029 in each Phase should have the operand changed from 4000 4500. Similarly, the DORG card 98100 in each Phase should have its operand incremented from 3948 by the same amount. In our example, where the program was expanded by 500 positions, this change would be from 3948 to 4448.

6. After reassembling and condensing, be sure columns 1 and 2 of the last card in each Phase contain "41" not "48". Otherwise a programmed halt will occur at the end of each Phase.

To modify 1620 PERT for 40K and 60K machines, change the operand in card number 91140 in Phase I (the Input Routine) from 20000 to 26077. Although the capacity of the machine is larger, the nature of the program prohibits a larger number from being used. This allows for a maximum of 999 activities. (This change can be made to the Phase I condensed SPS deck by changing columns 33-37 in card 00022 from 19988 to 26054 .

VI.

B. Incorporating Changes into the Input Routine

Changes should be made in accordance with the requirements listed above in Section VI A. Be sure the activity records are set up by the Input Routine in the form described in Section II B.

If a change is made in the format of the input activity cards, remember that the Ouput Routine is based on the same format since the activity cards are passed through the 1620 a second time to obtain descriptive information from them. Actually the event numbers (cols. 1-8), the status code (col. 18), the scheduled or completion date (cols. 19-24) and the activity description (col. 25-55) are the only card fields which the Output Routine requires. Other columns may be used as desired without affecting anything but the Input Routine.

Columns 56 through 80 of the input activity cards are not used by the Input Routine and may be used for other identification purposes.

If a major revision in card input format is required carefully consider writing a program to convert to the format required by 1620 PERT rather than modifying both the Input Routine and Output Routine. This would likely be the simplest way of obtaining compatibility with the two-card format frequently used by programs written for larger computers.

VI.

C. Incorporating Changes in the Output Routine

Many of the remarks in Sections VI A and VI B also apply here and should be reviewed before modifying the Output Routine. 1620 PERT emphasises completion dates. Normal output includes the Earliest Expected Completion Date (Earliest Finish Time EFT when refering to Critical Path Scheduling or LESS programs) and the Latest Allowable Completion Date (Latest Finish Time LFT in LESS programs). LESS programs also include the Earliest Start Time EST and the Latest Start Time LST. Both of these times can be calculated in the Output Routine. The EST is immediately available in positions 15 - 17 of each activity record. The LST can be calculated by subtracting the Expected Time (average of the three time estimates) from the Latest Allowable Completion time. This calculation may be made by incorporating the proper instructions in the SPS source program after the instruction at PCALC + 36. Conversion of both the EST and LST to a date in 1620 double digit form suitable for output should be made after the instruction at PNOTSC + 60 following the 3-instruction method used for the Expected Completion Date (EXPTIM) and the Latest Allowable Completion Date (AFTADD) in the first six instructions of PNOTSC. The Output Routine works on only one activity record at a time. When the completed record for an activity is punched it begins processing the next activity. The addresses of the fields in question for an activity at any given time are located at the following symbolic locations:

ESTADD	address of EST
DADD	address of the expected time (duration time D)
AFTADD	address of Latest Allowable Completion time (AFT or LFT)
EXPTIM	Expected Completion Time
MODAYR	entry to the MODAYR subroutine to convert to a date
NTOA	entry to a Numeric to Alpha subroutine.
PRINT + 2	Corresponds to the first column of the output activity card.

VIII A 407 Panel for Listing 1620 Input and Output Data.

The 407 PERT BOARD assumes that all non-activity cards (i.e. Header Cards) have an "H" in Card Col. 18.

If there are no header cards it will be necessary to place a blank card with an "H" in cc. 18 ahead of the other cards.

Alter SW #1 Off: Gives the Pre List

On: Gives the Post List

Alter SW #2 Off: Single Space

On: Double Space

A Carriage tape must contain a one punch for the first printing line and a twelve punch for overflow.

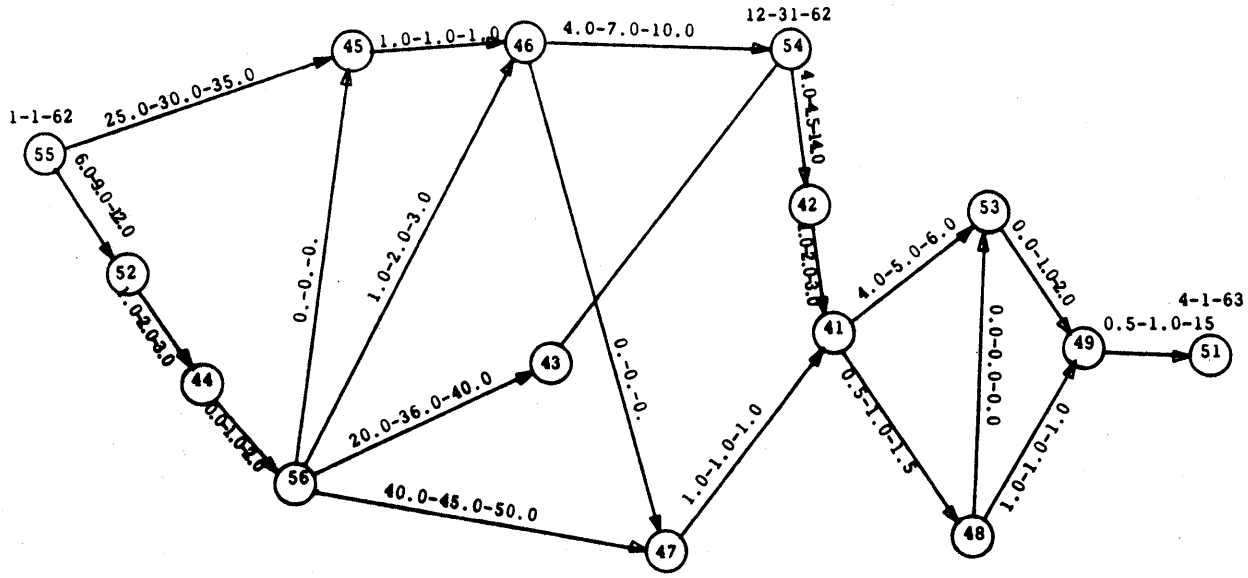

Figure V.1 A Small PERT Network - Complete Project

1620 PERT

NETWORK NO. 7777 NO. OF ACTIVITIES 211 CASE NO. 001 PAGE 1 OF 1

NETWORK TITLE TEST NETWORK ANALYST

RUN DATE (M-D-Y) 121061 START DATE (M-D-Y) 010162 FINISH DATE (M-D-Y) 041063

STATUS CODES (COL. 18) C-COMPLETED ACTIVITY S-SCHEDULED ACTIVITY BLANK-NON-SCHEDULED ACTIVITY

EVENTS BEGIN	EVENTS END	TIMES (WEEKS) OPT	TIMES (WEEKS) Likely	TIMES (WEEKS) Pess		Sched. of completion date (M-D-Y)	ACTIVITY DESCRIPTION	COMMENTS (not punched)
0055	0045	2.5	3.0	3.5			ACT 16	
0045	0046	0.1	0.1	0.1			ACT 6	
0046	0054	0.4	0.7	1.0	S	123162	ACT 8	
0054	0042	0.4	0.45	1.4			ACT 15	
0042	0041	0.1	0.2	0.3			ACT 3	
0055	0052	0.6	0.9	1.2			ACT 17	
0052	0044	0.1	0.2	0.3			ACT 13	
0044	0056	0.0	0.1	0.2			ACT 5	
0056	0045	0.0	0.0	0.0			ACT 19	
0056	0046	0.1	0.2	0.3			ACT 20	
0046	0047	0.0	0.0	0.0			ACT 7	
0056	0043	2.0	3.6	4.0			ACT 18	
0043	0054	0.2	0.8	0.8			ACT 4	
0056	0047	4.0	4.5	5.0			ACT 14	
0047	0041	0.1	0.1	0.1			ACT 9	
0041	0053	0.4	0.5	0.6			ACT 2	
0041	0048	0.05	0.1	0.15			ACT 1 V 1 T Y 1	
0048	0053	0.0	0.0	0.0			ACT 11	
0048	0049	0.1	0.1	0.1			ACT 10	
0049	0051	0.05	0.1	0.15	S	061063	ACT 12	

FIGURE V.2

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1620 PERT

Network No. Number of Activities Case No. Page of

Network Title Analyst

Run Date (M-D-Y) Start Date (M-D-Y) Finish Date (M-D-Y)

Status Codes (Col. 18) C-Completed Activity S-Scheduled Activity blank-Non-Scheduled Activity

Events Begin	Events End	Times (Weeks) Opt	Likely	Pess		Sched. of completion date (M-D-Y)	Activity Description	Comments (Not Punched)

34

Top

7777 21 TEST NETWORK 1 4 01 63 1 01 62 3 15 62

1620 PERT PAGE 1

EVENT PREC	EVENT SUCC	ACTIVITY	OPTIM	LIKELY	PESS	STS	SCHED
41	48	ACTIVITY 1	.5	1.0	1.5		
41	53	ACT 2	4.0	5.0	6.0		
42	41	ACT 3	1.0	2.0	3.0		
43	54	ACT 4	2.0	8.0	8.0		
44	56	ACT 5	.0	1.0	2.0		
45	46	ACT 6	1.0	1.0	1.0		
46	47	ACT 7	.0	.0	.0		
46	54	ACT 8	4.0	7.0	10.0	S	12 31 62
47	41	ACT 9	1.0	1.0	1.0		
48	49	ACT 10	1.0	1.0	1.0		
48	53	ACT 11	.0	.0	.0		
49	51	ACT 12	.5	1.0	1.5	S	4 01 63
52	44	ACT 13	1.0	2.0	3.0		
53	49	ACT 14	.0	1.0	2.0		
54	42	ACT 15	4.0	4.5	14.0		
55	45	ACT 16	25.0	30.0	35.0		
55	52	ACT 17	6.0	9.0	12.0		
56	43	ACT 18	20.0	36.0	40.0		
56	45	ACT 19	.0	.0	.0		
56	46	ACT 20	1.0	2.0	3.0		
56	47	ACT 21	40.0	45.0	50.0		
						E	ND

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Figure V.3

35

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```
NETWORK  CASE  TITLE                                NO. OF ACT.  RUN     START   FINISH
 7777     001  TEST NETWORK                              21     031562  010162  040163

Ø01 TERMINAL EVENTS     Ø01 ORIGINATING EVENTS

 EVENTS   TIMES   S OR C   ACTIVITY DESCRIPTION        EXPSLKTOT PRBXPECTDLATEST
PREDSUCCOPTLIKPES MODAYR                               TIM    VAR   MODAYRMODAYR

00410048005010015          ACTIVITY 1                  0100100162    031163031863
00410053040050060          ACT 2                       05003-0163    040863031863
00420041010020030          ACT 3                       02003-0162    030463021163
00430054020080080          ACT 4                       07003-0133    010763121762
00440056000010020          ACT 5                       01003-0012    032662030562
00450046010010010          ACT 6                       0101200028    080662102962
00460047000000000          ACT 7                       0002600028    080662020463
00460054040070100S123162ACT 8                          0701200038100092462121762
00470041010010010          ACT 9                       0100000040    021163021163
00480049010010010          ACT 10                      0100100162    031863032563
00480053000000000          ACT 11                      0000100162    031163031863
00490051005010015S040163ACT 12                         01003-0164023042263040163
00520044010020030          ACT 13                      02003-0011    031962022662
00530049000010020          ACT 14                      01003-0164    041563032563
00540042040045140          ACT 15                      06003-0161    021863012863
00550045250300350          ACT 16                      3001200028    073062102262
00550052060090120          ACT 17                      09003-0010    030562021262
00560043200360400          ACT 18                      34003-0123    111962102962
00560045000000000          ACT 19                      0003000012    032662102262
00560046010020030          ACT 20                      0202900013    040962102962
00560047400450500          ACT 21                      4500000040    020463020463
THE END
```

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 21 TEST NETWORK 1 01 62 4 01 63 3 15 62

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EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PRO
55	52	ACT 17	9.0	3.0-	1.0		3 05 62	2 12 62		
52	44	ACT 13	2.0	3.0-	1.1		3 19 62	2 26 62		
44	56	ACT 5	1.0	3.0-	1.2		3 26 62	3 05 62		
56	45	ACT 16	30.0	3.0-	12.3		11 19 62	10 29 62		
49	54	ACT 4	7.0	3.0-	13.3		1 07 63	12 17 62		
54	42	ACT 15	6.0	3.0-	16.1		2 18 63	1 28 63		
42	41	ACT 3	2.0	3.0-	16.2		3 04 63	2 11 63		
41	53	ACT 2	5.0	3.0-	16.3		4 08 63	3 18 63		
53	49	ACT 14	1.0	3.0-	16.4		4 15 63	3 25 63		
49	51	ACT 12	1.0	3.0-	16.4	S	4 22 63	4 01 63	4 01 63	.23
56	47	ACT 21	45.0	.0	4.0		2 04 63	2 04 63		
47	41	ACT 9	1.0	.0	4.0		2 11 63	2 11 63		
41	48	ACTIVITY 1	1.0	1.0	16.2		3 11 63	3 18 63		
48	53	ACT 11	.0	1.0	16.2		3 11 63	3 18 63		
48	49	ACT 10	1.0	1.0	16.2		3 18 63	3 25 63		
44	46	ACT 18	34.0	3.0-	12.3		11 19 62	10 29 62		
46	54	ACT 8	7.0	12.0	3.8	S	9 24 62	12 17 62	12 31 62	1.00
56	46	ACT 20	2.0	29.0	1.3		4 09 62	10 29 62		
56	45	ACT 19	.0	30.0	1.2		3 26 62	10 22 62		

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Figure V.5

ACTIVITY LISTING BY
LATEST ALLOWABLE
COMPLETION DATE

777 21 TEST NETWORK 1 01 62 4 01 63 3 15 62

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EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PRO
55	52	ACT 17	9.0	3.0-	1.0		3 05 62	2 12 62		
52	44	ACT 13	2.0	3.0-	1.1		3 19 62	2 26 62		
44	56	ACT 5	1.0	3.0-	1.2		3 26 62	3 05 62		
55	45	ACT 16	30.0	12.0	2.8		7 30 62	10 22 62		
56	45	ACT 19	.0	30.0	1.2		3 26 62	10 22 62		
56	43	ACT 18	34.0	3.0-	12.3		11 19 62	10 29 62		
45	46	ACT 6	1.0	12.0	2.8		8 06 62	10 29 62		
56	46	ACT 20	2.0	29.0	1.3		4 09 62	10 29 62		
49	54	ACT 4	7.0	3.0-	13.3		1 07 63	12 17 62		
46	54	ACT 8	7.0	12.0	3.8	S	9 24 62	12 17 62	12 31 62	1.00
54	42	ACT 15	6.0	3.0-	16.1		2 18 63	1 28 63		
56	47	ACT 21	45.0	.0	4.0		2 04 63	2 04 63		
46	47	ACT 7	.0	26.0	2.8		8 06 62	2 04 63		
42	41	ACT 3	2.0	3.0-	16.2		3 04 63	2 11 63		
47	41	ACT 9	1.0	.0	4.0		2 11 63	2 11 63		
41	53	ACT 2	5.0	3.0-	16.3		4 08 63	3 18 63		
41	48	ACTIVITY 1	1.0	1.0	16.2		3 11 63	3 18 63		
48	53	ACT 11	.0	1.0	16.2		3 11 63	3 18 63		
53	49	ACT 14	1.0	3.0-	16.4		4 15 63	3 25 63		
48	49	ACT 10	1.0	1.0	16.2		3 18 63	3 25 63		
49	51	ACT 12	1.0	3.0-	16.4	S	4 22 63	4 01 63	4 01 63	.23

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Figure V.6

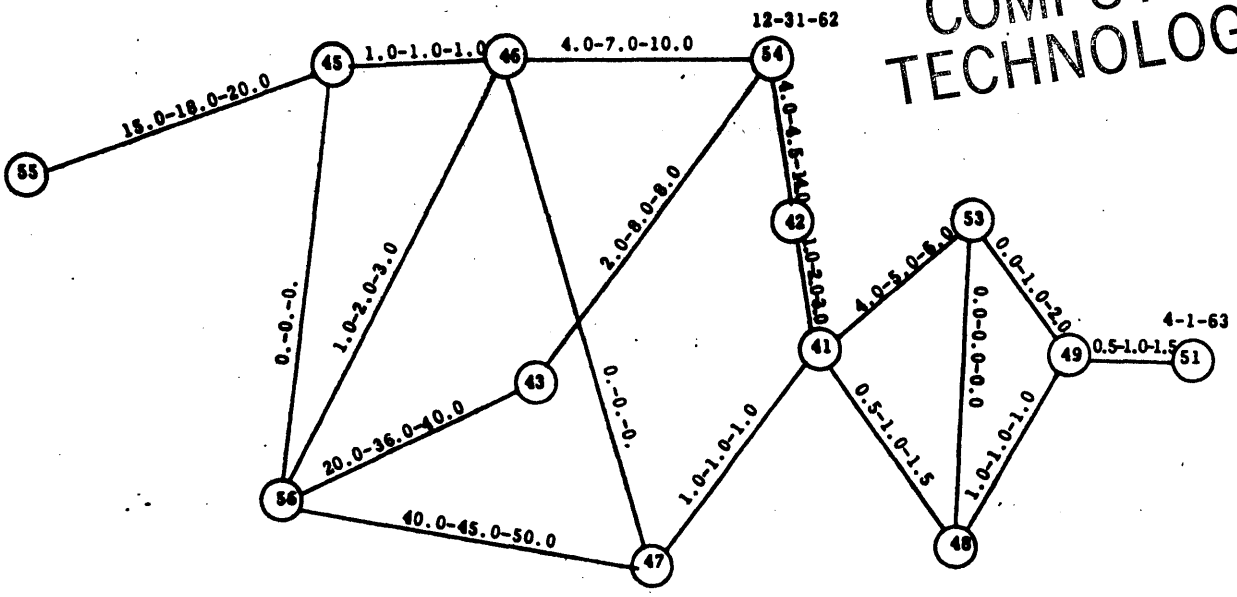

FIGURE V.7 THE PROJECT PARTIALLY COMPLETED

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 TEST NETWORK 3 15 62 4 01 63 3 15 62

1620 PERT PAGE 1

EVENT REC	SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PRO
56	44	ACT 18	34.0	1.4-	11.1		11 08 62	10 29 62		
44	54	ACT 4	7.0	1.4-	12.1		12 27 62	12 17 62		
46	47	ACT 15	6.0	1.4-	14.9		2 07 63	1 28 63		
42	41	ACT 3	2.0	1.4-	15.0		2 21 63	2 11 63		
41	53	ACT 2	5.0	1.4-	15.1		3 28 63	3 18 63		
53	49	ACT 14	1.0	1.4-	15.2		4 04 63	3 25 63		
49	51	ACT 12	1.0	1.4-	15.2	S	4 11 63	4 01 63	4 01 63	.93
55	45	ACT 16	30.0	1.6	2.8		10 11 62	10 22 62		
45	46	ACT 6	1.0	1.6	2.8		10 18 62	10 29 62		
46	54	ACT 8	7.0	1.6	2.8	S	12 06 62	12 17 62	12 31 62	.97
46	47	ACT 21	49.0	1.6	2.8		1 24 63	2 04 63		
47	41	ACT 9	1.0	1.6	2.8		1 31 63	2 11 63		
41	44	ACTIVITY 1	1.0	2.6	15.0		2 28 63	3 18 63		
48	53	ACT 11	.0	2.6	15.0		2 28 63	3 18 63		
44	49	ACT 10	1.0	2.6	15.0		3 07 63	3 25 63		
46	47	ACT 7	.0	15.6	2.8		10 18 62	2 04 63		
56	45	ACT 20	2.0	30.6	.1		9 29 62	10 29 62		
56	45	ACT 19	.0	31.6	.0		3 15 62	10 22 62		
44	56	ACT 5	•	•	•	C			3 15 62	
52	44	ACT 13	•	•	•	C			3 15 62	
54	52	ACT 17	•	•	•	C			3 15 62	

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Figure V.8

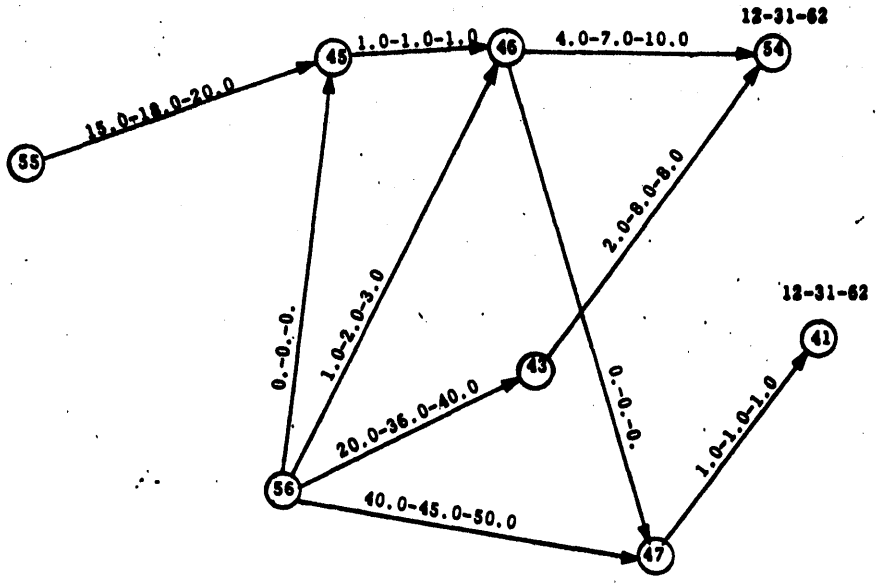

FIGURE V.9 A PARTITIONED NETWORK

ACTIVITY LISTING BY
MOST CRITICAL ACTIVITY TO
LEAST CRITICAL ACTIVITY

777 TEST NETWORK 3 15 62 1 01 63 3 15 62

1620 PERT PAGE 1

EVENT REC	EVENT SUCC	ACTIVITY	TIME	SLACK	VARI	STS	EXPECTED	LATEST	SCHED	PRO
56	47	ACT 21	45.0	4.3-	2.8		1 24 63	12 25 62		
47	41	ACT 9	1.0	4.3-	2.8		1 31 63	1 01 63		
56	43	ACT 18	34.0	.7	11.1		11 08 62	11 14 62		
43	54	ACT 4	7.0	.7	12.1		12 27 62	1 01 63		
45	45	ACT 16	30.0	3.7	2.8		10 11 62	11 06 62		
45	44	ACT 6	1.0	3.7	2.8		10 18 62	11 13 62		
45	54	ACT 8	7.0	3.7	3.8	S	12 06 62	1 01 63	12 31 62	.97
46	47	ACT 7	.0	9.7	2.8		10 18 62	12 25 62		
56	46	ACT 20	2.0	32.7	.1		3 29 62	11 13 62		
46	44	ACT 19	.0	33.7	.0		3 15 62	11 06 62		
44	54	ACT 5	.	.	.	C			3 15 62	
52	44	ACT 13	.	.	.	C			3 15 62	
54	52	ACT 17	.	.	.	C			3 15 62	

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Figure V.10

```
LOAD SOURCE DECK
THEN PUSH START
C  BEGIN INPUT CONVERSION
      DIMENSION  NEP(25),NES(25),NAP(25),NAS(25),M(25)
      DIMENSION D(25),VAR(25),EST(25),AFT(25)
      DIMENSION CUM(12)
      CUM(1)=31.
      CUM(2)=59.
      CUM(3)=90.
      CUM(4)=120.
      CUM(5)=151.
      CUM(6)=181.
      CUM(7)=212.
      CUM(8)=243.
      CUM(9)=273.
      CUM(10)=304.
      CUM(11)=334.
      CUM(12)=365.
  200 READ 1,N,STAMO,STADA,STAYR,SCHMO,SCHDA,SCHYR
      DO 210 I=1,N
      NAP(I)=0
      NAS(I)=0
      M(I)=0
      READ 2,NEP(I),NES(I),A,AB,B
      IF(AB-A)205,201,201
  201 IF(B-AB)205,202,202
  205 PRINT,NEP(I),NES(I),A,AB,B
  202 D(I)=(A+4.*AB+B)/6.
      VAR(I)=((B-A)/6.)**2
      IF(SENSE SWITCH 1)209,210
  209 PRINT,NEP(I),NES(I),D(I),VAR(I)
  210 CONTINUE
C     BEGIN TOPTHREAD
      JSW1=1
      LAST=N+1
   20 DO 21 I=1,N
      IF(M(I))21,25,25
   21 CONTINUE
   22 GO TO 100
   25 NFRST=I
      L=I
      JSW2=1
   30 K=I
      M(K)=M(K)+1
      IF(M(K)  -N)32,32,31
   31 PRINT,N,K,NEP(K),NES(K)
      STOP CLOSED LOOP ERROR
   32 IF(K-N)34,50,50
   34 IF(NEP(K+1)-NEP(K))35,40,50
   35 PRINT,  K,NEP(K),NES(K)
      STOP OUT OF SEQUENCE
   40 I=I+1
      GO TO (41,30),JSW1
   41 IF(NAP(I))42,43,42
   42 NAS1=NAS(I)
      NAP1=NAP(I)
      NAP(NAS1)=NAP(I)
      NAS(NAP1)=NAS(I)
   43 NAP(I)=K
      NAS(K)=I
      GO TO 30
```



```
   50 GO TO(52,51),JSW2
   51 L=NAS(L)
      GO TO 53
   52 JSW2=2
   53 JSW1=1
      DO 55 I=1,N
      IF(M(I))55,54,54
   54 IF(NEP(I)-NES(L))55,57,55
   55 CONTINUE
   56 GO TO 60
   57 IF(NEP(I)-NEP(K))41,58,41
   58 JSW1=2
      GO TO 30
   60 NASL=NAS(L)
      IF(K-L)62,61,62
   62 L=NASL
      GO TO 53
   61 NAP(NFRST)=0
      NAS(L)=LAST
      IF(LAST-(N+1))64,63,63
   64 NAP(LAST)=L
   63 LAST=NFRST
      DO 69 I=1,N
      IF(M(I))69,65,65
   65 IF(NAS(I))66,69,66
   66 M(I)=-M(I)
   69 CONTINUE
      GO TO 20
  100 DO 101 I=1,N
  101 PUNCH,NEP(I),NES(I),NAP(I),NAS(I),D(I),VAR(I)
      GO TO 200
      END

END OF COMPILATION
LOAD SUBROUTINE DECK
THEN PUSH START
```

```
LOAD SOURCE DECK
THEN PUSH START
      DIMENSION NEP(22),NES(22),NAP(22),NAS(22)
      DIMENSION D(22),VAR(22),EST(22),AFT(22)
      DIMENSION CUM(12)
      CUM(1)=31.
      CUM(2)=59.
      CUM(3)=90.
      CUM(4)=120.
      CUM(5)=151.
      CUM(6)=181.
      CUM(7)=212.
      CUM(8)=243.
      CUM(9)=273.
      CUM(10)=304.
      CUM(11)=334.
      CUM(12)=365.
  200 READ 1,N,STAMO,STADA,STAYR,SCHMO,SCHDA,SCHYR
      DO 201 I=1,N
  201 READ, NEP(I),NES(I),NAP(I),NAS(I),D(I),VAR(I)
C     BEGIN MO/DA/YR TO DAYS FO START, SCHEDULE
      YR=STAYR
      DA=STADA
      MO=STAMO
      JSW1=1
  301 YRS=YR-60.
      DAYS=365.*YRS
      IYR=YRS/4.
      ENTYR=IYR
      DAYS=DAYS+1.+ENTYR
      IF(MO-1)305,304,305
  304 DAYS=DAYS+DA
      GO TO 306
  305 DAYS=DAYS+CUM(MO-1)+DA
  306 GO TO (302,303),JSW1
  302 START=DAYS
      YR=SCHYR
      DA=SCHDA
      MO=SCHMO
      JSW1=2
      GO TO 301
  303 SCHED=DAYS
C     BEGIN BACKWARD PASS
      DO 401 I=1,N
      IF(NAS(I)-N-1)401,402,401
  401 CONTINUE
  402 KN=I
      K=I
      AFT(K)=SCHED-START
  410 K=NAP(K)
      I=K
      IF(K)420,501,420
  420 I=NAS(I)
      IF(I-N-1)422,421,422
  421 AFT(K)=SCHED-START
      GO TO 410
  422 IF(NEP(I)-NES(K))420,430,420
  430 TMIN=AFT(I)-D(I)
  440 IF (I-N)444,441,444
  444 IF(NEP(I+1)-NEP(I))441,442,441
  441 AFT(K)=TMIN
      GO TO 410
```

FORTRAN LISTING
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```
  442 I=I+1
      TIME=AFT(I)-D(I)
      IF(TIME-TMIN)443,440,440
  443 TMIN=TIME
      GO TO 440
C     BEGIN FORWARD PASS
  501 TIME=0.
      VANCE=0.
      DO 502 I=1,N
      IF(NAP(I))502,503,502
  502 CONTINUE
  503 K1=I
      K=K1
  510 EST(K)=TIME
      VAR(K)=VANCE+VAR(K)
      IF(K-N)511,515,515
  511 IF(NEP(K+1)-NEP(K))515,512,515
  512 K=K+1
      GO TO 510
  515 IF(NAS(K)-(N+1))520,600,600
  520 K=NAS(K)
      I=K1
      TIME=0.
      VANCE=0.
  530 IF(NES(I)-NEP(K))540,531,540
  531 IF((D(I)+EST(I))-TIME)540,532,534
  532 IF(VAR(I)-VANCE)540,540,535
  534 TIME=D(I)+EST(I)
  535 VANCE=VAR(I)
  540 IF(I-NAP(K))541,510,541
  541 I=NAS(I)
      GO TO 530
C      BEGIN OUTPUT ROUTINE
  600 IF(SENSE SWITCH 1)605,606
  605 DO 601 I=1,N
      PRINT,NEP(I),NES(I),EST(I),AFT(I),VAR(I)
  601 CONTINUE
  606 IF(SENSE SWITCH 2)602,200
  602 DO 650 I=1,N
  603 JSW2=1
      DAYS=EST(I)+START
  604 INDEX=0
      IYR=60
  610 IF(INDEX)612,611,612
  611 IF(DAYS-366.)621,621,613
  613 DAYS=DAYS-366.
      GO TO 614
  612 IF (DAYS - 365.)626,626,615
  615 DAYS=DAYS-365.
      IF (INDEX-3)614,616,614
  614 INDEX=INDEX+1
      GO TO 617
  616 INDEX=0
  617 IYR=IYR+1
      GO TO 610
  621 IF(DAYS-60.)626,623,624
  623 MO =2
      IDAY=29
      GO TO 645
  624 DAYS=DAYS-1.
  626 IF(DAYS-31.)625,625,630
  625 MO=1
      IDAY=DAYS
      GO TO 645
  630 DO 631 J=2,12
      IF(DAYS-CUM(J))640,640,631
```

FORTRAN LISTING
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```
  631 CONTINUE
  640 MO=J
      IDAY=DAYS-CUM(J-1)
      GO TO (645,649),JSW2
  645 IMO=MO
      IIDAY=IDAY
      IIYR=IYR
  646 DAYS=AFT(I)+START
      JSW2=2
      GO TO 604
  649 PRINT,NEP(I),NES(I),IMO,IIDAY,IIYR,MO,IDAY,IYR
  650 CONTINUE
      PAUSE
      GO TO 200
      END

END OF COMPILATION
LOAD SUBROUTINE DECK
THEN PUSH START
```

FORTRAN LISTING
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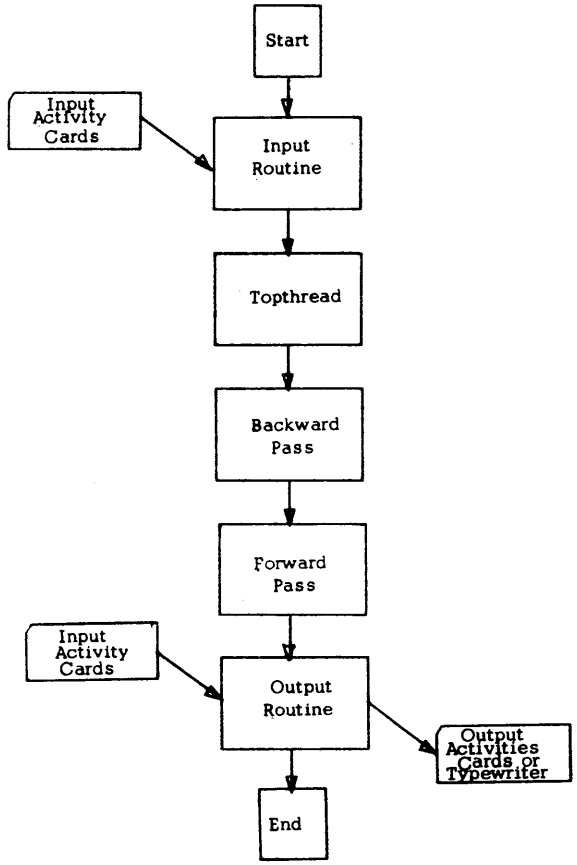


Diagram 1
General Block Diagram

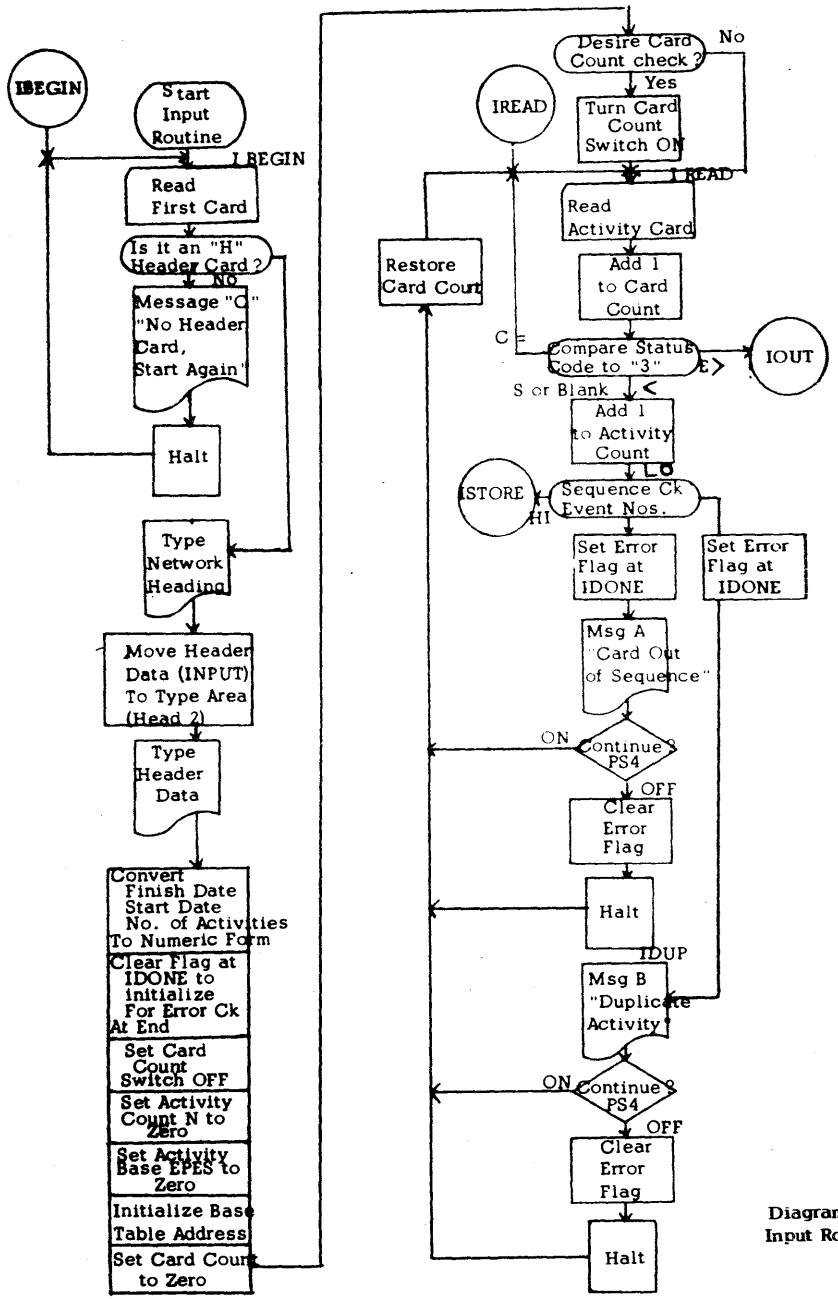
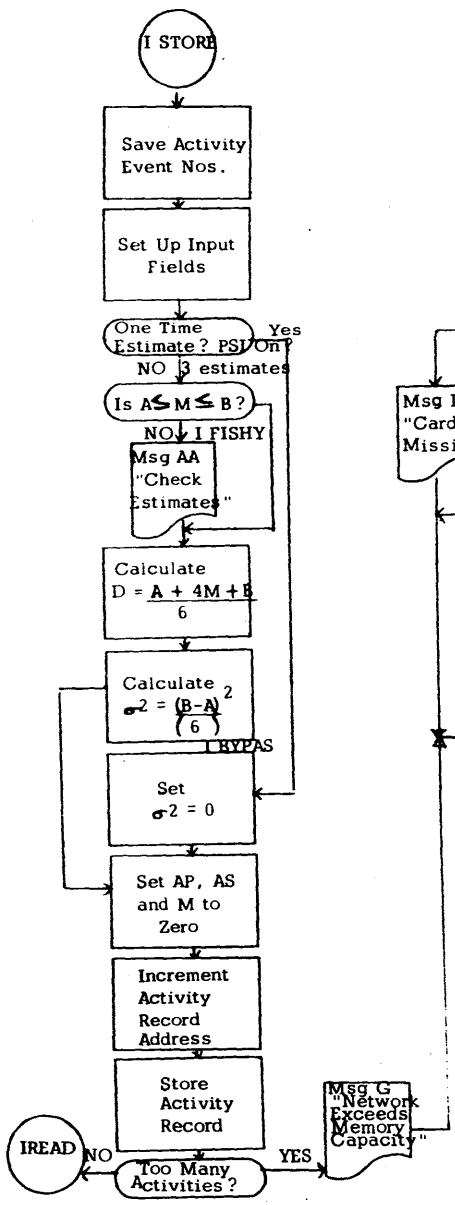


Diagram 2
Input Routine I



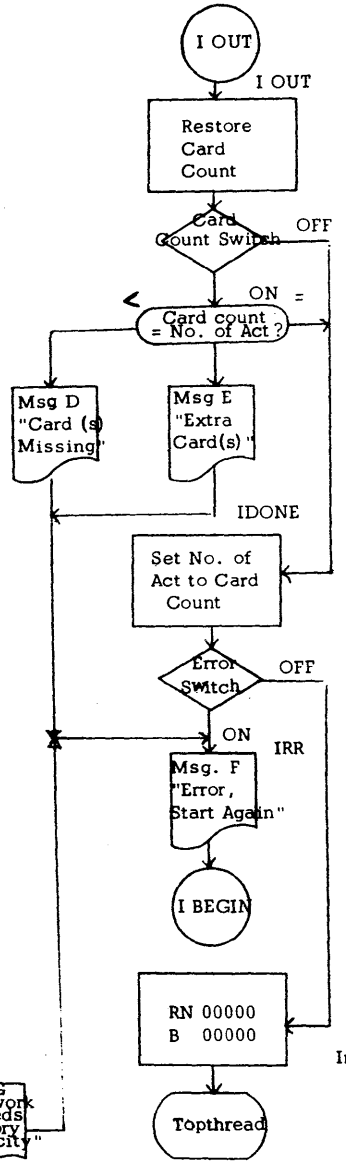


Diagram 3
Input Routine II

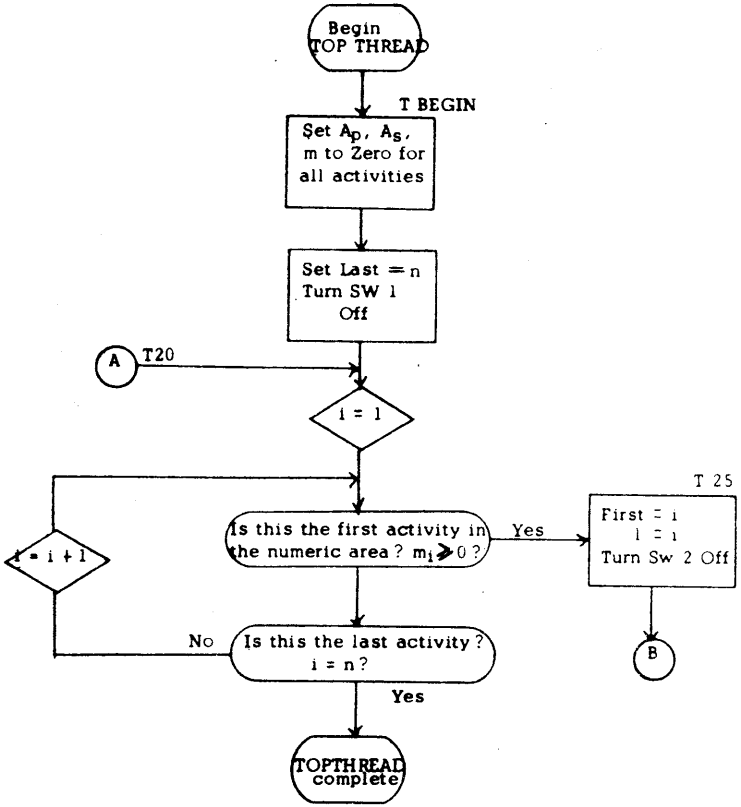


Diagram 4
TOPTHREAD I

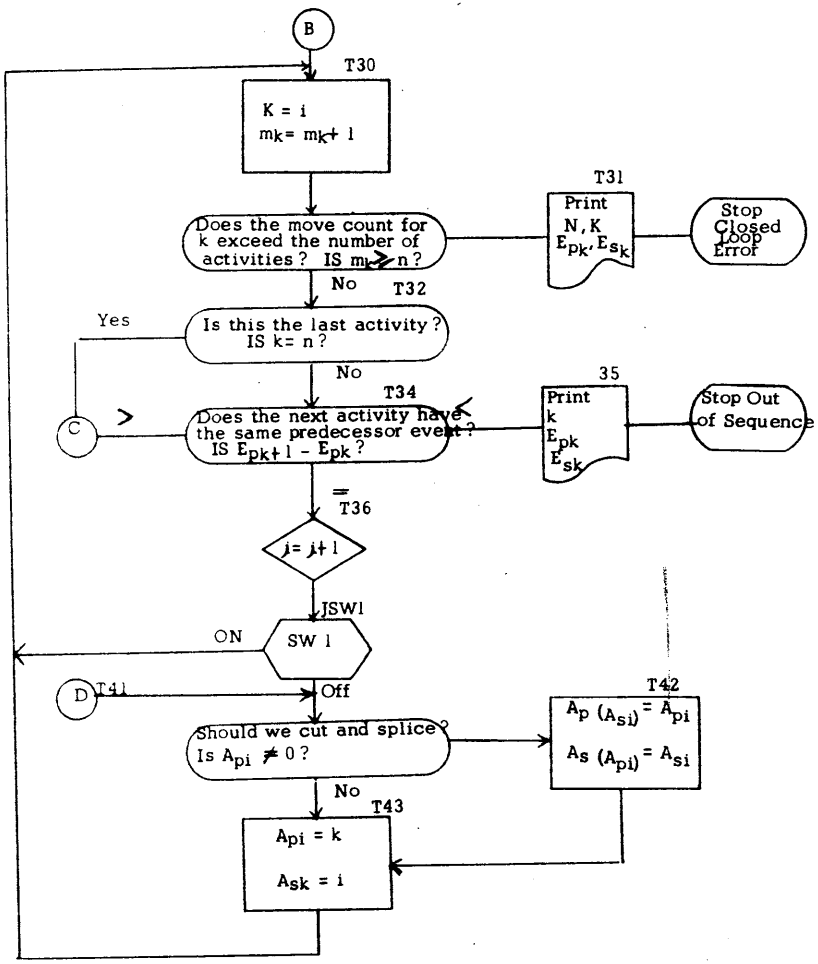


Diagram 5
TOPTHREAD II

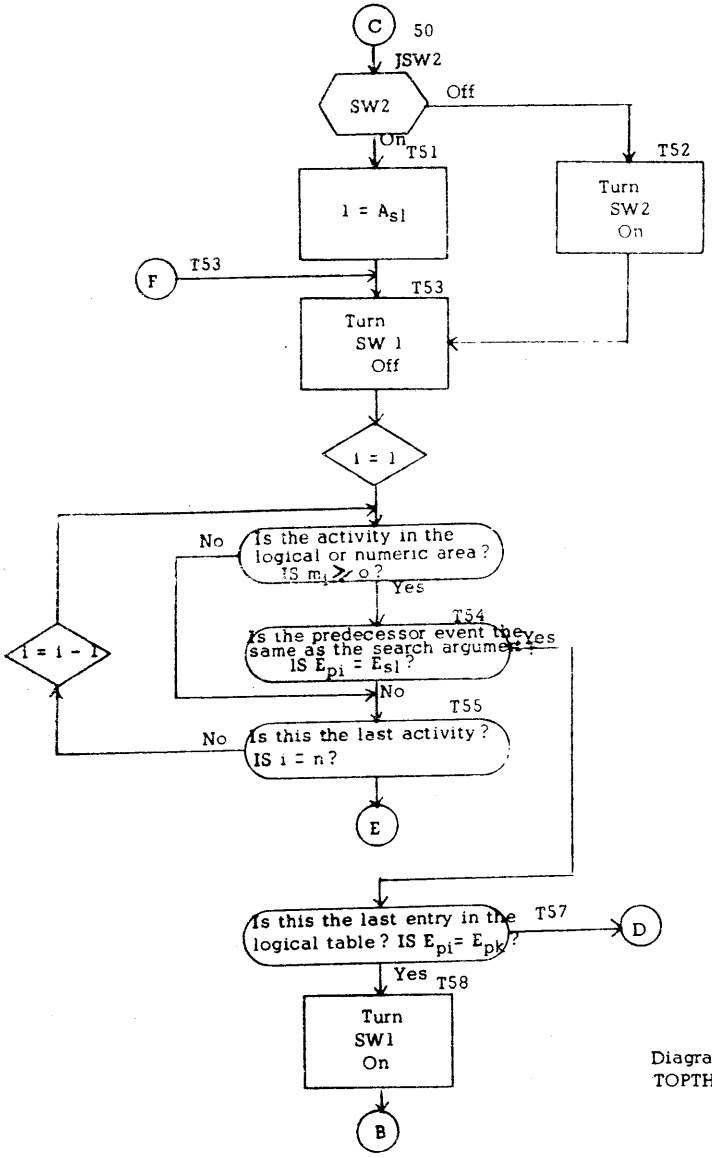
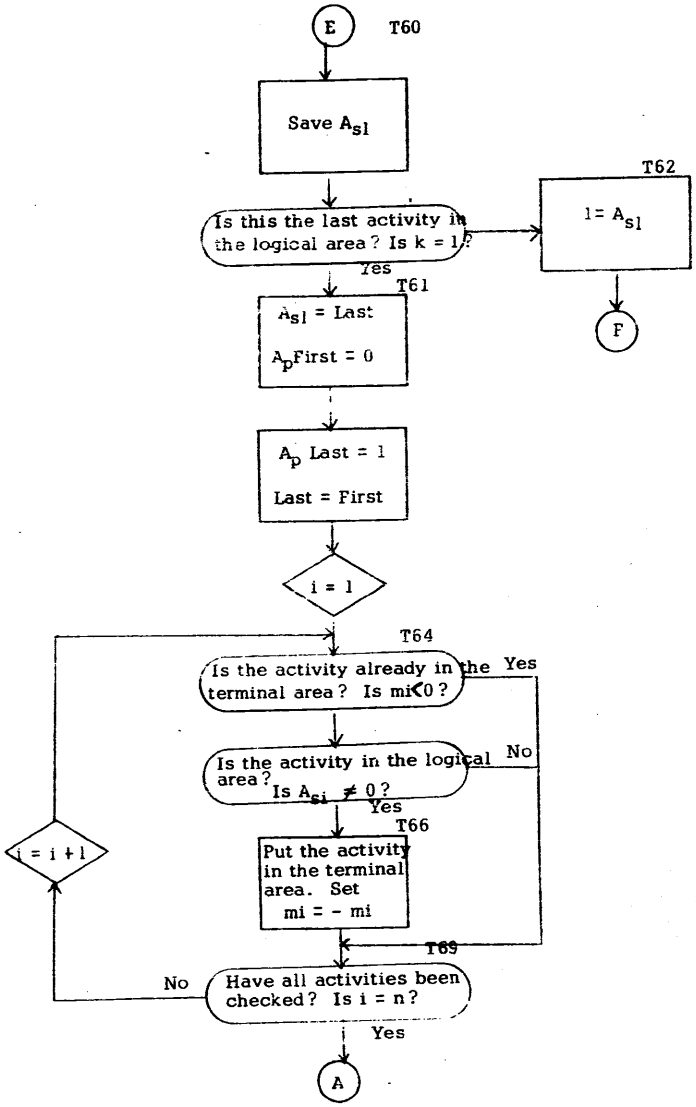


Diagram 6
TOPTHREAD III



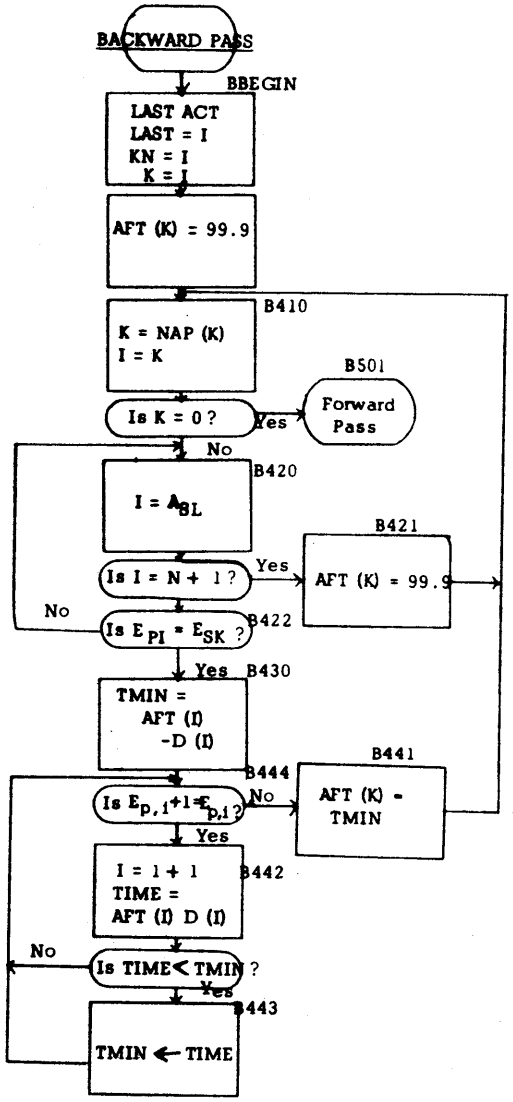


Diagram 8
Backward Pass

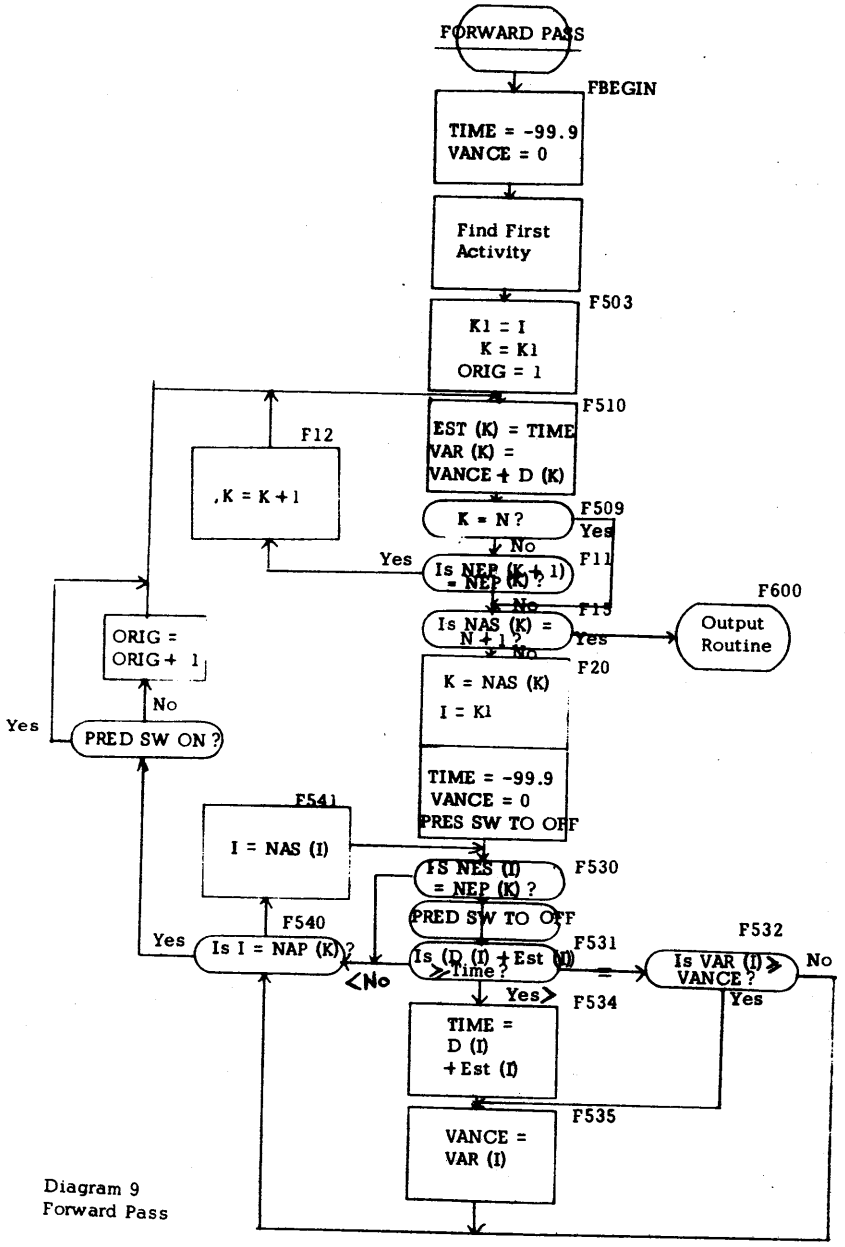


Diagram 9
Forward Pass

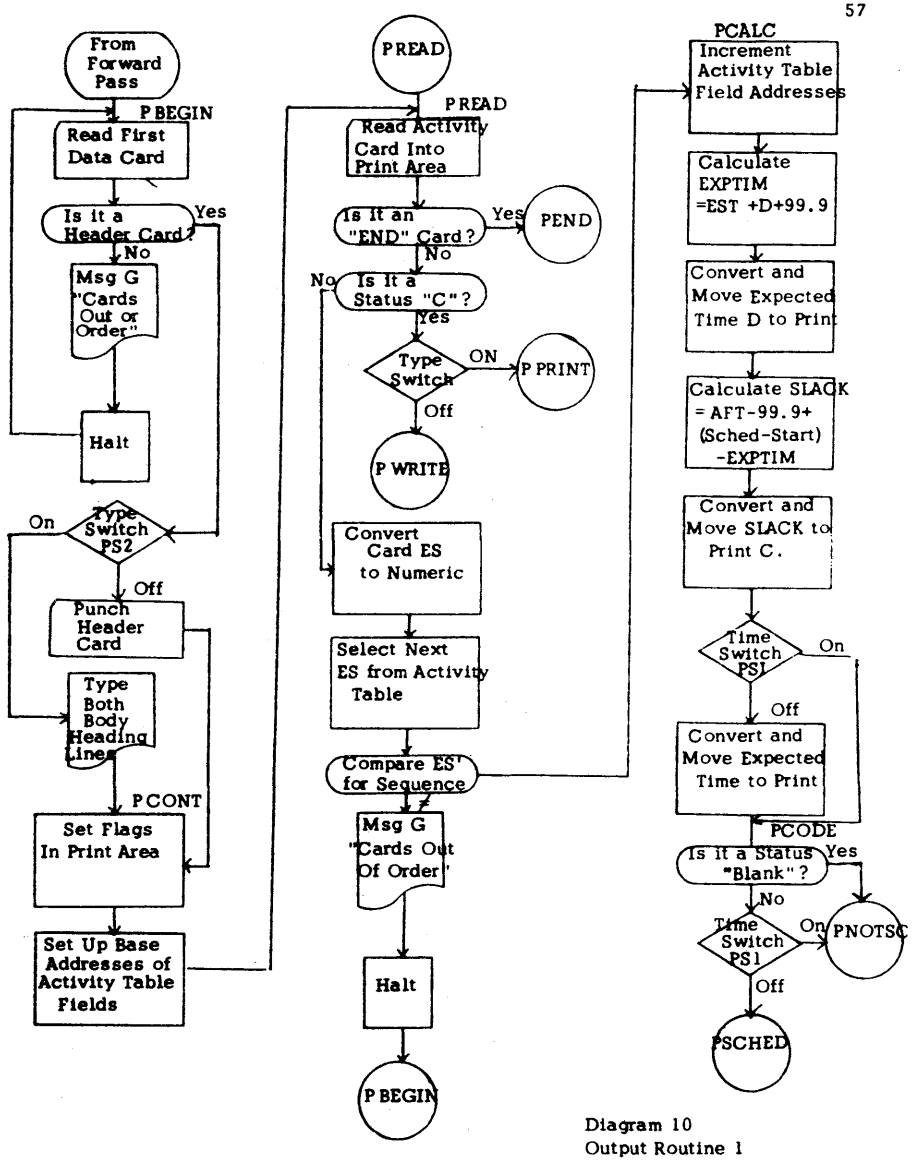
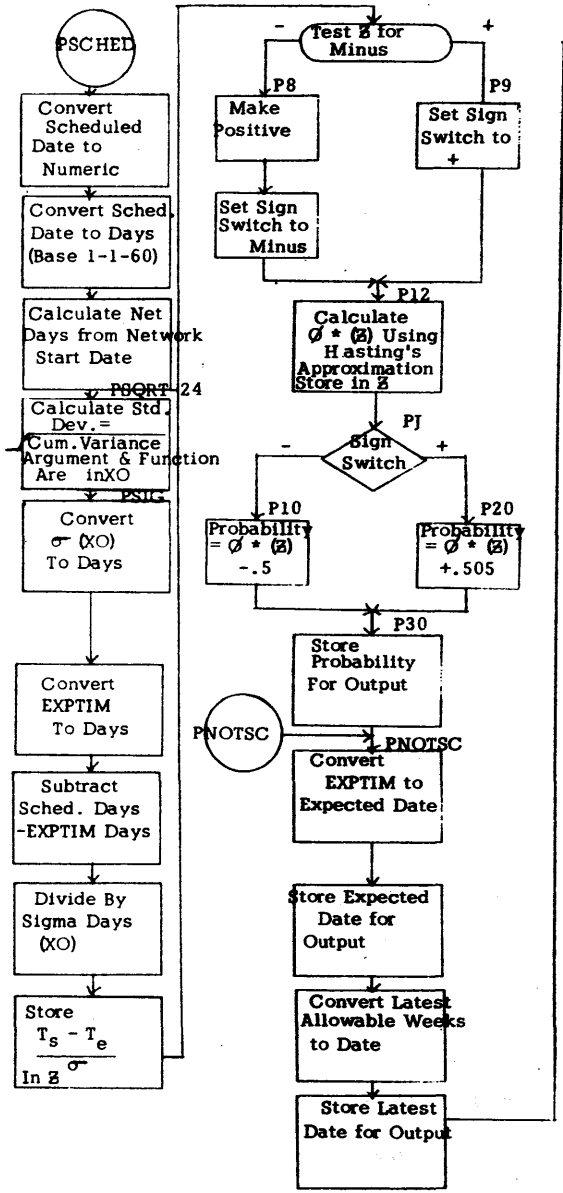


Diagram 10
Output Routine 1



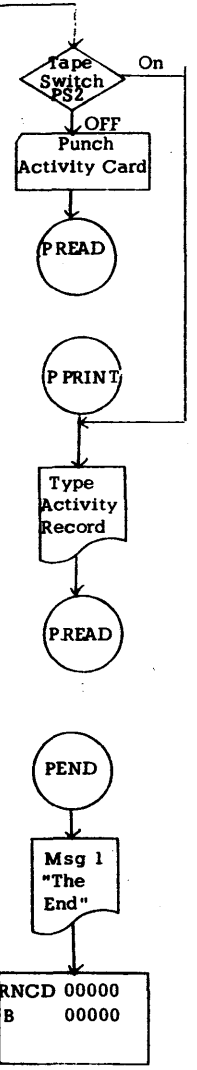


Diagram 11
Output Routine 11

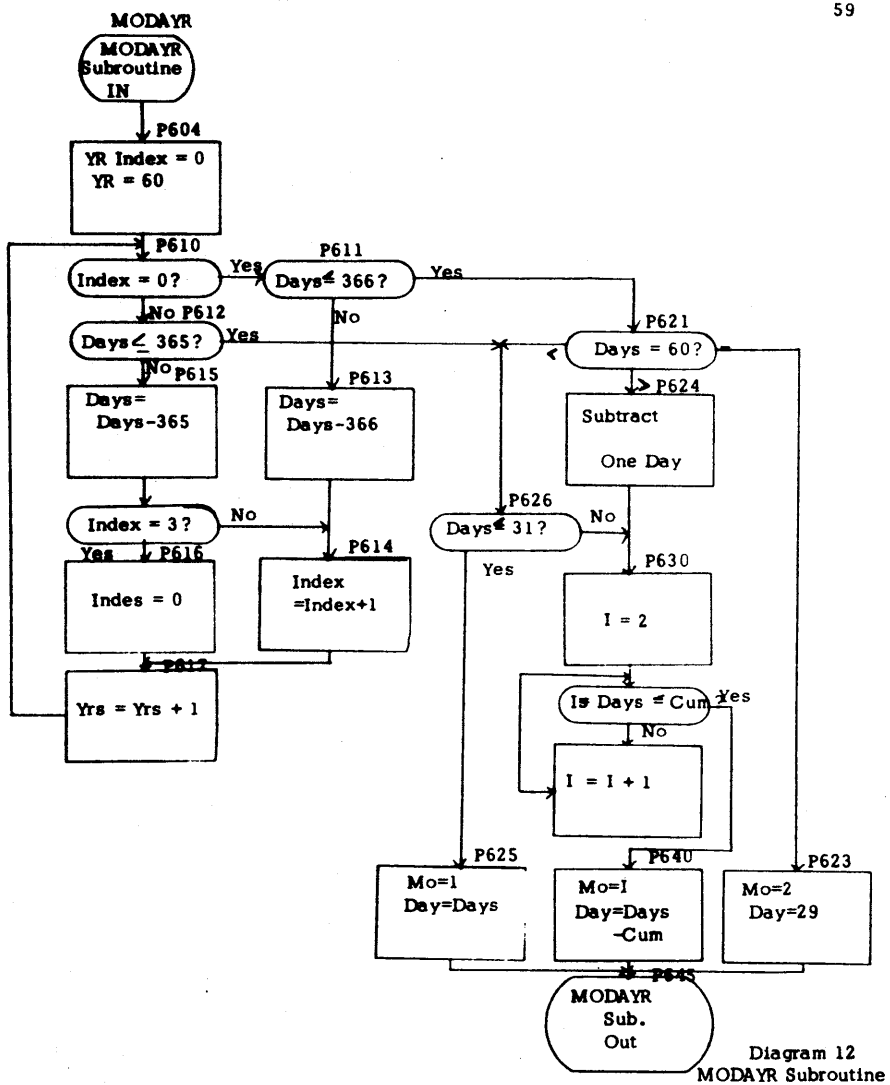
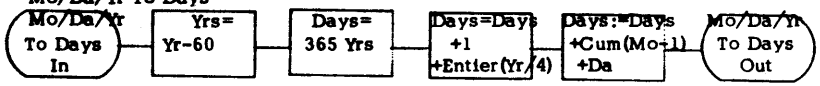


Diagram 12
MODAYR Subroutine

Mo/Da/Yr To Days




```
                                    1 *       BEGI N INPUT CONVERSIONZ
00402                               10        DORG 402Z
00402 37 02113 00500                20 IBEGIN RACD INPUT&2Z
00414 32 02146 00000                21        SF   INPUT&35Z
00426 14 02147 000M8                22        CM   INPUT&36,48,10Z
00438 46 00498 01200                23        BF   *&60Z
00450 34 00000 00102                24        RCTY  Z
00462 39 02753 00100                25        WATY MSGCZ
00474 48 00000 00000                26        H     Z
00486 49 00402 00000                27        B     IBEGINZ
00498 34 00000 00102                30        RCTY  Z
00510 39 01947 00100                40        WATY HEAD1AZ
00522 39 02041 00100                50        WATY HEAD1BZ
00534 32 02117 00000                60        SF   INPUT&1Z
00546 26 02283 02119                70        TF   HEAD2&10,INPUT&8Z
00558 32 02128 00000                80        SF   INPUT&17Z
00570 26 02299 02133                90        TF   HEAD2&26,INPUT&22Z
00582 32 02160 00000               100        SF   INPUT&49Z
00594 26 02365 02221               110        TF   HEAD2&92,INPUT&110Z
00606 32 02120 00000               120        SF   INPUT&9Z
00618 26 02381 02127               130        TF   HEAD2&108,INPUT&16Z
00630 32 02148 00000               140        SF   INPUT&37Z
00642 26 02401 02159               150        TF   HEAD2&128,INPUT&48Z
00654 32 02248 00000               160        SF   INPUT&137Z
00666 26 02417 02259               170        TF   HEAD2&144,INPUT&148Z
00678 32 02260 00000               180        SF   INPUT&149Z
00690 26 02433 02271               190        TF   HEAD2&160,INPUT&160Z
00702 34 00000 00102               193        RCTY  Z
00714 39 02275 00100               195        WATY HEAD2&2Z
00726 27 02464 02271               210        RT   ATON,INPUT&160Z
00738 26 03996 02441               220        TF   DATES,NUMZ
00750 27 02464 02259               230        RT   ATON,INPUT&148Z
00762 26 03990 02441               240        TF   DATES-6,NUMZ
00774 27 02464 02127               250        RT   ATON,INPUT&16Z
00786 26 02811 02441               260        TF   NUMR,NUMZ
00798 39 01850 00000 01 79         270        CF   IDONEZ
00810 15 01719 00009 01 78         280        TDM  IOUT&13,9Z
00822 16 03984 00-00 01 80         290        TFM  N,0,9Z
00834 26 02671 02661 01 81         300        TF   FPFS,ZEROFSZ
00846 16 01656  3977 01 82         310        TFM  IPUT&6,ACT-2*512F  &17
00858 16 02815 0 000 01 87         320        TFM  TOTAL,0,8Z
00870 14 02811 0 000 01 88         330        CM   NUMR,0,8Z
00882 46 00930 01200 01 89         340        BF   IREADZ
00894 15 01719 00001 01 90         350        TDM  IOUT&13,1Z
00906 49 00930 00000 01 91         360        B    IREADZ
00918 12 02819 0 001 01 94         370        SM   TOTAL,1,8Z
00930 36 02112 00500 01 95 IREAD   380        RNCD INPUT&1Z
00942 11 02819 0 001 01 99         390        AM   TOTAL,1,8Z
00954 25 02663 02129 01100         400        TD   CODF,INPUT&18Z
00966 14 02663 000-3 01110         410        CM   CODF,3,10Z
00978 46 01706 01100 01120         420        BH   IOUTZ
00990 46 00930 01200 01130         430        BF   IREADZ
01002 11 03984 00-01 01140         440        AM   N,1,9Z
01014 32 02112 00000 01150         450        SF   INPUT&1Z
01026 24 02119 02671 01160         460        C    INPUT&8,FPFSZ
01038 46 01230 01100 01170         470        BH   ISTORFZ
01050 32 01850 00000 01175         480        SF   IDONEZ
01062 34 00000 00102 01180         490        RCTY  Z
```

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01074 46 01198 01200 01190          BF   IDUPZ
01086 38 02812 00100 01199          WNTY TOTAL-3Z
01098 39 02673 00100 01200          WATY MSGAZ
01110 46 00930 00400 02  5          BC4  IREADZ
01122 33 01850 00000 02  6          CF   IDONFZ
01134 48 00000 00000 02 10          H    Z
01146 49 00918 00000 02 20          R    IREAD-12Z
01158 38 02812 00100 02 42 IDUP     WNTY TOTAL-3Z
01170 39 02715 00100 02 43          WATY MSGBZ
01182 46 01218 00400 02 44          BC4  *&36Z
01194 33 01850 00000 02 46          CF   IDONFZ
01206 48 00000 00000 02 50          H    Z
01218 49 00918 00000 02 60          R    IREAD-12Z
01230 26 02671 02119 02 61 ISTORE   TF   FPES,INPUT& 8Z
01242 32 02116 00000 02 82          SF   INPUT&52
01254 32 02120 00000 02 70          SF   INPUT&9Z
01266 32 02123 00000 02 80          SF   INPUT&12Z
01278 32 02126 00000 02 90          SF   INPUT&15Z
01290 46 01300 00100 02 91          BC1  IRYPASZ
01302 24 02122 02125 02100          C    OPT,LIKELYZ
01314 46 01350 01100 02110          BH   IFISHYZ
01326 24 02125 02128 02120          C    LIKELY,PESSZ
01338 47 01398 01100 02130          BNH  ICALCZ
01350 24 02129 00400 02140 IFISHY   TD   INPUT&18,&00Z
01362 48 00000 00102 02150          RCTY Z
01374 38 02112 00100 02160          WNTY INPUT&1Z
01386 39 02879 00100 02162          WATY MSGAAZ
01398 13 02124 000-4 02170 ICALC    MM   LIKELY,4,10Z
01410 28 02914 00098 02180          TF   WA1,PROD7
01422 21 02914 02122 02190          A    WA1,OPTZ
01434 21 02914 02128 02200          A    WA1,PESSZ
01446 13 02914 16667 03 10          MM   WA1,16667Z
01458 32 00092 00000 03 20          SF   92Z
01470 11 00095 000-5 03 30          AM   95,5,10Z
01482 28 02124 00094 03 40          TF   LIKELY,94Z
01494 22 02128 02122 03 50          S    PESS,OPTZ
01506 13 02128 16667 03 60          MM   PESS,16667Z
01518 28 02914 00096 03 70          TF   WA1,96Z
01530 29 02914 02914 03 80          M    WA1,WA1Z
01542 32 00092 00000 03 90          SF   92Z
01554 11 00095 000-5 03100          AM   95,5,10Z
01566 28 02122 00094 03110          TF   OPT,94Z
01578 49 01602 00000 03119          R    *&28Z
01590 16 02122 00-00 03120 IRYPAS   TFM  INPUT&11,0,9Z
01602 31 02126 02644 03125          TR   INPUT&15,ZERO-2Z
01614 21 01656 03998 03130          A    IPUT&6,RECSIZZ
01626 14 01656 10077 03195          CM   IPUT&6,MEMSIZ-<17F7
01638 46 01674 01100 03196          BH   *&36Z
01650 31 00000 02112 03140 IPUT     TR   ,INPUT&1Z
01662 49 00930 00000 03150          R    IREADZ
01674 48 00000 00102 03154          RCTY Z
01686 39 02969 00100 03156          WATY MSGGZ
01698 49 01874 00000 03158          R    IERRZ
01706                03160          DORG *-9Z
01706 12 02815 0 001 03170 IOUT     SM   TOTAL,1,0Z
01718 49 01850 00000 03180          R    IDONFZ
01730 24 02815 02811 03190          C    TOTAL,NUMBZ
```



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01742 46 01850 01200 03200          BF   IDONFZ
01754 34 00000 00102 03210          RCTY 7
01766 47 01814 01300 03220          BL   IMISSZ
01778 38 02812 00100 03228          WNTY TOTAL-3Z
01790 39 02819 00100 03230          WATY MSGDZ
01802 49 01874 00000 03242          R    IDONF&24Z
01814 38 02812 00100 03248 IMISS    WNTY TOTAL-3Z
01826 39 02847 00100 03250          WATY MSGFZ
01838 49 01874 00000 03262          R    IDONF&24Z
01850 26 02811 02815 03270 IDONF    TF   NUMB,TOTALZ
01862 44 01922 01850 03272          BNF  ILOAD,IDONFZ
01874 34 00000 00102 03273 IERR     RCTY Z
01886 39 02917 00100 03274          WATY MSGFZ
01898 48 00000 00000 03275          H    Z
01910 49 00402 00000 03276          R    IBEGINZ
01922 36 00000 00500 03280 ILOAD    RNCD Z
01934 49 00000 00000 03290          R    Z
01947       47       04 10 HEADIA   DAC  47,NETWORK  CASE  TITLE
02041       35       04 20 HEADIB   DAC  35,NO. OF ACT.  RUN  START
02111        1       04 30 INPUT    DAS  1Z
02113       80       04 40          DAS  80Z
02271       50       04 42          DC   50,0,INPUT&160Z
02222       50       04 44          DC   50,0,INPUT&111Z
02173       50       04 46          DC   50,0,INPUT&62Z
02124       15       04 48          DC   15,0,INPUT&13Z
02273        1       04 50 HEAD2    DAS  1Z
02275       80       04 60          DAS  80Z
02435        1       04 70          DAC  1,@7
02433       50       04 72          DC   50,0,HEAD2&160Z
02384       50       04 74          DC   50,0,HEAD2&111Z
02335       50       04 76          DC   50,0,HEAD2&62Z
02286       15       04 78          DC   15,0,HEAD2&13Z
02441        6       40 60 NUM      DS   6Z
02446        5       40250 NADD     DS   5Z
02451        5       40260 AADD     DS   5Z
                     41 10 *  ALPHA TO NUMERIC CONVERSIONZ
                     41 20 *  CALLING SEQUENCEZ
                     41 30 *       RT   ATON,AFIELDZ
                     41 40 *       TF   NFIELD,NUMZ
02463       12       41 60 ALPHA    DS   12Z
02464 25 02441 02463 41 70 ATON     TD   NUM,ALPHAZ
02476 32 02462 00000 41 80          SF   ALPHA-1Z
02488 13 02463 00000 41 90          MM   ALPHA,50,10Z
02500 43 02524 02462 41100          BD   *&24,ALPHA-17
02512 32 02441 00000 41110          SF   NUMZ
02524 16 02446  2440 41120          TFM  NADD,NUM-1Z
02536 16 02451  2461 41130          TFM  AADD,ALPHA-2Z
02548 25 02446 0245J 41140 ATON1    TD   NADD,AADD,611Z
02560 13 02451  0001 41150          MM   AADD,17
02572 44 02608 0245J 41160          BNF  *&36,AADD,11Z
02584 32 02446 00000 41170          SF   NADD,,6Z
02596 42 00000 00000 41180          BR   Z
02608 12 02446  0001 41190          SM   NADD,1Z
02620 12 02451  0001 41200          SM   AADD,1Z
02632 49 02548 00000 41210          R    ATON1Z
                     90 10 *  AREA RESERVATIONZ
02646        3       90190 ZERO     DC   3,0Z
```

```
02649     3          90191          DC    3,0Z
02652     3          90197          DC    3,0Z
02655     1          90193          DC    1,0Z
02661     8          90194 ZEROES   DC    8,0Z
02663     2          90200 CODE     DC    2,0Z
02671     8          91 10 EPES     DS    8Z
02679    21          91 20 MSGA     DAC   21,CARD OUT OF SEQUENCE@Z
02715    19          91 30 MSGB     DAC   19,DUPLICATE ACTIVITY@Z
02753    28          91 35 MSGC     DAC   28,NO HEADER CARD, START AGAIN
02811     4          91 40 NUMR     DS    4Z
02815     4          91 50 TOTAL    DS    4Z
02819     1          90 91          DC    1,@Z
02819    14          91 60 MSGD     DAC   14,EXTRA CARD$S@Z
02847    16          91 70 MSGE     DAC   16,CARD$S0 MISSING@Z
02879    16          91 72 MSGAA    DAC   16,CHECK ESTIMATES@Z
02122     3          91 80 OPT      DS    3,INPUT&11Z
02125     3          91 90 LIKELY   DS    3,INPUT&14Z
02128     3          91100 PESS     DS    3,INPUT&17Z
02914     5          91120 WA1      DS    5Z
02917    26          91130 MSGE     DAC   26,ERROR, START NEXT NETWORK@Z
20000                91140 MEMSIZ   DS    ,20000Z
02969    32          91150 MSGG     DAC   32,NETWORK EXCEEDS MEMORY CAPA
03948                98100          DORG  3948Z
03992     3          98110 DI       DS    3Z
03995     3          98120 NPONE    DS    3Z
03960     5          98130 START    DS    5Z
03965     5          98140 DAYS     DS    5Z
03968     3          98150 K        DS    3Z
03973     5          98160 KADD     DS    5Z
03978     3          98170 I        DS    3Z
03981     5          98180 IADD     DS    5Z
03984     3          98190 N        DS    3Z
00099    20          98200 PROD     DS    20,99Z
03996    12          99 20 DATES    DS    12Z
03998     2          99 21 RECSIZ   DC    2,29Z
00029                99 29 SIZE     DS    29Z
04000                99 29          DORG  4000Z
04022    23 00700    99 30 ACT      DSR   SIZE,700Z
04003     4          99 40 EP       DS    4,ACT-19Z
04007     4          99 50 ES       DS    4,ACT-19Z
04010     3          99 60 VAR      DS    3,ACT-12Z
04013     3          99 70 D        DS    3,ACT=9Z
04016     3          99 80 AP       DS    3,ACT-6Z
04019     3          99 90 AS       DS    3,ACT-3Z
04022     3          99100 M        DS    3,ACTZ
04016     3          99110 EST      DS    3,ACT-6Z
04022     3          99120 AET      DS    3,ACTZ
00402                99998          DEND  TBEGINZ
```



```
                     99999 *        ENDT  OPTHREADZ
                     10 10 *    RE  GIN   TOPTHREADZ
00402                10 20          DORG  402Z
00402 32 00870 00000 10 30 TBEGIN   SF    JSW1Z
00414 26 01844 03984 10 40          TF    LAST,NZ
00426 11 01844 00-01 10 50          AM    LAST,1,9Z
00438 23 01844 03998 10 60          M     LAST,RECSIZZ
00450 26 01849 00099 10 61          TF    LIMIT,PRODZ
00462 11 01849  3999 10 62          AM    LIMIT,ACT-SIZEZ
00474 16 00509  4022 10 70          TFM   T20611,MZ
00486 16 03976 00-01 10 80          TFM   I,1,9Z
00498 44 00570 04022 10 90 T20      RNF   T25,MZ
00510 11 03976 00-01 10 99          AM    I,1,9Z
00522 21 00509 03998 10100          A     T20611,RECSIZZ
00534 24 00509 01849 10120          C     T20611,LIMITZ
00546 47 00498 01200 10130          BNF   T20Z
00558 49 01818 00000 10140          B     T100Z
00570 26 01852 03976 10150 T25      TF    NEXST,IZ
00582 26 01855 03976 10160          TF    L,IZ
00594 32 01122 00000 10170          SF    JSW2Z
00606 26 03968 03976 10180 T30      TF    K,IZ
00618 23 03968 03998 10190          M     K,RECSIZZ
00630 11 00099  3999 10191          AM    PROD,ACT-SIZEZ
00642 26 03973 00099 10200          TF    KADD,PRODZ
00654 11 00099 00-01 11 20          AM    PROD,1,69Z
00666 24 00099 03984 11 30          C     PROD,N,6Z
00678 47 00774 01100 10 40          BNH   T32Z
00690 12 00099  0014 11 50 T31      SM    PROD,14Z
00702 25 00099 00400 11 60          TD    PROD,400,6Z
00714 12 00099  0008 11 70          SM    PROD,8Z
00726 34 00000 00102 11 80          RCTY  Z
00738 38 00099 00100 11 90          WNTY  PROD,,6Z
00750 39 01857 00100 11100          WATY  MSGC7
00762 48 00000 00000 11110          H     Z
00774 24 03968 03984 11120 T32      C     K,NZ
00786 46 01122 01400 11130          BNL   JSW2Z
00798 12 00099  0010 11150 T34      SM    PROD,19Z
00810 26 00094 00099 11160          TF    PROD-5,PRODZ
00822 21 00094 03998 11170          A     PROD-5,RECSIZZ
00834 24 00094 00098 11180          C     PROD-5,PROD,611Z
00846 46 01122 01100 11190          BH    JSW2Z
00858 11 03976 00-01 12 10 T40      AM    I,1,9Z
00870 44 00606 00870 12 20 JSW1     BNF   T30,JSW1Z
00882 23 03976 03998 12 30 T41      M     I,RECSIZZ
00894 11 00099  3999 12 31          AM    PROD,ACT-SIZEZ
00906 26 03981 00099 12 40          TF    IADD,PRODZ
00918 12 00099  0006 12 50          SM    PROD,6Z
00930 26 01890 00099 12 51          TF    APADD,PRODZ
00942 14 0189  00-00 12 60          CM    APADD,0,69Z
00954 46 01062 01200 12 70          BE    T43Z
00966 26 01895 00099 12 90 T42      TF    ASADD,PRODZ
00978 11 01895  0003 12100          AM    ASADD,3Z
00990 23 0189  03998 12110          M     APADD,RECSIZ,6Z
01002 11 00099  3996 12120          AM    PROD,AS-SIZEZ
01014 26 00099 0189N 12130          TF    PROD,ASADD,611Z
01026 23 01895 03998 12140          M     ASADD,RECSIZ,6Z
```

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01038 11 00099  3993 12150        AM   PROD,AP-SIZEZ
01050 26 00099 0189- 12160        TF   PROD,APADD,611Z
01067 26 0189  03968 12170 T43    TF   APADD,K,6Z
01074 26 00099 03973 12180        TF   PROD,KADDZ
01086 12 00099  0003 12190        SM   PROD,3Z
01098 26 00099 03976 12200        TF   PROD,I,6Z
01110 49 00606 00000 12210        B    T30Z
01122 44 01158 01122 13 10 JSW2   BNF  T51,JSW2Z
01134 33 01172 00000 13 20 T52    CF   JSW2Z
01146 49 01194 00000 13 30        B    T53Z
01158 29 01899 03998 13 40 T51    M    L,RECSIZZ
01170 11 00099  3996 13 50        AM   PROD,AS-SIZEZ
01182 26 01899 00098 13 60        TF   L,PROD,11Z
01194 32 00870 00000 13 70 T53    SF   JSW1Z
01206 29 01899 03998 13 71        M    L,RECSIZZ
01218 11 00099  3994 13 79        AM   PROD,ES-SIZEZ
01230 26 01900 00099 13 75        TF   LADD,PRODZ
01242 16 03981  4022 13 80        TFM  IADD,ACTZ
01254 16 03976 00-01 13 81        TFM  I,1,9Z
01266 44 01290 0398J 13 90 T54    BNF  *624,IADD,11Z
01278 49 01338 00000 13100        B    T55Z
01290 12 03981  0019 13110        SM   IADD,19Z
01302 24 03981 0190- 13120        C    IADD,LADD,611Z
01314 46 01398 01200 13130        BE   T57Z
01326 11 03981  0019 13140        AM   IADD,19Z
01338 11 03981  0023 13150 T55    AM   IADD,23Z
01350 11 03976 00-01 13151        AM   I,1,9Z
01362 24 03981 01849 13160        C    IADD,LIMITZ
01374 47 01266 01300 13170        BL   T54Z
01386 49 01470 00000 13180        B    T60Z
01398 26 00099 03973 13190 T57    TF   PROD,KADDZ
01410 12 00099  0019 13195        SM   PROD,19Z
01422 24 03981 00098 13200        C    IADD,PROD,611Z
01434 47 00882 01200 14 10        BNE  T41Z
01446 33 00870 00000 14 20 T58    CF   JSW1Z
01458 49 00606 00000 14 30        B    T30Z
01470 11 01900  0012 14 40 T60    AM   LADD,12Z
01482 26 01903 0190- 14 50        TF   NASL,LADD,11Z
01494 24 03968 01859 14 60        C    K,LZ
01506 46 01542 01200 14 70        BE   T61Z
01518 26 01899 01903 14 80 T62    TF   L,NASLZ
01530 49 01194 00000 14 90        B    T53Z
01542 29 01842 03998 14100 T61    M    WERST,RECSIZZ
01554 11 00099  3993 14110        AM   PROD,AP-SIZEZ
01566 16 00099 00-00 14120        TFM  PROD,0,69Z
01578 26 0190  01844 14130        TF   LADD,LAST,6Z
01590 29 01844 03998 14139        M    LAST,RECSIZZ
01602 11 00099  3999 14140        AM   PROD,ACT-SIZEZ
01614 24 00099 01849 14141        C    PROD,LIMITZ
01626 46 01662 01200 14142        BE   *636Z
01638 12 00099  0006 14150        SM   PROD,6Z
01650 26 00099 01855 14160        TF   PROD,L,6Z
01662 26 01844 01852 14161        TF   LAST,WERSTZ
01674 16 03981  4022 14170        TFM  IADD,ACTZ
01686 44 01710 0398J 14180 T64    BNF  T65,IADD,11Z
01698 49 01770 00000 14190        B    T69Z
01710 26 00099 03981 15 10 T65    TF   PROD,IADDZ
```



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01722 12 00099  0003 15 20        SM   PROD,3Z
01734 14 00099 00-00 15 30        CM   PROD,0,69Z
01746 46 01770 01200 15 40        BE   T69Z
01758 32 03981 00000 15 50 T66    SF   IADD,,6Z
01770 11 03981  0023 15 60 T69    AM   IADD,23Z
01782 24 03981 01849 15 70        C    IADD,LIMITZ
01794 47 01686 01300 15 80        BL   T64Z
01806 46 00474 01300 15 90        BNL  T20-247
01818 36 00000 00500 15100 T100   BNCO 7
01830 49 00000 00000 15110        B    Z
                       92 10 *  TOP THRE AD AREASZ
01844        3         92 20 LAST   DS   3Z
01847        3         92 30 LIMIT  DS   3Z
01850        3         92 40 WERST  DS   3Z
01853        3         92 50 L      DS   3Z
01857       15         92 60 MSGC   DAC  15,IN CLOSED LOOP@Z
01890        5         92 70 APADD  DS   5Z
01895        5         92 80 ASADD  DS   5Z
01900        3         92 90 LADD   DS   3Z
01903        3         92100 NASL   DS   3Z
03948                  98100        DORG 3948Z
03952        5         98110 DI     DS   5Z
03955        3         98120 NPONE  DS   3Z
03960        5         98130 START  DS   5Z
03965        3         98140 DATE   DS   3Z
03968        3         98150 K      DS   3Z
03973        5         98160 KADD   DS   5Z
03976        3         98170 I      DS   3Z
03981        5         98180 IADD   DS   5Z
03984        3         98190 N      DS   3Z
04000       20         98200 PROD   DS   20,99Z
03996       12         99 20 DATES  DS   12Z
03998        2         99 21 RECSIZ DC   2,23Z
00023                  99 22 SIZE   DS   ,23Z
04000                  99 29        DORG 4000Z
04022       23 00700   99 30 ACT    DSR  SIZE,700Z
04000        4         99 40 EP     DS   4,ACT-19Z
04007        4         99 50 ES     DS   4,ACT-15Z
04010        3         99 60 VAR    DS   3,ACT-12Z
04013        3         99 70 D      DS   3,ACT-9Z
04016        3         99 80 AP     DS   3,ACT-6Z
04019        3         99 90 AS     DS   3,ACT-3Z
04022        3         99100 M      DS   3,ACTZ
04016        3         99110 EST    DS   3,ACT-6Z
04022        3         99120 AET    DS   3,ACTZ
00402                  99998        DEND TBEGINZ
```

```
                                20010 *  BEG IN M D/DA/YR TO DAYS FOR START, SCHED
00402                           20020          DORG 402Z
00402 32 00666 00000 20030 BBEGIN SF    JSWZ                *
00414 32 03989 00000 20040 M301   SF    DATES-7Z            *
00426 32 03987 00000 20050        SF    DATES-9Z            *
00438 12 03990 00000 20060        SM    DATES-6,60,10Z      *
00450 13 03990 00L65 20070        MM    DATES-6,365,9Z      *
00462 26 03965 00099 20080        TF    DAYS,PRODZ          *
00474 11 03965 000-1 20100        AM    DAYS,1,10Z          *
00486 13 03990 000K5 20090        MM    DATES-6,25,10Z      *
00498 21 03965 00097 20110        A     DAYS,PROD-2Z        *
00510 14 03986 000-2 21111        CM    DATES-10,2,10Z      *
00522 46 00606 01100 21112        BH    M305Z               *
00534 32 00098 00000 21113        SF    PROD-1Z             *
00546 14 00099 000-0 21114        CM    PROD,0,10Z          *
00558 47 00582 01200 21115        BNE   *624Z               *
00570 12 03965 000-1 21116        SM    DAYS,1,10Z          *
00582 14 03986 000-1 20120 M304   CM    DATES-10,1,10Z      *
00594 46 00654 01200 20130        BE    M306Z               *
00606 13 03986 000-3 20160 M305   MM    DATES-10,3,10Z      *
00618 16 00653  1862 20170        TFM   *635,COM-6Z         *
00630 21 00653 00099 20180        A     *623,PRODZ          *
00642 21 03965 00000 20190        A     DAYSZ               *
00654 21 03965 03988 20200 M306   A     DAYS,DATES-8Z       *
00666 44 00738 00666 21010 JSW    BNF   M303,JSWZ           *
00678 26 03960 03965 21020 M302   TF    START,DAYSZ         *
00690 32 03991 00000 21030        SF    DATES-5Z            *
00702 26 03990 03996 21040        TF    DATES-6,DATESZ      *
00714 33 00666 00000 21050        CF    JSWZ                *
00726 49 00414 00000 21060        B     M301Z               *
00738 26 01906 03965 21070 M303   TF    SCHED,DAYSZ         *
                                21090 * BEGI N BA CKWARD PASSZ
00750 26 03955 03984 21100 BBEGIN TF    NPONE,NZ            *
00762 11 03955 00-01 21110        AM    NPONE,1,9Z          *
00774 16 03976 00-01 21115        TFM   I,1,9Z              *
00786 24  4019 03955 21120 B401   C     ACT-3,NPONE,2Z      *
00798 46 00846 01200 21130        BE    B402Z               *
00810 21 00792 03998 21140        A     B40166,RECSIZZ      *
00822 11 03976 00-01 21145        AM    I,1,9Z              *
00834 49 00786 00000 21150        B     B401Z               *
00846 26 02004 03976 21160 B402   TF    KN,IZ               *
00858 26 03968 03976 21170        TF    K,IZ                *
00870 26 03947 01906 21180        TF    SCMST,SCHEDZ        *
00882 22 03947 03960 21190        S     SCMST,STARTZ        *
00894 13 03947 14286 21192        MM    SCMST,14286Z        *
00906 32 00091 00000 21194        SF    PROD-8Z             *
00918 11 00096 00-05 21196        AM    PROD-3,5,9Z         *
00930 26 03947 00095 21198        TF    SCMST,PROD-4Z       *
00942 23 03968 03998 21200        M     K,RECSIZZ           *
00954 26 02032 00099 22010        TF    AFTK,PRODZ          *
00966 11 00099  3984 22012        AM    PROD,ES-SIZEZ       *
00978 26 02009 0009R 22013        TF    ESKN,PROD,11Z       *
00990 11 02032  3999 22015        AM    AFTK,AFT-SIZEZ      *
01002 16 02032 00R99 22020        TFM   AFTK,999,69Z        *
01014 16 02000 00-01 22025        TFM   TERM,1,9Z           *
01026 23 03968 03998 22030 B410   M     K,RECSIZZ           *
01038 11 00099  3993 22040        AM    PROD,AP-SIZEZ       *
01050 26 03968 0009R 22050        TF    K,PROD,11Z          *
01062 23 03968 03998 22052        M     K,RECSIZZ           *
                                22054        TF    AFTK,PRODZ
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01074 26 02032 00099                                        *
01086 26 02014 00099 22056        TF    ESK,PRODZ           *
01098 26 03976 03968 22060        TF    I,KZ                *
01110 11 02032  3999 22063        AM    AFTK,AFT-SIZEZ      *
01122 11 02014  3984 22065        AM    ESK,ES-SIZEZ        *
01134 14 03968 00-00 22070        CM    K,0,9Z              *
01146 46 01794 01200 22080        BE    B501Z               *
01158 23 03976 03998 22090 B420   M     I,RECSIZZ           *
01170 11 00099  3996 22100        AM    PROD,AS-SIZEZ       *
01182 26 03976 0009R 22105        TF    I,PROD,11Z          *
01194 24 03976 03955 22110        C     I,NPONEZ            *
01206 47 01242 01200 22120        BNE   B422Z               *
01218 16 02032 00R99 22150 B421   TFM   AFTK,999,69Z        *
01230 49 01650 00000 22160        B     B5014Z              *
01242 23 03976 03998 22170 B422   M     I,RECSIZZ           *
01254 26 03981 00099 22180        TF    IADD,PRODZ          *
01266 26 02019 00099 22190        TF    EPI,PRODZ           *
01278 11 02019  3980 22200        AM    EPI,EP-SIZEZ        *
01290 24 02019 0201M 23010        C     EPI,ESK,611Z        *
01302 47 01158 01200 23020        BNE   B420Z               *
01314 26 02027 03981 23030 B430   TF    AFTI,IADDZ          *
01326 11 02027  3999 23040        AM    AFTI,AFT-SIZEZ      *
01338 26 03952 03981 23050        TF    DI,IADDZ            *
01350 11 03952  3990 23060        AM    DI,D-SIZEZ          *
01362 26 02022 0202P 23070        TF    TMIN,AFTI,11Z       *
01374 22 02022 0395K 23080        S     TMIN,DI,11Z         *
01386 47 01446 01400 23081        BNV   B440Z               *
01398 34 00000 00102 23082        RCTY  Z                   *
01410 39 01909 00100 23083        WATY  MSGJZ               *
01422 48 00000 00000 23084        H     Z                   *
01434 49 01398 00000 23085        B     *-36Z               *
01446 24 03976 03984 23090 B440   C     I,NZ                *
01458 46 01518 01200 23100        BE    B441Z               *
01470 26 00099 02019 23110 B444   TF    PROD,EPIZ           *
01482 21 02019 03998 23120        A     EPI,RECSIZZ         *
01494 24 02019 0009R 23130        C     EPI,PROD,611Z       *
01506 46 01542 01200 23140        BE    B442Z               *
01518 26 02032 02022 23150 B441   TF    AFTK,TMIN,6Z        *
01530 49 01026 00000 23160        B     B410Z               *
01542 21 02027 03998 23170 B442   A     AFTI,RECSIZZ        *
01554 21 03952 03998 23180        A     DI,RECSIZZ          *
01566 11 03976 00-01 23181        AM    I,1,9Z              *
01578 26 00099 0202P 23190        TF    PROD,AFTI,11Z       *
01590 22 00099 0395K 23200        S     PROD,DI,11Z         *
01602 24 00099 02022 24010        C     PROD,TMINZ          *
01614 46 01446 01300 24020        BNL   B440Z               *
01626 26 02022 00099 24030 B443   TF    TMIN,PRODZ          *
01638 49 01446 00000 24040        B     B440Z               *
01650 24 02009 0201M 24110 B5014  C     ESKN,ESK,11Z        *
01662 46 01026 01200 24120        BE    B410Z               *
01674 16 03981  4007 24130        TFM   IADD,ESZ            *
01686 16 03976 00-01 24140        TFM   I,1,9Z              *
01698 24 03981 0201M 24170        C     IADD,ESK ,611Z      *
01710 46 01026 01200 24180        BE    B410Z               *
01722 11 03981  0023 24190        AM    IADD,SIZEZ          *
01734 11 03976 00-01 24200        AM    I,1,9Z              *
01746 24 03976 03968 25010        C     I,KZ                *
01758 47 01698 01300 25020 B5015  BL    B5014&48Z           *
01770 11 02000 00-01 25030        AM    TERM,1,9Z           *
01782 49 01026 00000 25040        B     B410Z               *
                                25070 B501   RCTY  Z
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01794 34 00000 00102                                                    *
01806 34 00000 00102 25080          RCTY  Z                             *
01818 38 01998 00100 25090          WATY TERM-2Z                        *
01830 39 01965 00100 25100          WATY MSGKZ                          *
01842 36 00000 00500 25110          RNCD  Z                             *
01854 49 00000 00000 25120          B     Z                             *
                                   93010 *    M O/DA /YR FIELDSZ
01868          3                   93030 CUM    DC   3,31Z
01871          3                   93040        DC   3,59Z
01874          3                   93050        DC   3,90Z
01877          3                   93060        DC   3,120Z
01880          3                   93070        DC   3,151Z
01883          3                   93080        DC   3,181Z
01886          3                   93090        DC   3,212Z
01889          3                   93100        DC   3,243Z
01892          3                   93110        DC   3,273Z
01895          3                   93120        DC   3,304Z
01898          3                   93130        DC   3,334Z
01901          3                   93140        DC   3,365Z
01906          5                   93150 SCHED  DS   5Z
                                   94010 *  BAC KWAR D PASS FIELDSZ
01909         28    *               94015 MSGJ   DAC  28,PROJECT EXCEEDS 199.8 WEEKS@Z
01965         17    *               94016 MSGK   DAC  17, TERMINAL EVENTS@Z
02000          3                   94017 TERM   DS   3Z
02001          1                   94018        DC   1,@Z
02004          3                   94020 KN     DS   3Z
02009          5                   94030 FSKN   DS   5Z
02014          5                   94050 FSK    DS   5Z
02019          5                   94060 EPI    DS   5Z
02022          3                   94070 TMIN   DS   3Z
02027          5                   94080 AFTI   DS   5Z
02032          5                   94090 AFTK   DS   5Z
03943                              98080        DORG 3943Z
03947          5                   98090 SCMST  DS   5Z
03948                              98100        DORG 3948Z
03952          5                   98110 DI     DS   5Z
03955          3                   98120 NPONE  DS   3Z
03960          5                   98130 START  DS   5Z
03965          5                   98140 DAYS   DS   5Z
03968          3                   98150 K      DS   3Z
03973          5                   98160 KADD   DS   5Z
03976          3                   98170 I      DS   3Z
03981          5                   98180 IADD   DS   5Z
03984          3                   98190 N      DS   3Z
00099         20                   98200 PROD   DS   20,99Z
03996         12                   99020 DATES  DS   12Z
03998          2                   99021 RECSIZ DC   2,23Z
00023                              99022 SIZE   DS   ,23Z
04000                              99029        DORG 4000Z
04022         23 00700             99030 ACT    DSB  SIZE,700Z          *
04003          4                   99040 EP     DS   4,ACT-19Z
04007          4                   99050 ES     DS   4,ACT-15Z
04010          3                   99060 VAR    DS   3,ACT-12Z
04013          3                   99070 D      DS   3,ACT-9Z
04016          3                   99080 AP     DS   3,ACT-6Z
04019          3                   99090 AS     DS   3,ACT-3Z
04022          3                   99100 M      DS   3,ACTZ
04016          3                   99110 FST    DS   3,ACT-6Z
04022          3                   99120 AFT    DS   3,ACTZ
00402                              99999        DEND MBEGINZ
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                                   30010 * BEGI N FO RWARD PASSZ
00402                              30015        DORG 402Z
00402 16 01704 00R9R               30020 FBEGIN TFM  TIME,999,911Z      *
00414 16 01708 0 000               30030        TFM  VANCE,0,8Z        *
00426 16 03976 00-00               30031        TFM  I,0,9Z            *
00438 16 00480  3993               30040        TFM  *642,AP-SIZEZ     *
00450 21 00480 03998               30050        A    *630,RECSIZZ      *
00462 11 03976 00-01               30051        AM   I,1,9Z            *
00474 14 00000 00-00               30060        CM   ,0,9Z             *
00486 47 00450 01200               30070        BNE  *-36Z             *
00498 26 01711 03976               30080 F503   TF   KONE,1Z           *
00510 26 03968 01711               30090        TF   K,KONEZ           *
00522 23 03968 03998               30100        M    K,RECSIZZ         *
00534 16 01648 00-01               30115        TFM  ORIG,1,9Z         *
00546 26 03973 00099               30110        TF   KADD,PRODZ        *
00558 16 00099  3993               30120 F510   TFM  PROD,EST-SIZEZ    *
00570 21 00099 03973               30130        A    PROD,KADDZ        *
00582 26 00099 01704               30140        TF   PROD,TIME,6Z      *
00594 16 00094  3987               30150        TFM  PROD-5,VAR-SIZEZ  *
00606 21 00094 03973               30160        A    PROD-5,KADDZ      *
00618 16 00099  3980               30170        TFM  PROD,EP-SIZEZ     *
00630 21 00099 03973               30180        A    PROD,KADDZ        *
00642 26 01726 0009R               30190        TF   EPK,PROD,11Z      *
00654 26 00099 01708               31010        TF   PROD,VANCE,6Z     *
00666 22 00099 000@M               31015        S    PROD,PROD-5,611,MAKE CUM VAR NEGA
00678 47 00738 01400               31016        BNV  F509Z             *
00690 34 00000 00102               31017        RCTY  Z                *
00702 39 01567 00100               31018        WATY MSGLZ             *
00714 48 00000 00000               31019        H     Z                *
00726 49 00690 00000               31020        B    *-36Z             *
00738 24 03968 03984               31021 F509   C    K,NZ              *
00750 46 00834 01300               31030        BNL  F515Z             *
00762 21 00099 03998               31050 F511   A    PROD,RECSIZZ      *
00774 24 00099 01726               31060        C    PROD,EPK,6Z       *
00786 47 00834 01200               31070        BNE  F515Z             *
00798 11 03968 00-01               31080 F512   AM   K,1,9Z            *
00810 21 03973 03998               31090        A    KADD,RECSIZZ      *
00822 49 00558 00000               31100        B    F510Z             *
00834 16 00099  3996               31110 F515   TFM  PROD,AS-SIZEZ     *
00846 21 00099 03973               31120        A    PROD,KADDZ        *
00858 24 00099 03955               31130        C    PROD,NPONE,6Z     *
00870 46 01470 01300               31140        BNL  F550,,,FORWARD PASS*COMPUTATION C
00882 26 03968 0009R               31150 F520   TF   K,PROD,11Z        *
00894 26 03976 01711               31160        TF   I,KONEZ           *
00906 23 03968 03996               31162        M    K,RECSIZZ         *
00918 26 03973 00099               31164        TF   KADD,PRODZ        *
00930 11 00099  3980               31166        AM   PROD,EP-SIZEZ     *
00942 26 01726 0009R               31168        TF   EPK,PROD,11Z      *
00954 16 01704 00R9R               31170        TFM  TIME,999,911Z     *
00966 16 01708 0 000               31180        TFM  VANCE,0,8Z        *
00978 32 01326 00000               31185        SF   PREDSWZ           *
00990 23 03976 03998               31190 F530   M    I,RECSIZZ         *
01002 26 03981 00099               31200        TF   IADD,PRODZ        *
01014 11 00099  3984               32010        AM   PROD,ES-SIZEZ     *
01026 24 00099 01726               32030        C    PROD,EPK,6Z       *
01038 47 01278 01200               32040        BNE  F540Z             *
01050 33 01326 00000               32045        CF   PREDSWZ           *
01062 16 03952  3990               32050 F531   TFM  DI,D-SIZEZ        *
01074 21 03952 03981               32060        A    DI,IADDZ          *
                                   32070        TFM  ESTI,EST-SIZEZ
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01086 16 01716  3993                                    *
01098 21 01716 03981 32080          A    ESTI,IADDZ     *
01110 26 00099 0395K 32090          TF   PROD,DI,11Z    *
01122 21 00099 01710 32100          A    PROD,ESTI,11Z  *
01134 24 00099 01704 32110          C    PROD,TIMEZ     *
01146 47 01278 01300 32120          BL   F540Z          *
01158 46 01230 01100 32130          BH   F534Z          *
01170 16 01721  3980 32140 F532     TFM  VARI,EP -SIZEZ *
01182 21 01721 03981 32150          A    VARI,IADDZ     *
01194 24 01721 01708 32160          C    VARI,VANCE,6Z  *
01206 47 01242 01100 32170          BNH  F535Z          *
01218 49 01278 00000 32180          B    F540Z          *
01230 26 01704 00099 32190 F534     TF   TIME,PRODZ     *
01242 16 01721  3980 32010 F535     TFM  VARI,EP -SIZEZ *
01254 21 01721 03981 32020          A    VARI,IADDZ     *
01266 26 01708 0172J 32040          TF   VANCE,VARI,11Z *
01278 16 00099  3993 32050 F540     TFM  PROD,AP-SIZEZ  *
01290 21 00099 03973 32060          A    PROD,KADDZ     *
01302 24 03976 0009R 32070          C    I,PROD,11Z     *
01314 47 01362 01200 32080          BNE  F541Z          *
01326 44 01350 01326 32083 PREDSW   BNF  *-24,PREDSWZ   *
01338 11 01648 00-01 32084          AM   ORIG,1,9Z      *
01350 49 00558 00000 32086          B    F510Z          *
01362 16 00099  3996 32090 F541     TFM  PROD,AS-SIZEZ  *
01374 21 00099 03981 32100          A    PROD,IADDZ     *
01386 26 03976 0009R 32110          TF   I,PROD,11Z     *
01398 49 00990 00000 32120          B    F530Z          *
01410 39 01651 00100 32122 F600     WATY MSGMZ          *
01422 38 01646 00100 32124          WNTY ORIG-2Z        *
01434 39 01663 00100 32126          WATY MSGNZ          *
01446 36 00000 00500 32130          RNCD Z              *
01458 49 00000 00000 32140          B    Z              *
01470 16 01512  3980 34100 F550     TFM  FCF66,EP-SIZE,,ROUTINE TO CLEARZ
01482 23 03984 03998 34110          M    N,RECSIZ,,     FLAGS FROM COMZ
01494 21 01512 00099 34120          A    FCF66,PROD,,   VARIANCE WHICHZ
01506 33 00000 00000 34130 FCF      CF   ,,,            IS STORED WHEREZ
01518 14 01512  4003 34140          CM   FCF66,EP,,     EP WAS STOREDZ
01530 46 01410 01200 34150          BE   F600Z          *
01542 22 01512 03998 34160          S    FCF66,RECSIZZ  *
01554 49 01506 00000 34170          B    FCFZ           *
                     95010 *  FOR WARD  PASS FIELDSZ
01567       40     * 95012 MSGL   DAC  40,CUMULATIVE VARIANCE EXCEEDS 99
01648        3       95014 ORIG   DS   3Z
01649        1       95016        DC   1,@Z
01651        6       95017 MSGM   DAC  6,    @Z
01663       20     * 95018 MSGN   DAC  20, ORIGINATING EVENTS@Z
01704        3       95020 TIME   DS   3Z
01708        4       95030 VANCE  DS   4Z
01711        3       95040 KONE   DS   3Z
01716        5       95050 ESTI   DS   5Z
01721        5       95060 VARI   DS   5Z
01726        5       95070 EPK    DS   5Z
03943                98080        DORG 3943Z
03947        5       98090 SCMST  DS   5Z
03948                98100        DORG 3948Z
03952        5       98110 DI     DS   5Z
03955        3       98120 NPONE  DS   3Z
03960        5       98130 STAKT  DS   5Z
03965        5       98140 DAYS   DS   5Z
03968        3       98150 K      DS   3Z
                     98160 KADD   DS   5Z
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03973        5
03976        3       98170 I      DS   3Z
03981        5       98180 IADD   DS   5Z
03984        3       98190 N      DS   3Z
03999       20       98200 PROD   DS   20,99Z
03996       12       99020 DATES  DS   12Z
03998        2       99021 RECSIZ DC   2,23Z
04023                99022 SIZE   DS   ,23Z
04000                99029        DORG 4000Z
04022       23 00700 99030 ACT    DSB  SIZE,700Z      *
04003        4       99040 EP     DS   4,ACT-19Z
04007        4       99050 ES     DS   4,ACT-15Z
04010        3       99060 VAR    DS   3,ACT-12Z
04013        3       99070 D      DS   3,ACT-9Z
04016        3       99080 AP     DS   3,ACT-6Z
04019        3       99090 AS     DS   3,ACT-3Z
04022        3       99100 M      DS   3,ACTZ
04016        3       99110 EST    DS   3,ACT-6Z
04022        3       99120 AFT    DS   3,ACTZ
04002                99999        DEND FBEGINZ
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                        40000 *  OUT PUT  ROUTINE7
00402                   40001          DORG 4027
                        40019 *  NUM ERIC  TO ALPHA CONVERSION7
                        40020 *  CAL LING  SEQUENCE7
                        40030 *        BT   NTOA,NFIELD7
                        40050 *        TF   AFIELD,ALPHA7
00407         6         40060 NUM      DS   67
00408 44    440 00407   40080 NTOA     BNF  *632,NUM7
00420 15    614 00005   40090          TDM  ALPHA-1,57
00432 49    452 00000   40100          B    *6207
00440                   40105          DORG *-37
00440 15    614 00007   40110          TDM  ALPHA-1,77
00452 29    615 00007   40111          TD   ALPHA,NUM7
00464 16    603  0613   40120          TFM  AADD,ALPHA-27
00476 16    598  0605   40130          TFM  NADD,NUM-17
00488 25    603 00590   40140 NTOA1    TD   AADD,NADD,6117
00500 33    603 00000   40145          CF   AADD,,67
00512 12    603  0001   40150          SM   AADD,17
00524 13    603 00007   40160          TDM  AADD,7,62
00536 44    562 00590   40170          BNF  *626,NADD,117
00548 32    603 00000   40180          SF   AADD,,62
00560 42                40190          BR    7
00562                   40195          DORG *-97
00562 12    598  0001   40200          SM   NADD,17
00574 12    603  0001   40210          SM   AADD,17
00586 49    488 00000   40220          B    NTOA17
00596                   40230          DORG *-37
00598         5         40250 NADD     DS   57
00603         6         40260 AADD     DS   67
                        41010 *  ALP HA T O NUMERIC CONVERSION7
                        41020 *  CAL LING  SEQUENCE7
                        41030 *        BT   ATON,AFIELD7
                        41040 *        TF   NFIELD,NUM7
00615        12         41060 ALPHA    DS   127
00616 29    607 00615   41070 ATON     TD   NUM,ALPHA7
00628 32    614 00000   41080          SF   ALPHA-17
00640 12    615 00000   41090          SM   ALPHA,597,107
00652 43    676 00614   41100          BD   *624,ALPHA-17
00664 32    607 00000   41110          SF   NUM7
00676 16    598  0606   41120          TFM  NADD,NUM-17
00688 16    603  0619   41130          TFM  AADD,ALPHA-27
00700 25    598 0060L   41140 ATON1    TD   NADD,AADD,6117
00717 12    603  0001   41150          SM   AADD,17
00724 44    750 0060L   41160          BNF  *626,AADD,117
00736 32    598 00000   41170          SF   NADD,,62
00748 42                41180          BR    7
00750                   41185          DORG *-97
00750 12    598  0001   41190          SM   NADD,17
00762 12    603  0001   41200          SM   AADD,17
00774 49    700 00000   41210          B    ATON17
00782                   42080          DORG *-37
00782 37   3409 00500   42090 PREGIN   RACD PRINT627
00794 32   3447 00000   42091          SF   PRINT635,,,7 STORED HERE IN Q7
00806 14   3443 000M8   42092          CM   PRINT636,48,107
00818 46    674 01200   42093          BF   *6587
00830 34        102     42094 PMSGG    RCTY ,,,CUMADD STORED HERE IN P7
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00842 39   3899 00100   42095          WATY MSGG7
00854 48               42096          H    ,,,IYR AND XO STORED HERE7
00866 49    782 00000   42097          B    PREGIN7
00874                  42098          DORG *-37
00874 46    906 00200   42100          BC2  *6327
00886 39   3409 00400   42105          WACD PRINT6227
00898 49   1002 00000   42120          B    PCONT7
00906                  42130          DORG *-37
00906 34        102     42132 PHEAD    RCTY ,,,FSADD STORED HERE IN P7
00918 34        102     42133          RCTY ,,,DADD STORED HERE IN P7
00930 39   3571 00100   42134          WATY HEAD5A7
00942 39   3571 00100   42135          WATY HEAD5B7
00954 34        102     42136          RCTY ,,,AFTADD STORED HERE IN P7
00966 39   3745 00100   42137          WATY HEAD6A7
00978 39   3835 00100   42138          WATY HEAD6B7
00990 34        102     42139          RCTY ,,,FPADD STORED HERE IN P7
01002 32   3416 00000   42140 PCONT    SF   PRINT69,,,FSTADD STORED HERE IN Q
01014 32   3447 00000   42150          SF   PRINT635,,,EXPTIM STORED HERE IN
01026 32   3444 00000   42160          SF   PRINT637,,,SLACK STORED HERE IN Q
01038 16    917  3994   42190          TFM  FSADD,FS-SIZE7
01050 16   1013  3993   42200          TFM  FSTADD,FST-SIZE7
01062 16    924  3998   42210          TFM  DADD,D-SIZE7
01074 16    960  3998   42220          TFM  AFTADD,AFT-SIZE7
01086 16    996  3998   42230          TFM  FPADD,FP-SIZE7
01098 37   3409 00500   43010 PREAD    RACD PRINT627
01110 14   3443 000M5   43020          CM   PRINT646,45,107
01122 46   2726 01200   43030          BF   PEND7
01134 14   3443 000M3   43040          CM   PRINT636,43,107
01146 47   1178 00200   43042          BNC2 *6327
01158 46   2694 01200   43044          BF   PPRINT7
01170 49   1190 00000   43046          B    *6207
01178                  43048          DORG *-37
01178 46   2674 01200   43050          BF   PWRITE7
01190 27    616 03823   43060          BT   ATON,PRINT6167
01202 21    912 03998   43070          A    FSADD,RECSIZ27
01214 24    807 0091K   43080          C    NUM,ESADD,117
01226 47    830 01200   43090          BNF  PMSGG7
01238 21   1013 03998   43280 PCALC    A    FSTADD,RECSIZ27
01250 21    924 03998   43290          A    DADD,RECSIZ27
01262 21    996 03998   43291          A    FPADD,RECSIZ27
01274 21    960 03998   43292          A    AFTADD,RECSIZ27
01286 16   1025  0999   43294          TFM  FXPTIM,9997
01298 21   1025 0101L   43300          A    FXPTIM,FSTADD,117
01310 21   1025 0092M   43310          A    FXPTIM,DADD,117
01322 27    408 0092M   43320          BT   NTOA,DADD,117
01334 26   3529 00615   43330          TF   PRINT6116,ALPHA7
01346 16   1037  099R   43336          TFM  SLACK,-9997
01358 21   1037 03947   43338          A    SLACK,SCMSTZ
01370 21   1037 0096-   43340          A    SLACK,AFTADD,117
01382 26   3974 01037   43345          TF   CADD,SLACK7
01394 22   1037 01025   43350          S    SLACK,FXPTIM7
01406 32   1037 00000   43355          SF   SLACK-27
01418 27    408 01037   43360          BT   NTOA,SLACK7
01430 26   3529 00615   43370          TF   PRINT6122,ALPHA7
01442 46   1478 00100   43371          BC1  PCODE7
01454 27    408 00990   43380          BT   NTOA,FPADD,117
01466 26   3537 00615   43390          TF   PRINT6130,ALPHA7
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01478 14  3443 000-0 43400 PCODE  CM    PRINT&36,00,10Z
01490 46  2590 01200 43450        BF    PNOTSC7
01502 46  2590 00100 43451        BC1   PNOTSC7
01514 27  A1A 03858 43460 PSCHED  BT    ATON,PRINT&47
01526 26  3006 00007 43461        TF    DATES,NUM7
01538 42  3004 00000 43470        SF    DATES-17
01550 32  3003 00000 43480        SF    DATES-37
01562 12  3006 00001 43490        SM    DATES,60,10Z
01574 13  3006 00L65 43500        MM    DATES,365,97
01586 26  3005 00000 44010        TF    DAYS,PROD7
01598 13  3006 00065 44020        MM    DATES,25,10Z
01610 11  3005 000-1 44030        AM    DAYS,1,10Z
01622 21  3005 00007 44040        A     DAYS,PROD-27
01634 12  3007 000-1 44050        CM    DATES-4,1,10Z
01646 46  1706 01200 44060        BF    P3067
01658 13  3007 000-4 44070 P305   MM    DATES-4,3,10Z
01670 16  1705  3366 44080        TFM   P306-1,CUM-67
01682 21  1705 00007 44090        A     P306-1,PROD7
01694 21  3005 00000 44100        A     DAYS7
01706 21  3005 03908 44110 P306   A     DAYS,DATES-27
01718 22  3005 03960 44111        S     DAYS,START7
01730 16  B69  0000 44130        TFM   X0,07
01742 16  B61 000-3 44140        TFM   X0-4,3,10Z
01754 28  07 00000 44150 PSORT    LD    PROD-7,FPADD,11Z
01766 29  89 00B65 44160        D     PROD&1-11,X0Z
01778 42  87 00000 44170        SF    PROD-127
01790 26  79 00007 44180        TF    PROD-20,PROD-67
01802 21  79 00B65 44185        A     PROD-20,X07
01814 13  79 000-5 44190        MM    PROD-20,5,10Z
01826 11  99 000-5 44200        AM    PROD,5,10Z
01838 32  93 00000 44210        SF    PROD-67
01850 22  B65 00098 44220        S     X0,PROD-1Z
01862 33  B65 00000 44230        CF    X0Z
01874 14  B65 0001 44240        CM    X0,1Z
01886 26  B65 00098 44250        TF    X0,PROD-1Z
01898 47  1918 01400 44260        BL    PSIG7
01910 49  1754 00000 44270        R     PSORTZ
01918             44271        DORG  *-9Z
01918 13  B65 000-7 44272 PSIG   MM    X0,7,10Z
01930 42  93 00000 44274        SF    PROD-67
01942 11  99 000-5 44276        AM    PROD,5,10Z
01954 26  B69 00098 44278        TF    X0,PROD-1Z
01966 32  1022 00000 44280       SF    FXPTIM-3Z
01978 13  1025 000-7 44290       MM    FXPTIM,7,10Z
01990 11  99 000-5 45010        AM    PROD,5,10Z
02007 22  3005 00008 45020       S     DAYS,PROD-1Z
02014 28  93 03965 45030        LD    PROD-7,DAYS7
02026 29  88 00B65 45040        D     PROD&1-12,X0Z
02038 43  2070 00088 45042       BO    *&32,PROD-117
02050 43  2070 00087 45044       BO    *&20,PROD-127
02062 49  2082 00000 45046       R     *&20Z
02070             45047        DORG  *-8Z
02070 16  92 09999 4504R        TFM   PROD-7,9999,8Z
02082 42  80 00000 45050        SF    PROD-10Z
02094 26  B05 00093 45060        TF    7,PROD-67
02106 44  2190 00B04 45070       BNF   P9,27
02118 33  B05 00000 45080 P8     CF    7Z
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02130 33  2486 00000 45090        CF    PJ7
02142 49  2162 00000 45100        R     P127
02150             45105        DORG  *-37
02150 37  2486 00000 45110 P9     SF    PJZ
                     45115 *  THE  FOL LOWING FORMULA MAY BE FOUND7
                     45116 *  IN  HAST INGS APPROXIMATIONS PAGE 1857
02162 13   B05 70711 45117 P12    MM    7,70711Z
02174 26   B05 00004 45118        TF    7,PROD-57
02186 13   B05 78108 45120        MM    7,78108,,FORM 5.4 * FORM 5.67
02198 26   79 00005 45130         TF    PROD-20,PROD-47
02210 11   79  0972 45140         AM    PROD-20,972Z
02222 23   79 00B85 45150         M     PROD-20,27
02234 26   79 00004 45160         TF    PROD-20,PROD-57
02246 11   79 23039 45170         AM    PROD-20,23039Z
02258 23   79 00B85 45180         M     PROD-20,77
02270 26   79 00005 45190         TF    PROD-20,PROD-47
02282 11   79 27839 45200         AM    PROD-20,27839Z
02294 23   79 00B85 45210         M     PROD-20,ZZ
02306 11   90 000-1 45220         AM    PROD-9,1,10Z
02318 26   79 00004 45230         TF    PROD-20,PROD-6,,FORM 6.47
02330 23   79 00079 45231         M     PROD-20,PROD-20,,FORM 12.67
02342 26   79 00007 45232         TF    PROD-20,PROD-2 ,,FORM 10.47
02354 23   79 00079 45233         M     PROD-20,PROD-20 ,,FORM 12.87
02366 26   79 00004 45235         TF    PROD-25,PROD-5,,FORM 12.37
02378 16   79  0000 45238         TFM   PROD-20,07
02390 18   96 10000 45240         LDM   PROD-3,10000 ,,FORM 8.77
02402 29   92 00074 45250         D     PROD&1-8,PROD-25,,QUOTIENT 8.4 --
02414 42   80 00000 45260         SF    PROD-19,,,FORM 5.47
02426 16   B05 10000 45270        TFM   7,10000Z
02438 22   B05 00084 45280        S     7,PROD-15Z
02450 13   B05 000-5 45290        MM    7,5,10Z
02462 32   94 00000 45300         SF    PROD-57
02474 26   B05 00098 45310        TF    Z,PROD-1Z
02486 44   2522 02486 45340 PJ    BNF   P10,PJ7
02498 11   B05  5050 45350 P20    AM    7,5050Z
02510 49   2558 00000 45360        R     P30Z
02522 16   99  5000 45370 P10     TFM   PROD,5000Z
02534 22   99 00B85 45372         S     PROD,77
02546 26   B05 00099 45374        TF    Z,PRODZ
02558 27   408 00B83 45390 P30    BT    NTOA,Z-27
02570 26  3543 00615 45400        TF    PRINT&136,ALPHAZ
02582 49  2590 00000 45410        R     PNOTSC7
02590             46010        DORG  *-3Z
02590 27  2756 01025 46020 PNOTSC BT    MODAYR,FXPTIMZ
02602 27   408 02755 46030        BT    NTOA,MODAYR-1Z
02614 26  3555 00615 46040        TF    PRINT&148,ALPHAZ
02626 27  2756 03973 46050        BT    MODAYR,KADDZ
02638 27   408 02755 46060        BT    NTOA,MODAYR-1Z
02650 26  3567 00615 46070        TF    PRINT&160,ALPHAZ
02662 46  2694 002B0 46075        RC2   PPRINTZ
02674 39  3409 00400 46080 PWRITE WACD PRINT&2Z
02686 49  1098 00000 46085        R     PREADZ
02694             46090        DORG  *-3Z
02694 36          102 46091 PPRINT RCTY  7
02706 39  3409 00100 46092        WATY  PRINT&2Z
02718 49  1098 00000 46093        R     PREAD7
02726             46095        DORG  *-3Z
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02726 16   848  3921 46140 PEND    TFM  PMSGG&18,MSGIZ
02738 49   830 00000 46150         B    PMSGGZ
02755                47010         DORG *&6Z
02756 15  2755 00-07 47020 MODAYR  MM   MODAYR-1,7,9Z
02768 32    94 00000 47025         SF   PROD-5Z
02780 44  2824 00000 47026         BNF  *&44,PRODZ
02792 12    99  0005 47027         SM   99,5Z
02804 32    98 00000 47028         SF   98Z
02816 49  2836 00000 47029         B    *&20Z
02828                47030         DORG *-3Z
02824 11    99 000-5 47031         AM   PROD,5,10Z
02836 26    99 00098 47040         TF   PROD,PROD-1Z
02848 21    99 03960 47050         A    PROD,STARTZ
02860 16  3407 000-0 47060 P604    TFM  INDEX,0,10Z
02872 16   859 00000 47070         TFM  IYR,60,10Z
02884 14  3407 000-0 47080 P610    CM   INDEX,0,10Z
02896 47  2952 01200 47090         BNF  P612Z
02908 14    99  0366 47100 P611    CM   PROD,366Z
02920 47  3064 01100 47110         BNH  P621Z
02932 12    99  0366 47120 P619    SM   PROD,366Z
02944 49  3012 00000 47130         B    P614Z
02952                47135         DORG *-3Z
02952 14    99  0365 47140 P612    CM   PROD,365Z
02964 47  3144 01100 47150         BNH  P626Z
02976 12    99  0365 47160 P615    SM   PROD,365Z
02988 14  3407 000-4 47170         CM   INDEX,4,10Z
03000 46  3032 01200 47180         BE   P616Z
03012 11  3407 000-1 47190 P614    AM   INDEX,1,10Z
03024 49  3044 00000 47200         B    P617Z
03032                47210         DORG *-3Z
03032 16  3407 000-0 48010 P616    TFM  INDEX,0,10Z
03044 11   859 000-1 48020 P617    AM   IYR,1,10Z
03056 49  2884 00000 48030         B    P610Z
03064                48035         DORG *-3Z
03064 14    99  0060 48040 P621    CM   PROD,60Z
03076 47  3144 01400 48050         BL   P626Z
03088 46  3132 01100 48060         BH   P624Z
03100 16  2751 000-2 48070 P629    TFM  MODAYR-5,2,10Z
03112 16  2753 000K9 48080         TFM  MODAYR-3,29,10Z
03124 49  3332 00000 48090         B    P645Z
03132                48095         DORG *-3Z
03132 12    99  0001 48100 P624    SM   PROD,1Z
03144 14    99  0031 48110 P626    CM   PROD,31Z
03156 46  3212 01100 48120         BH   P630Z
03168 16  2751 000-1 48130 P625    TFM  MODAYR-5,1,10Z
03180 32    98 00000 48140         SF   PROD-1Z
03192 26  2753 00099 48150         TF   MODAYR-3,PRODZ
03204 49  3332 00000 48159         B    P645Z
03212                48160         DORG *-3Z
03212 16  2751 000-1 48161 P630    TFM  MODAYR-5,1,10Z
03224 16   836  3372 48170         TFM  CUMADD,CUMZ
03236 11  2751 000-1 48171         AM   MODAYR-5,1,10Z
03248 11   836  0003 48180         AM   CUMADD,3Z
03260 24    99 00840 48190         C    PROD,CUMADD,11Z
03272 46  3236 01100 48200         BH   *-36Z
03284 12   836  0003 48210         SM   CUMADD,3Z
03296 22    99 00830 48220         S    PROD,CUMADD,11Z
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03308 32    98 00000 48230         SF   PROD-1Z
03320 26  2753 00099 48240         TF   MODAYR-3,PRODZ
03332 26  2755 00859 48250 P645    TF   MODAYR-1,IYRZ
03344 33  2754 00000 48260         CF   MODAYR-2Z
03356 33  2752 00000 48270         CF   MODAYR-4Z
03368 42             48480         BB   Z
03370                48490         DORG *-9Z
                     93010 *  OUT  PUT  AREASZ
03372        3       93030 CUM     DC   3,31Z
03375        3       93040         DC   3,59Z
03378        3       93050         DC   3,90Z
03381        3       93060         DC   3,120Z
03384        3       93070         DC   3,151Z
03387        3       93080         DC   3,181Z
03390        3       93090         DC   3,212Z
03393        3       93100         DC   3,243Z
03396        3       93110         DC   3,273Z
03399        3       93120         DC   3,304Z
03402        3       93130         DC   3,334Z
03405        3       93140         DC   3,365Z
03407       81       96030 PRINT   DAS  81Z
03569        1       96031         DAC  1,@Z
03567       50       96032         DC   50,0,PRINT&160Z
03518       50       96033         DC   50,0,PRINT&111Z
03469       50       96034         DC   50,0,PRINT&62Z
03420       19       96035         DC   19,0,PRINT&13Z
03571       50       96040 HEAD5A  DAC  50, EVENTS   TIMES    S OR C   ACT
03671       32       96045 HEAD5B  DAC  32,       EXPSLKTOT PRBXPECTDLATES
03735       50       96050 HEAD6A  DAC  50,PREDSUCCOPTLIKPES MODAYR
03835       32       96055 HEAD6B  DAC  32,       TIM    VAR   MODAYRMODAY
03899       11       96060 MSGG    DAC  11,CD SEQ ERR@Z
01013        5       96070 ESTADD  DS   5,PCONT&11Z
01025        5       96090 EXPTIM  DS   5  ,PCONT&23Z
01037        5       96100 SLACK   DS   5,PCONT&35Z
03921        8       96110 MSGI    DAC  8,THE END@Z
03407        2       96120 INDEX   DS   2,PRINTZ
00865        6       96130 XO      DS   6,PMSGG&35Z
00805        5       96140 Z       DS   5,PBEGIN&29Z
00912        5       96150 ESADD   DS   5,PHEAD&6Z
00924        5       96160 DADD    DS   5,PHEAD&18Z
00960        5       96170 AFTADD  DS   5,PHEAD&54Z
00996        5       96180 EPADD   DS   5,PHEAD&90Z
00859        2       96200 IYR     DS   2,PMSGG&29Z
00836        5       96210 CUMADD  DS   5, PMSGG&6Z
03943                98080         DORG 3943Z
03947        5       98090 SCMST   DS   5Z
03948                98100         DORG 3948Z
03952        5       98110 DI      DS   5Z
03955        3       98120 NPONE   DS   3Z
03960        5       98130 START   DS   5Z
03965        5       98140 DAYS    DS   5Z
03968        3       98150 K       DS   3Z
03973        5       98160 KADD    DS   5Z
03976        3       98170 I       DS   3Z
03981        5       98180 IADD    DS   5Z
03984        3       98190 N       DS   3Z
00099       20       98200 PROD    DS   20,99Z
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03996         12           99020 DATES   DS     12Z
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~~04003        4           99040 PP      DS     4,ACT-19Z~~
04007          4           99050 FS      DS     4,ACT-15Z
~~04010        3           99060 VAR     DS     3,ACT-12Z~~
04013          3           99070 D       DS     3,ACT-9Z
~~04016        3           99080 AP      DS     3,ACT-6Z~~
04019          3           99090 AS      DS     3,ACT-3Z
~~04022        3           99100 P       DS     3,ACTZ~~
04016          3           99110 FST     DS     3,ACT-6Z
~~04022        3           99120 AFT     DS     3,ACTZ~~
00782                      99999         DEND   PREGINZ
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  430054 20080080        ACT  4
  440056     10020       ACT  5
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  460047                 ACT  7
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  520044 10020030        ACT  13
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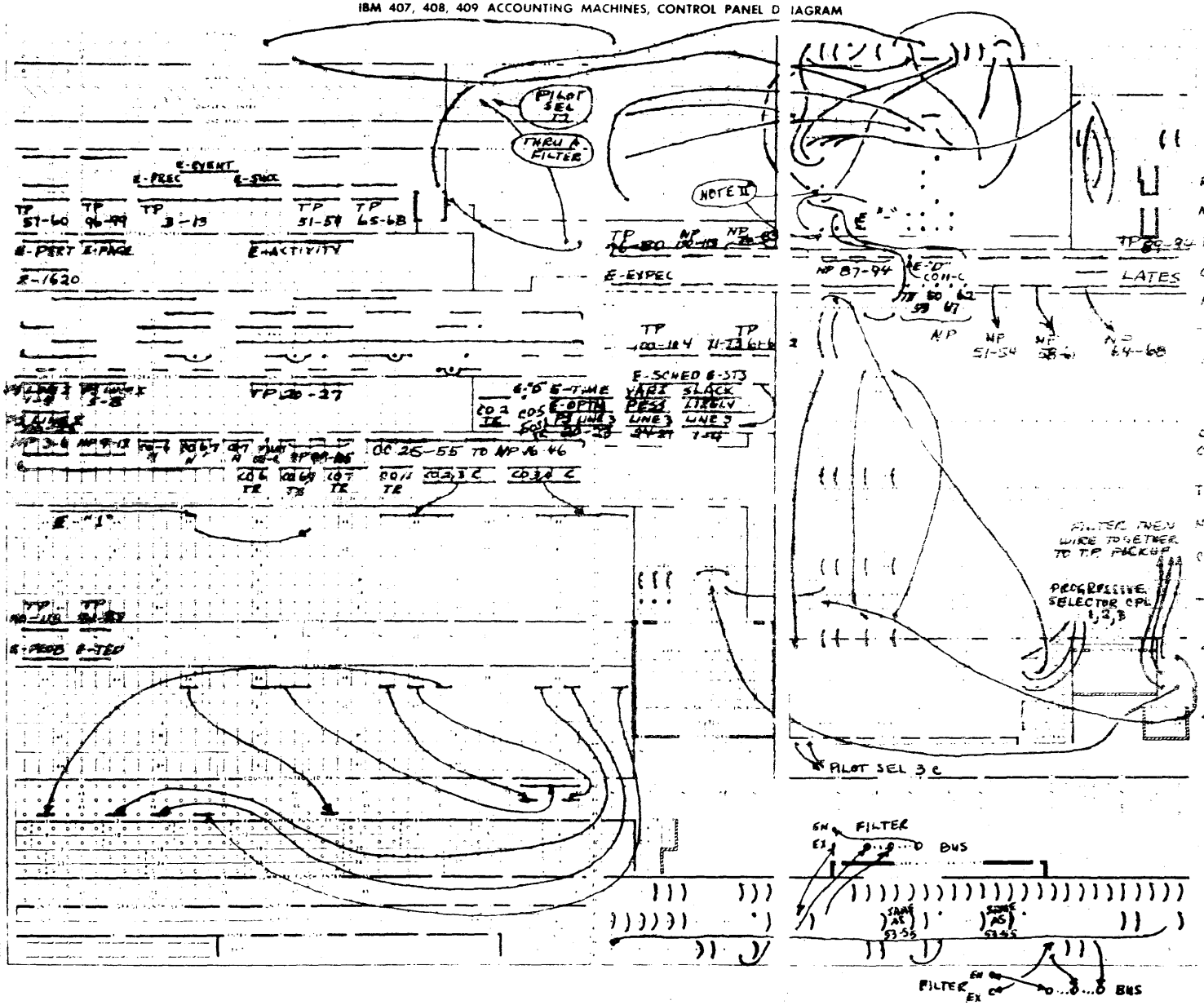
IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM 407, 408, 409 ACCOUNTING MACHINES, CONTROL PANEL D IAGRAM

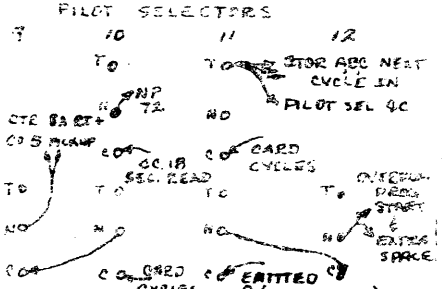
Form X24-6421-0
Printed in U.S.A.

FIXED 408, 409 CARRIAGE CONTROL PANEL



RI - READ IN	CC - CARD COLUMN
NP - NORMAL PRINT	TR - TRANSFERRED
TP TRANSFER PRINT	D - EMITTED DECIMAL PT.
CO - CO SELECTOR	E - EMITTED WORD FOLLOWS
N - NORMAL	PS - PROGRESSING SELECTOR

PILOT SELECTORS



NOTES

I A "T" SPLIT-WIRED FROM CO 8 TO TP 91 AND 94 WILL FILL IN THE WORD "LATEST"

II USE TWO ALL CYCLES IMPULSES WIRED THRU PILOT SELECTOR 3 TR WHICH IS TRANSFERRED FOR ALTER SW 1 TRANSFERRED

REPORT 1620 PERT LISTING

ALTER SW1 - OFF - INPUT LISTING
ALTER SW1 - ON - OUTPUT LISTING
ALTER SW1 - OFF - SINGLE SPACE
ALTER SW1 - ON - DOUBLE SPACE

DIAGRAM NO

DATE

(7-61 20M-S)

FOLD TO HERE