Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: Utility Control Program

To: Scientific and Engineering Computation Staff and Operators

From: F. C. Helwig

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Abstract: The S&EC Group has developed a large library of utility tapes which includes input programs, conversion programs, post-mortem programs and equipment checking programs. The more frequently used programs in this library have been semi-permanently recorded either on the nagmetic drums or as numbered blocks on magnetic tape.

The selection and use of programs from the library is initiated by a utility control program which has been semi-permanently recorded in group 11 of the auxiliary drum.

Individual Distribution List

S. Manber

P. R. Bagley

J. Ackley

A.J.Roberts

P.M.Arden

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1. General Description of the Utility Control Program

The use of the utility control program is initiated by pressing the read-in button. This transfers computer control to the test storage input program which block records MCM on group 0 of the auxiliary drum and block reads group 11 of the auxiliary drum into MCM. Group 11 includes the utility control program to which computer control is now transferred .

The mode of operation of the utility control program is determined by the settings of the upper activate (examine selector panel) button, the lower activate (erase) button, the right insertion register (selector panel) and the left insertion register(insertion panel).

If the examine selector panel button has NOT been pushed, the utility control program assumes that a paper tape will be processed and read in using the PETR. Subsequent utility program selection is made following an examination of the initial characters on the paper tape. This will be called the automatic read-in mode.

If the examine selector panel button has been pushed, the utility control program examines the contents of the selector panel. Subsequent utility program selection is determined from its contents. This will be called the manual read-in mode.

Pushing the erase button causes the utility control program to record +0 on all registers of group 0 of the auxiliary drum in certain cases.

2. The Automatic Read-In Mode

2.1 Drum Utility Programs

If the examine selector panel button has NOT been pushed, the utility control program assumes that a paper tape will be read in using the PETR. The admissible types of paper tape have the following general form:

(1) Identifying information

(2) Title

(3) Body of tape

The utility control program processes the identifying information (for utility selection) and the title (for logging). The selected utility program processes the body of the tape.

In general, the utility programs involved here are stored on magnetic tape unit 0 and form a special class of utility programs which are called drum utility programs.

Drum utility programs can be used only after they have been read from magnetic tape to the drums. Provision has been built into the utility control program so that once a drum utility program has been read from tape to drum it can be used directly from the drum provided

it has not been disturbed. This is done by forming a sum-mod-one of a specified drum range immediately after a drum utility program has been read from tape to drum and recording this sum on the drum. Whenever the drum utility program is requested this same sum is formed again from the contents of the drum and is checked against the contents of the sum register. If the sums agree the drum utility program is used from the drum. If the sums do not agree, the tape unit is searched for the desired utility program which is then read from tape to drum. A new sum is then formed and recorded on the drum in the sum register.

2.2 Utility Program Selection

The utility control program selects the utility program needed to process the tape by examining the initial flexo character on the tape.

Four cases arise as a result of this processing:

2.2.1 Illegal Initial Characters

Certain flexo characters[1.] have been disallowed as initial characters on paper tapes. If one of these occurs, the utility control program restores MCM to its contents prior to read-in and stops the computer.

2.2.2 CS I Binary (556) Tapes

Certain flexo characters[2.] are considered to be the first line of a 556 word. If one of these occurs, the utility control program erases group 0 (if the erase button has been pushed) and selects the binary input program which processes the tape.

2.2.3 Fence Tapes

Any tape whose initial character is a vertical bar is assumed to be a CS II flexo tape.

2.2.4 Tapes with Flexo Titles

The flexo character f is used to introduce tapes which begin with a flexo title. The utility program required to process the tape is selected by examining the next flexo character on the tape.

Several cases may arise:

2.2.4.1 Illegal and Ignorable Characters

Certain flexo characters are illegal if they follow an initial

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1. The octal values of the illegal initial characters are the following: 30, 31, 33-35, 41-43
2. The octal values of the characters which can introduce CS I 556 tape are:
   0-4, 6-27, 36-40, 44-77

f.[1] If one of these occurs, the utility control program restores MCM to its contents prior to read-in and stops the computer.

Nullify characters following an initial f are ignored.

2.2.4.2 CS II Binary Tapes(fb tapes)

The flexo combination fb introduces CS II binary tapes. The utility control program reads-in and logs the tape title, erases group 0 (if the erase button has been pushed) and selects the binary input program which processes the tape.

2.2.4.3 CS II Flexo Tapes (fc tapes)

The flexo combination fc introduces CS II flexo tapes. The utility control program reads-in and logs the tape title, erases group 0 if the erase button has been pushed and selects the comprehensive system which processes the tape.

2.2.4.4 Post-Mortem Request Tapes

The flexo combination fp introduces post-mortem request tapes. The utility control program reads in and logs the tape title and selects the generalized post-mortem program which processes the tape.

2.2.4.5 Summer Session Tapes

The flexo combination fs introduces summer session tapes. The utility control program reads in and logs the tape title and selects the summer session computer which processes the tape.

2.2.4.6 Single Address Computer(SAC) Tapes

The flexo combination f2s introduces SAC tapes. The utility control program reads in and logs the tape title and selects SAC which processes the tape.

2.2.4.7 Three Address Computer (TAC) Tapes

The flexo combination f2t introduces TAC tapes. The utility control program reads in and logs the tape title and selects TAC which processes the tape.

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1. The octal values of the illegal characters following an f are: 0-11, 13, 15, 16, 20-31, 33, 35-37, 41-53, 55-61, 63-67, 71-76. This leaves 12(s), 14(i), 17(z), 32(f), 34(c), 40(t), 54(p), 62(b), 70(m) and 77(nullify).

2.3 Computer Logging

2.3.1 Flexo Tape Titles

Tapes beginning with the flexo character f are introduced by flexo logging titles. These titles have the following form:

(1) Identifying characters

(2) Tape number

(3) Tape description

(4) Terminating carriage return

The identifying characters consist of the flexo character f followed by one of the combinations

c, b, p, s, 2s or 2t

The tape numbers can have one of two forms. S&EC tape numbers have the form:

TAPE 100-0-0 or simply 100-0-0

m or p tape numbers have the form:

TAPE 1234m5 or simply 1234m5

TAPE 1234p5 or simply 1234p5

The tape description can consist of any collection of flexo letters and generally includes at least the programmers name.

The entire flexo tape title should not contain more than 150 flexo characters.

A flexo tape title must include at least Identifying characters and a terminating carriage return.

2.3.2 The Various Computer Logs

Tapes with flexo titles are logged by the utility control program. Logging may occur on any of the following output units:

(1) The scope

(2) The direct punch

(3) The direct typewriter

The units on which logging occurs and the logging format depend on the kind of tape being read in.

2.3.3 Logging of fc Tapes

The form of logging for fc tapes depends on the tape number.

If the tape has an m or a p number, logging occurs on the direct printer only. In this case the flexo character, e, is recorded (if the erase button was pushed) followed by the entire tape title (except for the identifying characters). For example:

e TAPE 1234m5 JONES→

If the tape has an S&EC number, logging occurs on the direct punch and the scope.

The digits of the tape number are displayed on the scope. Each dash appearing in the tape number terminates a line on the scope. For example the tape number:

TAPE 100-0-0

will appear on the scope as

100
0
0

Logging on the direct punch consists of the following:

(1) The flexo character e(if the erase button was pushed)

(2) An identification character

(3) The digits of the tape number

(4) The time of read in

Identifying Character: If a direct read in was requested the identifying character d is recorded in the log. If a binary conversion was requested the identifying character c is recorded in the log.

Tape Number: The digits of the tape number are recorded in the log, e.g., the tape number, TAPE 100-0-0, is recorded as 100-0-0 in the log.

Time: The time of read in will be recorded in the log either as standard clock time or as computer clock time. It will be recorded as standard time provided that a reference standard time has been set up and recorded on the buffer drum. Otherwise, it is recorded as computer clock time.

Standard time is recorded on a 24 hour basis to the nearest 0.1 minute, e.g., 1720.3, and is obtained by adding the contents of the computer clock to the reference standard time. (The computer clock is reset to +0 whenever a reference standard time is formed.) Computer clock time is simply the contents of the computer clock converted to hours and minutes and is recorded in the form:

3h2.1 (3 hours and 2.1 minutes)

If the reference standard time once set is disturbed on the drum the logging will automatically switch from standard time to computer clock time.

2.3.4 Logging of fb Tapes

The logging of fb tapes is the same as the logging of fc tapes except that the identifying character b is recorded for tapes with S&EC tape numbers instead of the characters c or d.

2.3.5 Logging of fp and fs Tapes

fp and fs tapes are logged on the direct punch only.

The identifying characters p or s are recorded followed by the time (either standard or computer clock time). The tape number is not logged.

2.3.6 Logging of f2s and f2t Tapes

The logging of f2s and f2t tapes is the same as the logging of fc tapes with the following exceptions:

(1) No logging occurs on the scope.

(2) The identifying characters s or t are recorded instead of the identifying characters c or d.

2.3.7 Log Initiation

The procedure for setting up and recording the reference standard time on the buffer drum is contained in the description of the manual mode of the utility control program.

2.3.8 Log Termination

The log termination program records the word "stop" followed by the time (either standard or computer clock time) in the direct punch log. The procedure is contained in the description of the manual mode of the utility control program.

2.4 The Binary Input Program

2.4.1 General Description

The binary input program, which is recorded on group 11 of the auxiliary drum, reads blocks of 556 binary words from paper tape into blocks of registers on the drums with specified initial addresses. The information required for read-in of each block, namely the length and the initial address, is also stored as 556 words on paper tape preceding the block. Words of this type on paper tape are called control words. They do not form part of the binary information being read in but specify, rather, how it should be processed.

Each control word commands the binary input programs to perform a certain function and contains implicitly in its definition the number of binary words appearing on the tape before the next control word. The binary input program thus jumps from control word to control word while processing the intervening information.

The control words for CS II binary tape follow.

2.4.2 The Block Length Control Word

A block length control word is a binary word of the form -n+1 where n = 1, 2, ...2048. The block length control word sets the block length indicator to -n+1. The block length indicator is initially set to -0.

2.4.3 The Drum Address Control Word

The drum address control word specifies the initial address on the drums at which a block of words is to be stored. The drum is specified by the sign digit (with the convention that 0 specifies the auxiliary drum and 1 specifies the buffer drum). The 15 remaining digits specify the drum address. The drum address control word cannot be used to place words in test storage.

If a drum address control word is encountered on tape, the binary input program reads in the next n words from tape, where -n+1 is the contents of the block length indicator, and stores the block on the drum beginning at the initial address specified by the drum address control word. A sum-mod-one of the words in the block is formed during read in and is placed in a sum register. Finally, the block length indicator is reset to -0.

2.4.4 The Check Sum Control Word

The check sum control word, ck5, is followed on tape by a check sum which is a sum-mod-one of the block of words preceding it. The check sum is formed and punched out by the conversion program during the conversion of the tape.

If a check sum control word is encountered on tape, the binary input program reads in the check sum from tape and compares it with the contents of the sum register. If these do not agree a check alarm is generated. Finally, the block length indicator is reset to -0.

2.4.5 The Ditto Control Word

If a ditto control word, ck512+n, n = 1, 2,..., is encountered, the binary input program reads in next block of words from tape (this consists of at least a storage address control word and a single program word) and records this block of words n times on the drums in a block of consecutive registers starting at the initial address specified on tape for the block of words. The total length of the block formed in this manner on the drum should not exceed 1024 registers.

If n=0, i.e., ck512, the next block of words on tape is ignored.

In any case the block length indicator is finally reset to -0.

2.4.6 Termination of the Read-In Process

The reading in of a paper tape is terminated by means of the control word spn, n = 1,2. An spl or sp2 control word on tape must always be followed on tape by a control word of the form spx.

If an spn control word is encountered the binary input program reads in the next word on tape (i.e., spx) and stores it in test storage register 2, block reads group 0 of the auxiliary drum into MCM and transfers computer control to register n.

Thus if n = 1, the computer will stop provided the stop on sil switch is on. The program can then be operated by pressing the restart button (transferring computer control to 2 and hence to the starting address of the program).

If n = 2 computer control is immediately transferred to the starting address of the program.

If an spn control word is changed to make $n \geq 3$ both the spn control word and the following spx control word will be ignored by the binary input program.

2.4.7 CS I Binary Tape

The control words for CS I binary tape are exactly the same as those for CS II binary tape with the following exception:

Drum address control words which would normally address group 8 of the auxiliary drum (i.e., words of the form tsx) instead always address group 0 of the auxiliary drum.

Thus tsx and six are equivalent control words on CS I binary tape.

2.5 The CS II Conversion Program

2.5.1 General Description

fc tapes are processed and read in by the CS II conversion system.

The CS II conversion system is a drum utility program which occupies group 4, register 310(octal), through group 6, register 2400(octal) of the buffer drum and is recorded in blocks 250-262 on magnetic tape unit 0.

There are three independent factors involved in operating with the CS II conversion system:

(1) Either the PETR or the mechanical tape reader may be selected as the input device.

(2) Either the delayed or the direct printer and punch may be selected as the output device.

(3) A binary tape may or may not be obtained as a by-product of conversion.

A normal situation (PETR, delayed, no binary tape) occurs unless the examine selector panel button has been pushed and information placed in the selector panel (see description of manual mode).

2.5.2 Operating Instructions

The tape to be converted is placed in the PETR (or MTR) and the read in button pressed. The utility control program logs the tape title (see description of logging) and brings in the CS II conversion system.

The title section of the CS II conversion system then records the tape title (everything up to the terminating carriage return) on the delayed (or direct) printer and if a binary tape is requested, records both a visual and a logging title on the delayed(or direct) punch.

The first pass section of the CS II conversion system then reads in the flexo tape and records a modified version of the tape on magnetic tape unit 1. When a START AT block is encountered, the computer is stopped on an sil instruction in register 1530(octal).

If other tapes are to be converted with the first tape as a dependent set they are placed in the PETR (or MTR) at this time and the SA40 button is pressed. Subsequent printed and visual titles (for binary tapes) are not recorded. (Subsequent logging titles on the binary tape do not contain the tape number and consist only of the characters fb)

After the last dependent tape is read in, conversion can be completed by pressing the restart button. The converted program is then stored on the auxiliary drum and a binary tape, if required, is recorded on the delayed (or direct) punch.

When conversion is finished, a printed flad table is recorded on the delayed (or direct) printer.

Group 0 of the auxiliary drum is then read into MCM, spx (where x is the starting address of the program) is stored in test storage register 2 and computer control is transferred to register 1.

The program may now be operated by pressing the restart button or a new fc tape may be converted by pressing the read-in button.

2.5.3 Conversion Post-Mortems

Certain errors in the program (duplicate flads, indefinite flad

assignments, etc) can be detected by the conversion program. If one of these occurs, an indication of the error is recorded on the direct printer and the computer is stopped. In the case of unassigned flads, however, the conversion is completed and the converted program may be operated as usual if so desired.

2.5.4 Post-Mortem during Operation

If the programmed arithmetic (PA) subroutine encounters an impossible instruction it will call for a PA post-mortem (PAPM) by stopping the computer on a ck instruction in register 3763(octal). The PAR register contains cax at this time, where x is the location of the interpreted instruction causing the alarm. The AR contains the address from which computer control was transferred to the ck instruction and gives an indication of the type of alarm.

Techniques for obtaining a PAPM are given in the descriptions of the manual mode and the generalized post-mortem program.

2.6 The Generalized Post-Mortem Program

2.6.1 General Description

fp tapes are processed and read in by the generalized post-mortem (PM) program.

The PM program is a drum utility program which occupies group 6, register 2401(octal) through group 7, register 3447(octal) of the buffer drum and is recorded in blocks 262-277 on magnetic tape unit 0.

2.6.2 Operating Instructions

fp tapes can be read in using either the PETR or the MTR. The PETR is used unless the examine selector button has been pushed (see description of the manual read-in mode).

After processing the fp tape, the PM program executes the required requests and records results on the output units selected in the fp tape. Finally MCM is restored to its contents prior to read-in and the computer is stopped.

Single post-mortem requests may also be obtained manually. The procedure for setting up the insertion and selection panels is given in the description of the manual read-in mode. The PM program executes the request, restores MCM to its contents prior to read in and stops the computer.

2.6.3 Programmed Arithmetic Post Mortems

A PAPM will be automatically given by fp tapes whenever the program contains a programmed arithmetic subroutine.

A PAPM may also be obtained manually on either the direct or the delayed printer (see description of manual mode).

In all cases the PM program restores MCM to its contents prior to read-in and stops the computer.

2.7 The Three Address Computer

2.7.1 General Description

f2t tapes are processed and read in by the three address computer (TAC).

TAC is a drum utility program which occupies group 1, register 0 through group 8, register 3777(octal) of the auxiliary drum and uses group 4, register 0 through group 7, register 3777(Octal) of the buffer drum as temporary storage. It is recorded in blocks 300-337 on magnetic tape unit 2.

There are two independent factors involved in operating with TAC.

(1) Either the PETR or the MTR may be selected as input device.

(2) Either the delayed or the direct printer may be selected as output device.

A normal situation (PETR, delayed) occurs unless the examine selector panel button has been pushed and information placed in the selector panel (see description of the manual mode).

2.7.2 Operating Instructions

The tape to be converted is placed in the PETR (or MTR) and the read in button pressed. The utility control program logs the tape number and the time on the direct punch and selects the TAC computer.

If the erase button has been pressed, the following will occur:

(1) TAC storage will be erased

(2) The TAC simulated magnetic tape units will be reset to their given initial values.

(3) The positions of the simulated tape and drum units will be reset.

(4) The TAC time register will be reset to zero.

The TAC computer reads in and converts the f2t tape and then stops the computer on an sil in register 1. The program may then be operated by pressing the restart button or another tape may be read in.

Pressing the restart button starts the program at the starting address contained on the tape. The program may also be started at an arbitrary address x by placing x (in octal decimal) in the insertion panel, pressing the erase button, and pressing the SA40 button.

2.7.3 Conversion Post-Mortems

Many typing errors are detected by the TAC computer during the conversion of the tape. These errors are recorded on the direct printer during the conversion process.

2.7.4 The Read (R) Instruction

The TAC instruction R reads in characters from punched paper tape. The input device can be either the PETR or MTR and is selected in accordance with the contents of the selector panel (see description of manual mode).

2.7.6 Post-Mortems during Operation

A post-mortem will be given automatically whenever the TAC computer encounters an impossible instruction. This post-mortem can also be obtained manually in the following ways:

(1) Directly after read in of a tape, the post-mortem can be obtained by pressing the examine selector panel button and pressing the SA40 button.

(2) The post-mortem can be obtained while the program is operating by pressing the examine selector panel button.

The post-mortem is given on the direct or delayed printer, whichever has been selected.

2.7.7 Output of Results

The TAC computer records output on either the delayed or direct printer. TAC contains an automatic feedout feature so that at the end of each TAC program enough carriage returns are recorded on the delayed (direct) printer to feed out the paper to a standard position on a new page.

If TAC results are recorded on the delayed printer, a stop character is automatically recorded at the end of the information. If several recordings are made consecutively on the same tape unit, only one stop character occurs, however, at the end of the final recording.

2.8 The Summer Session Computer

2.8.1 General Description .

fs tapes are processed and read in by the summer session (SS) computer.

The SS computer is a drum utility program which occupies group 3, register 0 through group 6, register 3777 of the auxiliary drum and is recorded in blocks 740-757 on magnetic tape unit 0.

SS tapes can be read in using either the PETR or the MTR. The PETR will be used unless the examine selector panel button has been pushed (see description of the manual mode).

2.8.2 Operating Instructions

The tape to be converted is placed in the PETR (MTR) and the read in button pressed. The utility control program logs the time of read in and brings in the SS computer.

The SS computer records the tape title on whichever output units are used by the program, converts the tape and stops on an sil in register 57 after conversion. The program is then operated by pressing the restart button.

SS storage is erased before every read-in.

SS programs halt either by executing an STP (stop) instruction (here PC=2245(o) or by calling for a post-mortem (here PC = 43(octal)). In the former case, pressing the restart button will restart the program. In the latter case, pressing the restart button will give a post-mortem on the delayed printer. (A post-mortem will be obtained on the direct printer if the erase button is pushed and the selector panel contains a negative number.)

2.8.3 Conversion Post-Mortems

Certain errors in the program can be detected during conversion and result in a conversion post-mortem being recorded on the direct printer.

2.9 The Single Address Computer

2.9.1 General Description

f2s tapes are processed and read in by the single address computer (SAC).

SAC is a drum utility program which occupies group 3, register 40 (octal) through group 6, register 3776 of the auxiliary drum and is recorded in blocks 220-237 on magnetic tape unit 2.

SAC tapes can be read in using either the PETR or the MTR. The PETR will be used unless the examine selector panel button has been pushed (see description of the manual mode).

2.9.2 Operating Instructions

The tape to be converted is placed in the PETR (or MTR) and the

read-in button pressed. The utility control program logs the tape number and time on the direct punch and selects SAC.

SAC then records the tape title on whichever output units are used by the program.

If the erase button has been pushed the following will occur:

(1) SAC storage will be erased.

(2) The SAC simulated magnetic tape units will be erased.

(3) The positions of the simulated tape units will be reset.

(4) The SAC time register will be reset to zero.

The SAC computer converts and reads in the tape and then stops the computer on an sil in register 57. The program may then be operated by pressing the restart button or another tape may be read in.

A program which is operating may be stopped in one of the following ways:

(1) By an STP (stop) instruction (stops on si0)

(2) By a generated ck alarm (stops on ck instruction)

(3) By pushing the examine selector panel button (which generates the ck alarm in (2))

In case (1), the program may be restarted by pressing the restart button. A post-mortem will be obtained at this point, however, if the examine selector panel button is pressed before pressing the restart button. It will occur on the direct or delayed printer according to whether the erase button is pushed or not.

In case (2), a post-mortem can be obtained by pressing the restart button and will be recorded on the direct or delayed printer according to whether the erase button is pushed or not.

2.9.3 Conversion Post-Mortems

Certain errors can be detected during conversion and result in a conversion post-mortem being recorded on the direct printer.

2.10 Drum Utility Program Parameters

The following table gives the values of the various parameters associated with the drum utility programs. The parameters are the following:

(1) Initial drum address of the utility program

Program	Parameters							
	1	2	3	4	5	6	7	8
Post Mortem	1.32000	0.37447	1.37777	1.34040	bi40	0.00200	sp45	0.00262
Summer Session	0.14000	0.33776	0.33777	0.20000	bi40	0.00400	sp407	0.00740
CS II	1.20310	0.32777	1.20307	1.20000	bi2756	0.00760	sp3346	0.00250
TAC	0.04000	0.43777	0.47777	0.04040	bi40	0.00163	sp40	0.00300(1)
SAC	0.14040	0.33776	0.33777	0.20000	bi40	0.01000	sp347	0.00220(1)
Utility Control Program	1.10000	0.02000	1.37777	--	--	--	--	0.00244

(1) These drum utility programs are recorded on magnetic tape unit 2.

(2) Final drum address of the utility program

(3) Drum address in which the check sum for the utility program is stored

(4) Initial drum address of the first block of the utility program to be executed

(5) Initial MCM address of the first block of the utility program to be executed (expressed as address of a bi instruction)

(6) Length of the first block of the utility program to be executed

(7) Starting address of the first block of the utility program to be executed (expressed as address of an sp instruction)

(8) Initial block number on magnetic tape of the utility program

A 1 in the sign digit of a drum address refers to the buffer drum except for the parameter giving the final drum address. In this case the sign digit is always 0 and the utility program is assumed to lie entirely on the drum specified by the initial address of the program.

All addresses are given in octal.

2.11 A List of Blocks Recorded on Magnetic Tape

The majority of the S&EC utility programs have been recorded on magnetic tape unit 0 as numbered blocks. The recording is done by using tape fb 100-12-9064 (or its equivalent) which is described in DCL-12.

The recorded programs have the following form:

÷	Block mark
can	Block number recorded in the forward direction
fb100-0-0	Logging title
can	Block number recorded in the reverse direction
÷	Block mark
can	Block number recorded in the forward direction
	Binary tape
can	Block number recorded in the reverse direction

The utility control program contains a search routine which is used to position the tape unit to a desired block. This is done by examination of the block numbers (can).

The block numbers can be in the octal range $7 < x < 777$.

The following blocks have been recorded on magnetic tape unit 0:

7	Dummy Limiting Block
30	Drum Checking Program
40	Magnetic Tape Checking Program
50	Scope Calibration Program
60	PETR Checking Program
71	Test Storage Checking Program
244-247	Utility Control Program
250-262	CS II
262-267	Generalized Post-Mortem Program
270-410	CS II Output Blocks
600	CS I PAPM
601-717	CS I
740-757	Summer Session Computer
777	Dummy Limiting Block

Drum utility programs in general occupy several consecutive blocks on magnetic tape. If a drum utility program is being read from tape to drum, the utility control program continues to read in blocks until it encounters a block whose starting address is not 26 (decimal).

The following blocks have been recorded for read-in from magnetic tape unit 2.

220-237	The Single Address Computer
300-337	The Three Address Computer

3. The Manual Read In Mode

3.1 General Description

If the examine selector panel button has been pushed, the utility

control program assumes that a utility program is being selected by inserting information into the selector panel and the insertion panel.

The selector and insertion panels are 16 binary digit registers into which 5 digit octal numbers (with sign digits) can be inserted by means of a set of octal push buttons. The following definitions are made with respect to the selector panel:

Digit 1 is called the post-mortem request digit. Normally this will be zero.

Digit 2 is called the unit selection digit. This is used to specify the magnetic tape unit on which the utility programs are recorded (+n in this digit is used to designate unit n, n=0,1,2,3). Utility programs are normally recorded on unit 0.

Digits 3-5 are called the utility program selection digits. The utility programs in the library have been assigned code numbers in the octal range $0 \leq p \leq 111$. Manual requests for utility programs are made by inserting the assigned code number into the utility program selection digits.

The bulk of the library of utility programs has been recorded on magnetic tape unit 0 as blocks numbered monotonically in the octal range $7 < b < 777$. Requesting these programs may require searching magnetic tape for the numbered blocks in which the program is stored. The code number of the utility program (i.e., the number placed in the utility program selection digits) is not in general the same as the number of the block on magnetic tape unit 0 in which the program is stored.

3.2 Utility Program Selection

If the contents of the selector panel is of the form

0.00ijk

where

$0 \leq ijk \leq 111$ (octal)

the utility program sets up for the execution of the utility program whose code number if ijk.

A list of code numbers and descriptions of the various utility programs follows.

If a particular number does not appear in the list, this means that no program has been assigned to the number. If such a number is used for utility selection, the control program restores MCM to its contents prior to read in and stops the computer.

The contents of the insertion panel can be assumed meaningless unless specifically mentioned.

Pushing the erase button has no effect unless it is specifically mentioned.

3.2.1

0.00000 PETR, Delayed Output, Direct Read In

Perform an automatic read-in. The utility control program ignores the fact that the examine selector panel button has been pushed.

3.2.2

0.00001 PETR, Delayed Output, Convert to Binary

The utility control program sets indicators for use by the CS II conversion program directing it to produce a binary tape as part of conversion and then executes an automatic read-in.

3.2.3

0.00002 Examine Drums

The contents of the drum register specified in the insertion panel (with the convention that 0 in the sign digit designates the auxiliary drum and a 1 in the sign digit designates the buffer drum) is displayed in the indicator lights. MCM is then restored to its contents prior to read-in and the computer is stopped.

3.2.4

0.00003 Record Stop Character

The utility control program records a flexo stop character on magnetic tape unit 3. MCM is then restored to its contents prior to read-in and the computer is stopped.

3.2.5

0.00005 PAPM on Delayed Printer

The utility control program sets indicators which direct the generalized post-mortem (PM) program to perform a programmed arithmetic post-mortem and record the results on the delayed printer. The PM program is then brought into MCM and computer control transferred to it.

3.2.6

0.00006 PA PM on Direct Printer

Same as 0.0005 except that PAPM results will be printed directly.

3.2.7

0.00010 PETR, Direct Output, Direct Read-In

The utility control program sets indicators for use by the utility programs involved in the automatic read-in mode directing these programs to record any results for output (e.g., flad tables, punched paper tapes, etc.) on the direct printer and punch. An automatic read-in is then performed.

3.2.8

0.00011 PETR, Direct Output, Convert to Binary

The utility control program sets indicators for use by the utility programs involved in the automatic read-in mode directing these programs to record any results for output (e.g., flad tables, punched paper tapes, ect.) on the direct printer and punch, and directing the CS 2 conversion program to produce a binary tape as part of conversion. An automatic read-in is then performed.

3.2.9

0.00020 CS I Conversion

Convert a CS I flexo tape to a 556 tape. Group 0 is erased if the erase button has been pushed. The utility control program searches magnetic tape for the CS I conversion program and reads it from tape into MCM.

3.2.10

0.00022 Direct Read-In to MCM Using the PETR

Read a binary tape directly into MCM using the PETR. The utility control program transfers computer control to a simplified binary input program which is located in registers 2010-2047 (decimal) of MCM. The simplified input program can be used to read binary tapes,which address only MCM and which do not contain ditto control words, directly into MCM (exclusive of registers 2014-2047). The original contents of MCM are left undisturbed on group 0 during the process.

3.2.11

0.00023 Direct Read-In to MCM using the MTR

Same as 0.00022 except that the mechanical reader is used for input.

3.2.12

0.00030 Drum Checking Program

Group 0 is erased if the erase button has been pushed. The

utility control program searches magnetic tape for the drum checking program and reads it into MCM.

3.2.13

0.00033 Execute Post-Mortem Request Stored on Buffer Drum

The utility control program sets indicators directing the generalized post-mortem program to execute a post-mortem request which has been read-in previously and stored on the buffer drum (see description of director tapes).

3.2.14

0.00040 Magnetic Tape Checking Program

Group 0 is erased if the erase button has been pushed. The utility control program searches magnetic tape for the magnetic tape checking program and reads it into MCM.

3.2.15

0.00044 Scope Post-Mortem

The utility control program brings the scope post-mortem program into MCM and transfers computer control to it.

The scope post-mortem program is a drum utility program which operates from group 2 of the buffer drum.

If the erase button has not been pushed the scope post-mortem program displays (and photographs) the contents of group 0, registers 40-3777(octal), of the auxiliary drum (i.e., the contents of MCM before read-in) as octal fractions.

If the erase button has been pushed, the scope post-mortem program examines the contents of the insertion panel and displays the contents (in this case registers 0-3777 octal) of a particular drum group selected according to the following conventions:

(1) The sign digit of the insertion panel selects the drum - 0 denotes the auxiliary drum and 1 denotes the buffer drum.

(2) The number of the desired group is placed in the right hand two digits of the insertion panel (as an octal number).

MCM is then restored to its contents prior to read-in and the computer stopped.

3.2.16

0.00050 Scope Calibration Program

Group 0 is erased if the erase button has been pushed. The utility control program searches magnetic tape for the scope calibration program and reads it into MCM.

3.2.17

0.00060 PETR Checking Program

Group 0 is erased if the erase button has been pushed. The utility control program searches magnetic tape for the PETR checking program and reads it into MCM.

3.2.18

0.00061 Group 61 Entry Point

Used to read in specially recorded programs from magnetic tape unit 0.

3.2.19

0.00062 Record Check Sum for Drum Utility Program

The utility control program forms a check sum for a particular drum utility program and records the check sum on the drum in the check sum register associated with the program. It is assumed that the program is initially on the drum. The drum utility program is selected in accordance with the contents of the insertion register as follows:

0 Generalized Post-Mortem Program
1 Summer Session Computer
2 CS II
3 Three Address Computer (TAC)
4 Single Address Computer (SAC)
5 Utility Control Program

MCM is then restored to its contents prior to read in and the computer stopped.

3.2.20

0.00063 Read-In a Drum Utility Program

The utility control program tests to see if a particular drum utility program is on the drum. If this is not the case, magnetic tape is searched for the utility program which is then placed on the drum. The drum utility program is selected in accordance with the contents of the insertion panel as in 0.00062.

MCM is then restored to its contents prior to read-in and the computer stopped.

3.2.21

0.00070 Log Termination

The utility control program records the word "stop" followed by the

time on the direct punch. The time recorded will be standard time if this has been set up using 0.00076, otherwise, it will be computer clock time. MCM is then restored to its contents prior to read-in and the computer stopped.

3.2.22

0.0071 Check Test Storage

Group 0 is erased if the erase button has been pushed. The utility control program searches magnetic tape for the test storage checking program and reads it into MCM.

3.2.23

0.00072 Change Word on the Drums

The contents of the drum register specified in the insertion panel (with the convention that 0 in the sign digit designates the auxiliary drum and a 1 in the sign digit designates the buffer drum) is displayed in the indicator lights and the computer is stopped. The word to be inserted on the drum is then placed in the insertion panel. Pressing the restart button causes this word to be recorded in the selected drum register. The new contents of the register is then read from the drum and displayed in the indicator lights.

MCM is then restored to its contents prior to read-in and the computer stopped.

3.2.24

0.00076 Log Initiation (Set Standard Time)

The utility control program records a reference standard time, which has been placed in the insertion panel, on the buffer drum and resets the computer clock. Subsequent time entries in the paper tape log will then be made in terms of standard time unless the reference time on the drum has been disturbed. In this case, time entries in the log will be made in terms of computer time.

The reference standard time is set up in the insertion panel as follows:

The hour, a number between 0 and 23, is put into digits 1 and 2 of the insertion panel as an octal number.

The number of tens of minutes, a number between 0 and 5, is put into digit 3 of the insertion panel.

The remaining number of minutes, a number between 0 and 9, is put into digits 4 and 5 of the insertion panel as an octal number.

Placing a 1 in the sign digit of the insertion panel adds 0.5 minutes to the standard time.

Thus if the reference standard time is to be 2359.5 hours, the octal number, 1.27511, is placed in the insertion panel.

The reference standard time is then recorded on the paper tape and the direct printer logs.

Finally, MCM is restored to its contents prior to read-in and the computer stopped.

3.2.25

0.00077 Clear the Examine Selector Panel and Erase Buttons

MCM is restored to its contents prior to read-in and the computer stopped.

3.2.26

0.00100 MTR, Delayed Output, Direct Read-In

Same as 0.00000 except that the utility control program sets indicators which direct all utility programs to use the mechanical reader for the input device.

3.2.27

0.00101 MTR, Delayed Output, Convert to Binary

Same as 0.00001 except that the utility control program sets indicators which direct all utility programs to use the mechanical reader for the input device.

3.2.28

0.00110 MTR, Direct Output, Direct Read-In

Same as 0.00010 except that the utility control program sets indicators which direct all utility programs to use the mechanical reader for the input device.

3.2.29

0.00111 MTR, Direct Output, Convert to Binary

Same as 0.00011 except that the utility control program sets indicators which direct all utility programs to use the mechanical reader for the input device.

3.3 Magnetic Tape Searching

The manual read-in mode can be used to search on magnetic tape for a particular numbered block. Two types of search can occur. These are:

(1) Search and read-in.

(2) Search and stop.

(1) Search and read-in: if the contents of the selector panel has the form

0.0,n,ijk

where

$n = 0,1,2,3$

$112 \leq ijk \leq 776$ (octal)

then the utility control program erases group 0 if the erase button has been pushed, searches magnetic tape unit n for block ijk and reads in this block.

(2) Search and stop: if the contents of the selector panel has the form:

0.0,4+n,ijk

where

$n=0,1,2,3$

$10 \leq ijk \leq 776$

then the utility control program erases group 0 if the erase button has been pushed, searches magnetic tape unit n for block ijk, stops magnetic tape in front of this block and stops the computer. The block will be read-in if the restart button is pressed.

3.4 Storage Print-Outs

Storage print-outs of ranges lying entirely within a single drum group may be obtained using the manual mode. The utility control program sets indicators for use by the generalized post-mortem program directing it to perform a particular request.

Range: The initial drum address of the range to be printed out is placed in the insertion panel (with the convention that 0 in the sign digit designates the auxiliary drum and a 1 in the sign digit designates the buffer drum). The last four digits of the final drum address of the desired range (a number between 0.00001 and 0.03777) are placed in digits 2-5 of the selector panel.

Mode: The type of storage print-out required is specified by digit 1 of the selector panel according to the following conventions:

2 Interpreted Instructions (ii)

3 Generalized Decimal Numbers (gd)

4 Whirlwind Instructions (wi)

5 Octal Fractions (of)

6 Decimal Integers (di)

7 Decimal Fractions (df)

Addresses of words in the request (and of Whirlwind instructions if this mode is used) will be printed as decimal numbers if 0 is placed in the sign digit of selector panel or as octal numbers if a 1 is placed in the sign digit of the selector panel.

Output: Post-mortem requests set up according to the previous conventions will be recorded on the delayed printer. The direct printer and the scope can be used for output according to the following conventions:

If the erase button has been pushed, the post-mortem request will be recorded on the direct printer.

If 4 is added to the contents of digit 2 of the selector panel (i.e., the second digit of the final address of the range) the post-mortem request will be recorded on the scope and photographed.

If both of these conventions have been followed, the post-mortem request will be recorded on the scope.

3.5 Storage Punch Outs

Ranges of storage lying entirely within a single drum group may be punched out as binary tape using the manual mode. The utility control program sets indicators for use by the generalized post-mortem program directing it to perform a particular request.

Range: The initial drum address of the range to be punched is placed in the insertion panel (with the convention that 0 in the sign digit designates the auxiliary drum and a 1 in the sign digit designates the buffer drum). The last four digits of the final drum address of the desired range (a number between 0.00001 and 0.03777) are placed in digits 2-5 of the selector panel.

Mode: The type of punch out required is specified by the sign digit (which is always 1) and digit 1 of the selector panel according to the following conventions:

1.0 Start a new block of binary words every time the address of a word being punched out is a multiple of 400(octal).

1.1 Start a new block of binary words every time the address of a word being punched out is a multiple of 100(octal).

Output: The delayed punch will be used unless the erase button has been pushed, in which case the direct punch will be used.

The binary blocks punched out contain a ck5 control word and a sum-mod-one. No sp control block will be punched out, however, so that the binary tape cannot be read-in using the binary input program.

4. The Director Tape Program

4.1 Performance Requests

S&EC performance requests provide the operator with a set of instructions for using the utility control program. The following standard abbreviations should be used on performance requests.

e, Press the erase button.

ri, Press the read-in button.

rs, Press the restart button.

sax, Set the PC reset switches to x(octal) and press the start over button.

fc100-0-0, Place the corresponding tape in the PETR.

rmx, Set the selector panel to x(octal) and push the examine selector panel button.

lmx, Set the insertion panel to x(octal) and push the examine selector panel button.

ric, Read-in and convert to binary the fc tape(s) perviously placed in the PETR.

fc100-0-0), Place the corresponding fc tape in the PETR and read-in as part of a set of dependent fc tapes.

Performance requests are described in DCL 24.

4.2 Director Tapes

Director tapes are paper tapes obtained by typing performance requests on a flexowriter. Under certain restrictions it is possible to place the director tape in the MTR, the tapes in the run (spliced together in the proper sequence) in the PETR, and to execute the run by a single pressing of the read-in button.

The restrictions involved are the following:

(1) Only standard abbreviations can be used on the performance request.

(2) CS I flexo tapes cannot be used.

(3) The performance request must be written as if the stop on sil switch were on, all binary tapes end with an spl control block and all programs terminate by stopping the computer.

(4) All programs involved must terminate using the CS II instruction, STOP.

Director tapes are described in DCL 25.

4.3 The Director Tape Program

The use of a director tape is indicated by setting the selector panel to 1.00000 and not pushing the examine selector panel button. The utility control program in this case selects the MTR. If 6 consecutive initial nullifies are detected the utility control program assumes there is no paper tape in the MTR and executes an automatic read-in. Otherwise, the director tape program is brought into MCM.

The director tape program is part of a drum utility program which occupies group 2, register 0, through group 2, register 3777(octal), on the buffer drum and is recorded in blocks 244-247 on magnetic tape unit 0.

The director tape program reads in words from the director tape and acts accordingly. Director words are recorded on the direct printer as they are read in.

4.4 The Director Word e

The director word, e, sets an indicator for the utility control program directing it to erase MCM as part of the next read-in process. Computer control is retained by the director tape program which then reads in another director word.

4.5 The Director Words, rmx and lmx

The director word, rmx(lmx), sets an indicator for the utility control program instructing it that the next read-in process performed be that obtained by placing x(octal) in the selector (insertion) panel. The indicator is normally set to 0 giving an automatic mode read-in process.

Computer control is retained by the director tape program which then reads in another director word.

4.6 The Director Words, fc100-0-0, fb100-0-0, fp100-0-0,

These director words are ignored by the director tape program.

4.7 The Director Word, fc100-0-0)

The director word,), indexes an indicator which tells the CS II conversion program how many fc tapes are to be read in and converted as a dependent set during the next read-in process.

Computer control is retained by the director tape program which then reads in another director word.

4.8 The Director Word, ri

The director word, ri, restores the utility control program in MCM (a part of this was destroyed by the director tape program) and executes a manual mode read-in in accordance with the indicators set up by the previously mentioned director words. The read-in process is not, however, terminated by stopping the computer. Instead, computer control is transferred to register 26(decimal) of the test storage input program and a new read-in process takes place.

4.9 The Director Word, ric

The director word, ric, performs the same function as the director word, ri, except that the utility control program is directed to always perform the manual read-in procedure obtained by inserting 0.00001 in the selector panel.

4.10 The Director Word, rs

The director word, rs, reads group 0 of the auxiliary drum into MCM and transfers control to test storage register 2 which normally contains the instruction spx, where x is the starting address of the program.

Test storage register 2 is set up each time an fc or an fb tape is read-in and each time a STOP instruction is executed.

4.11 The Director Word, sax

The director word, sax, stores spx in test storage register 2, reads group 0 of the auxiliary drum into MCM, and transfers computer control to test storage register 2.

4.12 The Director Word, isax

The director word, isax, records cax in register 3743(octal) of group 0 of the auxiliary drum and stores sp 3743(octal) in test storage register 2. Group 0 of the auxiliary drum is then read into MCM and computer control transferred to test storage register 2.

4.13 The Director Word, egx

The director word, egx, records +0 in all registers of auxiliary drum group x. Computer control is retained by the director tape program which then reads in another director word.

4.14 The Director Word, box

The director word, box, copies the contents of auxiliary drum group 0 onto auxiliary drum group x(octal), (register i of group 0 being copied into register i of group x). Group 0 of the auxiliary drum is then read into MCM and computer control transferred to register 26(decimal) of the test storage input program.

4.15 The Director Word, bix

The director word, bix, copies the contents of auxiliary drum group x(octal) onto auxiliary drum group 0(register i of group x being copied into register i of group 0). Group 0 of the auxiliary drum is then read into MCM and computer control transferred to register 26(decimal) of the test storage input program.

4.16 Post-Mortem Request Tapes

Post-mortem request tapes which are read in using a director tape are not executed immediately but are, instead, recorded on group 7 of the buffer drum. A request tape so recorded can be executed in the following ways.

(1) If an alarm has occured and the computer has stopped, the drum request can be executed by placing 1.00000 in the selector panel, pressing the examine selector panel button and pressing the read-in button.

(2) A drum request will be executed if the following words occur in the director tape

rm33,ri,

A post-mortem request which has been recorded on the drum will remain undisturbed on the drum until a new post-mortem request is read in. The same request may thus be executed several times.

The execution of a request stored on the drum is conditional upon the fact that it has not been disturbed on the drum. This is detected by making use of a check sum recorded along with the request. If a request has been disturbed, then any attempt to execute it will be ignored by the post-mortem program.

5. The STOP Instruction

The instruction, STOP (or iSTOP), is converted to the instruction sp25(decimal). Execution of the STOP instruction thus transfers computer control to register 25 of the test storage input program. This records the address, say y+1, of the register following the STOP instruction in test storage register 2 and brings the utility control program into MCM.

If the address section of test storage register 2 contains the integer y+1, and register y in MCM contains the instructions sp25(decimal) or cp25(decimal), then the utility control program assumes that it was called

in by a STOP instruction. Furthermore, if register 3743(octal) contains the instruction, cay, and register 3564(octal) contains the instruction, cpy, the utility control program assumes that the STOP instruction was interpreted.

In the former case, the utility control program stores the instruction spy+1, in test storage register 2. In the latter case, the utility control program stores the instruction, sp3742(octal) in test storage register 2.

If the selector panel contains the number 1.00000, the utility control program assumes that a director tape is being used. In this case computer control is transferred to the director tape program which reads in the next director word.

If a director tape is not being used, the utility control program reads group 0 of the auxiliary drum into MCM and transfers computer control to test storage register 1, (thus stopping the computer if the stop on sil switch is on).

6. Interrupted Use of the Utility Control Program

If the use of the utility control program has been interrupted for any reason(e.g., no tape in PETR, etc.) it may not be proper to repeat the process by pressing the read-in button since this block records MCM (now containing the utility control program) on group 0 and destroys the original contents of MCM. It may be possible, however, to repeat the read-in process by using the SA40 button to initiate the process. This transfers computer control to a section of the utility control program which block reads group 11 into MCM without disturbing group 0.

If this section of the utility control program has been disturbed by the previous read-in then there is no simple procedure for repeating the read-in process without disturbing MCM.

7. The Test Storage Input Program

Decimal Addresses	Octal Instructions	
0	+0	
1	+1	
2	Flip Flop 2	
3	Flip Flop 3	
22	mh36	
25	ta2	
26	ca32	Record MCM on group 0 of the auxiliary drum
27	si707	
29	bo32	

29	ad26	
30	si703	Read group 11 of the auxiliary drum (the
31	bi36	utility control program) into MCM

The test storage input program has entry points at registers 25 and 26 (decimal).

The entry point at 26 is obtained by pressing the read-in button.

The entry point at 25 is used by the STOP instruction.