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Memorandum M-2815

Division 6 - Lincoln Laboratory  
Massachusetts Institute of Technology  
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR MAY 7, 1954

To: Jay W. Forrester

From: Division 6 Staff

CLASSIFICATION CHANGED TO:  
Auth: DD 254  
By: R. K. Everett  
Date: 2-1-60

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

Work on the 1954 Cape Cod System program is well under way. A memo has been issued describing the proposed logical functions of each Weapons Direction station, and an outline has been drawn up for the correlation and smoothing and prediction programs. In addition to the operational programs, programs are being written to analyze actions and determine the length of time taken by various subprograms.

The joint Weapons Direction-Track-While-Scan meetings are producing useful results. For instance, the decision has been made to have the Weapons Direction program supply ground x, y velocity components for use with the smoothing and prediction program for command tracking of interceptors.

A program for cross-telling tracks between the Cape Cod System and some of the M-33 radars in the Boston AA defenses is being set up in connection with ADES studies.

M-2807, "Suspension of 1953 Cape Cod System Activities," specifies the schedule for shutdown this summer.

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UNCLASSIFIED1.12 Data Screening

(R. L. Walquist) (CONFIDENTIAL)

An outline has been drawn up for the correlation and smoothing and prediction programs in the 1954 Cape Cod System. This outline emphasizes the ways in which crossing tracks, maneuvering tracks, and automatic initiation should be handled. Various details of the outline have been discussed with W. Wells to make sure that he agrees with the methods specified. With some slight modifications, this outline will become the basic description of the 1954 Cape Cod correlation and smoothing and prediction programs.

The joint WD-TWS meetings have continued and produced several important results. It was decided to keep the track number assigned to a track separate from the tracking channel in which the track is stored. This allows the use of more track numbers than there are tracking channels and also permits track numbers to be assigned to new tracks in sequential order. The decision was also made to use command tracking for interceptors. The WD program will provide the ground x, y velocity components for use with the smoothing and prediction program. An indication will also be provided which tells when a command heading is not being used by the interceptor pilot.

A timing program is being written by D. Bailey to assist us in determining the length of time taken by each of the TWS subprograms. The program will print out the time as a function of the number of tracks carried and the total amount of radar data processed by the program. Results of this analysis will be used to estimate the time required in the 1954 Cape Cod System and in the XD-1 System.

Arrangements have been made with Ed Rich and Ken McVicar to obtain an extra field of auxiliary memory on the buffer drum. This will require some slight modification of the buffer-drum system; it is planned to make this modification during the June shutdown. This extra auxiliary memory will not affect the number of radar sets which can be tied into the computer; i.e., it is still planned to provide eight gap fillers, two long-range sets, and one Mark X. Arrangements have been made with Bert Green (Group 38) to run a test on the benefits of angling the 19-inch display scopes at the Track Monitors' position. This is being done since the equipment people would prefer to keep the consoles in a straight line, whereas the operations people feel that it is more desirable to angle the consoles at about 45°. The test to be run by Bert Green should give us more information on the operational differences between straight and angled consoles.

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

I have attended several joint meetings of the Weapons Direction and Track-While-Scan Sections concerning items affecting the 1954 Cape Cod

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1.12 Data Screening (Continued)

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

System. In relation to this a critique of M-2775, "Proposal for the 1954 Cape Cod Simulation Programs," has been prepared.

The weekly training meetings with the TWS Air Force personnel have continued to produce beneficial results. Topics recently discussed in detail are command heading vectors, TWS SOP's, and interceptor scramble SOP's. The interceptor scramble SOP's have been revised with C. Zraket.

(D. L. Bailey) (CONFIDENTIAL)

During the past biweekly period I prepared for acting as a Cape Cod System guide and served in that capacity on two occasions.

I am writing a program to record the time required by each sub-program of the Cape Cod Program. This will be available early in the week of 10 May.

Several proposals for various phases of the 1954 System have been studied.

(H. Frachtman) (CONFIDENTIAL)

Some time has been spent in preliminary work on the 1954 Cape Cod System.

A program has been almost completed which will partially analyze the Track Monitor and Track Control registers recorded by J. Levenson. This tape will read up to 500 scans of data and record the frequency of occurrence of various lengths of sequences of total track life, trouble-free track life, trouble incidence, and total trouble-track life for track histories which have been completed during the 500 scans. In addition, counts of the sources and disposition of the tracks are recorded.

(F. E. Heart) (CONFIDENTIAL)

Consideration is being given to various modifications and additions to track-while-scan techniques. Several joint TWS-Weapons Direction Section meetings have been attended.

(J. Levenson) (CONFIDENTIAL)

The general indoctrination memo for TWS personnel has presented many writing problems and is not yet complete.

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1.12 Data Screening (Continued)

(J. Levenson) (CONFIDENTIAL) (Continued)

Data is still being collected on live missions but is not yet analyzed. The recorded data is being correlated with visual observations made on an Audograph during the test.

Time was spent lecturing to the group here for the Cape Cod familiarization program and attending those lectures on XD-1.

(H. Peterson) (CONFIDENTIAL)

I have checked out three programs that are modifications to the September Cape Cod System:

1. A program to aid in communication between the Weapons Director and Tracking Officer,
2. A program to control the camera for data pictures, if the interlock is removed,
3. A program to adjust the center of the search area back along the line from the predicted position towards the present position.

None of these programs has been evaluated.

I am in the process of writing a radar-data-analysis program which will be done early in the week of 10 May.

(H. H. Seward) (CONFIDENTIAL)

M-2772, "Cape Cod Simulation Program," was studied, discussed, and comments forwarded. The "Outline for Air Surveillance, 54 System" was also studied, discussed, and comments forwarded. Several conferences were held to discuss equipment requirements for the 1954 System.

Some time was spent as a guide for visitors to the Direction Center.

(E. W. Wolf) (CONFIDENTIAL)

All calibration flights scheduled for this biweekly period were canceled. Memorandum M-2776, "Rectangular Coordinates of Radars in Cape Cod System," by D. Goldenberg, gives the coordinates of the gap-filler radars with respect to S. Truro as obtained from a stereographic projection using S. Truro as the reference radar site. These coordinates had been previously obtained from the relative coordinates of S. Truro and the gap

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UNCLASSIFIED1.12 Data Screening (Continued)

(E. W. Wolf) (CONFIDENTIAL) (Continued)

fillers with respect to N. Truro, based on a projection using N. Truro as the reference radar site. The new coordinates are expected to permit a slight improvement in future calibration operations.

(W. M. Wolf) (CONFIDENTIAL)

On the two Thursdays of the past biweekly period, visitors were guided about the Cape Cod System.

Various proposals for the 1954 Cape Cod System are being studied. The taking of pictures of data and maps is continuing.

1.13 Tracking and Control

(W. Lone) (CONFIDENTIAL)

The octal-to-binary conversion program to be used with the XD-1 has been completed. During the past week it was tried out at IBM in New York using the simulated XD-1 operations program written by IBM staff for use on the 701 computer. Program errors have been detected, and corrections are being made.

Some time was spent in review of the specifications for the XD-1 magnetic-tape units.

(A. Mathiasen) (CONFIDENTIAL)

The tracking section of the tracking-analysis program previously discussed has now been checked out.

I have talked with various people on methods of generating random numbers. These are to be used in connection with a BTL formula for blip-scan ratios. A simple system with low storage requirements is desired. While investigation is not complete, the best method for this purpose seems to be the extraction of the middle digits of the product of two numbers. Thus for WWI  $a_n = a_{n-1} \cdot a_{n-2} \cdot 2^p \pmod{1}$ . A shift of 7 has been tried with sequence lengths long enough for the present need and with good distribution of digits.

(H. D. Houser, H. D. Neumann) (CONFIDENTIAL)

Work on the manned-interceptor simulation program has been started. It is planned to write this program in separate independent sections

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1.13 Tracking and Control (Continued)

(H. D. Houser, H. D. Neumann) (CONFIDENTIAL) (Continued)

for flexibility and ease of checking. A block diagram for the command computation section is being prepared now. The interception equations are for the two-dimensional case, since it is assumed that the interceptor will be initially at the altitude of the target. Preliminary specifications for some of the other parts of the program were drawn up.

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1.14 Weapons Direction

(D. R. Israel) (CONFIDENTIAL)

The flight-test program memo, M-2785, which has been described in previous Biweeklies, has now been issued. It is complete except for sections by Attridge and Davis which will be issued as supplements. The memos and the results of the operation of various sections of the 1953 Cape Cod System through the end of February are now being typed or are already in the process of distribution.

M-2807, "Suspension of 1953 Cape Cod System Activities" (Israel, Walquist, Wieser), has been issued. This memo specifies the schedule for shutdown this summer and presents specific details regarding the use of aircraft, Air Force personnel, radars, etc.

Herb Benington and Charlie Zraket have prepared and issued a lengthy inter-office memo outlining in considerable detail the Weapons Direction functions of the 1954 Cape Cod System. Following discussions and revisions to the material, this memo will serve as the primary guide to the inputs, outputs, and logical action in each of the programs. Herb Benington has been made responsible for the co-ordination, preparation, and checkout of the Weapons Direction sections of the 1954 Cape Cod program. These duties will include the necessary co-ordination with the Track-While-Scan functions as well as among the Weapons Direction programs themselves. Plans and scheduling of the writing of these programs and their checkout and assembly into the large Weapons Direction program will be handled by Benington. This work will be supervised by Zraket who will spend a large portion of his time in the operation of the 1953 Cape Cod System, the documenting of the results of this operation, and the preparation of plans for the operation of the 1954 System. Conant and Hazel will assist Benington, particularly with the DID, Master Make-Up, and display programs.

Together with Conant and other members of the Group, the various telephone facilities for each of the operating positions of the 1954 Cape Cod System have been decided upon. Conant will co-ordinate the various requirements and will prepare the necessary order for the Telephone Company. In conjunction with Rawling, Zraket, and Benington, firm decisions have been reached on the 1954 Cape Cod floor plans, panel layouts, and intervention leached wire. Rawling is preparing the necessary drawings to be given to Group 64. The next item to be handled in accordance with the schedule established by Group 64 is the specification of the display lines to be available at each console. This should be finished during the coming week.

Joint meetings of members of the Weapons Direction and Track-While-Scan Sections continue with a fair amount of progress and positive results. Benington and Ishihara prepare the agenda and minutes for these meetings, which occur once or twice a week, and will assemble these notes within a week or so for formal distribution.

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UNCLASSIFIED1.14 Weapons Direction (Continued)

(D. R. Israel) (CONFIDENTIAL) (Continued)

M-2775, "Proposal For 1954 Cape Cod Simulation Program" (Knapp and Gaudette), has been typed and distributed. M-2799, "Proposal For The Master Control Program Of The 1954 Cape Cod System" (Knapp and Gaudette), will be distributed early in the week.

The Weapons Direction Section has instituted a series of weekly meetings to discuss the matters of interest to the Section as a whole and to listen to short talks on items of particular interest. These meetings, held each Monday at 10:30, are organized by Jack Cahill and Bill Lemnios.

(H. D. Benington) (CONFIDENTIAL)

An inter-office memo was issued describing program features, displays, switches, and alarms for the Weapons Direction stations in the 1954 System. This memo, which was prepared by Zraket and myself, is a proposal which will be reviewed by D. R. Israel and other members of the Section. Once concurrence is reached, program responsibility and design can begin.

Two more meetings between the Tracking and Weapons Direction Sections were held. Points of agreement have been summarized in an inter-office memo.

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

There were two anti-aircraft guidance missions this period. On 29 April, 3 tracks were passed to AAA. Two were locked on, assigned by the Weapons Director for engagement, and splashed. A clue as to the failure of AAA to acquire the third track is afforded by the fact that reinitiation moved the track about 30-50 miles when it was about 10-20 miles from Boston. On 6 May, four tracks were passed, locked on, and assigned. Three were splashed, but the fourth was locked on too late for engagement.

Some time was spent in assisting with the last Cape Cod familiarization program.

A meeting was attended with Walquist and Favret of Group 61 and representatives of Bell Telephone Labs. and Western Electric on 5 May. The meeting was in connection with the ADES program to compare the completeness of Cape Cod System surveillance with that of the 15th Group AAA. (Boston). Group 61 will cooperate with BTL and Western Electric in this program but will not be actively engaged.

Two Weapons Direction Section meetings were attended this per-

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1.14 Weapons Direction (Continued)

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

iod, during which topics of general interest to Section members were discussed. Minutes will be distributed to Weapons Direction Section members and other interested Group 61 members. It is hoped that these meetings will be a permanent and productive feature of Group 61 operations in the future.

(O. T. Conant) (CONFIDENTIAL)

The organization of the telephone system for 1954 Cape Cod has been fixed. Only one or two minor details remain to be settled. The order to the telephone company must specify equipment location quite exactly and therefore must wait for freezing of frame and panel layout and floor plan. This is to be done not later than 15 May.

(A. G. Favret) (CONFIDENTIAL)

Some of the Height Finder Data Analysis forms were revised and prepared for reproduction as DL's.

Several minor modifications were made in the proposed AA program for the 1954 System.

Some timing data was collected during normal height-finding operations as part of the current flight-test program.

I attended a meeting on 5 May 1954 (along with R. Walquist and J. Cahill) to discuss plans for cross-telling tracks between the Cape Cod System and some of the M-33 radars in the Boston AA defenses. This meeting was also attended by representatives of Bell Telephone Laboratories, Western Electric, and Div. 2. The ultimate objective is to provide data for ADES studies.

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

The past biweekly period was spent in discussions with D. Israel, C. Zraket, and H. Benington concerning the logical features of the identification function of the 1954 Cape Cod System. Expression of these logical features is reflected in the form of switch allocations, special displays, alarms, and DID's. A summary of the results of these discussions appears in an inter-office memo from H. Benington and C. Zraket, dated 5 May 1954.

We are continuing with analysis of data logged at the identification (ID) station, and in conformity with directions in M-2785, "Cape Cod

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1.14 Weapons Direction (Continued)

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

Flight Test Program for April 1 - June 15, 1954," we are considering changes in the log format to be used in this period. We plan to brief the Air Force personnel at the ID station on the use and purpose of these logs to the end of improving the efficiency of data recording.

In the next period our attention will be divided about evenly between evaluation studies of the 1953 Cape Cod System and programming studies of the 1954 Cape Cod System.

(S. C. Knapp) (CONFIDENTIAL)

The program which analyzes Weapons Direction Section switch actions is now complete, so that every station may now have a printed record of all actions taken. The program which prints out intercept data has been modified to produce punched as well as printed data. The program records for delayed punching the same data that it prints on the intercept pairings specified. These punched tapes will be used with a program now being written by F. Webster to take pictures of the interceptions for analysis.

(W. Z. Lemnios) (CONFIDENTIAL)

A modification has been made to the interception calculations program to stabilize some of the final interceptions. This mod has been checked out.

A memo is being written which will describe how the climbing characteristics of interceptors have been approximated. A set of graphs showing the actual characteristics and their approximating function is also being prepared and will be issued with the memo.

At the 3 May conference of the WD Section a talk was given on the interception results from 1 October 1953 to 28 February 1954.

(L. Murray) (CONFIDENTIAL)

The results of the saturation test of 22 March, for the 1953 Cape Cod System, have been published and distributed to a limited number of interested people.

Another saturation test was held on 29 March. This test was not too successful. Poor radar, radio trouble, and the like limited the results of the test. A summary of this test is now being written and will be distributed during the coming week.

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1.14 Weapons Direction (Continued)

(J. Nolan) (CONFIDENTIAL)

Time during the past period has been spent in work on saturation flight tests and in preparing a final-turn stability analysis program.

(G. Rawling)

1953 Cape Cod System. I have served as a guide in the Thursday demonstrations during the past period.

1954 Cape Cod System. The non-track-while-scan data-insertions registers have been reallocated and a chart prepared giving pertinent data.

Drawings of console combinations and panel description (buttons digits, title, spares, no-connections) for each frame are completed. Preliminary drafts of the non-TWS section may be seen in the inter-office memo of 5 May on the Cape Cod (1954) System by Benington and Zraket. Changes and corrections for the drawings should be brought to my attention.

Preliminary floor plans for the Training and Battle Simulation Room showing measurements are available.

A preliminary floor plan for the entire Air Defense Room 222 is available for the 1954 Cape Cod System.

(F. A. Webster) (CONFIDENTIAL)

A preliminary floor diagram has been set up to implement the inter-office memo: "Proposal for Photographic Plots of Intercepts by the Computer" (W. Z. Lemnios).

(C. A. Zraket) (CONFIDENTIAL)

1953 Cape Cod System. A summary of the operation of the Direction Center is given in the following section, "Direction Center Operations".

M-2782, "Results of Interception Tests for Period October 1, 1953 - March 1, 1954" (Israel, Lemnios, Zraket), and M-2785, "Cape Cod Flight Test Program for Period April 1 - June 15, 1954" (Israel, Zraket), was issued. The latter describes the procedures to be used for the rapid scrambling of aircraft to five separate interceptor flights from an airbase.

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1.14 Weapons Direction (Continued)

(C. A. Zraket) (CONFIDENTIAL) (Continued)

The Cape Cod flight-test program was somewhat restricted this past biweekly period due to prevailing weather conditions. Some "simulated-data" tests were conducted for the benefit of visitors taking the Group 61 indoctrination course. Operational procedures in the Center have improved a great deal as a result of recent training courses.

An inter-office memo to D. R. Israel, "1954 Cape Cod System" (Benington, Zraket), issued this week describes in detail the proposed logical functions of each Weapons Direction station in the System. This memo will serve as a central reference for future discussions of the Computer program for the proposed system.

A series of meetings with members of the Group was attended which considered mutual problems of the Track-While-Scan and Weapons Direction Sections. In addition, the details of the floor plan, telephone communications, and intervention-digit allocations for the 1954 System were settled.

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1.15 Direction Center Operations

(C. Zraket, W. Attridge, P. Cioffi, R. Davis) (CONFIDENTIAL)

Following is a brief summary of the Cape Cod Direction Center operation for the past biweekly period. Details on any of the tests are available from P. Cioffi. Results of radar calibration and the automatic ground/air data-link tests are available from E. Wolf and L. Murray, respectively.

27 April 1954 (Tuesday) - A systems-evaluation test to study saturation limits of effective intercept direction was scheduled to be run with 3 target aircraft. This test was not run because of weather. A training mission was held using simulated data.

28 April 1954 (Wednesday) - Data-link and radar-calibration tests scheduled were canceled because of weather.

29 April 1954 (Thursday) - A systems-evaluation test to study effective intercept direction saturation limits was run with 4 target aircraft (Ops Plan 15, Mod. 4). Adverse temperature-inversion effects cluttered the radar picture and complicated tracking. Repeated tracking difficulties impaired intercept attempts. Two of a total of 5 attempted intercepts were completed successfully. An F89 scheduled for data-link testing was not available.

30 April 1954 (Friday) - Two F89 aircraft were flown for data-link testing.

4 May 1954 (Tuesday) - A scheduled systems-evaluation test to study saturation limits of effective intercept direction was canceled because of weather. The test time was utilized running with simulated data for training and visitor demonstration.

5 May 1954 (Wednesday) - Data-link and radar-calibration tests were canceled because of weather.

6 May 1954 (Thursday) - A scheduled systems-evaluation test to study effective intercept direction saturation limits using 5 target aircraft (Ops Plan 15, Mod. 5) was not run as such--weather was below minimum acceptable limits for interceptor operations. The target aircraft were run on their flight-planned courses twice for AAA and height exercises. Intercepts using simulated data were also conducted for visitor demonstration. This particular test was outstanding in many ways. The radar picture was uniquely good--returns were consistent even on targets at long range (about 150 miles). Height reports were consistent and believed to be accurate--a small negative report percentage existed. AAA exercises reported satisfactory results. Operational personnel participation (attention) and operating techniques were observed to be generally excellent.

7 May 1954 (Friday) - Two F89 aircraft scheduled for data-link testing were cancelled because of Barta D-1 equipment being inoperative.

1.15 Direction Center Operations (Continued)

(Zraket, Attridge, Cioffi, Davis) (CONFIDENTIAL) (Continued)

One B-29 aircraft was flown as scheduled for radar-calibration purposes.

Summary of Biweekly Operations	1st Quarter 1954	Week (15 & 16) Last Period	Week (17 & 18) This Period
<b>System Operational Test Sorties</b>			
Requirement	325	50	50
Scheduled	312	17	30
Flown	88	10	12
Per Cent Flown (of required)	27	20	24
<b>System Evaluation Test Sorties</b>			
Requirement	156	24	24
Scheduled	168	30	24
Flown	95	17	0
Per Cent Flown (of required)	61	71	0
<b>Calibration Sorties</b>			
Requirement	13	2	2
Scheduled	25	4	4
Flown	15	2	1
Per Cent Flown (of required)	115	100	50
Per Cent Flown (of scheduled)	60	50	25
<b>Data-Link Sorties</b>			
Requirement	0	0	0
Scheduled	77	12	10
Flown	25.5	2	2
Per Cent Flown (of scheduled)	33	17	20
<b>Total Sorties</b>			
Requirement	494	76	76
Scheduled	582	63	68
Flown	223	31	15
Per Cent Flown (of required)	45	40	20
Per Cent Flown (of scheduled)	38	49	22
Per Cent Scheduled (of required)	118	86	90

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1.15 Direction Center Operations (Continued)

(A. Morriss) (CONFIDENTIAL)

The following is the statistical breakdown of the equipment-reliability reports for the Cape Cod System operations during the past biweekly period. Data for the cumulative period are also included.

	Last Biweekly Period		Cumulative Period (since 9/29/53)	
	Hours	Per Cent	Hours	Per Cent
Assigned Time for System Operations	12.5	100	249.2	100
Unrestricted Operating Time	12	96	152.7	61
Limited Operating Time	0	0	59.5	24
Down Time	0.5	4	34.2	14
Recovery Time	0	0	2.8	1
Time Lost (Hours)				
	Down Time	Limited Operations	Down Time	Limited Operations
Computer	0.5	0.0	31.2	0.0
Room 222	0.0	0.0	2.6	49.9
Radar and Input	0.0	0.0	0.3	43.7
Misc.	0.0	0.0	0.0	25.3
Telephone Troubles remain at 3.6 hr				

(W. Vecchia) (CONFIDENTIAL)

Computer Operations:

Total Assigned Time - 85 hr

Weapons Direction	2 hr 35 min	
Data Screening	14 hr 50 min	
Combined Operations		
Weapons Direction & Data Screening	17 hr	
Tracking & Control	13 hr 20 min	
Equipment Check	2 hr 15 min	
	<hr/>	
	50 hr	
Time Given to Math Group	29 hr 05 min	
Time Given to In-Out	2 hr	
Time Given to Ck-Out	1 hr 30 min	50 hr
Time Lost to Computer	2 hr 25 min	35 hr
	<hr/>	
	35 hr	Total 85 hr

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

(D. R. Israel) (CONFIDENTIAL)

On Wednesday, 5 May, Colonels Halley and Stevenson from Project Group for ADES at Headquarters ADC presented their requirements for the Direction and Combat Center displays at a meeting attended by personnel from Divisions 2 and 6. These requirements are specified in a short memo which has since been duplicated for distribution to interested personnel. One of the major items presented in this memo is the need for a large vertical display in both the Direction Center and Combat Center. These requirements are presently being studied, prior to a meeting during the week of 17 May at which time the implementation of these requirements will be discussed in detail with Project Group for ADES.

At the above meeting, plans were made for a one-week course to be held by Group 61 for Air Division Commanders. This course is for purposes of familiarizing these officers with the Transition System and with the present plans for the Direction and Combat Center. The first two days of the course will be an abbreviated version of the one-week program which Group 61 has given several times in the past. A tentative agenda for this course, which is slated to begin 24 May, has been prepared and is available from the author.

The Drafting Room has now completed a new drawing of the floor plan of the second floor of Building F. This will be attached to M-2720-1, "Equipment Estimates and Allocation for XD-1 Operation Procedures," which is now being typed for distribution. This memo contains revisions in equipment allocation and layouts.

During the past week, a discussion was held with L. Dorff and M. Rosenbluth of ADES regarding the use of teletypes for handling air-movements information. Dorff and Rosenbluth presented a proposal for the use of teletypes as a major communication link to the Air Route Traffic Control Center. Several shortcomings in this proposal were pointed out, and they will reconsider their plan.

(O. T. Conant) (CONFIDENTIAL)

A change in Typotron circuit specifications by Group 62 will permit individual erase of all digital-display scopes in the XD-1 center. This obviates the need for Group 61's investigation of erase-write timing. However, Inez Hazel's program is checked out and will be available for demonstration or other use.

(B. G. Farley) (CONFIDENTIAL)

The article on MTC for the Quarterly Progress Report is to be completed during the week of 10 May. Study of XD-1 logic, in preparation for test-program writing, is proceeding.

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1.16 AN/FSQ-7 (XD-1) Support (Continued)

(G. Rawling) (CONFIDENTIAL)

A supplement, M-2720-1, "Equipment Estimates and Allocation for XD-1 Operation Procedures," has been prepared with D. R. Israel. Included is a floor plan of the Air Defense Center showing equipment-installation positions.

1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

Computer operation has been good during the past biweekly period. The applications group estimates that about 95 per cent of assigned computer time was usable.

Marginal-checking procedures have been extended to the intervention registers and the auxiliary-storage sections of the buffer drum. Reliability of the terminal equipment has been increasing regularly as preventive-maintenance routines have become more comprehensive.

The major portion of the bay wiring for the electronic-write-selection system on the auxiliary drum has been finished. A complete changeover to electronic switching may be delayed by a strike currently in progress at the plant which is our source of writing transformers.

1.21 WWI System Operation

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

Computer operation was interrupted for approximately 8 hours as a result of a gassy 6BL7 in a digit-plane-driver. The trouble was first noted following a failure of the -450-v bias supply. The disturbance at first was of an intermittent nature but eventually became steady state. The replacement of the plug-in unit containing this tube corrected the trouble and permitted the resumption of normal operation.

An additional hour of computer time was lost because of drum parity alarms caused by close timing at digit 15 of the parity register. The trouble occurred only during the blackout of test storage. The difficulty was corrected by introducing an additional 0.1  $\mu$ sec delay of the parity count pulse. This enabled the flip-flop to become stable before sensing its gate tubes.

In the previous biweekly report we mentioned that an investigation of approximately 200 allied plug-in relays revealed that 8 had unsoldered connections. A check of 1140 others has been made since then. As a result, 69 additional relays were discovered with faulty connections. We have approximately 500 more relays to check on our next installation day. Anyone desiring additional information concerning these relays may obtain it by referring to the Component Report for Job #001-012 made by B. B. Paine.

Magnetic Tape

(A. X. Perry) (UNCLASSIFIED)

Margins of the read/record circuits have been improved with the replacement of a few drifting components during this period.

The delayed print-out equipment for Unit 2 is now complete, but unfortunately we have been plagued with a timing difficulty which is more critical during the punch-out operation. More time will be utilized toward the tracking down of this fault.

Unit 2 and Unit 3, IOS selection, can now be interchanged by the manual switching of the Mod. III transfer panel, and the FL printers are easily changed to operate from either unit by the Mod. II transfer panel.

The FL machine normally tied into Unit 2 can also be switched to operate as a manual typewriter for paper-tape preparations. A memo will be proposed shortly in regard to the flexibility of operations available with two complete delayed outputs.

1.22 Terminal Equipment

(R. H. Gould) (UNCLASSIFIED)

The changes to block control were accomplished very successfully.

It is planned to provide an indication when the Fairchild Display Scope camera runs low on film to keep the computer from attempting to take pictures without film. As now planned contacts in the camera magazine will cause the si 0004 order to "switch to push-button" as well as index the camera. Enough film will be in the magazine at this time to provide a convenient leader for processing. It will not be possible to suppress this "Sw to PB" action, but if it is desired to take only a few more pictures on the same film the "restart" button will start the program, and the same action will occur on the next si 0004 order. The green alarm light will flash, and the alarm gong will ring as with the si 0000 and si 0001 orders, but 0004 will be in the in-out switch to provide a unique indication.

CRT Filter System

(S. B. Ginsburg) (UNCLASSIFIED)

The old MITE'S were removed from K-row in Room 156. The new filter system is now being installed.

Marginal Checking

(T. J. Sandy) (UNCLASSIFIED)

The criterion for assigning variable voltage lines to the in-out element has been completed, and that part of the in-out element in the WWI computer room has been divided according to this criterion.

The necessary WWI modifications for the reassigning of variable voltage lines will be started during the coming biweekly period.

Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

Digits 8-15 of the new writing circuits in the auxiliary drum have been thoroughly checked out and are ready to be made a permanent part of the drum system. These eight digits will be put into service as rapidly as installation periods permit.

Strike troubles are holding up the transformers necessary to complete the remainder of the Type 3 chassis now in the construction shop. Delivery of these completed chassis will determine the time for installation of digits 0-7 of the new auxiliary-drum writing circuitry.

(L. D. Healy) (UNCLASSIFIED)

A checking procedure was devised for locating failures which cause persistent parity alarms in the auxiliary-drum system.

Work was continued on a technician's handbook covering the drum systems.

MITE

(K. E. McVicar) (UNCLASSIFIED)

The old MITE units and their flip-flop buffer-storage registers have been disconnected. It is now necessary for programmers to use the MITE units which operate with the buffer drum. Details on the orders affected by this change are contained in M-2791 to which interested persons may refer.

1.22 Terminal Equipment (Continued)

Intervention Registers

(F. E. Irish) (UNCLASSIFIED)

The marginal-checking procedure for the intervention registers has been improved to the point where any one of the 1500 crystals used in the register can be "pinpointed" if its back resistance falls below 50,000 ohms.

Ferranti PETR

(F. E. Irish) (UNCLASSIFIED)

The installation of the production model of the Ferranti PETR has been completed. From the standpoint of the computer operation the only difference will be that the reader can now be stopped at any time by pressing the "stop" button and then restarted by using the "restart" button.

Data Link

(R. B. Paddock) (CONFIDENTIAL)

Testing of the 32-position switch and indicator-light register has shown the need for minor changes in the panel. The panel can be put into service upon completion of the changes and final testing.

Pathfinder

(N. Alperin) (CONFIDENTIAL)

The prototype mapper scope was tested and found satisfactory. The scope will be sent to the shop to be used as a model.

I was unable to test the phototube pickup as it arrived too late in the week. This will have to be postponed until the first unit is finished by the shop.

A number of methods to provide label illumination were tried but none was wholly satisfactory. Work along these lines will continue.

The modification manual is near completion.

1.22 Terminal Equipment (Continued)CRT Filter Scan Synchronizer

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

The scan-synchronizer design is about ready for drafting. The pulse-generator circuit has been tested with a counter consisting of plug-in units rather than test equipment. The flip-flop waveform will be integrated and fed through a low-pass filter to the power amplifier which drives the synchronous motor.

A test with azimuth data from Martha's Vineyard was made using the scan synchronizer in conjunction with the modified Pathfinder. Although the jitter was nearly + 50 per cent, the motor remained in synchronism with the north reference. Severe wind loading of the antenna could be detected as the motor speed changed considerably every 180°.

Test Programming

(G. A. Young) (UNCLASSIFIED)

The daily programmed-marginal-checking (PMC) consolidated tape has been modified to include buffer-drum checks on groups 4 to 7. These tapes are similar to those used with the auxiliary drum. PMC tapes for in-out control and the intervention registers are being written. The alarm-check program is being modified to include a program alarm.

The routine for checking the output coder is being included in the calibration program so that the coder may be checked during the equipment check-outs for Room 222 on Tuesday and Thursday mornings.

1.23 Records of Operation

(F. J. Eramo) (UNCLASSIFIED)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 23 April - 6 May 1954:

Number of assigned hours	168
Usable percentage of assigned time	95
Usable percentage of assigned time since March 1951	87
Usable percentage of assigned time since September 1953	92*
Number of transient errors	7
Number of steady-state errors	2
Number of intermittent errors	4

\* Dependence on two banks of magnetic-core memory.

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 23 April 1954:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Crystals</u>			
1N34A	1	2000 - 3000	Low $R_b$
	1	6000 - 7000	Low $R_b$
	2	7000 - 8000	Low $R_b$
1N38A	1	19000 - 20000	Low $R_b$
D-357	1	16000 - 17000	Low $R_b$
	1	17000 - 18000	Low $R_b$
<u>Transformers</u>			
U.T.C. 0-14	1	10000 - 11000	Sensitive to vibration
<u>Tubes</u>			
5687	1	0 - 1000	Leakage
	1	2000 - 3000	Leakage
	1	3000 - 4000	Leakage
	1	9000 - 10000	Low $I_b$
5881	1	2000 - 3000	Low $I_b$
5963	1	2000 - 3000	Low $I_b$
	3	8000 - 9000	2 open filament; 1 low $I_b$

1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (Continued) (UNCLASSIFIED)

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Tubes (Continued)</u>			
5965	1	3000 - 4000	Intermittent filament
	1	4000 - 5000	Short
6080	1	0 - 1000	Leakage
	2	1000 - 2000	1 short; 1 low I <sub>b</sub>
	3	2000 - 3000	1 leakage; 1 gassy
	1	3000 - 4000	1 short
6080WA	1	3000 - 4000	Short
	2	4000 - 5000	Short
6145	1	2000 - 3000	Broken pin
	4	0 - 1000	1 leakage; 2 short, 1 low I <sub>b</sub>
6AK5	2	1000 - 2000	Short
	1	2000 - 3000	Unbalance
	7	3000 - 4000	4 short; 1 low I <sub>b</sub>
	1	4000 - 5000	2 leakage
7AD7	1	4000 - 5000	Leakage
	1	2000 - 3000	Low I <sub>b</sub>
7AK7	2	7000 - 8000	1 gassy; 1 leakage
	2	18000 - 19000	Short
	1	19000 - 20000	Short
	2	20000 - 21000	1 leakage; 1 short
	2	23000 - 24000	Short
	4	24000 - 25000	2 short; 1 low I <sub>b</sub>
	1	24000 - 25000	1 gone to air
2D21	2	1000 - 2000	1 leakage, 1 high cutoff
	2	23000 - 24000	1 low I <sub>b</sub> ; 1 leakage
	1	24000 - 25000	Broken envelope
3E29	3	1000 - 2000	High firing point
5U4G	1	no hours kept	Low I <sub>b</sub>
6AC7	1	9000 - 10000	Short
	1	14000 - 15000	Gassy
6AG7	1	3000 - 4000	Short
	2	10000 - 11000	Gassy
6AS7G	1	0 - 1000	Short
6AS7G	1	21000 - 22000	Short

1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (Continued) (UNCLASSIFIED)

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Tubes</u> (Continued)			
6BL7	1	1000 - 2000	Leakage
	1	2000 - 3000	Control grid
6J5	1	6000 - 7000	Loose base
6SN7GT	4	7000 - 8000	1 leakage; 3 low I <sub>b</sub>
	1	10000 - 11000	Leakage
6V6	1	0 - 1000	Open heater
	1	2000 - 3000	Open cathode
Vr150	1	0 - 1000	Broken envelope
6AU6	2	0 - 1000	Short
	10	1000 - 2000	2 open heater; 2 leakage; 2 short; 1 broken align. pin; 2 high cutoff;
	1	5000 - 6000	1 gassy Short

1.24 Power

D-C Power Supplies

(S. T. Coffin) UNCLASSIFIED)

The WWI -15-v, 6-amp d-c supply has been redesigned and will be placed back in service on 10 May.

This installation will mark the completion of our program begun a year ago for increasing the speed of response of all the WWI d-c power supplies.

General

(D. M. Fisher) (UNCLASSIFIED)

A new 10-v, 10-amp series-tube-type power supply is being constructed for use in the laboratory in Lexington. Preliminary tests revealed that the minimum output ripple of the supply was limited by the high ripple magnitude of an auxiliary supply.

1.24 Power (Continued)

General

(D. M. Fisher) (Continued) (UNCLASSIFIED)

A new auxiliary supply has been designed, and upon completion of construction it will be installed in the new power supply where final testing will be done.

The design of a 600-v amplifier for a 600-v regulator to be used in a new 600-v, 10-amp supply will be completed shortly. This supply will also be installed in the lab at Lexington.

1.25 AN/FSQ-7

Duplex Design and Planning

(B. E. Morriss) (UNCLASSIFIED)

The first draft of a report on the duplex has been reviewed and substantially rewritten. It is expected that the report will be issued in first-draft form during the coming period.

Some work has been done on setting up concurrence procedures for the duplex. As presently planned, the procedure will involve the Systems Office and their briefs exactly as ID-1 and ID-2 were handled. It is expected that some members of Group 64 working on the duplex will join the Systems Office.

AN/FSQ-7 Schedules

(T. R. Parkins) (UNCLASSIFIED)

New Schedules

On 3 May, Irving Aronson issued summary schedules of the digital-data receiver and transmitter frames.

Progress Reports

IBM will receive on 10 May reports covering progress of the display system. IBM progress reports are due this week but have not arrived yet.

Schedules Due but not Issued

IBM      Central Computer  
          Maintenance Console  
          Test Memory  
          Card Machines

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1.25 AN/FSQ-7 (Continued)

AN/FSQ-7 Schedules

(T. R. Parkins) (Continued) (UNCLASSIFIED)

Basic Circuits

MIT Basic Circuits

Display System

(R. C. Jeffrey) (CONFIDENTIAL)

A proposal for the display system in the duplex central has been completed and will be circulated for comment as part of "Draft of Proposal for AN/FSQ-7 Duplex Central" during this biweekly period. It is proposed that the duplex display system be the same as that for XD-1 except that the display generators, including display-assignment flip-flops, will be duplexed, and the warning-light memory, which will not be duplexed, will be switchable between the two computers. Individual consoles will differ only slightly from the XD-1 consoles. Each console can be switched between the two display generators and between two power supplies by switches at the consoles. In addition, three "big switches" one for a-c power, one for d-c power, and one for information, can switch all consoles at once between the power supplies and display generators.

Power

(P. Morrill) (UNCLASSIFIED)

Building F electrical-power drawings are in the hands of Cleverdon, Varney, and Pike. A report has been written on relative power costs for AN/FSQ-7.

Utilities have been contacted for power rates and continuity of service records.

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1.3 Group 651.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

Recent reports from Convair indicate that in the past three weeks they have made rapid progress in getting their tube-production facilities compatible with their development and production needs. They had contracted to ship three tubes to IBM on or about 15 May. There were no final reports on their progress with these scheduled tubes. However, they reported that components have been constructed and assembled for twelve starts. These starts will be made in regular 19-inch TV bulbs and without the helical-dag coating.

In April there was a tentative decision to use a 2-inch neck on the Charactron bulb instead of the regular 1 7/16-inch TV neck. This decision temporarily delayed work at Corning Glass Works on the making of molds and tools for the Charactron bulbs. There is every indication that Corning is now progressing satisfactorily with the order. Molds and tools should be ready not later than 28 May. Convair has placed an order for five hundred bulbs. Corning has agreed to schedule this early in June and finish it before their summer vacation, the first two weeks in July.

Group 65 has continued to evaluate helical-dag coatings. A series of tubes was made to test the reproducibility of the coatings and processing techniques. The resistance of the coatings has been uniform and reproducible. However, the tubes were not processed properly for long life of the cathodes. Another series of tubes will be made with a new processing procedure designed for long life of the cathodes.

Joe Klein of Group 25, Joe Palermo, and I have been carefully evaluating all commercial aluminizing techniques employed for metallizing the phosphor surfaces of cathode-ray tubes. All commercial concerns have had problems associated with this technique. This program in our Group will continue for another month.

Group 65 is preparing its facilities so that it can evaluate all of the techniques and production methods of Convair and Hughes Aircraft. A mechanical tilt table for liquid settling of luminescent screens and processing of lacquer films was constructed, installed, and tested. A unit for aluminizing phosphor screens is under construction. Three ovens for the exhaust systems have been redesigned to accommodate the larger tubes. This assignment is almost ready for the shop and vendors. The assembly room has been made smaller, and the glass shop has been enlarged.

Seven Typotron tubes are under life tests. L. Martin has issued a 1500-hour life-test progress report. In the past these tubes were so scarce and valuable that they had always been brought from the

1.31 Activities of Group 65 (Continued)

(P. Youtz) (UNCLASSIFIED) (Continued)

West Coast by a person who was visiting Hughes Aircraft or by a Hughes Aircraft employee coming East. It was decided at our last meeting at Hughes on 15 April that a shipping crate for the tubes should be designed so that they could be handled by a common carrier. They promised to design a crate and send a marginal tube to test the crate, but we have not yet received the tube. They have two good tubes for us whenever someone visits Hughes or a shipping method is proved.

In order to prepare themselves for production in their new production facilities, they are training a crew in the development laboratory. This crew is making two or three starts a week. Our tubes are coming from this group. Hughes is now developing Typotrons under contract to MIT. IBM is negotiating a production contract with Hughes Aircraft. This work is scheduled so that our development and production-refinement contract will terminate about the time IBM's production contract begins.

A two-day trip was made with IBM to the General Electric Plant at Owensboro, Kentucky, to review their progress with the Z-2177 (improved 5965). Specifications were agreed upon so that GE could make a final 1000-tube lot for IBM. These tubes will be tested and studied before the final production order is released by IBM. In general GE's progress with this tube is satisfactory.

A one-day trip was made with IBM to Raytheon in Newton to investigate the 5783WA and the 5651WA. All information obtained from Raytheon and our investigations was quite favorable for the tubes. These tubes are now under consideration by the IBM Tube Group for use in XD-1.

A one-day trip was made with J. A. Klein to IBM at Poughkeepsie to discuss a 16-inch cathode-ray tube for their work with the video-mapper group. This trip was a fellow-up of our visit to Du Mont. There was a definite decision not to use a flat-faced tube. Al Myers of the IBM Tube Group is in charge of following the work on this tube.

There was a request that the Tube Group consider the use of Du Mont's 3/4-inch photomultiplier K1211 for the new light gun. Toward this end a trip was made to Du Mont the previous period. Tests have shown that out of twenty-two tubes received at Endicott, fifteen had a short when tapped. This tube must be redesigned before it can be considered reliable enough for XD-1. Work will be done on this program during the next period. Also a search will be initiated to find a substitute tube.

George Sponsler is preparing a report on his electron-trajectory studies. The preliminary drafts should be distributed during this next period. Group 65 is checking empirically these results in

1.31 Activities of Group 65 (Continued)

(P. Youtz) (UNCLASSIFIED) (Continued)

the helical-dag tubes.

Joe Klein has been working with Group 65 on the phosphor techniques, aluminizing processes, and nonreflective coatings. He spent some time this past period on the parallax problem associated with the video mapper.

Group 65 did some work for the research studies of Frank Rodgers.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

The construction of a second series of helical-dag tubes was completed during this past week. Thereafter our efforts were directed toward the revision of our facilities for the preparation of helical coatings. The tilt table received on 22 April 1954, and installed in our chemical department during this past period, was tested and proved successful with the preparation of many luminescent screens and lacquer films.

Evaluation of the two methods of preparing P7 screens has been started and is expected to continue for some time. In addition to this program we are designing methods for the masking of aluminized tubes. Both mechanical and chemical masking techniques will be investigated.

(P. C. Tandy) (UNCLASSIFIED)

During this past period 9 processed helical-dag tubes have been given initial tests. The initial zero-bias cathode current varied from 0.7 to 2.7 milliamperes with an average of 1.6 milliamperes. The average zero-bias cathode current increased to 2.6 milliamperes with a range from 0.75 to 3.75 milliamperes. Two tubes were not sent back to be based because of low emission.

Three of the 6 tubes which were based have been life tested with discouraging results. One had negligible emission, while the other 2 developed voltage breakdown in the gun in less than 2 hours of operation on retest. The filament of both of these tubes burned out; 1 tube was gassy. These tubes will be opened and the cathodes examined for ion bombardment.

Life-test equipment for helical-dag tubes is being designed. Until this equipment is available, tubes will be life tested, 1 at a

1.33 Research and Development (Continued)

(P. C. Tandy) (UNCLASSIFIED) (Continued)

time, on present equipment.

(H. B. Frost) (UNCLASSIFIED)

Life tests on three different tube types using A31 alloy have now been run in this Laboratory. The results are rather interesting. (A31 is an active alloy originated by the Superior Tube Company as a high-strength cathode material. The major alloying element is tungsten, at a 4 per cent level.) Type 5899 tubes were run to about 6000 hours with good results (cutoff life). No interface impedance was found; in fact, none has been found in any life tests so far. Type 5687 tubes were run to 1000 hours, with the development of considerable grid emission. Emission maintenance was better than on regular 5687's. However, low emission was a problem on type Z-2177 tubes run to 600 hours. No grid emission was observed, but contact-potential measurements indicated a considerable reduction in the work function of the grid. The change in grid work function was confirmed by cutoff changes as well. All in all, A31 remains an interesting, but not yet proven, alloy.

Results on an ASTM interface impedance roundrobin have been analyzed by statisticians at the Bell Telephone Laboratories. The results are to be presented to the cathode interace task force of ASTM B4 VIIIA at a meeting to be held at the Bell Telephone Laboratories within the next two weeks.

Thesis Research

Thesis research has continued at an intensive level during the past two weeks; the results have been rewarding.

Additional analysis of Nergaard's form of the diffusion equation has revealed conditions for which it will describe with reasonable precision the experimental results. While the basic form of the differential equation remains the same, a second solution has been found which is much more useful in describing experimental results than Nergaard's solution. The transient solution of the equation is a classical form.

A technique has been developed which allows the measurement of the pulsed emission of a cathode while a direct current is flowing through it. The anode of the tube to be tested is driven by a current generator and a pulsed voltage generator in parallel; the pulse generator presents a high impedance except during pulses.

A number of experimental tubes as well as some standard commercial tubes have been tested with this technique. The results

Thesis Research (Continued)

(H. B. Frost) (UNCLASSIFIED) (Continued)

indicate that the emission of a cathode is a linear function of the amount of direct current flowing through the cathode. The amount of reduction in emission caused by direct current seems to be related to the resistance of the cathode coating (as demanded by theory) in those experimental tubes where the coating resistance can be measured. In commercial tubes which show considerable "droop," a severe reduction of emission with direct current has been found. It thus appears that the reason for the droop has been isolated.

I am at the present time writing an outline of my thesis prior to presenting it to my thesis committee.

(T. F. Clough) (UNCLASSIFIED)

The Biweekly of 12 February 1954 reported that six 4x150A's had high insulation leakage. These tubes have been replaced by the manufacturer (EIMAC) without comment.

Two thousand 6145's are on order from Sylvania; delivery is expected within 30 days.

It has been decided to replace the 5965's presently in MTC with the newly developed Z-2177. The IBM Engineering Laboratory at High Street has consigned 1112 Z-2177's for this purpose. These tubes have been tested at IBM, and the data has been punched on IBM cards in a manner similar to the method proposed for the XD-1. This MTC change-over will provide us with essential application and life data on this developmental type and will give us a mechanism to develop and improve the tube records system which will be applied to the XD-1.

A. Zacharias and I have had a series of conferences with J. Sanders of IBM, L. Sutro, and R. Hughes of MTC on the preliminary arrangement for this changeover. We will continue to work with these groups in order to assure co-ordination among all interested persons.

(S. Twicken) (UNCLASSIFIED)

A trip was made to the General Electric Plant at Owensboro, Kentucky, to review test data on 6 lots of final-design tubes and to bring the spec into shape for construction of the first final-design tubes to be built in the factory. A 1000-tube lot will now be made, the test data of which will indicate what production refinements are necessary.

A trip was also made to Raytheon in Newton to obtain information on the 5783WA subminiature reference tube for possible use in XD-1.

1.33 Research and Development (Continued)

(S. Twicken) (UNCLASSIFIED) (Continued)

The information obtained was quite favorable in regard to stability, etc., and it will in all probability be accepted where a socket is available, as will the 5651WA.

A life test on the 4688B (RCA 5965) has reached 600 hours with no unusual changes.

A life test on engineering sample Z-2177's with A31 (tungsten-nickel) cathode alloy has reached 600 hours. In addition to a rather large shift in contact potential there is also a major shift in ( $200 \mu\text{A } I_c$ ) plate current. This rather perplexing shift is not accompanied by a decrease in emission and has not yet been explained.

Further work is being done on the General Radio bridge setup on the Mod. III tester to reduce noise and improve sensitivity.

(A. Zacharias) (UNCLASSIFIED)

A trip was made to IBM on 27 April 1954 to set up a record system for the Z-2177 tubes to be installed in MTC. At present, codes are being set up by L. Sutro and R. Hughes for the socket numbering on these tubes.

The General Radio vacuum-tube bridge has given trouble in measuring  $G_m$  on the 5998. The null detector has been found responsible for this trouble. The amplifier of this unit has been and currently is being modified.

SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

Mark X, FGD, and Automatic Height-Finder Inputs

(R. C. Hopkins) (CONFIDENTIAL)

Memorandum M-2802, "FGD, Mark X IFF, and Semiautomatic Height Finder Input Requirements for AN/FSQ-7," was issued 3 May 1954. Draft of performance specifications, based on M-2802, was prepared by IBM 4 May 1954. A meeting to discuss these specifications and accept or amend them will be held 11 May 1954 in Poughkeepsie.

XD-1 Logic

(R. P. Mayer) (UNCLASSIFIED)

The "XD-1 Design Notes" drawings, outlined in M-2761, are made from a detailed analysis of the IBM logical drawings and block schematics. The IBM drawings used, and the resultant XD-1 design notes, will be listed on sheets available from the Print Room. These sheets will be titled "Logical Design Coordination," and each will have an LDC number. The sheet "LDC #0" (SA-58696) will list all the LDC sheets available and will indicate which ones are obsolete. This system will eventually result in a systematic listing of all IBM logical drawings. R. J. Cypser and W. S. Squire, of IBM, are assisting in this work.

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2.11 Systems (Continued)

Digital-Data Transmitters and Receivers

(I. Aronson) (CONFIDENTIAL)

The method of packaging this equipment was described in an inter-office memo addressed to the Systems Office and dated 27 April 1954.

Two detailed schedules have been prepared: Digital-Data Receiver Frame, B-58420, and Digital-Data Transmitter Frame, B-58421.

Temporary approval has been secured for several components which were purchased as "off the shelf" items (for engineering models), with the idea in mind of purchasing to more stringent specifications for production models. This procedure should hasten formal approval of the SDV demodulator for IBM.

General

(W. A. Klein) (UNCLASSIFIED)

An interesting development in my thesis work is that many flow-output tables are not realizable with the logical blocks employed by the laboratory.

2.12 Magnetic-Core Memories

MTC Memory

(W. J. Canty) (UNCLASSIFIED)

A new transformer-coupled sensing amplifier for the 64 x 64 core memory has been designed and tested in MTC. The results look encouraging. Five more of these units are being built in the shop and should be in service in MTC within the next few weeks.

Installation of high-speed flip-flops in the A-register, MTC, has caused some concern over the possibility of damage to the digit-plane drivers occasioned by "sticking" of the inhibit gate-generator flip-flop. A new a-c coupled inhibit gate generator has been designed, and its installation on 8 May should eliminate this possibility of damage.

(J. L. Mitchell) (UNCLASSIFIED)

The testing of the new memory-address-register cathode followers has been completed, and the necessary prints have been "red penciled" so that the modifications can be made on the present panels when time is available in the MTC schedule.

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2.12 Magnetic-Core Memories (Continued)

Memory Array Tester

(J. L. Mitchell) (UNCLASSIFIED)

An automatic "shmoo" plotter is being designed for use in the testing of memory planes. The basic logic has been worked out, and the design of the special decoders that are needed has begun. With the exception of the decoders it looks as though the unit can be built from standard test equipment.

Memory Test Setup VI

(E. A. Guditz) (UNCLASSIFIED)

The gate panels necessary for automatic address skipping are being constructed. When in use, these will permit the taking of several sets of margins per plane to eliminate the possibility that one core is seriously limiting the margins.

The ventilating ductwork is installed in the memory tester including a pipe to the outdoors so that outside air can be drawn through the planes.

Preparations are being made to install the attachable jumper strips in the memory tester to facilitate plane changing during tests.

Preparation is under way towards the addition of automatic "shmoo" plotting equipment to the memory tester. This equipment, in conjunction with the attachable jumper strips, should enable one to evaluate a plane in a fraction of the time previously required.

Considerable effort is being directed towards designing a frame for a 128 x 128 memory plane. Several designs are being evaluated, and construction on at least two which show promise should begin by 14 May.

Some progress is being made in designing a printed-circuit memory plane. Contact has been made with people in Group 24 who are also interested in this effort. They are equipped to make experimental models and have offered to help in whatever way they can.

External Register Selection

(J. Raffel, G. Davidson) (UNCLASSIFIED)

The 256-word, 16-digit, switch-driven memory is operating satisfactorily. One digit plane at a time is being tested, and patterns of standard type such as a ONE cycling through a field of ZERO's and a ZERO through a field of ONE's are held without difficulty.

## 2.12 Magnetic-Core Memories (Continued)

(J. Raffel, G. Davidson) (UNCLASSIFIED) (Continued)

The uniformity of outputs is fair, and some improvement is expected when some difficulties with the 90-v supply have been eliminated. The ONE-to-ZERO ratio is excellent, the ZERO's being slightly negative at strobe time.

### Sense Amplifier, Mod. II

(S. Fine) (UNCLASSIFIED)

Work is continuing on experimental sense amplifier, Mod. II.

A plug-in model is being tried in MTC. Some unforeseen difficulties have been corrected, with resultant improvement in margins.

### 64-Position Core Switch

(A. D. Hughes) (UNCLASSIFIED)

Noise (current) outputs from unselected switch positions during the rise of the reset (write) pulse are quite large (10 per cent to 20 per cent of  $I_m/2$ ). Observations of these noise outputs and their possible undesirable effects are being made.

### 3-to-2 Selection

(R. S. DiNolfo) (UNCLASSIFIED)

A 64 x 64 plane which will use a 4-co-ordinate read and 5-co-ordinate write is now being built and should be completed by 14 May. This plane will use MF 1326 B cores at a 3-to-2 selection ratio, and the sensing scheme will involve disturbing and integrating techniques.

### Core Memory with External Selection

(S. Bradspies) (UNCLASSIFIED)

Information has been stored and read out of a 3-core memory. The switch cores are of Mo-Permalloy 4-79 (50 wraps,  $\frac{1}{4}$  inch wide,  $\frac{1}{4}$  mil thick), and the memory core is MF 1326 B.

Rough measurements were taken to establish the fact that the logic, wiring, and windings were correct. Switch-core biases were set at about -4 amp-turns, and x and y excitations were set at about +4 amp-turns each. Output ONE's from the memory core were about +1.2 volts, and output

2.12 Magnetic-Core Memories (Continued)

(S. Bradspies) (UNCLASSIFIED) (Continued)

ZERO's were somewhat less than +0.1 volt. These results were very encouraging. However, the logic proved to be faulty; occasionally pulses applied to switch cores arrived at the proper times, but more often they did not. Because of this, the logic has been completely revamped, and it is hoped that the setup will now operate more satisfactorily, so that data can be taken earnestly.

2.13 Vacuum-Tube Circuits

Drums

(H. Boyd, H. Anderson) (UNCLASSIFIED)

MRD writeups on the XD-1 magnetic-drum circuits are now under way, and an M-note is soon to follow which will explain how these circuits work in conjunction with the drum.

Magnetic-Core-Matrix Switch Driver

(D. Shansky) (UNCLASSIFIED)

Parasitic oscillations in the output stage of the driver have been partially eliminated. Debugging is still in progress on half of the driver.

Universal Amplifier

(H. J. Platt) (UNCLASSIFIED)

The first breadboard has been received from the shops a week ahead of schedule. Work has begun on checking out the circuit.

Gated Variable Pulse-Width Generator

(H. J. Platt) (UNCLASSIFIED)

This circuit has been built, and at present the component values are being adjusted for proper pulse widths.

With the standard transformers available, we cannot get a pulse 0.2 microsecond wide. However, we can get one 0.16 microsecond wide.

2.13 Vacuum-Tube Circuits (Continued)

Display Generator Buffer Storage

(E. Anfenger) (UNCLASSIFIED)

A report has been written on all three types of drivers and is now being typed.

Phone-Line Demodulator

(E. B. Glover) (UNCLASSIFIED)

Preliminary checks on the methods of marginal checking the last three stages of the input circuit have been completed. Varying the plate voltage of these stages seems to give satisfactory results -- giving no appreciable difference in output from +90 to 0 and giving a marked change in output below 0.

The slicer circuits are now being thoroughly investigated to note the effects of varying the plate-supply voltages. It has been found that for a certain range of settings of plate-supply voltage and input voltage level the circuit will oscillate. This has been improved appreciably by reducing the value of the coupling condenser; however, work has not been completed on this at present. It has also been noted that for variations of the plate supply not only does the slicer triggering level vary but also the amplitude of the output. This may prove to be quite a serious fault in the circuit.

Future efforts will be toward completing the investigation of the slicer circuits and investigating the margins of the timing circuit.

Sensing Amplifier

(C. A. Laspina) (UNCLASSIFIED)

Testing of a sense amplifier incorporating an input transformer and diodes is being continued.

This amplifier uses cathode degeneration as a means to obtain gain stability. Loop feedback is not used because of the clamping circuits in the amplifier which cause a base shift with changes in prf.

## 2.14 Memory Test Computer

### General

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

Specifications for the new MTC cooling system in Building B (which will operate from chilled water supplied by the Lincoln-CRC power plant) have been drawn up by Francis Associates and submitted to four contractors for bids. It is anticipated that construction of this system will proceed fast enough for MTC to move by 7 June. Other planning and construction work is going ahead approximately on schedule.

A new sensing amplifier designed by Saul Fine and Chris Laspina was tried out with encouraging results. The unit, having only three tubes and using a 1:10 stepup input transformer, gives margins considerably better than the present unit, which has six tubes.

### Magnetic Drum

(H. Anderson, H. Boyd) (UNCLASSIFIED)

The drum system has been shut down to allow installation of the final hardware, which is now available. Plans call for having this completed before moving to Lexington.

### Camera

(L. Sutro) (UNCLASSIFIED)

Decisions have been reached on the automatic camera control, its power supply, and the mounting of the 16-inch display scope and camera. The automatic camera control will be essentially that used now in WW1. Two 2D21's will be added, one to give a pulse when the camera magazine is lacking, the other to turn on a neon indicator lamp under the same conditions. The power supply will deliver the 10 amperes at 28 volts required by the main solenoid in the Fairchild camera. All of the above equipment - display scope with camera, automatic camera control, and power supply - will be mounted in a 26-inch rack next to the console when the computer is reassembled in Lexington.

### MTC Accumulator

(R. Hughes, J. Crane, C. Schultz) (UNCLASSIFIED)

All modifications on the new accumulator have been completed. Testing of the accumulator as a unit will proceed in accordance with the outline given in M-1887, "MTC Accumulator Test."

2.14 Memory Test Computer (Continued)Moving Preparation for MTC

(R. Hughes, J. Crane) (UNCLASSIFIED)

Many of the gate-buffer panels in MTC have been modified for use as dual-gate panels where + 10 volts is available for the gate input. These changes are being made as soon as possible so that this work will not hinder any moving preparations. In fact, panels are being arranged so that these changes conform to the new proposed layout, and completion of the work at this time will lessen the work load for the new installation.

Test Equipment

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

Work has continued on a method of marginal-checking the Burroughs gate and delayed-pulse generator. At present this is the unit of test equipment that most often causes trouble in MTC: a spurious pulse is delivered at the beginning of the delay as well as the desired pulse at the end of the delay. In the course of work on the marginal-checking system, it was discovered that the spurious pulse might be eliminated by changing the resistor in the damping circuit of the RLC peaker that follows the delay generator. The modification has been successful on two units and will now be tried on more. The modification has to be approved by the Test Equipment Committee.

2.16 TransistorsMeeting with RCA

(D. J. Eckl) (UNCLASSIFIED)

On 4 May the following people from the Transistor Section of the RCA Tube Division visited our Transistor Section: M. S. Rose, application engineer; R. M. Cohen, mgr. applications division; A. L. Cleland, point-contact transistor design engr; A. E. Mohr, computer ckt. design engr. Also present at the meeting were R. Rediker and S. Schwartz of Group 35.

We discussed the RCA point-contact 2N32 and p-n-p junction 2N34 transistors. These are both being made on a full production basis. They stated that present production units are much improved over the experimental units which we have on hand. Arrangements have been made to obtain samples.

2.16 Transistors (Continued)

Sample Transistors

(D. J. Eckl) (UNCLASSIFIED)

We have recently received 8 sample p-n-p junction transistors from GE.

Texas Instruments have sent for evaluation: 6 tetrode transistors, 6 n-p-n transistors selected for 2-mc cutoff, and 12 type 102 point-contact transistors.

Testing of 20 Transistor Products type 2C and 24 type 2F point-contact transistors has been completed, and results will appear in an M-note.

Transistor Gates

(C.T. Kirk, Jr.) (UNCLASSIFIED)

A majority of the breadboards of experimental gates have been constructed. Debugging of the circuits will begin shortly.

An M-note on a promising transistor gate, entitled "A Transistor Grounded-Base Amplifier as an "And" Gate" (M-2810), has been written and will be available shortly.

Transistor Equivalent Circuit

(C.T. Kirk, Jr.) (UNCLASSIFIED)

Representative values for the RC network and delay line of the equivalent circuit of an n-p-n grown junction transistor have been obtained. The RC network has a rise time of 0.08 microsecond, and the ideal delay line has a delay of 0.03 microsecond.

Junction-Tetrode Theory

(C.T. Kirk, Jr.) (UNCLASSIFIED)

An attempt is being made to extend the theory of alpha for junction triodes to the junction tetrode.

At this time it is not known whether this has already been done or not. A search of the literature will be made during the next biweekly period to ascertain this.

2.16 TransistorsTransistor Light Gun

(S. Oken) (UNCLASSIFIED)

A unit employing a photodiode and two grounded-emitter transistor stages was built. The unit was capable of supplying over 15 milliamperes upon the application of light from a flashlight. However, it was not affected by light from an oscilloscope screen. This was due to the characteristics of the photodiode, which has a peak sensitivity in the infrared region and very little sensitivity in the blue region.

We are ordering several phototransistors which consist of a light-sensitive element and one stage of amplification. The peak sensitivity of this unit will be at about the same place as the photodiode since it is possible to use some other semiconductor material, such as silicon, which could shift the sensitivity curve toward the blue region. Another method might be to add some infrared material on the scope screens.

Transistor Magnetic Switch

(S. Oken) (UNCLASSIFIED)

One of the transistors in the magnetic-switch circuit has failed. It was a Westinghouse p-n-p junction transistor rated at 150 milliwatts. It is probably necessary to use transistors with about a 300-mw rating to supply the 50 milliamperes needed to bias the switch.

The magnetic switch was capable of driving a transistor flip-flop, but the operation was marginal. This was because the input impedance of the flip-flop circuit is of the usual "n" curve variety. This low and negative impedance load on the output of the switch cores reduces the output voltage so that it is practically not usable. This problem of triggering the flip-flop circuit will be further investigated.

Angular Position Counter

(E. U. Cohler) (UNCLASSIFIED)

The APC and its test setup are about complete. Some difficulty with power supplies was encountered, so a set of bleeders was built which now supplies power from a laboratory outlet. This is interchangeable with MTC. The testing going on now is in conjunction with the drum pulses from MTC. So far operation has been impossible because of a change in the timing track, and some readjustments are necessary in our test setup.

~~CONFIDENTIAL~~  
UNCLASSIFIED

## 2.16 Transistors (Continued)

### Junction Flip-Flop

(E. U. Cohler) (UNCLASSIFIED)

The junction flip-flop is being examined and transformer coupling attempted in hopes of getting very high frequency operation. The emitter hole storage is being reduced by the use of point-contact diodes. It is hoped that a flip-flop will be developed to run at about 500 kilocycles.

### Diode and Transistor Storage

(N. T. Jones) (UNCLASSIFIED)

Since the thesis deadline is 24 May, a major effort has been spent trying to get loose ends tied together for publication. Most of the necessary illustrations have already been processed by the Drafting Room, and plans include submitting the remainder by Monday, 10 May.

At least one chapter will be published as a memorandum. This chapter will go to the typist on 10 May as M-2689, "Reverse Recovery Measurements of Diodes."

A number of the new Hughes HD 2060 and 2061 diodes have been tested for reverse recovery. These are fairly nonuniform in recovery characteristics and some (4 out of one sample of 25) are sufficiently poor to possibly give real trouble in circuits. It should be noted that high back-to-front resistance ratios in diodes tend to give slower switching. A "garden variety" Sylvania 1N34A with a ratio of 100k/100 or  $10^3$  will be fast, while a Western Electric 1787 with 10 meg/10 or  $10^6$  will be a very slow switching diode. Reverse recovery is certainly more complicated than this, but the above is true in general. As diode applications go to higher forward currents and corresponding diodes, the result is longer reverse-recovery times. Speed is the payment for high forward-current capabilities and high back-to-front ratios.

## 2.17 Display

(C. L. Corderman) (CONFIDENTIAL)

Considerable progress was made in the display meeting on 4 May in which several activities in the proposal stage were concurred upon. M-2813 is a summary of this meeting.

A major consideration when operating a number of Charactrons in a system is the point at which the compensation voltage is introduced. This compensation voltage must introduce a deflection which is proportional to each character location on the matrix, so that all characters are referenced to one character space. Thus, this voltage varies from tube to tube,

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2.17 Display (Continued)

(C. L. Corderman) (CONFIDENTIAL) (Continued)

being a function of the deflection sensitivity, the matrix size, and the exact matrix position (i.e., the magnification from the converging coil lens). In view of the developmental nature of the Characteron and Typotron tubes, it has been felt highly desirable to have separate adjustments of compensation and format size at each console. Assuming these two signals go into the same deflection system, a high-gain amplifier is required to obtain the required precision of addition of these signals as well as stability of gain.

Since a high-gain amplifier is needed for the yoke drivers, the introduction of compensation- and format-deflection voltages into this amplifier posed no problems in the original model Characteron. However, when the second set of electrostatic plates was added (and in the case of the Typotron), the decision was made to add another high-gain electrostatic amplifier for these plates. This amplifier would allow separate adjustment of compensation- and format-size voltages and would aid in obtaining a faster display rate since the line-driver problem is minimized. The cost of this system was approximately 3000 tubes.

This decision is being reviewed. By combining the compensation- and format-size voltages in one amplifier at the central display frame, these 3000 tubes are saved, and an improvement in reliability can be expected. However, in order to use practical line drivers, a low-capacitance coaxial cable is needed; the display rate might be somewhat slower, and variations of possibly 10 per cent in format size and vector length from console to console will exist.

Digital Display

(M. Epstein, B. Remis) (CONFIDENTIAL)

A decision has been reached to erase separately at each scope. With this change the logic appears settled and will probably appear in XD-1 as is.

The work of putting the digital display into hardware was started. During the past biweekly period two card assemblies were drawn up, and a plug-in wiring diagram was started. Parts for these plug-ins have been requested from IBM as plug-in testing will have to start within a few weeks if the schedule is to be met. A new power estimate was made.

(R. H. Gerhardt) (UNCLASSIFIED)

Memorandum M-2783, "A Description of the Expansion Circuits Proposed for XD-1," was issued this week. It contains a description of digital

2.17 Display (Continued)

(R. H. Gerhardt) (UNCLASSIFIED) (Continued)

expansion, of the circuitry used and of the flexibility offered by the plugboard.

I have made two block diagrams of the timing and control section of the XD-1 situation-display generator. One diagram uses one big diode matrix to generate the feature and other levels; the second uses two-level "AND" circuits. I am in the process of evaluating each of these in terms of the number of tubes, number of diode-switching levels, number of series cathode followers, and ease of packaging in pluggable units.

(R. Fallows) (CONFIDENTIAL)

Work on the actual packaging of circuitry for the central display frames is well under way. A meeting on 4 May (reported by R. von Buelow in M-2813) permitted the completion of the logic of the digital-display generator and resolved most of the outstanding questions affecting the situation-display generator. The only remaining item of major concern is the time of the situation-display cycle--this will require some evaluation.

Pluggable-unit layouts have been started for both display-generator frames. We are receiving excellent cooperation from IBM in every respect. The Basic Circuits Group has offered to instruct and advise us in etched-card and pluggable-unit layout and testing. Members of the Cabling Group, under A. F. Di Marco have indicated that they will be able to do our back-panel and frame-cabling charts and diagrams in July. The Release Section will make up all bills of material for the display frames.

A status report based on our present schedule was made last week. It indicated that various items are behind schedule as much as six weeks, with the over-all activity approximately three weeks late. It is not possible to make an accurate appraisal of the result of this lateness on production until a more accurate picture of the types and numbers of pluggable units is known.

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

The sweep generator for the vector generator has been redesigned and now produces an acceptable waveform which is virtually independent of changes in the decoder current. This had been a problem in the original sweep generator.

Several problems still exist in the vector decoders. First, there appears to be a slight d-c shift at the origin of the vector. Secondly, the output waveforms of the two decoders are not similar at the early part of the vector, so some distortion of the vector is present. This

2.17 Display (Continued)

(J. Woolf, H. Zieman) (UNCLASSIFIED) (Continued)

problem seems to exist only when the constant-current tubes are being turned on but does not seem to be present on the return trace when the tubes are being turned off. These problems are being further investigated.

Typotron Life Test

(L. B. Martin) (UNCLASSIFIED)

Tube 335 has been started on life test. The pulsed-collector and storage facilities are in operation on all tubes. Sections of the storage surface of Tube 268 switch positive at relatively low collector voltage. This has been observed for over 500 hours but appears to be getting worse. The tube is still usable. The other tubes have not changed appreciably.

Tubes now on test are:

<u>Tube No.</u>	<u>Total Hours</u>
265	1776
268	1766
292	1766
280	958
319	958
326	958
335	141

2.2 Group 63 (Magnetic Materials)Vacuum System

(N. Menyuk) (UNCLASSIFIED)

A Phillips gage and metal-to-glass seals have been added to the vacuum system by L. Nelson. This system, which is to be used in the determination of magnetic and electrical properties of ferrites at low temperature, is now complete. A preliminary check indicates a satisfactory vacuum is attainable with this system.

S<sub>w</sub> Measurements

(N. Menyuk) (UNCLASSIFIED)

The results of the experimental investigation of the effects of tape thickness and temperature variation on the flux-reversal characteristics of 4-79 molybdenum Permalloy have been written up. They will appear in Memorandum M-2474.

LaMnO<sub>3</sub>

(J. B. Goodenough) (UNCLASSIFIED)

The substances  $\text{La}_{(1-x)}\text{Ca}_x\text{MnO}_3$  and  $\text{La}_{(1-x)}\text{Sr}_x\text{MnO}_3$  are ferromagnetic for  $x \approx 0.3$ . They have the perovskite structure of the ferroelectric  $\text{BaTiO}_3$ . While at Washington to give a talk on the role of the covalent bond in spinels, I attended a talk which discussed some recent neutron diffraction studies in  $\text{La}_{(1-x)}\text{Ca}_x\text{MnO}_3$ . The covalent-bond concepts which have proven applicable to the spinels appear to be applicable to these compounds also. A calculation is under way to determine whether both the distortions from cubic symmetry and the maximum conductivity and ferromagnetism at  $x = 0.3$  can be explained.

Production of Memory Cores

(F. S. Maddocks and J. J. Sacco) (UNCLASSIFIED)

Experiments in progress are aimed at reducing the switching time and drive requirements of DCL memory cores. Tests of a new batch of material, DCL-2-418, indicate a shorter switching time can be achieved through the use of different grades of ingredient  $\text{Fe}_2\text{O}_3$ . Harder firing of the green cores is required to give adequate output voltages at 820-ma drive, resulting in a shorter switching time. Further tests of this batch are required before production firings can be started.

2.2 Group 63 (Continued)Production of Memory Cores (Continued)

Lots of 2000 cores each of DCL-2-416 cores are being fired in the Harper electric furnace. Cores of this material have a switching time slightly longer (1.30  $\mu$ sec at 820 ma) than desired, but data from these firings will be useful in correlating Harper firing results with those of the Burrell furnaces. Approximately 100,000 green cores of this batch are on hand for firing, pending the outcome of trial firings.

Pilot-Plant Production of F-394 Cores

(R. A. Maglio) (UNCLASSIFIED)

The Stokes press has been operating quite well with punches of revised design. The first set put in service has made 178,000 cores to date and is still operating satisfactorily. Forty-thousand cores have been pressed from batch DCL-2-418 thus far. These cores are holding both weight and thickness tolerances very well.

The core sorter has been rebuilt using heavier stock for the sorting blades. With non-flexible sorting blades it is expected that the size sorting will be more effective. The blades are ready for grinding after which the unit will be reassembled.

Semiautomatic Core Testing

(E. J. Stevens) (UNCLASSIFIED)

The semiautomatic-core-testing logic has been revised to obtain output reading of  $dV_z$  along with  $rV_1$ . The reason for this change is to determine by experimentation whether the present three tests for evaluating acceptable cores can be shortened to one pass by evaluating disturb sensitivity with the  $dV_z$  output. No definite results have yet been obtained.

Core Specifications

(J. H. McCusker) (UNCLASSIFIED)

Discussions have been held with IBM on core specifications. Bob West and Jim Crowe of IBM are being sent to MIT to collaborate on a simplified core-testing procedure.

D-C Hysteresigraph

(R. A. Pacl) (UNCLASSIFIED)

An auxiliary amplifier and other auxiliary equipment are being designed for the d-c hysteresigraph.

2.2 Group 63 (continued)Cryotron

(D. A. Buck) (UNCLASSIFIED)

Probe 8 has been constructed giving a magnetic field of 0.7 oersted per milliamperere over a 7-inch tube, 1/4-inch in diameter. The resistance of this copper winding drops from its room-temperature resistance of 1600 ohms to a resistance of 17 ohms in liquid helium. Tantalum resistance 8A, wound of 0.0003-inch wire, exhibited cryotron characteristics but not as large as desired. Annealing in vacuum to remove strains did not improve the characteristics. Probe 8B is under construction.

The Effects of Magnetostriction on Loop Squareness

(P. K. Baltzer) (UNCLASSIFIED)

It is believed that magnetostriction is an important factor in causing square hysteresis loops in ferrites. On the basis of a simple model it has been found that macroscopic alignment of the magnetic moment from grain to grain in a polycrystalline material depends on the parameter  $S = (\text{magnetoelastic energy})/(\text{anisotropy energy})$  which varies as the square of the saturation magnetostrictive coefficient. If  $S \gg 1$ , the alignment of the magnetic moment from grain to grain is almost complete.

The hysteresis loop and stress sensitivity of a magnetic material are affected by this grain-to-grain alignment in the following way:

1. Hysteresis Loop Squareness

Squareness should be increased as the grain-to-grain alignment increases. This would be caused by the reduction of the magnetic switching mechanism to that of 180° domain wall-motion, as the grain-to-grain alignment is increased.

2. Stress Sensitivity

Stress sensitivity will go from zero to a maximum and then to zero as  $1 \gg S > 0$ . This is the result of two effects, an increase caused by an increase of magnetostriction coefficient and a decrease caused by grain-to-grain alignment.

Sufficient data are available on some materials to allow a calculation of  $S$ .

$$S_{\text{iron}} = 0.01, \quad S_{\text{nickel}} \approx 0.1, \quad S_{\text{NiOFe}_2\text{O}_3} = 0.5$$

Hence the effect of magnetostriction will be small for iron and nickel, but is not small for  $\text{NiOFe}_2\text{O}_3$ . On the basis of the above discussion,

2.2 Group 63 (continued)

The Effects of Magnetostriction on Loop Squareness (continued)

$\text{NiOFe}_2\text{O}_3$  should exhibit fair squareness and stress sensitivity, which it does. A qualitative correlation with theory concerning squareness and stress sensitivity of the square-looped ferrites exists. Therefore, it would appear that it is very reasonable to expect that magnetostriction plays an important role in square-looped ferrites.

SECTION III - CENTRAL SERVICES

3.1 Purchasing & Stock:

(H. B. Morley) (UNCLASSIFIED)

A contractor has been selected to install the equipment-conditioning system for Rooms 216 and 222, Barta Building. The order will be placed as soon as approval has been granted.

Further investigation into the problem of an Ultrasonic Machine Tool for Group 63 has been completed. A vendor has been chosen, and the order is now waiting approval.

Bidders have been selected and specifications issued for the MTC cooling system at Building B, Lexington. All bids are expected by Wednesday, 12 May, and every effort will be made to obtain approval and place the order in record time.

An inventory of standard components has been completed by the Stock Room, and Kardex records have been revised where necessary. Labels on boxes are being changed to conform to new Lincoln Laboratory numbers as fast as the new standards are issued.

During April the work load on this department continued at the same high level -- both March and April saw approximately 20 per cent more orders placed than February.

Month of April  
Total Orders Received - 475

Received on Time	263	55%
Received 1-7 days overdue	123	26%
Received 8-14 days overdue	41	9%
Received 15-22 days overdue	17	3%
Received 23-30 days overdue	10	2%
Received 1-2 months overdue	15	3%
Received 2-3 months overdue	5	1%
Received 3 or more months overdue	1	1%
	<u>475</u>	<u>100%</u>

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 30 Construction Requisitions totaling 281 items satisfied since 23 April 1954, and there are 32 Construction Requisitions totaling 1720 items under construction by the Group 60 Electronic Shops.

For further information please call the Production Control office (ext. 3492).

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There are 7 orders now open with vendors totaling 110 items. Deliveries in the past biweekly period have totaled 39 items. Information on specific orders may be obtained from the writer (ext. 3492).

3.3 Component Analysis and Standards

3.31 Components

(B. B. Paine) (UNCLASSIFIED)

Two trips were taken recently to attend symposia and to visit component suppliers. The Conference on Reliability of Electrical Connections at Illinois Institute of Technology, the Symposium on Automatic Production of Electronic Equipment in San Francisco, and the 1954 Electronic Components Symposium in Washington, D. C., were attended, yielding a number of valuable contacts with others working in these fields. Hughes Aircraft, Triad Transformer, and Chance Vought Aircraft were visited.

The activities of the Components Section are presently being re-examined to determine the tasks which now should be undertaken. It will be proposed that the following projects be undertaken: (1) remodeling of the component-failure reporting system, to allow all information to be recorded in a single writing instead of the five used now in the WWI program, to collect data on punched cards, and to make available an effective system for XD-1; (2) initiation of an intensive study of crystal diodes, including measurements, life tests, and preparation of adequate standards for the Laboratory; (3) study of circuit fabrication techniques, such as various methods for using etched circuits, the Tinkertoy and similar methods, automatic assembly techniques, and potting and coating methods; and (4) remodeling of our incoming-component-inspection procedures.

3.31 Components (Continued)

(B. B. Paine) (UNCLASSIFIED) (Continued)

A large portion of our time is spent in consulting with design engineers and in performing liaison activities with IBM. Testing and approval of components for use in MIT-designed portions of AN/FSQ-7 are proceeding with increasing smoothness.

3.5 Drafting

Central Display Frames

(A. M. Falcione) (UNCLASSIFIED)

The Drafting Room has started to make card details and assembly drawings for etched cards for the pluggable unit for central display frames. The procedures which we are following on the etched-card drawings are similar to those used at IBM. In order that the drawings, when completed, may be integrated with the IBM system, we have requested IBM to furnish us with duplicate card negatives for most of the basic cards made to date. These negatives will enable us to reproduce basic etched cards through Division 2 at Lincoln. IBM has promised delivery of these negatives within five to ten days.

Document Room Procedures

(A. M. Falcione) (UNCLASSIFIED)

There have been several instances in the past few weeks where heavy demands have been placed on the Document Room to deliver and transmit many copies of classified documents with a very short notice being given for the preparation of the document. In most instances, it was possible for the individual to advise the Document Room of the request much sooner, and this would have prevented a delay in transmission and delivery of the documents. It would be greatly appreciated if engineers would give the Document Room the maximum time available when a heavy demand is to be placed upon it so that the documents and receipts can be properly prepared and delivered on time.

3.6 Administration and Personnel

New Staff

(J. C. Proctor) (UNCLASSIFIED)

Lloyd B. Smith is working as a DDL Staff Member and has been assigned to Group 60. Until recently, he has been working as a Design Engineer at the Laboratory for Insulation Research.

3.6 Administration and Personnel (Continued)

Staff Transfers

(J. C. Proctor) (UNCLASSIFIED)

Edmund U. Cohler has transferred from Group 62 to Group 63.

Donald J. Eckl has transferred from Group 62 to Group 63.

Nolan T. Jones has transferred from Group 62 to Group 63.

Charles T. Kirk has transferred from Group 62 to Group 63.

Stanley Oken has transferred from Group 62 to Group 63.

Theodore Clough has transferred from Group 60 to Group 65.

H. Bonnell Frost has transferred from Group 60 to Group 65.

Saul Twicken has transferred from Group 60 to Group 65.

Alfred Zacharias has transferred from Group 60 to Group 65.

Staff Termination

(J. C. Proctor) (UNCLASSIFIED)

Robert Maglio

New Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Gerald Avarbock is a new technician in the Construction Shop.

Donald Duncklee has also joined the Construction Shop as a technician.

Ruth Hobbs is Steve Dodd's new secretary.

Terminated Non-Staff

Renee Feinstein

Carol Small

Marilyn Susskind

3.6 Administration and Personnel (Continued)

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

1 Clerk (Ozalid Operator)

6 Jr. Electronic Technicians for Group 62

2 Secretaries for Group 61

1 Secretary for Group 62

1 Laboratory Assistant (Female) for Group 62