

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

COPY NO 1 OF 155 COPIES

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

SUBJECT: BIWEEKLY REPORT FOR 11 FEBRUARY 1955

To: Jay W. Forrester

From: Division 6 Staff

CLASSIFICATION CHANGED TO:
Auth: DD 254
By: RRG
Date: 3-21-60

COVER SHEET

This document is issued for internal distribution and use only by and for Lincoln Laboratory personnel. It should not be given or shown to any other individuals or groups without express authorization. It may not be reproduced in whole or in part without permission in writing from Lincoln Laboratory.

The research reported in this document was supported jointly by the Department of the Army, the Department of the Navy, and the Department of the Air Force under Air Force Contract No. AF 19(122)-468.

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, (Title 18 U. S. C. Sections 793 and 794). Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 1 of 58

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

SUBJECT: BIWEEKLY REPORT FOR 11 FEBRUARY 1955

To: Jay W. Forrester

From: Division 6 Staff

Approved: John B. Bennett

John B. Bennett

CONTENTS

Section I - System Test & Planning	5
Section II - AN/FSQ-7	19
Section III - Advance Development	43
Section IV - Central Services	54

INTRODUCTION

Division 6 Group Transfers

(J. W. Forrester) (UNCLASSIFIED)

The SAGE System load on all Division 6 Groups is very heavy at the present time. The nature of the work in several areas is changing, and some reorganizations are taking place in all Groups. If any staff member especially desires to transfer to a different Group or area of activity, he may feel free to discuss his future work with his Group Leader and R. R. Everett.

Search for New Staff Members

(J. W. Forrester) (UNCLASSIFIED)

The present tasks of the Lincoln Laboratory, even without very pressing demands to take on additional future responsibilities, exceed the load which our present staff can carry. For Division 6, in particular, the demands of the SAGE System are growing more rapidly than we are turn-

This document is issued for internal distribution and use only by and for Lincoln Laboratory personnel. It should not be given or shown to any other individuals or groups without express authorization. It may not be reproduced in whole or in part without permission in writing from Lincoln Laboratory.

The research reported in this document was supported jointly by the Department of the Army, the Department of the Navy, and the Department of the Air Force under Air Force Contract No. AF 19(122)-458.

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, (Title 18 U.S.C. Sections 793 and 794). Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

Memorandum 6M-3375

Page 2

ing duties over to IBM and Western Electric.

The Laboratory, therefore, is looking for unusually well qualified men to add to the staff. Several Lincoln teams are visiting colleges this month to interview candidates, and the most promising men will be invited to visit the Laboratory. The emphasis is on quality rather than quantity.

Staff Advancement Training

(J. W. Forrester) (UNCLASSIFIED)

As I announced a few weeks ago, we plan to experiment with a non-academic staff training program to fit the Lincoln Laboratory staff. Dr. John B. Goodenough has agreed to make plans for starting this program. Suggestions so far include a series of lectures on computer logic, a seminar in research management, and coaching in public speaking. Please discuss any suggestions you wish to make with Dr. Goodenough.

SAGE System Operational Plan

(J. W. Forrester) (UNCLASSIFIED)

According to the latest schedule, Col. O. T. Halley will present the "Operational Plan" for Air Defense Command Council approval on 10 February 1955. He will come here on 21 February, and we will turn out the final edited form of the text by 7 March for printing.

College Recruiting Program

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

The initial program of college visits is now complete, and return trips for the presentation of technical talks and interviewing are now under way. A statement of procedures and materials available will be issued to all interviewers and other staff members concerned with the program during the week of 14 February. The program is now operating as a joint effort of all Divisions and the Personnel Office.

The colleges visited during this biweekly period are the following:

<u>Representative</u>	<u>College</u>	<u>Date</u>
H. Benington	Carnegie Tech	7 Feb.
	U. of Pittsburgh	7 Feb.
	Penn State	8 Feb.
	Duquesne U.	8 Feb.
	U. of Toledo	9 Feb.
	Wayne U.	9 Feb.

Memorandum 6M-3375

Page 3

<u>Representative</u>	<u>College</u>	<u>Date</u>
H. Benington (Cont'd)	U. of Detroit	10 Feb.
	Michigan State	10 Feb.
	U. of Michigan	11 Feb.
J. Jacobs and D. Bailey	Illinois Tech	31 Jan.
	U. of Notre Dame	31 Jan.
	Marquette U.	1 Feb.
	U. of Wisconsin	1 Feb.
	U. of Minnesota	2 Feb.
	South Dakota State	3 Feb.
J. Ishihara	North Dakota Agricultural	4 Feb.
	Purdue U.	31 Jan.
E. Wolf and F. Irish	Indiana U.	1 Feb.
	U. of Illinois	2 Feb.
	DePaul U.	3 Feb.
	Loyola U.	3 Feb.
	Northwestern U.	3 Feb.
	Roosevelt U.	3 Feb.
	U. of Chicago	4 Feb.
	U. of Dayton	31 Jan.
W. Attridge and S. Manber	Antioch	31 Jan.
	U. of Tennessee	1 Feb.
	Vanderbilt U.	1 Feb.
	U. of Kentucky	3 Feb.
	U. of Cincinnati	4 Feb.
J. Nolan and H. Anderson	U. of Buffalo	3 Feb.
	Rochester U.	3 Feb.
	Syracuse U.	4 Feb.
J. Cahill	Oklahoma A and M	31 Jan.
	U. of Tulsa	1 Feb.
	U. of Oklahoma	2 Feb.
	Southern Methodist	3 Feb.
	Texas A and M	4 Feb.
	Tulane U.	7 Feb.
G. Harris	Louisiana State	8 Feb.
	U. of Virginia	1 Feb.
	U. of Maryland	3 Feb.
J. Cahill	Johns Hopkins U.	3 Feb.
	CCNY	31 Jan.
	Cooper Union	31 Jan.
	NYU, Downtown	31 Jan.
	Rutgers	1 Feb.
J. Cahill	Princeton	1 Feb.
	Fordham	2 Feb.

Memorandum 6M-3375

Page 4

<u>Representative</u>	<u>College</u>	<u>Date</u>
J. Cahill (Cont'd)	St. John's U.	2 Feb.
	Barnard	3 Feb.
	Columbia	3 Feb.
	Stevens Tech	3 Feb.
	Manhattan College	4 Feb.
	Brooklyn Polytech	4 Feb.
	NYU, Uptown	4 Feb.
	Adelphi College	7 Feb.
	Hofstra College	7 Feb.
	Brooklyn College	7 Feb.
	Queens College	8 Feb.
	Iona College	8 Feb.
	New Rochelle	8 Feb.

(W. Ogden, Jr.) (UNCLASSIFIED)

I am currently turning over all MTC responsibilities to W. Hosier and taking on duties in connection with the Lincoln recruiting program. This turnover will be completed during the next 2 weeks.

~~CONFIDENTIAL~~

UNCLASSIFIED

Memorandum 6M-3375

Page 5

I - SYSTEM TEST & PLANNING

1.1 Air Defense1.1.2 Cape Cod System Operation (See also page 14)

(C. A. Zraket) (CONFIDENTIAL)

Most of the live testing of the Cape Cod System during the last 2 weeks has been directed toward the checking of the Mark X System and the training of operational personnel. All of the radar inputs, with the exception of Mark X, have been operating satisfactorily. The Cape Cod computer program, after minor corrections, has exhibited no errors. The final version of the program which includes weapons-assignment display and other sophistications is now being operationally checked. The complete program and its documentation should be completed and checked by the end of the month. Preparations for the three demonstrations to be held on 15, 16, and 17 February have been completed.

Anomalies in the results obtained from Raydist data for radar-orientation tests are now being analyzed. The radar-orientation program has been held up because of this.

D. Israel and I visited A. Herckmans and E. Ennis of BTL at Whippany, N.J., on 11 February to discuss items concerning the test program for the Cape Cod System. In addition to the radar-data noise studies now being made, tracking-accuracy tests will be scheduled for the month of March.

Schedule and planning of items concerning the test program for the Cape Cod System have been completed with D. Israel. These items include the recording program, data-generation program for simulation, tracking-accuracy tests, and data-reduction programs.

The second 2-week familiarization course on the Cape Cod System will start as scheduled on 23 February. All those desiring to attend should contact L. Murray for details. A memo describing the course will be issued the week of 14 February.

(E. Bedrosian) (CONFIDENTIAL)

Features of the present tracking-simulation program are being incorporated into a system-simulation program to be used in the 1954 Cape Cod System.

(A. E. Budd) (CONFIDENTIAL)

I have started revising Memorandum M-3374 and reading the SAGE manuals.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 6

UNCLASSIFIED

(R. Davis, A. Smalley, P. Dolan, A. Hill) (CONFIDENTIAL)

Test Coordination Sub-Section scheduled three accuracy-training tests, four Mark X confirmation (and data analysis) tests, one saturation test, and three Raydist tests.

One accuracy-training test was cancelled because of weather and one because S. Truro Mark X was operationally unsatisfactory for interceptions. In both instances simulated training missions were conducted. The one accuracy-training test conducted was with only fair success because of Mark X unreliability.

One Mark X confirmation test was cancelled because of weather, two because the time was required for work on Mark X equipment. Two Mark X tests were flown. Results of the first were that the equipment was operationally unsatisfactory. Incomplete analysis of the second mission indicates that the system might be operationally usable on a minimal basis and that several aspects must be explored to determine if good operational use can be obtained.

Results of the saturation mission were only fair as some Mark X difficulties were still present.

Of the three Raydist tests, one was cancelled because of weather, one because time was needed to work on the S. Truro equipment. One Raydist test was flown with fair results.

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

Identification section members of the 6520th AC&W Squadron met with us last week to discuss problems and new operation procedures. Capt. Conners informed us there should be some altitude code to inform the Identification Officer an aircraft intends flying above an overcast and, therefore, will not keep to a constant altitude. We agreed with the group that, since a 000 altitude thus far has had no meaning, in the future it should be inserted whenever a flight plan or revision reports a pilot plans to fly "on top."

The Navy early-warning relay station at Beavertail, Rhode Island, reports that because of insufficient manpower it will be unable to provide early-warning reports to the 1954 Cape Cod System. We have written a letter to the Navy Liaison Office requesting that there be an increase in the relay-station personnel sufficient to enable a renewal of their service.

(W. F. Harris) (CONFIDENTIAL)

Work on Group 31's radar-system problems which are being programmed for solution on MTC is progressing satisfactorily. Preliminary results from the first series of computations (which has produced about 350 display-scope photographs to date) produced sufficient information so that I will probably be able to complete the calculations of most immediate importance in the very near future.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 7

(D. Latimer) (CONFIDENTIAL)

I have been checking out previously written indoctrination programs, and I have been gathering information to revise the Memorandum 6M-3078 ("Program and Storage Organization for 1954 Cape Cod Tracking Program").

I have been assigned to write a program to evaluate the CCS tracking program. The specifications for this program have not yet been issued.

(S. Manber) (CONFIDENTIAL)

The new radar-data-input programs have been modified by reducing data-history storage to provide additional storage for other programs. Magnetic-tape recordings of the new tracking and weapons-direction program have been made, and the program has been cycled for about 1 hour.

(A. Mathiasen) (CONFIDENTIAL)

The possibility of determining Raydist lane counts when zeros are not established has been investigated. There seems to be no simple method. If determination is to be made during a straight portion of a flight at constant speed, six equations are required. Since these are not linear, a programmed solution will be attempted.

A memo giving the coordinates of the radars in the Cape Cod System has been written and should be ready for distribution soon.

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

On 31 January and 1 February, together with George Harris of Group 22, we visited the Hastings Instrument Company for conferences on the Raydist system. Topics considered were: (1) an automatic digitalizer for determining lane counts; (2) determination of Raydist lane counts without using zero orbit; and (3) errors introduced by the earth's curvature and its effect on propagation. An inter-office memorandum describing the trip has been written and is available from Mathiasen or Stahl.

Further analysis of T 3719, the Raydist conversion program, has satisfied us that it is working successfully. Some doubt as to its success and effectiveness had arisen because there was not enough agreement among the three separate solutions obtained from three sets of lane counts. We are now convinced that this difficulty can be traced to errors in the lane counts themselves. On this basis we can now proceed to make an attempt at radar orientation.

In this connection, it seems that the advantage of an automatic system of determining lane counts would be the elimination of clerical errors. This is entirely apart from its obvious real-time advantages.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 8

(R. Smith) (CONFIDENTIAL)

The new Cape Cod Equipment Notebook has been completed and will be issued during the next biweekly period. This notebook contains detailed drawings of all stations in the operations center. Insertion-switch digits, indicator-light digits, audible-alarm digits, activate-switch digits, and display-switch matrix pairs are indicated for each station.

(F. Garside) (CONFIDENTIAL)

	<u>hr</u>	<u>min</u>
Total Assigned Time	124	
Extra Assigned Time	2	30
	126	30
	<u>hr</u>	<u>min</u>
Weapons Direction	45	35
Tracking	20	15
Equipment Check	8	10
Analysis	11	55
Raydist	10	45
Systems Operations	7	25
Combined Tracking	15	
Mark X Test		30
Simulation & Analysis	1	
CCS Systems	4	05
TOTAL	124	40
Time Lost to Computer (malfunction)	1	50
GRAND TOTAL	126	30

1.1.3 XD-1 Programming

(W. E. Ball, Jr.) (CONFIDENTIAL)

My weapons-assignment-display program has been incorporated into the 1954 Cape Cod System. The final phases of this assignment, namely program annotation and flow diagrams, will be completed by Monday, 14 February. At that time I will return to the study of the XD-1 System for future programming.

~~CONFIDENTIAL~~
UNCLASSIFIED

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 9

(H. Benington, A. Chandler) (CONFIDENTIAL)

The weapons-direction portion of the Cape Cod System has been reorganized and enlarged to accommodate weapons-assignment display, identification digital displays, and other features not present in the system now in use. The tracking programs have been modified to allow for this change. During the last biweekly period magnetic-tape recordings of the weapons-direction programs were made. A. Chandler and S. Manber have combined these recordings with the modified tracking programs and have made recordings of the entire system on three magnetic tapes. We have operated this new system for short periods and will have it ready for testing by Monday, 14 February. All of the weapons-direction programs are being punched on paper tape from this system by means of a drum-punchout program (see Memorandum 6M-3243). Documentation of these programs should be completed within the next biweekly period.

(L. B. Collins) (CONFIDENTIAL)

I am nearing completion of a utility program for 1954 Cape Cod System designed to display any 200 (octal) storage registers as alpha-numerical instructions or octal constants.

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

A schedule of Monday, Wednesday, and Friday of each week for 3 weeks has been arranged with the 6520th AC&W Squadron whereby we can meet with four airmen to train them in O26 card-punch operation. When they have acquired an average skill, we plan to test them in direct and indirect transmission of air-movements data onto IBM 5081 cards. Thus far three practice sessions have been held.

We are revising the XD-1 manual-inputs-test proposal we had previously written to carry out the above training and testing. This is to meet with Bell Laboratory requirements.

(C. Gaudette, R. Gildea, J. Yienger, S. Knapp) (CONFIDENTIAL)

Two memos, "XD-1 Card Forms and Card Preparation Procedures" and "Operating Procedures for the Card Preparation Equipment and the XD-1 Computer," have been written.

The binary-octal loading program, the binary punching program, and the arctangent subroutine are being coded. The debugging of the trace program is in its final phases.

(C. Grandy, A. Shoolman) (CONFIDENTIAL)

The draft of Memorandum 6M-3330, tentatively entitled "Auxiliary Console and Wing Unit Equipment Specification and Layout for AN/FSQ-7 Direction Centers," is being revised to bring XD-1 and AN/FSQ-7 specifications into as close agreement as possible. A seminar and meeting to discuss display consoles, manual inputs, and warning lights was held at IBM in Foughkeepsie on 4 February 1955. The revised draft of 6M-3330 will reflect matters discussed at this meeting.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 10

UNCLASSIFIED

(F. F. Gucker) (CONFIDENTIAL)

During the past biweekly period the new and more detailed digital display (DD) for interceptors on combat air patrol or return to base was checked out. This is the last function to be added to the DD program in the 1954 Cape Cod System. Documentation should be completed in a few days. My next task will be working on the track-monitoring function for XD-1 under J. Ishihara.

(I. Hazel) (CONFIDENTIAL)

Modifications to the situation-display programs are completely checked out. The annotation to these programs has also been completed. During the next biweekly period, I will revise and complete the detailed flow diagrams for the situation-display programs. The memo and chart for scope-display assignments (si addresses and matrix pairs) have been brought up to date and turned over to Sol Manber.

(E. McEvoy, P. Vance) (CONFIDENTIAL)

The final start-over program has been checked out and documented but not recorded on magnetic tape. The program will be submitted to C. Zraket.

1.1.4 SAGE Planning

(W. S. Attridge, Jr.) (CONFIDENTIAL)

At a meeting in New York on Tuesday, 1 February, I presented to APES and Telephone Company representatives the time requirements for installation of external communication for the first Direction Center. A report of this meeting is being prepared by T. N. Blake of Western Electric.

Remainder of time was spent recruiting.

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

I spent most of this period visiting colleges in Greater New York in connection with the Group 61 recruiting campaign. My impressions were reported in a memo to J. W. Forrester.

The Lincoln proposal for the integration of AA with SAGE is being issued as Lincoln Technical Memorandum No. 63.

(A. G. Favret) (CONFIDENTIAL)

The "Report of Flight Size Assessment Tests" (6M-3171) is being revised for eventual release as a Lincoln Technical Memorandum.

Characteristics of the SAGE System were discussed with representatives of Marquardt Aircraft Co. (developers of ram-jets for F-99 and the Lockheed missile).

~~CONFIDENTIAL~~

UNCLASSIFIED

Memorandum 6M-3375

Page 11

~~CONFIDENTIAL~~
UNCLASSIFIED

(F. E. Heart) (CONFIDENTIAL)

A preliminary study of FSQ-7 interlock timing has been completed and will be available in a few days. This study, initiated with H. Seward, primarily proves that XD-1 programmers will have to exercise extreme caution in using the in-out system. The first estimate for interlock time is less than 10 seconds but not too much less. A small amount of time has been spent in studying more general FSQ-7 timing problems.

Considerable time has been spent preparing for an interviewing trip and assisting in the preparation of material for such trips.

Some time has been spent on countermeasures problems. In particular, the people at Rome have requested a further conference with Lincoln Laboratory regarding a passive detection system; an answer was drafted by Mr. R. Mildram which indicated that Lincoln was willing to talk but would like to see a concrete system operating. Also, with reference to countermeasures, some thought is being given to tracking aircraft when the data source produces only azimuth information instead of azimuth and range information.

In preparation for further discussions with Rand Corporation regarding simulation, requests have been made to IBM for information regarding interchangeability of magnetic tapes from IBM 701 through 705 type calculators and the FSQ-7 and FSQ-8 machines. Hopefully, magnetic tapes could be recorded by Rand Corporation and read by Direction Center FSQ-7's.

With the aid of A. Vanderburgh, some time has been spent assisting the Photographic Laboratory in planning a proposed short movie on the subject of "how a computer works."

On 26 January a group of persons from the University of Pennsylvania visited the Laboratory to discuss weapon-system communications. They are attached to a group called "Wescom" and are interested in fairly long-range general thinking.

On 28 January a 1-day trip was made to the Operations Research Office at Johns Hopkins to look at the preliminary draft of a report. The purpose of this trip was to check on the accuracy of sections which referred to the SAGE System.

A former member of Group 61, Milton Brand, is participating in a panel discussion on the subject of "Requirements and Applications of Computers in Business," Thursday, 24 February, MIT Room 6-120, 7:30 p.m.

~~CONFIDENTIAL~~
UNCLASSIFIED

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 12

(W. Lone) (CONFIDENTIAL)

I have resumed working on the description of the Combat Center operations. A report on the operation of the Air Surveillance Section of the Combat Center is near completion.

I have been attending the Group 62, 64 SAGE familiarization program to assist in the operational discussions where required.

(H. Peterson) (CONFIDENTIAL)

I spent the biweekly period working on AN/FSQ-7 display, endeavoring to find the minimum displays needed at each station and what other displays would be useful.

(W. Z. Lemnios) (CONFIDENTIAL)

The weapons-assignment program has been checked out. The flow diagram of the intercept-calculations and weapons-assignment programs is being copied by M. Cronin. It will eventually be put on Ozalid and distributed.

I attended a meeting at which inaccuracies in Raydist data were discussed. Methods of theoretically and experimentally determining the inaccuracies were outlined. It is hoped that these results will be made available in the near future. Once these Raydist errors are known, the measurement of tracking accuracy in the 1954 Cape Cod System by means of Raydist data can begin.

A conference was held with F. Heart, W. Attridge, C. Gaudette, C. Grandy, and J. Ishihara, at which the effect of additional external memory upon the operating time of the SAGE System was discussed. A report was written by the people attending this conference.

(J. Levenson) (CONFIDENTIAL)

Work on initiation studies has been postponed for the present so that more urgent work on test methods and instrumentation can be done. This latter work involves a revision of the specifications for the simulated-data-generation program and a review of the recording-program specifications for the 1954 Cape Cod System. When this is completed, data-reduction programs will be formulated.

(E. W. Wolf) (CONFIDENTIAL)

The representation of the monitor-assignment program by a 24 x 24 matrix has been completed.

UNCLASSIFIED
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 13

1.1.7 Analysis and Simulation

Charactron Display

(H. D. Houser) (CONFIDENTIAL)

A program has been written for MTC to read in punched IBM cards. This program will:

- a. Convert every card to 64 column registers;
- b. Decide whether it is a master card or a detail card;
- c. Transfer selected columns of the detail cards to storage.

Parts of this program have been checked out.

Also, a display program is being written which will make use of the selection switches of the XD-1 console now being connected to MTC.

Manned-Interceptor Simulation

(B. Smulowicz) (CONFIDENTIAL)

A new evaluation program for the Manned-Interceptor Simulation has been written and is now being checked out. This program will accept more complicated contours for the vectoring limits. It is planned to transcribe the limits manually onto IBM cards and to use H. Houser's program to feed them into the computer storage for further processing.

Numerical Evaluation of Markov Processes

(C. Friedman) (CONFIDENTIAL)

The program to compute first-order Markov processes is being checked out.

Blip-Scan-Data Analysis

(R. W. Sittler) (CONFIDENTIAL)

Samples of the blip-scan data taken by Group 22 are being surveyed to determine the statistical tests appropriate for checking the adequacy of various blip-scan models.

Vectoring Limits

(W. I. Wells) (CONFIDENTIAL)

A format has been worked out which will allow various vectoring limits to be punched on Flexo tape. The tapes then will be stored as a library of vectoring limits for use with the Manned-Interceptor Simulation Program.

~~CONFIDENTIAL~~

UNCLASSIFIED

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 14

UNCLASSIFIED

1.1.2 Cape Cod System Operation (Continued)

(O. T. Conant) (CONFIDENTIAL)

The major portion of my time during the past biweekly period has been spent on documentation of my Cape Cod programs. I have completed and turned over to Benington and Chandler annotated program forms for the following programs in the master makeup and display group: conditional-switch and height-switch interpretation; identification-switch interpretation; and track-cycle and anti-aircraft-switch interpretation. The flow diagram of the identification-switch program has been completed, primarily through the efforts of Betty Bedrosian and Maureen Cronin. I will complete the flow diagrams of the two other above-mentioned programs by 18 February.

Up to now, only a small part of my time has been spent on XD-1. Following completion of the above work, XD-1 planning and programming will consume all of my efforts.

~~CONFIDENTIAL~~

UNCLASSIFIED

1.2 Whirlwind I1.2.1 Cape Cod System Engineering

(E. S. Rich) (UNCLASSIFIED)

Problems still remain in obtaining satisfactory data from the Mark X radar. During the past 2 weeks, Division 2 has completed installation of 11-bit azimuth-word equipment, and evaluation tests were run with the Cape Cod System. The results of these tests indicated that our present difficulty may be corrected by a logical-design change in the equipment at the radar site. No attempt will be made to make such a change until after the demonstrations the week of 21 February.

1.2.2 WWI System OperationRecords of Operation

(M. F. Currier, E. H. Jacobs) (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 28 January - 10 February 1955:

Number of assigned hours	203
Usable percentage of assigned time	99
Usable percentage of assigned time since March 1951	89
Usable percentage of assigned time since September 1953	94
Number of transient errors	0
Number of steady-state errors	3
Number of intermittent errors	3

Analysis of WWI Failures

(A. R. Curtiss) (UNCLASSIFIED)

The following is a breakdown of interrupting and potentially interrupting failures occurring in the WWI computer system for the biweekly period, 28 January to 10 February 1955, inclusive.

Total Number of Failures	18
Total Number of No-Lost-Time Failures	1
Total Number of Lost-Time Failures	17
Total Lost Time in Hours	5 1/2
Total Operating Time in Hours	291 1/2

Memorandum GM-3375

Page 16

Class of Failure	Essential Maintenance		Chargeable to System			
			Explainable		Unexplainable	
	No.	Min. Lost	No.	Min. Lost	No.	Min. Lost
Video Cables and Jacks; Wiring Errors			1	10		
Passive Electrical Components			1	0		
Alarms			4	27	6	34
Design Weakness			1	170		
Miscellaneous	1	10	2	30	2	37
Number of Lost-Time Incidents	1	10	8	237	8	71
Number of No Lost Time Incidents			1			

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

The estimated computer dependability for 205 hours of assigned applications time was 98.6%. Approximately two-thirds of the computer down time resulted when oscillations developed in the amplifier section of the voltage regulator for the -450-v supply. A newly designed amplifier has been installed since that interrupting incident. It is believed that four of the nine reported transient errors were caused by the replaced amplifier.

The marginal-checking system was revised to permit efficient programmed marginal checking of terminal equipment. Prior to the change the maximum duration of a sinusoidal excursion was 6 seconds. It is now possible to have the program select a voltage-variation line and retain a maximum positive or negative excursion for any desired length of time.

Power Supplies

(E. W. Pughe, Jr.) (UNCLASSIFIED)

A new amplifier was installed in the -450-v power supply. The amplifier has low gain and low frequency response and seems to be working very well.

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 17

UNCLASSIFIED

The difficulties anticipated in using the new filament alternator drive motor to regulate the laboratory a-c have been eliminated by deciding not to use the drive motor to regulate the laboratory a-c.

1.2.3 Terminal Equipment

(C. S. Lin, L. D. Healy) (UNCLASSIFIED)

All four buffer-storage groups of the buffer drum are operating with a gate-writer status system.

Ampex Recorders

(A. V. Shortell, Jr.) (CONFIDENTIAL)

It is planned to add another stage of amplification and limiting to the present playback amplifiers. This should reduce the dropout problem and increase the number of usable channels. A breadboard incorporating this stage and a cathode follower are being constructed.

The ten reels of mylar-backed tape received from the Radio Shack on 26 January have been returned to the Minnesota Mining and Mfg. Company. The tape was improperly wound on our nonstandard size reels by them and will be replaced. The best estimate for delivery of new tape is 1 month to 6 weeks.

Fairchild Camera for Mapping Monitor

(A. V. Shortell, Jr.) (CONFIDENTIAL)

The experimental mount should be received during the week of 14 February. Demonstrations during that week will prevent installation and adjustment until the following week.

Data Inputs

(A. V. Shortell, Jr.) (CONFIDENTIAL)

Telephone Circuits. Conversion of all data circuits, with the exception of the Mark X phone line, has been completed. This line will be converted on 12 February. Results of the changeover have looked very good.

Since the completion of the changeover we have been measuring relative amplitudes to obtain some data on the day-to-day variations with the new circuits.

~~CONFIDENTIAL~~
UNCLASSIFIED

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 18

UNCLASSIFIED

An attempt is being made to bring all telephone-circuit records for the Cape Cod System up to date.

CRT Filter Sweep Circuit. A breadboard which incorporates some IBM modifications has been constructed. When this circuit has been debugged, these modifications will be made on all CRT filter sweep circuits to prevent further deterioration of 2D21's.

Output Coder

(L. H. Norcott) (UNCLASSIFIED)

Initial tests of the test-message generator with the output coder have revealed shortcomings in the test-message selector switch. We are now trying to improve the operation of this selector switch. (The output coder can still be used with the computer, however.)

Maintenance Programming

(J. N. Ackley) (UNCLASSIFIED)

D. A. Morrison and I have written and checked out the control program for the Room 156 consolidated test program.

I have written eight of the nine test programs that will go into this consolidated program. Four of the eight programs have been checked out and are now in regular use. These four are:

The Buffer Drum Reference Record Check
The Buffer Drum Control Check
The Auxiliary Drum Control Check
The Auxiliary Drum WBS Check.

(T. Sandy) (UNCLASSIFIED)

The audible-alarm switching panel has been constructed and tested.

A prototype of the audible-alarm oscillator panel has been constructed and is ready to be tested.

One of the very noisy tubes from one of the 5-inch DuMont scopes is being tested for short-time variation in transconductance and interface.

UNCLASSIFIED
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 19

UNCLASSIFIED
SECTION II - AN/FSQ-72.1 System LiaisonProduction Coordination Office

(A. P. Kromer) (UNCLASSIFIED)

Processing of Technical Information Release documents covering various aspects of the AN/FSQ-7 and SAGE System, preparation of equipment exhibits for AFCRC, and work on equipment layout and lighting problems continues as noted below.

The PCO will provide a coordination and follow-up service for both the XD-1 (H. Anderson) and duplex (K. McVicar) planning groups. Preparation of schedule charts, engineering investigation, and reporting of status of work should serve to indicate areas where special attention seems necessary to maintain the planned program satisfactorily. To facilitate and make this work most effective, the staff should keep the PCO fully advised of their work by forwarding copies of correspondence and other documents which are pertinent to either XD-1 or SAGE System.

Monthly ADES Status Meeting - SAGE System

(A. P. Kromer) (CONFIDENTIAL)

The regular status meeting was held last week. Reports by representatives of the various organizations indicated that work is progressing satisfactorily, and it appears that the presently planned schedule will be met for manufacture of equipment, construction of buildings, installation, and start of operation in the first Subsector.

Highlights reported were:

1. Ground has been broken at Maguire Air Force Base, Fort Dix, N.J., site of first Direction Center building.
2. IBM has made initial occupancy of the new Kingston Plant.
3. Authorization will be given IBM immediately for engineering work required for additional auxiliary memory drums, but final Air Force authorization for procurement of the equipment will be deferred until later this month when estimates of cost and effect on schedule can be furnished.
4. Initial group of XD-1 equipment has been delivered to Building F and is operating satisfactorily.
5. The Engineering - Installation Committee presented a schedule showing how the first SAGE Subsector could have all equipment installed

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 20

and tested by the desired date. The study shows that a very high degree of coordination of all aspects of the work will be required.

Technical Information Releases

(P. Bragar, F. F. Manning,
E. D. Lundberg, J. J. Carson) (UNCLASSIFIED)

The following material has been released as engineering data for AN/FSQ-7 & SAGE System.

<u>TIR</u>	<u>M-Note</u>	<u>Subject</u>
1-56	6M-3267-2	Recommended Quantities of Input and Output Equipment for the First and Second AN/FSQ-7
1-57	6M-3291	Drum System, AN/FSQ-7
	6M-3292	Central Computer System, AN/FSQ-7
	6M-3293	Specifications for Display System, AN/FSQ-7
	6M-3297	Specifications for the Power Conversion and Distribution System, AN/FSQ-7
	6M-3298	Specifications for the Manual Input System for the AN/FSQ-7
	6M-3299	Specifications for the Output System for the AN/FSQ-7
	6M-3300	Specifications for the Maintenance Equipment of AN/FSQ-7
	6M-3301	Specifications for the Automatic Input Elements, AN/FSQ-7
	6M-3309	Specifications for the Warning Light System, AN/FSQ-7

Exhibit AFCRC-55-18

(P. J. Gray) (UNCLASSIFIED)

I am concentrating on Exhibit 55-18 for the AN/FSQ-8 to insure its release by 1 March. It is expected that this document will be basically the same as Exhibit AFCRC-17 except for the deletion of radar-input equipment.

Memorandum 6M-3375

Page 21

~~CONFIDENTIAL~~
UNCLASSIFIEDAmendment 1 - Exhibit AFCRC-1A

(P. J. Gray) (UNCLASSIFIED)

This amendment adds the necessary equipment for the XD-1 command post. It is planned to release this to AFCRC by 21 February.

2.2 XD-1, XD-22.2.1 SystemsSAGE Experimental Subsector Planning Committee(H. E. Anderson, I Aronson,
J. H. Newitt, H. J. Platt) (CONFIDENTIAL)

A "broad brush" schedule of XD-1 equipment flow has been issued for comment. All presently available information is being collected on remote inputs to XD-1 (gap-filler radars, long-range radars, etc.). Manpower and space requirements for operation of the Experimental Subsector are also being gathered.

Several commercially available devices for displaying the status information have been demonstrated by salesmen. A choice will have to be made soon, and it is hoped that this information will be partially available within a month.

Changes to the Experimental Subsector

(H. J. Platt) (UNCLASSIFIED)

A compilation is being made of all proposed changes, agreed upon or not, to be made to the equipment in the Experimental Subsector. A letter has been sent to those people who are responsible for large areas of equipment requesting that they list the changes they know of and present them to me. Please let me know if there are any contemplated changes which have not started through the release and concurrence process.

General

(J. Giordano) (UNCLASSIFIED)

Pertinent Systems Office activities during the period have included the following:

1. "Proposal for Drum MCD Specifications for XD-1 and XD-2," 11 January 1955, by N. H. Decker has received LM-SO concurrence.

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 22

~~CONFIDENTIAL~~
UNCLASSIFIED

2. The Systems Office has in a notebook the XD-1 daily reports of operations and testing activities for general reference.

3. A study is being made of the format and mechanics of a system for evaluation of changes in production AN/FSQ-7 machines.

Compatibility of LRI with Various Inputs

(A. D. Hughes, J. P. May, A. M. Werlin) (CONFIDENTIAL)

The changes proposed in 6M-3333 will affect the LRI element, the output element, and the drum element. The changes reflected in the drum element received concurrence. The procedure for concurrence for the output element and the LRI element has been instituted.

Lexington-Poughkeepsie Data Circuit for GFI Tests

(A. D. Hughes, J. P. May, A. M. Werlin) (CONFIDENTIAL)

The data circuit was placed in operation on 2 February 1955. IHM, Div. 6, and Div. 2 personnel have agreed on the type of tests, means of record keeping, and the nature of liaison to utilize the circuit efficiently.

Monitor for LRI

(A. D. Hughes, J. P. May, A. M. Werlin) (CONFIDENTIAL)

At a meeting with J. A. O'Brien, E. S. Rich, J. McCusker, and J. F. Jacobs, a program for implementation of an LRI monitor was discussed. It was decided that J. McCusker and E. S. Rich would continue study of the monitor. Also, it was agreed that monitor equipment for both XD-1 and WWI would be duplicated where possible.

Telephone Communications

(F. E. Irish, H. J. Kirshner) (UNCLASSIFIED)

Specifications for data-circuit patching facilities (6M-3000, Supplement 6) have been written by Aronson and have been distributed for comment.

Specifications for ground/air radio switching equipment have been written in draft form by Irish; however, publication of this material is being delayed pending the outcome of discussions to be held the week of 14 February with ADC and ADES.

~~CONFIDENTIAL~~
UNCLASSIFIED

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 23

UNCLASSIFIED

External-circuit requirements were discussed with representatives of NET&T and Group 22 in order that a consolidated list of all circuits going in and out of Building F may be issued (6M-3275).

A liaison committee consisting of a representative of the Systems Office, Group 61, Group 22, NET&T Co., AFCRC, and the ADC Liaison Office (or EADF) will be required to go to each Air Force site to which XD-1 connects. This committee will determine what new or existing telephone facilities are to be used and who is to furnish the facilities.

Auxiliary Memory

(R. P. Mayer, N. T. Jones) (UNCLASSIFIED)

The summary of the data collected by the Auxiliary Memory Study Group has been written up in Memoranda 6M-3349 and 6M-3350. These will be published and distributed as soon as approval is received from the IBM people quoted in the memoranda. This approval is expected by 14 February.

2.2.2 Installation

XD-1 Installation Information - Report 28 (Extract)

(H. Mercer, P. Morrill, H. Wainwright) (CONFIDENTIAL)

I. Building Construction

On 7 February the following rooms were turned over to us for "beneficial occupancy":

Training and Battle Simulation
Weapons Direction
Identification
Manual Data Input
Switchboard (Message Center)
Communications (Teletype)

As previously reported, we expect the remaining rooms by 14 February and the balance of the building by 21 February. These ready dates do not, in all cases, include completion of lighting and sprinkler installations.

III. Power Equipment

With the arrival and installation of the PCD amplidyne-control section, the installation phase of this job was completed except for performance testing and resulting modifications being accomplished by Lincoln and IBM personnel.

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 24

IV. Equipment Cooling

Progress is quite satisfactory. We are pushing to get the chilled-water and dehumidification features of the system in operation.

V. Cabling and Method of Distribution

B. Cabling

Job II (PCD to MCD's) - All cables have been pulled into place. PCD termination connections are being made only when power is off, generally resulting in overtime. These connections will be completed on 12 February.

Job III - Power cabling to end modules for frames on first floor east will be prefabricated, using dummy modules, starting 14 February.

Job IIIA - Console power cabling. Distribution boxes will be delivered to the contractor for installation within a week. The contractor will start pulling cables once these boxes are installed.

Job IV - First-floor signal cabling. All that remains for completion of this job is the cutting of holes in the expanded metal over the frames on the east side of the building. Frame-to-frame signal cables may then be installed as they are delivered.

VI. Equipment Layout

Projection room. Preliminary drawings have been received from Francis Associates. We will await Group 61's approval of equipment allocation and layout before checking the FA prints against building drawings.

VII. Lighting

At the moment, the greatest deterrent to early completion seems to be poor delivery of the louvered ceiling and fittings. The work will probably be completed by 15 March.

IX. General

With the completion of the rooms on the second floor, some of our immediate space requirements would seem to be eased. However, despite the time lag between room readiness and equipment delivery, one should keep in mind the console cabling which must be performed in this area. This does not preclude use of the rooms as long as such use is compatible with the installation program.

Memorandum 6M-3375

Page 25

Telephone Installation

(C. J. Carter) (UNCLASSIFIED)

Some dial switching equipment and relay racks have been installed. Work has also begun on installing the two-position 607A switchboard. Detailed specifications for cabling the consoles have been drawn up and given to the Telephone Company.

Equipment Arrangement and Lighting

(E. L. Smiley, W. H. Ayer) (UNCLASSIFIED)

A tentative layout of the computer floor in the D. C. buildings which includes the additional auxiliary-drum memory has been made. This layout will be distributed for concurrence during the next biweekly period.

Additional hex louvres (eggcrate) to provide 60° instead of 45° cutoff have been installed in the light-testing room (B-034). Blue filters (AAF S/N #7000-770572, upper limit cutoff at 5400 angstroms) have been installed over the bulbs in the room, and Group 38 is conducting tests to determine the readability of the Charactron tube under these new conditions. Future operations contemplate using a lower blue cutoff (in the range of 4800 to 5200 angstroms) filter and increasing the number of lamps in the room to counteract the transmission loss of the deeper blue filter. We are also planning to use another type of indirect fixture to eliminate shadows caused by the fixtures.

2.2.3 Testing

(J. A. O'Brien) (UNCLASSIFIED)

The XD-1 installation is still a little ahead of schedule in that the second bank of memory has been delivered and installed. There have been a few memory troubles, and the second bank is not completely integrated into the system as yet.

The printer and punch have not thus far operated completely satisfactorily, and a good part of the time is being put on them.

The marginal-checking system is now operating in the manual mode, and one shift is now being devoted to marginal-checking studies. Not all circuit margins have been measured, but first indications are that they are not quite as good as they were in Poughkeepsie. There have been changes since then (new cables, new tubes) so the difference doesn't mean much yet.

A certain variety of tubes in the machine, the 1782's, were poorly based. These tubes have now all been replaced by new 2420's. Approximately 1900 tubes were replaced.

Memorandum 6M-3375

Page 26

(J. Crane) (UNCLASSIFIED)

A study of XD-1 logbook data and daily operations reports is being made. The purpose of the investigation is to determine how useful these records will be for computer evaluation tests as described in 6M-3326, "Central Computer Evaluation."

(S. L. Thompson) (UNCLASSIFIED)

The drum system was studied during the past 2 weeks. Procedures for evaluating the drum system will be prepared.

(W. Canty) (UNCLASSIFIED)

Memorandum 6M-3351, "Time Schedule for XD-1 Machine Specifications and Evaluation Reports," has been written and published.

Power System

(A. Chopourian) (UNCLASSIFIED)

A ground fault on the 125-v d-c system has been eliminated. The negative side of the battery voltage found its way to an a-c ground; the a-c ground was removed by the use of an isolating transformer.

Until recently the d-c power supplies were not cycling down because of a premature opening of their input contactors. The fault was found to be caused by switchgear controls removing a signal before the proper time. This is now corrected.

Considerable effort is being spent in reducing the Westinghouse switchgear-control schematics to such a form that those who are not closely associated with power switchgear will require a minimum amount of background to understand the system. A drawing of this type which does not presuppose familiarity with switchgear equipment will assist in trouble shooting and thus reduce down time.

D-C Supplies

(S. Coffin, J. Clarke) (UNCLASSIFIED)

We have completed testing on all the d-c voltage units except the -48-v and +600-v on the A-bank. These tests have included peak-to-peak ripple, the slow load regulation, and dynamic regulation for steps of load. The -48-v unit requires a choke in the output to reduce its ripple, and the +600-v unit has to be checked by the G. E. people as it oscillates at a light load of 15 amps and the ripple becomes excessive. In testing the low-voltage units we have found that we need a different load bank to get proper load. At present we are using the G. E. 16-kw load bank and are designing a new load bank for our own use.

Memorandum 6M-3375

Page 27

2.3 Production System

(S. H. Dodd) (UNCLASSIFIED)

At ADES request, Lincoln is cooperating in the development of a proposal which will define the extent of ADES assistance to Lincoln Laboratory in preparing system test specifications for the production system. An initial product of this joint ADES-Lincoln effort is the rough draft of a document entitled "SAGE System Test Planning." The rough draft is being circulated for comments before it is issued as an M-note.

(R. C. Jeffrey, K. E. McVicar, T. R. Parkins, C. W. Watt)(UNCLASSIFIED)

A SAGE System goal outline is being assembled. We will incorporate this information in a series of time schedules to be used for coordinating the development of the first few Subsectors.

Distribution of 6M-3347, "Responsibilities and Organization of the SAGE Technical Liaison Section," is being held up pending completion of discussions with interested parties concerning the proper scope of activities of the Committee. It is expected that the note will be distributed during the week of 14 February.

(R. H. Gould) (UNCLASSIFIED)

Discussions with IBM have led to tentative agreement on the "mimic board" that will indicate in the maintenance-console area the status of the power generation and distribution system and the air-conditioning system. Detailed specifications are being written.

At a meeting at Poughkeepsie on 15 February detailed specifications, as far as possible, of the test equipment needed for maintenance of a duplex Central will be provided for review by the Air Force. Both commercial and special equipment will be covered.

The telephone equipment requested for maintenance of a duplex Central was reviewed at a meeting with IBM and ADES to check the justification of the quantities.

(R. H. Gould, H. L. Ziegler) (UNCLASSIFIED)

Present AN/FSQ-7 maintenance studies are aimed at establishing a program for development of techniques and equipment for maintenance of the duplex Centrals.

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 28

Committee on Maintenance Programming

(P. R. Bagley, B. G. Farley, L. R. Jeffery) (CONFIDENTIAL)

We announced in the previous Biweekly that we were about to publish the results of a study as 6M-3341, "Maintenance Requirements for FSQ-7 Based on Predicted Computer Performance." After circulating and discussing the first draft, however, we became aware that the memo was inadequate and incomplete. With the assistance of E. S. Rich, we are writing a revised draft.

As the Systems Office Committee on Maintenance Programming (SOCOMP) we have planned six projects for 1955 and early 1956:

1. Reviewing the requirements for FSQ-7 memory;
2. Determining the characteristics of the air-defense program to be included in maintenance programs;
3. Determining the value of a reliability check to be interleaved with the air-defense program;
4. Exploring the capabilities of diagnostic programs and procedures;
5. Studying the functions of the standby computer;
6. Arranging for suitable data-link maintenance programs.

In addition, 25% of our time will be devoted to unspecified but necessary Systems Office activities ("firefighting"). These plans are reported in more detail in 6M-3366, "Planned Activities of Systems Office Committee on Maintenance Programming."

Trip to General Mills

(C. W. Watt, Jr.) (UNCLASSIFIED)

A visit was paid on 9 February to General Mills, Inc., in Minneapolis, Minnesota, by C. W. Watt, J. N. Harris of Division 2, and H. C. Nichols of Division 7. The purpose of the visit was to inspect the automatic etched-card assembly machine which they are building for IBM. The machine was demonstrated and thoroughly discussed with the engineers who developed it. It was our opinion that the machine was a well designed piece of equipment and that it would probably be a successful manufacturing tool. A full description of the machine is contained in Memorandum 6M-3373 which will soon be issued.

UNCLASSIFIED
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 29

Automatic Inputs

(A. D. Hughes, J. P. May, A. M. Werlin) (CONFIDENTIAL)

A memorandum, 6M-3301, was published setting forth Lincoln's position regarding the automatic-input-elements specifications and changes.

A meeting to discuss problems of concurrence on automatic-input specifications was held with C. E. Walston, W. S. Squire, and R. Lowrie of IBM.

Long-Range-Radar Inputs (LRI)

(A. D. Hughes, J. P. May, A. M. Werlin) (CONFIDENTIAL)

A memorandum which is intended to justify the LRI specifications (6M-3276) is being written.

A supplement to the LRI specifications (6M-3276) is being written to correct, delete, or add to the specifications.

Output System

(M. D. Feldstein, S. B. Ginsburg, H. K. Rising) (UNCLASSIFIED)

"Specifications for the Output System for the AN/FSQ-7," 6M-3299, dated 28 January 1955, gives the current status of specifications for the output system.

A new specification for the duplex AN/FSQ-7 is being written with H. J. White of IBM. This document is a revision of the XD-1 specification together with all its amendments. The methods for duplex switching and provisions for possible remote testing have yet to be fully resolved.

Power Generation

(J. J. Gano) (UNCLASSIFIED)

A draft of the Jackson and Moreland report on the transient analysis of the power system for the fourth Direction Center was received. The report shows the effects on voltage and speed at the diesel-generator bus and at the output of the computer motor-generator sets for three-phase or phase-to-ground faults with low resistance. Calculations were made using standard M-G sets of two manufacturers for speeds of 900, 1200, and 1800 rpm.

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 30

I have asked them to extend their study to cover, at least qualitatively, the first two Direction Centers and the first Combat Center where our generating plant is different. In addition, they have been asked to estimate the magnitude and probability of the various faults and group them in banks according to magnitude.

Power Distribution

(G. F. Sandy) (UNCLASSIFIED)

The production AN/FSQ-7's will have a mimic (or graphic) panel mounted on a wall in the maintenance area. This panel will indicate the condition of the power system from the diesel generators and utility connection in the powerhouse to and including the power control and distribution (PCD) frames in the Direction Center building. The proposal for the details of this panel is being prepared by Warren Hunt of IBM and should be ready for concurrence 17 February 1955.

D33-1, the revision to D33, "Marginal Checking System" for the production machine, has been agreed upon with IBM and will be formally concurred upon in the near future.

2.4 Vacuum-Tube Circuits

Experimental 10-Mc High-Speed Flip-Flop

(B. Barrett) (UNCLASSIFIED)

An experimental 10-mc high-speed flip-flop has been breadboarded and is being debugged.

Pulse Converter

(W. F. Santelmann, Jr.) (UNCLASSIFIED)

The problem of designing a pulse generator to convert standard, random, 0.1- μ sec pulses to pulses of 0.05- μ sec to 0.2- μ sec width and up to a positive or negative 10-v amplitude has been undertaken.

Three types of fast pulse-generating circuits are being investigated in breadboard form to determine their relative usefulness for solving this problem. The first is a delay-line-controlled blocking oscillator; the second is a delay-line-controlled monostable (one-shot) multivibrator; the third is a delay-line pulse generator using no regeneration.

Memorandum 6M-3375

Page 31

Flip-Flop, Model A

(N. J. Ockene) (UNCLASSIFIED)

The use of silicon diodes in the cathode circuit of the flip-flop has proved promising in improving the triggering characteristic when simulated 40% "down" Z2177 tubes are employed. In addition, the operating margin for higher trigger levels has been substantially improved in several of the circuit configurations.

The present problem is the improvement of the circuit delay without a deterioration of any of the above-mentioned improvements.

Phone-Line Demodulator and Modulator

(E. B. Glover) (UNCLASSIFIED)

All data on both the demodulator and modulator were taken to Fred Ordeman of IBM last week so that he could start writing the MRD report. I am keeping in close touch with him so that I can furnish any additional information he may need.

In the meantime, I have started writing the M-notes for both units. These notes should be completed within the next biweekly period.

Sensing Amplifiers for Memory Planes

(R. C. Zopatti) (UNCLASSIFIED)

The Mod. IV MTC sense amplifier with the newly developed input transformer was tested in MTC. The unit had sufficient gain, 40 volts output for 0.1-v signal input. The over-all delay was 0.3 microsecond more than that of the Mod. II MTC sense amplifier. The Mod. IV MTC sense amplifier with the original input transformer had 0.6 microsecond more delay than the Mod. II MTC sense amplifier.

The prototype of a new sense amplifier (transformer input to a triode) was also tested in MTC. Its over-all delay was only 0.15 microsecond more than that of the Mod. II MTC sense amplifier; however, the maximum gain was only half that of the Mod. II MTC sense amplifier.

Magnetic-Core Matrix Switch Driver (256 x 256 Memory)

(D. Shansky) (UNCLASSIFIED)

This driver is presently being redesigned to increase its margins of operation.

Memorandum 6M-3375

Page 32

High-Speed Memory Selection-Plane Driver

(D. Shansky) (UNCLASSIFIED)

A driver is presently being designed which will produce current pulses with an amplitude of 3 amperes, rise and fall times of 0.05 microsecond, and a pulse duration (flat-top) of 0.5 microsecond. The duty cycle of the driver may be as high as 50%. The load which the driver will drive is inductive and will present a back voltage of 40-50 volts.

Memorandum GM-3375

Page 33

2.5 Display

Display Consoles

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

Debugging of the prototype display console for XD-1 is in process. At present, the circuitry necessary to select and position characters with electrostatic and magnetic deflection systems has been checked. The electromagnetic deflection amplifiers have a 60-cycle ripple, which deflects the beam one character width. The source of this ripple was traced to the -300-v supply in MTC. In the coming period the remainder of the circuitry associated with the situation display will be checked. A Typotron will be installed in the display console and the associated circuitry checked. When the console debugging is completed the preprototype display unit will be hooked in parallel. This will permit us to have two display consoles in MTC, one available for photography and the other for XD-1 simulation.

(J. Woolf) (UNCLASSIFIED)

In the vector generator one stage of a-c coupling had an incorrect value of coupling capacitor installed during construction. With the proper value installed the prf sensitivity was improved. The prf sensitivity of the vector generator will be minimized by eliminating one stage of a-c coupling.

(R. Fallows) (UNCLASSIFIED)

The major effort of the past 2 weeks has centered on preparation for frame tests. Bob Gerhardt is working with people from Goldman's and Walter's groups at IHM preparing for system test of displays in June. Bob Callahan and Ben Gurley are planning the debugging and frame tests for frame 24 (situation-display generator). Bob Paddock will remain with the display activity through frame testing, and Jim Delmege has been assigned to this work to help in frame testing. Paddock and Delmege will work on frame 25.

Frame debugging started on 7 February when the checking of frame 25 wiring began. Two technicians, Jim Sullivan and Ed Harwood, have been assigned to assist in display-frame work. Arthur Acquaviva has been transferred to Group 62 where he will continue working on display frames.

As a result of our experience to date, we are going to request that frame 24 be delivered with intramodule coax lines not installed. It is felt that this will facilitate wire checking.

The Hazeltine Electronic Corp. has been awarded a subcontract by IHM to work on the duplex design and production of all FSQ-7 display equipment. To date their commitment only covers the study and design

~~CONFIDENTIAL~~

Memorandum 6M-3375

Page 34

UNCLASSIFIED

phases; but it is planned that they will pick up full responsibility for the production of DC-1 equipment. The plans include the delivery of the XD-2 display frames and an early (XD-1) production console to Hazeltine. Several days were spent with the Hazeltine engineering people during the last 2 weeks.

Display Specifications

(R. D. Buzzard) (CONFIDENTIAL)

Memorandum 6M-3293, "Specifications for the Display System AN/FSQ-7," was completed. This document summarizes the display specifications for the duplex central.

I am collecting information for specifications for the projected display and the Command Post DD desk.

Display System Test Planning

(R. H. Gerhardt) (UNCLASSIFIED)

The digital-display-system test has been put into outline form. Each section of the outline will be completed when detailed studies are made. D. Williams of IBM will write the program.

The situation-display (SD) system test is not quite in outline form. This should be accomplished by 17 February.

MTC Connection to the XD-1 Display Frames

(R. H. Gerhardt) (UNCLASSIFIED)

The MTC drum will be used as a signal source for the XD-1 display frames. I have written a memorandum describing the use of the MTC drum. This memo should be issued soon.

I have drawn a block diagram of the equipment which will be required for the display frames. A memo describing this equipment will be written shortly.

Situation-Display Element

(B. M. Gurley, R. J. Callahan) (UNCLASSIFIED)

For the past 2 weeks most of our time has been spent in planning the frame test for frame 24 (situation-display generator element). This planning will probably require our full attention until the middle or end of March, at which time the frame is expected to arrive.

~~CONFIDENTIAL~~

UNCLASSIFIED

Memorandum 6M-3375

Page 35

We have completed a compressed drawing of the situation-display-generator element timing and control section (4.1.8). Anyone who would like a copy of this drawing should contact one of us.

(R. B. Paddock) (UNCLASSIFIED)

The digital-display frame (#25) has been delivered to Bldg. F; continuity-checking on this frame is under way and should be completed in about another week. At that time system-checking of the frame will begin.

A test rack is being built up which consists of test equipment and special panels to substitute for the display-tester console until the console is completed. It is anticipated that this test rack will be sufficient for system-checking both frame 25 and frame 24.

SD Camera and Camera Control for AN/FSQ-7

(L. Sutro) (UNCLASSIFIED)

Specifications for the automatic camera and camera control have been printed in 6M-3296. The block schematic of the system (D-61622) has been greatly revised to provide for a different "Suppress Automatic Index" control than I had planned. The new plan, urged by Ron Mayer, permits the computer, after the automatic index has been suppressed, to command the intensification of any number of displays before the shutter closes and the film advances. To insure proper timing of the system, I have made other minor changes to the logic. The 12 relays in the system have received tentative approval by the IBM components group. I am now laying out the electronic circuits.

Display-Line Drivers

(H. E. Zieman) (UNCLASSIFIED)

Modifications in the line-driver amplifier improved margins on four of the stages. These stages now have margins of +50 volts on the -300-v line. A hysteresis effect in one of the stages must still be removed, and a third marginal-check line on the regulator section must be improved. (Since this checking was proceeding too slowly, it has been temporarily discontinued to complete marginal-checking of two decoder circuits.)

A second line driver has been modified to incorporate the changes made in the first. Both amplifiers behave with sufficient similarity to promise satisfactory performance from production models. The output stages are completely interchangeable without a noticeable effect on the response. The preamplifiers are not interchangeable without some adjustment of the position and mean-level controls.

Marginal data on the decoder circuits is presently being compiled.

Memorandum 6M-3375

Page 36

Status of Drawings and Drawing Releases:

(A. Grennell) (UNCLASSIFIED)

Frame 25 is 100% completed.

	<u>Frame 24</u>
Etched-card drawings released to IBM	100%
Pluggable-unit design released to IBM	100%
Logic drawings completed	100%
Logic drawings released to IBM	100%
Frame drawings completed	100%
Frame drawings released to IBM	100%
Pluggable-unit test specs and test-adaptor designs released to IBM	100%
Status of experimental pluggable-unit construction and type testing:	
Ordered through Production Control	100%
Construction completed	100%
Type test completed	80%

2.6 Vacuum Tubes2.6.1 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

I spent the first few days of this period in San Diego at the request of Ralph Mork of IBM finishing a study of Convair's constructional techniques and processing procedures for the 19-inch Charactron. This information was given to Convair's Quality Control Department to aid them in their in-process control and surveillance of the tube. The Convair Tube Plant started two 19-inch Charactrons a day, 6 days a week during this past fortnight. On 11 February 1955 production was increased to three starts a day; this rate will be held for another month. At that time it will be increased to four starts a day. Convair shipped to IBM at Lexington six tubes that passed all of IBM's specifications.

Memorandum 6M-3375

Page 37

Work in Group 65 on optimizing the P7 screens to get more light output has been reactivated with a high priority to satisfy the requests of the display group. Conferences with the operational groups and psychologists indicate a need for more light from the 19-inch Charactron tube.

No convergence coils or Typotrons have been received from Hughes Aircraft for the life-test program. These coils and tubes were available at the Hughes Plant on 20 December 1954, but the Hughes contract office is having a difficult time pricing their products and processing our purchase order.

The newly formed Hazeltine Display Group spent one half day at Barta Building discussing the display tubes and inspecting the tube-construction and testing facilities.

Saul Twicken and I visited Sylvania at Emporium on 9 February 1955. Their increased production is most satisfactory. IBM was able to bring back more than 2500 of the 2420 tubes. Sylvania is now on schedule with their delivery commitments of the 2420. There is every indication that Sylvania can stay on schedule. Work at Barta has continued on polycasting 2420/7AK7 tubes and making measurements so that Sylvania can eventually reach the objective specifications of the 1782 tube.

2.6.2 Tube Research and Development

(S. Twicken) (UNCLASSIFIED)

Preliminary results of the 2420 polycasting and dimensional-analysis program indicate that the production tolerance on the major diameter of the screen grid is not compatible with the tolerance on the corresponding mica holes. This results in some distortion of the minor diameter of the screen grid and corresponding change in plate current, bearing out the hypothesis made at the initial comparison of manufacturing tolerances and test data. Sylvania has begun to hold tighter tolerances on the screen-grid major and minor dimensions in production.

A meeting held at Emporium shows the recent doubling of production to be in good control. The lot-evaluation program should yield a more complete specification including 500-hour life-test limits by 1 May 1955. Arrangements were made to provide 2420's to other equipment manufacturers subcontracting to Lincoln.

Discussions with RCA in regard to the 5963 interface-impedance problem indicate that the difficulty may have been cleared up late in 1954. We are looking into this as a solution to the present 5963 problems in WWI. It is becoming increasingly apparent that mere control of the percentage of silicon is not a sufficient safeguard against interface-impedance formation.

I attended a meeting of the JETEC Computer Gas Tube Task Force. A spec format having been written, an attempt will now be made to fit the

Memorandum 6M-3375

Page 38

2D21 to it. Sections have been written for the proposed JETEC "Manual of Practice for Computer Tubes" explaining thyratron ratings.

(D. C. Lynch, J. S. Palermo) (UNCLASSIFIED)

The construction of a new series of 19-inch Charactron tubes has been started during the past week. Two of these tubes made to Charactron specifications have been designated for life studies. The remaining tubes will incorporate a modification in the composition of the phosphor. The ZnS component of the P7 phosphor will be replaced with P16 in order to obtain greater screen intensity.

In addition to this program another 19-inch tube has been started to evaluate the gold-band connection between the aluminized screen and A₃.

Improved formulae and techniques have been adopted into the polycasting program of the 7AK7's and 2420's. All necessary apparatus has been obtained and is now in operation.

(T. F. Clough) (UNCLASSIFIED)

During the past period I spent some time with members of the vacuum-tube construction section in the measurement of polycast 7AK7/2420 tube sections and in the interpretation of these data.

I made a trip to Poughkeepsie to discuss with the Project High Tube Group AN/FSQ-7 problems.

Work has been initiated to organize our tube-construction specifications so that specific facts of interest can be more easily located.

(L. B. Martin) (UNCLASSIFIED)

The 16-position Typotron life test is now completed and checked out. The convergence-coil drivers will be modified at Lexington.

Typotron tubes 335 and 366 were retired after 5389.2 and 4825.2 hours, respectively, from the 8-position life test because of open flood-gun cathode leads and will be returned to Hughes for dissection. Two other tubes, retired for the same reason, will be dissected in our laboratory. It is believed that the post mortems will show that it would be desirable to double-up on the flood-gun cathode leads.

Tube 349 was used to check out the 16-position life test. Within 24 hours two collector-to-storage mesh shorts have occurred. When this happens, the storage mesh is pulled up to collector potential, providing the 100-K protective resistor is used, and switches positive. The shorts were cleared by discharging a capacitor, charged to 90 volts, through the short.

Memorandum 6M-3375

Page 39

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

<u>Tube</u>	<u>Total Hours</u>	<u>Condition</u>
265	7185.8	marginal
280	6367.8	satisfactory
389	4765.2	satisfactory
390	4849.0	satisfactory
392	4849.0	satisfactory
394	4066.9	marginal
11601	161.6	satisfactory

(A. Zacharias) (UNCLASSIFIED)

Further tests on P7 yellow were made, but the results are not conclusive. A further optimization procedure for the P7 yellow with P11 (mod. for P7) excitation has been initiated. The results should allow the selection of a phosphorescence characteristic best suited for its use.

Sintered cathodes of the British and Lincoln type have been put in CT-100 tubes and activated. The British type has been activating in accord with expectation, but the Lincoln type has been acting somewhat erratically, giving extremely high currents and developing grid emission and leakage. Further study of both varieties using CT's and CT-100's will continue.

Six sprayed oxide CT's are on life under standard conditions. About 500 hours of aging and 100 hours of high-voltage life have been logged, and operation is satisfactory.

(P. C. Tandy) (UNCLASSIFIED)

The five 19-inch Charactrons on life test, CHT-61, CHT-62-1, CHT-74, CHT-75, and CHT-80, now have operating times ranging from 1182 to 2693 hours. CHT-68-1, CHT-72-2, CHT-73, and Convair 7-1 have been received from C. L. Corderman and will be put on life test as soon as preliminary tests have been completed.

The pulse-matrix current at zero bias of CHT-61, CHT-75, and CHT-80 had dropped about 50 microamperes in the last 450 hours. CHT-62-1 and CHT-74 had no appreciable change.

A leakage check has been made on CHT-68-1, CHT-72-2, and Convair 7-1. The only appreciable leakage noted was on G_1 of CHT-68-1.

Memorandum 6M-3375

Page 40

2.7 Memory Test Computer

(W. A. Hosier) (UNCLASSIFIED)

The XD-1 display system made heavier demands on MTC this period, both from the standpoint of operating time and of staff time for planning and design. The former was occasioned by arrival of the prototype display console from IBM, checking out of which is still going on. The latter demand had its origin in the desire to pipe display data from the MTC drum to Building F to test the display circuits prior to arrival of XD-1 drum equipment.

At a conference on Friday, 4 February, attended by Gerhardt and Fallows of the Display Section and by Hosier, Gates, and McCusker of MTC, it was agreed to provide for reading 32 bits in parallel off either of two fields of the MTC drum, sending these over coax along with timing and index pulses; and for receiving two field-selection pulse lines from the display-frame end. Extra heads (64) on the MTC drum will be used solely for this readout; construction has been started on the necessary read amplifiers, field-switching equipment, and line drivers. The run of coaxial cable (modified RG62 A/U) will be about 700 feet; 3-inch conduit will be installed so that this cable is in place by 1 April. Eighty cables will be run, allowing 40 each way. It is felt that, although display-testing requirements are only for one-way transmission, some application (such as cross-telling) will very likely come up for sending information in parallel from XD-1 to MTC, and it is much simpler to pull all cables at once.

Computer time during this biweekly period was divided approximately as follows:

	<u>Hours</u>	<u>Per Cent</u>
Development	129.4	37.5%
Programming	138.4	40.4%
Scheduled maintenance	58.1	16.8%
Installation	7.5	2.2%
Interrupting failures	<u>10.8</u>	<u>3.1%</u>
	344.2	100.0%

Card Machine

(F. R. Durgin) (UNCLASSIFIED)

The card machine is now operating under the control of the computer, reading and punching 48 words per card. The problem remaining is to prove reliability.

Memorandum 6M-3375

Page 41

Magnetic Drums

(J. McCusker, E. Gates) (UNCLASSIFIED)

Charles King from IBM discussed with us some of the mechanical problems such as dimensional stability of the rotor, the head mounting bars, and the head. Our findings at MTC indicate that the heads need some changes, and a list of these changes is being sent to Mr. King to be included in a comprehensive report on mechanical stability of the drums.

Several diodes in the drum diode switch have failed over the past few weeks, possibly because of vibration.

Technician Training Manual

(A. Vanderburgh, Jr.) (UNCLASSIFIED)

Chapter II of the MTC Technician Training Manual is finished. Proofreading and printing should take a few more days. It is expected that copies will be available in the Document Room Friday, 18 February 1955. Ask for Memorandum 6M-3364.

Chapter II is intended as an over-all view of MTC. The approach is through gradual automatization of the human computing system of Chapter I (6M-3004). Chapter II marks the end of the use of a human analogy. Computer jargon and MTC abbreviations have been introduced and will be used henceforth.

(E. Albanese) (UNCLASSIFIED)

The following is a summary for the period 31 January to 11 February, of defects found in tubes and in components in MTC:

<u>Tube or Component</u>	<u>Defect</u>	<u>Number</u>	<u>Hours Lost</u>
2X2A	Low plate current	1	0.7
2X2A	Gone to air	1	0
5881	Tap short	1	0
5998	Low plate current	1	0
6145	Tap or flicker short	2	0.3
6145	Shorted	1	0
6145	Heater defect	1	0.1
22177	Heater defect	1	0.1

Memorandum 6M-3375

Page 42

<u>Tube or Component</u>	<u>Defect</u>	<u>Number</u>	<u>Hours Lost</u>
Z2177	Tap or flicker short	1	0.1
Crystals type 1N34A	Back resistance too low	1	0
Crystals type 1N38A	Back resistance too low	2	1.0
Toggle Switches	Intermittent	2	0
Toggle Switches	Shorted	2	1.5
Resistors	Open	<u>1</u>	<u>0.2</u>
		18	4.0

SECTION III - ADVANCE DEVELOPMENT

3.1 Magnetic Materials3.1.1 ChemistryProduction of Memory Cores

(J. Sacco) (UNCLASSIFIED)

The difficulties encountered with the Stokes press and the Harper furnace seem to have been overcome, and the pilot-plant production of cores for the 256 x 256 memory bank is now under way. These cores will be of the DCL-2-832 type, switching in about 0.95 microsecond at 820 milliamperes.

Ceramics Lab Power

(R. Jahn) (UNCLASSIFIED)

Stray pickup has been noticed in a Harper furnace thermocouple since the new boost transformer was installed. This pickup causes temperature readings to jump 3° when the furnace is switched on.

We believe this is caused by rectification of the pickup voltage in the thermocouple junctions or by improper grounding. Several methods of eliminating this pickup are being investigated.

Microstructure of Ferrites

(F. S. Maddocks) (UNCLASSIFIED)

A number of DCL test compositions high in manganese content in the magnesium-manganese ferrite system have been reprocessed and fired under carefully controlled conditions. Microstructure data from these firings have produced a more clearly defined boundary between twinned and single-phase regions. It is now possible to define an area in the system within which all compositions are single-phase for all firing conditions examined. This area corresponds quite well with the area of good hysteresis-loop squareness.

X-ray diffraction patterns of these borderline compositions indicate clearly that the refired cores are much better crystallized. A complete analysis of the diffraction patterns is in progress.

Ferrites for Magnetostriction Measurements

(D. L. Brown) (UNCLASSIFIED)

Firing of the nickel-manganese ferrite series, DCL 3-121 to 133, and the nickel-zinc-manganese ferrite series, DCL 3-155 to 165, was

Memorandum 6M-3375

Page 44

continued. Additional compositions prepared, fired, and refired:

DCL 3 - 195 and 197, magnesium-manganese ferrite.

DCL 3 - 195 is a composition which should have zero effective magnetostriction according to data previously taken in this compositional system;

DCL 3 - 196 and 201 to 204, magnesium-zinc-manganese ferrite;

DCL 3 - 198, magnesium -nickel-manganese ferrite.

DCL 3 - 200, lithium ferrite, was prepared. Experimental firings are being made on this composition.

Chemical Analysis

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

Quantitative analyses of the following have been completed:

1. DCL-2-825, a memory-core composition;
2. A sample of General Ceramics 1326B, grade S-1 cores.

Quantitative analyses of DCL-2-825 special, DCL-2-826, DCL-2-827, all of memory-core composition, are in progress.

Cores for First 256 x 256 Memory Plane

(J. Schallerer) (UNCLASSIFIED)

Approximately 69,000 acceptable cores are on hand for the first 256 x 256 memory plane. About 30,000 of these have already been submitted to the Memory Section for plane construction. It is planned to test the assembled arrays in this plane in a manner analogous to that used in the past for the checking of matrices, after the x and y windings have been installed. However, contemplated techniques for future plane assembly will preclude the possibility of testing at this point in the actual assembly of units for the 256 x 256 memories. It is planned, therefore, that cores supplied for this memory will be tested twice and that the individual plane units will not be checked for marginal cores.

Of the cores supplied for the first 256 x 256 plane, approximately 24,000 were double tested. The 2,000,000 cores required for the 256 x 256 memory will all be double-tested cores. The first 6000 are already on hand.

Memorandum 6M-3375

Page 45

Core Test Equipment

(J. Schallerer) (UNCLASSIFIED)

In order to plane test the 64 x 64 sections of the first 256 x 256 memory plane, a special tester has been devised, using mechanical switching. The automatic core counter has been revised and put in operation to facilitate the handling of the large number of cores required for the 256 x 256 memory.

Inorganic Chemistry

(D. G. Wickham) (UNCLASSIFIED)

A series of compositions in the solid-solution range between zinc ferrite and ferrous germanate ($ZnFe_{2}^{III}O_{4} - Fe_{2}^{II}Ge^{IV}O_{4}$) is being prepared for the purpose of studying their possibly useful magnetic properties.

3.1.2 PhysicsSwitching Mechanism

(N. Menyuk) (UNCLASSIFIED)

A study was made of the fundamental parameters involved in the switching mechanism of ferromagnetic materials. This was done to determine the lower limit of the switching coefficient that can reasonably be anticipated and the conditions which must be met to approach the limit. As a result of this investigation, it was concluded that obtaining ferrites which switch faster than presently available metal tape cores is possible. However, one of the prime requisites of such fast switching materials is a low Bloch wall energy σ_w . This reduces the probability of the material having a square hysteresis loop. Therefore, it is felt that the main emphasis should be on finding a fast switching material regardless of loop shape and then attempting to square the loop by means of a magnetic anneal. This technique is limited to ferrites with a Curie temperature $T_c > 450$ C.

Current Pulse Generator

(J. D. Childress) (UNCLASSIFIED)

The evaluation of magnetic materials with very short switching times (low S_w) requires a current pulse generator capable of producing, from a current source, pulses of 10-amp amplitude, rise time of 0.01 microsecond, and pulse duration of 1 microsecond. It has been decided, tentatively, to use a distributed-amplifier type circuit in the output stage. The aid of anyone having experience with this type circuitry is hereby solicited and will certainly be appreciated.

Memorandum 6M-3375

Page 46

Magnetostriction

(P. K. Baltzer) (UNCLASSIFIED)

Two discs have been cut out along the $[110]$ plane of a nickel ferrite single crystal. Magnetostriction measurements have been made on one of these discs in the $[100]$ direction at 26 C, 0 C, and -78 C. The strain gage has been reset on the sample for additional magnetostrictive measurements in the $[111]$ direction.

D-C Fluxmeter

(R. A. Pacl, Jr.) (UNCLASSIFIED)

The thermal lagging of the input circuit (to minimize incremental thermal emf's) is being accomplished by using a Fiberglas insulated aluminum box and heavy copper plates at the copper-to-copper junctions. It is hoped that this will result in an order-of-magnitude improvement.

Memorandum 6M-3375

Page 47

3.2 New Components and Circuits

3.2.1 Transistor Circuits

Experimental Circuits

(T. H. Meisling) (UNCLASSIFIED)

The work is being redirected to provide within the next few months the circuits needed for the eight-digit multiplier. The flip-flops will be provided with delay elements and amplifiers to form flexible building blocks capable of being complemented and capable of driving transfer lines.

Visit to Western Electric Co., Allentown, Pa.

(D. J. Eckl) (UNCLASSIFIED)

On 2 February with a group from Lincoln I visited the Western Electric transistor-production facilities at Allentown and Laureldale, Pennsylvania. The types in quantity production are medium-frequency units.

Visit to GE, Syracuse

(D. J. Eckl) (UNCLASSIFIED)

A visit was made with the same group to Electronics Park in Syracuse to see the GE production of transistors. Their greatest progress has been in the 2N43A, which is a pnp alloy 1-mc transistor specified by the military. Their operation was very impressive.

Life Tests

(D. J. Eckl) (UNCLASSIFIED)

The life tests on surface-barrier transistors have now reached 1900 hours for the first group of 8 and 1100 hours for the remaining 16. These transistors are operating in flip-flop and gate circuits.

Design of Arithmetic Elements

(A. L. Pugh) (UNCLASSIFIED)

A preliminary investigation has been made of generating pulses and driving transmission lines.

Design of Arithmetic Elements

(K. H. Konkle) (UNCLASSIFIED)

Further basic investigation of surface-barrier-transistor circuits was made. The circuit levels and pulse-delay time of the chain-type circuit was measured. The circuit has the disadvantage of large current flow in the bottom transistors of the chain, which causes a large voltage drop across the chain at saturation and limits the length of a chain having good pulse-response time and safe current levels. The pulse-delay time was measured for a short chain and was found to be independent of chain length or transistor pulsed. A more thorough investigation of rise and fall times of all surface-barrier-transistor circuits is planned.

Shift-Register Marginal Testing

(J. R. Freeman) (UNCLASSIFIED)

Symmetrical clipping of the output from an R-F signal generator furnishes dual-pulse half-sine waves which are perfectly suited for shift-register driving. Since the pulse widths accommodate to the prf (i.e., maintain a 50% duty cycle), overlapping of the dual pulses is prevented automatically. Operating margins obtained from such a driver seem to furnish information in a worthwhile form. By applying 100% modulation to the R-F signal and sweeping with the modulator, an oscilloscope display of the upper and lower pulse-amplitude operating margins is obtained simultaneously.

Tetrode-Transistor Switching Characteristics

(C. T. Kirk) (UNCLASSIFIED)

In view of the fact that high-frequency tetrode transistors will soon become available, a study of the switching characteristics of these devices has been initiated. Several interesting conclusions have been drawn from a study of some low-frequency tetrodes that are available at the present time. These may be summarized as follows:

1. $f_{c\alpha}$, the cutoff frequency of the current amplification factor, is independent of the applied potential (at least to a first approximation);
2. The high maximum oscillator frequencies ($f_{max} \approx 3000$ mc) that have been reported are due largely to the reduction in base resistance, r_b ;
3. Considerable reduction in storage time can be obtained without adversely affecting the turn-on time and the fall time by operating these devices at reduced α_0 's ($\alpha_0 \approx 0.4 - 0.6$).

Voltage-Type Decoder

(L. Jedynak) (UNCLASSIFIED)

The voltage-type decoder utilizes emitter-follower transistor circuitry. When a -30-volt input signal is applied at the base, the emitter swings from 0 volt to a -25 volt reference voltage. A T-7G diode clamps the emitter at the reference voltage for the duration of the input signal. The current in the clamping diode, and hence the voltage drop across the diode, varies with alpha variations. Calculations and measurements show that the resultant variation of output voltage due to a small change in alpha, of the order of 0.01, can be equal to the magnitude of the smallest increment of the decoder output. The present problem is to reduce the sensitivity of the circuitry to alpha variations and hence eliminate the effects of the variation of voltage drop across the reference-voltage diode.

Problems Arising from Transistor Circuitry

(E. U. Cohler, K. Konkle) (UNCLASSIFIED)

We are determining the following: Complete rise and fall characteristics of typical surface-barrier transistors (SBT's), variation of the current gain at saturation for various saturation currents in SBT's, the best method for driving a series "chain" of SBT's, the limitations on the number of transistors allowable in a chain, and the improvement to be achieved by using silicon diodes. Graphs of typical characteristics of SBT's will be available shortly for the use of circuit designers.

Plans for intragroup lectures on transistor circuitry are now being made.

3.2.2 Magnetic-Core CircuitsReport on Core Circuitry

(E. U. Cohler) (UNCLASSIFIED)

Work on core circuitry is now essentially completed, and a joint report will be issued on this phase. A number of problems have been encountered, particularly at high frequencies.

Errata

(E. U. Cohler) (UNCLASSIFIED)

In the last Biweekly Report (28 January 1955) it was stated that the best diode tested for use in a core shift register was a 1N191 (3.2.2 Stepping Registers, P. Griffith). In actuality this diode was a special type with a very high forward conductivity made by Transitron.

Memorandum 6M-3375

Page 50

Stepping Registers

(P. Griffith) (UNCLASSIFIED)

The period of 1-11 February was spent concluding the work of single-core-per-bit stepping registers.

The next phase of work will concern the surface-barrier transistor and will begin by a study of its static and dynamic characteristics for familiarity with some of the fundamental aspects.

Ramey Amplifiers

(M. M. Cerier) (UNCLASSIFIED)

Work on the "Ramey" type of amplifier has been stopped. A report is being written on the work done until now.

The Ramey type of amplifier has some advantages which seem lacking in the saturable-transformer type of circuit. Some of the advantages are: ease of interconnection with other circuits, symmetry of circuits, ease of design, and use of a sinusoidal voltage driver. One big disadvantage is that the Ramey circuit necessarily requires two diodes per core.

Thesis Proposal

(M. Epstein) (UNCLASSIFIED)

Current activity lies in the preparation of a thesis proposal embodying various approaches to reliable computer operation as measured by the reliability of components.

3.2.2 Memory

(W. N. Papian) (UNCLASSIFIED)

As much of the 256 x 256 x 34 core memory will be transistorized as is possible under the development schedule. F. W. Sarles is actively working on the sense amplifier; this unit is the likeliest one to be transistorized early in the program. Following that we may have circuits, developed by the Transistor Section, which will satisfactorily replace the lower-level vacuum-tube circuits in the rest of the memory. The high-level drivers, for the X and Y switches and the digit windings, will probably prove most difficult. Some work is, however, being started in this area by Group 24. We have supplied them with a dummy load of a 64 x 64 core memory which they will attempt to drive directly from transistors; collaboration on this problem will be close.

Memorandum 6M-3375

Page 51

Dr. E. Gaugler of Magnetics, Inc., was here for a discussion of mutual problems in the tape-core field. Our support of their research program is apparently to be confined to consulting help and the purchase of a few cores now and then.

Other visitors included Messrs. Elliot and Katz from RCA, Camden, who came via the MIT Industrial Liaison Office, and some people from NRL, who came via the Lincoln Navy Office.

256 x 256 Memory

(J. L. Mitchell) (UNCLASSIFIED)

A switch driver was tested on a switch with a 12-turn primary. Since it was not able to supply the necessary volt-amperes, its output stage is being redesigned.

Fifty switch cores were received from Magnetics, Inc., and are now being evaluated. First results indicate a number of cores with shorted wraps.

A four-tube plug-in unit (two 5998's and two 5965's) is being designed. The construction of the prototype will begin soon.

Mechanical Design and Layout for 256 x 256 Memory

(E. A. Guditz) (UNCLASSIFIED)

Plans are being made to produce 600 64 x 64 memory-plane modules. Arrangements have been made for the services of two vendors, Arthur Koch and Cambridge Thermionic Corporation.

It is anticipated that 16 256 x 256 memory planes will be ready for use with associated equipment by autumn.

Memory Test Setup VI

(E. A. Guditz) (UNCLASSIFIED)

Modification of the memory tester has been completed. Planes of any physical shape, reasonable size, and connection requirements can now be tested. Planes larger than 64 x 64 must be tested in parts.

High-Speed Operation of Cores (D. H. Ellis) (UNCLASSIFIED)

A standard memory core was driven through two complete flux reversals every microsecond to determine the possible effect of core heating on the output. No change was noted for the full-select output. More tests will

Memorandum 6M-3375

Page 52

be made to determine the effect on half-select and ZERO outputs. Variation of switching time with frequency will also be determined.

Memory with External Selection (S. Bradspies) (UNCLASSIFIED)

Tests have been run in an effort to determine the most suitable value of loop resistance for coupling together the three cores of the memory cell. The switch core was 1.5 times standard core size (height); each memory core was 0.25 times standard size. Such a cell is about what would be used in an actual memory plane.

The resistance value selected was 3.2 ohms per foot. The length of a coupling loop is about 3/4 inch.

Transistor Sense Amplifier

(F. W. Sarles) (UNCLASSIFIED)

I am preparing a thesis proposal on transistor sensing amplifiers for the magnetic-core memory.

3.2.4 Systems

3.2.4.1 Systems Design

(K. H. Olsen) (UNCLASSIFIED)

The System Design Section is now studying the problem of packaging transistor circuits and the problem of electrically matching Flexowriter equipment and tape readers to the transistor circuits.

(N. L. Daggett, J. W. Forgie) (UNCLASSIFIED)

In accordance with the recently adopted time schedules for Group 63 activity, we are currently engaged in two activities. One is the re-examination of the over-all logical-design requirements of a computer to handle the SAGE System job. As a first step we are investigating recent changes which have taken place in the FSQ-7 input-output specifications to see the extent to which such changes would require basic modifications to the multisequence-program concept (6M-3114) arrived at last fall as a new approach to the design of a computer with large and varied input-output requirements. We hope to produce either a justification of this concept or a better one in the near future so that logical design can move to the microscopic phase with some feeling of security.

Memorandum 6M-3375

Page 53

Our second activity involves the logical design for the proposed test multiplier to be built in the near future. Current thinking indicates that the design should be approximately a prototype for a realistic arithmetic element. So far, three basically different designs, each with two versions, have been produced. These designs offer choices of pulse vs level carry-propagation and of speed vs complexity. All designs yet produced have been ultraconservative in the requirements on the transistors used.

Systems Research

(W. A. Clark) (UNCLASSIFIED)

B. Farley and I have completed a series of experiments using MTC to simulate the operation of one type of self-organizing system. These experiments and their results will be presented at the Western Joint Computer Conference in March and will be published in the proceedings of the conference.

3.2.4.2 System Planning

R. A. Hughes (UNCLASSIFIED)

An investigation has been started of the characteristics of photo diodes and power transistors with a view to using these devices in a tape reader and punch system for the transistor computer.

SECTION IV - CENTRAL SERVICES

4.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

We were successful in negotiating the loan of an oven from Group 63 for use by the Barta Tube Laboratory pending delivery of a new unit.

The number of requisitions currently being placed exceeds by about 4% the number of (6889) purchase orders placed during a similar period a year ago.

4.2 Engineering Services4.2.1 Components

(H. W. Hodgdon, C. Morrione, R. J. Biagiotti) (UNCLASSIFIED)

Components Section personnel visited CBS Hytron and Sylvania diode plants during this period to discuss current diode development and production. No items of major interest were turned up, but contacts were established that will keep us informed.

C. Morrione attended a joint conference at IBM with Cinch Manufacturing Company representatives to discuss details of adaptation of the Western Electric "Nike" connector design for duplex production. Pertinent details will be covered in a memorandum.

Information has been received that our environmental chamber has been ordered and delivery is anticipated in 6 to 8 weeks.

Pending the implementation of a formal failure-reporting system for XD-1, such failures reported to the Components Section will be given immediate attention.

4.2.2 Test EquipmentTest Equipment Headquarters

(A. Bille, L. Sutro) (UNCLASSIFIED)

All is not well in paradise. We have received a General Radio instrument which we expected to be exemplary in its workmanship and two DuMont Type 336 scopes which we expected not to attenuate 0.1- μ sec pulses. Two unsoldered joints together with poor soldering elsewhere in the G-R instrument prompted us to call G-R. They have responded by taking the instrument back both to repair it and to show it to their production people. The DuMont scopes instead of presenting the 0.1- μ sec pulse

Memorandum 6M-3375

Page 55

unattenuated show it with 5% attenuation. This percentage has been determined by measuring the pulse amplitude first on a scope where the pulse can be applied directly to the plates of the cathode-ray tube, then on the DuMont scope. The amplifier of the DuMont scope is not giving promised performance.

4.2.3 Mechanical Engineering

(A. R. Smith, L. B. Smith, L. B. Prentice) (UNCLASSIFIED)

The final development stage of mounting 200 transistors for prospective use as a transistor multiplier has been reached. A piece of rectangular polystyrene serves the combined function of handle and male plug for each separately mounted transistor.

4.3 Drafting

New Developments in Diazo Reproduction Methods

(A. M. Falcione) (UNCLASSIFIED)

On 1, 2, and 3 February I attended a Training Aids Seminar at the Technifax Corporation, Holyoke, Mass. At the conference I saw displays on the latest developments in Diazo-type materials, techniques, and processes. The Seminar was attended by a large representation of personnel from all over the country. At the Seminar, demonstrations were given using the latest type of Technichrome materials, which is a new development in the Diazo field. This material makes it possible to make overlays in many colors, which may be of considerable value in some of our work. Anyone interested in seeing samples or discussing procedures may do so at any time.

Drawings for Memoranda

(A. M. Falcione) (UNCLASSIFIED)

We are still running into delays in reproduction of certain memoranda because authors have not given advance notice to Drafting for preparation of drawings needed.

Memorandum 6M-3375

Page 56

4.4 Administration & Personnel4.4.1 Staff

(J. C. Proctor) (UNCLASSIFIED)

New

Robert Gildea is a new member of Group 61. He received his MS degree from Brown University and until recently was employed as a technical assistant by the Digital Computer Laboratory.

William F. Santelmann, Jr., is a new member of Group 62. Mr. Santelmann received his SM from MIT and was employed as a senior engineer by the Atomic Instrument Company.

Transfers

Sydney Bradspies has transferred from MIT Staff to DDL Staff.

Charles T. Kirk has transferred from MIT Staff to DDL Staff.

Bela B. Paine has transferred from Group 60 to Group 62. H. W. Hodgdon will assume direction of the Components Section, assisted by C. Morrione.

4.4.2 Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

New

Allen Anderson is a Mechanical Technician who has transferred from the Sloan Automotive Laboratory to Group 60.

Fred Brening is a new clerk in the Print Room where he will operate the Ozalid machine.

William Holst is an MIT graduate student who will work part time for Group 61.

Barbara Murphy is another new clerk in the Print Room.

Open Requisitions

- 1 Clerk for Group 62
- 1 Clerk-Typist for Group 62
- 1 Layout Draftsman
- 1 Temporary Technician C for Group 63
- 1 Technical Assistant for Group 61

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 57

Accessions List

(D. B. Helwig) (CONFIDENTIAL)

The following documents were published by Division 6 or received from IBM during the period 31-January - 14 February 1955:

Division 6 Reports

<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-3255	T. Clough	Vacuum Tube Failures During the Month of November, 1954	U
6M-3283	B. Searle	Vacuum Tube Failures During the Month of December, 1954	U
6M-3291	T. Clough	Specifications for the Central Computer System for the AN/FSQ-7	U
6M-3292	P. Bagley	Specifications for the Drum System for the AN/FSQ-7	U
6M-3293	R. Mayer	Specifications for the Display System for AN/FSQ-7	U
6M-3296	R. Buzzard	Specifications for the Automatic Camera and Control for AN/FSQ-7	C
6M-3297	J. Newitt	Specifications for the Power Conversion and Distribution System	U
6M-3298	L. Sutro	Specifications for the Manual Inputs System for the AN/FSQ-7	U
6M-3299	M. Feldstein	Specifications for the Output System for the AN/FSQ-7	C
6M-3300	H. Rising	Specifications for the Maintenance Equipment of AN/FSQ-7	U
6M-3301	R. Gould	Specifications for the Automatic Input Elements of AN/FSQ-7	C
6M-3302	H. Anderson et al.	SAGE System Meeting, Jan. 17, 1955	U
6M-3303	J. Proctor	Initiation Studies and Tests	C
6M-3309	D. R. Israel	Specifications for the Warning Light System AN/FSQ-7	U
6M-3315	R. Gould	Minutes of Data Service Committee Meetings, Jan. 14	U
6M-3328	F. Irish	Proposed Specifications for Auxiliary Memory Expansion of the AN/FSQ-7	U
6M-3333	B. Housman	Proposal for the Modification of the XD-1 Long-Range Input (LRI) Equipment to Provide for the Acceptance of Production-Type of P-Site Phone Line Signal	U
6M-3334	R. Mayer	Proposal for the Modification of the XD-1 Long-Range Radar Input (LRI) Equipment to Provide for the Acceptance of Phone Line Data from South Truro	U
6M-3335	A. Werlin	SAGE Experimental Subsector Planning	U
6M-3336	J. Jacobs	SAGE System Meeting, Jan. 24, 1955	C
6M-3337	D. Brown	Proposal for Installation of the Collins Data Link C Within the XD-1 System	C
6M-3339	S. Ginsburg	Gp. 61 Mission Specifications (10-55) for Live Training Tests on 1 and 3 1955	U

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~
UNCLASSIFIED

Memorandum 6M-3375

Page 58

Accessions List (Continued)

<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-3340	A. Smalley	Mission Specifications (11-55) for Raydist Orientation on 2 and 4 February, 1955	U
6M-3343	- - -	Laboratory Personnel for February	U
6M-3344	Jackson & Moreland	Power Generation Equipment and Electrical Distribution System for SAGE System Combat and Direction Centers	C
6M-3345	- - -	Biweekly Report for January 28, 1955	C
6M-3346	P. Bragar	SAGE System Meeting, January 31, 1955	U
6M-3348	R. Mayer	Systems Office Training Program	U
6M-3351	W. Cauty	Time Schedule for XD-1 Machine Specifications and Evaluation Reports	U
6M-3353	W. Attridge	Manual Inputs Requirements for Subsector 1	C
6M-3354	A. Smalley	Group 61 Mission Specifications (12-55) for an Accuracy Training Test on Tuesday 8 February and a Saturation Test on Thursday 10 February	U
6M-3355	A. Smalley	Group 61 Mission Specifications (11-55) for Data Analysis Test on Wednesday 9 February 1955	U
6M-3356	A. Smalley	Mission Specifications (13-55) for Raydist Orientation 11 February 1955	U
6M-3357	V. Tessari	Component Test: Pulse Transformers Hermetically Sealed, Ferrite Core	U
6M-3358	W. Pughe	Procedure in Case of Failure of Commercial Power	U
6M-3360	P. Bragar	SAGE System Meeting	U
6M-3361	J. Mazza	Rough Notes on Systems Planning Meeting on 7 February 1955 at 0930E	U
6M-3362	A. Smalley	Group 61 Mission Specifications (15-55) for Live Demonstrations on 15, 16, and 17 Feb. 1955	U
6M-3363	A. Smalley	Mission Specifications (16-66) for Raydist Orientation on 18 February 1955	U
6M-3365	S. Twicken	SR-1782A/3002420 Meeting of January 12, 1955	U
6M-3366	P. Bagley et al.	Planned Activities of Systems Office Committee On Maintenance Programming	U

IBM Reports

IBM-684	R. Cunningham	Prototype Input System, Logical, Unit & Drawing Nos.	C
IBM-685	R. Cunningham	Prototype Power Supply and Marginal Checking System	U
IBM-686	B. Salzberg	Tube Reliability	U
IBM-687	R. Cunningham	Prototype Display System, Logical, Unit & Drawing Nos.	C
IBM-688	W. Cornett	Conversion Between Prototype and Production AN/FSQ-7 Drawing Nos.	U
IBM-689	- - -	Central Reference Room Bulletins 56 - 63	U
IBM-690	- - -	AN/FSQ-7 Biweekly Progress Report, 1-10-55 to 1-21-55	C
IBM-691	- - -	Display System Subcontract Exhibit	C
IBM-692	R. Cunningham	Prototype Output System, Logical, Unit & Drawing Nos.	C
IBM-693	W. Strohm	Project High Ferrite Core Dev. Program with RCA	U

NOTE: We have received our regular stock of PM-3, Drum System, CIC, AN/FSQ-7, classified CONFIDENTIAL, IBM-689.

~~CONFIDENTIAL~~