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

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SUBJECT: BIWEEKLY REPORT FOR 17 JUNE 1955

To: Jay W. Forrester

From: Division 6 Staff

Approved: J.C. Proctor / cp
 John C. Proctor

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I - SYSTEM TEST & PLANNING

1.1 Air Defense1.1.1 Test Program

(E. Bedrosian) (CONFIDENTIAL)

The new system-simulation program for the 1954 Cape Cod System has been checked out. This program consists of a magnetic-tape read-in of simulated radar data (generated by the data generation program written by H. Frachtman), the generation of simulated Mark X data from two interceptor simulation stations, and an association program. The records for this program which are required for the 1954 Cape Cod System computer program documentation are now being completed.

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(M. Cronin, S. Manber, H. Peterson) (CONFIDENTIAL)

Verification of the 1954 Cape Cod System Program has been started. The monitor action programs have been modified and checked out. The new system data-simulation program has been checked out.

M. Cronin is now in charge of assigning computer time for Group 61. She is also supervising all Group 61 non-staff personnel at the Barta Building.

(R. N. Davis, P. F. Dolan, R. L. Smith, E. Conley)
(CONFIDENTIAL)

During the past biweekly period this Section attempted 11 missions in support of the SAGE Test Office.

Of these 11, six were canceled, and five were flown. Of the six which were canceled, three were of the ABN type, two of the IA and one AIN type. One of the ABN type was canceled due to weather conditions, all of the others were due to Cape Cod Equipment.

(F. W. Graham) (CONFIDENTIAL)

I am writing the test specifications for the scramble and initiation phases of the interception tests.

(H. A. Keit) (CONFIDENTIAL)

An indication study of initiation methods for CCS is underway. One test was run at the Direction Center, using live data which was recorded on Ampex tape for subsequent use.

Another test has been planned for next week, using both simulated tracks and the recorded data.

(D. Latimer) (CONFIDENTIAL)

The memorandum 6M-3539 on all 1954 CCS tables is now being Multilithed and will soon be distributed.

I now am doing preliminary planning for the proposed 16-aircraft tracking program as outlined in Memorandum 6M-3687.

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(W. Z. Lemnios) (CONFIDENTIAL)

Two more tracking-accuracy tests were held, making a total of five thus far. However, the magnetic tape recording for one test was found to have been erased so that only the results from four tests are available. This data is now being analyzed.

Test specifications for three of the seven series of interception tests are being written. Test specifications for two more series of tracking-accuracy tests are being prepared.

(J. A. Levenson) (CONFIDENTIAL)

Investigation of the initiation program in the 1954 CCS has led to the correction of several subtle errors. The behavior of the corrected program will be studied informally with live and simulated radar data before further large-scale tests are tried.

(E. McEvoy) (CONFIDENTIAL)

The conversion program for the initial paper tape input to the Data-Generation Program has been completely checked out. Procedures for preparing the paper tape are specified in Memorandum 6M-5027, which will be published in the next biweekly period.

Specifications for the checkout tests of semiautomatic height-finder equipment will be written by R. Mayer, Group 62.

(A. L. Smalley) (CONFIDENTIAL)

Simulation is becoming increasingly important as a means of testing, evaluating and training for operating personnel in the 1954 Cape Cod System. Simulation, in order to be effective, must be realistic. This requires using appropriate blip-scan ratios for the type aircraft being simulated, data characteristics (scan-to-scan transition correlation and multiple print frequencies), and, if live or recorded radar data is not employed as background noise, then track-centered and area noise values must be included. Memorandum 6M-5027, "Procedures for Preparation of Simulated Data Input Tapes For Use In The 1954 Cape Cod System" is being published. This memo states that a library of information and assistance in constructing simulation programs is now available in Room C-184G.

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(W. Vecchia) (CONFIDENTIAL)

		<u>hr</u>	<u>min</u>	
Total Assigned Time				183.5
Analysis & Program Checking	111	10		
System-Operation	52	30		
Raydist	11			
Equipment Checkout	<u>5</u>	<u>50</u>		
TOTAL	180	30		
Time Lost to Computer (malfunction)	3			
		<u>hr</u>	<u>min</u>	
		180	30	
		<u>3</u>	<u>—</u>	
GRAND TOTAL	183	30		

1.1.2 Analysis and Simulation

Seminar on Interceptor Vectoring

(W. I. Wells) (CONFIDENTIAL)

The recent seminar on interceptor vectoring was successful in arousing interest in the details of the SAGE System and the over-all picture of Air Defense. In particular, ADC made a very nice presentation which showed clearly how lacking our defense capabilities are, especially with regard to interceptor capabilities.

Manned-Interceptor Simulation

(H. D. Neumann) (CONFIDENTIAL)

The F-99 simulation program has been modified for the runs requested by Westinghouse. The detailed printout will be available in several days.

Parameter tapes are being prepared for the manned-interceptor simulation program (MISP) to study FGD.

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(B. Smulowicz) (CONFIDENTIAL)

I am continuing work on the weather-clutter generator and correlation program to be used with MISP. The clutter generator, the correlation section, and the main data-analysis section have already been written and are ready to be checked out. Suitable test programs to analyze and check out each separate section are being planned.

(H. D. Houser) (CONFIDENTIAL)

The sections of the correlation program to be added to MISP which do smoothing and prediction, command tracking of the interceptor, and tracking of the interceptor when Mark X radar is used have been coded. The sections which must still be coded are the split detection and track comparison subroutines, and the modifications of the MISP control program to add the correlation program.

Statistical Evaluation of Simulation Results

(C. Friedman) (CONFIDENTIAL)

Initial studies are being made into the various methods of analyzing the results of MISP. The first analysis will be a statistical one, in which an effort will be made to determine the distribution of these results. In view of this, a program is presently being written which will compute fundamental statistical data such as means, variances, and higher moments.

Azimuth Tracking

(F. F. Gucker) (CONFIDENTIAL)

F. Heart and I have completed a portion of the checkout task for the azimuth-information-only initiation-simulation program. Some refinements as well as corrections have been made to the program.

In addition, we have been trying to estimate the computation time that azimuth-only initiation would consume when used as part of an operational program. A major part of the effort during the next biweekly period will probably go into finding ways of making the present program faster.

Blip-Scan Data Analysis

(B. R. Stahl) (CONFIDENTIAL)

The blip-scan analysis program has been completed and has undergone some checking on MTC. The output section seems to be working satisfactorily, and at present I am attempting to find the source of some arithmetic errors in the analysis section. It is not entirely outside the realm of possibility that the programs will be working before the end of the forthcoming biweekly period.

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1.1.3 SAGE Training

(S. B. Hibbard) (CONFIDENTIAL)

Mr. Gardner Reed was assigned to the Training Section on 13 June 1955. Mr. Reed comes to Lincoln from the Boston ARTC office where he was an Airway Operation Specialist.

A meeting was held with representatives of the Lincoln Project Office, 6520th AC&W Squadron, and Lincoln Lab to determine what action to take on 6M-3656.

The Experimental Training Course that has been in progress on Cape Cod is about concluded. Planning for a Training Course on XD-1 is now under way. The Training Section will put out a memo soon in an attempt to determine what requirements will be made on the use of Section "C" personnel, from 1 October 1955 to 1 April 1956, in implementing the Experimental SAGE System. This will be important in that it will affect the planning of a training course for XD-1.

1.1.4 Coordination

(M. D. Feldstein) (CONFIDENTIAL)

The following memoranda have been issued:

1. 6M-3667, "Detailed Schedule for Weapons Direction Section from 1 May to 1 October 1955,"
2. 6M-3679, "Detailed Schedule for Tracking Section from 1 May to 1 October 1955."

These schedules are intended as an aid in preparing the Operational and Mathematical Specifications for the SAGE Direction Center.

I attended meetings on 14 and 15 June with RAND to discuss the implementation of systems training for the SAGE System.

(A. P. Hill, P. R. Bagley) (CONFIDENTIAL)

The Phase II ADES Training Course has been under way for 2 weeks, with the lecture-discussions being led by A. P. Hill and P. R. Bagley. Phase II will be completed on 24 June and will be followed by the Phase III training to be given 27 June - 15 July. Phase III will be a 3-week course on SAGE equipment. Two sections will be taught simultaneously: Section A on Direction Center Equipment, and Section B on External Equipment. The primary purpose of the Phase III course is to provide an understanding on the detailed functions of all the SAGE equipments. Upon completing this course, students should possess the necessary vocabulary to communicate intelligently on technical problems involving SAGE equipment.

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1.1.5 Tracking Section

(F. Brooks) (CONFIDENTIAL)

The XD-1 manual interception program has been checked out. It needs still to be reassembled with its modifications.

Memorandum 6M-3677, "Comparison of Possible Programs for (r, e) to (x, y) Conversion of Radar Data in the AN/FSQ-7," has been completed.

Work on the radar inputs operational specifications continues.

The study of methods for sorting tracks and radar returns for the correlation program indicates that the method which will be quickest will depend on the number of storage registers to be used. In the cases for which computations were made, the results were as follows. If about 125 sorting categories are used, it is best to sort the tracks into boxes and to compute for each radar return how many boxes (1, 2, or 4) it is necessary to search through.

If about 250 sorting categories are used, it is best to sort the tracks into half-strips, and to search through both halves of the strips only for those returns near the center of the strips.

If about 350 or more sorting categories are used, it is best to sort the tracks into boxes, and to search through four boxes for every return. These conclusions take into consideration the presence of overlapping tentative tracks and of uncorrelated returns to be used for auto-initiation.

(F. E. Heart) (CONFIDENTIAL)

A small amount of continued support has been given to the Lincoln Radar Coordinating Committee.

The feasibility of azimuth-only tracking is still being studied.

A re-examination of AEW has been started. A very small inter-divisional committee has been organized to further study this problem. Also, it appears that some efforts are now taking place in Group 34 (and elsewhere) towards critical examination of the AEW navigational and orientation difficulties.

(W. Lone) (CONFIDENTIAL)

I have been specifying the console equipment and label layouts for the FSQ-8. It is expected that this will be completed by 1 July.

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(H. H. Seward) (CONFIDENTIAL)

Crossteling procedures for tracks involved in weapons assignments have been outlined in cooperation with R. Nelson and C. Grandy. A tentative display format for overlap tracks is also being designed and should satisfy the needs of both tracking and weapons personnel.

A series of meetings on Direction Center communications was concluded and the resulting recommendations were forwarded to ADC.

(E. W. Wolf) (CONFIDENTIAL)

Work on a draft of the radar input operational specifications is nearing completion. The problem of an optimum initial slant range correction for all radar returns is under study.

1.1.6 Program Organization

(R. Walquist, W. Ball, H. Benington, L. Collins, C. Gaudette, R. Gildea, W. Harris, S. Knapp, R. Reed, A. Schwartz, A. Shoolman, P. Vance) (CONFIDENTIAL)

I. General

On Friday, 17 June 1955, a meeting was held with Ray Paddock and Bob Bottomley of IBM to discuss

1. Using heavier IBM card stock (0.009" thick instead of 0.0065") to reduce card jams in the reader;
2. Obtaining a second card reader and possibly a second line printer in case of extended failure of present equipment.

Definite conclusions have not been reached on either of these items.

A Master Program Preparation Schedule has been issued which covers both time and manpower requirements for the design, coding, and checkout of the first SAGE master program (see 6M-3661). The time schedule calls for completion of program design by 1 October 1955, of coding by 1 February 1956, and of checkout by 30 April 1956; the manpower estimates require a peak force of 41 programmers at the end of 1955.

Program organization studies are continuing; definition outlines for the areas described in the last Biweekly will be issued during the next biweekly period.

The interpretive section of the comprehensive checkout program for WWI has been checked out.

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Much of the new version of the XD-1 assembly program has been checked out. This new version allows more freedom in specifying symbolic notation.

Two different radius vector ($\sqrt{x^2 + y^2}$) subroutines have been coded and checked out.

The XD-1 auxiliary memory drums are now available for programmers' use during the MIT-assigned periods.

II. Use of XD-1 Application Time

During the past 2 weeks the total XD-1 applications time was 12½ hours with the percentage of usable time at about 92%. The following table summarizes the useful time for the assigned periods from the first week in April to the present.

<u>Time Period</u>	<u>Usable Time</u>	<u>Printer</u>	<u>Reader</u>	<u>Punch</u>	<u>Core Storage</u>	<u>Other</u>
3/28-4/6	97.2%					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%	20.7%
6/2-6/8	94.9%				0.7%	4.4%
6/9-6/15	88.8%	8%			3.2%	

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

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.

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III. Memos

Memos issued during this biweekly period:

- 6M-3661, "Master Program Preparation Schedule,"
H. D. Benington, 14 June 1955
- 6M-3691, "Modes of AN/FSQ-7 Duplex Operation,"
P. R. Vance, A. R. Shoolman, 15 June 1955
- 6M-3694, "Alarm Monitoring in AN/FSQ-7 Duplex Operation,"
P. R. Vance, A. R. Shoolman, 15 June 1955
- 6M-3600, "Alarm and Intercommunication Facilities for
Sup. 1 AN/FSQ-7 Duplex Operation," P. R. Vance,
A. R. Shoolman, 17 June 1955
- 6M-3685, "Dimensions of AN/FSQ-7 Situation Display
Character Format," R. R. Reed, 16 June 1955
- 6M-3539, (previously referred to as 6M-3568), "1954
Cape Cod System Data Storage Tables," W. E. Ball,
L. B. Collins, D. P. Latimer, 13 June 1955

Memos in progress during this biweekly period:

- 6M- (Preliminary assignment of categories and
display-assignment bits for SAGE situation
display consoles) R. R. Reed

IV. Personnel

Mrs. J. E. Yienger left the Laboratory on 8 June 1955.

Mrs. M. M. Arden joined the Utility Programming group on
13 June 1955.V. Individual Comments (R. L. Walquist)

In the Biweekly dated 6 May 1955 I included a prediction concerning Group 61 use of XD-1. I was subsequently reprimanded and informed that the Biweekly is no longer a place for personal opinions--only "the facts" should be included. However, our usable time on XD-1 has so improved over the last 2 weeks (the 2 weeks average better than 90%) that at the risk of further reprimand I wish to complement the IBM personnel on their cooperation and extensive effort to provide highly reliable operation of XD-1.

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1.1.7 Weapons Direction

(C. A. Zraket) (CONFIDENTIAL)

A second draft of the operational specifications for the following SAGE System functions will be issued during the week of 20 June: height finding, weather, manual inputs, identification, raid forming, Subsector Command Post, and antiaircraft. The first draft of the specifications for weapons-direction crosstopping, weapons assignment and control, and intercept direction will also be issued at this time. Following agreement and concurrence on the content of the memoranda, Frank Hazel of Publications has volunteered to aid in the formal writing and editing of the material into understandable documents.

In connection with the above activities, coordination has been carried on with Hawley Rising on switch panel layout and labels for XD-1 and the duplx system and with Bob Reed, Hazeltine representative with Group 61, on displays. Mr. Reed has been especially helpful in coordinating operational requirements of displays with equipment requirements.

A meeting has been scheduled for 22 June to decide on general operational problems concerning the SAGE master program, viz. system boundary conditions, program timing, display-slot utilization, in-out timing, etc.

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

A draft proposal on raid forming has been issued in hectographed form for discussion.

Likewise, Sections A, B, and C of the proposal on weapons direction have been issued, and D and E will be issued during the next biweekly period.

- A. Threat Evaluation
- B. Weapons Allocation and Deployment
- C. Crosstopping for Weapons Direction and Warning
- D. Weapons Assignment and Controls
- E. Intercept Direction

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(J. J. Cahill) (CONFIDENTIAL)

I have written a draft of 6M-3686, "Problems of Integrating Antiaircraft and SAGE." It is currently being circulated among members of the Lincoln Steering Committee and other interested persons. If the Steering Committee approves, the memo will be transmitted to the Lincoln Joint Services Advisory Committee with a letter requesting the aid of the Advisory Committee in solving the problems. The memo will also serve as the basis for a presentation to be given to the Technical Advisory Panel on Electronics (TAPE) by C. R. Wieser during the panel's visit to Lincoln on 29-30 June 1955.

Work on 6M-3686 has prevented me from completing a draft of the operational specification for the interim SAGE AA Direction Section. However, the draft goes quickly when I have time to work on it, and I expect that it will be finished early in the next period.

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

We have completed revisions to the memos on the operational specifications of identification, manual inputs, and weather input. We will undertake discussions on these topics this week.

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1.2 Whirlwind I

(S. H. Dodd) (CONFIDENTIAL)

As a result of a memo from D. R. Israel to the SAGE Test Committee, an investigation will be made of the practicality of adding more terminal equipment to the Cape Cod System to enable it to carry out a greater variety of tests significant to the evaluation of the Experimental SAGE Subsector. Suggested additional equipment includes: an XD-1 to WWI crosstopping link, an output to the GE data link, a crosstopping output to one or more semiautomatic height finders, and a modification of the IRI equipment to accept the longer word length from one or more of the service test AN/FST-2 equipments in the Experimental SAGE Subsector.

Beginning with this Biweekly Report, sections on Analysis of WWI Failures and Records of Operation (WWI) will be omitted. This data can be obtained by calling the WWI Records Office, Extension 3745 (Barta).

1.2.2 WWI System Operation

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

The computer is now being scheduled 24 hours a day, 7 days a week. There has been no apparent decrease in reliability. The percentage of good operating time for this biweekly period was 98%. Approximately 7 hours were lost as the result of 24 interruption incidents. Two intermittent troubles were corrected:

1. A faulty reading amplifier caused several buffer-drum parity alarms;
2. A wiring error in the magnetic-tape system resulted in excessive heater-cathode voltage being applied to several tubes. One of these tubes developed an intermittent short.

The output system for the crosstopping link is being installed and should have power applied after the installation of 27 June. The block diagrams for the crosstopping input system are nearing completion. Construction of the 85-bit shift register has been completed.

1.2.3 Terminal Equipment

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

Existing equipment in racks L11 through L15 in Room 156 is being removed to provide space for the planned crosstell installation.

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The shift register of the crosstell MITE has been designed with standardization in mind. Only two types of PIUMP's are used, and the layout and construction of the PIUMP's are therefore considerably simplified. The construction of the 30 PIUMP's for the shift register is almost completed.

The logic of the control section for this MITE has also been worked out. Because of the length of the input word, it has to be recorded over several slots. Consequently, the control section of this MITE is more complex than that of MITE O.

14-Channel Ampex Recorder

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

A second preamplifier panel has been ordered for use with recorder #1.

A 1200-ft sample reel of Irish Tape was ordered from Orradio Industries. The manufacturer claims his method of polishing the oxide coating reduces dropouts to an absolute minimum.

Radar Mappers

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

Work is being done on the new sweep circuit to eliminate jitter.

Data Input

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

Phone lines for crosstell input and output have been ordered. The necessary wiring to the console patch panel has been completed.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Frequent failure of the direct output punch to punch code hole #1 was investigated. This trouble was encountered with two different FL punches while "logging" tapes were being perforated, but it did not show up with other programs. A third punch was tried and the trouble disappeared. At present we have no satisfactory explanation why two punches should fail only during this one program or why a third punch should operate properly.

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Power Supplies

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

The -450-v supply has been modified to provide front panel indication of blown fuses.

The +150-v supply was modified to insure adequate current in the voltage regulator tubes under all operating conditions.

The new filament alternator has been installed upon its foundation and grouted in place.

A multivalued d-c standby supply has been built and is now being debugged.

WWI Crosstell Coder

(J. Ackley) (UNCLASSIFIED)

The design of the WWI crosstell coder being complete, installation of the coder will begin 27 June 1955.

To save a large amount of equipment, it was decided to use a WWI program to control the coder. It will be controlled by three new si's (all octal) which will be installed 27 June 1955. These are si 420 ("sync"), si 410 ("data"), and si 400 ("timing").

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II - SAGE AND EXPERIMENTAL SUBSECTOR

2.1 System Liaison2.1.1 CommunicationsXD-1 Communications

(C. J. Carter, H. J. Kirshner) (UNCLASSIFIED)

Memorandum 6M-3000, Supplement 11, "Teletype Facilities for SAGE Experimental Subsector," which describes the teletype network for XD-1, has been published and is available in the Division 6 Document Room.

Meetings have been held with members of the ADC Liaison Group and representatives of Division 2 to discuss problems connected with providing on-base telephone cable at Air Force sites. A meeting will be held at EDAF Headquarters on 21 June to further discuss this problem.

Telephone circuits to gap-filler sites now terminating at the Building B switchboard will be moved to the Building F dial system and will operate as dial stations sometime between 20 June and 18 July.

Production System

(F. E. Irish) (CONFIDENTIAL)

Two ADES documents published during May have been reviewed by the communications committee. They are "Internal Communications for AN/FSQ-7 Direction Center" and "External Communications for AN/FSQ-7 Direction Center." Our comments along with those of other interested parties have been transmitted to ADES via the RCO.

2.1.2 PowerEquipment Cooling Loads

(J. J. Gano, R. Jahn) (UNCLASSIFIED)

A preliminary draft of 6M-3692, "Equipment Cooling Loads for a Direction Center," has been distributed to Lincoln Laboratory and Francis Associates only. After comments have been received, it will be released for IBM and Western Electric concurrence.

Testing D-C Supplies

(S. T. Coffin) (UNCLASSIFIED)

Tests have been conducted on XD-1 to study the sensitivity of the computer to variations in the d-c supply voltages. One voltage

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at a time was slowly varied above and below its rated voltage until the test program failed. Most of the margins thus obtained fall between 10% and 20% above or below rated voltage, the lowest being 8% and the highest 30%. These results are much better than anticipated.

Power Distribution

(G. F. Sandy) (UNCLASSIFIED)

Investigation of the properties of thermistors when used in the primary side of filament transformers for the purpose of limiting the filament current upon application of power has continued. The results are, as yet, inconclusive; but it appears that thermistors can be made to do the job very nicely for a very wide range of filament loads. A single thermistor with a parallel resistance can be devised to give satisfactory results. However, two thermistors in series with a resistor across one of them gives much better results.

It was also found that the current rating of the thermistors could be increased three or four fold by attaching radiators such as copper plates.

Testing

(J. D. Clarke) (UNCLASSIFIED)

General Electric men are still working to bring the regulation of the d-c supplies within specifications. It has been found that those supplies not regulated within specification limits exhibit drifting of their output voltages.

2.1.3 Specs and Building

Lighting Meeting

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

The scheduled meeting with the Air Force building people from New York to discuss the psychological effects of blue light was held on 9 June.

Attendance was limited to personnel from Wright Air Development Center, Rome Air Development Center, and Cambridge Research Center, all part of Air Research and Development Command; Air Defense Command, Air Force Installations Requirements Office in New York, Western Electric, Burns & Roe, Ohio State University, and Lincoln Laboratory. It was the unanimous opinion of ARDC and ADC that the blue lighting system satisfies their requirements and should be used in the SAGE operational areas. The representative from AFIR in New York stated that the system is much too complicated and much too blue, but that he would build it anyway.

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Effect on Facilities of Rand Proposal

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

Preliminary plans, sketches, and estimates were made to investigate incorporation of the Rand programming activities at the Syracuse site. The most promising plan seems to be replacement of the CC building at Syracuse with a modified DC building. However, this change would undoubtedly cause some delay in the building schedule unless several hundred thousand dollars of overtime work were authorized.

Building Study Group

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

Preliminary discussions were held with WE-ADES and IBM with regard to a restudy of the AN/FSQ-7 facilities. It is presently proposed to form a committee composed of representatives from WE-ADES, IBM, Lincoln, JPO, and ADC to study the facility requirements in the light of present thinking and to contemplate new designs which may better meet their needs. This study group will probably get under way during the next biweekly period.

XD-1 Status

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

The central computer is undergoing installation and testing. Difficulties experienced with the drums, high-speed memory, and display system are being eliminated. Card machine reliability has been improved. It has been necessary to replace Stemag resistors. New testing procedures are being applied to the input-output system in that frame and system tests are being overlapped. These procedures should enable system testing to be completed on schedule. The gap-filler-input equipment will be system tested by the end of July.

The display equipment has been rescheduled. Due to requirements for more complete testing, it will not be ready for system testing before the end of Auguts, 8 weeks behind schedule.

The design of the auxiliary-drum unit (Class "A" Change) is on schedule.

It is expected that all AN/FSQ-7 (XD-1) equipment will be system tested by 15 October 1955, but this date does not include the two additional index registers.

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To date there are five mapper consoles in Building F. All mapper consoles will be delivered to Lexington by the end of July, on schedule. There are seven XD-1 situation-display consoles in Building F. The remaining situation-display consoles will not arrive at Building F by the end of July as scheduled.

All necessary equipment to build the pluggable unit orifice testing rig was ordered during the first week of May, and at that time an estimated completion date of 1 July was quoted. Due to the current truck strike, this completion date will go beyond schedule.

Installation

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

I. Building Construction

The lock cylinders have been delivered and installed. Our understanding is that the interior of the building, under the Air Force Contract, is now complete. Finishing of the exterior, under the same contract, is under way. Probably half of the exterior wall finish is complete; road construction is also complete.

The following items of the IBM contract have not been completed:

1. Roof emergency air monitor,
2. Movable sash installation,
3. Paint one section of the first floor plenum wall,
4. Patch around the equipment cooling control panel.

II. Equipment Cooling

At a meeting held here on 16 June, IBM agreed that Berman Company has installed the equipment cooling system according to contract drawings and specifications. Further refinements, necessary for efficient control and dehumidification operation, are over and above the original scope of work and, as such, are justifiable extras.

III. Cabling

Approximately 85% of the entire cabling for XD-1 has been installed. At the moment, cabling installation is ahead of equipment installation.

IV. Equipment Layout

Command Post - During this past week, a modification increasing the size of the projection booth was approved. Revision of the drawings has started.

V. Lighting

On the basis of tests conducted in B-034, drawings and specifications for the operational lighting system are being prepared. In an effort to speed up the installation time, requests have been delivered to Purchasing for ordering the following:

1. New louver sections,
2. Hanger (support) system,
3. Fluorescent tubes,
4. End caps for tubes,
5. Dimmer units.

Specifications and drawings for fixtures will be forwarded to fabricators early during the week of 20 June asking for price and delivery of specified fixtures.

2.2 Systems Office

Logical Services Committee

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

Final drawings and pictures were obtained of the Command Post DD Desk mockup. Nolan Jones is preparing a description of the table for liaison people in the Command Post.

R. D. Buzzard assisted L. R. Jeffery in his study of the use of the first AN/FSQ-8 for program checkout and training.

Approval of a change in the stair location in the XD-1 Command Post has been obtained.

The set of documents published by Group 61 describing console equipment and label layouts for XD-1 and AN/FSQ-7 were discussed with representatives of IBM.

Outputs

(S. B. Ginsburg) (UNCLASSIFIED)

A program which operates with MTC for adequately testing the feasibility of interleaved or noninterleaved transmission of crosstell messages has been completely coded. The program will be checked out as computer time becomes available.

2.3 Test Planning and Coordination

(K. E. McVicar) (UNCLASSIFIED)

A workbook is being assembled which contains detailed listing of the jobs to be coordinated by the Test Planning Section. This workbook is being assembled for the purpose of delineating more clearly the responsibilities of the Section and to serve as a basis for manpower and computer time requirements estimates.

The System Operation and Testing Subcommittee has issued schedules and reports for the Stewart and Syracuse Direction Centers and the Syracuse Combat Center. These progress reports are currently being circulated among interested parties at Lincoln for comments. They will eventually be issued by ADES as part of a Summary Report for each subsector similar to that issued for McGuire. It will be our desire to release this Summary Report along with Lincoln comments by a TIR.

Program Services Committee

(R. P. Mayer, H. I. Rundquist) (UNCLASSIFIED)

A Program Services Committee, to be responsible for providing computer programs for tests of equipment installations in the SAGE System, has been formed as part of the Equipment Testing Section. A detailed outline of this Committee's responsibilities and procedures will soon appear in an M-note.

Tests under consideration at present are:

1. The effect, on mapper consoles, of various wind conditions at the gap-filler radar sites;
2. The effectiveness of various parity-checking schemes in catching crosstell phone-line errors;
3. The operation of a semiautomatic height finder as used in the automatic height request section of the Cape Cod System.

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Records

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

A study has been under way for the last few weeks of possible methods to be used in the analysis of Cape Cod System records. A daily operational summary form has been devised and will be put into operation Monday, 20 June. Group 61 and Group 22 have both been consulted and have concurred on the use of this form. This form will provide a mission-by-mission summary of system operations. It is anticipated that in a short time a consistent method of summarizing Cape Cod operations on a biweekly basis will also be put into operation.

A larger study of record-keeping procedures for the SAGE System has started. This is being done by a Task Force consisting of:

C. W. Uskavitch - Group 22
C. W. Watt - Group 64
W. Mitchell - IBM
E. F. Ennis - BTL

It is expected that in a few weeks some definite recommendations which can be tried out in the Cape Cod System will be formulated.

2.4 Testing OperationsDigital-Display Generator

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

The logical changes mentioned in the last Biweekly Report have been made.

We now are listing failures which may occur during marginal checking and valid indications of these failures. When this is completed, in most cases the circuit margins may be determined by looking at the Typotron displays.

MTC Connection to Display Frames

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

The MTC drum signals are now connected to the situation-display generator. Two troubles which heretofore were not evident were found. The closure of the drum timing track is not perfect. This was evident only when reading eight-word track data slots and caused trouble due to a particular logic arrangement. It is a difficult job to rewrite the timing track, and there is no guarantee

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that it would be any more accurate. The second trouble was caused by spurious signals written on the drum. These spurious signals are such that their effect is not eliminated by storing one set of words on the drum. Possibly the best method of eliminating this effect is to erase the entire drum with a magnet. In MTC this can not be done due to the danger of erasing the timing track.

2.5 Display

(J. Woolf) (UNCLASSIFIED)

Five consoles arrived and are in the process of being debugged and installed. These units still lack the mechanical changes to strengthen the tube carriage. W. Santelmann of the Basic Circuits Section is designing a circuit to modulate the intensity gate based on vector magnitude.

Earl Gates and two technicians from MTC are studying the display console with the objective of maintaining the display equipment in MTC.

(H. Zieman) (UNCLASSIFIED)

Recent experiments have verified the fact that the magnetic deflection systems in the display consoles will have to be individually compensated. The principal causes of nonuniformity in the deflection systems appear to be the deflection yoke and the magnetic shield around the tube. To correct for this nonuniformity, the damping resistor, output stage cathode compensation, must be tailored for each yoke-shield combination. This would normally be done in the magnetic deflection preamplifier and output stage. However, this would make these stages nonuniform so that each yoke-shield combination would have to have a specific set of preamplifiers and output stages assigned to it. To overcome this difficulty, it is being suggested that 12 leads be brought from the preamplifier and output stages to two unused tube sockets in the decoder simulator plug-in unit. All the compensation components could then be enclosed in a small plug-in unit which would plug into these two space sockets. This would leave all units in the console uniform except the two small compensation units, which would then be assigned to a given yoke-shield combination.

Automatic Camera and Control

(L. Sutro) (UNCLASSIFIED)

Wiring of the parts of this system in frame 25 is within 1 day of completion. Modification of the console to be used for photography appears to be within 3 days of completion. There is a

problem with the circuit designed to suppress an arc across the contacts that switch current to the main solenoid in the camera. A 1N93 diode placed across the solenoid slows down its release more than can be tolerated. Suppression, therefore, will be attained by an R and C in series across the switching contacts; but the C rings with the L of the solenoid delaying release long enough to change the timing of the system. The rest of the system will have to be held back with a delay relay while the solenoid is dropping out.

Large-Board Display

(L. Sutro) (UNCLASSIFIED)

Work continues on two methods of achieving a large-board display. One would automatically photograph a Charactertron, develop the film, and project it at 12 to 20-sec intervals. A second method requires that one man photograph a Charactertron and a second mount the film in a slide and project it, at intervals of 1 minute or more. The automatic system has proved successful in photographing a 5-inch Charactertron. Tests are being made of a 19-inch Charactertron. If successful, a standard console might be coupled optically with the Kelvin and Hughes automatic developing and projection system in time for the initial use of the Command Post. Otherwise, the manual system of taking, building, and projecting pictures will have to be used until 5-inch Charactertrons can be obtained and circuits designed to use them. Progress of all work on the large-board display to date is described in 6M-3690.

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2.6 Evaluation

(J. D. Crane) (UNCLASSIFIED)

Preparations are being made for the fourth evaluation of the XD-1 central computer. At present, it is planned to include the central computer, magnetic drums (CD side and portions of the OD side), and the card entry portion of the manual input frame in this evaluation.

(R. H. Gould) (UNCLASSIFIED)

The Charactron setup in the light testing room has been re-activated for use by Group 38 for legibility tests and for light-gun tests. Operation of the light gun with various filters will be checked to determine the filter which best satisfies the requirements of the human operator and the light gun.

Dual-Beam Scope

(R. H. Gould) (UNCLASSIFIED)

Specifications have been received from DuMont on a dual-beam scope that they feel they can build. Their tube development program is apparently not as far along as we had been led to believe. The unsatisfactory reliability of the type 336 scope would make one less than optimistic about the operation of a scope that was essentially two 336's in one box.

Tektronix has shown renewed interest in building a dual-beam scope, and general specifications have been given to their local representative.

There will be a meeting in Poughkeepsie on 22 June 1955 to discuss the dual-beam scope.

2.7 Basic Circuits

Gap-Filler Sweep Circuit

(B. W. Barrett) (UNCLASSIFIED)

The breadboard of the modified gap-filler sweep circuit is now under construction.

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Vector Generator

(E. B. Glover) (UNCLASSIFIED)

The sweep generator design has been optimized and checked in operation. Its sweep time can be increased approximately 30% before the sweep begins to lose linearity due to grid current. This gives a reasonable margin for the output amplitude.

Efforts are now being directed at keeping the ladder tubes below the grid current region (to retain accuracy) and still maintain the desired output swing.

Display Line Driver

(J. Kriensky) (UNCLASSIFIED)

Marginal checking of this unit is now being conducted. A savings of approximately 250w of power per driver is now being realized by connecting the cathodes of the output stages to the -150-v supply through low value resistors.

Flip-Flop, Model E

(N. J. Ockene) (UNCLASSIFIED)

The latest suggested circuit changes in the Model E flip-flop have been tested in a pluggable unit and have been found successful.

The minimum trigger necessary at low prf's when "40% down" 22177's are used is approximately 9 volts. "20% up" 22177's require approximately 11 volts. The corresponding sensitivity at high prf's is 11 volts and 13 volts, respectively.

The margins in all cases are adequate, the bias buildup is negligible, and the upper level delay has been reduced from a previous value of 0.25 μ sec (for complementing) to approximately 0.15 μ sec.

Direct-Coupled Video Probe

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

Work has begun on a revised version of the probe system as the result of a new design compromise which sacrifices electrical performance slightly for increased mechanical usefulness. The new system will consist of a probe, containing a subminiature, high-transconductance pentode, which is connected to a power and signal plug by a 15-foot cable. The presently used box will be eliminated and its circuitry will be divided between the probe and the connector plug cover.

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The "trigger-tip" modification for the DuMont 2607 probe has been finished by L. B. Prentice. Its performance is excellent; it is a marked advance over the klipzon and alligator clips. The new probe system will utilize a trigger-tip modified to its needs.

Charactron Vector Intensity Decoder

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

A new decoder design is nearly finished on paper and will soon be constructed for testing. It is being designed to provide a 15-level intensity-control voltage between the limits of 0 and -60 volts under the control of three "X" and three "Y" digits from the computer. It will be able to drive 100 Charactron consoles at a total load of 680 ohms and 0.1 μ f.

Matrix Output Amplifier (256² Core Memory)

(D. Shansky) (UNCLASSIFIED)

The operating margins of this circuit have been taken and the results indicate a reasonably well balanced design. It is expected that a note describing the circuit and its performance will be issued shortly. A modification of this circuit capable of being driven by a transistor level setter is presently being designed and will be tested in the next period.

Gate Generator (256² Core Memory)

(D. Shansky) (UNCLASSIFIED)

The operating margins of this circuit are being investigated. This circuit must also be modified so that it can be driven by a transistor level setter.

Sensing Amplifiers for Memory Planes

(R. C. Zopatti) (UNCLASSIFIED)

I have set up the necessary logic to provide an input to the sense amplifier consisting of bursts of positive ("read") and negative ("write") pulses separated by a positive then negative ("inhibit") pulse. The number of pulses, their amplitude, width, and repetition rate can be varied. Using this input the recovery time and frequency response of an amplifier can be quickly determined.

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2.8 Memory Test Computer

(W. Hosier) (UNCLASSIFIED)

This period has seen the beginning of testing the ID-1 gap-filler input (GFI) system with MTC as a combined signal generator and output analyzer. Two or three basic types of signal have been already transmitted: constant azimuth rate and constant range target every azimuth (circle), constant azimuth rate with target range as a linear function of azimuth (spiral), and constant-range target with $\pm 5\%$ random azimuth jitter. More refinements will be introduced as programs are written, such as sinusoidal azimuth variation to simulate wind-loading of the antenna, and a target moving through a simulated cloud return.

Other testing, such as display frame, measurement of SDV azimuth variation from DDR inputs, and measurement of phone-line noise, has also continued; considerable MTC time has been devoted by Rundquist to studying probability of storage on ID-1 input drums.

Group 61 simulation work has slacked off for the time being.

Computer operation has been fairly satisfactory, the only weak point being the Ferranti tape reader, which has given some difficulty on line-by-line reading. This has to the best of our knowledge been remedied by replacement of two cathode follower 5965's which possibly were subject to over-voltage from vagaries of the -150-v supply, by mechanical adjustment of the brake, and by replacement of the light source bulb which has become slightly darkened in operation.

Distribution of operating time this period was as follows:

<u>Application</u>	<u>Hours</u>	<u>Per Cent</u>
Programming	122.38	46.9
Development and Testing	72.60	27.9
Reliability Check Programs	26.44	10.3
Installation	23.33	8.9
Interrupting Failures	11.31	4.3
Maintenance & Marginal Checking	4.47	1.7
Total	260.53	100.0

(A. Vanderburgh) (UNCLASSIFIED)

The MTC Technician Training Course has been postponed until the text is completed.

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(H. Ziegler) (UNCLASSIFIED)

Circuit designs for the new MTC display system are nearing completion, and mechanical design of a one-piece camera and cathode-ray tube mount is scheduled to start Monday, 20 June 1955. Amplifier chassis and high-voltage distribution boxes will then be designed for mounting within the new mount.

Regulated high-voltage supplies are on order with a promised delivery date of about 1 August 1955. On this basis the display system should be checked out and in use by mid-August.

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

The following is a summary, for the period 3 June to 17 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>
6145	Low output	1	0
Toggle switch	Intermittent	1	0
Toggle switch	Shorted	<u>1</u>	<u>0</u>
		3	0

2.9 Vacuum Tubes

2.9.1 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

I attended a joint HAC-IBM-MIT committee meeting at Hughes Aircraft on 14-15 June to discuss Typotron production problems and changes in test specifications. At the moment it appears that Hughes has all production problems under control. It was decided that it is not necessary to process any Typotron tubes at the Lincoln Tube Laboratory in order to study any of the manufacturing process specifications for the tubes. There are a few problems associated with the correlation of test data taken by IBM at Lexington and the production data taken by Hughes.

There was a meeting at San Diego to review Convair's most recent manufacturing process specifications. It was observed that many of these specifications were over a month behind the changes that were inaugurated in the production line. Convair has engaged a number of consultants to advise them on production problems. Convair will no longer need any direct help from the Lincoln Tube Laboratory. Facilities of the Lincoln Tube Laboratory will be used to evaluate Convair's processes to enable IBM and MIT to monitor the work of the Convair line.

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I attended meetings at General Electric and Sylvania the week of 6 June to review their recent technical progress and expedite the second-source programs for the gate pentode and twin triode.

2.9.2 Tube Research and Development

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

Recent research in the preparation of luminescent screens seems to indicate that higher concentrations of potassium silicate produce better screens. The latest data indicates that one such level is at 4400 ppm of Kasil #22 (potassium silicate) solids in the total cushion. In order to evaluate this information we have proceeded to prepare P7 screens for study. Initial observations after bakeout and aluminizing deserve further consideration and experimentation in our chemistry laboratory.

In order to evaluate the selective method of aluminizing, XD-182 was prepared. Although the "dip-meter" reading was within specifications, the D and CRL had increased beyond specifications after bakeout. It is apparent that the geometry of the present Con-vair Manufacturing Process Specification method for selective aluminizing has extremely narrow margins.

Two 19-inch tubes, CHT-112 and CHT-113, for yoke studies and two 19-inch tubes, CHT-108 and CHT-109, for display evaluation have been processed for Group 62. CHT-108, with a Mod. XII matrix, is in transit to Lexington, while CHT-109 is ready to be shipped there. CHT-112 and CHT-113 have been tested in Barta.

(S. Twicken) (UNCLASSIFIED)

A life test has been initiated on the 2420 under cutoff conditions.

The Leeds and Northrup X-Y Plotter has been set up for taking tube characteristics under d-c or pulse conditions.

I have begun the layout of a rack for life testing 5998's and DT-438's.

(T. F. Clough) (UNCLASSIFIED)

Eleven tubes of a recent lot of four hundred 7AK7's developed air leaks during preburning. This condition is apparently confined to tubes of one production run as the preburn results of a different production run were normal. Sylvania has been notified and a close check will be made of this defect during all preburning and life testing.

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Equipment is being set up to test the 6161's which are being used as deflection drivers in display consoles.

(L. B. Martin) (UNCLASSIFIED)

Tubes removed from the eight-position life-test rack will be started on the new life test the week of 20 June 1955.

Tubes 11981, 12122, 12221, 12523, 12622, and 12641 have been on the 16-position life test for 1411.5 hours, while tubes 12242, 12461, and 12522 have been on for 685.8 hours. All are satisfactory.

(P. C. Tandy) (UNCLASSIFIED)

Five 19-inch tubes, CHT-62-1, CHT-72-2, CHT-75, CHT-80, and Convair 0083, have completed from 1414 to 4897 hours of life test. Since the last report CHT-61, CHT-73, Convair 14-1, and Convair 0208 have failed the 50- μ a pulse-matrix-current requirement. The results of the last transfer-characteristic test are given in Table I. All zero-bias matrix currents have dropped from the previous test, but part of this drop is due to calibration of the pulse from the 2 channel gate mixer amplifier. All CHT's and 0208 were operated at one-half cutoff previous to this test.

The leakage currents which were measured greater than 1 microampere are noted in Table II. CHT-61 had checked all right previously, while 0197 had not been checked before. CHT-73, Convair 14-1, 0082, 0187, 0199, and 0208 did not show leakage currents greater than 1 microampere.

Table III gives the helical accelerator resistances measured, along with previous readings when made. The results indicate accuracy of the method, and they show no appreciable changes.

The gas ratios of tubes which failed are given in Table IV. Convair 14-1 shows a change from 0.9 to 19 millimicroamperes between 668 and 1367 hours. The Convair tubes appear to have more gas in them than the CHT's. Some of the tubes would not give the specified 100- μ a cathode current for the test, but the ion currents should be a direct ratio to cathode currents so that equivalent ion currents can be calculated.

Table V gives the screen-backing capacitance and dissipation factors measured. CHT-100 was made with no phosphor or aluminum screen, and the results on this tube are included for reference only. None of the tubes which had been measured previously showed great changes. CHT-61, 0082, and 0197 do not appear to have adequate screen backing. CHT-61 was made previous to the use of this test procedure.

The results of the cathode-uniformity measurements are shown in Table VI. The only tube to show a change while operating at one-half cutoff d-c was CHT-73.

The tabulated data referred to above is available on request at Room 006, Barta Building.

CHT-61, CHT-68-1, and CHT-73 will be dissected to make observation of the cathode surface possible. The cathode-oxide coating will be observed for mechanical damage or other possible causes of failure. The following Convair tube cathodes will also be observed when permission to dissect them is obtained: 7-1, 14-1, 14-5, 0082, 0123, 0124, 0127, 0187, 0197, 0199, and 0208. These tubes represent all except one (0117) of the Convair Charactrons which have failed the life test. Convair 0117 has been dissected previously and indicated voltage breakdown or short between G_1 and cathode.

Several of the short length CHT yoke study tubes will be put on life test shortly. The pulse A_2 current will have to be measured on these tubes since they do not have matrices.

The chemical analysis made of a sample of Ca^{2+} Fe^{2+} Fe^{3+} Mg^{2+} Na^+ K^+ NH_4^+ of very nearly stoichiometric composition has been obtained and compared with previous runs of other samples of Ca^{2+} Fe^{2+} Fe^{3+} . The magnitude of the calcium peak is reduced, indicating that this peak may be due to Ca^{2+} from the cathode rather than from the matrix.

Several test tubes of short length were made and tested. The results of these tests were very similar to those obtained with the longer tubes. The results show that the cathode composition is very similar to that of the longer tubes. The results of the chemical analysis should be made with care.

Chemical Analysis

The tubes, 7-1, 14-1, 14-5, 0082, 0123, 0124, 0127, 0187, 0197, 0199, and 0208.

Qualitative analysis of the following was made:

1. 7-1-1 and 14-1-1, heavy-duty type tubes;
2. 14-5-1 and 0082-1, heavy-duty type tubes;
3. 0123-1, 0124-1, 0127-1, 0187-1, 0197-1, 0199-1, and 0208-1, all samples of Ca^{2+} Fe^{2+} Fe^{3+} Mg^{2+} Na^+ K^+ NH_4^+ ;
4. Sample of Ca^{2+} Fe^{2+} Fe^{3+} Mg^{2+} Na^+ K^+ NH_4^+ ;
5. Sample of Ca^{2+} Fe^{2+} Fe^{3+} Mg^{2+} Na^+ K^+ NH_4^+ .

Quantitative analysis of the following was made:

1. 7-1-1, 14-1-1, 14-5-1, 0082-1, 0123-1, 0124-1, 0127-1, 0187-1, 0197-1, 0199-1, and 0208-1.

III. ADVANCE DEVELOPMENT

3.1 Chemistry of Magnetic MaterialsExperimental Ferrites

(D. L. Brown, F. E. Vinal) (UNCLASSIFIED)

Additional firings of the lithium ferrite plus a small amount of nickel ferrite samples have shown that slight increases in H_s max and B_s can be obtained; however, as these measurements increase so does the coercive force. Additions of zinc ferrite to lithium ferrite reduce both the coercive force and the squareness. An investigation has begun to find some combination of the three ferrites - lithium, nickel and zinc - that will possess high squareness, high flux and low coercive force.

Thermal Stability of Magnetic Spinels

(D. Wickham, F. S. Maddocks) (UNCLASSIFIED)

The thermal analysis curve of a sample of $\text{Li}^{+1}(\text{Mn}^{+3}\text{Mn}^{+4})\text{O}_4$, DCL-8-70, of very nearly stoichiometric composition has been obtained and compared with previous runs of other samples of LiMn_2O_4 . The magnitude of the second endothermic peak is reduced, indicating that this peak may be due to an impurity whose concentration is less in this sample.

Several test runs of the thermal analysis furnace, using thermally inert samples, were made during this biweekly period. Results show that to prevent contamination of the thermocouple wire where it contacts the sample, replacement of the thermocouple should be made after each run.

Chemical Analysis

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

Quantitative analyses of the following have been completed:

1. DCL-2-851 and DCL-2-852, memory-core compositions;
2. DCL-3-250 and DCL-2-250B, lithium ferrites;
3. DCL-8-68, DCL-8-69, DCL-8-70 and DCL-8-72, all samples of LiMn_2O_4 ;
4. Assay of Fe_2O_3 , Lot # R-2199
5. Assay of Li_2CO_3 , Lot # 5462.

Quantitative analysis of the following is in progress:

DCL-2-853, memory-core composition.

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Production of Memory Cores

(J. Sacco)

(UNCLASSIFIED)

During the past week, approximately 210,000 memory cores were produced. Electrical test results are incomplete, but they indicate acceptance yields of greater than 90%.

Two new batches have been processed, and full-capacity pilot-plant production will continue during the coming biweekly period.

Core Testing

(J. Schallerer)

(UNCLASSIFIED)

Sixty-one thousand cores were double-tested during the past biweekly period, bringing the total to 875,000. Most of the period was used to make revisions and improvements on the automatic tester. The rate of testing on the automatic is now 5,000 an hour, compared to the previous rate of 3600 per hour.

3.2 Physics of Magnetic MaterialsMagnetic Conference in Pittsburgh

(J. Goodenough)

(UNCLASSIFIED)

A paper entitled "The Role of Covalence in Oxides Containing Manganese" was prepared for publication, and a talk on the same subject was given at the Magnetic Conference in Pittsburgh, 14-16 June, 1955.

Temperature Variation

(N. Menyuk)

(UNCLASSIFIED)

A dummy sample holder of the same dimensions as the unit to be used with the new magnet has been constructed for temperature control measurements over the range from room temperature to liquid helium.

Tests will be conducted to determine the rate of temperature variation between the sample holder and equilibrium temperature, and of position along the sample holder. The results will indicate the adequacy of present design.

Visit to General Ceramics

(N. Menyuk)

(UNCLASSIFIED)

The General Ceramics Company was visited 13 June to discuss the switch-core problem. A sample of the latest switch-core material produced by General Ceramics, MF 2810, was brought back to this laboratory and tested. It has a low coercive force and extremely high squareness; however, it is too slow-switching to be suitable for our purposes.

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Vibrating Coil Magnetometer

(D. O. Smith)

(UNCLASSIFIED)

The input circuit, detector, and zero-shift circuit for the vcm have been designed and submitted to the Drafting Room.

Magnetic Conference in Pittsburgh

(D. O. Smith)

(UNCLASSIFIED)

The Conference on Magnetic Materials held in Pittsburgh 14-16 June was attended, and a paper was given describing the vcm and its use in studying the Curie point of magnetite.

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3.3 New Components and Circuits

D-C Bias on Transistor Bases

(T. H. Meisling) (UNCLASSIFIED)

The effect of positive bias on transistor bases can only be investigated properly if other operating conditions (base and collector currents in the "on" condition) remain fixed when the bias is applied. A theoretical and practical analysis of this type has been initiated.

Philco Subcontract

(T. H. Meisling) (UNCLASSIFIED)

During a meeting in Philadelphia, Philco summed up its main accomplishments during the past 5 months:

1. A series of high-temperature life tests of surface-barrier transistors has indicated a chemical decay which proceeds very slowly at ordinary temperatures. The decay is caused by unwanted impurities introduced during fabrication. Relevant changes in manufacture may be evaluated by subsequent high-temperature life tests.
2. The hole-storage effect and other aspects of the dynamic performance of a SBT have been studied and measured. Philco has proposed a figure-of-merit value which may be useful as a transistor specification.
3. Philco's so-called "direct-coupled" circuits have been tested in great detail. Marginal checking is being applied to these circuits. The circuit work at Lincoln has taken a different direction and the work at Philco will be brought into greater conformity with our approach and requirements.

Following the regular contract meeting, a meeting was held for the discussion of next year's contract. The work described above will be continued and expanded. Additional work will be done on the development of a memory drive transistor.

Surface-Barrier Transistor Life Tests

(D. J. Eckl) (UNCLASSIFIED)

Sufficient time has passed to make a complete report on the SBT life tests desirable. There are seven tests which employ 288 transistors. The total number of hours for all tests is 14,045. This means a total of 4,044,960 transistor-hours with one failure (caused by an accident during data taking). The breakdown follows:

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1.	{ Flip-flops (2 stages)	8 transistors	4895 hours	1 failure
	{ Flip-flops (4 stages)	16 "	4100 hours	
2.	double rank shift register, #1 and control (shielded)	100 "	1515 hours	
3.	oscillating shift register (direct coupled)	16 "	1224 hours	
4.	oscillating shift register (RC-coupled)	16 "	1175 hours	
5.	shelf life	16 "	700 hours	
6.	oscillating shift register (diode-coupled)	16 "	264 hours	
7.	double-rank shift register, #2 and control (unshielded)	100 "	172 hours	

Tests #3, 4, 5, and 6 have had parameter measurements made periodically on their transistors with no serious changes. Both shielded and unshielded shift registers have held a pattern for the past 4 days.

Transistor Measurements

(P. A. Fergus) (UNCLASSIFIED)

All routine measurements have been made on 200 new Philco surface-barrier transistors. Distribution curves of α_n and α_p have been plotted. Results of all tests indicate acceptable characteristics.

Recovery Time in Surface-Barrier Transistors

(C. T. Kirk) (UNCLASSIFIED)

New measurements of minimum switching time in p-n-p alloy transistors (GE - 2N43's and 2N45's) indicate that the accumulation of holes in the outer regions of the base during saturation occurs in alloy junction transistors as well as SBT's. This accumulation of holes appears to increase the effective base width of the transistor. In the measured alloy units, this effective base width was found to exceed the actual base width by a factor of 3.5.

Positive Bias on Transistor Bases

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

We analyzed the effects of positive base bias on transistor circuits and found that an improvement of d-c margins could be obtained without changing the transistor operating point. Positive base bias results in less susceptibility to noise and variation in transistor parameters. We also expect an improvement in rise and fall times. Analysis has revealed that positive bias is equivalent to the introduction of a battery into the base lead of the biased transistor.

Flip-Flop

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

Using the aforementioned analysis, two flip-flops were designed having identical transistor operating points, one with and the other without positive bias. Experiments are now in progress to verify our predictions and to determine the other effects of positive bias.

Hole Storage

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

Some early data on hole storage in surface barriers has been reanalyzed and seems to indicate two significant effects. First, the time during which the collector does not move (after a step of turn-off current has been applied to the base) seems to be largely dependent on the applied forward base current (during saturation) and largely independent of the drive which turns the transistor off. On the other hand, the decay time (i.e., the time it takes the transistor to go off once it starts moving) seems to be largely independent of the saturation current, and solely a function of the amount of drive used to turn the transistor off. This matter will be investigated further to point the way to optimum saturation and turn-off conditions.

Three-Digit Counter

(A. L. Pugh, III) (UNCLASSIFIED)

A three-digit counter has been built and operated using a transistor pulse shaper and buffer and the latest flip-flop. The counter will count up to 8 megacycles.

Pulse Generator

(M. E. Petersen) (UNCLASSIFIED)

A panel mounted transistor pulse generator has been completed and tested. With the present plug-in coils, the pulse rate can be varied from 3 to 12 megacycles.

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The pulse width can be varied continuously from 40 to 150 millimicroseconds using a General Radio variable delay line.

Dependable operation was secured over a supply voltage range of 1.5 to 3.0 volts using a random selection of transistors. A pulse of 1.0 volt amplitude across 100 ohms was obtained at the low supply voltage.

Transformer-Transistor Amplifier

(M. Cerier) (UNCLASSIFIED)

An M-note is being prepared which indicates the advantages and disadvantages of a transformer-transistor type of amplifier as compared to a simple inverter type of amplifier.

Some transformers are being wound in an attempt to find one that will work well with pulses shorter than 0.1 microsecond.

Transformer Drive

(M. Cerier) (UNCLASSIFIED)

A set of preliminary tests has been given. Failure for the transistors is attributed to an excess drive.

High Voltage Pulse Switch

(M. Cerier) (UNCLASSIFIED)

A trial run of the first complete 200-pulse switch has been given. The switch is being assembled using some surplus parts to give some idea of the general geometry of the design.

High Voltage Pulse and Switch

(M. Cerier) (UNCLASSIFIED)

The general and preliminary tests, most of which have been given, have been winding, have been made as shown.

The glass frame construction, difficulties have been noted. The glass frame is being "lapped" by the company. Another M note will be prepared.

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3.4 Memory

256² Memory

(J. L. Mitchell) (UNCLASSIFIED)

Magnetics Inc. has promised to ship the remainder of our switch core order by 30 June. Six-hundred switch cores have been ordered from Burroughs.

John Clarke of Group 66 has started to write the specifications for the power supplies. He has been assigned to help us with our power and distribution problems.

All modifications on the vacuum-tube plug-in unit have been completed, and the prototype is in its final form.

Transistor Drive

(J. Raffel) (UNCLASSIFIED)

A set of preliminary specs has been given Philco for the transistors to be developed for memory drive.

256² Memory Driver Switch

(J. Raffel) (UNCLASSIFIED)

Fabrication of the first complete 256-position switch has begun. Sixteen-core plug-in units are being assembled using cores already available plus some to be delivered shortly by Magnetics Inc.

256² Memory Planes and Stall

(E. A. Guditz) (UNCLASSIFIED)

One-hundred and seventy-five mats, most of which lack one-half of the sense winding, have been made to date.

The plane frame production bottleneck has been broken. Seventy-five frames are being "lugged" by the vendor. Another 75 are ready for "lugging."

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By 1 July, 300 frames will have been machined in our shops. The remaining 400 will be machined by an outside vendor.

Design of the stall for the 256^2 memory is about half completed.

V.T. Plug-in Unit

(E. A. Guditz) (UNCLASSIFIED)

The vacuum-tube plug-in unit design is completed. An order for 200 units will soon be placed. Design of the racks for the plug-in units is progressing satisfactorily.

Memory Test Setup VIII

(D. H. Ellis) (UNCLASSIFIED)

The hardware for 20 magnetic-switch plug-in units was completed by an outside vendor. Wiring of those units for which cores are available is under way.

The lack of availability of 1N208 and 1N216 diodes is delaying the completion of the matrix output amplifiers.

Transistor Selection Switch

(G. Davidson) (UNCLASSIFIED)

The first draft of my thesis proposal was reviewed by several members of the staff and by Dick Thornton, MIT Staff. After some revisions, addition and deletions, it was submitted to Frank Hazel for his comments.

N. T. Jones' thesis appears to have information on switching time of diodes that may be valuable in the work on turning transistors on and off with the collector open circuited.

Construction has started on a driving circuit for the forward-recovery and reverse-recovery tests on transistors.

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3.6 Systems Design

(J. Fadiman) (UNCLASSIFIED)

During the past 2 weeks, the transistor gating system has been investigated in order to determine the d-c current requirements. This has led to the determination of the workable resistance and capacitance values.

(J. Fadiman, R. A. Hughes) (UNCLASSIFIED)

A testing unit for plug-in flip-flops has been designed and built, and data is being taken on the first of the quantity plug-in flip-flops.

(R. Sawyer) (UNCLASSIFIED)

The necessary control and power-supply equipment for operation of the 8-digit multiplier has been installed into racks, and work is being started on the inter-rack wiring.

Register drive experiments have been conducted in order to determine the amount of drive needed to operate a register (8) of gates and/or flip-flop.

(R. Hughes) (UNCLASSIFIED)

An investigation of ionization and de-ionization time of Ne2A glow lamps has been started.

(R. D. Gloor) (UNCLASSIFIED)

Measurements were made on power transistors, Minneapolis Honeywell types H-2 and H-4. Static characteristic curves were plotted and base temperature monitored by means of a thermocouple. Small signal parameters were measured, and variation of these parameters with frequency and emitter current was also checked.

Above measurements were made to determine suitability of these transistors for use in semi-conductor regulated power supply.

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IV - CENTRAL SERVICES

4.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

A large order for perforator tape has been placed with the Link Paper Company. To arrive at the quantity we combined the requirements of Groups 61, 62, 63, and 64. In the future it may be advisable to stock this tape as a standard item.

We have been requested to remove all 6345 property presently stored in the 6th Street (Cambridge) warehouse because of critical space requirements. Steps will be taken to accomplish this as soon as time permits.

Efforts should be made to use the new LL Standard components rather than those from the old DCL Standards Book; however, any former DCL items may be requisitioned if necessary. As a Div. 6 Standards representative, I would be interested in receiving comments or suggestions concerning this subject.

4.2 Engineering Services4.2.2 Test EquipmentTest Equipment Committee

(L. Sutro) (UNCLASSIFIED)

The Test Equipment Committee now includes the following:

<u>Group</u>	<u>Representatives</u>
60	A. Bille, L. Sutro
62	R. Best, J. O'Brien, L. Sutro
63	D. Brown, K. Olsen
64	A. Roberts
65	S. Twicken

Every request for new test equipment should be sent to one of the above representatives who will bring it before the Committee for action. The Committee is trying to standardize and limit the number of types of test equipment as far as possible. To insure an adequate supply of test equipment, the Committee surveys the needs of the entire Division and places equipment orders based on these needs.

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Test Equipment Headquarters

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

A course is now in progress on the maintenance of Tektronix oscilloscopes. The Tektronix field engineer in New England, Vic Fricke, is conducting the course during the five mornings of this week.

We are striving to contract the operations in Test Equipment Headquarters into smaller space, to make room for expansion of MTC staff. The Test Equipment Committee has directed that there be no curtailment of service as a result of this contraction.

4.2.3 Mechanical Engineering

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

The group has been conferring on problems involving:

1. Consolidation of Div. 6 model shop facilities;
2. Layout and design of the XD-1 Command Post Projection Room and status boards;
3. Design weaknesses disclosed in the situation-display consoles.

It has also initiated design or construction activities for:

1. Cryotron helium Dewar flask;
2. Jigs and fixtures for 19-inch Charactron assembly;
3. Portable table for the taper pin swaging machine;
4. Installation of a WWI motor generator.

4.3 DraftingMemoranda - For Internal Distribution Only

(A. M. Falcione) (UNCLASSIFIED)

All memoranda which are specified "For Internal Distribution Only" will be issued only to those specified on the respective distribution list. Copies will not be issued to non-Lincoln personnel by the Division 6 Document Room, unless approval is obtained from the Section or Group Leader who approved the respective memorandum. This is necessary to insure proper control of material of a proprietary nature or still in an experimental stage.

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Memoranda - Flight Test Schedules

(A. M. Falcione) (UNCLASSIFIED)

Group 61 Flight Test Schedules, Summaries, and Requirement Lists written by R. N. Davis no longer bear memoranda numbers but are issued by the Document Room by their scheduling symbols, such as 6-ARL.

Drawings for Memoranda

(A. M. Falcione) (UNCLASSIFIED)

We are running into many delays in the reproduction of memoranda because the authors have not given advance notice to Drafting for preparation of the necessary drawings. In many cases, the drawings require photographic reduction which takes several days for processing through the Photo Laboratory. Most of the memoranda which we issue require from 80 - 125 copies which are most economically reproduced by Multilith. Ozalid prints should not be specified if more than 40 copies are required. Drawings should be submitted to the Drafting Room so that all necessary processing can be done by the time the text material is ready for reproduction.

I have mentioned this matter in previous Biweeklies, but it has not had the desired effect on some of the Staff members. I am stressing the point again with the hope that we can improve service by eliminating unnecessary delays in the reproduction of Laboratory memoranda.

4.4 Administration & Personnel4.4.1 Staff

(J. C. Proctor) (UNCLASSIFIED)

Leland Hager is a new staff member assigned to Group 61. He received his BS in Electrical Engineering from Tufts College.

Howard W. Briscoe is a new staff member in Group 61. He received his SM in Geophysics from MIT and was employed by the Gulf Research and Development Company.

Daniel Ladd is a new staff member assigned to Group 61. He received his MA from Columbia University and was employed by Sylvania.

John Russell is a new staff member assigned to Group 66. He received his BS degree in Mechanical Engineering from Marquette University and was employed by the A. O. Smith Corporation.

William Walsh is a new staff member assigned to Group 61. He received his Ph.D. from MIT and was employed by the Gulf Research and Development Company.

4.4.2 Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

New

Antonio DeCastro has returned to work in the Drafting Room for the summer.

Ruth Green is working for the summer in Group 61 as a Technical Assistant.

Owen Hill has joined the Chemistry Section of Group 63 as a Lab Assistant.

Philip Ineson is another new Lab Assistant in Group 63's Chemistry Section.

Francis Kimball is also a Lab Assistant in the Chemistry Section of Group 61.

Peter Lynch is an MIT student working part time in Group 65 at the Barta Building.

Ward McAllister is an MIT student working in Group 61 for the summer.

Harold Ness is another MIT student working part time for Group 65.

Eugene Richman is a new clerk in Group 62.

Jane Sawyer is a new clerk in the Document Room.

Martha Sifnas is a new technical clerk in Group 61.

Terminations

- James Delmege
- Harry Mogensen
- Clifford Monzeglio
- Alta Vincent

Transfer

Charles Giacera has gone to Division 7.

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Accessions List

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(Frances Christopher) (CONFIDENTIAL)

The following documents were published by Division 6 or received from IBM during the period 6 June - 17 June 1955.

<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-1624-2 S#1	P. R. Bagley	Precepts for WWI Programmers	U
6M-2833 S#1	G. E. Mahoney	Correction of Programming Procedure for CS II	U
6M-3246	A. L. Smalley	Group (1 Mission Spec. 1-55 for a Live Training Test on 4 Jan. and a Demonstration on Jan. 1955	U
6M-3447	H. Anderson	Internal Procedure for Processing Changes to AN/FSQ-7 Equipment Specifications	U
6M-3583	E. Lundberg		
	H. K. Rising	XD-1 Console Equipment and Label Layouts Part I Equipment Summary	C
6M-3584	R. D. Buzzard		
	H. K. Rising	XD-1 Console Equipment and Label Layouts Part II Room S	C
6M-3585	R. D. Buzzard		
	H. K. Rising	XD-1 Console Equipment and Label Layouts Part III Room W	C
6M-3586	R. D. Buzzard		
	H. K. Rising	XD-1 Console Equipment and Label Layouts Part IV Command Post	C
6M-3587	R. D. Buzzard		
	H. K. Rising	XD-1 Console Equipment and Label Layouts Part V Room T, I, D, M and Computer	C
6M-3600 S#1	P. R. Vance	Alarm and Intercommunication Facilities for AN/FSQ-7 Duplex Operation	U
6M-3603	et al		
	L. B. Martin	Progress Report to the Department Committee on Graduate Study and Research	U
6M-3604	P. C. Tandy	Progress Report to the Department Committee on Graduate Study and Research	U
6M-3632	H. K. Rising	AN/FSQ-7 Console Equipment and Label Layouts Part I Equipment Summary	C
6M-3633	R. D. Buzzard		
	H. K. Rising	AN/FSQ-7 Console Equipment and Label Layouts Part II Room S	C
6M-3634	R. D. Buzzard		
	H. K. Rising	AN/FSQ-7 Console Equipment and Labels Layout Part III Room W	C
6M-3635	R. D. Buzzard		
	H. K. Rising	AN/FSQ-7 Console Equipment and Label Layouts Part IV Command Post	C
6M-3636	R. D. Buzzard		
	H. K. Rising	AN/FSQ-7 Console Equipment and Label Layouts Part V Room T, I, M, R and Computer	C
6M-3644	E. S. Rich	Subsector System - Integration Planning	C
6M-3651	S. Twicken	3002420 Meeting of 11 and 12 May 1955	U
6M-3654	E. A. Guditz	Procedure for Stripping Wires for 64 x 64 Memory Plane Modules	U
6M-3656	S. Hibbard	The Training of ARDC Personnel to Man the Direction Centers for Cape Cod and XD-1	C
6M-3661	A. Heineck		
	H. D. Benington	Master Program Preparation Schedule	C
6M-3662	F. E. Heart	Program Interrogation of Display Cycle	C
6M-3663	J. F. Jacobs	Visit from Rand to Discuss Rand's Permanent Facilities and STP for Sage	U
6M-3667	M. D. Feldstein	Detailed Schedule for Weapons Direction Section from 1 May to 1 October 1955	C
6M-3669	J. D. Grans	XD-1 Evaluation, 20 May 1955	U
6M-3671	S. L. Thompson	Laboratory Personnel List	U

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<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
6M-3673	J. F. Jacobs	Need for Programmers Training Course for ADES, RAND, ADC, and Lincoln to be Provided by IBM	C
6M-3674	Div. 6 Staff	Biweekly Report for 27 May 1955	C
6M-3676	D. R. Brown	Group 63 Approval Committee Meeting June 3 1955	U
6M-3677	F. Brooks	Comparison of Possible Programs for (r,e) to (x, y) Conversion of Radar Data in the AN/FSQ-7	C
6M-3678	D. R. Brown	Group 63 Approval Committee Meeting June 7 1955	U
6M-3679	M. D. Feldstein	Detailed Schedule for Tracking Section from May 1 to October 1 1955	C
6M-3684	J. P. May	X Telling XD-1 to WW and Returns: Future Sage Tests with Whirlwind	C
6M-3685	R. R. Reed	Dimensions of AN/FSQ-7 Situation Display Format	U
6M-3687	D. Latimer	Proposal for a New 16-Aircraft Program for WWI	C
6M-3689	H. J. Platt	Minutes of Experimental Sage Subsector Planning Approval Committee Meeting of 13 June 1955	C
6M-3690	W. L. Gardner	Progress of XD-1 Large Board Display	U
6M-3691	L. L. Sutro		
6M-3691	A. R. Shoolman	Modes of AN/FSQ-7 Duplex Operation	C
6M-3693	P. R. Vance		
6M-3693	C. W. Watt	A Method of Interpreting and Using Cape Cod System Records	C
6M-3694	A. R. Shoolman	Alarm Monitoring in AN/FSQ-7 Duplex Operation	U
6M-3694	P. R. Vance		

Group 61 Flight Test Schedules, Summaries, and Requirement Lists written by R. N. Davis, no longer bear memoranda numbers, but are issued by the Document Room by their Scheduling Symbols.

IBM DOCUMENTS

IBM-760	_____	Central Reference Room Bulletin #82	U
IBM-761	_____	Central Reference Room Bulletin #83-84	U
IBM-762	C. J. Hesner	Project High Program Identification	U

LL-DR REPORTS

DR-249	W. A. Hunt	Drum Specifications for the Production System	U
DR-250	W. A. Hunt	Perselben Codes	U
DR-251	W. A. Hunt	Perselben Codes	U
DR-252	W. A. Hunt	Duplex Input MGD Frame	U
DR-253	R. W. Lowrie	Concurrence on Display Console Side Frame Specifications	U
DR-254	C. E. Walston	Drum Specifications for the Production System	U
DR-255	J. Feitler	Core Memory Assignment Switch	U
	L. R. Walters		
	W. A. Hunt		
DR-256	J. Giordano	IBM-SO Concurrence Letter	U
DR-257	D. G. Ross	Concurrence on Long-Range Input Specification for Initial AN/FSQ-7 Machines	U

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<u>NO.</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>CLS.</u>
<u>LL-DR REPORTS</u> (Continued)			
DR-258	R. C. Marden	Equipment Layout for Maintenance Control Area Duplex Central	U
DR-259	R. W. Lowrie	Supplement 4 to the Specifications for the AN/FSQ-7 Auxiliary Console	U
DR-260	R. W. Lowrie	Concurrence on D-25-2. Supplement 2 to Display Console Specifications	U
DR-261	L. J. Thompson	Proposal for Duplex Central Motor-Generator Sets	U
DR-262	D. C. Ross et al	Concurrence on AN/FSQ-7 Auxiliary Console Specifications for XD-1, XD-2, and the Production Machine	U
DR-263	W. A. Hunt	Specification for the Duplex Maintenance Console for the Production System	U
DR-264	R. W. Lowrie	Supplement 2 to Display Console Side Frame Specifications for XD-1, XD-2, and the Production Machine	U
DR-265	R. C. Marden et al	Concurrence on D-81-3	U
DR-266	D. C. Ross et al	Concurrence: Specifications for the Input Pattern Generator	U
DR-267	D. C. Ross	Concurrence: Drum Specification for the Production System	U
DR-268	R. W. Lowrie	Unit Status Indication from Simplex Equipment D-84-1	U
DR-269	W. A. Hunt	Test Memory for the Production System	U

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