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WIREX, a Fortran Computer Program
for Producing Wire Lists

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WIREX, a Fortran Computer Program
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by

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WIREX,
A FORTRAN COMPUTER PROGRAM
FOR PRODUCING WIRE LISTS

by
K. H. Duerre and J. R. Case

ABSTRACT

WIREX is an IBM 7090 computer program that produces wiring lists containing all the information normally found on detailed wiring drawings. Input to WIREX is simple, and output is in the form of a job book containing information in the order in which it is required for an electrician to proceed logically through a wiring job.

Code listings, flow diagrams, and a sample problem are included in this report.

INTRODUCTION

WIREX, an IBM 7090 computer program that produces wiring lists containing all the information normally found on detailed wiring drawings, was developed when it became evident that hundreds of nearly identical wiring drawings would be required for installation of instrumentation and control wiring in the UHTREX project.⁽¹⁾

WIREX lists are presented to the electricians as a job book containing information in the order in which it is required for logical procedure through a wiring job. Figures 1 through 12 are the output for a sample problem which is discussed in detail later.

The General Notes (Fig. 1) give general and special instructions, special routing details, and other procedures and information required. The Material Notes (Fig. 2) give the quantities and types of materials to be drawn or ordered from the sources indicated. The Cable Length Summary list (Fig. 3) is useful in determining the quantity of each type of cable needed.

The electrician uses the Cable Routing list (Fig. 4) when he pulls cable. In the example, he

would note that the first cable to be pulled, number 1, is a type 2 cable approximately 50 feet long. He would select the proper cable roll by referring to the type definition in the Material Notes, ensuring that at least 50 feet of that cable were available since item 4 of General Notes states that cable splices are not permitted. The cable is tagged and pulled from its origin, channel M0100 of a meteorological device in Room 107, through conduit 15 to its destination, cabinet N in Room 306 (see Fig. 4).

The Cable Routing list indicates that no containment seal is required for this cable. The connector number of the seal would be given if the cable left a containment area. Cabinets, racks, and channels are not distinguished in the list since each has its unique identifier. The room, channel, or cabinet data are sufficient to enable the electrician to locate the device or cabinet.

After running the cables the electrician refers to the Channel List (Fig. 5), which describes how the wires in a cable are connected to a device or transducer. The numbers and colors of the wires and the connectors and pins to which they are attached are supplied. The channel number is unique and defines

*** GENERAL NOTES ***

1. ALL CABLES SHALL BE TAGGED WITH CABLE NUMBER ON EACH END.
2. ALL WIRES SHALL BE LARELED AT EACH JUNCTION WITH ITS PATH NUMBER.
3. CONTRACTOR WIRING WILL ORIGINATE AT THE CONNECTOR LISTED IN THE CHANNEL WIRING LIST AND WILL TERMINATE IN CABINETS C1 AND B1.
4. ALL CABLES WILL BE PULLED IN CONTINUOUS RUNS WITH NO SPLICES ALLOWED
5. CABLE ROUTING SHALL BE THRU EXISTING CONDUIT, DUCT OR TRAY. ROUTE ZZ IS BELOW THE FALSE FLOOR OF THE CONTROL ROOM.
6. AFTER INSTALLATION, ALL WIRES SHALL BE CHECKED FOR CONTINUITY AND FOR ISOLATION FROM GROUND.
7. ALL WORK ON THIS JOB SHALL CONFORM TO THE LATEST RULES OF THE NATIONAL ELECTRIC CODE.
8. THE COLOR CODE AS USED ON THIS JOB IS AS FOLLOWS-----

YE--YELLOW	WH--WHITE	BU--BLUE	PU--PURPLE
RD--RED	GN--GREEN	BR--BROWN	TN--TAN
BK--BLACK	OR--ORANGE	GY--GRAY	PK--PINK

Fig. 1. Sample problem General Notes list.

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*** MATERIAL NOTES ***

CABLE TYPE 1

MULTICONDUCTOR THERMOCOUPLE EXTENSION CABLE, 8 CONDUCTORS, 4 PAIRS OF CHROMEL-ALUMEL. NO. 18AWG SOLID, PVC INSULATION, PVC JACKET OVERALL. THIS CABLE HAS BEEN ORDERED ON LASL PURCHASE NUMBER LE7-43097. EXPECTED DELIVERY 05/01/67.

CABLE TYPE 2

THERMOCOUPLE EXTENSION LEAD WIRE, SINGLE PAIR OF CHROMEL-ALUMEL NO. 18AWG SOLID, PVC INSULATION, PVC JACKET OVERALL. THIS CABLE WILL BE SUPPLIED BY LASL FROM LASL STOCK.

Fig. 2. Sample problem Material Notes list.

CABLE LENGTH SUMMARY

TYPE	EST. LENGTH FT.
01	230
02	200

Fig. 3. Cable Length Summary list.

CABLE ROUTING

PAGE 1 OF 1

CABLE NO	CABLE TYPE	ROOM NO	CABINET OR CHANNEL	ROUTE THRU	CABINET NO	ROOM NO	SEAL	CGB NO	EST LENGTH FT
001	02	107	M0100	15	N	306	NO		50
002	01	306	N	TA	LL	301	NO		125
003	01	301	LL	DA	15	202	NO		35
004	01	202	15	ZZ	C1	202	NO		35
005	01	202	15	ZZ	B1	202	NO		35
006	02	107	M0101	15	N	306	NO		50
007	02	107	M0102	15	N	306	NO		50
008	02	107	M0103	15	N	306	NO		50

END OF CABLE ROUTING DATE 06/01/67

Fig. 4. Sample problem Cable Routing list.

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CHANNEL LIST

ROOM 107

DATE 06/01/67

CHANNEL	CONTACT	CONNECTOR	PIN ID	PATH NO	WIRE ID	CABLE
M0100	+	01	A	00121	YE	001
M0100	-	01	B	00122	RD	001
M0101	+	01	C	00123	YE	006
M0101	-	01	D	00124	RD	006
M0102	+	01	E	00125	YE	007
M0102	-	01	F	00126	RD	007
M0103	+	01	G	00127	YE	008
M0103	-	01	H	00128	RD	008

END OF CHANNEL LIST

Fig. 5. Sample problem Channel list.

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CABINET N WIRING ROOM 306

 STRIP NO 001 TERMINALS 001 THRU 008 SHEET 1 OF 1
 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
001	YE	00121	001	00121	1YE	002	
001	RD	00122	002	00122	1RD	002	
006	YE	00123	003	00123	2YE	002	
006	RD	00124	004	00124	2RD	002	
007	YE	00125	005	00125	3YE	002	
007	RD	00126	006	00126	3RD	002	
008	YE	00127	007	00127	4YE	002	
008	RD	00128	008	00128	4RD	002	

END OF CABINET N WIRING DATE 06/01/67

Incoming Wires

Outgoing Wires

Fig. 6. Sample Cabinet Wiring list.

CABINET LL WIRING ROOM301

STRIP NO TERMINALS 001 SHEET 1 OF 1
D1 THRU 008 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
002	1YE	00121	001	00121	1YE	003	
002	1RD	00122	002	00122	1RD	003	
002	2YE	00123	003	00123	2YE	003	
002	2RD	00124	004	00124	2RD	003	
002	3YE	00125	005	00125	3YE	003	
002	3RD	00126	006	00126	3RD	003	
002	4YE	00127	007	00127	4YE	003	
002	4RD	00128	008	00128	4RD	003	

END OF CABINET LL WIRING DATE 06/01/67

Fig. 7. Sample Cabinet Wiring list.

CABINET 15 WIRING ROOM202

STRIP NO TERMINALS 001 SHEET 1 OF 1
002 THRU 014 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
003	1YE	00121	001	00121	1YE	004	YES
003	1RD	00122	002	00122	1RD	004	YES
		00121	003	00121	1YE	005	
****	JUMPER STRIP	002	TERM 001	TO STRIP 002	TERM 003		
****	JUMPER STRIP	002	TERM 002	TO STRIP 002	TERM 004		
		00122	004	00122	1RD	005	
003	2YE	00123	005	00123	2YE	004	YES
003	2RD	00124	005	00124	2RD	004	YES
		00123	007	00123	2YE	005	
****	JUMPER STRIP	002	TERM 005	TO STRIP 002	TERM 007		
****	JUMPER STRIP	002	TERM 006	TO STRIP 002	TERM 008		
		00124	009	00124	2RD	005	
003	3YE	00125	009	00125	3YE	004	YES
003	3RD	00126	010	00126	3RD	004	YES
003	4YE	00127	013	00127	4YE	004	YES
003	4RD	00128	014	00128	4RD	004	YES

Fig. 8. Sample Cabinet Wiring list.

CABINET 15 WIRING ROOM202

STRIP NO TERMINALS 009 SHEET 1 OF 1
003 THRU 014 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
****	JUMPER STRIP	002	TERM 009	TO STRIP 003	TERM 009		
		00125	009	00125	3YE	005	
		00126	010	00126	3RD	005	
****	JUMPER STRIP	002	TERM 010	TO STRIP 003	TERM 010		
		00127	013	00127	4YE	005	
****	JUMPER STRIP	002	TERM 013	TO STRIP 003	TERM 013		
****	JUMPER STRIP	002	TERM 014	TO STRIP 003	TERM 014		
		00128	014	00128	4RD	005	

Fig. 9. Sample Cabinet Wiring list.

CABINET 15 JUMPER INFORMATION PAGE 1

TERMINAL	STRIP	TERMINAL	STRIP
001	002	003	002
002	002	004	002
005	002	007	002
006	002	008	002
009	002	009	003
010	002	010	003
013	002	013	003
014	002	014	003

END OF CABINET 15 WIRING DATE 06/01/67

Fig. 10. Jumper information for cabinet 15.

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CABINET B1 WIRING ROOM 202

STRIP NO 001 TERMINALS 001 SHEET 1 OF 1
001 THRU 008 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
005	1YE	00121	001	00121			
005	1RD	00122	002	00122			
005	2YE	00123	003	00123			
005	2RD	00124	004	00124			
005	3YE	00125	005	00125			
005	3RD	00126	006	00126			
005	4YE	00127	007	00127			
005	4RD	00128	008	00128			

END OF CABINET B1 WIRING DATE 06/01/67

Fig. 11. Termination cabinet B1 wire list.

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CABINET C1 WIRING ROOM 202

STRIP NO A12 TERMINALS 001 SHEET 1 OF 1
A12 THRU 008 DATE 06/01/67

CABLE	WIRE ID	PATH NO	TERML.	PATH NO	WIRE ID	CABLE	JUMPER
004	1YE	00121	001	00121			
004	1RD	00122	002	00122			
004	2YE	00123	003	00123			
004	2RD	00124	004	00124			
004	3YE	00125	005	00125			
004	3RD	00126	006	00126			
004	4YE	00127	007	00127			
004	4RD	00128	008	00128			

END OF CABINET C1 WIRING DATE 06/01/67

Fig. 12. Termination cabinet C1 wire list.

a signal from a device. Path numbers are installed on the cable wires at this point. Channel Lists are produced for each room so the electrician can complete the hookups for one room before continuing to another.

Cabinet Wiring lists (Figs. 6 through 12) are the final lists produced by WIREX. The lists are

grouped by cabinet and strip, and several pages may be required to define all the connections for a cabinet or strip. An electrician makes the connections from the lists in order of ascending strip and terminal number. Jumpers can be attached to terminals during strip wiring or later, with the aid of the Jumper Information Summary (Fig. 10), which is

provided, when required, for each cabinet.

The Cabinet Wiring list headings are arranged so that an electrician can use the left part for incoming wire connections (see Fig. 6) and later use the right part to connect wires leaving the cabinet. He locates the wire in the specified cable by the "WIRE ID," tags it with the specified Path Number, and connects it to the proper terminal of the current strip. A "YES" appearing under "JUMPER," as in Fig. 8, indicates that the terminal has a jumper in addition to normal incoming and outgoing wires.

Blank information under "CABLE" and "WIRE ID" on the input side of the Cabinet Wiring lists (Fig. 8) indicates:

- a. input is from a terminal with a jumper, or
- b. the input part of the job is not defined.

Blank information in the same categories on the right (Fig. 11) indicates:

- a. terminal is termination point of rack,
- b. output part of job is not defined, or
- c. this is part of a multiple station routing (see Input Data Preparation).

WIREX lists were used extensively during wiring installation for the UHTREX project,⁽¹⁾ an experimental, high temperature, helium-cooled, nuclear reactor which can be refueled during operation. UHTREX systems are identified in Table I. Signals or measurements transmitted to and monitored from the UHTREX systems include temperature, coolant pressure and flow, stress, nuclear power and reactor period, electrical signals (such as motor current and indicator lights), positions, controls, and analyses.

TABLE I

UHTREX SYSTEMS

Gas Cleanup	Secondary Coolant Loop
Health Physics	Reactor
Meteorological	Special Instrumentation
Primary Coolant Loop	Utilities

Figure 13 shows the routing of wires from systems to maintenance and control areas. A typical circuit starts at a connector or terminal on a device or transducer. The wire is routed through a cable to a terminal in a cabinet inside the reactor containment and then passes through a sealed pene-

tration in the containment wall to a terminal in a cabinet outside the containment area. The wire then normally follows a unique path through cable and intermediate cabinets to the process computer or to the control room instrumentation racks. Parallel wires are used to supply the same signal to more than one point, for example, to both the computer and the instrumentation racks. Cabinets are used for intermediate routing and contain only terminal strips. Racks also contain electrical components. The point-to-point wiring for UHTREX was easily processed by the WIREX code.

Approximately 400 miles of UHTREX wiring was done using lists produced by WIREX. A rule of thumb established early was that WIREX was not suitable for jobs consisting of fewer than 100 paths. The WIREX code has been shown to be flexible in application; any routing through intermediate points that can be adequately specified can be "WIREXED." Appropriate modifications could be made so that piping routings could be "WIREXED." Chassis wire routing is inherently different from that mentioned above and was not suitable to our WIREX approach.

Personnel who were not electrical draftsmen filled data sheets and produced finished lists for the electrical systems which they had designed or in which they were otherwise involved. This job was easily done and there were few errors due to misunderstanding of the functions of signals or circuits.

For small changes in wiring, all that is required is to change a card or two and rerun the WIREX job deck. During the early stages of UHTREX wiring, a transducer would be wired as far as an intermediate cabinet. Later, when the final destination for its signals had been defined, that information was put into WIREX data and a complete wiring list was developed. The electricians completed as much of the job as was defined at a given time with no difficulty.

The electricians' response was gratifying. The complete job was done using WIREX lists, and no other information was required. Perhaps the most important contribution of WIREX was that it forced both designers and electricians to work systematically.

Fig. 13. Typical UHTREX wire and cable routings.

INPUT DATA PREPARATION

General.

The size of job that can be processed by WIREX is limited by the core storage of the IBM 7090 computer. The compromises between computer storage and job size are reflected in Table II.

The only input data that WIREX must have in numerical form are the control information and the cable lengths. All other data may be letters, numbers, or a combination. WIREX orders the data for output lists. Lead zeros for number designators and following blanks for letter designators are required to ensure proper ordering. (See section on LOGI.) Circuit components must be uniquely identified to describe the circuit properly. Cabinets, racks, devices, and routes (such as cable trays and conduits) are tagged before the wire is installed; cables and wires are tagged during installation. Each signal-producing unit of a device is assigned a channel number, and every wire in a channel is

TABLE II

MAXIMUM NUMBER OF VARIABLES FOR WIREX

Variable	Number
Path Card Pairs	2000 Per Job
Rooms	49 Per Job
Cabinets	100 Per Job
Cables	350 Per Job
General Notes Cards	999 Per Job
Material Notes Cards	999 Per Job
Strips	100 Per Cabinet
Paths and Jumpers	1000 Per Strip
Jumpers	1000 Per Cabinet

identified by a path number. If a path splits to carry the signal to two or more points, all wires carrying that signal retain the original path number.

In UHTREX, all wiring terminated at a strip in a cabinet, rack or computer frame. Alphabetic names

were assigned to cabinets, numerical names to racks, and combination letter and number names to computer frames. Wires and cables were routed through cable trays, wireways (ducts), and conduits. All trays had the letter "T" as the first character of their name, all ducts had an initial "D," and all conduits had number designators. Cases in which no designated route was available require an artificial routing, "ZZ," the instructions for which were given in the General Notes..

Sample Problem.

Input data preparation for WIREX is best illustrated by an example. The complete data deck for the sample problem is shown in Fig. 14 exactly as it was submitted to the computer, and a diagram of the problem is shown in Fig. 15.

The sample problem was derived from an actual situation encountered on the UHTREX project. It describes the wiring required to connect and monitor four thermocouples in the Meteorological System. Thermocouples M0100, M0101, M0102, and M0103 in Room 107 must be routed through intermediate cabinets to computer frames B1 and C1 in Room 202. Instructions for setting up the input are given below; the specific examples are taken from Fig. 14.

1. Job Title Card

This card contains the title for the cover sheet, "SAMPLE PROBLEM --- WIREX."

2. Control Information Card

This card contains the information needed by WIREX to process the rest of the data. The variables, as they appear on the card, are:

1. Total number of Path card pairs* = 024,
2. Total number of Cables* = 008,
3. DATE = 06/01/67,
4. Number of General Notes cards* = 026,

and

5. Number of Material Notes cards* = 017.

3. Cable Information Cards

These cards contain four items per cable, six cables maximum per card. Fifty-nine is the maximum number of cards permitted. Notes 6 through 9 of Fig. 14 identify the items which are, as they appear on the card:

6. Cable designator = 007,
7. Cable type = 02,

*Data must be numbers only.

8. CGB connector (four characters) = blank,
and

9. Cable length* = 050 ft.

4. General Notes Cards

These cards give the instructions required for the job. Blank cards are inserted to space the information.

5. Material Notes Cards

These cards describe the material required by the electricians.

6. Path Routing Information Cards

Path routing cards type 1 and type 2 (Figs. 16 and 17) combine to form a path card pair. Type 2 follows type 1 in the job deck. Further ordering of the card pairs is not required, since WIREX orders the information for output lists. Normal input for a card pair permits the specification of four cabinet stations, that is, a wire can be routed through four cabinets the fourth of which is a termination station. If more cabinets are required, as is illustrated in Fig. 18; another card pair extends the number of stations (cabinets) to seven with the seventh, again, a termination station. The fourth station of the first card pair has only incoming data, which must be repeated as input to station 4 (first station) of the second card pair.

Terminals and strips may have jumpers installed (see Figs. 15b and c). The "Jumper?" column data (Figs. 16 and 17) indicate three possibilities.

a. A blank indicates that this terminal does not have a jumper.

b. "J" indicates that this card contains jumper information. The data in "Cable No." columns contain the terminal number to which this terminal (normal terminal number) is jumped, and the "To Room" columns contain the strip number of the terminal in the "Cable No." columns.

c. "D" indicates that this terminal has a jumper, but that the jumper information is found on cards that contain a "J" in the "Jumper?" column. The other path information is normal.

The paths may be split at some station to permit alternate routes for a signal. The path number for the alternate route is the same as that of the main route so a path card pair that contains a "D" in the "Jumper?" column is required to specify the

*Data must be numbers only.

Fig. 14. Sample problem input data list.

Fig. 15. Diagram of sample problem.

alternate route. The first card of a path card pair might contain only the path number data when used to specify jumper information. Three path card pairs are required to specify the normal route, the jumper, and the alternate route. A cabinet that contained only jumpers would require a path card pair that specified the path, cabinet, and room number.

The data sheets for two path routing cards are shown in Figs. 16 and 17. Card number 1, Fig. 16, and card 2, Fig. 17, combine to form a path card pair. Cards 17 and 18, and 33 and 34, form similar pairs. Cards 17 and 18 could precede cards 1 and 2, since WIREX orders the data for output lists. Thermocouple channel M0100 has two paths, 121 and 122. The data sheets for path 121 are shown and are described below.

On card 1, categories "Channel Number" (columns 1 through 5), "Path Number" (columns 6 through 10), and "Xducer Location" (columns 13 through 15) contain M0100, 00121, and 107, respectively. The "Xducer Type" and the categories of columns 16 through 20 are not processed by WIREX but may be filled in for completeness. The extension wire of jack A from the

thermocouple is labeled +; it joins connector 1 on pin A (columns 21 through 26 of card 1).

Path 121 is identified as the YE wire (columns 27 through 32, Card 1) in cable 001 (columns 33 through 35). Cable 1 starts at pin A of transducer channel M0100 in Room 107 and is routed through conduit 15 (columns 39 and 40) to Room 306 (columns 36 through 38) and cabinet N (columns 42 and 43). The strip and terminal of cabinet N for path 121 are 001 and 001. (Note the lead zeros in columns 44, 45, 47, and 48.) Terminal 1 does not have a jumper, so the jumper tag (column 41) is left blank.

Path 121 leaves cabinet N as a 1YE wire in cable 002 (columns 50 through 58). Cable 2 proceeds in tray TA (columns 62 and 63) to Room 301 (columns 59 through 61) and cabinet LL (columns 7 and 8 of Card 2, Fig. 17). The Path Number is repeated on the second card of the pair for convenience (it is not processed again by WIREX).

Path 121 leaves strip D1, terminal 001 (columns 9 through 14) of cabinet LL as a 1YE wire in cable 003 (columns 15 through 23). Cable 3 is routed through duct DA (columns 27 and 28) to Room 202

PROGRAMMER						DATE						PAGE						OF								
PATH No.		JUMPER No.		CABINET No.	STRIP No.	TERMINAL No.	WIRE IDENT.	CABLE No.	J. TERM. No.	TO ROOM	J. STRIP No.	ROUTE JUMPER	CABINET No.	STRIP No.	TERMINAL No.	WIRE IDENT.	CABLE No.	J. TERM. No.	TO ROOM	J. STRIP No.	ROUTE JUMPER	CABINET No.	STRIP No.	TERMINAL No.	REVISION No.	REVISED BY
1	45	E9	213	1617	23	21		00121	LL	D1001	1YE0032	02DAD1500	2,001		1YE0042	02ZZ	CIA12001									
								001002		J1500	2,003															
								202		J1500	2,003				1YE0052	02ZZ	B1001001									

Fig. 17. Data sheet for path routing card type 2.

Fig. 18. Multiple cabinet station routing.

(columns 24 through 26) where cabinet 15 (columns 30 and 31) is located. Column 29, the jumper tag, contains a "D," which indicates to WIREX that Path 121 becomes a dual path at this point (strip 002, terminal 001, columns 32 through 37). Terminal 1 has a jumper as in Fig. 15b. The jumper information appears on other cards; card 2 contains the routing to cabinet C1 (columns 53 and 54).

A 1YE wire in cable 004 (columns 38 through 46) is Path 121 in its dummy route ZZ (see General Note 5) under the false floor of Room 202 to its terminal point, strip A1, terminal 001, (columns 55 through 60) in cabinet C1.

The jumper information for Path 121 appears on card 18. Card 17 is necessary, in this instance, to provide the path number and to be the other half of the card pair. The jumper tag (column 29, card 18) contains a "J," which indicates that WIREX must interpret the cable number and the "to room" data as the jumpered strip and jumpered terminal (see the upper headings above columns 21 through 26 on card 18). WIREX further interprets columns 32 through 37 as the end point of the jumper; that is, terminal 1 of strip 2 is jumped to terminal 3 on strip 2. Columns 30 and 31 again specify cabinet 15, since path card pair 17 and 18 may not immediately follow card pair 1 and 2 in the job deck. (This is the case in Fig. 14.)

The card pair 33 and 34 is necessary to specify the alternate route for Path 121 from terminal 3, strip 2 of cabinet 15 to cabinet B1 (columns 53 and 54). Card 37 is required by WIREX for the same reasons stated for the jumper data. A 1YE wire in cable 005 is routed again ZZ through the false floor to Room 202 but this time to termination cabinet B1. Strip 001 and terminal 001 define the end point of this alternate route for Path 121. Figure 8 (data

lines 1, 3, and 4) shows the connections in cabinet 15 for Path 121.

Twenty-four path card pairs were required to specify the path routing, alternate routing and jumper data for the four thermocouples in the meteorological system. The card pairs are shown in Fig. 14.

THE COMPUTER PROGRAM

Computer Requirements.

WIREX is a FORTRAN II IBM 7090 computer program. It uses 450 drum tracks for fast, random-access storage, 2,200 words of disc storage, and nearly all of the 32,000 words of core storage. Random transfer of data between core and auxiliary storage was made by a disc-tape version of FORTRAN II IOB.⁽²⁾ This subroutine allows reading and writing on disc or drum by "READ TAPE N, List" and "WRITE TAPE, N, List" statements, where N may have been calculated prior to the READ/WRITE statement.

The most complex problem run with WIREX produced 150 pages of output and required about 4 minutes of computer time.

Organization of WIREX.

Figure 19 shows the basic outline of WIREX; the

Fig. 19. WIREX main program flow diagram.

program list is given as Appendix A-1. The main program reads and prints the notes in a straightforward way and needs only the card counts for the notes. The path cards are a map for the wires. The cards contain 45 BCD* variables associated with a given path. The program calculates the number of tracks required for each variable based on the input path count. Each track, except possibly the

last, contains 300 items. The 300 items do not fill a track. This reflects a compromise in available core storage versus number of tracks used per variable.

Data for a particular variable are placed on contiguous tracks. Table III shows the assignment of tracks to the different variables. A maximum of 10 tracks is allotted to each variable. Three

*Binary Coded Decimal information may consist of numbers, letters, or both.

TABLE III
DRUM TRACK CATALOG

Variable	Drum Track	Variable	Drum Track
CARD TYPE 1		CARD TYPE 2	
Channel	20,001 through 20,010	Jumper Tag	20,251 through 20,260
Path	20,011 through 20,020	Cabinet	20,261 through 20,270
Transducer Type	20,021 through 20,030	Strip	20,271 through 20,280
Transducer Location	20,031 through 20,040	Terminal	20,281 through 20,290
Extension Wire Identification/Pin Identification	20,041 through 20,050	Wire Identification	20,291 through 20,300
Jack Identification	20,051 through 20,060	Cable/Jumper Terminal	20,301 through 20,310
Connector	20,061 through 20,070	Room/Jumper Strip	20,311 through 20,320
Pin Identification	20,071 through 20,080	Route	20,321 through 20,330
Extension Wire Identification	20,081 through 20,090	Jumper Tag	20,331 through 20,340
Jack Identification	20,091 through 20,100	Cabinet	20,341 through 20,350
Connector	20,101 through 20,110	Strip	20,351 through 20,360
Pin Identification	20,111 through 20,120	Terminal	20,361 through 20,370
Wire Identification	20,121 through 20,130	Wire Identification	20,371 through 20,380
Cable/Jumper Terminal	20,131 through 20,140	Cable/Jumper Terminal	20,381 through 20,390
Room/Jumper Strip	20,141 through 20,150	Room	20,391 through 20,400
Route Identification	20,151 through 20,160	Route	20,401 through 20,410
Jumper Tag	20,161 through 20,170	Jumper Tag	20,411 through 20,420
Cabinet	20,171 through 20,180	Cabinet	20,421 through 20,430
Strip	20,181 through 20,190	Strip	20,431 through 20,440
Terminal	20,191 through 20,200	Terminal	20,441 through 20,450
Wire Identification	20,201 through 20,210		
Cable/Jumper Terminal	20,211 through 20,220		
Room/Jumper Strip	20,221 through 20,230		
Route	20,231 through 20,240		
Penetration	20,241 through 20,250		

hundred data items are read into core for each of the 45 variables and are then placed on the drum. The process is repeated until all the data are placed on the drum.

The number of paths, the number of tracks calculated for each variable, and the date of the run are in common storage, available to the subroutines. The main program and the subroutines share 18,000 words of core storage.

After the main program stores the data on the drum, it acts as a supervisor, calling the subroutines to process the data and print output lists. The subroutines are called with the track numbers given for the item, and for this reason the subroutines are not data-format oriented.

The subroutines CABNL and CABLE, which produce the cabinet and cable routing lists, are called four times for the sample job: once for each station. The CABNL station may be recognized in Figs. 16 and 17 as the group of data categories that contain the information specific to cabinets at a point in the path routing. These categories are the cable number (into cabinet), the wire identification (into cabinet), the path number, the strip number, the cabinet number, the jumper information, the wire identification (out of cabinet), and the cable number (out of cabinet).

The CABLE station has the information describing starting and termination points for the cable as well as routing. The applicable categories in Figs. 16 and 17 are the origin (cabinet or channel number), the room number (origin), the cable number, the route or penetration, the termination cabinet number, and the room number (termination cabinet).

The subroutines CHANL, CBLFIN, and CBLSUM are called only once by WIREX and, strictly speaking, need not have been subroutines. It was convenient to treat them as such because of the assignments of core storage.

Special Techniques.

Most WIREX subroutines tally different items, such as cabinets/station and strips/cabinet, and prepare a table of them. The technique is illustrated in Fig. 20. The numbers in the flow diagram are keyed to the CHANL code list (Appendix A-5). Statement 15 (Appendix A-5) replaces the first table entry (which was blank) with the maximum BCD value 747474747474. After sorting, this is the last

Fig. 20. Variable tabulator flow diagram.

entry in the ordered table. The count is then shortened by one and a table of the correct length is obtained.

Another task frequently performed in WIREX subroutines is searching a column of data for a particular designator, saving the index in a smaller table when correspondence is found, and finally obtaining the number of occurrences of this variable. This technique is illustrated in Fig. 21. Here, as before, the flow diagram is keyed to the CHANL code list, specifically statements 20 through 30. The path number was saved in a separate table for sorting in the case illustrated.

In this example the data are ordered by increasing path number. The index table is considered the dependent variable; the path number, the independent variable for the SORTA subroutine. The other output categories had not been sorted, since their indices had already been sorted by path number.

LOGI.

The LOGI FAP subroutine is used to compare two BCD variables. It is called by CALL LOGI (Y1, Y2, X), where:

Y1 = first BCD variable

Y2 = second BCD variable

X = a value returned to the main program

X < 0 if Y1 < Y2

X = 0 if Y1 = Y2

X > 0 if Y1 > Y2.

A FORTRAN "IF" statement can then be used with X.

Fig. 21. Variable index search and table builder flow diagram.

The program list for LOGI is Appendix A-9.

A BCD variable may consist of as many as six symbols. Each symbol, such as 5, Z, or \$, is assigned a BCD code (octal number) consisting of two digits (see Table IV⁽³⁾). The variable is left-justified; that is, a cabinet designator, AZ, would have blanks right-filled and would appear to the computer as the number 217160606060. The value of BA is greater than AZ since 222160606060 is greater than 217160606060. It follows that variables with lead blanks may not be properly sorted in the normal sense, and for this reason lead zeros for number designators and following blanks for alphabetic designators must be used.

SORTA.

The SORTA subroutine, a modification of a LASL subroutine,⁽⁴⁾ orders BCD variables according to the values described in the discussion of LOGI. The routine is called by CALL SORTA (N, L, X, TEMP, Y1, Y2, ... Y_L), where:

N = dimension of X's to be sorted,
L = number of dependent variables,
X = independent variable to be sorted,
TEMP = a block of 2N cells to be used as temporary storage, and
Y1, Y2, Y3, ... Y_L = dependent variables to be sorted.

TABLE IV

BCD CHARACTER CODES

Character	Code	Character	Code
0	00	-	40
1	01	J	41
2	02	K	42
3	03	L	43
4	04	M	44
5	05	N	45
6	06	O	46
/	07	P	47
8	10	Q	50
9	11	R	51
=	13	\$	53
'	14	*	54
+	20	(blank)	60
A	21	S	62
B	22	T	63
C	23	U	64
D	24	V	65
E	25	W	66
F	26	X	67
G	27	Y	70
H	30	Z	71
I	31	,	73
.	33	(	74
)	34		

READRM.

The READRM subroutine (Fig. 22) is used in conjunction with IOBD⁽²⁾ to transfer the selected variables from drum to core memory. The drum track catalog (Table III) is used in selecting the first track numbers for the selected variables. The routine is called by CALL READRM (N, M, I, K1, Y, K2, Y2, ... K8, Y8) where:

N = number of paths (items per variable),

(continued next page)

M = calculated variable (number of tracks per variable),
 I = number of variables to read ($I \leq 8$),
 K1 = first track number for first variable,
 Y1 = first variable to read,
 K2 = first track number for second variable,
 Y2 = second variable to read, and
 K3, Y3, through K8, Y8 are as in the description for K1, Y1.

Fig. 22. READRM flow diagram.

CABLE.

The CABLE subroutine, (Fig. 23) unlike the other subroutines, must compile data for lists from several stations, since the input is flexible and the cable number unique; that is, cable 1 might be at station 4 and cable 73 at station 1. CABLE searches each station and finds the first entry for a cable, determines whether this cable number is jumper information or not,* and adds the data for this cable to growing tables of cable routing information. These tables are saved for sorting and output after the last station is processed. The core storage requirement is severe, because six categories of data of up to 2000 items each are

*The "Cable Number" and "To Room" categories of Figs. 16 and 17 serve a dual purpose and are legitimate cable information if the value in the jumper category is not J. Otherwise, the values appearing in these columns are jumper information.

Fig. 23. CABLE flow diagram.

necessarily in core at one time for the processing of a single station. A reasonable maximum of 350 cables was chosen so that smaller composite tables might be kept in core for updating during the processing of a station. CABLE is called by CALL CABLE (CCBL, CTYPE, CCGB, KLENGTH, NCABLE, X_1 , X_2 , X_3 , X_4 , X_5 , X_6 , X_7 , X_8 , X_9 , NT) where:

CCBL = Cable numbers
 CTYPE = Cable types
 CCGB = CGB connector numbers
 KLENGTH = Cable lengths
 NCABLE = Total number of cables

(continued next page)

X_1 = KCBL = Cable numbers
 X_2 = KRML = Room numbers (origin)
 X_3 = KCABNL = Cabinet numbers (origin)
 X_4 = KJCOLL = Jumper tag items (origin)
 X_5 = KRMR = Room numbers (termination)
 X_6 = KCABNR = Cabinet names (termination)
 X_7 = KJCOLR = Jumper tag items (termination)
 X_8 = KRTE = Route items
 X_9 = KPEN = Penetration numbers
 NT = Running total of cables processed.

Track number of first track

CBLFIN.

This subroutine (Fig. 24) takes the composite tables Y1 through Y8 and I9 prepared by the CABLE subroutine, sorts the data by cable number, and prints the cable routing information.

Fig. 24. CBLFIN flow diagram.

CBLSUM.

The CBLSUM subroutine (Fig. 25) uses table Y2 created by CABLE. Table Y2 is ordered by increasing cable number by CBLFIN to find the numbers and designations of different types of cable. CBLSUM then adds the lengths of each type from table I9 and prints this information in the Cable Length Summary list following the cable routing.

Fig. 25. CBLSUM flow diagram.

CHANL.

The CHANL subroutine (Fig. 26) gathers the information needed to wire a channel from the originating contact or connector through intermediate connectors to the first cable. Definitions of the subroutine arguments are as follows.

Argument	First Track No. Of
KRM	= Room number data of channel
KCHN	= Channel designator data
KWIDL	= Wire identification (left side of junction) data
KCON	= Connector number/identifier data
KPIN	= Pin identifier data
KPATH	= Path number data for channel
KWIDR	= Wire identification (right side of junction) data
KCBL	= Cable number data

CABNL.

The CABNL subroutine (Fig. 27) processes cabinet information for each cabinet of the station described in "Organization of WIREX." CABNL determines the numbers and designations of cabinets for this station and strips for a particular cabinet in a manner similar to that described under "Special Techniques."

Fig. 26. CHANL flow diagram.

CABNL interrogates the jumper column during outputting to determine whether the data are in normal or jumper format. A tag of "J" in the jumper column indicates that columns normally containing cable and room number data now contain jumper terminal and strip information (see Fig. 16).

A tag of "D" in the jumper column indicates normal data in the cable and room number columns, and also that the terminal has a jumper. The additional jumper information is found on cards that have a "J" in the jumper column. No tag in the jumper column signifies normal output.

The final phase of cabinet listing consists of finding, tabulating, and outputting all the paths that are tagged with "J" in the jumper column. This yields the jumper information summary at the end of every cabinet list.

The volume of data which may be required for strip and jumper information summary lists is so large that the path indices for a cabinet are saved for subsequent processing. (Strip and jumper indices are a subset of the cabinet path indices.)

The arguments of the CABNL subroutine are as follows.

Argument	First Track Number Of
ICABN	= Cabinet designator data
IRM	= Room number data
ISTRP	= Strip number data
ICBL	= Cable number (into cabinet) data
IWIDL	= Wire identification (into cabinet) data
IPTH	= Path number data
ITRML	= Terminal number data
IWIDR	= Wire identification (out of cabinet) data
ICBR	= Cable number (out of cabinet) data
IJCOL	= Jumper information tag data

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2. R. K. Nelson, "IB-IOBD" (an IBM systems program), July 17, 1963.
3. "Reference Manual, IBM 709/7090 Programming Systems: FORTRAN Assembly Program (FAP)," C28-6235, IBM Corporation, September 1962.
4. B. Bacon, "LA SRT 1, FORTRAN II Extended Sort Routine," LASL internal document, July 26, 1961.

CONTINUED NEXT PAGE

Fig. 27. CABNL flow diagram.

Fig. 27. (Continued).

Fig. 27. (Continued).

APPENDIX A-1. MAIN PROGRAM LIST.

WIREX

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```

    DIMENSION A(300,60),AA(18000),XH(12),CCBL(350),CTYPE(350),
1  CCGH(350),KLNGTH(350)
    COMMON AA,NPATH,M,DATE1,DATE2
    EQUIVALENCE (A,AA),(AA(14000),CCBL),(AA(14350),CTYPE),
1  (AA(14700),CCGH),(AA(15050),KLNGTH)
1  READ INPUT TAPE 10,2000,(XH(I),I=1,12)
    WRITE OUTPUT TAPE 9,2100
    WRITE OUTPUT TAPE 9,2101,(XH(I),I=1,12)
    READ INPUT TAPE 10,2001,NPATH,NCABLE,DATE1,DATE2,NGEN,NCBLST
    READ INPUT TAPE 10,2002,(CCHL(I),CTYPE(I),CCGB(I),
1  KLNGTH(I),I=1,NCABLE)
    CALL SEEK(20)
C   CABLE INFORMATION TO DISK
    WRITE TAPE 20,(CCBL(I),CTYPE(I),CCGB(I),KLNGTH(I),I=1,NCABLE)
C   GENERAL NOTES
    I1=(NGEN-1)/50+1
    DO 10 K=1,I1
        WRITE OUTPUT TAPE 9,2102,K,I1
        KA=(K-1)*50
        IF(K-I1)2,3,3
    2  NMAX=50
        GO TO 4
    3  NMAX=NGEN-KA
    4  DO 7 L=1,NMAX
        READ INPUT TAPE 10,2000,(XH(I),I=1,12)
        WRITE OUTPUT TAPE 9,2103,(XH(I),I=1,12)
    7  CONTINUE
    10 CONTINUE
C   MATERIAL NOTES
    I1=(NCBLST-1)/50+1
    DO 20 K=1,I1
        WRITE OUTPUT TAPE 9,2102,K,I1
        KA=(K-1)*50
        IF(K-I1)12,13,13
    12 NMAX=50
        GO TO 14
    13 NMAX=NCBLST-KA
    14 DO 17 L=1,NMAX
        READ INPUT TAPE 10,2000,(XH(I),I=1,12)
        WRITE OUTPUT TAPE 9,2103,(XH(I),I=1,12)
    17 CONTINUE
    20 CONTINUE
    NA=20000
C   CALCULATE NUMBER OF TRACKS/VARIABLE
    M=(NPATH-1)/300+1
C   READ CARDS (TYPES 1 AND 2)
    DO 100 JTRF=1,M
        NA=NA+1
        KA=(JTRF-1)*300
        IF(JTRF-M)25,26,26
    25 NMAX=300
        GO TO 30
    26 NMAX=NPATH-KA
    30 DO 40 I=1,NMAX
        READ INPUT TAPE 10,2003,(A(I,J),J=1,25)
        READ INPUT TAPE 10,2004,(A(I,N),N=26,45)
    40 CONTINUE
    NX=NA
C   WIREX DATA TO DRUM
    DO 50 J=1,45
        WRITE TAPE NX,(A(I,J),I=1,NMAX)
        NX=NX+10
    50 CONTINUE
    100 CONTINUE
C   OUTPUT LISTS

```

```

C   CABLE ROUTING
    NT=0
    READ TAPE 20, (CCBL(I), CTYPE(I), CCG3(I), KLNPTH(I),
    1 I=1, NCABLE)
    CALL CABLE(CCBL, CTYPE, CCG3, KLNPTH, NCABLE, 20131, FIRST
120031, 20001, 0, 20141, 20171, 20161, 20151, 0, NT)
    CALL CABLE(CCBL, CTYPE, CCG3, KLNPTH, NCABLE, 20211, 2ND
120141, 20171, 20161, 20221, 20261, 20251, 20231, 20241, NT)
    CALL CABLE(CCBL, CTYPE, CCG3, KLNPTH, NCABLE, 20301, 3RD
120221, 20261, 20251, 20311, 20341, 20331, 20321, 0, NT)
    CALL CABLE(CCBL, CTYPE, CCG3, KLNPTH, NCABLE, 20381, LAST
120311, 20341, 20331, 20391, 20421, 20411, 20401, 0, NT)
    CALL CHLFIN(NCABLE)
C   CABLE LENGTH SUMMARY
    CALL CHLSUM(NCABLE)
C   CHANNEL LISTING
    CALL CHANL(20031, 20001, 20081, 20101, 20111, 20011, 20121, 20131)
C   CABINET LISTS
    CALL CABNL(20171, 20141, 20181, 20131, 20121, 20011, FIRST
120191, 20201, 20211, 20161)
    CALL CABNL(20261, 20221, 20271, 20211, 20201, 20011, 2ND SET
120281, 20291, 20301, 20251)
    CALL CABNL(20341, 20311, 20351, 20301, 20291, 20011, 3RD SET
120361, 20371, 20381, 20331)
    CALL CABNL(20421, 20391, 20431, 20391, 20371, 20011, LAST
120441, 0, 0, 20411)
    WRITE OUTPUT TAPE 9, 2100
    GO TO 1
2000 FORMAT(12A6)
2001 FORMAT(I4, I3, A6, A2, 2I3)
2002 FORMAT(6(A3, A2, A4, I3))
2003 FORMAT(2A5, A2, A3, A2, 3A1, A2, A1, A2, A1, A6, 2A3, A2, A1, A2,
12A3, A6, 2A3, A2, A6)
2004 FORMAT(5X, A1, A2, 2A3, A6, 2A3, A2, A1, A2, 2A3, A6, 2A3, A2, A1,
1A2, 2A3)
2100 FORMAT(1H1)
2101 FORMAT(1H7, 10X, 12A6)
2102 FORMAT(1H1, 10X, 5HPAGE I3, 3HOF I3, 32X,
115HLAB JOB 2325-52)
2103 FORMAT(1H , 10X, 12A6)
    END(1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0)

```

APPENDIX A-2. CABLE SUBROUTINE LIST.

CABLE

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```

SUBROUTINE CABLE(CCBL, CTYPE, CCG3, KLNPTH, NCABLE, KCBL,
1 KRML, KCABL, KJCOLL, KRMR, KCABNR, KJCOLR, KRTE, KPEN, NT)
    DIMENSION AA(18000), CCBL(350), CTYPE(350), CCG3(350), KLNPTH(350),
1 X1(2000), X2(2000), X3(2000), X4(2000), X5(2000), Y1(350), Y2(350),
2 Y3(350), Y4(350), Y5(350), Y6(350), Y7(350), Y8(350), I9(350), MAP(350)
    COMMON AA, NPATH, M, DATE1, DATE2
    EQUIVALENCE (AA, Y1), (AA(351), Y2), (AA(701), Y3), (AA(1051), Y4),
1 (AA(1401), Y5), (AA(1751), Y6), (AA(2101), Y7), (AA(2451), Y8), (AA(2801),
2 I9), (AA(4000), X1), (AA(6000), X2), (AA(8000), X3), (AA(10000), X4),
3 (AA(12000), X5), (AA(16000), MAP)
    R=1H
    R1=1HJ
    X=0.0
    K1=NT
11 IF (KJCOLL) 1, 1, 2
1 CALL READRM(NPATH, M, 4, KCBL, X1, KJCOLR, X3, KRML, X4,
1 KRMR, X5, 0, X, 0, X, 0, X, 0, X)
    DO 6 I=1, NPATH
6 X2(I)=R
    GO TO 3

```

```

2 CALL READRM(NPATH,M,5,KCRL,X1,KJCOLL,X2,KJCOLR,X3,KRML,X4,
1KRMR,X5,0,X,0,X,0,X)
3 DO 200 L=1,NCABLE
  IF(NT)4,4,7
7 DO 20 K=1,NT
  CALL LOGI(CCRL(L),Y1(K),X)
  IF(X)20,200,20
20 CONTINUE
C GET PROPER INDICES
4 DO 100 I=1,NPATH
  CALL LOGI(X1(I),CCRL(L),X)
  IF(X)100,5,100
5 CALL LOGI(X2(I),B1,X)
  IF(X)10,100,10
10 CALL LOGI(X3(I),B1,X)
  IF(X)30,100,30
30 IN=I
  NT=NT+1
  MAP(NT)=1
  GO TO 105
100 CONTINUE
  GO TO 200
105 Y1(NT)=X1(IN)
  Y2(NT)=CTYPE(L)
  Y3(NT)=X4(IN)
  Y7(NT)=X5(IN)
  Y8(NT)=CCGR(L)
  I9(NT)=KLENGTH(L)
200 CONTINUE
  IF(NT-K1)301,301,190
190 LMIN=K1+1
  IF(KPEN)201,201,202
201 JX=1
  CALL READRM(NPATH,M,3,KCABNL,X1,KCABNR,X2,KRTE,X3,
10,X,0,X,0,X,0,X,0,X)
  GO TO 203
202 JX=2
  CALL READRM(NPATH,M,4,KCABNL,X1,KCABNR,X2,KRTE,X3,
1KPEN,X4,0,X,0,X,0,X,0,X)
203 DO 300 J=LMIN,NT
  KL=MAP(J)
  GO TO(210,205),JX
C CHECK, ADJUST PENETRATION INFO.
205 CALL LOGI(X4(KL),B,X)
  IF(X)207,210,207
207 Y5(J)=X4(KL)
  GO TO 211
C ROUTING INFO.
210 Y5(J)=X3(KL)
211 Y4(J)=X1(KL)
  Y6(J)=X2(KL)
300 CONTINUE
301 RETURN
END(1,0,0,0,0,0,0,1,0,0,0,1,0,0,0,0,0)

```

APPENDIX A-3. CBLFIN SUBROUTINE LIST.

CBLFIN

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```

SUBROUTINE CBLFIN(NCABLE)
  VARIABLES (Y) OBTAINED FROM CABLE CALLS
  DIMENSION Y1(350),Y2(350),Y3(350),Y4(350),Y5(350),
1 Y6(350),Y7(350),Y8(350),I9(350),MAP(350),TEMP(700),
2 AA(18000)
  COMMON AA,NPATH,M,DATE1,DATE2
  EQUIVALENCE (AA,Y1),(AA(351),Y2),(AA(701),Y3),(AA(1051),Y4),
1 (AA(1401),Y5),(AA(1751),Y6),(AA(2101),Y7),(AA(2451),Y8),(AA(2801),
2 I9),(AA(3151),TEMP),(AA(13000),MAP)
  R=1H
  R2=3HYES
  R3=6H0000
  R4=2HN0
  X=0.0
  DO 50 I=1,NCABLE
50 MAP(I)=I
  C SORT INFO. INDICES BY CABLE NO.
  CALL SORTA(NCABLE,1,Y1,TEMP,MAP)
  L15=(NCABLE-1)/50+1
  IMIN=1
  DO 100 L=1,L15
  IF(L-L15)110,111,110
110 IMAX=L-50
  GO TO 115
111 IMAX=NCABLE
115 WRITE OUTPUT TAPE 9,2000
  WRITE OUTPUT TAPE 9,2001,L,L15
  WRITE OUTPUT TAPE 9,2002
  DO 130 J=IMIN,IMAX
  KL=MAP(J)
  CALL LOGI(Y8(KL),B,X)
  IF(X)131,134,131
  C CHECK IF SEAL REQUIRED
131 CALL LOGI(Y8(KL),B3,X)
  IF(X)135,134,135
134 SEAL=B4
  GO TO 133
135 SEAL=B2
133 WRITE OUTPUT TAPE 9,2004,Y1(J),Y2(KL),Y3(KL),Y4(KL),
1 Y5(KL),Y6(KL),Y7(KL),SEAL,Y8(KL),I9(KL)
130 CONTINUE
  IMIN=IMIN+50
  C TO NEXT PAGE
100 CONTINUE
  WRITE OUTPUT TAPE 9,2005,DATE1,DATE2
  RETURN
2000 FORMAT(1H1,65X,15HLAR JOR 2325-52)
2001 FORMAT(1H0,30X,13HCABLE ROUTING,12X,5HPAGE 11,4H OF 11)
2002 FORMAT(1H0,10X,35HCABLE CABLE ROOM CABINET ROUTE,2X,
130HCABINET ROOM SEAL CGR EST/11X,2HN0,5X,4HTYPE,
24X,2HN0,6X,2HOR,5X,4HTHRU,5X,24NJ,5X,2HN0,10X,2HN0,
32X,9HLENGTH FT/32X,7HCHANNEL)
2004 FORMAT(1H ,11X,A3,5X,A2,5X,A3,3X,A5,3X,A6,4X,A3,4X,A3,
13X,A3,2X,A4,3X,13)
2005 FORMAT(1H0,10X,26HEND OF CABLE ROUTING DATE A6,A2)
  END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)

```

NO

YES

APPENDIX A-4. CBLSUM SUBROUTINE LIST.

CBLSUM

9/13/67

```

SUBROUTINE CBLSUM(NCABLE)
C   Y2 AND I9 FROM CBLFIN CALL
  DIMENSION AA(18000),Y2(350),I9(350),X(350),MAP(350),TEMP(700)
  COMMON AA,NPATH,M,DATE1,DATE2
  EQUIVALENCE (AA(351),Y2),(AA(2801),I9),(AA(701),X),
1(AA(5000),MAP),(AA(3151),TEMP)
  MY=1
  P=0.0
  X(1)=6H((((
  DO 100 I=1,NCABLE
    NY=MY
    DO 110 J=1,NY
      CALL LOGI(Y2(I),X(J),P)
      IF(P)110,100,110
110  CONTINUE
      MY=MY+1
      X(MY)=Y2(I)
100  CONTINUE
      NY1=MY-1
      CALL SORTA(MY,0,X,TEMP)
      WRITE OUTPUT TAPE 9,2000
      DO 200 K=1,NY1
        L1=1
C     GET INDICES FOR THIS TYPE
        DO 150 J=1,NCABLE
          CALL LOGI(Y2(J),X(K),P)
          IF(P)150,125,150
125  MAP(L1)=J
          L1=L1+1
150  CONTINUE
          L1=L1-1
          Y=X(K)
          KSUM=0
C     SUM LENGTH FOR THIS TYPE
          DO 130 L=1,L1
            LK=MAP(L)
            KSUM=KSUM+I9(LK)
130  CONTINUE
            WRITE OUTPUT TAPE 9,2001,Y,KSUM
200  CONTINUE
500  RETURN
2000  FORMAT(1H1,20X,20HCABLE LENGTH SUMMARY//10X,
14HTYPE,43X,15HEST. LENGTH FT.)
2001  FORMAT(1H ,10X,A3,50X,I4)
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)

```

APPENDIX A-5. CHANL SUBROUTINE LIST.

CHANL

9/13/67

```

SUBROUTINE CHANL(KRM,KCHN,KWIDL,KCON,KPIN,KPATH,KWIDR,KCBL)
  DIMENSION AA(18000),TEMPR(50),MAP(2000),TEMP(4000),
1X1(2000),X2(2000),X3(2000),X4(2000),X5(2000),X6(2000),
2SVAR(2000)
  COMMON AA,NPATH,M,DATE1,DATE2
  EQUIVALENCE (AA(2001),MAP),(AA(4001),X3),
1(AA(6001),X4),(AA(8001),X5),(AA(10001),X6),
2(AA(12001),SVAR),(AA(14001),TEMP,X1),(AA(16001),X2),
3(AA,TEMPR)
  R=1H
  CALL READRM(NPATH,M,1,KRM,X1,0,X,0,X,0,X,0,X,0,X,0,X,0,X)
  X=0,

```

```

1 TEMPR(1)=8
  NY=1
  DO 10 I=1,NPATH
    MY=NY
    DO 5 J=1,MY
      CALL LOGI(X1(I),TEMPR(J),X)
      IF(X)5,10,5
    5 CONTINUE
    6 NY=NY+1
  C   TEMPR=ROOM NO.
    TEMPR(NY)=X1(I)
  10 CONTINUE
    IPAGE=1
    IF(NY-1)1000,1000,15
  15 TEMPR(1)=6H((((
    CALL SORTA(NY,0,TEMPR,TEMP)
    NT=NY-1
    DO 500 IR=1,NT
      AROOM=TEMPR(IR)
      CALL READRM(NPATH,M,2,KRM,X1,KPATH,X5,0,X,0,X,0,X,0,X,0,X)
      WRITE OUTPUT TAPE 9,2000,IPAGE
      IPAGE=IPAGE+1
      LINES=0
      WRITE OUTPUT TAPE 9,2001,AROOM,DATE1,DATE2
  20 J1=1
    DO 30 K=1,NPATH
      CALL LOGI(X1(K),AROOM,X)
      IF(X)30,25,30
    C   MAP=INDEX OF ITEMS FOR THIS ROOM
  25 MAP(J1)=K
    C   SVAR=PATH NO.
      SVAR(J1)=X5(K)
      J1=J1+1
  30 CONTINUE
      JMAX=J1-1
      IF(JMAX)500,500,31
    C   SORT INDICES BY PATH NO.
  31 CALL SORTA(JMAX,1,SVAR,TEMP,MAP)
      CALL READRM(NPATH,M,6,KCIN,X1,KWID,X2,KCON,X3,
1 KPIN,X4,KWIDR,X5,KCBL,X6,0,X,0,X)
      DO 50 K=1,JMAX
        LINES=LINES+1
        KL=MAP(K)
        WRITE OUTPUT TAPE 9,2002,X1(KL),X2(KL),X3(KL),X4(KL),
1 SVAR(K),X5(KL),X6(KL)
        IF(LINES-50)50,50,40
  40 WRITE OUTPUT TAPE 9,2000,IPAGE
      IPAGE=IPAGE+1
      LINES=0
      WRITE OUTPUT TAPE 9,2001,AROOM,DATE1,DATE2
    C   NEXT PAGE
  50 CONTINUE
  500 CONTINUE
      WRITE OUTPUT TAPE 9,2003
  1000 RETURN
  2000 FORMAT(1H1,10X,8HPAGE DW-12,38X,15HLAB JOB 2325-52)
  2001 FORMAT(1H0,20X,13HCHANNEL LIST ,5X,5HROOM A3,13X,
15HDATE A6,A2//10X,7HCHANNEL,7X,7HCONTACT,2X,
1 29HCONNECTOR,4X,8HPIN ID ,7HPATH NO,2X,7HWIRE ID,2X,
1 35HCABLE)
  2002 FORMAT(1H ,10X,A5,12X,A2,7X,A3,8X,A2,4X,A5,3X,A6,4X,A3)
  2003 FORMAT(1H0,10X,20HEND OF CHANNEL LIST )
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)

```

APPENDIX A-6. CABNL SUBROUTINE LIST.

CABNLS

9/13/67

```

SURROUTINE CABNL(ICABN,IRM,ISTRP,ICBL,IWIDL,IPTH,ITRML,
1 IWIDR,ICBR,IJCOL)
  DIMENSION AA(18000),X1(2000),X2(2000),X3(2000),X4(2000),
1 X5(2000),X6(2000),XT7(2000),XT8(2000),MAPC(2000),
2 MAPS(1000),TEMPS(2000),SVAR(1000),TEMPC(100),TEMPST(100),
3 TEMP(200)
  COMMON AA,NPATH,M,DATE1,DATE2
  EQUIVALENCE (AA,X1),(AA(2001),X2),(AA(4001),X3),(AA(6001),X4),
1 (AA(8001),X5),(AA(10001),X6),(AA(12001),SVAR,XT7),
2 (AA(14001),MAPC,TEMPS,XT8),(AA(16001),MAPS),(AA(17001),TEMPC),
3 (AA(17101),TEMPST),(AA(17201),TEMP)
  R=1H
  H1=1HD
  P2=1HJ
  R3=3HYES
  X=0.
  R4=6H((((
  CALL READRM(NPATH,M,1,ICABN,X1,0,X,0,X,0,X,0,X,0,X,0,X,0,X)
  GET CABINETS
  TEMPC(1)=8
  N=1
  DO 5 I=1,NPATH
  MN=N
  DO 4 J=1,MN
  CALL LOGI(X1(I),TEMPC(J),X)
  IF(X)4,5,4
  4 CONTINUE
  N=N+1
  TEMPC(N)=X1(I)
  5 CONTINUE
  NCABN=N-1
  TEMPC(1)=84
  6 CALL SORTA(N,0,TEMPC,TEMP)
  DO 1000 JC=1,NCABN
  YCABN=TEMPC(JC)
  IPAGE=1
  10 J1=1
  CALL READRM(NPATH,M,3,ICABN,X1,IJCOL,X5,IRM,X4,0,X,0,X,0,X,0,X,0,X
  1)
  GET INDICES FOR THIS CABINET
  DO 20 JK=1,NPATH
  CALL LOGI(X1(JK),YCABN,X)
  IF(X)20,15,20
  15 MAPC(J1)=JK
  J1=J1+1
  20 CONTINUE
  JCNMAX=J1-1
  WRITE TAPE20490,(MAPC(I),I=1,JCNMAX)
  GET ROOM NO. FOR THIS CABINET
  DO 65 I=1,JCNMAX
  IN=MAPC(I)
  CALL LOGI(X5(IN),82,X)
  IF(X)70,65,70
  65 CONTINUE
  70 ARoom=X4(IN)
  22 CALL READRM(NPATH,M,1,ISTRP,X1,0,X,0,X,0,X,0,X,0,X,0,X,0,X)
  GET STRIPS
  TEMPST(1)=8
  N=1
  DO 30 I=1,JCNMAX
  M1=MAPC(I)
  MN=N
  DO 25 J=1,MN
  CALL LOGI(X1(M1),TEMPST(J),X)
  IF(X)25,30,25

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LEFT PAR

```

25 CONTINUE
   N=N+1
   TEMPST(N)=X1(M1)
30 CONTINUE
   NSTRIP=N-1
   IF(NSTRIP)1000,1000,26
25 TEMPST(1)=R4
   CALL SORTA(N,0,TEMPST,TEMP)
C   STRIP LIST
   DO 900 JS=1,NSTRIP
   STRIP=TEMPST(JS)
   CALL READRM(NPATH,M,4,ISTRP,X2,ITRML,X3,IRM,X4,
11JCOL,X5,0,X,0,X,0,X,0,X)
   J1=1
C   RETREIVE INDICES (THIS CABINET)
35 READ TAPE 20490,(MAPC(I),I=1,JCNMAX)
C   GET INDICES FOR THIS STRIP
   DO 40 I=1,JCNMAX
   J2=MAPC(I)
   CALL LOGI(X2(J2),STRIP,X)
   IF(X)40,36,40
36 MAPS(J1)=J2
   J1=J1+1
40 CONTINUE
   JSMAX=J1-1
41 IF(JSMAX-1000)50,50,42
42 WRITE OUTPUT TAPE 9,2010,JSMAX,STRIP
2010 FORMAT(1H0,10X,27HTOO MANY WIRES/STRIP WIRES=14,2X,6HSTRIP=A6)
   CALL EXIT
C   SET UP TERMINALS FOR SORT
50 DO 51 I=1,JSMAX
   J2=MAPS(I)
   SVAR(I)=X3(J2)
51 CONTINUE
C   SORT INDICES BY TERMINAL NO.
   CALL SORTA(JSMAX,1,SVAR,TEMPS,MAPS)
   IF (IWIDR)54,54,55
54 CALL READRM(NPATH,M,3,ICRL,X1,IWIDL,X2,IPTH,XT8,0,X,0,X,0,X,
10,X,0,X)
   DO 53 I=1,NPATH
   X6(I)=R
53 XT7(I)=8
   GO TO 60
C   TERMINATION CABINET
55 CALL READRM(NPATH,M,5,ICRL,X1,IWIDL,X2,IPTH,XT8,IWIDR,X6,
11CRR,XT7,0,X,0,X,0,X)
C   CALCULATE NO. OF PAGES THIS STRIP
60 JM=(JSMAX-1)/50+1
   IMIN=1
   DO 500 I=1,JM
   IF(I-JM)100,101,101
100 IMAX=I+50
   GO TO 105
101 IMAX=JSMAX
105 WRITE OUTPUT TAPE 9,2000,YCASN,IPAGE
   IPAGE=IPAGE+1
   WRITE OUTPUT TAPE 9,2001,YCASN,AROOM
   JL=MAPS(IMIN)
   JH=MAPS(IMAX)
   WRITE OUTPUT TAPE 9,2002,X3(JL),I,JM
   WRITE OUTPUT TAPE 9,2003,STRIP,X3(JH),DATE1,DATE2
   WRITE OUTPUT TAPE 9,2004
   DO 400 J=IMIN,IMAX
   JX=MAPS(J)
   CALL LOGI(X5(JX),B,X)
   IF(X)301,300,301
C   JCOL=BLANK
300 QUEST=B
   GO TO 320
301 CALL LOGI(X5(JX),B1,X)
   IF(X)303,302,303

```

```

C      JCOL=DUAL
302  QUEST=83
      GO TO 320
C      JCOL=J, WRITE JUMPER INFO.
303  WRITE OUTPUT TAPE 9,2006,X4(JX),X1(JX),STRIP,X3(JX)
      GO TO 400
C      NORMAL INFO.
320  WRITE OUTPUT TAPE 9,2005,X1(JX),X2(JX),XT8(JX),X3(JX),XT8(JX),
1X6(JX),XT7(JX),QUEST
400  CONTINUE
      IMIN=IMIN+50
500  CONTINUE
900  CONTINUE
C      GET JUMPER SUMMARY THIS CABINET
      CALL READRM(NPATH,M,5,ICBL,X1,IR4,X2,ITRML,X4,
1ISTRP,X5,IJCOL,X6,0,X,0,X,0,X)
      READ TAPE 20490,(MAPC(I),I=1,JCNMAX)
      JP=JCNMAX
      J1=1
C      GET INDICES FOR JUMPERS THIS CABINET
      DO 910 I=1,JP
      K=MAPC(I)
      CALL LOGI(X6(K),R2,X)
      IF(X)910,905,910
905  MAPS(J1)=K
      SVAR(J1)=X5(K)
      J1=J1+1
910  CONTINUE
      JJMAX=J1-1
      IF(JJMAX)990,990,915
915  CALL SORTA(JJMAX,1,SVAR,TEMPS,MAPS)
      MMAX=(JJMAX-1)/50+1
      IMIN=1
      DO 950 I=1,MMAX
      IF(I-MMAX)930,931,931
930  IMAX=I+50
      GO TO 935
931  IMAX=JJMAX
935  WRITE OUTPUT TAPE 9,2020,YCABN,I
      WRITE OUTPUT TAPE 9,2021
      DO 940 J=IMIN,IMAX
      IN=MAPS(J)
      WRITE OUTPUT TAPE 9,2022,X1(IN),X2(IN),X4(IN),X5(IN)
940  CONTINUE
      IMIN=IMIN+50
950  CONTINUE
990  WRITE OUTPUT TAPE 9,2007,YCABN,DATE1,DATE2
C      TO NEXT CABINET
1000 CONTINUE
1001 RETURN
2000 FORMAT(1H1,10X,5HPAGE A3,1H-13,34X,15HLAB JOB 2325-52)
2001 FORMAT(1H0,20X,8HCABINET A3,11HWIRING ROOMA3)
2002 FORMAT(1H0,33X,8HSTRIP NO,3X,10HTERMINALS A3,3X,
16HSHEET 11,4H OF 11)
2003 FORMAT(1H ,35X,A3,10X,5HTHRU A3,3X,5HDATE A6,A2)
2004 FORMAT(1H0,10X,5HCABLE,3X,7HWIRE ID,3X,7HPATH NO,3X,
16HTERML.,3X,7HPATH NO,3X,7HWIRE ID,3X,5HCABLE,3X,6HJUMPER)
2005 FORMAT(1H ,11X,A3,4X,A6,5X,A5,5X,A3,6X,A5,4X,A6,5X,A3,5X,A3)
2006 FORMAT(1H ,7X,4H***,3X,13HJUMPER STRIP ,A3,7H TERM ,A3,2X,
19HTO STRIP ,A3,7H TERM ,A3)
2007 FORMAT(1H0,10X,15HEND OF CABINET A3,13H WIRING DATE A6,A2)
2020 FORMAT(1H1,10X,7HCABINET,A3,5X,7HJUMPER ,11HINFORMATION,
15X,4HPAGE13)
2021 FORMAT(1H0,10X,8HTERMINAL,5X,5HSTRIP,5X,7X,8HTERMINAL,
15X,5HSTRIP)
2022 FORMAT(1H ,13X,A3,8X,A3,16X,A3,9X,A3)
      END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)

```

APPENDIX A-7. READRM SUBROUTINE LIST.

READRM

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```

SUBROUTINE READRM(NN,MM,IX,N1,Y1,N2,Y2,N3,Y3,N4,Y4,
1N5,Y5,N6,Y6,N7,Y7,N8,Y8)
  DIMENSION Y1(2000),Y2(2000),Y3(2000),Y4(2000),
1Y5(2000),Y6(2000),Y7(2000),Y8(2000)
C  INITIALIZE TRACK NUMRERS
C  SURSEQUENT CALLS COULD DESTROY
  M1=N1
  M2=N2
  M3=N3
  M4=N4
  M5=N5
  M6=N6
  M7=N7
  M8=N8
  N=0
1  DO 100 I=1,IX
  NMIN=1
  N=N+1
  DO 50 J=1,MM
  IF(J-MM)20,21,21
20  NMAX=J+300
  GO TO 25
21  NMAX=NN
25  GO TO(31,32,33,34,35,36,37,38),N
31  READ TAPE M1,(Y1(L),L=NMIN,NMAX)
  M1=M1+1
  GO TO 40
32  READ TAPE M2,(Y2(L),L=NMIN,NMAX)
  M2=M2+1
  GO TO 40
33  READ TAPE M3,(Y3(L),L=NMIN,NMAX)
  M3=M3+1
  GO TO 40
34  READ TAPE M4,(Y4(L),L=NMIN,NMAX)
  M4=M4+1
  GO TO 40
35  READ TAPE M5,(Y5(L),L=NMIN,NMAX)
  M5=M5+1
  GO TO 40
36  READ TAPE M6,(Y6(L),L=NMIN,NMAX)
  M6=M6+1
  GO TO 40
37  READ TAPE M7,(Y7(L),L=NMIN,NMAX)
  M7=M7+1
  GO TO 40
38  READ TAPE M8,(Y8(L),L=NMIN,NMAX)
  M8=M8+1
40  NMIN=NMIN+300
50  CONTINUE
100 CONTINUE
  RETURN
  END(1,0,0,0,0,0,1,0,0,1,0,0,0,0,0)

```

APPENDIX A-8. SCRTA SUBROUTINE LIST.

SORTA

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				ENTRY	SORTA		
00000	-0634	00	1	00102	SORTA	SXD	XA,1
00001	-0634	00	2	00116		SXD	X3,2
00002	-0634	00	4	00120		SXD	XC,4
00003	0500	00	4	00001		CLA	1,4
00004	0621	00	0	00005		STA	++1
00005	0500	00	0	00000		CLA	**
00006	0601	00	0	00202		STO	ND
00007	0771	00	0	00022		ARS	18
00010	0601	00	0	00203		STO	N
00011	0601	00	0	00204		STO	M
00012	0500	00	4	00002		CLA	2,4
00013	0621	00	0	00014		STA	++1
00014	0500	00	0	00000		CLA	**
00015	0601	00	0	00205		STO	L
00016	0500	00	4	00003		CLA	3,4
00017	0400	00	0	00206		ADD	ONE
00020	0621	00	0	00100		STA	X1
00021	0621	00	0	00103		STA	X2
00022	0621	00	0	00105		STA	X3
00023	0621	00	0	00122		STA	X4
00024	0500	00	4	00004		CLA	4,4
00025	0400	00	0	00206		ADD	ONE
00026	0621	00	0	00046		STA	T1
00027	0621	00	0	00107		STA	T2
00030	0621	00	0	00111		STA	T3
00031	0621	00	0	00142		STA	T4
00032	0621	00	0	00165		STA	T5
00033	0621	00	0	00167		STA	T6
00034	0402	00	0	00203		SUB	N
00035	0621	00	0	00145		STA	T7
00036	0621	00	0	00151		STA	T8
00037	-0534	00	1	00202		LXD	ND,1
00040	-0634	00	1	00051		SXD	A1,1
00041	-0634	00	1	00147		SXD	A2,1
00042	-0634	00	1	00154		SXD	A3,1
00043	-0634	00	1	00171		SXD	A4,1
00044	0534	00	1	00206		LXA	ONE,1
00045	0500	00	0	00206		CLA	ONE
00046	0601	00	1	00000	T1	STO	++,1
00047	0400	00	0	00206		ADD	ONE
00050	1 00001	1	00051			TXI	++,1,1
00051	-3 00000	1	00046	A1		TXL	T1,1,**
00052	0534	00	4	00204		LXA	M,4
00053	0500	00	0	00204		CLA	M
00054	3 00017	4	00117			TXH	GR15,4,15
00055	-3 00001	4	00126			TXL	EXIT1,4,1
00056	0771	00	0	00001		ARS	1
							X+1
							TEMP+1
							1 TO XA
							N IN DEC.
							M GREATER THAN 15, DIVIDE M BY 4
							M/2

SRT1006
SRT1007
SRT1008
SRT1009
SRT1010
SRT1011
SRT1012
SRT1013
SRT1014
SRT1015
SRT1016
SRT1017
SRT1018
SRT1019
SRT1020
SRT1021
SRT1022
SRT1023
SRT1024
SRT1025
SRT1026
SRT1027
SRT1028
SRT1029
SRT1030
SRT1031
SRT1032
SRT1033
SRT1034
SRT1035
SRT1036
SRT1037
SRT1038
SRT1039
SRT1040
SRT1041
SRT1042
SRT1043
SRT1044
SRT1045
SRT1046
SRT1047
SRT1048
SRT1049
SRT1050
SRT1051
SRT1052
SRT1053

	00057	-0501 00 0 00206		ORA	DVE		SRT1054
	00060	0601 00 0 00204	S2	STO	M		SRT1055
	00061	0534 00 4 00204		LXA	M,4		SRT1056
	00062	-0634 00 4 00112		SXD	S1,4		SRT1057
	00063	0402 00 0 00203		SUB	M		SRT1058
	00064	0734 00 5 00000		PAX	0,5		SRT1059
	00065	-0634 00 1 00113		SXD	S3,1		SRT1060
	00066	-0500 00 0 00100		CAL	X1		SRT1061
	00067	0402 00 0 00204		SUB	M		SRT1062
	00070	0621 00 0 00077		STA	S4		SRT1063
	00071	0621 00 0 00121		STA	S5		SRT1064
	00072	0621 00 0 00104		STA	S6		SRT1065
	00073	-0500 00 0 00107		CAL	T2		SRT1066
	00074	0402 00 0 00204		SUB	M		SRT1067
	00075	0621 00 0 00106		STA	S7		SRT1068
	00076	0621 00 0 00110		STA	S8		SRT1069
	00077	-0500 00 4 00000	S4	CAL	**,4		SRT1070
	00100	-0340 00 4 00000	X1	LAS	**,4		SRT1071
	00101	2 00001 5 00077		TIX	-2,5,1		SRT1072
TD	00102	1 00000 0 00115	XA	TXI	S9	XA STORED IN DEC.	SRT1073
	00103	0560 00 4 00000	X2	LDQ	**,4		SRT1074
	00104	-0600 00 4 00000	S6	STQ	**,4		SRT1075
	00105	0602 00 4 00000	X3	SLW	**,4		SRT1076
	00106	0500 00 4 00000	S7	CLA	**,4		SRT1077
	00107	0560 00 4 00000	T2	LDQ	**,4		SRT1078
	00110	-0600 00 4 00000	S8	STQ	**,4		SRT1079
	00111	0501 00 4 00000	T3	STO	**,4		SRT1080
	00112	1 00000 4 00113	S1	TXI	**,4,**		SRT1081
	00113	-3 00000 4 00121	S3	TXL	S5,4,**		SRT1082
	00114	-0534 00 4 00204		LXD	M,4		SRT1083
	00115	2 00001 5 00077	S5	TIX	S4,5,1		SRT1084
TD	00116	1 00000 0 00052	XF	TXI	A1+1	XB STORED IN DEC.	SRT1085
	00117	0771 00 0 00002	GF15	ARS	2		SRT1086
TD	00120	1 00000 0 00057	XC	TXI	S2-1	XC STORED IN DEC.	SRT1087
	00121	-0500 00 4 00000	S5	CAL	**,4		SRT1088
	00122	-0340 00 4 00000	X4	LAS	**,4		SRT1089
	00123	0020 00 0 00114		TRA	S3+1		SRT1090
	00124	0020 00 0 00114		TRA	S3+1		SRT1091
	00125	0020 00 0 00103		TRA	X2		SRT1092
	00126	0500 00 0 00205	EXIT1	CLA	L		SRT1093
	00127	0100 00 0 00164		TZE	T5-1		SRT1094
	00130	0500 00 0 00206		CLA	CNE		SRT1095
	00131	0767 00 0 00022		ALS	18		SRT1096
	00132	0622 00 0 00207		STD	I		SRT1097
	00133	-0534 00 4 00120		LXD	XC,4		SRT1098
	00134	1 77777 4 00135		TXI	**-1,4,-1		SRT1099

00135	0500	00	4	00004	S10	CLA	4,4	SRT1100
00136	0400	00	0	00206		ADD	ONE	SRT1101
00137	0621	00	0	00144		STA	Y1	SRT1102
00140	0621	00	0	00152		STA	Y2	SRT1103
00141	0534	00	2	00206		LXA	ONE,2	SRT1104
00142	0500	00	2	00000	T4	CLA	** ,2	SRT1105
00143	0734	00	1	00000		PAX	0,1	SRT1106
00144	0500	00	1	00000	Y1	CLA	** ,1	SRT1107
00145	0601	00	2	00000	T7	STO	** ,2	SRT1108
00146	1 00001	2	00147			TXI	**1,2,1	SRT1109
00147	-3 00000	2	00142	A2	TXL	T4,2,**		SRT1110
00150	0534	00	2	00206		LXA	ONE,2	SRT1111
00151	0500	00	2	00000	T8	CLA	** ,2	SRT1112
00152	0601	00	2	00000	Y2	STO	** ,2	SRT1113
00153	1 00001	2	00154			TXI	A3,2,1	SRT1114
00154	-3 00000	2	00151	A3	TXL	T8,2,**		SRT1115
00155	0500	00	0	00207		CLA	I	SRT1116
00156	0340	00	0	00205		CAS	L	SRT1117
00157	0020	00	0	00164		TRA	T5-1	SRT1118
00160	0020	00	0	00164		TRA	T5-1	SRT1119
00161	0400	00	0	00210		ADD	ONED	SRT1120
00162	0601	00	0	00207		STO	I	SRT1121
00163	1 77777	4	00135			TXI	S10,4,-1	SRT1122
00164	0534	00	1	00206		LXA	ONE,1	SRT1123
00165	0500	00	1	00000	T5	CLA	** ,1	SRT1124
00166	0767	00	0	00022		A-S	18	SRT1125
00167	0601	00	1	00000	T6	STO	** ,1	SRT1126
00170	1 00001	1	00171			TXI	A4,1,1	SRT1127
00171	-3 00000	1	00165	A4	TXL	T5,1,**		SRT1128
00172	-0534	00	1	00102		LXD	XA,1	SRT1129
00173	-0534	00	2	00116		LXD	XB,2	SRT1130
00174	-0534	00	4	00120		LXD	XC,4	SRT1131
00175	0500	00	0	00211		CLA	FIVE	SRT1132
00176	0400	00	0	00205		ADD	L	SRT1133
00177	0771	00	0	00022		ARS	18	SRT1134
00200	0621	00	0	00201		STA	**1	SRT1135
00201	0020	00	4	00000		TRA	** ,4	SRT1136
00202	0 00000	0	00000	ND	PZE	0		SRT1137
00203	0 00000	0	00000	N	PZE	0		SRT1138
00204	0 00000	0	00000	M	PZE	0		SRT1139
00205	0 00000	0	00000	L	PZE	0		SRT1140
00206	+000000000001			ONE	OCT	1		SRT1141
00207	0 00000	0	00000	I	PZE	0		SRT1142
00210	+000001000000			ONED	OCT	1000000		SRT1143
00211	+000005000000			FIVE	OCT	5000000		SRT1144
					END			SRT1145

APPENDIX A-9. LOGI SUBROUTINE LIST.

Address	Op	Reg	Imm	Label	Instruction	Comments
00000	0500	00	4	00000	ENTRY LOGI	
00001	0621	00	0	00001	LOGI CLA	1,4
00002	0500	00	4	00002	STA A	
00003	0621	00	0	00003	CLA 2,4	
00004	0500	00	4	00004	STA B	
00005	0621	00	0	00005	CLA 3,4	
00006	0500	00	0	00006	STA E	
00007	0340	00	0	00007	CAL **	ARGUMENT 1
00008	0020	00	0	00008	LAS **	ARGUMENT 2
00009	0020	00	0	00009	TRA E	GREATER THAN
00010	0020	00	0	00010	TRA D	EQUALS
00011	0760	00	0	00011	CHS	LESS THAN
00012	0601	00	0	00012	STO **	ARGUMENT 3
00013	0020	00	4	00013	TRA 4,4	
00014	0760	00	0	00014	CLM	
00015	0020	00	0	00015	TRA E	
00016	0020	00	0	00016	END	