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Memorandum 6M-3674

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Page 1 of 46

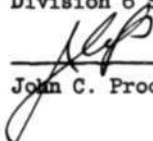
Division 6 - Lincoln Laboratory  
Massachusetts Institute of Technology  
Lexington 73, Massachusetts

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SUBJECT: BIWEEKLY REPORT FOR 27 MAY 1955

To: Jay W. Forrester

From: Division 6 Staff

Approved:   
John C. Proctor

CONTENTS

Section I - System Test & Planning	1
Section II - AN/FSQ-7	15
Section III - Advance Development	33
Section IV - Central Services	41

I - SYSTEM TEST & PLANNING

1.1 Air Defense

1.1.1 Test Program

(D. R. Israel) (CONFIDENTIAL)

The SAGE Test Committee held its third meeting on 1 and 2 June. Minutes of the meeting will be prepared and distributed as 6M-5023.

Test program continues at a satisfactory pace. Despite excellent cooperation from all concerned, the programming and checkout of the simulated data-generation program and the post-test data-processing programs have been delayed beyond expectation. A concentrated effort will be made to clean up these matters within a week. Some order of the magnitude of the task involved in preparing these non-system programs may be had from the sum total of the orders in the various programs concerned: 11,000 (decimal).

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UNCLASSIFIED

Memorandum 6M-3674

Page 2

At a meeting on Thursday, 26 May, with representatives of Division 5, Group 22, Group 38, and Group 61, plans for ECM activities in the 1954 CCS test program were made. These plans will be summarized in a forthcoming memo, 6M-5022.

In order to assist Group 22 in the checking of the Mark X and FGD equipment at South Truro, we will revise our schedules to avoid use of the South Truro FPS-3 on three Tuesdays at the end of this month: 14, 21, and 28 June. In this way, Group 22 will have three uninterrupted 2-day periods for their checking and testing.

(E. Bedrosian, H. Frachtman, S. Manber, E. McEvoy) (CONFIDENTIAL)

The new system-simulation program for the 1954 Cape Cod System is being checked out. Changes to the recording program and the start-over program have been written and are also being checked out. The changes to the input program required by the change of interlace on the buffer drum has been written and will be checked out after the equipment has been modified.

(A. E. Budd) (CONFIDENTIAL)

The magnetic-tape read-in subroutine to read magnetic-tape records of CCS has been checked out. An M-note will be written in the near future to give complete specifications.

I am at present studying interceptor program with F. Graham to determine specifications for future studies.

(R. David, A. Smalley, P. Dolan, R. Smith) (CONFIDENTIAL)

During the past biweekly period this Section attempted 12 missions in support of SAGE Test Office.

Of these 12, five were canceled and seven were flown. Of the five canceled, four were of the ABW type and one a Holmes Raydist.

(F. W. Graham) (CONFIDENTIAL)

I am making a survey of the interception problem to determine what data should be recorded. This data will be used to evaluate the interception phase of the 1954 Cape Cod System.

UNCLASSIFIED

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

UNCLASSIFIED

Memorandum 6M-3674

Page 3

(H. A. Keit) (CONFIDENTIAL)

Work continues on the radar mapping and initiation studies. A conference was held with A. Bark of Division 5 to consider the use of chaff and jamming methods in studying radar mapping procedures.

Preliminary investigation of a method of smoothing data counts was initiated.

Training by Sol Manber in the operation of the CCS continued at the Barta Building. Some progress was made in checking out the magnetic tape-to-tape (1954 CCS) transfer program.

(W. Z. Lemnios) (CONFIDENTIAL)

The survey memo outlining the seven series of interception tests is being published. Test specifications for two of the series are being written.

Two more tracking-accuracy tests have been conducted. This makes a total of three tracking-accuracy tests that have been held thus far. The processing of the data is about to begin.

The June seminar on interceptor vectoring now will be attended by 214 people from 38 organizations.

(J. Levenson) (CONFIDENTIAL)

Two Series A initiation tests have been run. The first allowed adjustment of Cape Cod operating procedures although performances at the FPS-6 height finder and the Montauk radar was not good enough to permit analysis of the collected data. The second test yielded useful data which is being processed, and has shown errors and inadequacies in the CCS automatic initiation program. Before further tests are made, the program will be corrected and checked on simulated tracks.

(A. Mathiasen) (CONFIDENTIAL)

The output section of the simulated data print and punch program has not been checked out yet.

The Raydist tracking program will be modified by 7 June to use the new buffer-drum addresses for radar input.

I am writing a modification to the Cape Cod program which will provide automatic initiation for simulated tracks during the non-monitoring phase of the track and which will shut off this feature during the monitored phase. It will also shut off tracks at the end. This will be done to obviate the need for any manual intervention except that desired from the monitors during the monitoring tests.

~~CONFIDENTIAL~~

UNCLASSIFIED  
~~CONFIDENTIAL~~

Memorandum 6M-3674

Page 4

(W. Vecchia) (CONFIDENTIAL)

	<u>hr</u>	
Total Assigned Time	156.5	
Extra Assigned Time	<u>9.5</u>	
	166	
	<u>hr</u> <u>min</u>	
System Operation	49	20
Program Checking & Analysis	89	25
Raydist & FGD	17	
Equipment Checkout	<u>6</u>	<u>35</u>
TOTAL	162	20
Time Lost to Computer (malfunction)	<u>3</u>	<u>40</u>
TOTAL	3	40
	<u>hr</u> <u>min</u>	
	162	20
	<u>3</u>	<u>40</u>
GRAND TOTAL	166	

1.1.2 Analysis and Simulation

Manned-Interceptor Simulation

(W. I. Wells, H. D. Neumann) (CONFIDENTIAL)

All interceptions simulated by the manned-interceptor simulation program for the study of quantization and scan rate were run and evaluated.

The 214 simulated interceptions requested by Westinghouse are being run with the F-99 simulation program with detailed printout.

(B. Smulowicz) (CONFIDENTIAL)

Work is continuing on the flow diagrams and coding of the weather-clutter generator and track correlation program to be used with the manned-interceptor simulation.

(H. D. Houser) (CONFIDENTIAL)

Final flow diagrams for adding correlation of simulated weather clutter to the present program have been completed and the program is being coded.

UNCLASSIFIED  
~~CONFIDENTIAL~~

UNCLASSIFIED  
~~CONFIDENTIAL~~

Memorandum 6M-3674

Page 5

Statistical Analysis of Simulation Results

(C. Friedman) (CONFIDENTIAL)

A study is being made of the various methods and tests which will be useful to statistically analyze MISP. A program is being planned which will facilitate this analysis.

Radar Data Analysis

(H. D. Houser) (CONFIDENTIAL)

The radar data analysis program has been modified to use the new op 1400 order for the MTC card machine. This speeds up the data analysis program by a factor of two.

Azimuth Tracking

(F. F. Gucker) (CONFIDENTIAL)

F. Heart and I are now checking out an azimuth-only initiation-simulation program on WWI. Full-scale tests will aid in finding the expected number of ghosts as a function of the number of aircraft, the number of radars, the azimuth beamwidth, and the elevation beamwidth.

Future effort is to be divided between improving the present initiation program and extending the azimuth-only tracking system to include smoothing and prediction.

Noise Studies

(H. Peterson) (CONFIDENTIAL)

Some progress has been made on the initiation program previously discussed, and 2 full days work should easily put this program on the computer.

Initiation Studies

(R. W. Sittler) (CONFIDENTIAL)

Results obtained by an MTC program of C. Friedman on the performance of automatic initiation systems proposed for use with the 1954 Cape Cod System have been correlated with, and used to extend the scope of, past initiation studies.

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UNCLASSIFIED

Memorandum 6M-3674

Page 6

Analysis of Blip-Scan Data

(B. Stahl) (CONFIDENTIAL)

I have completed writing the blip-scan analysis program except for some minor details in the output section. The program should be on tape and ready for checkout on MTC by 8 June.

Tracking and Monitoring Test Series

(J. Nolan) (CONFIDENTIAL)

The computer programs needed for the initiation of the track-monitoring test series are not as yet completely checked out. The present estimate of the first test date is Thursday, 9 June.

1.1.3 SAGE Training

(S. B. Hibbard) (CONFIDENTIAL)

The Training Section in conjunction with Section "C" is conducting a program to train approximately 20 new airmen as console operators in the Cape Cod System. We have had a fair amount of success but have been handicapped by lack of computer time. It is planned to operate Saturday mornings from 8 A.M. to 12 Noon so the computer problem should be somewhat relieved. Representatives from ATC, ADES, WE Co., BTL and AFPTRC have also been attending the course. Manuals for all positions in the Cape Cod System have been written and a limited number are available to those interested outside the Training Section.

The Training Section has a memo (6M-3656) coming out covering the problems facing it in the training of ARDC personnel to man the Direction Centers for Cape Cod and XD-1.

1.1.4 Coordination

(P. R. Bagley) (CONFIDENTIAL)

A 3-week course will be held 6 June to 24 June for ADES personnel. The intent of the course is to have them thoroughly familiar with the SAGE Operational Plan. Memorandum 6M-3648 describes the course in detail.

Plans are more firm for the training course in FSQ-7 programming. The course will be taught by IBM at Lexington. It will run for 9 weeks full time, 18 July through 16 September 1955. The course will be repeated at approximately 10-week intervals for at least 1 year. Applicants should communicate with J. F. Jacobs.

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Memorandum 6M-3674

Page 7

The MTC Programming Manual has been rewritten and brought up to date. It has been published as 6M-2527-2, "Memory Test Computer Programming Reference Manual." Copies are available on request from the Division 6 Document Room.

(A. P. Hill) (CONFIDENTIAL)

I have been working on lecture and discussion outlines for a course to be given 6 June through 24 June. The 3-week course will be conducted for approximately 17 ADES personnel and will be given by P. Bagley and A. Hill.

The purpose of this course is to familiarize selected ADES personnel with the SAGE Operational Plan. Generally, the discussion periods will be held each day from 0900 - 1200, with the afternoons open for study. Part of the course will include two 3-hour periods in the evening (2100-2400) at the Barta Bldg. with the ADES personnel actually operating the Direction Center equipment.

1.1.5 Tracking

(W. S. Attridge) (CONFIDENTIAL)

Several proposals for the automatic tracking function have been discussed by the Tracking Section. It is obvious that in this area particularly, a great amount of research is necessary to determine good ways of using overlapping FGD.

(D. Bailey) (CONFIDENTIAL)

I have been looking into the use of Mode X data in the SAGE System. This situation is still rather confused and the outlook bleak. One thing is apparent at this stage: the SIF features described in the SAGE Operational Plan will not be available at the time the first computer programs must be ready.

A sketch of the operational requirements for automatic tracking has been issued by Attridge and myself.

(F. E. Heart) (CONFIDENTIAL)

With W. Wells, continued support has been given to the Lincoln Radar Coordinating Committee.

The study of azimuth-only tracking has continued. R. Sittler has been studying several theoretical aspects of the ghost problem. In order to get experimental check points for the theoretical work, F. Gucker and I have been checking out a simulation problem for WWI; another reason for the programming effort is to determine approximate computation time

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UNCLASSIFIED

Memorandum 6M-3674

Page 8

estimates. Unfortunately, it is still not clear whether an azimuth-only tracking system is feasible.

Continued effort has been given to acquiring background on Talos and similar systems. On 25 May I attended a Talos meeting in Washington. From the discussions at that meeting, the largest single stumbling block in the Talos effort is the indeterminacy between Army and Air Force sponsorship of land-based Talos.

An attempt has been made to settle the recurrent question of program interrogation of the display system in XD-1, FSQ-7, and FSQ-8. Memorandum 6M-3662 is now being issued and Group 61 concurrence is expected.

A small amount of effort has been given to continued study of communication problems, especially in regard to automatic teletype.

(E. W. Wolf) (CONFIDENTIAL)

A satisfactory solution to the Subsector boundary problem has been derived. The boundaries will appear as straight lines on all displays with an error of less than 1 mile for any Subsector. They will appear as arcs of circles on maps using the Mercator and Lambert projection.

1.1.6 Program Organization

(R. L. Walquist) (CONFIDENTIAL)

I. General

In order to improve the quality of the Biweekly, the Program Organization Section will henceforth submit a single, condensed report. We intend to eliminate redundancy and improve readability. It is hoped that other sections will find it desirable to do likewise.

The program-organization task for the SAGE System is under way; the following areas have been assigned (see 6M-3624 for description of these functions):

- Storage and table organization, L. Collins
- In-out control, W. Harris
- Switches, inputs and outputs, W. Ball
- Operational and equipment aspects of displays, R. Reed
- Programming aspects of display, A. Schwartz
- Program design, H. Benington

Outline definitions of these tasks will be prepared during the next biweekly period by the individuals indicated. These definitions will be circulated among the operational sections for concurrence.

~~CONFIDENTIAL~~ UNCLASSIFIED



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UNCLASSIFIED

Memorandum 6M-3674

Page 9

The comprehensive checkout program for Whirlwind I is now partially checked out (to be described in 6M-3642). The checkout program, which is controlled by "executive" tapes, provides alarm and dynamic postmortems in either fixed or floating addresses. The interpretive portion of the program was written by A. Schwartz as an indoctrination problem; executive, control and utility portions have been written by H. D. Benington, J. Cox, L. Collins, and W. Ball in their spare time.

The IBM 402 Tabulating Machine in the Card Preparation Room, C-168, will be replaced by an IBM 407 Tabulating Machine in 2 or 3 weeks. Plugboards for the 407 have already been received; all jobs requiring 402 plugboards as soon as possible.

The XD-1 trace program has been modified to include three printing options in the area being traced: print every instruction, print every instruction of a selected class (such as transfer or add class) of instructions, or print only on a particular instruction (such as FST, CAD, etc.).

#### II. Use of XD-1 Application Time

During the past 2 weeks, the total XD-1 applications time was 12 hr., 35 min. with the percentage of usable time at slightly better than 50%. The following table summarizes the useful time for the assigned periods from the first week in April to the present.

#### Use of Group 61's Assigned XD-1 Time

Time Period	Usable Time	Causes of Down Time				
		Printer	Reader	Punch	Core Storage	Other
3/28-4/6	92.7%					2.8%
4/7-4/13	85%	1.7%	10%	3.3%		
4/14-4/20	70.2%		4.8%		25%	
4/21-4/27	72%		2%		6%	20%
4/28-5/4	51.7%	41.9%			1.6%	4.8%
-----						
5/5-5/11	82.2%		4.4%		2.8%	10.6%
5/12-5/18	53%	6.1%	23%		1.7%	16.2%
5/19-5/25	52.4%					47.6%*
5/26-6/1	52.7%	25%			1.6%	21.1%

\* All 47.6% due to failure of card machine in-out equipment.

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Memorandum 6M-3674

Page 10

The figures above the dotted line are based on 60 minutes of operation a day, 5 days a week and below the line on 75 minutes of operation a day, 5 days a week.

III. Memos

Memos issued during this biweekly period:

6M-3628, "Guaranteed Data Storage in AN/FSQ-7 Duplex Computer Operation," P. R. Vance, A. R. Shoolman, 23 May

6M-3624, "Coding of the Master Program for the SAGE System," R. L. Walquist, 27 May

Memos in progress during this biweekly period:

6M-3661, "Master Program Preparation Schedule," H. Benington

6M-3642, "WWI Comprehensive Checkout Program," H. Benington

6M-3606, "XD-1 Utility Programs (Octal Print, Binary Punch, and Basic Trace and Trap)," J. E. Yienger

6M- "XD-1 Utility Programs (Assembly and Read-in)," S. Knapp

1.1.7 Weapons Direction

(C. A. Zraket) (CONFIDENTIAL)

Proposals for the operational specifications of the following SAGE System functions have been issued with limited distribution for comment: height finding, raid forming, manual inputs, weather identification, Subsector command post, and antiaircraft. The proposal for weapons assignment and intercept direction will be issued the week of 6 June. Discussions of the proposals have taken place with members of Group 61 and the ADC representatives (Lt. Col. Stevenson, Maj. Janek, Maj. Chesler) at Lincoln. As a result, revisions are in progress. It is expected that the new rough drafts can be given wider distribution. Anyone desiring to be put on the distribution list should contact J. Jacob's Office.

A manpower and time schedule for the Weapons Direction Section has been prepared with M. Feldstein and is available in 6M-3667, "Detailed Schedule for Weapons Direction Section from 1 May to 1 October 1955."

The following memoranda have been issued pertinent to the integration of AA with the SAGE System:

1. PL-AS-66, "Meeting With Army Personnel to Discuss Integration of AA With SAGE, 12-13 May 1955" (Cahill).

UNCLASSIFIED

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~  
UNCLASSIFIED

Memorandum 6M-3674

Page 11

2. 6M-3596, "Proposed Operational Specifications for the SAGE Antiaircraft Direction Section" (Cahill).
3. 6M-3647, "Current Status of AA Integration With SAGE System" (Cahill), 31 May 1955.

A definition of the 400-track capacity of the SAGE System has been informally agreed upon between Group 61 and the ADC representatives at Lincoln. This definition, plus other items (track symbology and numbering, program timing, system boundary conditions, etc.) pertinent to system operation will be issued in a few weeks in a document titled, "Guide to System Operation."

A meeting concerning the utilization of weather data in SAGE was held at Lincoln on 31 May with Maj. Scott of the 3rd Weather Group. A proposal on the use of weather data in SAGE will be issued shortly as an M-note by F. Garth and S. Hauser.

The Western Electric document on internal and external communications for SAGE has been reviewed and comments given to E. Lundberg.

I have issued 6M-3647, "Current Status of AA Integration With SAGE System," 31 May 1955, which defines the problem areas of AA integration and suggests solutions. Local ADC representatives and Group 61 have decided to seek guidance from the Joint Services Advisory Committee with regard to these problems. It is hoped that a request will be drafted early in the next period.

A meeting was held on 27 May at Bell Telephone Labs, Whippany, New Jersey, at which representatives of SCEL, BTL, IBM, and Lincoln tried to lay the groundwork for a compromise solution to the problem of data transmission from SAGE to associated AN/FSG-1 AA defense systems. It developed that Coles Signal Lab is willing to undertake (with the help of BTL) a study of the development required to supply a 1300 bit/sec to 750 bit/sec TSQ-7 data converter or a special TSQ-7 type receiver which would operate at 1300 bits/sec. IBM, on the other hand, will not undertake a similar study, directed toward a TSQ-7-type SAGE output section, unless asked to do so by the Air Force. I have written a memo giving the details of the meeting.

I am preparing a draft of an operational specification for an interim SAGE AA Direction Section, for use from 1 March 1957 until AN/FSG-1 is operative and can be completely integrated with SAGE. The program will be essentially as described in the SAGE operational plan.

(P. Bragar) (CONFIDENTIAL)

A revised draft of the operational specifications of the raid-forming function at a D.C. has prepared for distribution among Group 61 and ADC personnel during the coming week.

UNCLASSIFIED  
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~  
UNCLASSIFIED

Memorandum 6M-3674

Page 12

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

Questions derived from a preliminary writing of operational specifications for SAGE identification were discussed with representatives of ADC at Lincoln. Revisions resulting from the discussion will be incorporated in a rewrite of the preliminary specifications.

A proposal for a new category of tracks, Surveillance Tracks, was written with the assistance of J. Ishihara and was circulated among members of Group 61 for their comment.

We wrote a proposal on the use and presentation of weather data in the SAGE System. A discussion with Maj. Scott, representing the Weather Group, resulted in some detail additions and corrections to the proposal. Another proposal will be written by 1 July and presented for concurrence.

(C. C. Grandy) (CONFIDENTIAL)

The ADES proposal for SAGE communications facilities, circulated by the Production Coordination Office for Lincoln concurrence, has required much attention. Many provisions, dependent on and affecting operational procedures, require modification. It is hoped that the detailed consideration now being given the proposal will lead to a satisfactory communications system.

(C. C. Grandy, A. R. Chandler, A. W. Heineck, R. A. Nelson)  
(CONFIDENTIAL)

The draft proposals for system operation with respect to the weapon direction functions are still being evaluated and revised; hectographed versions will be distributed to the Weapons Direction and Air Surveillance Sections of Group 61 for further coordination.

Heineck has transferred to the Section and is working with Chandler on threat evaluation, weapons allocation and deployment, and weapons assignment.

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## 1.2 Whirlwind I

### 1.2.2 WWI System Operation

#### WWI Computer Operation and Equipment Changes

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

There were 33 incidents of interruption resulting in 8 hours of down time during 292 computer operating hours. The total number of incidents was 33% higher than the average figure for a biweekly period. The majority of failures were of a short duration resulting in 97% usable time. Transient alarms accounted for 50% of the failures.

Group 61 recently increased their time requirements for the WWI computer from 65 to 90 hours per week. By carefully reducing the amount of Group 64 maintenance time and the scheduling of previously unused weekend hours, the new demands have been met.

The system for locking the magnetic-tape units (Unit 2, Unit 3A, Unit 3B) in the read mode has been installed. Memorandum 6M-3646 describes the programming requirements and installation details.

The interlace on the auxiliary section of the buffer drum has been changed to increase the speed of drum block transfers. For further details, see Memorandum 6M-3646.

#### Crosstelling Between XD-1 and WWI

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

On 31 May it was decided to install a crosstelling link between XD-1 and WWI. At WWI the input system will employ an 85-bit FF shift register while the output system will use the computer to generate the phone-line message serially bit by bit. The installation at the Barta Building will be completed by the middle of September.

The crosstelling output installation at the Barta Building will also be utilized in the systems test of the semiautomatic height finder at S. Truro. The new equipment will eliminate the voice link now in operation between WWI and Lexington. We will first build our output system to enable the testing of the height-finding equipment to commence sometime in August.

### 1.2.3 Terminal Equipment

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

The regularly used check programs which refer to the buffer section of the buffer drum have been modified in accordance with Memorandum 6M-3622.

Memorandum 6M-3674

Page 14

The buffer-drum interlace will be changed 4 June as planned.

(T. Sandy) (UNCLASSIFIED)

The intervention-register marginal-checking program has been completely checked out and turned over to Don Morrison so that he can add this program to the consolidated test program, WWI.

4-Channel Ampex Recorders

(N. N. Alperin, A. V. Shortell) (UNCLASSIFIED)

The playback preamplifier panel is now in service. Numerous wiring errors and noisy supplies had to be corrected before the panel could be put into operation.

Typewriters and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

The tape comparer has been quieted down considerably by substituting a nylon gear for a steel gear in the drive mechanism. A second comparer is now being assembled and wired by the Flexo shop.

Our present gray paper tape has worked so well that we are now ordering a 1-year supply. This tape can now be used with all of our FL punches.

Maintenance Programming

(J. Ackley) (UNCLASSIFIED)

I am working on a consolidated test program for Group 6345. One of its novel features is drum checking between scope displays for camera scope adjustment. By the time the scope has been adjusted, the drums have also been checked!

Power Supplies

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

The foundation for the new WWI filament alternator is now installed.

Memorandum 6M-3674

Page 15

II - AN/FSQ-7

General

(S. H. Dodd, N. H. Taylor) (UNCLASSIFIED)

In cooperation with Divisions 2 and 3, preparations were made for a Steering Committee presentation on 6 June of the status and planning for the Experimental SAGE Subsector.

An effort is being made to coordinate the interest of concerned personnel in reliability records for systems performance analysis.

It has been decided to install a crossteling link between XD-1 and WWI. The output equipment will be installed first to meet the August 1955 test schedule of the S. Truro semiautomatic height finder.

2.1 Liaison2.1.1 System

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

The broad-band blue operational lighting system designed for the SAGE operations rooms was shown to WE-ADES and Air Force building personnel on 24 May 1955. It was their impression that the blue environment caused dizziness and vertigo upon entering the room. There was no agreement among them as to whether the effects tend to disappear with time or not. At a subsequent meeting on 1 June 1955 in New York a draft specification of the system was discussed. Since we were unable to resolve the vertigo problem in New York, still another meeting has been scheduled here at Lincoln for 9 June 1955. At this time the Air Force building people will be accompanied by several experts of their choice who will help them evaluate the effects of blue light.

Since these meetings, we have contacted many people with medical, psychological, and operational backgrounds, and we can find no one who knows of any physical problems that arise from the blue environment. Some people did state that there may be mental reasons for feeling depressed under the blue lights. However, this problem is not severe enough to reject the system when compared to the difficult operating conditions existing in the extremely low levels of light that would be necessary if we did not restrict the ambient light to the blue region.

The operational people were completely unanimous in their approval of the system, because it allowed them to operate at light levels much beyond anything they had previously experienced and, furthermore, it does not require dark adaptation upon entering, nor the momentary blindness on leaving the room.

XD-1 and SAGE Schedules

(J. J. Carson, F. F. Manning, W. H. Ayer) (UNCLASSIFIED)

Material has been gathered and an agenda prepared for the Lincoln Laboratory Pre-ADES Meeting to be held on 7 June 1955.

XD-1 Status

(J. J. Carson, F. F. Manning, W. H. Ayer) (UNCLASSIFIED)

The display frame 24 and the display generator 25 are undergoing testing of margins and reliability checkout. The display system is approximately 6 weeks behind schedule. A firm schedule for end dates on which consoles must be installed has been released. It is contemplated that there will be no further lag in the display schedule.

Technical Information Releases

(E. D. Lundberg, J. J. Carson, R. R. Shorey) (UNCLASSIFIED)

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

<u>TIR</u>	<u>M-Note</u>	<u>Subject</u>
1-72	6M-3378	Power Generation & Distribution for the SAGE System D.C.'s, Fifth and Subsequent Sites.
1-74	6M-3501	Annunciator System for Monitoring Air Flow in SAGE D.C.'s and C.C.'s
1-75	Specifications	Equipment, Ferrite Memory Core Specifications.
1-76	Group Report M-24-48	Data Input Specifications to AN/FST-2.
1-77	6M-3570, Supp. 1	Air Force Personnel Required for the Experimental Subsector.



Memorandum 6M-3674

Page 17

2.2 XD-1, XD-22.2.1 SystemsLogical Services Committee

(N. T. Jones, R. D. Buzzard) (UNCLASSIFIED)

Command Post DD Desk. Three mockups were demonstrated 1 June and one was selected to be modified. The decision is summarized in Memorandum 6M-3660, "Command Post Desk Design."

Crosstabling

(J. P. May, A. M. Werlin) (UNCLASSIFIED)

A meeting was held 31 May 1955 in which the requirements for crosstabling between XD-1 and WWI were discussed further. The equipment, manpower and scheduling requirements were set forth by L. Holmes and A. Roberts, and it was proposed that the 85 bit FF input shift register be constructed for the WW input drum system. For the output WWI will be programmed to generate the output message bit by bit. The equipment requirements for this would be negligible. It was estimated that this crosstabling equipment at Barta would be constructed and ready for systems test by late fall. The data circuits for this operation have been ordered from the telephone company.

South Truro FGD

(H. E. Anderson, J. P. May) (UNCLASSIFIED)

A trip was made to the South Truro P-site to observe operation of the prototype AN/FST-2 (FGD) equipment and determine differences with the production AN/FST-2.

Power

(J. J. Gano, G. F. Sandy) (UNCLASSIFIED)

Acceptance test discussions with IBM yielded the following:

1. The motor-generator sets and switchgear are presently acceptable;
2. The d-c supplies are now being corrected by GE;
3. The distribution system is acceptable provided that IBM will replace the Struthers-Dunn relays if, despite the modifications, they become faulty again. The 1 July goal for acceptance appears reasonable.

Memorandum 6M-3674

Page 18

External Magnetic-Tape Equipment

(S. L. Thompson) (UNCLASSIFIED)

A study to determine if external magnetic-tape equipment should be used to supplement XD-1 in-out equipment has begun. The advantages will be:

1. External magnetic-tape equipment will transfer information on a magnetic tape to punched cards, paper tape, or a printer without going through the computer.
2. Information on punched cards or paper tape could also be transferred to the magnetic tape.
3. The computer can, with this equipment, perform in-out operations on the relatively high-speed magnetic-tape units.
4. Information can be later transferred to the relatively slow printer or card machines at some later time.

Communications

(C. J. Carter, F. E. Irish) (UNCLASSIFIED)

Messrs. F. E. Irish and C. J. Carter announce the marriage of their cohort, Mr. Howard J. Kirshner, to Miss Diane Bierer of Kittanning, Pennsylvania, on 29 May 1955. It is expected that their honeymoon in Miami, Florida, will be concluded during the next biweekly period.

Memorandum 6M-3275, "Leased Telephone Circuits for AN/FSQ-7 (XD-1)," which gives the maximum requirements and the dates for XD-1 leased circuits has been revised and published as 6M-3275-1.

Word has been received from EADF that, in general, we cannot use any existing entrance facilities at Air Force sites. Lincoln must provide the cable for XD-1 circuits.

On 31 May 1955 a meeting was held with representatives of Division 1 and AFRCRC to discuss the possible administrative procedures for ordering and paying for XD-1 leased telephone circuits.

### 2.2.2 Installation

(H. F. Mercer, H. Wainwright) (UNCLASSIFIED)

#### I. Building Construction

As last reported, receipt and installation of specified cylinder locks is the only deterrent to completion of the interior of the building.

The general contractor has started work on completing the exterior of the building.

Under IBM contracts, the general contractor has some door hardware and emergency fresh air roof monitor equipment to install and some painting and caulking to finish.

#### II. Equipment Cooling

It has been decided to keep the dehumidification section of the equipment-cooling system operating continuously rather than shut it down as in the past. This is consistent with XD-1's operating schedule which calls for shutdown midnight Friday through midnight Sunday. Despite our shutdown, the chilled-water supply from Cambridge Research Center source continues circulating and has been causing condensate when the building "warms up" during the shutdown period. We expect to eliminate this condition by keeping the dehumidifier and, possibly, one air handler in operation continuously.

#### III. Cabling

In an effort to meet testing schedules, it may be necessary to rehire Livingston Company, the power wiring contractor, to expedite installation of signal cables, because IBM has been unable to supply promised manpower to augment Lincoln's technicians now engaged in signal-cable installation.

#### IV. Equipment Layout

Command Post - We have received construction drawings and specifications from Cleverdon, Varney & Pike. We hope that review and revision of these items will be completed before 10 June. Our investigation of the requirements of the Projection Room in particular has led us to specify grating for the floor of the Projection Room. This will permit, we feel, greater flexibility in the location of equipment in that area, since final location of the equipment has not been decided and probably cannot be until the Command Post has been prepared.

#### V. Lighting

Within the next week, we hope to start modifying the existing system on the second floor consistent with the requirements specified for the production buildings, after testing conducted in B-034. Orders will be placed as rapidly as possible for the ceiling and fixtures required. The production buildings system is to be installed in the ID room for evaluation before all fixtures are ordered.

Memorandum 6M-3674

Page 20

### 2.2.3 Testing

(S. L. Thompson) (UNCLASSIFIED)

Lack of computer time has limited progress on the sandwich program.

The GFI frame is being connected to MTC and will be tested with MTC during the next 2 weeks.

A program to test field switching for the addressable fields is being prepared for the drums.

### XD-1 Records

(J. D. Crane) (UNCLASSIFIED)

The new XD-1 log is now being used by IBM and MIT personnel to record the history of XD-1 operation. When this log system is operating in a satisfactory manner, reports of the XD-1 operation will be presented in the Biweekly Report.

### XD-1 Evaluation

(J. D. Crane, S. L. Thompson) (UNCLASSIFIED)

Results of the third evaluation test run on the XD-1 computer on 20 May 1955 are being published in 6M-3669, "XD-1 Evaluation, 20 May 1955."

### XD-1 Memory

(W. Canty) (UNCLASSIFIED)

Investigations of the woes of core memory have resulted in six experimental modifications of circuitry in Memory II. The latest of these was a modification change in the sense-amplifier circuit to extend its high-frequency response. This change was installed in all 33 sense amplifiers of Memory II in 6 hours thanks to the efficient service of the Division 6 shops and the Bldg. F pluggable-unit repair section.

Immediately after these modified units were returned to Memory II, it was possible to run program RMM 204 (the so-called "worst memory pattern without post-write disturb") with sense-amplifier bias margins twice as large as ever recorded for this program in any FSQ-7 memory.

An attempt will be made to finish XD-1 memory investigations next week and recommend a set of permanent modifications.

Memorandum 6M-3674

Page 21

D-C Power

(S. T. Coffin) (UNCLASSIFIED)

General Electric has resumed efforts to improve regulation of XD-1 d-c supplies. They should be finished with bank A in about a week. We will then put the computer on bank A and test bank B.

2.3 Production System

(K. E. McVicar) (UNCLASSIFIED)

We are in the process of preparing an outline of job tasks which the Test Planning and Coordination Section will do. This job list will be used as a basis for manpower deployment and computer time requests.

(C. W. Watt) (UNCLASSIFIED)

Some time has been spent during the last 2 weeks in investigation of record-keeping methods for the Cape Cod System. This is a different and somewhat more complicated problem than keeping such records for the Direction Center itself and is complicated at the moment by the fact that the entire Cape Cod System is not in full operation. The tests being run for the SAGE Test Committee on Cape Cod do not demand the full complement of external equipment. The actual equipment used varies from day to day, and making an analysis of system reliability requires that a uniform method of evaluating the day-to-day operation be set up. This is being worked on and a concrete proposal will be ready in 2 or 3 weeks.

Memorandum 6M-3674

Page 22

LRI Monitor

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

A meeting was held with the subcontractor IBM has chosen to design and produce the LRI monitor equipment. The proposed method of operation was described and the justification for the system limits was stated.

The LRI monitor specifications have been completed and distributed for review for concurrence.

(J. McCusker) (UNCLASSIFIED)

Logical and special conversion circuits needed to convert radar site data to a form suitable for scope display performed encouragingly in a demonstration which used MTC logical circuits. The display time was 100 microseconds as compared to 8 milliseconds for WWI's flying circle method. The new system with modifications in the multiplication techniques was considered by the Bendix engineers to be suitable for the production model of the LRI monitor.

Reliability

(R. C. Jeffrey) (UNCLASSIFIED)

Memorandum 6M-3441, "Reliability of Duplexed Equipment," has been distributed; comments and criticisms are invited. The memo deals with two problems: (1) given the reliability figures for a simplex machine, how do you derive the corresponding figures for the duplex? and (2) given the reliability requirements for the duplex, what does this imply about the reliability figures for the two simplexes? A meeting will be held within this biweekly period to discuss the memo.

Additional problems are: (1) to clarify what is meant by simplex reliability figures such as percentage down time, mean free time between failures and duty cycle so that two different people making the same observations on the same machine would come up with the same reliability figures; (2) to combine the various reliability figures into a single figure of merit which will be a meaningful measure of the ability of the machine to perform its task.

Power Generation

(J. J. Gano) (UNCLASSIFIED)

Jackson and Moreland has been calculating the voltage dip on the generating bus due to motor-generator set starting. Although computer operation is not affected, it is desirable to maintain the drop

Memorandum 6M-3674

Page 23

below that which creates fluorescent light dropout. Reduced voltage starting using reactors and autotransformers has been checked. The latter are more favorable but require more equipment.

(R. Jahn) (UNCLASSIFIED)

I have obtained more power measurements of XD-1 frames and am revising estimates of duplex central power consumption and updating cooling-equipment requirements. A-c measurements are still running about 25% less than the original estimates.

(A. S. Chopourian) (UNCLASSIFIED)

The first draft of the specification on a mimic panel to be installed in the maintenance console area has been written and should be distributed during the week of 6 June 1955.

Memorandum 6M-3674

Page 24

## 2.4 Vacuum-Tube Circuits

### Gap-Filler Sweep Circuit

(B. W. Barrett) (UNCLASSIFIED)

The gap-filler sweep circuit will sweep in both directions, and I am now finding its operating margins.

### Vector Generator

(E. B. Glover) (UNCLASSIFIED)

A new sweep generator has been designed using the boot-strap principle. This circuit has been breadboarded and proved to be feasible. During the next biweekly period it will be checked for margins and optimum component values.

### Display-Line Driver

(J. Kriensky) (UNCLASSIFIED)

Testing of this unit is being continued to optimize the margins of the circuit.

### Flip-Flop, Model E

(N. J. Ockene) (UNCLASSIFIED)

Further tests on the Model E flip-flop using a special biasing network in the cathode circuit have been partially successful. The main drawbacks of the new circuit configuration have been poor margins and marginal asymmetry. The problem of insufficient margins has now been solved, but the marginal asymmetry still exists and additional work will be done to improve it.

### Direct-Coupled Video Probe

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

The diagnosis of the probe system's faults made in the last Biweekly was partially incorrect. Grid-current loading was occurring and its effect was minimized by reducing the grid-circuit resistance. However, the variation of tube input capacitance proved to be minor in effect. It was discovered that probe cable ringing lasting for only 0.1  $\mu$ sec produced a 100- $\mu$ sec degradation on the transitions of a fast-rise square-wave signal. The cable ringing has now been largely suppressed with small resistors placed at the ends of the probe cable.



Memorandum 6M-3674

Page 25

It has been possible to lengthen the probe cable to 5 feet and preserve an over-all rise time, when used with the DuMont 336 oscilloscope, of 22-25  $\mu$ sec. The probe input impedance is 1.3  $M\Omega$  and 20  $\mu$ f with a 10:1 over-all attenuation ratio, and the unit exhibits no bias buildup.

The probe system and a DuMont 336 oscilloscope are now installed in XD-1 with 100 feet of cable strung through the ceiling. It appears to perform satisfactorily, but it is obvious that new ideas are needed for methods of packaging the probe system and attaching it to the computer.

#### Sensing Amplifiers for Memory Planes

(R. C. Zopatti) (UNCLASSIFIED)

The plug-in unit of a sense amplifier (experimental) with a difference amplifier input was inserted in the memory section of XD-1 in order to compare it with the XD-1 sense amplifier. The unit had comparable gain and bandwidth but still has the prf sensitivity problem of the XD-1 amplifier.

#### XD-1 Memory

(D. Shansky) (UNCLASSIFIED)

A modified version of the XD-1 sensing amplifier (modification proposed by S. Bradspies) was tested in Poughkeepsie and was found to operate satisfactorily.

An improved version of the XD-1 digit-plane driver was also tested in the XD-2 computer and ran successfully.

Work on a new memory gate generator is proceeding, and the design of this unit should be completed in a few weeks.

### 2.5 Display

(R. S. Fallows) (UNCLASSIFIED)

The situation display part of console 168 (display maintenance) has been working intermittently for several weeks. The over-all frame tests on both central display frames have been pending for 1 to 4 weeks while miscellaneous debugging, cabling, and repairing have been causing daily delays. We are finding bad Stemag resistors in both frames almost daily. Troubles in MTC have caused several days of delay also.

A few minor deficiencies in the logical design of frame 25 (digital-display generator and display tester) have been discovered and are being corrected.

Memorandum 6M-3674

Page 26

Frame 24 (situation-display operator) has been tied in with the MTC drum and is in the process of being debugged.

Four engineers and eight technicians from Hazeltine have joined our console installation team. These men are in the process of training for the job. We do not yet have a clear picture of the state in which consoles will be delivered from Crosley. I am expecting and hoping that the IBM and Hazeltine people will be able to handle the entire debugging, reworking, and installing of XD-1 consoles with only a small amount of assistance from MIT.

The console cabling situation is still very poor. About 70% of the DB (distribution box) to DB cables have been delivered and about 10% have been installed. About a month ago it was discovered that IBM had ordered only half enough bulk cable of the special type used for DB to console. We understand that this cable was ordered from Supernaut this week and is scheduled for production around the end of June. We thus can expect to have all console cables around the end of July. This delay may not cause any trouble, but I fear it will. It appears that we will be making up or modifying cables for most consoles installed before August. Ed Reardon should have more to say on this subject.

(R. H. Gerhardt, R. B. Paddock) (UNCLASSIFIED)

Operation of the digital-display frame has shown a need for several logical changes which are now in process: positive automatic turnoff of the tester when its use is not required; inhibition of any intensification prior to the first D.D. loading; positive resets of the slot line counter for DD-1 and DD-2 operation. A few additional changes may still be required for operation with the MTC drums. Once these changes are completed and checked out operationally, there will remain only some marginal checking before frame 25 can be considered in final form for release to regular maintenance personnel.

Many troubles continue to occur as a result of faulty Stemag resistors for which replacements have not yet arrived.

Power modifications to handle a surge on the +90-v line and to power the tester separately from the rest of frame 25 are ready to be made this weekend or next.

(J. Woolf) (UNCLASSIFIED)

In order to expedite the console installation and maintenance for XD-1 a program was set up to train Hazeltine personnel. They will complete the installation of console 2 and assume as much of the installation program as possible. Steps were taken to set up facilities for plug-in unit testing. Until these units are available the console in MTC will serve as a plug-in unit tester.

Memorandum 6M-3674

Page 27

Console 1 suffered from trouble caused by the failure of three Stemag resistors. The -3.3-kv unit blew. It appears that the initial transient is enough to cause the sensitrol to kick out. This problem will be referred to the people at IBM who approved this supply.

In order to develop simple techniques for compensating for the eddy currents in the shield caused by the deflection amplifier, facilities have been incorporated in MTC to run tests which would correspond to worst conditions possible in XD-1 operation.

(H. E. Zieman) (UNCLASSIFIED)

Experiments with the magnetic-deflection system indicate that the consoles will have to be individually compensated to provide a rise time better than the required 30 microseconds. Since several different time constants are involved, the compensation procedure at present is rather complex, but all yokes tested so far have provided rise times in the order of 20 microseconds when properly compensated. However, no single set of time constants will satisfy all yokes sufficiently to maintain the rise time below 30 microseconds. Fixed circuit components can be used to compensate for certain time constants which depend on the magnetic properties of the yoke materials. The plan at present is to provide a minimum of variable time constants which would have to be adjusted for an optimum square wave response. Experiments are now being carried out in MTC to develop a straightforward procedure for compensating the yokes.

Automatic Camera and Camera Control

(L. Sutro) (UNCLASSIFIED)

Experiments with the relays in the camera control that switch large inductive loads have led to a uniform arc suppression circuit. A 0.22- $\mu$ f capacitor in series with 22 ohms will be connected across the relay contact. The capacitor stores the energy from the inductance at break; the resistor limits the current from the capacitor through the relay contacts at make. One inductive load, namely the index solenoid in the camera, would require a series capacitor of 10  $\mu$ f across the relay contact to suppress the arc at break. However, by diverting a major part of the energy from the solenoid through a parallel 1N93 rectifier, it is found possible to use only 0.22  $\mu$ f across the relay contact.

## 2.6 Vacuum Tubes

### 2.6.1 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

I spent the week of 23 May 1955 at the Convair Charactron Tube Plant with T. F. Clough and IIM tube personnel. Convair had finalized their manufacturing process specifications for the Charactron tube and started a pilot run of tubes that week. The first week's production during our visit tested very satisfactorily. The results of this run indicate that they should get a high yield from their present run. However, a new test-specification problem arose. The IIM-Convair production test units have a high impedance in the selection-plate circuits which accentuate and give a new beam-center-shift problem. Since low-impedance circuits are used in the display console, a new test specification should be written for the beam-center shift or the test unit should be redesigned.

Work continued in the Lincoln Tube Laboratory on evaluating the new cathode processing schedules proposed by Superior Electronics for the guns which they are selling to Convair. At the moment it appears that almost any cathode-processing schedule will produce tubes which pass acceptance tests provided the proper bulb preparation is used.

Hughes Aircraft has called a joint HAC-IIM-MIT committee meeting for 15 and 16 June on Typotron production problems. The agenda for this meeting is a review of their last 6 weeks' production, correlation of test data, and discussion of changes in the test specifications.

Trips are scheduled to Sylvania and General Electric the week of 6 June to review recent progress and expedite the second source for the pentode and twin triode.

### 2.6.2 Tube Research and Development

(J. S. Palermo) (UNCLASSIFIED)

Observations and data recorded at the Convair Charactron Plant and supplementary work conducted in our laboratory clearly indicate that the "gold band" used in the Convair Charactron tube is neither necessary nor conducive for production of a quality-display tube. However, the evaluation of all available data cannot substantiate any theories that the gold band causes cathode poisoning. Surface preparation and adequate bakeouts of glass components are the prime factors in the production of quality 19-inch Charactron tubes. A series of tubes prepared as close as possible to Convair Manufacturing Process Specification (26 April 1955) will be processed in our laboratory to determine the effect of inadequate bakeout on cathode operation.

Memorandum 6M-3674

Page 29

(S. Twicken) (UNCLASSIFIED)

At a meeting of the IBM and MIT Tube and Circuits Groups at High Street, decisions were reached on the lower limit of Class A plate current for the 0528 (Z-2177-3) and the potential redesign by General Electric. Since the high-speed flip-flop requires redesign for duplex machines irrespective of the lower acceptance limit for plate current, it was decided to accept all tubes compatible with the present product distribution and other specification requirements. This will allow GE to get out of their present difficulty resulting from the Class A plate current of factory tubes being somewhat lower than that of development-shop tubes. It was also decided that the GE redesign to increase the Class A plate current is not acceptable because of somewhat lower  $\mu$  of the resultant tube. GE will be informed to cease and desist from all redesign activity.

I attended a joint MIT-IBM-Sylvania-Bendix meeting held at Kingston in order to get the cooperation effort under way on the second source of gate pentodes for AN/FSQ-7.

A meeting at Tung-Sol on the DT-438 (improved 5998) shows the first material progress to have been made. The hooded, pressurized mount-line is in operation, a team of operators is being trained, the first tubes are being exhausted, parts-cleaning equipment is being set up, etc. The initial period of equipment ordering and delay is over, and the program is now gaining momentum.

(T. F. Clough) (UNCLASSIFIED)

I spent the week of 23 May 1955 with P. Youtz, W. Mutter of IBM, and Convair engineers discussing and comparing procedures reported in the Convair Manufacturing Process Specifications with the Lincoln Tube Process Specifications.

We also discussed thoroughly the procedure Convair intends to use for controlling process changes, keeping specifications in their plant up to date, and notifying properly IBM and MIT of these changes.

(D. C. Lynch) (UNCLASSIFIED)

Work has continued on bulbs for the 19-inch display program and evaluation of Convair Manufacturing Process Specifications. A complete revision of the chemical processing procedures has been undertaken to conform more closely with the format of the Lincoln Tube Process Specifications.

Experiments associated with other display problems have been conducted for Group 25.

Memorandum 6M-3674

Page 30

(L. B. Martin) (UNCLASSIFIED)

The eight-position Typotron life test has been dismantled because of duplication of equipment with two Typotron life tests. This unit was hurriedly built and, as a consequence, awkward to operate. The 16-position unit is currently being expanded to 22 positions and is about 75% completed. Only nine positions are currently occupied on this unit. Seven tubes will be removed from the eight-position unit and continue their life test on the 16-position unit.

The automatic transfer-characteristic curve plotter is almost completed. Reorganization of equipment in the laboratory the week of 30 May made work on this plotter impractical.

Full time is now being devoted to my Master's thesis which should be completed in 2 weeks.

The following is a list of tubes, their condition, and total hours on the eight-position life test:

<u>Tube</u>	<u>Total Hours</u>	<u>Condition</u>
265	9335.5	marginal <sup>1</sup>
280	8517.5	marginal <sup>2</sup>
389	6914.9	satisfactory
390	6998.3	satisfactory
392	6998.3	satisfactory
394	6216.6	marginal <sup>3</sup>
11601	2311.3	satisfactory
11521	2066.8	satisfactory

<sup>1</sup>Tube 265 is marginal because of ion damage to center of storage surface. Tubes of a later model have ion-repeller screens.

<sup>2</sup>Tube 280 is considered marginal because of low beam current.

<sup>3</sup>Tube 394 is marginal because part of the storage surface switches positive at low-collector current.

Tubes 11981, 12122, 12523, 12622, and 12641 have been on the 16-position life test for 1533.6 hours, while tubes 12242, 12461, and 12522 have been on for 807.9 hours. All are satisfactory.

(P. C. Tandy) (UNCLASSIFIED)

Nine 19-inch tubes, CHT-61, CHT-62-1, CHT-72-2, CHT-73, CHT-75, CHT-80, Convair 14-1, 0083, and 0208, will be returned to life test following a shutdown to reorganize the laboratory area and modify equipment to accommodate 20 tubes. Tube 0082 will be retested to determine any improvement.

Memorandum 6M-3674

Page 31

My Master's thesis on "Investigation of Factors Affecting Life of Charactron Tubes" has been issued.

## 2.7 Memory Test Computer

(W. A. Hosier) (UNCLASSIFIED)

There have been no major new developments in MTC operations or planning this past fortnight. Signal generation and transmission for the DD display testing continues, with no SD testing as yet; installations are virtually complete for the GFI testing, and a preliminary checkout of this setup is scheduled for Monday, 6 June.

A demonstration of the Charactron was given to a missile-control symposium under the direction of Doug Ross of the MIT Servo Lab on Thursday, 2 June; those present seemed to feel that the Charactron could be quite useful in the real-time display and control of missile trajectories.

Another demonstration of McCusker's  $r-\theta$  conversion apparatus for PGD plotting was given to a group of Bendix engineers on Friday, 3 June (Bendix having the task of putting this breadboard equipment into production).

Wells' Section of Group 61 has finished a large block of interception simulation and data processing in preparation for their tracking symposium on Monday, 6 June.

There were two fairly serious interruptions to computer operation this period: first, some 4 hours at intervals lost to faulty operation of the brake on the Ferranti photoelectric tape reader; second, approximately 8 hours lost to straightening out control cabling and switches inadvertently mixed up by test equipment personnel in the process of testing Burroughs units in MTC Control. This last, due mainly to misunderstanding but partly also to carelessness, was unfortunate to say the least, and all precautions are being taken to see that it is not repeated. This testing of Burroughs units by methods somewhat more sensitive than MTC marginal checking revealed that about half the units tested were approaching marginal efficiency (usually because of tubes) and should be restored to proper condition.

Distribution of computer time this period has been as follows:

<u>Application</u>	<u>Hours</u>	<u>Per Cent</u>
Programming	141.98	61.9
Development	19.75	8.6
Maintenance & Marginal Checking	24.45	10.7
Installation	6.16	2.7
Interrupted Failures	14.91	6.5
Reliability Check Programs	21.88	9.6
	229.13	100.0

Memorandum 6M-3674

Page 32

(B. G. Farley) (UNCLASSIFIED)

A program for MTC post-mortem punchout on cards is nearly completed. It will enable a field to be punched out in about 2.5 minutes for later printing by the IBM line printer.

(J. H. Newitt) (UNCLASSIFIED)

Work on the GFI-MTC test program continues with preliminary equipment tests planned during the coming period.

(E. Albanese, B. Searle) (UNCLASSIFIED)

The following is a summary, for the period 23 May to 3 June, of defects found in tubes and in components in MTC:

<u>Tube or Component</u>	<u>Defect</u>	<u>Quantity</u>	<u>Hours Lost</u>
2D21	Out of tolerance	1	0
6145	Tap short	1	0
Z2177	Tap short	2	0
Resistor	Open	2	0
Resistor	Burned out	1	0.56
Crystals type 1N34	Back resistance too low	2	0
Circuit breaker 50-amp	Intermittent	1	0
		<u>10</u>	<u>0.56</u>

Marginal Checking

(R. Hughes) (UNCLASSIFIED)

MC-92, the new MTC marginal checking program, has been completed. This program has disclosed some very low margins which have been temporarily repaired. Work has started on a new marginal checking program which will contain MC-92 and will test equipment not presently being checked by MC-92.



## III. ADVANCE DEVELOPMENT

3.1 Chemistry of Magnetic MaterialsInorganic Chemistry

(F. S. Maddocks, D. G. Wickham, F. E. Vinal) (UNCLASSIFIED)

It has been predicted that a spinel with the composition  $\text{Li}^{+1}(\text{Mn}^{+3}\text{Mn}^{+4})\text{O}_4$  would exhibit ferromagnetic properties. The preparation of this material has been attempted. A procedure was developed for estimating the molar ratio,  $\text{Mn}^{+4}/\text{Mn}^{+3}$ . The products obtained (1) by reacting  $\text{MnO}_2$  with  $\text{LiOH}$  at 700-800C, (2) by reacting  $\text{MnO}_2$  with  $\text{Na}_2\text{CO}_3$  and excess  $\text{LiCl}$  at 750C and (3) by reacting  $\text{Li}_2\text{CO}_3$  and  $\text{MnO}_2$  in a fused salt bath are essentially the same. They are all apparently spinels and contain the manganese in oxidation states expressed by  $\text{Mn}^{+4}/\text{Mn}^{+3} = 1.4$  rather than the desired  $\text{Mn}^{+4}/\text{Mn}^{+3} = 1.0$ . This ratio can possibly be controlled by varying the temperature at which the sample is prepared. The magnetic properties of several compositions will be investigated.

Thermal Stability of Magnetic Spinel

(F. S. Maddocks, D. G. Wickham, F. E. Vinal) (UNCLASSIFIED)

Thermal analysis curves for three samples of  $\text{LiMn}_2\text{O}_4$  prepared by different methods in the laboratory have been obtained. Results are essentially the same for the three samples: thermal stability to about 900C, an endothermic peak at about 985C, and a sharper endothermic peak at about 1085C was observed for each sample. On cooling from 1150C each sample showed a sharp exothermic peak at about 1030C indicating that the sharp peak at 1085C represented a reversible reaction, possibly a polymorphic change whose true temperature of occurrence would be about 1055C.

Experimental Ferrites

(D. L. Brown) (UNCLASSIFIED)

The preparation of magnesium-copper ferrites was continued.

The firing of lithium ferrite in oxygen indicated no advantage over firing in air. It is believed that the unsatisfactory results obtained so far are possibly due to a loss of lithium at the temperature required for sintering, regardless of atmosphere. Chemical analyses are being made to determine whether or not composition changes upon firing.

Lithium ferrite samples containing nickel ferrite and magnesium ferrite have been prepared to ascertain the effects of these additives on squareness. Lithium ferrites containing a small amount of nickel ferrite have shown in preliminary samples values such as  $R_s \text{ max.} = 0.78$ ,  $B_s = 2500$  gauss, and  $H_c \text{ sat.} = 2.2$  oersteds.

Memorandum 6M-3674

Page 34

Chemical Analysis

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

Quantitative analyses of the following have been completed:

1. Bell Laboratories Ferrite "x", a magnesium-manganese ferrite;
2. IR-6, a magnesium ferrite;
3. DCL-8-66.2, DCL-8-65, and DCL-8-66.1, all samples of  $\text{LiMn}_2\text{O}_4$ ;
4. DCL-1-200, a sample of  $\text{Mn}_2\text{O}_3$ ;
5. Assay of  $\text{MnO}_2$  Lot No. 8007.

Quantitative analyses of the following are in progress:

1. DCL-2-851 and DCL-2-852, memory-core compositions;
2. DCL-3-250B, a lithium ferrite;
3. DCL-8-68, a sample of  $\text{LiMn}_2\text{O}_4$ .

Production of Memory Cores

(J. Sacco) (UNCLASSIFIED)

The difficulties encountered in the processing of memory cores seem to have been eliminated. During this biweekly period, two successful firings were made. Full-capacity pilot-plant production will be resumed during the coming week.

Core Testing

(J. W. Schallerer) (UNCLASSIFIED)

Eighty-thousand cores were double-tested during the past biweekly period bringing the total to 814,000.

3.2 Physics of Magnetic MaterialsConference on Remagnetization Processes in Metal Tapes

(J. B. Goodenough) (UNCLASSIFIED)

A symposium on the remagnetization process in thin metal tapes was held at the Armour Research Foundation, Chicago. Although the purpose

Memorandum 6M-3674

Page 35

of the conference was to put forth a different remagnetization mechanism than that already proposed by this Laboratory, I came away more convinced than ever of the correctness of the essential features of the model worked out here.

Eddy Current Voltage Output

(N. Menyuk) (UNCLASSIFIED)

The remagnetization process of thin metallic tapes of thickness 0.001 inch or greater are primarily limited by eddy current effects. A calculation has been made of the voltage output curve due solely to eddy current loss during the collapse of an elliptic domain of reverse magnetization. The resultant output voltage waveform is initially high, gradually tails off, and has a sharp cutoff. This is in qualitative agreement with the observed output form beyond the peak voltage point. The lack of an observed sharp cutoff is believed due to a time distribution of collapsing domains.

Magnetic Measurements

(D. O. Smith) (UNCLASSIFIED)

A vibration-amplitude stabilizing circuit for the vibrating coil magnetometer (vcm) has been designed and is in the wiring shop.

The mechanical design of the vcm itself is in the drafting room and is proceeding satisfactorily. Auxiliary equipment for use with the vcm has been sketched.

Memory-Matrix Noise

(J. D. Childress) (UNCLASSIFIED)

A paper on the magnetic-material-dependent contribution to memory-matrix noise is being prepared for the Conference on Magnetism at Pittsburgh, 14-16 June.

3.3 New Components and Circuits

Circuit Work at Philco

(T. H. Meisling) (UNCLASSIFIED)

During a visit to Philco's Plant 50, I discussed Philco's and our transistor circuit work with H. Affel and R. Brown. It was agreed that the work at Philco under the contract needs to be redirected in order to make it more useful to us. This change can be accomplished by the beginning of the next contract period, 15 July.

High-Frequency Alloy Transistors

(D. J. Eckl) (UNCLASSIFIED)

Six of an original order of 25 Raytheon CK762 pnp alloy transistors have arrived. These transistors have a hole storage figure of merit of about  $2\mu\text{sec}^{-1}$  as compared to a value of about  $40\mu\text{sec}^{-1}$  for surface-barrier transistors. Testing is continuing.

Power Transistors

(D. J. Eckl) (UNCLASSIFIED)

R. Rediker, R. Baker, and I visited the production facilities of Minneapolis-Honeywell Co. which makes power transistors of a type usable in regulated power supplies.

Transistor Parameter Data

(D. J. Eckl) (UNCLASSIFIED)

It appears feasible to use IBM punched cards to keep records of our surface-barrier transistors. A system to do this will be set up.

Maximum Frequency of Oscillation

(D. J. Eckl) (UNCLASSIFIED)

Both Group 35 and ourselves have been developing equipment to measure  $f_{\text{max}}$ . Results so far are in fair agreement with Philco's measurements.

Trip to Bell Laboratories at Whippany, N. J. (E. U. Cohler)

Experience on Tradic (a computer employing 700 point-contact transistors in a SEAC-like logic) indicates that great increases in component reliability may be expected in low-voltage circuits. They have had extremely few diode failures (approximately 0.01 percent/1000 hours), and those were among a group that was relatively overworked. They have had some trouble with some early model delay lines, but this seems to be clearing up with newer units. Otherwise they have had no failures or deteriorations in 2 years in: ceramic capacitors, midget mica capacitors, Allen-Bradley carbon resistors, silicon zener diodes, or other conventional components.

Their circuit work indicates that in some ways the Sylvania 2N94A is an excellent transistor. Speeds up to  $1/4$  those of SBT's have been obtained. Saturation voltages of  $1/4$  those in SBT's have been found. In addition the "break-points" seem sharper.

Series Chains of SBT Transistors

(T. Meisling, A. Pugh) (UNCLASSIFIED)

Series chains of surface-barrier transistors were investigated for over-all voltage drop. It was found that the transistor closest to ground is the most critical transistor. To a series chain of four average transistors, the voltage drop with an output current of 3 milli-amperes was found to be about 0.45 volts. Curves were prepared for various numbers of transistors, varying  $\alpha$  and varying base current.

Recovery Time in Surface-Barrier Transistors

(C. T. Kirk) (UNCLASSIFIED)

A test setup for measuring effective lifetime has been installed in the laboratory and is in operation. Effective lifetime measurements are now being made on all surface-barrier transistors coming into the laboratory.

An experimental unit for measuring recovery times of surface-barrier transistors under known saturation conditions is under construction. This unit is expected to be completed during the next biweekly period.

Transistor Measurements

(P. A. Fergus) (UNCLASSIFIED)

Measurements of grounded-emitter characteristics have been made of Minneapolis-Honeywell 2N57 power transistors, Minneapolis-Honeywell H-2 transistors and Sylvania 2N68 power transistors, and curves ( $I_c V_c$ ) of these characteristics have been plotted.

A new test has been set up to determine the effective lifetime of the base of the surface-barrier transistors. Approximately 150 Philco SBT's have been measured and a distribution curve has been plotted. Results indicate most values lie between 4 and 10 microseconds.

Twelve Raytheon high-frequency transistors have been received and routine measurements have been made.

Pulse Generator

(M. E. Petersen) (UNCLASSIFIED)

The pulse generator has been modified by redesigning the oscillator to obtain more stability and output. This made it possible to eliminate one stage of the buffer amplifier. The circuit will now generate pulses at rates up to 12 megacycles. Hole storage in the emitter-follower output limits the maximum rate with a stable reference level to approximately 11 megacycles with a 91-ohm emitter resistor. Evaluation of the circuit with low  $\beta$  transistors has been started.

Memorandum 64-3674

Page 38

### 3.4 Memory

#### XD-1 Memory

(J. L. Mitchell) (UNCLASSIFIED)

The XD-1 sense amplifiers have been modified so that their performance is approximately equal to the performance of the MTC amplifiers. The result is an increase in the operating margins for most programs.

#### 256<sup>2</sup> Memory

(J. L. Mitchell) (UNCLASSIFIED)

A proposal for a method of communication between memory and the transistor circuits of the TX-O machine has been offered, and a decision as to acceptance will be made within the next two weeks.

The prototype vacuum-tube plug-in unit is about complete.

#### Transistors for Memory

(J. Raffel) (UNCLASSIFIED)

An outline is being drawn up of alternative systems for using transistors to drive the x-y coordinate lines of memory, along with estimates of the transistor operating specs needed for such systems. It is hoped that this will provide a start in setting up a transistor development program with Philco specifically for the memory driving application.

#### 256<sup>2</sup> Memory

(J. Raffel) (UNCLASSIFIED)

The results of J. Schallerer's single-core tests indicate that the total voltage contribution on the sense winding due to switch-core noise-currents may be negligible and is, in any case, much less than was originally anticipated. Spurious voltages due to stray capacity still remain something of a problem.

#### 256<sup>2</sup> Memory

(E. A. Guditz) (UNCLASSIFIED)

One hundred and thirty-two mats, most of which lack one-half

Memorandum GM-3674

Page 39

of the sense winding, have been made to date.

Delays in frame production have been encountered due principally to dimensional stability of the master used for photo-etching the frames. The use of a glass master shows promise of breaking this bottleneck.

#### Printed Plane

(E. A. Guditz) (UNCLASSIFIED)

Experiments have been resumed on the printed plane. A laminating press has been purchased and installed. It is now possible to laminate cold-rolled copper to a variety of base materials.

#### Memory Test Setup VIII

(D. H. Ellis) (UNCLASSIFIED)

All the switch-driver panels are complete, and the work on the matrix output amplifiers is progressing satisfactorily.

The magnetic-core switch plug-in units are to go into production next week.

#### XD-1 Sensing Amplifier

(S. Bradspies) (UNCLASSIFIED)

The speed of the XD-1 amplifier was improved by adding shunt compensation in the final stage. The pulse rise time is now .5  $\mu$ sec as compared with the 1.5  $\mu$ sec rise time before compensation.

#### Transistor Selection Switch

(G. Davidson) (UNCLASSIFIED)

Dick Thornton, Instructor, MIT, has agreed to supervise my thesis, but the proposal is still being written. Search for a transistor with high  $\beta$  at high values of emitter currents continues, and several possible circuit configurations are being considered; however, pulse testing will be necessary to determine turn-on times, turn-off times and dissipation.

Memorandum GM-3674

Page 40

### 3.5 Logical Design

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

A number of sample block schematics and block diagrams have been drawn in an attempt to find a satisfactory way of representing the logic of transistor circuitry. One problem which arises is the inversion between stages of serial circuits such as the carry circuits. The inversion is desirable for circuit reasons, yet to show it explicitly, badly clutters the block diagram.

We have finally arrived at a set of symbols which seem satisfactory. Examples of these will be circulated to interested people.

### 3.6 Systems Design

(R.A. Hughes) (UNCLASSIFIED)

Temporary air connections have been made to the A-M-F taper pin machine so that we may be able to use it on the 8-digit multiplier construction work.

The marginal-checking panel and the alarm panel have been built and tested for use in the multiplier.

Work has started on the indicator pulser circuit for the multiplier indicator lights.

(R. Sawyer) (UNCLASSIFIED)

Three digits of an accumulator were breadboarded to obtain information on the proposed logic, and the etched-boards are being laid out for the 8-digit multiplier logic.

(C. Norman) (UNCLASSIFIED)

The indicator panel for the multiplier is complete, and a panel is being built which amplifies the output of the checking circuitry so that it can control the test equipment control.

(M. Parfemk) (UNCLASSIFIED)

Drawings for the multiplier racks have been graded. Several experimental plug-in units have been built.



## IV - CENTRAL SERVICES

4.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

Some time ago we ordered special king size 8-foot relay racks with a view toward easing the space shortage. These have arrived and are now available in Division 6 special stockroom.

Division 6 stockroom has relinquished an area to the Production Control assigned stockroom in the interests of space conservation.

XD-1 lighting studies continue to present problems. The straight, smooth plastic tubes which were ordered from the William Crook Company looked as gnarled and crooked as shillelaghs when delivered.

Division 6 activity continues to increase. The number of requisitions processed by this office per day hit a new high in May, averaging 12% more than March, the previous high.

The 48-kva M-G set (WWI) has arrived in Boston after much expediting. It is in the hands of a rigging company and will be delivered as soon as we are ready for it.

4.2 Engineering Services4.2.1 Components

(C. Morrione, R. J. Biagiotti) (UNCLASSIFIED)

Some preliminary tests on a sample lot of 2% Corning Glass power resistors have been performed; results were favorable. A larger group, representing different wattages and ohmic values, has been ordered for more conclusive evaluation.

We have been trying to track down the cause of a few cases of open eyelets on the printed boards in XD-1, but it has been difficult to obtain a board with a failed eyelet because these eyelets, in most cases, have been repaired with a soldering iron.

4.2.3 Mechanical Engineering

(H. Wainwright, L. Smith, A. Smith, L. Prentice) (UNCLASSIFIED)

The techniques for hand wiring a 64 x 64 memory plane have about reached the ultimate. It is now possible to completely wire a plane in one girl-day.

Memorandum 6M-3674

Page 42

This final reduction in time was made possible by two main factors. The first is the fine cooperation and dexterity of Hilda Carpenter, May Wyman, and Alberta Rackliff. They have been willing and able to try any suggestion which might improve the wiring techniques. Their comments and suggestions have been invaluable in evaluating the various ideas tried.

The other factor has been the use of a valve which allows each girl to control the vacuum at her wiring stage. This valve was designed by Arthur B. Koch, the vendor wiring planes for us.

#### 4.2.4 Power

##### D-C Supplies

(J. Clarke) (UNCLASSIFIED)

Tests were conducted on XD-1 90 and 250-v d-c supplies to determine the effect of 2, 6, 14, and 30 cycle duration line transients on the output. Three-phase line-to-ground, and line-to-line disturbances were applied. Regulation was within specified limits in each case.

#### 4.3 Drafting

##### XD-1 Brownline File

(A. M. Falcione) (UNCLASSIFIED)

IBM is changing their reproduction system from the brownline to the Xerox Multilith method. Starting next week, IBM will furnish us with printed originals which have been reduced 50% in size in lieu of brownlines.

<u>Present Size</u>	<u>New Size</u>
A	A
B	A
C	A
D	B

All other size drawings will remain as is for the present. Using a Xerox machine the drawing is photographed and reduced 50%, then is reproduced on a Multilith 2260 machine using vellum paper. They estimate that this process will save their operations approximately \$80,000 per year in reproduction, handling, and processing of prints. This method will also greatly assist our Print Room operations in the distribution of XD-1 prints at Lincoln Laboratory. It will mean a complete change-over in our filing system for IBM drawings because of the reduced sizes in lieu of the larger ones previously received.

Memorandum 6M-3674

Page 43

At the present time, the only drawings which we are maintaining on XD-1 are as follows: Card Assemblies, Card Details, Block Schematics, Block Diagrams, Logic Diagrams, Wiring Schedules, Wiring Charts, Electrical Components, and Specifications. All other drawings will be filed and maintained by the IBM group.

#### 4.4 Administration & Personnel

##### 4.4.1 Staff

(J. C. Proctor) (UNCLASSIFIED)

##### New

Albert Ginsberg is a new staff member in Group 61. Mr. Ginsberg received his BBA from City College of New York and was employed by Iowa State College as a Lab Assistant.

F. Bancroft Johnson is a new staff member in Group 61. Mr. Johnson received his BA from College of Wooster and was employed by The Franklin Life Insurance Co.

##### 4.4.2 Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

##### New

Betty Cole is a new clerk in Group 61.

Edward Conley is an Administrative Assistant in Group 61.

John Uihlein is a Northeastern Cooperative Student in Group 65.

Cynthia Stavro is a Boston College Student working in the Barta Building for Group 61.

##### Terminations

Ralph Lanciano  
Jean MacDonald  
Ralph Porter  
Helena Rebman  
Gerard Sullivan

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Memorandum 6M-3674

UNCLASSIFIED

Page 44

Accessions List

(Frances Christopher) (CONFIDENTIAL)

The following documents were published by Division 6 or received from IBM during the period 23 May - 3 June 1955.

<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-2977	H. Benington et al	1954 Cape Cod System Master Make-up and Display Program Specifications (Supplement to M-2706: 1954 CCS	C
6M-3090	P. J. Gray	Synchronized Clock System for Sage System Direction Center	U
6M-3101	C. W. Watt	Equipment required for Maintenance Area In the Production Building	U
6M-2527-2	P. R. Bagley	Memory Test Computer Programming Reference Manual	U
6M-3275-1	H. J. Kirshner	Leased Telephone Circuits for AN/FSQ-7 XD-1	C
6M-3000 Sup. #11	H. J. Kirshner	Teletype Facilities for Sage Experimental Subsector	C
6M-3378	J. J. Gano	Power Generation and Distribution for the Sage System Direction Centers, Fifth and Subsequent Sites	C
6M-3391	J. F. Jacobs	Justification for Increase in Auxiliary Memory and the Method of Increasing It	C
6M-3441	R. C. Jeffrey	Reliability of Duplexed Equipment	C
6M-3522	P. C. Tandy	Investigation of Factors Affecting Life of Characteron Tubes (Master Thesis Proposal)	U
6M-3537	M. D. Feldstein	Survey of the Facilities of the IBM Card Preparation Room, C-168	C
6M-3570 S#1	M. Anderson	Air Force Personnel Required for the Experimental Subsector	U
6M-3579	B. Housman et al	IRI Monitor Specifications for AN/FSQ-7	U
6M-3600	P. R. Vance	Alarm and Intercommunication Facilities for AN/FSQ-7 Duplex Operation	U
6M-3605	A. R. Shoolman A. L. Smalley	Cape Cod Mission Specifications 66-55 for a Track Accuracy (ABN) Mission on Friday 20 May 1955	U
6M-3609	A. L. Smalley	Cape Cod Mission Specification 68-55 for a Sage System Familiarization Indoctrination on Thursday and Friday 19 and 20 May 1955	U
6M-3610	A. L. Smalley	Cape Cod Mission Specifications 72-55 for a Holmes Data Mission on Wednesday 18 May 1955	U
6M-3611	A. L. Smalley	Cape Cod System Mission Specification 70-55 for Track Initiation (IA) Mission on Wednesday 18 May 1955	U
6M-3613	A. L. Smalley	Cape Cod System Mission Specification 78-55 for a Track Initiation (IA) Mission on Wednesday 25 May 1955	U

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Memorandum 6M-3674

UNCLASSIFIED

Page 45

Accessions List (Continued)

<u>N O.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-3614	A. L. Smalley	Cape Cod System Mission Specification 73-55 for Radar Mapping Missions on Monday and Friday 23 and 27 May 1955	U
6M-3615	A. L. Smalley	Cape Cod System Mission Specification 75-55 for Track Accuracy (ABN) Mission on Tuesday and Thursday 24 and 26 May 1955	U
6M-3616	L. Grush	Cape Cod System Mission Specifications 80-55 for Blip/Scan Missions on Tuesday, Wednesday, Thursday, Friday 24, 25, 26, 27 May 1955	U
6M-3617	A. L. Smalley	Cape Cod System Mission Specification 77-55 for a Simulated Training Mission on 25 May 1955	U
6M-3618	A. W. Heineck	A Definition of Operational and Mathematical Specifications	C
6M-3619	S. L. Thompson	Proposed XD-1 Evaluation, 20 May 1955	U
6M-3620	A. W. Heineck	Minutes of a Meeting on a Program for the Standby Computer	C
6M-3621	H. F. Mercer	Operation of Building F Sprinkler System	U
6M-3622	C. L. Waite		
6M-3622	L. D. Healy	Change of Interlace on the Buffer Drum	U
6M-3623	T. F. Clough	Vacuum Tube Failures During the Month of April 1955	U
6M-3623 S#1	T. F. Clough	Same Title	U
6M-3624	R. L. Walquist	Coding of the Master Program for the Sage System	U
6M-3625	Sage Test Office	Cape Cod System Weekly Operation Schedule	U
6M-3626	A. L. Smalley	Cape Cod System Mission Specification 76-55 for a Track Monitoring Test (MS) on Tuesday and Thursday 24 and 26 May 1955	U
6M-3627	A. L. Smalley	Cape Cod System Mission Specification 74-55 for Holmes Data Missions Wednesday and Friday 25 and 27 May 1955	U
6M-3628	A. R. Shoolman	Guaranteed Data Storage in AN/FSQ-7 Duplex Computer Operation	C
6M-3630	P. R. Vance		
6M-3630	Division 6 Staff	Biweekly Report for 20 May 1955	C
6M-3631	E. D. Lundberg	Sage System Meeting 23 May 1955	U
6M-3637	L. S. Sutro	Test Equipment Committee Meeting 20 May 1955	U
6M-3638	Sage Test Office	Cape Cod System Weekly Operation Schedule	U
6M-3639	P. R. Bagley	Planned IBM Programmer Training Manual	C
6M-3640	J. F. Jacobs	Visit from Rand	C
6M-3641	D. R. Brown	Group 63 Approval Committee Meeting May 24 1955	U
6M-3643	J. Giordano	IBM-SO Concurrence Meeting #28 Held at Lincoln Laboratory 26 May 1955	U
6M-3645	H. J. Platt	Minutes of Experimental Sage Subsector Planning Approval Committee Meeting of May 23 1955	U
6M-3646	A. J. Roberts	Installation of a Lock-in-Read Mode for Magnetic Tape	U

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Memorandum 6M-3674

Page 46

Accessions List (Continued)

UNCLASSIFIED

<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-3647	J. J. Cahill	Current Status of AA Integration With Sage System	S
6M-3648	F. R. Bagley A. P. Hill	Phase II Training Course for ADES Personnel	C
6M-3650	D. R. Brown	Philco Transistor Subcontract	U
6M-3652	D. R. Brown	Group 63 Approval Committee Meeting May 31 1955	U
6M-3657	A. Vanderburgh	Flip-Flop Adder	U
6M-3658	Sage Test Office	Cape Cod System Weekly Operation Schedule	U
6M-5020	W. P. Harris	Test Specification: Initial Mapping Study	C
6M-5021	J. E. Keith Smith	Test Specification: Cross-Tell Function of the Manual Input Room	U

IBM Documents

IBM-752	R. Paddock	Sequence of Operations for Types 713, 718, and 723 Card Machines	U
IBM-753	-----	Project High Biweekly Progress Report #54	C
IBM-754	H. L. Kurkjian D. C. Laneto D. G. Hallock	Instruction Interleaving and Break Cycle Controls	U
IBM-755	-----	Operation of Magnetic Tape Element	U
IBM-756	-----	Central Reference Room Bulletin #81	U
IBM-757	-----	Input System - Pre-preliminary Manual PM 8-10	C
IBM-758	-----	Core Memory - Pre-preliminary Manual PM 8-4	U
IBM-759	R. J. Pfaff	Programs Written by Project Personnel	U

Division 6 LL-DR Reports

DR-241	J. Giordano	Concurrence on Selection Control D-19-3 dated 3-30-55 for Production System	U
DR-242	R. A. Imm	Revision to Program Element Production System	U
DR-243	R. W. Lowrie	Supplement 3 to the Display Console Specifications for AN/FSQ-7	U
DR-244	R. W. Lowrie	Duplex Central Specifications for the GFI Mapper Consoles D-34-2	U
DR-245	W. A. Hunt	Selection and Input-Output Control Specifications for the Production System	U
DR-246	J. Giordano	IBM-SO Concurrence on Drum Specification for Production System	U
DR-247	R. A. Imm	Revision of Specification for the Magnetic Tape Element	U
DR-248	R. A. Imm	Concurrence on Revision of Specification for the Magnetic Tape Element D-4-3	U

R Report

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6R-235	R. S. DiNolfo	Multi-Coordinate Selection Systems for Magnetic-Core Storage	U
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