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SUBJECT: THE CONSOLIDATED TEST PROGRAM -- T-3432

To: E. S. Rich

From: D. A. Morrison

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Abstract: The WWI Consolidated Test Program, T-3432, is a step in the direction of shortening the time required by the daily Marginal Checking Routine. Thirteen different test programs are used to check out the various elements of the computer. These thirteen programs have been combined with a "leader" read-in program and a "trailer" control program to form a composite, semi-automatic computer testing routine. Certain of the programs require manual assistance to successfully perform the desired check. Such requests are printed out on the Flexowriter printer equipment and the computer halts operation awaiting proper action. It is necessary to press the Start-Over button to cause the routine to continue after filling the request. In the absence of such requests, or alarms, the computer proceeds through the Consolidated Test Program, automatically checking itself with one program after another.

When an alarm occurs, the marginal checking equipment is switched to "manual" and the computer is stopped.

1.0 Using the Consolidated Test Program, T-3432

1.1 Program Selection

The Consolidated Test Program is a very flexible device. One may choose which programs he desires to use; he may change his selection at any time, and he may start examining over again the marginal checking lines of any program the computer happens to be using.

Program selection is made by placing the proper digits of Flip-Flop Storage Register (FFSR #2) on a 1. The test programs are arranged in the order in which read in; digits 1 through 14 of FFSR #2 control the decision as to which programs are called up from drum storage. The test programs are arranged in the following order:

digit 1:	Alarm Check Program	T-3219
digit 2:	Arithmetic Element Check	T-3218
digit 3:	Core Memory Test	T-3170
digit 4:	Diagonal Line Test	T-3233
digit 5:	PETR Check	T-3232
digit 6:	Aux. Drum System Test	T-2723
digit 7:	Aux. Drum Read Check	T-3386
digit 8:	Aux. Drum Track Check	T-2553
digit 9:	Timing Register Check	T-3488
digit 10:	Buffer Drum System Test	T-3551
digit 11:	Buffer Drum Read Check	T-3550
digit 12:	Buffer Drum Track Check	T-3552
digit 13:	IOC Check	T-3562
digit 14:	No Program (Spare)	

At the present time there is no program for digit 14 to control.

Digit 0 of FFSR #2 must be on a 1 for PMC operation to function. If digit 0 is on a 0 at the time of read-in, the first program selected is read in to the computer, but marginal checking does not begin. Returning the digit "0" switch to 0 during PMC operation halts the marginal checking routine.

#### 1.2 Use of Digit 15, FFSR #2

Complementing digit 15 of FFSR #2 causes the line selection routine of the test program in use to start over.

#### 1.3 Use of Digit 0, FFSR #3

Complementing digit 0 of FFSR #3 causes the over-all marginal checking routine to begin over. Thus, if a different combination of test programs is desired from that first selected, the new combination should be inserted in digits 1 through 14 of FFSR #2; when digit 0 of FFSR #3 is complemented, the marginal checking routine begins over again, using the new combination of test programs.

#### 1.4 Reading the Consolidated Test Program into the Computer

The Consolidated Test Program is on a paper tape at the present time. The following precautions should be observed if the program is to run successfully:

- a. The direct-printing Flexowriter should be turned on.
- b. All maintenance switches should be in the normal position.
- c. If the in-out control program (T-3562) is to be selected, the magnetic tape equipment should be turned on.
- d. The flip-flop storage registers should be in the normal order.
- e. The magnetic drum equipment should be operating.

Place the tape T-3432 in PETR and press the READ IN button. Any further instructions necessary for running T-3432 are printed out on the Flexowriter printer.

#### 1.5 The "Line Insertion" Feature

Normally, the Consolidated Test Program is used for routine examination of WWI Computer circuits.

Situations can exist where it is desirable to substitute marginal checking lines for those normally used, or to search through only a portion of the total number of lines available.

Flip-Flop Storage Register #4 allows programmed marginal checking to start over at the line number designated by the right ten digits of FFSR #4, instead of at the line normally programmed. That is, digits 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 represent the desired line number; digit 5 contains fast-slow cycle information and must be included. Digit 0 is sensed to determine whether the normally-programmed number or the number in FFSR #4 should be selected. Changing the contents of digit 0 causes the number in FFSR #4 to be chosen.

The marginal checking equipment employs the binary-coded decimal form of notation in line designation; it is necessary to convert line numbers from the strictly decimal form before insertion in FFSR #4.

The binary-coded decimal system of number notation allows four binary bits to each decimal digit. As 9 is the highest decimal digit, 1001 is the highest binary-coded decimal number usable.

The marginal checking equipment is designed to accommodate 399 marginal checking lines, arranged in three decimal digits.

Examples of binary-coded decimal numbers, with cycle-speed information are as follows:

	<u>Cycle Speed</u>	<u>Decimal Line Number</u>	<u>Cycle Speed</u>	<u>Binary-Coded Decimal</u>		
				100's	10's	1's
1)	fast	3	0	00	0000	0011
2)	fast	215	0	10	0001	0101
3)	slow	330	1	11	011	0000
4)	slow	399	1	11	1001	1001

If one of the binary-coded decimal digits contains a number greater than 9, the Flexowriter printer prints out "illegal number" and the computer stops. Place the correct number in FFSR #4, press the START OVER button, and the program proceeds properly.

Example of "illegal number":

	<u>Cycle Speed</u>	<u>Decimal Line Number</u>	<u>Cycle Speed</u>	<u>Binary-Coded Decimal</u>		
				100's	10's	1's
5)	fast	215	0	10	0000	1111

### 1.6 The "Repeat Line" Feature

When it is desired to repeatedly marginal check the line designated in FFSR #4, simply place the digit 1 switch of FFSR #4 on a 1 before completing the "line insertion" procedure (complementing digit 0).

Returning digit 1 switch to 0 the "repeat line" cycle terminates; the program proceeds as in the "line insertion" operation.

### 1.7 Priority

Digits 0 and 15 of FFSR #2 and digit 0 of FFSR #3 hold priority over actions of FFSR #4.

## 2.0 Program Logic of T-3432

### 2.1 Description of the "Flow Diagram"

Drawing SD-59309-1, called a "Flow Diagram," presents a pictorial description of Consolidated Test Program, T-3432.

## 2.2 Actions of the Leader Program

The "leader" program, T-3492, "clears" the active registers of both the Auxiliary and Buffer Drums, places the sum check program and the test program location-determining program onto Auxiliary Drum Group 9, and Sp's to the Read-In program.

The test programs are read in, one after another, and placed in drum storage. The sum check number and location of each program are recorded elsewhere on the drums. The Magnetic Core Memory is erased up to register 1177 between the read-in of each test program to assure consistent read-in conditions.

## 2.3 Actions of the Trailer Program

The "trailer" control program, T-3606, as its name indicates, is the last program of T-3432. It is placed on Auxiliary Drum Group #9, and proceeds to take control of the marginal checking routine.

The control program first makes certain that test programs were included in the read-in. If no test programs were read in, the computer stops; otherwise, it prints out "Consolidated Test Program" and prepares to start the control program over. On subsequent start-over pulses, the control program does not start over unless digit 0, FFSR #3, has been complemented.

The control program observes that at least one test program has been selected in FFSR #2 and then determines which program to do first. If no programs had been selected, the instruction "Select Program" is printed on the Flexewriter.

The selected test program, complete with PMC lines and title information, is brought up from the drums and the title printed on the Flexewriter. The test program is allowed to run through once, in order to accomplish any resets or other modifications before storing in Auxiliary Drum Group #9.

The preliminary actions of the control program, prior to the actual marginal checking phase, are now complete.

The control program ascertains whether or not PMC operation has been requested. If PMC has not been requested, the contents of magnetic core memory (MCM) are read onto Auxiliary Drum Group #9 and the computer Sp's back to the test program.

When PMC operation is selected (by placing the digit 0 switch of FFSR #2 on a 1), after storing the contents of MCM in Auxiliary Drum Group #9, the control program prepares to start PMC over. The content of FFSR #4 is stored for future reference and the "line insertion by-passes 1, 2, and 3" are cleared. The line number-code indexing registers are reset in readiness to examine the Master Code Register.

## 2.4 Conversion of Line-Number Information

A digression is relevant at this time to explain the method by which line number information is converted into usable data.

The control program allots registers 3671 to 3723 inclusive, called 15-line code registers, for holding information concerning the 400 marginal checking lines which are available to PMC. Line numbers as such do not exist at this time, but each digit of the "15-line code" registers, with the exception of digit 0, represents a line number. That is, register 3671 represents line numbers 1-15, inclusive; register 3672 represents line numbers 16-30, inclusive; and so on. If a digit is on a 0, the represented line is not to be marginal checked; if the digit is on a 1, the line is to be marginal checked. Octally speaking, if register 3671 holds 0.30070; lines 2, 3, 10, 11, and 12 are to be marginal checked. When digit 5 holds a 0, fast cycle operation is selected; when digit 5 holds a 1, slow cycle operation is selected.

Each test program supplies the proper numbers in registers 3671-3723, inclusive, to select the desired marginal checking lines.

In order to save time, when searching for lines to be marginal checked, in PMC operation, "Master Code" registers are examined before the 15-line code registers. Each digit of the Master Code register, with the exception of digit 0, represents one of the 15-line code registers. If no lines are to be marginal-checked in a 15-line code register, a 0 is placed in the corresponding location in the Master Code register. A 1 in a given digit of the Master Code register indicates that the represented 15-line code register has at least one line to be marginal checked. Two master code registers are required to accommodate the necessary number of 15-line code registers.

The code-register examination process indexes the contents of reference registers, and by mathematical manipulation this information is converted into the desired binary-coded decimal number.

## 2.5 Line Selection

Before actually selecting a line, the control program checks for the presence of a "line insertion" request. If there has been none, the line location information is stored on the drum and the line is selected.

Selection of a line gives a start-over pulse and initiates a cp to the test program.

Upon conclusion of the marginal checking cycle, the marginal checking equipment sends out a switch-to-pushbutton pulse, drops the line out of selection, and sends out a start-over pulse. As no line is now selected, the control program checks the status of FFSR #3; if

unchanged checks for PMC. With PMC still requested, the status of digit 15 of FFSR #2 is examined. If unchanged, the next digit of the 15-line code register is examined, and so on. When the last program has been checked, operation of the computer is stopped.

## 2.6 Line Number Insertion Feature

When the sign digit of FFSR #4 is changed, instead of selecting the next programmed line, the control program examines the contents of FFSR #4. If the number is unacceptable to the marginal checking equipment, the Flexowriter prints "illegal number" and stops the computer. A "legal" number allows the control program to examine digit 1 of FFSR #4 to determine whether the "line number insertion" or the "repeat line" feature has been requested. A 0 in digit 1 signifies "line number insertion." The control program sets By-Passes #1 and 2 and clears By-Pass #3. The contents of FFSR #4 are re-stored, to cancel the "line number insertion" request, and the FFSR #4 line is selected.

Upon conclusion of the marginal checking process, the control program proceeds normally until By-Pass #2 is reached. As it is now in the "set" condition, PMC is started over. By-Pass #1 is also set, and the first PMC line number is compared to that in FFSR #4. The object is to find a PMC line number equal to or greater than the line number in FFSR #4. When this line number has been found, By-Passes #1 and #2 are cleared, line location information is stored on the drum, and the line is selected. Normal PMC operation is in control again.

## 2.7 "Repeat Line" Feature

When digit 1 of FFSR #4 is on a 1, By-Pass #3 is "set," and the line number in FFSR #4 is selected. By-Pass #3 shunts the control program around the code-register examination program to inspect digit 1 of FFSR #4. As long as digit 1 remains on a 1, the line number in FFSR #4 is selected for each marginal checking cycle.

When digit 1 is returned to 0, the system functions as in the "line number insertion" situation. However, the repeated line may be selected two more times if it is also a programmed line; once for the "line number insertion" phase, and once as a programmed number. In fact, if the digit 1 switch is thrown to 0 just prior to line selection, there may be a third appearance of the line.

## 3.0 Summary

The WWI Consolidated Test Program is an aid to routine marginal checking. It can also be of service in trouble-shooting and equipment performance investigations. The over-all design objective was to produce a framework for WWI test programs. Therefore, component programs may be

altered, exchanged, added, or deleted; possibly several Consolidated Test Programs may be developed.

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Drawing Attached:

SD-59309-1

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