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Memorandum 6M-3094

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Page 1 of 44

Division 6 - Lincoln Laboratory  
Massachusetts Institute of Technology  
Lexington 73, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR 8 OCTOBER 1954

To: Jay W. Forrester

From: Division 6 Staff

Approved: John B. Bennett  
John B. Bennett

CLASSIFICATION CHANGED TO:  
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Date: 2-1-60

CONTENTS

Section	I -	Cape Cod System	2
	1.1 -	Group 61	2
	1.2 -	Group 64	12
	1.3 -	Group 65	20
Section	II -	AN/FSQ-7	24
	2.1 -	Group 62	24
	2.2 -	Group 63	35
Section	III -	Central Services	41

COVER SHEET

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6M-3094

Page 2

## SECTION I - CAPE COD SYSTEM

1.1 Group 611.10 General

(R.J. Horn, Jr.) (CONFIDENTIAL)

The Group's activity continues to emphasize the 1954 Cape Cod System. The combined programs are expected to be checked out by 1 November.

Insofar as it can be done without hindering the start of Cape Cod operations, work is beginning in the additional areas -- such as Test-Program Planning -- set up by the new group organization outlined in the 24 September Biweekly.

(D.R. Israel) (CONFIDENTIAL)

A general plan for the 1954 Cape Cod System test program has been evolved during the past 2 weeks. This plan is outlined in 6M-3081, "Preliminary Plan for Test Program Organization" (D.R. Israel, 6 October 1954).

Section I of this plan, a study of the characteristics of radar-track and noise data, is an effort to derive satisfactory models and measurements for use in analytical studies of System operation and in preparation of realistic simulated data. It is summarized in 6M-3082, "Preliminary Outline of Section I of the Test Program" (D.R. Israel, 6 October 1954) prepared for discussion at a meeting at BTL (Whippany) on 11 October 1954.

Of particular interest during the past 2 weeks has been the study of methods of obtaining sufficient data during full System operation for use in subsequent analysis. Ampex recordings are not of sufficiently high quality; computer recording on Raytheon units will be satisfactory if the life of the recorded data is not jeopardized by frequent realignment of reading - writing heads. Further, only about 1 second of recording (500 words) per scan seems feasible during System operations. This is low by a factor of 2 or 3 if all incoming unprocessed data is recorded; it is satisfactory for recording track data on all tracks. At present, however, it is not yet clear that sufficient analysis or study can be accomplished without the radar data.

Maureen Cronin has finished transcribing the raid-size-test data to punched cards. Plans for data analysis are now being prepared.

1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

Major Group activity still lies in writing and checking out the TWS program for the 1954 Cape Cod System. The present status of this

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Memorandum 6M-3094

Page 3

1.12 Data Screening (Continued)

(R.L. Walquist) (CONFIDENTIAL) (Continued)

program is indicated below.

1954 TWS PROGRAM

Section	Memo	Percent Completed		
		Initial Coded Program	Initial (Unit) Testing	Final Individual Testing
Radar-Data Input	Issued (6M-2922)	100%	75%	30%
Tracking	With typist	80%	50%	10%
Monitoring	Issued (6M-2952)	90%	0%	0%

Time has been spent on the following XD-1 problems:

(1) FGD Maskers. Several meetings have been attended with both IBM and members of Division 6 Systems Group on the need for FGD maskers in the XD-1 and Sage Systems. J. Arnow and I have spent considerable time with these people discussing accuracy requirements and desirable scope resolution. The accuracy requirement of 1% has been stated as an operational need; however, the equipment people feel this may be too stringent. The question remains unresolved.

(2) Mapped-Area Boundaries. H. Benington, J. Ishihara, and I have had several discussions on the utilization of mapped-area boundaries in the Sage System. It is proposed that such boundaries be displayed to Direction Center personnel. The most desirable transmission scheme from an operational viewpoint appears to be a semiautomatic one. Memo 6M-3092, "Transmission and Utilization of Mapped-Area Boundaries in the SAGE System," will be issued shortly.

(3) XD-1 Telephone System. A meeting was held on 27 September to discuss the proposed XD-1 telephone system. The system as outlined appears adequate for internal communications; however, external communications with the XD-1 Direction Center are still unresolved. This is discussed further in Item 4 below.

(4) XD-1 Programming and Direction Center Schedules. Some time has been spent in determining just what functions should be undertaken with the XD-1 Direction Center. The big question is one of the scale or

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1.12 Data Screening (Continued)

(R.L. Walquist) (CONFIDENTIAL) (Continued)

size of the XD-1 Air Defense System. The present proposal is to make the XD-1 System at least as big as an average subsector in order to study problems of saturation and overload. Schedules for the XD-1 computer installation and installation of equipment at heavy-radar sites are being studied to determine a desirable computer programming schedule.

(5) XD-1 Equipment Wiring. Two memos on the XD-1 equipment wiring have been issued: "Installation of Activate Buttons for XD-1 Consoles" (6M-3088) and "Installation of Indicator Lights and Audible Alarm Panels for XD-1 Consoles" (6M-3093).

(D. Bailey, J. Ishihara, H. Peterson) (CONFIDENTIAL)

A complete cycle-test program for the 1954 Cape Cod tracking program has been checked out. Within this framework Tracking Section subprograms can be checked under operational conditions.

Effort has been primarily directed to checking the data-input program, and progress has been made in correcting minor errors. Lack of adequate recorded and live radar data has been a handicap.

The authors would like to note that the utility programs (6M-3006, "Utility Programs," Knapp and Gaudette) have aided materially in the checkout.

(J. Levenson) (CONFIDENTIAL)

While the collection of data is not complete, the results of the study of tracking in the 1953 Cape Cod System have been organized and studied to determine what kinds of information should be recorded during the operation of the 1954 Cape Cod System to provide both a quantitative description of activity and a diagnosis of particular phases of operation. C. Gaudette and I plan to write the operational specifications for a data-recording program to be used for data reconstruction or reduction.

(H. Peterson, H. Frachtman, F. Heart) (CONFIDENTIAL)

We have continued programming the track-monitor section of the 1954 Cape Cod System. There is an excellent chance that the programs will be operating during the next biweekly period. Memorandum 6M-2952, "Monitoring Functions in the 1954 Cape Cod System," was issued.

(H. Seward) (CONFIDENTIAL)

Testing of the tracking program in partial combination has so far demonstrated satisfactory operation of the correlation, track sorting, and smoothing-predict programs.

The tentative track section of the smooth-predict program is now being completed prior to initial testing.

CONFIDENTIAL

Memorandum 6M-3094

Page 5

1.13 Tracking and Control

(W.S. Attridge) (CONFIDENTIAL)

Coverage charts are prepared for heavy radars within and surrounding Subsector 1. These charts will be used to determine which radars should be tied into the first Direction Center. Plans are to do this for Subsectors 2 through 5 also.

I have gathered opinions from members of Group 61 regarding the types of IBM card machines which should be installed at each Direction Center. The consensus is that only one 026 and 010 is necessary while the 519 and 552 are not needed at each Direction Center.

I am preparing a note on the Mapping Supervisor's station indicating the need for such a station and the associated equipment and the minimum operational specifications for such equipment.

(W. Lone) (CONFIDENTIAL)

Several meetings were attended where attempts were made to define the functions of a Combat Center and the responsibilities of the personnel assigned to it.

The XD-1 utility program which compares a set of binary cards with storage and prints the contents of those registers which are different has been run and seems to be working. Together with the other utility programs, this one will be put through more extensive checks.

(J.E. Ylenger) (CONFIDENTIAL)

The octal print and trace utility programs for XD-1 have been partially tested on the IBM 701 computer in New York. Full-scale tests have been prepared and are ready to be tested.

(F. Heart) (CONFIDENTIAL)

On 1 October, Mr. M.O. Kappler (Rand Corp), Lt. Col. A.R. Schindler (ADC), and Capt R.G. Swaim (ADC) visited the Laboratory to discuss the subject of simulation. They spoke to H. Sherman and myself and were given a brief tour of the Cape Cod Direction Center. In particular, Rand is interested in possible SAGE System applications of simulation equipments and techniques developed by Rand for present ADC use. (An interoffice memo to C.R. Wieser summarized the results of this meeting. More time has been spent getting background on ECM (electronic countermeasures). On 5 October Mr. Bivans (Gr. 23), Mr. Bazemore (Gr. 24), and I participated in a discussion on the subject of ECM with members of Rome Air Development Center.

(A. Mathiasen, B. Stahl) (CONFIDENTIAL)

It is expected that the first flights using Raydist for orientation of CCS radars will be run the week of 18 October. In preparation for these and subsequent tests, conferences have been held with C. Zraket and E. Wolf concerning data-acceptance and analysis techniques and with those members of the Test Coordination Subsection who are drawing up the necessary operations plans and specifications.

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1.14 Weapons Direction (CONFIDENTIAL)

(E. Bedrosian, C. Gaudette) (CONFIDENTIAL)

A flow diagram for the tracking-simulation program has been prepared, and the coding of the program should be completed by 15 October. The program specifications for this program and the system simulation program are now being prepared and will be completed in a few days. The program specifications for the start-over program will be set up during the next period. This program should be ready for checkout by 20 October. The recording specifications are being written with J. Levenson.

(H. Benington) (CONFIDENTIAL)

Checkout of the Weapons Direction portion of the 1954 Cape Cod program is proceeding so that the entire WD program should be completed and ready for "marriage" with the Tracking program before 1 November. Although work is several days behind the schedule set forth in 6M-3063, "Organization and Schedule of Program Checkout for 1954 Cape Cod System" (H. D. Benington, J. Ishihara, C. A. Zraket 21 September 1954), some time should be gained during the next 2 weeks, if all goes well. In particular, marriage of the tracking and weapons programs should be facilitated by their common use of the master makeup and display (MMD) program before the final marriage. MMD performs most of the bookkeeping and communication between both programs; if each program has operated successfully with MMD, then both programs should operate successfully together.

The antiaircraft, height, and identification subprograms of the WD program are well within schedule. The MMD and interception programs will cause delays, if there are any. Since an operational Direction Center will not at first require simulation and recording facilities, these programs will be married with the combined tracking-weapons program after the latter program is thoroughly checked out.

Programming of MMD is being directed towards the earliest possible production of adequate magnetic tapes for unit-cycle checks with other programs (see 6M-3063). The cycle and situation-display programs have been written; all digital-display subprograms have been written; during the coming period, the switch-interpretation and digital-display makeup and control programs will be written and checked out.

In order to facilitate checkout of MMD programs, a trace program has been written and successfully operated. This program interprets CCS programs order-by-order and, for each order, either prints directly or records for delayed print out the contents of the program counter, program register, accumulator, B-register, etc. If sufficient interest is shown, the program will be made available as an utility program during the next period.

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## 1.14 Weapons Direction (CONFIDENTIAL) (Continued)

(J. J. Cahill, Jr.) (CONFIDENTIAL)

A final draft of the proposal for integrating AAA in SAGE has been prepared and submitted to directly interested Lincoln personnel for their consideration.

A visit was made to Headquarters, 15th AAA Group, to study Nike manuals and consult with the Guided Missile Officer on certain details of Nike equipment which bear on the method of integrating Nike with SAGE.

A day of this period was spent discussing AAA integration in SAGE with members of Office of Research Operations.

An afternoon was spent with Postoriza of CRC viewing their analog tracking equipment and discussing the possibility of its use as remote-display equipment at AAA batteries in the Zone of Interior.

(F. Garth, S. Hauser) (CONFIDENTIAL)

The identification and manual-inputs programs are punched on three tapes - 3655, 3657, and 3659. Tape 3655 contains the extrapolation program. Tape 3657 contains the expanded-display and AMD display program. Tape 3659 contains the AMD processing programs. The first two tapes have passed the parameter checkout.

In the next biweekly period tape 3659 will be put to the parameter test and a master program will be written to test the three programs working as one.

(F. Gucker) (CONFIDENTIAL)

The program for the Height Supervisor's digital display (DD) is now checked out. At present, I am working on the program for the Intercept Director's DD. These two stations between them use a large fraction of the total number of digital-display subprograms. With the completion of the Intercept Director's DD, a major portion of DD programming will be finished.

(R. N. Davis) (CONFIDENTIAL)

The Test Coordination Subsection scheduled and conducted four mapper-tracking tests in support of the Direction Center activities to prepare the System for full scale operations. Height-finding operations were added to the tests to shake down the FPS-6. S. Truro FPS-3 data input has been unavailable during this period because of the phone-line situation. FPS-6 operations have not materialized because of the phone-line situation. Ampex recording continues poor to useless as anticipated by Rich. Gap-filler data presented upon the Monitors seems to be improving and the number of available sites is increasing.

1.14 Weapons Direction (Continued)

(R. N. Davis) (CONFIDENTIAL) (Continued)

Mission specs 7 through 10 were utilized for the tests. Technical results are available through N. N. Alperin's reports to W. C. McDonald.

Weekly and monthly scheduling procedures have been consolidated, and schedules are being regularly distributed. Planning and coordination of Raydist calibration of the gap fillers has been instituted.

(I. B. Hazel) (CONFIDENTIAL)

The situation-display program for pendings and friendlies has been written and checked out. There is still work left to be done on sizes of squares and triangles for alarm situations, on spacing between characters, etc. The flow diagrams for hostiles and interceptor situation-display alarms has been drawn. The hostile displays will be added to the program early in the next period.

At the same time, character sizes and spacings will be fixed, and a memo will be issued specifying their values for other programmers.

(J. H. Newitt) (CONFIDENTIAL)

Detail requirements were set up for the design of the auxiliary (XD-1) console. This data will be integrated into IBM design planning during the coming period.

My breadboard model of the 12-kv r-f type supply for Charactron lighting seems to be operating successfully. We hope to obtain IBM acceptance of this type of design since it has numerous advantages.

We have obtained basement space for a console-environment test room and will start construction of the facility shortly.

I have devised a means to air condition the Barta conference room at negligible cost. A spec to cover the scheme will be issued shortly.

(C. A. Zraket) (CONFIDENTIAL)

The time schedule for the checkout of the 1954 Cape Cod Program still reads about the first week of November. Some difficulty has been encountered in obtaining reliable radar data for the checkout of the tracking programs. Groups 22, 64, and 61 are now coordinating on this problem by conducting a series of mapper-tracking tests.

The test programs and manuals for the checkout of Direction Center equipment have been completed. Equipment checkout periods conducted



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1.14 Weapons Direction (Continued)

(G. A. Zraket) (CONFIDENTIAL) (Continued)

by Air Force operational personnel will commence on 18 October.

The major problem of recording data during System operation for later reconstruction and analysis has been discussed with D. Israel. For the present, the radar data and all switch and light-gun actions will be recorded. A proposal for a reconstruction and analysis program will be considered as soon as the 1954 CCS is checked out.

We have received indications that ADC aircraft (F-94C) will be available for our 1954 tests. Coordination with the 6520th Wing and ADC is now being carried on for the use of these aircraft.

\*

1.15 Direction Center Operations (CONFIDENTIAL)

(W. Vecchia) (CONFIDENTIAL)

	<u>hr</u>	<u>min</u>		
TOTAL ASSIGNED TIME	62			
EXTRA ASSIGNED TIME			40	
			<hr/>	40
	62			
	<u>hr</u>	<u>min</u>		
Equipment check	3	55		
Utility	3	35		
Tracking	19	10		
Simulation		40		
Analysis	8	25		
Identification	10			
Weapon direction	4	50		
	<hr/>			
	50	35		
Time given to Math Group	4	30		
Time lost to computer	7	45		
(trouble with air-conditioning unit and malfunction)	12	05		
			<hr/>	35
			12	<hr/>
			62	40
	TOTAL		62	40

1.16 AN/FSQ-7 (XD-1) (CONFIDENTIAL)

(H. D. Benington) (CONFIDENTIAL)

Two memos written during this period will be issued as M-notes early in the next period. The first, written in conjunction with R. Walquist, will discuss the utility and means of transmitting mapped-radar boundary information from a P-site to a Direction Center (see 6M-3092, "Transmission of Mapped-Area Boundaries in the SAGE System," R. L. Walquist, H. D. Benington).

\* For additional material, Section 1.14, see page 11.

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1.16 Weapons Direction (Continued)

(H. D. Benington) (CONFIDENTIAL) (Continued)

The second memo will estimate digital-display storage requirements in FSQ-7 production models (see 6M-3091, "Requirements for Digital Display Storage in Production Models, "H. D. Benington).

1.17 Simulation And Analysis (CONFIDENTIAL)

(W. I. Wells) (CONFIDENTIAL)

The primary efforts of this Section are being directed to the question of analytical study, and study by simulation, of the tracking and interception capabilities of the Lincoln System. The number of facets to be considered is large; these will be treated first separately and then as they affect one another.

1. Data Gathering

In order to study the operation of the Lincoln System it is necessary to have a complete knowledge of the data inputs to the System. Discussions with Nedzel of Group 22 indicate that the methods being used by that Group (recording complete track information for a set of controlled flights on IBM cards) will be highly useful in describing the blip-scan properties of tracks. Discussions with the Test Planning Section of Group 61 indicates that the recording of complete scan-to-scan data on magnetic tape during the operation of the 1954 Cape Cod System will furnish data on clutter and noise characteristics, monitor actions, and additional data on blip-scan properties of the tracks. (R. Sittler, B. Smulowicz, W. I. Wells)

This data will be processed by computer programs to determine the important statistical properties. Programs of this type are now being written. (M. J. Curran, H. Meinholtz)

2. Analysis of Initiation Techniques

A study has begun to determine the theoretical limitations of track-initiation procedures. Since models for blip-scan have yet to be determined from radar data, it was decided to investigate the operation of initiation procedures for the 1953 Cape Cod System for tracks having blip-scan properties which are entirely random and follow the model proposed by Olmstead of Bell Labs. Plots of the probability of establishing a track on a true track as a function of the time delay have been obtained.

Next, a study of the effect of clutter was begun. The lack of a satisfactory model led to the investigation of random clutter. Plots are being calculated showing the probability of initiating an established track on clutter alone as a function of the clutter density.

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(W. I. Wells) (CONFIDENTIAL) (Continued)

It yet remains to refine these calculations, taking into account certain factors which were conveniently approximated at first. Also, there remains the question of how to combine the two calculations to obtain a figure of merit for initiation schemes. This may be done by determining the effective delay in establishing true tracks as a result of accepting or processing false tracks. (R. F. Jenney, R. Sittler, B. Wells)

3. Interception-Loop Stability

It has been known for some time that the instructions sent to an interceptor become quite erratic as the distance to the target decreases. This form of instability is similar to the case of a feed-back loop in linear systems with too high gain. A linearized model of the interception loop has been prepared which takes into account the sampling, smoothing equations, auto-pilot characteristics, and aircraft dynamics. The pole-zero diagrams are being studied by the "root locus" method to determine just which part of the loop tends to instability and in what manner. It is hoped that changes may be made to reduce this effect, rather than simply to open the loop, as is now done, when the distance between aircraft closes to a few miles. (W. I. Wells, R. Sittler, B. Widrow)

4. Manned Interceptor Simulation Program

The manned-interceptor simulation program is entirely written except for two parts. These are the subroutines for generating clutter (which cannot be written until the model for clutter is determined from measurements) and the data printout routine (which has been left undetermined since different quantities are required in the printout depending on what one is trying to determine). Parts of the program have been checked out, but lack of MTC computer time has held up the testing. (H. D. Houser, H. D. Neumann)

1.14 Weapons Direction (CONFIDENTIAL)

(O. T. Conant)

Programming of the "track cycle" section of the master makeup and display program is substantially complete; this section will be checked out early in the next period. Programming and checkout of the switch interpretation sections of MMD for the identification, height-finding, antiaircraft and simulation stations should be completed before the end of the next period.

The installation of the telephone inter-communication system in the Barta operations rooms has been complete for some time. The specifications of the system, as 6M-2966, will be published in the near future. Labels will be provided for the comm boxes before the start of System operations.

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1.2 Group 64

1.21 WWI System Operation

Records of Operation

(F. J. Eramo) (UNCLASSIFIED)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 24 September - 7 October 1954:

Number of assigned hours	147
Usable percentage of assigned time	97
Usable percentage of assigned time since March 1951	88
Usable percentage of assigned time since September 1953	94
Number of transient errors	6
Number of steady-state errors	7
Number of intermittent errors	1

Failure-Record Setup

(E. S. Rich) (UNCLASSIFIED)

Further work has been done on the analysis of failures in the WWI system. The immediate goal is to establish a record-keeping system which permits a periodic review to point out the more frequent and serious types of failures and which will facilitate later analyses of system reliability and maintenance effectiveness. All instances of failure including those in the special Cape Cod equipment connected to the computer are now being counted, although many of these cause no loss of computer time. They would have interrupted operation, however, if the computer had been in use for a Cape Cod test, so they are included in the breakdown as potentially interrupting failures. For the present, six classes of failures have been established to cover the more frequent incidents. Other miscellaneous incidents are described in the System section following the table. Failures attributable to new installation and modifications or to essential maintenance work are distinguished from those chargeable directly to the System. This distinction is intended to reflect the effect of physical disturbances to the System by maintenance personnel.

1.21 WWI System Operation (Continued)

Analysis of WWI Failures

(L. O. Leighton) (UNCLASSIFIED)

The following is a breakdown of interrupting and potentially interrupting failures in the WWI System for the period of 25 September - 7 October 1954:

Class of Failure	Attributable to		Chargeable to:			
	New Installation		Essential		System	
	or Modification		Maintenance		Explainable	Unexplainable
	Number	Time Lost	Number	Time Lost	No. Time Lost	No. Time Lost
Tubes					2 20	
			1	0	4 0	
Video Cables						
Video Jacks	1	22			3 100	
Power Plugs	1	0				
Wiring Errors						
Passive Electrical Components						
Fuses	1	5				3 127
	5	0	1	0	1 0	
Alarms					2 19	4 76
					1 0	1 0
Design Weakness					2 8	
					1 0	
Misc.	1	68				
Time Lost Totals (min.)		95		0	147	203
No. of Lost-Time Incidents	3				9	7
No. of No-Lost-Time Incidents	6		2		7	1
Total Number of Failures						35
Total Number of No-Lost-time Failures						16
Total Number of Lost-Time Failures						19
Total Lost Time						7.4 hr.
Total Time of Operation						265 hr.

1.21 WWI System Operation (Continued)

(A. J. Roberts, L. L. Holmes) (UNCLASSIFIED)

Computer reliability was very good during this period. There were 12 interrupting incidents which occurred during applications time. Some of the important difficulties are listed below:

1. An intermittent cable caused failure to preset the program counter on startover. A wiring error resulted in the loss of intensification to the display scopes. These two difficulties accounted for almost half of the time lost during applications.
2. Multiple selection of variable voltage circuits resulted when the marginal-checking equipment was in the "PMC" mode and the release button was depressed. A design change is being made to prevent this from occurring.
3. As a result of several parity alarms in a single digit of core memory a cathode follower in the parity register and a digit plane driver were replaced.
4. The protective fuses for the "Y" write and "Y" read current lines for Bank A were found blown. One blew several days after the other. An intermittently shorting cable was found on the write line but no difficulty could be discovered on the read line. These circuits may have been overloaded at some time prior to the fuses blowing.
5. Considerable time was spent in determining the cause of a blown fuse when one of the equipment racks was turned off. The trouble was traced to the use of three filter circuits with one fixed-voltage switching relay. The relay could not break the inductive load fast enough.
6. Another Freon leak in the Room 222 air-conditioning system was discovered.
7. Two transfer-check alarms occurred during this period. Their cause has not been determined.

1.22 Terminal Equipment

(A. M. Werlin, L. D. Healy) (UNCLASSIFIED)

The construction of MITE 3 (FGD) is complete, and the MITE is ready for cabling. Work is continuing on the checking of the MITE's now in operation and the buffer section of the buffer drum.

Groups two and three of the buffer drum are now being checked regularly with the other auxiliary-storage groups for writing between the slots. The PMC program is being revised to check these new groups.

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1.22 Terminal Equipment (Continued)Data Input

(N. N. Alperin and A. V. Shortell) (CONFIDENTIAL)

The twice-weekly missions for "shaking-down" the data input section are continuing. During the past biweekly period the tests were run as live data only due to the poor results originally obtained with the Ampex 14-channel recorder.

On the average, six out of eight gap fillers have been operative for the missions. Nantucket hasn't been sending a usable signal. The trouble is supposedly in the phone line. However, since we are unable to use their data because of the MTE being tied up for the IBM mapper test, we have not been inconvenienced. The two heavy radars have not been available for our tests. Montauk is not operative yet, and the signal from S. Truro has been unusable since the hurricane because of phone-line trouble. The S. Truro lines are under repair.

The equipment at our end other than the Ampex recorder has been working well. Most of the troubles have been small and were corrected. Two of the mappers have had trouble in the focus circuit. Large transients generated when the power is turned off at the scopes caused two focus coils to arc over. Damping resistors will be added to correct this trouble.

A circuit modification is being tried out on the Ampex 14-channel recorder, and results indicate that it may clear up a good part of our problem.

Test Programs

(D. A. Morrison) (UNCLASSIFIED)

Memo 6M-3058, "The Consolidated Test Program, T-3432," describing the operation of the combined test program, is now available. T-3432 is part of the daily marginal-checking procedure.

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1.23 AN/FSQ-7

Duplex Central

(B. E. Morriss) (UNCLASSIFIED)

R. B. Paddock and H. L. Ziegler have just joined the Section working on the duplex central. For the next couple of months Paddock will work as a member of the Group 62 Display Section.

Specifications have been received and are being circulated for comment on:

1. D-32, Duplex Maintenance Console;
2. D-33, Marginal Checking System;
3. D-31, MCD, CB, and PD Frames (list of frames with load frames and power sources);
4. Draft of Simplex Maintenance Console.

Phone-Line Requirements

(H. J. Kirshner) (UNCLASSIFIED)

A meeting was held to discuss XD-1 tactical telephone-system specifications (6M-3000). Before these specifications are accepted, it is necessary that most of the sites to be included in the XD-1 operation be decided upon.

Several conferences were held with IBM, ADES, Lincoln and Telephone Company personnel relative to maintenance of communications for XD-1. A document for concurrence will be written by Gayle of IBM outlining the system specifications.

Liaison between IBM, the BTL, AT&T, ADES, and Lincoln is in progress to set compatible specifications for DDR's and DDT's which may be supplied by the telephone companies.

The following drawings relating to telephone communications are available from the print room.

- E-75003, Maintenance Phone Line Location, Second Floor, Bldg. F, XD-1;
- E-75004, Maintenance Phone Line Location, First Floor, Bldg. F, XD-1;
- D-59935, AN/FSQ-7 (XD-1) Tactical Telephone System, Preliminary Traffic Diagram (Revised from SR-59935)

Provisions for input-output alarms and status indicators to be installed in the simplex maintenance consoles of production FSQ-7 were discussed with IBM.

An IBM, Lincoln, AT&T, ADES group will meet during the week of 18 October to specify back-up switching of telephone data equipment.



1.23 AN/FSQ-7 (Continued)

Duplex Maintenance Console (UNCLASSIFIED)

The electrical and functional requirements for the duplex maintenance console have now been agreed on in some detail by both IBM and MIT. The mechanical layout was the subject of a successful meeting last week, and an arrangement was reached that seemed to satisfy MIT and IBM. This is now being worked on by the FSQ-7 Mechanical Design Section at IBM; it embodies the following features:

1. The structure will be modular, with at most two standard module types, which can be lined up in any desired order.
2. The complete console will probably be arranged in a single line.
3. The card reader will be placed outside the console but easily accessible to the operators.
4. The probe-system controls, with scope, will be adjacent to the marginal-checking and computer controls.
5. The face of the console will slope back, and the desk space, covering only the operator's position, will be about 35 inches high, so that the operators will usually stand, or sit on draftsmen's stools.

Flexibility of construction and wiring will be emphasized. Register neons will be arranged for maximum readability, and the modules containing such lights, and other lights and switches not normally used, will have panel space for their full height. At least 15% spare space in the panels will be provided for expansion.

This design should be a great improvement over the XD-1 version, both functionally and productionwise.

A policy on spare parts for the production machines has been concurred in, and IBM is preparing a basic list of spare parts quantities. When this is received, a TIR will be issued.

Maintenance Console (UNCLASSIFIED)

(R. H. Gould and K. E. McVicar)

A document entitled "Specifications for the Duplex Maintenance Console of AN/FSQ-7 Production System," R. A. Imm, 29 September 1954, has been submitted for concurrence. It is the result of 2 weeks of discussions we and C. W. Watt had with the interested IBM staff. The facilities to be available for maintenance and trouble shooting appear to be adequate, but the mechanical layout is less flexible and convenient than it could be.

1.23 AN/FSQ-7 (Continued)

Maintenance Console (Continued)

(R. H. Gould and K. E. McVicar) (UNCLASSIFIED)

Discussions have been held on the simplex maintenance console, and a document should be submitted for concurrence next week.

Preliminary discussions were held on the design of the scope and probe system for the maintenance. A dual-beam scope with a wide-band amplifier is apparently not commercially available. Some design-engineering time would be worthwhile on such a scope and on a cathode-follower probe that can be calibrated so that all probes in the system could be adjusted to be identical in gain and voltage level.

Design will start next week on the duplex supervisor's console.

Mapper Supervisor's Console

(S. B. Ginsburg) (UNCLASSIFIED)

Two methods have thus far been considered concerning the installation of a Mapper Supervisor's console for monitoring SDV channels. The first method does not attempt to reduce azimuth synchronization time when selecting a desired channel. However, this method requires very little engineering time and employs existing circuitry and logic. The monitor mapper operates in parallel with a selected console. The second method requires a change in the design of the existing gear box and the addition of a selsyn with associated servo amplifiers for each SDV mapper console. However, azimuth synchronization time is greatly reduced. Very little external equipment is required by the Supervisor's console.

AN/FSQ-7 Schedules

(T. R. Parkins) (UNCLASSIFIED)

Schedule generation for duplex engineering continues; a sample schedule, Instruction Control Element, is nearing completion.

Two days of this period were spent with the High Street scheduling group successfully negotiating a change in method of reporting Project High progress. On 8 October, the Project High Progress Report for September was distributed to personnel concerned.

At the request of the Systems Office, J. Giordano, H. Flatt, and I began work this week on schedules which will more closely integrate the XD-1 activities of Divisions 2 and 6.

1.23 AN/FSQ-7 (Continued)

Power System

Power Sources and Prime-Power Distribution

(J. J. Gano) (UNCLASSIFIED)

The type of generation and distribution is being reviewed with the aid of outside consultants.

Marginal-Checking System

(G. F. Sandy) (UNCLASSIFIED)

The marginal-checking system for the production machines is to be concurred in next week. This system is the result of the joint efforts of Pat Sharkitt, Ralph Marden, Mike Zucker, and myself. It is a controversial system. The primary controversy is whether to permanently connect the marginal-checking system to one of the d-c supplies feeding the simplex equipment or to provide the ability to connect the marginal-checking system to either of the d-c supplies.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

A trip to the west coast is planned for the week of 11 October 1954 to finalize some of the specifications for the display tubes.

Intense efforts were directed toward screen aluminizing and optimizing the phosphor studies. These results were necessary to complete the final specifications for the Charactron tubes. The phosphor studies were not completed. A tentative specification for the P7 screen will be adopted next week. The aluminizing studies were completed satisfactorily. The data will be presented to Convair along with the necessary processing procedure. It is hoped that a specification can be written on the aluminized screen so no further problems arise.

Some effort was directed toward finding a new type of cathode for the Charactron gun. Present life-test studies indicate that the oxide-coating cathode is not the most satisfactory cathode for the Charactron gun. Under investigation and study is the sintered-cathode work of Bell Labs and others. More intense effort will be directed to this study in the future.

Work continues on expanding the life-test positions for the Charactron and Typotron studies.

Hughes has made some Typotrons this period which meet all of the tentative specifications.

Personnel from the IBM High Street Tube Group have been working with the test group at MIT to become familiar with display-tube test circuitry and operation.

I made a 2-day trip to Poughkeepsie to discuss the SR-1782 tube program and display-tube program.

1.33 Research and Development

(S. Twicken) (UNCLASSIFIED)

Discussions with the Project High Tube Group have resulted in concurrence on the specifications of all but one of the electron tubes for AN/FSQ-7 duplex equipment which are to be purchased to MIL specs. Specs on those tubes on which improvement programs have been underway are not yet completely frozen in regard to AQL's, etc.

1.33 Research and Development (Continued)

(S. Twicken) (UNCLASSIFIED)

The 5687 tungsten-nickel cathode-alloy life test has reached 3400 hours without any major changes in plate current such as are exhibited by standard tubes under the same conditions. A considerable amount of grid emission has developed on the cutoff sections, however, indicating a possible problem in the future application of this type of cathode sleeve.

Life tests on the RCA A4688B (5965 type) have reached 2000 hours with the appearance of considerable grid-cathode leakage. A small amount of interface has also appeared in a few tubes.

The life test on the GE 5965 has reached 5400 hours. No interface is apparent. Considerable grid emission has developed on the cutoff sections, however.

(T. F. Clough) (UNCLASSIFIED)

Group 63 has experienced some difficulty with the 3C45 hydrogen thyratron tubes which they use as a high-current pulse generator to examine the switching coefficients of magnetic cores. The rise time of pulses through these tubes increases appreciably after a few hundred hours of life. This probably results from the hydrogen cleanup process which is normal for these tubes. A series of tests at Bomac confirmed this. Data on several 3C45's of more recent manufacture have been recorded. These tubes will be observed during life to determine if the designs and processing changes in the more recent tubes will minimize this increase of rise time.

Work is being done in cooperation with Groups 60 and 62 to improve tube records by speeding up the feed-back of essential tube data.

Sylvania reports that 7AK7's have just gone back into production, and they estimate that delivery of our outstanding order should start within 1 month.

Replacement of the 5965's in MTC with Z-2177's (the improved 5965) began during this period. This will provide a large-scale test of this type and enable us to test the tube record-keeping procedure which is planned for XD-1.

(P. C. Tandy) (UNCLASSIFIED)

Pulse-transfer characteristics have been taken on three Characteron tubes. The curves for Cht-62-1 show little change between 25 and 265 hours on life test. Cht-61 is a good tube after 368 hours on life test, while Convair 0074 Characteron has a very noticeable hump in the cathode-current curve, and the beam current is flat over an approximate 30-v range of grid bias after 49 hours of life test. The Convair 0074

1.33 Research and Development (Continued)

(P. C. Tandy) (UNCLASSIFIED)

cathode emission is poor in the center indicating ion bombardment of the cathode.

A gas test has been made on Cht-61 and Cht-62-1. An ion current of 0.8 to 1.1 millimicroamperes on Cht-61 and 0.4 millimicroampere on Cht-62-1 were noted when the cathode current was 100 microamperes. The  $A_1$  and  $A_2$  voltage is 500 volts, the deflection plates and matrix voltage, 100 volts; the heaters were operated at 6.2 volts. This gas test could not be made on the Convair tube because it did not have a separate matrix lead, and it has different basing arrangement.

(L. B. Martin) (UNCLASSIFIED)

Two of the latest Typotron tubes, 419 and 426, have been tested for leakage; both tubes exceeded tentative specifications. An anode button on tube 419 came off because of a cold soldered job. Since this trouble has not been uncommon, a detail photograph was taken of the poor connection. The picture will be shown to Hughes in an effort to get them to direct more attention to their soldering technique.

A plan has been tentatively agreed upon for the location of the 16-position Typotron life test and the 10-position Charactron life test in 026 Barta. The plan involves the use of hall space adjacent to 026 for storage and the removal of about five benches. These changes will allow the two life tests to be lined up along the outside wall. Progress is continuing on the life-test units. Multiple units will be built at Lexington after the prototype is built and debugged at Barta.

Foster Holmes from IBM was at Barta 5 October to discuss modifying the Charactron Production Tester being built for IBM by Convair to test Typotrons. It would seem that the most difficult part of the modification will be mechanical in nature.

The following is a list of Typotron tubes, their condition, and total hours on life test:

<u>Typotron Tube</u>	<u>Total Hours</u>	<u>Condition</u>
265	4790.8	marginal
280	3972.8	satisfactory
335	3155.8	satisfactory
366	2454.0	satisfactory
389	2370.2	satisfactory
390	2454.0	satisfactory
392	2454.0	satisfactory
394	1671.9	marginal

1.33 Research and Development (Continued)

(A. Zacharias) (UNCLASSIFIED)

The experiments on aluminizing were completed. It was found that after an initial bakeout of the aluminized face, no further aluminum would be lost on successive bakeouts.

Phosphor evaluation studies on 7-inch cathode-ray tubes were started. To evaluate the aluminum-screen contact to the button, a suggestion by D. V. Mach was investigated. This involved the use of a capacitance bridge to measure the capacity and power factor of the condenser formed by the aluminum screen and a piece of aluminum foil formed over the outside of the tube face. This proved to be an excellent test for the condition of the screen contact.

The 7-inch tubes are presently being tested. Very definite indications of an optimum blue layer are evident from the initial tests.

## SECTION II - AN/FSQ-7

2.1 Group 622.11 SystemsMRI Coverage Mapper

(H. K. Rising, H. E. Anderson) (CONFIDENTIAL)

Several days have been spent with H. J. White of IHM considering the requirements on the mapping system with particular regard to the accuracy. The original operational requirements of  $\pm 3$  miles accuracy on boundaries would have meant  $1\frac{1}{2}\%$  range accuracy and  $1/4\%$  azimuth accuracy on a B scan. Relaxation of this accuracy requirement still means a  $1\%$  deflection system over a 4-hour period. There is serious question whether we should build a device requiring such accuracy.

AN/CPA-35 Development Engineering Inspection

(H. K. Rising, H. E. Anderson) (CONFIDENTIAL)

Two days were spent at Westinghouse in Baltimore inspecting AN/CPA-35, the ground environment for the Bomarc missile. This is a manually aided tracking system using one radar and an ERA 1104 computer with all data handling prior to the digital computer in analog form. The first day was an intensive orientation and tour of the system mock-up. The second day was used for more detailed explanation on an individual basis. This environment will be replaced by FSQ-7 in automatic sub-sectors.

Testing

(B. G. Farley) (UNCLASSIFIED)

Coordination with the IHM test-program group has continued. This is expected to result within a couple of weeks in a list of test-program functions which will be written for XD-1.

A plan has been initiated to test XD-1 with programs increasingly similar to operational programs to avoid a sudden appearance of unexpected faults when operation is commenced. Group 61 has agreed to make a man available as soon as possible to act in an advisory capacity on this project.

UNCLASSIFIED  
CONFIDENTIAL



## 2.11 Systems (Continued)

### Small-Scale Display Generators

(R. P. Mayer) (CONFIDENTIAL)

In order to provide estimates on the equipment necessary for projection-display systems and for display systems at AAOC, it was necessary to make some preliminary designs for small display generators and drum systems. A representative design will be outlined in an M-note summarizing the equipment estimates for various AAOC display systems.

### Suggested Changes in FSQ-7

(R. P. Mayer) (CONFIDENTIAL)

The Section Leaders of Groups 61 and 62 were asked to submit lists of changes or additions which they would like to see made in FSQ-7 (XD-1 or production), including those which seem unlikely as well as those which seem necessary. The purpose of this list was to collect ideas which will later be elaborated, evaluated, and then either accepted for inclusion or for further analysis, or rejected. A preliminary survey of the suggested changes is shown on drawing SB-75005.

### Power Distribution (XD-1)

(G. F. Sandy) (UNCLASSIFIED)

The drum MCD frame is completely assembled on the test floor at IHM. The central computer MCD frame is being assembled on the test floor. The mechanical and electrical design is very nearly complete for the input/outputs, mapper, and display-MI MCD's. However, the display-console MCD is lagging.

## 2.12 Magnetic-Core Memories

### Miscellany

(W. Papian) (UNCLASSIFIED)

The 256 x 256 x 33 core memory with the 700-bits-per-cathode figure of merit mentioned in the last biweekly would be vacuum-tube driven using approximately present techniques. Switch-core drive might raise this figure to the vicinity of 2000 bits per cathode.

Most of the present activity in this Section is devoted to studying problems associated with these very large memories.

2.12 Magnetic-Core Memories (Continued)

XD-1 Memory

(J. L. Mitchell) (UNCLASSIFIED)

The memory frame is now operating satisfactorily, and the testing program is moving along fairly rapidly. Margins so far are good.

Past-Write Disturb

(J. L. Mitchell) (UNCLASSIFIED)

The following facts about post-write disturb were obtained from memory-test setup VI:

1. The PWD pulse need only be 1- $\mu$ sec wide at the base when the rise and fall times are 0.5 microsecond.
2. The PWD pulse can be run in as close to the write pulse as desired; in fact, tests indicate the PWD and the write pulse can overlap by 0.5 microsecond.

256 x 256 Memory Study

(J. Raffel) (UNCLASSIFIED)

Preliminary design estimates for a core-switch-driven 256 x 256 x 33 memory indicate that it might be built with less than a thousand cathodes. (The XD-1 64 x 64 x 33 memory bank uses about 1500 cathodes.)

The successful design of such a memory presents a number of challenging problems, none of which seems at this time to be insurmountable.

The construction of a representative portion of a switch and a single memory plane should be sufficient to anticipate most of the problems to be encountered under actual operating conditions and to allow a thorough evaluation of the system. The construction of such a test section is now under way.

Trip to ERA

(J. Raffel) (UNCLASSIFIED)

E. A. Guditz and I visited ERA (St. Paul, Minn.) where a good deal of work on core circuits is being done. They have developed a number of basic circuits using cores and diodes and are generally optimistic about the possibility of using these as logical components in computers.

2.12 Magnetic Core Memory (Continued)

Modular Planes

(E. A. Guditz) (UNCLASSIFIED)

A 64 x 64 modular plane frame has been designed. The photographic master for printing this frame is being made. A metal frame for holding 16 of these 64 x 64 modular frames is designed and will soon be constructed. Wiring of a 256 x 256 sample plane made from these modules will begin in about 3 weeks.

The return trip from ERA included a visit to the Glass Products Co. in Chicago, Ill., to discuss printed-wiring techniques.

2.13 Vacuum-Tube Circuits

Circuit Releases

(R. L. Best) (UNCLASSIFIED)

The warning-light relay driver has been approved for XD-1 by IHM and MIT circuit sections.

Console Circuits

(R. L. Best) (UNCLASSIFIED)

A trip to Vestal Lab on 7 October with C. Corderman and J. Woolf resolved most of the outstanding circuit problems in the consoles.

Limiting the Register-Driver Output

(B. Barrett) (UNCLASSIFIED)

This circuit gives a good signal-to-noise ratio but must be optimized for low-level input signals.

Phone-Line Modulator

(E. B. Glover) (UNCLASSIFIED)

A distorted output has been traced to phase shift in the high-pass filter and possibly nonlinear distortion in the last amplifier stage. A harmonic-wave analyzer was borrowed to help solve this problem.

2.13 Vacuum Tube Circuits (Continued)

Flip-Flop, Model C

(N. J. Ockene) (UNCLASSIFIED)

Circuit cards have been rebuilt preparatory to running tests on a flip-flop circuit, and test circuit logic has been set up.

256 x 256 Core-Memory Circuits

(D. Shansky) (UNCLASSIFIED)

A breadboard of the selection-plane driver for this memory has been constructed and is presently being debugged.

2.14 Memory Test Computer

General

(W. Ogden, W. Hosier) (UNCLASSIFIED)

MTC was not operative during the first half of this biweekly period, largely because of the installation of high-speed flip-flops modified to accommodate the Z-2177 in place of the 5965. It remains to secure controlled quantitative data, but margins on the modified circuit seem inferior to the original, especially where trigger pulses were marginal (of the order of 20 volts). Increasing the size of several trigger pulses has restored operation to near-normal in most registers.

Some delay has also been encountered with wiring of power-supply control and with adjustment of certain supplies to the increased load imposed by Charactron equipment; these matters are being cleared up.

Installation of more cathode followers to drive the "and" gates associated with control has enabled us to get rid of 12 microseconds "padding" per instruction, thus bringing the time for ca, etc., down to 18 microseconds. Gradual tailoring of delays and improvement of margins should eventually bring this figure down to the desired goal of about 10 microseconds.

Following installation of double-seating control valves in the chilled-water lines, the air-conditioning system has been operating under full automatic temperature and humidity control. Inspection made by Francis Associates, the design engineers, indicates that operation is satisfactory.

A regular evening shift (1500--2348) has been operating for a week, thus making MTC available 5 nights a week, 4 of which in general should be open for applications.

2.14 Memory Test Computer (Continued)

Applications

(W. Ogden, W. Hosier) (UNCLASSIFIED)

Work has continued on the Charactron, most of the time devoted to photographic studies by Lloyd Sanford on the P-11 phosphor.

Preliminary tests of programs and equipment involved in the data link have been satisfactorily run.

Conversion and test runs of subroutines for the Group 61 simulation program have been made for Neuman and Houser.

Card Machine

(F. Durgin) (UNCLASSIFIED)

An IBM Type 513 reproducing punch has been received; inspection discloses that the reading and punching functions can be separated and put under computer control with minor modifications assented to by IBM. Design and construction of the necessary liaison circuits are proceeding; it is expected to have this equipment operating about the end of the year.

Earl Gates and Joe McCusker are working to get the drum functioning.

Replacement of 5965's by Z-2177's

(L. Sutro) (UNCLASSIFIED)

More than half the sockets that held 5965's have now been filled with Z-2177's. All the changes have taken place in flip-flops, Mod. II (high-speed flip-flop), where 446 tubes have been installed. The new tubes will next go into 21 other circuits which are being studied by their designers to decide what changes, if any, should be made before the new tubes are installed.

New Record System

(L. Sutro) (UNCLASSIFIED)

A new method of record keeping began 1 October. From new record forms filled out by MTC technicians data is now copied onto punched cards in the Records Office. The new forms accompany rejected tubes to the Tube Shop and rejected components to the Components Evaluation Laboratory, there to receive the results of analysis and be copied onto punched-card records of tubes and components. While the system is functioning, there remain

2.14 Memory Test Computer (Continued)New Record System (Continued)

(L. Sutro) (UNCLASSIFIED)

gaps in the past history that need to be filled in.

A list of all the panels and plug-in-units comprising the computer is part of the records system. Preparation of this list has led us to change many titles and to prepare drawings found to be lacking. When the list is complete it will be used by Drafting to prepare a bill of materials for the computer. Punched on cards, this bill of materials, together with the punched MTC history, will permit determining the quantity and average life of any type of component in the computer.

MTC Technician Training Course

(J. McCusker, A. Vanderburgh) (UNCLASSIFIED)

The MTC Technician Training Course has been in session 2 hours a day for the last 4 weeks. The first 3 weeks treated background material such as "Binary Numbers" and was applicable to other computers as well. The notes of this part are being rewritten for publication as an interoffice memo. The fourth week and the remainder of the course consider only MTC. This training course is being taught by J. McCusker and A. Vanderburgh. At present, J. McCusker is teaching "MTC Computer Logic" 4 days a week, and A. Vanderburgh is teaching "Programming" the fifth day.

Power SystemPower-Supply Control

(R. Jahn) (UNCLASSIFIED)

As computer time and other projects permit, we are slowly threading our way through MTC power-supply control. The over voltage - under voltage Sensitrol units are now wired to the indicator lights, but only the -15-volt bias unit will shut off power to MTC, pending a further study of voltage stability of the power supplies.

Amplifier Panel

(S. Coffin) (UNCLASSIFIED)

A new amplifier panel is being designed to replace the present amplifiers and auxiliary supplies in the MTC d-c power supplies. Consideration is being given to simplicity, reliability, and dynamic stability.

2.15 System Liaison

General

(A. P. Kromer) (UNCLASSIFIED)

A conference of MIT, IBM, Western Electric Co., and Air Force representatives studied the current status of the program for production systems and various problem areas which have arisen in connection with this program. This information will be presented to Defense Department officials during the week of 11 October for assistance with administrative and fiscal matters which appear to be adversely affecting the program.

The Air Force Joint Project Office is preparing a proposal to coordinate the approval and incorporation of changes into the system. This includes equipment, buildings, communications, personnel requirements, contracts, etc. All of the organizations involved will be consulted with the objective of having a mutually agreed upon procedure resolved by the latter part of November.

Equipment

(P. Gray) (UNCLASSIFIED)

Memorandum 6M-3090 concerning the synchronized clock system for the Direction Center buildings is being prepared for release to ADES early next week.

The JPO has expressed concern over the announced date of 1 December for completion of Exhibit AFCRC-17 describing the duplex central for the Direction Center. Steps are being taken to better this date.

A meeting with IBM is tentatively scheduled for 19 October to complete work on the XD-1 Exhibit in order to bring it up to date.

A revised equipment list will be written for XD-1, based on the latest issue of IM-67. This will be released by the PCO for information purposes.

Production Coordination Office

(P. Bragar, F.F. Manning) (UNCLASSIFIED)

TIR's issued during the past 2 weeks:

1-28, M-2947 Supplement 1, Outline of Track-While-Scan Training Program for Air Force Personnel, 1954 Cape Cod System (Supplement to 6M-2706, 1954 CCS).

2.15 System Liaison (Continued)

Production Coordination Office (Continued)

(P. Bragar, F. F. Manning) (UNCLASSIFIED)

1-28, M-2947 Supplement 2, Outline of Weapons Direction Section Training Program for Air Force Personnel, 1954 Cape Cod System (Supplement to 6M-2706, 1954 CCS).

1-29, 6M-2960 Addendum 1, Prime Power Requirements for AN/FSQ-7 Direction Center.

1-30, 6M-3044, Comments on Burns & Roe Drawings for the Direction Center Bldg. and Power House.

1-31, 6M-2924, Proposed Program of Activity for Digital Data Receivers (DDR) and Transmitters (DDT) for XD-1.

Direction Center Construction

(W. H. Ayer) (UNCLASSIFIED)

Studies have been undertaken by Lincoln in the last 2 weeks at the request of USAF public-works installations personnel with the objective of decreasing the cost of the Direction Center buildings. Preliminary plans will be available for comments and suggestions by interested Lincoln personnel on 11 October.

A study and review of the basic prime-power generation system is to be made in the next 6 weeks to assure that we will receive satisfactory reliability from the presently planned and any alternative power system. This study will not affect the planning for the first and possibly second installations.

2.16 Display

General

(J. Woolf, H. Zieman, C. Corderman) (UNCLASSIFIED)

Some inconvenience has been experienced recently in the Charactron display in changing the CRT for tests with P7 and P11 phosphors. It is now planned to build a second display setup to get experience in running two displays in parallel and at the same time to have both phosphors available continuously for further testing and demonstration.

All card details, card assemblies, pluggable-unit assemblies, and pluggable-unit block diagrams for the vector generator, line driver, six-bit decoder, and character-positioning and compensation decoders are now in the Drafting Room. They are well on the way to completion there.



2.16 Display (Continued)General (Continued)

(J. Woolf, H. Zieman, C. Corderman) (UNCLASSIFIED)

Intensive marginal checking of the line-driver prototype has been started and is progressing satisfactorily. A six-bit decoder breadboard is being built for preliminary margins on all the decoders. Margins are also being taken on the vector generator, but more thought is required on a satisfactory method for taking these margins on the computer. Present thoughts require the removal of certain tubes from the pluggable unit during the marginal test or a switch on the pluggable unit to accomplish the same function. Neither alternative seems satisfactory.

Miscellaneous

(R. S. Fallows) (UNCLASSIFIED)

Work on the central display frames continues with increasing pressure. We now have six "rented" engineers, and two more are scheduled to be transferred from IBM next week. Our MIT force has been augmented by the loan of Bob Buzzard from the Systems Section and Bob Paddock from the Duplex Group. We now have five full-time and two part-time MIT engineers. IBM has assigned a full-time expeditor, and Art Grennel is following drawings and releases here.

We are approximately 4 weeks behind schedule on our latest item, back-panel wiring. IBM has told us that the central-computer frames required some 100 man-hours per module for backpanel wiring charts. Harry Hagopian of IBM, who is experienced in the business, has been helping us with the digital-display generator frame, and he has expressed the opinion that our frames are going to be several times more difficult than those of the central computer because our registers go across a frame rather than vertically in a module. To date we have not completed the drawings for any module so it is almost impossible to estimate how long the job will take. Hagopian thinks that we will have to complete an entire frame as a package.

We have submitted about 24 pluggable-unit design to IBM for release. These will add up to some 200 pluggable units in production. Another 10 PU designs are in various stages of drafting, and another 10 have yet to be designed.

Prototype models of 11 pluggable units have been delivered for type testing. Another 10 are under construction in the shop.

Pluggable-unit adapters and test specifications for IBM production testing are being drawn and delivered to IBM at a satisfactory rate.

2.16 Display (Continued)

Miscellaneous (Continued)

(R. S. Fallows) (UNCLASSIFIED)

Approximately 90% of our logical block diagrams have been sketched. About 30% have cleared drafting and another 30% are in drafting.

Pluggable-Unit Type Testing

(B. Ganley) (UNCLASSIFIED)

In the past 2 weeks five pluggable units (PU) have been type-tested. Experience with these five has dictated the design of certain additional equipments. These include a d-c voltage & current-meter panel, d-c voltage interlock, standard pulse calibrator, a chopper "d-c" level calibrator, and a time-measurement device. The physical arrangement of the PU tester is also being changed.

Drawings

(R. Gerhardt) (UNCLASSIFIED)

Sketches of the timing and control section block schematics have been made. A number of destinations or origins of signal wires have been omitted because they were unknown or because it would be more convenient to label the lines at the time the drawings are checked. Some time was spent considering the marginal-checking breakdown.

During the next week, Bob Buzzard and I hope to check the drawings, label all lines, make charts of the wiring, and return the sketches for final drafting.

## 2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

The Group 63 ferrite-core pilot plant has successfully produced a number of batches of cores similar to those manufactured for the high-speed memory by General Ceramics. The Group 63 cores are superior in uniformity, signal ratios, and current margins.

Quantitative measurement of the new, experimental, low-coercive-force, square-loop ferrite reported in the last biweekly shows a coercive force of 0.07 oersted.

The Computer Techniques Section has demonstrated an experimental half adder using transistor flip-flops and gates and operating up to 500 kc.

Last-minute measurement of the magnetic moment of  $\text{GaFe}_2\text{O}_4$  showed 2 Bohr magnetons per molecule instead of the 9 Bohr magnetons per molecule anticipated. This measurement was made after the report below was written.

### 2.21 Magnetic Cores

#### Preparation of $\text{GaFe}_2\text{O}_4$

(D. Wickham, F. E. Vinal, J. B. Goodenough) (UNCLASSIFIED)

To obtain ferrites with higher flux densities, an attempt has been made to design a magnetic spinel which would be ferromagnetic (all atomic magnetic moments parallel) rather than ferrimagnetic (atomic moments on different lattice sites antiparallel). No such material has been discovered, designed, or prepared to date. Such a material should have a higher magnetic moment per molecule than the ferrimagnetic spinels; however, it is expected to have an electric conductivity as high as that in magnetite. The principle involved is to take advantage of double exchange, which aligns in parallel the atomic magnetic moments of ions of like atoms but different ionization that are located on similar lattice sites. It also requires the elimination of magnetic ions on the other type of occupied lattice site to avoid antiferromagnetic coupling between the atomic moments on the two different types of sites through superexchange. From previous studies of the importance of covalence in spinels, it was decided that  $\text{Ga}^{3+}$  should replace  $\text{Fe}^{3+}$  in the tetrahedral sites of the spinel lattice so that  $\text{Ga}^{3+}(\text{Fe}^{2+}\text{Fe}^{3+})\text{O}_4$  could be prepared. This substance should have a magnetic moment of 9  $\mu\text{B}$  per molecule as against about 2  $\mu\text{B}$  for the present memory cores. It should have a Curie point which is well above room temperature. This material has been prepared and found to be strongly magnetic. Its Curie point and saturation moment are being measured.

2.2 Group 63 (continued)2.21 Magnetic Cores (continued)New Core Compositions

(J. J. Sacco, P. A. Fergus) (UNCLASSIFIED)

Further preparations and evaluation in the system  $MgO \cdot Fe_2O_3 - ZnO \cdot Fe_2O_3 - Mn_3O_4$  have been completed. The processing of further samples in the  $NiO \cdot Fe_2O_3 - ZnO \cdot Fe_2O_3 - Mn_3O_4$  system is underway. Some very-low-coercive-force square-loop ferrites have been discovered in this system, but Curie temperatures are low.

Chemical Analysis

(E. Keith, P. Reimers) (UNCLASSIFIED)

Completed analyses have been reported for the following samples:

Memory core ferrite DCL-2-720

Magnesium-manganese ferrite DCL-8-11. This ferrite was prepared from mixed oxalate precipitation

A supply of lithium carbonate has been analyzed for use in ferrite compositions.

Analyses of the following samples are in progress.

Magnesium-manganese ferrite DCL-2-800 and DCL-2-801

Magnesium ferrite DCL-8-13.

Ferrites for Magnetostrictive Measurements

(D. L. Brown) (UNCLASSIFIED)

At the request of P. K. Baltzer, several series of specified compositions in the magnesium-manganese ferrite system are in preparation. Several weeks will be required to complete these series.

Curie Temperature

(P. K. Baltzer, J. B. Goodenough) (UNCLASSIFIED)

Measurements have been made of the Curie points of several cores of different composition which showed marked improvement in B-H loop squareness after a refire at 1100 C in a nitrogen atmosphere. The purpose was to compare the Curie points of the refired and unrefired samples. It was discovered that due to an apparent inhomogeneity, the unrefired sample had no definite Curie temperature. Apparently oxidation takes place inhomogeneously throughout the core. The cores with definite Curie temperatures all have square B-H loops. One of the effects of the refiring process is to create a chemically homogeneous sample.

2.2 Group 63 (continued)2.21 Magnetic Cores (continued)Curie Temperature

(N. Menyuk) (UNCLASSIFIED)

The Curie temperature of magnesium-manganese ferrite  $Mn_fMg_{(1-f)}OFe_2O_3$  has been calculated as a function of the composition parameter  $f$ . The manganese ions were taken to be in the form  $Mn^{+2}$  and to be exclusively in the inverse (B) sites. The magnesium was assumed to be partially inverse but with some of the ions in the normal (A) sites. The results indicate that the Curie temperature increases with increasing manganese content in an almost linear manner. In addition, the results predict that the Curie temperature is relatively insensitive to the degree of inverseness of the magnesium ions within the range found experimentally. There should therefore be little variation of Curie temperature with quenching temperature.

Microstructure of Ferrites

(F. S. Maddocks) (UNCLASSIFIED)

The survey of microstructures for the 1350-C and 1400-C firings of magnesium-manganese ferrites is approximately one-half completed.

Five magnesium-manganese ferrites of high manganese content have been compared for microstructure before and after a special annealing treatment. The lamellar precipitates which characterize this compositional region appear reduced in concentration by the annealing process.

Production of Memory Cores

(J. J. Sacco) (UNCLASSIFIED)

The optimum firing cycle has been determined for memory-core composition DCL-2-720 which has met the memory-core specifications in all respects. Approximately 30,000 cores have been prepared from several firings, each of which has been a satisfactory duplicate of the others. About 100,000 additional cores are pressed and ready for the firing cycle. Continued pilot production of this type of memory core is planned.

High-Quality Memory Cores

(F. E. Vinal) (UNCLASSIFIED)

The production of very high quality memory cores in the ceramics laboratory represents a milestone in the ferrite program. Repeated production in sufficient numbers, indicates that memory-core production in the ceramic laboratory is firmly in hand. Evaluation of these cores shows that memory planes with considerably extended operating margins may now be fabricated.

2.2 Group 63 (continued)

2.21 Magnetic Cores (continued)

Evaluation of DCL Memory Core Production

(J. W. Schallerer) (UNCLASSIFIED)

A total of 11,305 DCL-2-720 memory cores have been tested to the new core specifications. The over-all yield has been 92 per cent and the trend is toward higher yields. The accepted cores have been submitted to the memory section of Group 62 for plane construction. Planes made from these cores are expected to have wider operating margins than have been previously available with memory cores from any source. The undisturbed ONE output is approximately 50 per cent higher and the current operating range is considerably broader than those obtained from General Ceramics' cores. The switching time remains satisfactory, and half-selected values average approximately one-half of the maximum specified values.

"Delta" Evaluation Tester

(J. D. Childress) (UNCLASSIFIED)

The new "delta" evaluation tester is being debugged before being put into service. Considerable difficulty has been experienced with the crystal-diode pulse-mixing circuitry.

Automatic Core Tester

(R. Pacl) (UNCLASSIFIED)

The new core selector, which will group tested cores into three lots--high, low, and reject--has been assembled and apparently works satisfactorily.

Computer Techniques

(D. J. Eckl) (UNCLASSIFIED)

Torben Meisling and Bob Freeman have joined the Section. Torben has been doing some work on logical design and will build an experimental set to measure the delay through a series of level gates. Bob Freeman is working with Ed Cohler on the construction of a shift register and counter.

We have on order 6 Texas Instruments' type 904A silicon transistors which have an 8 - 10 mc alpha cutoff frequency.

Minneapolis-Honeywell have available three power transistor types: a 5-w, 400-ma unit; a 20-w, 800-ma unit; and a 60-w, 5-amp unit. The 5-w transistor has a 3 - 6µsec rise time if the current is limited to 250 ma. We have 10 of these on order for core and power-supply work.

2.2 Group 63 (continued)

2.21 Magnetic Cores (continued)

Transistor Systems

(C. T. Kirk) (UNCLASSIFIED)

A high-speed transistorized adder has been constructed capable of operating at a prf of 500 kc. This adder consists of a single-bit accumulator and A-register (both 4-transistor flip-flops) an emitter-follower-matrix half adder, a temporary storage register (another 4-transistor flip-flop), and 4 pulse gates. A transistorized pulse distributor consisting of a 4-transistor flip-flop and 2 pulse gates completes the system. The complete add operation consists of two separate commands which originate from the pulse distributor.

The first pulse is an add command which adds the contents of the A register and the accumulator together and places the sum in the temporary storage register. The second pulse is a shift command which transfers the sum stored in the temporary storage register back into the accumulator, completing the add operation.

The purpose of this system is to test the operation of the emitter follower half adder and the transistor pulse gates at high speeds and to find out how fast such a system will operate reliably.

Transistor Shift Register

(J. R. Freeman) (UNCLASSIFIED)

Preliminary work has begun on a five-digit transistor shift register with parallel read-in and serial read-out.

Unipolar-Field-Effect Transistors

(E. U. Cohler) (UNCLASSIFIED)

Two Sylvania field-effect transistors were received recently and the static characteristics taken. These devices are very similar to the vacuum-tube pentode in characteristics: high input and output impedances, transconductance around 600 micromhos, dissipation limit of 50 milliwatts, and maximum drain (corresponds to plate) voltage of about 100 volts. The measured characteristics of these two samples were quite similar and good, but of course the size of the sample is too small to support any judgments on uniformity. A flip-flop has been designed and built to test the dynamic characteristics of these devices, and their high cutoff frequencies (20 mc) promise fast operation.

2.2 Group 63 (continued)

2.21 Magnetic Cores (continued)

Flip-Flop Designs

(E. U. Cohler) (UNCLASSIFIED)

A recent thought on transistor flip-flop operation has opened promise for faster junction flip-flops. It seems that any transistor flip-flop operates much faster going "on" than when going "off." This is due to the fact that the transient currents may exceed the steady-state currents by as much as three to one, but they can never become less than zero. It is thus proposed to equalize the rise and fall times by operating in the middle of the allowable current-swing range. This will then enable the flip-flop to exceed its steady-state current values in both directions, and it is expected that the available speeds will be more than doubled.

Conferences

(E. U. Cohler) (UNCLASSIFIED)

National Union (represented by Messrs. E. G. Shewen and Brauer) told us that they are developing a 50-w, 75-kc-cutoff, bistable semiconductor device.

Transitron has promised us some new high conductance diodes (500 ma at 1 v) with 20 or 30 volts back ratings and good switching characteristics. They are also working on various high-frequency semiconductor devices and will keep us informed of progress.



SECTION III - CENTRAL SERVICES

3.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

Catalog Losses:

Our catalogs have been disappearing at an alarming rate. All personnel are welcome to use the Division 6 catalog file, but catalogs should be returned promptly so as to be available to all.

New Systems:

A revised system of handling requisitions will result in making information on outstanding requisitions more readily available.

New Products:

The IPC representative informs us of a new nontarnishing-plating process for co-ax connectors and contact pins. Further information has been requested.

3.2 Construction

Production Control

(W. O. Glass) (UNCLASSIFIED)

There have been 23 construction requisitions totaling 480 items satisfied since 24 September; and there are 26 construction requisitions totaling 471 items under construction by the Group 60 electronic shops.

For further information, please call the Division 6 Production Control Office (Ext. 861).

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There is 1 order outstanding totaling 20 items; 124 items have been delivered during the past biweekly period.

Information on specific orders may be obtained from the writer (Ext. 863).

3.5 Drafting

Use for Obsolete Memoranda

(A. M. Falcione) (UNCLASSIFIED)

There is a need for obsolete memoranda by the Duplicating Room (C-133). The obsolete memoranda are used as scrap paper for absorbing the ink from Multilith masters after the initial run has been made.

Drafting Room

(A. M. Falcione) (UNCLASSIFIED)

The Drafting Room annex (Rm. C-125) has been absorbed into Rm. C-130. The consolidation was necessary to enable the Document Room and Print Room to expand, in order that they might be better able to furnish effective service.

Division 6 Accessions List

(A. M. Falcione) (UNCLASSIFIED)

Future issues of the Division 6 Document Room Accessions List will be classified CONFIDENTIAL. Division 6 secretaries will keep binders of all issues on file; extra copies of the binders will be available for loan from the Document Room (C-129).

3.6 Administration and Personnel

New Staff

(J. C. Proctor) (UNCLASSIFIED)

Daniel Brown is a new DDL Staff member in Group 63. He received his BS in Chemistry and Math from Knoxville College in 1951 and has been employed by the U. S. Bureau of Mines Electrotechnical Laboratory as a Physical Science Aid.

Lawrence Jeffery is a new DDL Staff member assigned to Group 62. Mr. Jeffery received his MS in Math from the University of Chicago and has been employed as an engineer by Raytheon doing system analysis and design work.

Transfers

(J. C. Proctor) (UNCLASSIFIED)

Floyd Manning has transferred from Group 60 to Group 62.

3.6 Administration and Personnel (Continued)

New Non-Staff Personnel

(R. A. Osborne) (UNCLASSIFIED)

Madeline Carey is a new member of Group 61, where she will operate the IBM machines.

Frank Elksnin has joined the Drafting Department.

William Gumes is a new technician in the Construction Shop.

Madeline Terrasi is a new clerk in the Tube-Testing Section of Group 65.

James Tolliver has joined the Systems Group at the Barta Building as a technician.

Jeffrey Wisnia, an MIT student, will work part time in the Barta Building for Group 65.

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Pearl Edmunds

Joan Grine

Constantine Rhodes

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

2 Administrative Assistants for Group 60

1 Clerk (Multilith Operator)

2 Electrical Detailers

1 Secretary for Group 60

1 Secretary for Group 62

7 Technicians for Group 64.

Memorandum 6M-3094

Page 44

3.7 Miscellaneous

Lab Power, Rm. 10-397

(R. C. Jahn) (UNCLASSIFIED)

A complete regulated d-c power system using a Burroughs supply is being installed in Room 10-397 at MIT for Prof. Linvill's thesis group.