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Memorandum M-2772

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

SUBJECT: BIWEEKLY REPORT FOR APRIL 9, 1954

To: Jay W. Forrester

From: Division 6 Staff

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Auth: DD 254  
By: R. P. EVERETT  
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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

For the benefit of both Group 61 and Group 22, various radar operating modes were analyzed by a program which gives the number of radar returns in range increments of 5 miles; at the same time photographs of the data were taken in the mapping room.

With the exception of the one at Martha's Vineyard, all the radars whose data are available for introduction into Whirlwind have been calibrated at least once. It is now planned to use the experience gained thus far to enable more accurate calibrations to be programmed.

A series of lectures and tests for Air Force personnel in the Track-While-Scan Section has proved very useful and uncovered areas in which more training was needed.

Work on the 1954 Cape Cod System progresses, with specific proposals now being made for many functions.

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1.12 Data Screening

(R. L. Walquist) (CONFIDENTIAL)

Considerable study is going into the requirements for a test program for the air surveillance section of the Cape Cod System. This test program is being laid out now for the 1954 Cape Cod System in order that any special restrictions on programming will be clarified. One desirable feature is a way of getting a print-out of all radar data which is used to correlate with a particular track. This information would be used to study the types of data distribution which create tracking difficulties. In line with the test program, a memo is being prepared by Frachtman and myself which covers operational experience of the air surveillance section of the 1953 Cape Cod System for December 1953 and January and February 1954.

In co-operation with R. Mechlin and other members of Group 22, data was taken on 1 April 1954 on the effect of various operating conditions of the FPS-3 on the SDV data received at the computer center. This data is being plotted as a set of distribution curves by Ardis Morriss and will be issued shortly in the form of an inter-office memo.

Considerable effort is going into the design of a more automatic tracking program and better control of the trouble tracks presented to the Track Monitors. Two important points still need to be settled with regard to the incoming radar data. One of these is the way in which the Montauk FPS-3 is to be tied into the System, and the second is the way in which the fine-grain data (FGD) will be transmitted.

Some time was spent with Ben Morriss in a study of the inter-relationship of the two computers in a duplex central. This study was centered around how the machines might be programmed and how information transfers might take place between the machines.

(W. S. Attridge) (CONFIDENTIAL)

The radar-data-analysis program which gives a count of the number of radar returns in range increments of 5 miles as a function of range has been run for a second time partly for Group 22 benefit and partly for Group 61 benefit. Various radar operating modes were analyzed in this manner, and at the same time photographs of the data were taken in the mapping room. Graphs of the data plotted will be grouped with photographs of the data for analysis.

The training periods that J. Levenson and I have held with the Air Force personnel in the TWS Section have proved to be very revealing in that the understanding which the Air Force personnel have about certain aspects of our operation is much different from what we had thought. We have found out from the weekly quizzes much more than we had hoped for and many unusual things. In particular, much confusion exists in the definition of correlation and the difference between correlated data and uncorrelated data. We expect that these difficulties will be corrected shortly. However, we may have to increase the frequency of these training periods which we now run at one per week.

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1.12 Data Screening (Continued)

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

The past biweekly period has been spent in organizing and planning the TWS Section of the 1954 Cape Cod System. We anticipate that in the next period we will have completed the general outline and be entering upon the flow-diagram stage.

(H. Frachtman) (CONFIDENTIAL)

A memo has been completed on the results of some of the Cape Cod statistics.

The program which collects and tabulates this data is being revised.

(F. Heart) (CONFIDENTIAL)

During the past biweekly period a change was made in my status: I am now working primarily in the Track-While-Scan Section.

Some time was spent assisting in visitor demonstrations of the Cape Cod System.

(J. Levenson) (CONFIDENTIAL)

The track-history program for evaluation of tracking will now be run with each live mission, and a scan-by-scan report for each track will be printed. Copies of these prints will be available to aid other analyses being made of the same mission.

A new program has been written to display on all scopes the time in minutes, seconds, and tenths of seconds. This should aid evaluators who are watching operations to synchronize their results with computer-recorded data which will be printed with the same time reference.

Training classes with TWS personnel are being held once a week. They have been spent on a short lecture and a written examination. The results have shown difficulties with the terminology chosen by us to describe operations. By now the men have an understanding of TWS operations within the computer, and the emphasis will shift to on-the-job training.

(H. H. Seward) (CONFIDENTIAL)

The TWS program was run with varying search-area sizes and different radar sets in order to observe the effect of such changes on the System. However, definite conclusions were for the most part unobtainable since the radar data was unsatisfactory.

Possible TWS improvements were studied by D. Bailey and me, and the results have been submitted.

Some time was spent in observing demonstrations of the System.

1.12 Data Screening (Continued)

(E. W. Wolf) (CONFIDENTIAL)

With the calibration of Chatham and of the Mark X during the past biweekly period, all of the radars of the Cape Cod System, except Martha's Vineyard, whose data are available for introduction into WWI, have now been calibrated at least once. The calibration of all of these radars is within the experimental errors of our procedures. A comprehensive memorandum describing the calibration operations is now in preparation. It is also planned to rewrite the calibration programs so as to make future calibrations more accurate and precise by taking advantage of the experience gained from operations thus far.

1.13 Tracking and Control

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

While the Raydist data-conversion program worked insofar as agreement with manually checked points was concerned, the results were meaningless in two respects. One, the aircraft supposedly being tracked had too slow a speed. Two, there was no correlation with radar data on the same aircraft, either in time or position. In a lengthy conference with George Harris of Group 22, it was finally discovered that the parameters of the hyperbolas were in error, and it was suspected that clerical mistakes had been made in reading the Brush records. A rerun on the computer confirmed the first hypothesis and a check of the records, the second. Matching of radar and Raydist data can now be made.

(H. D. Neumann) (CONFIDENTIAL)

See M-2773 (SECRET) for this entry.

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1.14 Weapons Direction

(D. R. Israel) (CONFIDENTIAL)

The priority item of this Section is the preparation of four memos describing the results of the operation of the Identification, Anti-aircraft, Height Finding, and Interception Sections of the 1953 Cape Cod System between 1 October 1953 and 1 March 1954. Quite a bit of effort has been put into these memos to make them accurate and complete. They are now ready for publication, pending final review by C. R. Wieser.

For several weeks a memo discussing the flight-test program of the 1953 Cape Cod System between 1 April and 15 June has been in preparation. As time goes on, this memo has become longer and more detailed. At the present time it is expected that the memo will be issued within a week and that it will be a complete and detailed outline of the test program through 15 June.

Milton Brand is leaving the Laboratory. Steve Hauser and Francis Garth will assume responsibility for the Identification Section of the 1953 and 1954 Systems.

A firm decision has been made to proceed with the 1954 Cape Cod System. As a result of my visit to Colorado Springs and discussions with personnel in Operations and Training and with Dr. Jordan in Operations Analysis, further revisions have been made to the proposal for the Identification Section of the 1954 System. Meetings with J. Degan, H. Benington, S. Hauser and F. Garth have been held during the past week to hammer out details of this program. Zraket and Benington have been gathering information regarding each of the programs of the 1954 Cape Cod System to permit them to make decisions regarding the interrelation of programs, timing and storage allocation. This work has been delayed because of the more pressing requirements mentioned in the first two paragraphs.

M-2764, "Equipment Changes" (D. R. Israel), describes responsibilities regarding equipment installation and changes in the 1954 System. G. Rawling is co-ordinating this work with Group 64.

During the week of 29 March, Group 61 conducted another indoctrination program. This time it was held principally for the benefit of Group 61 staff members. This program is outlined in M-2726, "Syllabus for the Cape Cod Familiarization Program" (Gaudette and Grandy). This course will be run again during the week of 26 April. A one-week program is scheduled to begin 10 May for a selected group of Air Division Commanders.

Problems of training Air Force personnel for the 1953 Cape Cod System are fairly acute. In particular, there is a problem of continuous training, in addition to the indoctrination of new personnel. Similar problems seem in prospect for the 1954 and 1955 Systems. Discussions of these problems with J. Degan of Group 38 were held on Friday, 9 April. It is expected that a definite proposal from Group 38 will be made next week.

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1.14 Weapons Direction (Continued)

(H. Benington) (CONFIDENTIAL)

A memo on the operation of the 1954 Cape Cod System Weapons Direction Section is being written with C. Zraket. The intention is to collect data on all SOP's, displays, manual inputs, alarms, etc., that will be used at each station. Such a description of the "black box terminations" should facilitate program design. The operation of all stations has been considered and a gross estimate made of performance. This preliminary statement will now be reviewed in order to fix details.

(J. J. Cahill) (CONFIDENTIAL)

In the Biweekly Report of 26 March (M-2749), in the section by the writer (1.14 Weapons Direction, page 5), the AA-guidance mission of 16 March should have been described as a simulated mission.

Coding of the ATABE program is practically complete. It is hoped to perform initial tests during the next period.

A supplement to M-2668, "AA-Guidance Programming, Displays, and Communications for the 1953 Cape Cod System" (J. J. Cahill, Jr.), has been prepared. This supplement describes certain changes in procedure during AA-guidance exercises which were dictated by experience during early tests.

An M-note has been written which gives the results of AA-guidance missions of the 1953 CCS prior to 1 March 1954 and includes certain changes in the 1954 CCS, the desirability of which was indicated by the exercise results. The M-note will be part of the M-1815 series and will be entitled "Results of AA-Guidance Exercises of the 1953 CCS, October 1, 1953 to February 25, 1954."

During an AA-guidance exercise performed on 1 April 1954, 5 tracks were passed to AAA and 3 were locked on. These 3 were all assigned and splashed. The Liaison Officer from the Fifteenth Group AAA to CCS was present at the AAOC during the exercise and indicates that there was no apparent reason for the inability of AAA to lock on the remaining 2 tracks. Tracking of the strikes by TWS was excellent during this mission.

Two successful raid-size-estimation flight tests were performed during this period. Results indicate that the MPS-4 height finders can judge raid size and formation quite well for large, propeller-driven aircraft flying in various formations, with separations between aircraft of 500 feet or of 300 feet, provided the aspect is nose-on. Aspect seems to be considerably more important than range, separation (in the range of separations stated), or formation. For details see an inter-office memo by G. C. Grandy to D. R. Israel.

One further test will be attempted immediately, with 200 feet between aircraft. A further series of tests is planned for some future

1.14 Weapons Direction (Continued)

(J. J. Cahill) (CONFIDENTIAL) (Continued)

period. Requirements for these will be decided after reactions have been received to the results of the first series.

(P. O. Cioffi) (CONFIDENTIAL)

I am compiling in one reference a description of the Cape Cod computer-intercept feature and all of the assumptions of flight on which it is based for distribution in the flight-supporting groups (NADU and 6520th). Recent contacts with these groups pointed out a need for the distribution of such a memorandum to serve both as familiarization material and as a reference providing the specifications of flight performance requirements. (I learned from my contacts with these groups that there is not a universal knowledge throughout them of our requirements for turn and climb performance and scramble procedures. This was attributed to the lack of a ready reference outlining such requirements.)

I received a report this date of the electronics ability of NADU at a meeting with Lts. Stevenson and Munroe at the Lincoln Navy Liaison Office. As a result of intensified effort on the part of NADU during the past two biweekly periods particularly, it can be expected that the unit will have available for our use two ELO equipped F9F aircraft beginning next period. In addition, there is a third ELO AI radar setup on the bench. The AI readiness of the other aircraft is expected to be reported soon.

Description and specifications of the final-turn intercept testing were completed for inclusion in a memorandum by the Cape Cod System Directors and D. R. Israel outlining the program of final 1953 Cape Cod flight testing.

(O. T. Conant) (CONFIDENTIAL)

The alterations to the Cape Cod telephone system, ordered in December 1953, are finally being accomplished by the telephone company. The new arrangement of circuits is now expected to be completed on 13 April and will then remain fixed for the duration of the 1953 Cape Cod System. The specifications of connections will be summarized in M-2187-1, which should be available during the next biweekly period.

Telephone requirements for the 1954 Cape Cod System are now being determined. Any changes from the present system will be accomplished at the same time as other equipment alterations for the 1954 System.

A meeting with MIT's Chief Operator was attended to assist R. J. Horn in planning Group 61's office telephones for Building C.

1.14 Weapons Direction (Continued)

(O. T. Conant) (CONFIDENTIAL) (Continued)

A briefing on the Cape Cod telephone system was presented as part of the indoctrination course for new programmers.

Digital-information displays (DID's) for the 1954 Cape Cod System are being studied in conjunction with the over-all planning of system organization by C. Zraket and H. Benington. Some work will also be done on the situation display.

(F. M. Garth) (CONFIDENTIAL)

Several meetings were attended which dealt with obtaining a workable identification plan to be used in the 1954 Cape Cod System. The culmination of these meetings was to limit automatic identification to a "free zone," that portion of the Cape Cod System which extends over Continental United States. Strike, TOMCIS (Test of Multiple Corridor Identification System), and flight-plan aircraft will be monitored manually with a simple priority method used to direct attention to those of greatest threat.

The memorandum on revised NTWS data records has been completed. It was jointly written with P. Cioffi.

(C. H. Gaudette) (CONFIDENTIAL)

The action-analysis program for the 1953 Cape Cod System is nearing completion. The majority of the Weapons Direction (WD) station's actions may be printed out by this program, and henceforth the recording section of the program will be used during all flight tests.

(C. C. Grandy) (CONFIDENTIAL)

This period has been devoted to reworking and preparing for publication the report of the analysis of operation of the Height-Finding Section of the Cape Cod System. This report will be issued as an M-note in the forthcoming period.

It has been called to my attention that the summary of this report printed in the last Biweekly Report is subject to some misinterpretation. It should have been stated that the performance of this Section was unsatisfactory rather than unexpected. In fact, the over-all performance was not much lower than would be expected in light of the general performance of the Cape Cod System and in consideration of the mitigatory factors involved. These factors are, of course, too many and complex to discuss here but are considered in detail in the full report.



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(C. C. Grandy) (CONFIDENTIAL) (Continued)

Furthermore, it should have been noted that the generally low performance was caused to some extent by the degrading influence of the N. Truro CPS-6B radar. This set was consistently poor in most aspects of the operation. Perhaps the most significant remedial action to be taken is the replacement of this set by a TPS-10-D type nodding-beam radar located at S. Truro. Operation of this latter set in the Cape Cod System began on 6 April 1954, and its performance to date has been excellent.

A final point to emphasize is that the revisions for the 1954 System, beyond the replacement of the CPS-6B, are mainly changes in the height-finder programs. The other equipment changes are mostly a matter of convenience.

Two special raid-size tests were held during this past period, only one of which was satisfactory. The details of these tests are reported by J. J. Cahill, Jr.

(S. C. Knapp) (CONFIDENTIAL)

The proposal for the 1954 Cape Cod System simulation program, written with C. Gaudette, has been completed and should be ready for distribution soon.

The program for the scan-by-scan recording of data on aircraft involved in interceptions is checked out and is now included in the Cape Cod program to be used during flight tests. This program is a part of the "action recording" program.

The section of the analysis program which will analyze and print out the Identification Technician's actions (flight-plan insertions, etc.) is now being written.

(W. Z. Lemnios) (CONFIDENTIAL)

The final-turn program used in the interception calculations is based on an iterative procedure to calculate the command headings of the interceptor. This procedure is stable in most of the cases, and the correct headings are calculated. In a very few cases, however, the procedure leads to instability, and the calculated headings are incorrect. In the past it has been the practice to have the Intercept Directors switch the calculations to collision course whenever an unstable case appeared. During the past biweekly period, an analysis of the unstable cases has been carried out, and a modification will be made to the final-turn program which will allow the computer to automatically switch to collision course for any unstable cases.

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1.14 Weapons Direction (Continued)

(W. Z. Lemnios) (CONFIDENTIAL) (Continued)

More time was spent analyzing data for all attempted interceptions from 1 October 1953 to 28 February 1954. The results will appear eventually as an M-note written in conjunction with D. Israel and C. Zraket.

(L. J. Murray) (CONFIDENTIAL)

The testing program for the Collins ground-to-air data link (G/A D/L) equipment is now in its final phase. Five F-89's have operational D/L equipment. A reasonable G/A D/L program can now be written for the 1954 Cape Cod System.

A proposal has been written for a 14-week course in computers and their applications to real-time control problems. This course is to be given to the Air Force Officers attached to Group 61 to enable them to train their personnel. The course should also give a sufficient background in control problems to enable those attending to keep abreast of the design and operation of the 1954 Cape Cod System.

For information concerning saturation tests and their results, refer to the section by J. Nolan.

(J. Nolan) (CONFIDENTIAL)

Time during the past period has been given to the following work:

1. Saturation tests (in conjunction with L. Murray). On 1 April a live test was held as the first in the proposed series of saturation tests. Four interceptors were scrambled from Bedford, and only one successful intercept was made. The single intercept occurred when the Intercept Director (IND) was controlling only this one sortie. Poor tracking accounted for part of the poor results; however, improper control was also responsible. Reconstruction of the test indicates a poor feeling for the dynamic nature of the intercepts and several variations from the prescribed procedures. A similar test on 8 April was cancelled because of bad weather. The next test to be run will give three simultaneous intercepts, and operating procedures will be strictly followed.

2. A general review of the action of the interception-calculations program has been started in order to adapt its features from the 1953 CCS to the proposed 1954 CCS.

3. Some time was spent in observing the guided tours of the CCS.

4. A talk on the function of the Weapons Assignment and Direction (WA/D) station in both 1953 and 1954 CCS's was given to new staff members.

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1.14 Weapons Direction (Continued)

(G. A. Rawling) (CONFIDENTIAL)

1953 Cape Cod. A pictorial drawing of matrix pairs (for display selection) by frame, panel, and switch location has been completed and distributed. Future drawings will indicate type of display and addresses.

A rough-draft pictorial drawing of indicator-light assignment by insertion register and digit, including frame and panel location, light number, title, and remarks has been completed. When polished, copies will be distributed.

1954 Cape Cod. Pictorial drawings of consoles, with panel and switch locations, coupled with data-insertion register and digit, have been completed. Data-insertion-register allocation has been completed.

(C. A. Zraket) (CONFIDENTIAL)

With D. R. Israel and W. Lemnios, a rough draft of a memo summarizing the results of intercept tests for the period 1 October 1953 to 28 February 1954 was written.

A memo describing in detail a flight-test program for the Cape Cod System for the period 1 April to 15 June has been completed in rough-draft form and will be issued during this period.

Specifications for the various Weapons Direction stations of the 1954 Cape Cod System are being reviewed with other members of the Group.

7 April (Wednesday) - One F-2F aircraft was flown for radar and height-finder calibration testing. Three F-2F's were flown for data-link testing.

8 April (Thursday) - Data-link and Systems-evaluation testing cancelled because of weather.

9 April (Friday) - Two F-2F aircraft flown for data-link testing. One F-2F was flown for radar and height-finder calibration.

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1.15 Direction Center Operations

(Zraket, Attridge, Cioffi, 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.

30 March (Tuesday) - Systems-evaluation test cancelled because of weather.

31 March (Wednesday) - Test of 30 March rescheduled and run this date. A data-link test run simultaneously showed positive results. The major test was run with a formation of 5 target aircraft for height and raid-size estimate exercises.

1 April (Thursday) - Data-link test run with one F-89. Intercept-direction load testing run with 5 target aircraft and six F-89's. Result of the major test was not good, primarily because of the operational techniques of the control team.

2 April (Friday) - Data-link test cancelled. (Aircraft accident on runway that AM.) One B-29 aircraft was flown for radar calibration, Mark X, and height testing.

6 April (Tuesday) - Systems-evaluation test was run with a formation of 4 target aircraft for height and raid-size estimate exercises. (S. Truro TPS-10D height radar used for first time this date.) Results of this test were reported as good.

7 April (Wednesday) - One B-25 aircraft was flown for radar and height-finder calibration testing. Three F-89's were flown for data-link testing.

8 April (Thursday) - Data-link and Systems-evaluation testing cancelled because of weather.

9 April (Friday) - Two F-89 aircraft flown for data-link testing. One B-29 run for radar and height-finder calibration.

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1.15 Direction Center Operations (Continued)

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

Summary of Biweekly Operations:	Week (11 & 12) Last Period	Week (13 & 14) This Period	1st Quarter 1954
<b>System Operational Test Sorties</b>			
Requirement	50	50	325
Scheduled	50	27	312
Flown	0	10	88
Per Cent Flown (of required)	0	20	27
<b>System Evaluation Test Sorties</b>			
Requirement	24	24	156
Scheduled	24	36	168
Flown	20	14	95
Per Cent Flown (of required)	83	58	61
<b>Components Test Sorties</b>			
Calibration	2	2	13
Requirement	4	3	25
Scheduled	3	3	15
Flown	150	150	115
Per Cent Flown (of required)	75	100	60
Per Cent Flown (of scheduled)			
<b>Data-Link Sorties</b>			
Requirement	0	0	0
Scheduled	14	12	77
Flown	6	6	25.5
Per Cent Flown (of scheduled)	43	50	33
<b>Total Sorties</b>			
Requirement	76	76	494
Scheduled	92	78	582
Flown	29	33	223
Per Cent Flown (of required)	38	43	45
Per Cent Flown (of scheduled)	32	42	38
Per Cent Scheduled (of required)	121	103	118

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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	18	100	225.1	100
Unrestricted Operating Time	15.5	86	131.8	59
Limited Operation Time	0.8	4	59.1	26
Down Time	1.4	8	31.7	14
Recovery Time	0.3	2	2.5	1
Time Lost (Hours)				
	Down Time	Limited Operations	Down Time	Limited Operations
Computer	1.4	0.0	28.7	0.0
Room 222	0.0	0.8	2.6	49.5
Radar and Input	0.0	0.0	0.3	43.7
Miscellaneous	0.0	0.0	0.0	25.3

(W. Vecchia) (CONFIDENTIAL)

Computer Operations:

Total Assigned Time 82.5 hr

Weapons Direction	2 hr 30 min
Track-While-Scan	14 hr 15 min
Combined Operations	
Weapons Direction and	
Track-While-Scan	18 hr 40 min
Data Screening	1 hr 15 min
Tracking and Control	17 hr 15 min
Equipment Check	1 hr 25 min
	<hr/>
	55 hr 20 min
Time Given to Math Group	19 hr 30 min
Time Given to In-Out	2 hr 15 min
Time Given to Ck-Out	30 min
Time Lost to Computer (malfunction)	4 hr 55 min
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	27 hr 10 min
Grand Total	82 hr 30 min

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1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

During a review of the specifications for the digital-information displays for XD-1 and a consideration of the means of using Typotron tubes, a new and simplified proposal for the DID system was evolved. The new proposal eliminates selected DID's, saves equipment, and will generally result in economizing on computing time. Operationally, the new scheme appears superior to the previous one. An M-note describing this new proposal is being prepared by Benington and Conant.

M-2720, "Equipment Estimates and Allocation for XD-1 Operating Positions," (D.R. Israel and G. Rawling) supersedes a previously issued inter-office memo describing the equipment requirements for the operating positions in the XD-1 Direction Center. A revision to this memo is currently under way to account for certain equipment changes and improvements in the equipment layout.

During the past four weeks, floor plans for the second floor of Building F have undergone several changes and modifications. A fairly major revision included a relocation of equipment to provide better maintenance facilities behind the consoles. The change resulted from a meeting with Don Patterson of ADES. The current floor plan approved by Group 61 is given in Drawing E-58233. M-2720 is currently being revised to make it concur with E-58233. This drawing indicates the newly adopted name of the Flight Test Umpire Room: "Training and Battle Simulation."

During the week of 29 March problems of large-scale displays for the XD-1 Combat Center were discussed at Air Defense Command Headquarters in Colorado Springs. Project Group for ADES is preparing a detailed set of requirements for this display and will make them available to the Lincoln Laboratory before the end of April.

At Colorado Springs, questions regarding the use of weather information in the AN/FSQ-7 system were discussed. On Thursday, 8 April, personnel from the 3rd Weather Group at ADC and from Air Weather Service in Washington visited the Laboratory and discussed the use of weather for intercept direction. An M-note summarizing the results of these discussions and proposing an improved method of weather-data collection for use in the AN/FSQ-7 system is currently in preparation.

On Friday, 2 April, I visited the CAA Technical Development and Evaluation Center at Indianapolis to discuss their work on the use of the magnetic drum for storing flight-plan data. At the present time this work is not pertinent to the identification problems of the AN/FSQ-7.

On Thursday, 8 April, discussions with Mr. Cairnes and Mr. Vaughn of AT&T centered on the use of teletype circuits for transmission of information to and from AN/FSQ-7. Results of these discussions as well as those of Indianapolis do not indicate changes in present plans for handling this information.

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

(H. Benington) (CONFIDENTIAL)

An inter-office memo was prepared summarizing Group 61 concurrence on XD-1 DID's. The memo, which will be issued as an M-note, covered the material discussed in meetings held during this period.

(O.T. Conant) (CONFIDENTIAL)

A review by Group 61 of the digital-information display (DID) system for XD-1, concerning particularly the problem of Typotron erasure, culminated in a proposal for a major revision of the system. This will result in considerable simplification, including elimination of "selected" DID's and reduction of storage requirements to one drum field. This proposal has already been presented to Group 62 and IBM as an inter-office memo, and generally accepted, and will be available as an M-note during the next biweekly period.

(C. Gaudette) (CONFIDENTIAL)

Several meetings with W. Lone, R. Davis, R. von Buelow, and R. Jeffrey were held to discuss camera facilities for XD-1. The principal purpose of these meetings was to determine what type of equipment will be necessary to supply Group 61 with photographic records of system operators. A proposal for this equipment will be issued by W. Lone and me.

(C. Grandy) (CONFIDENTIAL)

A scheme of numbering positions and equipments for the XD-1 Direction Center has been established independently of IBM and will be used for the special convenience of Group 61. The basic elements of this scheme are similar to those used in the Cape Cod System; an operational area designator; an operational position designator; and an equipment-type designator. This basis can be supplemented by the addition of panel-location designators and wiring designators. A complete description of this numbering scheme will be reported in a forthcoming M-note.

(W. Lone) (CONFIDENTIAL)

Discussions with C. Gaudette and R. Jeffrey about the camera requirements for XD-1 took place at various times during this biweekly period. Since no delayed-output equipment will be available, it is felt that a camera with a high-speed developing feature such as the Polaroid Land camera would be desirable. C. Gaudette and I will write a memo proposing the camera to be used.



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

(W. Lone) (CONFIDENTIAL) (Continued)

D. Hallock, W. Thomas of IBM, and C. Gaudette, W. Lone of Group 61 held a meeting on 8 April to discuss the magnetic-tape units for XD-1. Most of the present difficulties center around the backspace and rewind. Further investigation of the circuitry is to be carried out by IBM.

Some time was spent on the XD-1 conversion program.

(G. Rawling) (CONFIDENTIAL)

Floor plans for the installation of consoles for the Air Defense Center have been revised in conjunction with Phil Bragar.

(F. Webster) (CONFIDENTIAL)

A display for the distribution of the means of samples from the output of pseudorandom member generators has been checked out on MTC. The next step is to program chi-square tests for the goodness of fit of different-sized samples.

~~CONFIDENTIAL~~

(C. Gaudette) (CONFIDENTIAL)

On 12 April the decision will be made as to which IBM prototype to use in the final IBM design amplifier (for core memory). Rebuilding of 10 of these units can then be started.

None of the prototype amplifiers showed any significant reduction in performance when all three 600 tubes had an  $I_p$  of approximately 2 milliamperes. (Reset rejection point for these tubes is 3 milliamperes.)

(W. Lone, A. J. Salvo) (CONFIDENTIAL)

The replacement in 77-104 of the fixed-voltage switching panels has been completed. As mentioned earlier, the panel has plug-in type relays which simplify the maintenance procedure.

On 13 April, the installation in 77-104 of the new type voltage-switching panels will commence. The replacement of the entire complement of panels in 77-104 will be accomplished during a three-day period.

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

Estimates by computer operators of the usable percentage of assigned operation time reveal a reduction in computer reliability during the past biweekly period. Failures of the -450-v supply, wiring errors which caused a breakdown in the power-distribution system, and terminal-equipment troubles account for a large part of the loss of application time.

The supply presently being used for -450-v is overage and will be replaced sometime during the next biweekly period. The troubles in terminal equipment were in sections associated with the magnetic-tape and the magnetic-drum systems. Difficulties were encountered when using the delayed-print-out facilities, and on several occasions the group and address-selection operation failed on the buffer drum.

Marginal-checking lines are being installed in the delayed-print-out system, and the number of lines now checked on the buffer-drum system is being increased to cover additional circuitry in an effort to prevent recurrence of these malfunctions.

1.21 WWI Systems OperationCore Memory

(N. L. Daggett) (UNCLASSIFIED)

By 12 April the decision will be made as to which ERA transformer to use in the Mod. III sense amplifier (for core memory). Production of 40 of these units can then be started.

Tests of the prototype amplifiers showed no significant reduction in performance when all three 5965 tubes had an  $I_b$  of approximately 4 milliamperes. (Retest rejection point for these tubes is 8 milliamperes.)

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

The replacement in "P" Row of the fixed-voltage switching panels has been completed. As mentioned earlier, the panel has plug-in type relays which simplify the maintenance procedure.

On Monday, 26 April, the installation in "P" Row of the new type voltage-variation switching panels will commence. The replacement of the entire complement of panels in "P" Row will be accomplished during a 6-week period.

1.21 WWI Systems Operation (Continued)

Core Memory

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

A core-memory parity alarm occurred on 4 April. The cause might have been tap shorts in two cathode-follower tubes. The tubes were being used to drive the core-memory matrices. Until this alarm occurred, no parity alarms had appeared from 11 March to 4 April.

Magnetic Tape

(A. X. Perry) (UNCLASSIFIED)

Facilities for marginal checking of the delayed print-out have been installed this week, and work towards reaching an efficient preventive-maintenance program will begin.

Some of the difficulties encountered in the delayed print-out system during the last biweekly period were traced to two suspected bad thyratrons, two Clare-type relays with dirty contacts, a poorly seated 29-pin power plug, and four poor Amperex 1N38A crystals.

Two instances of damaged magnetic tape have occurred, and it is necessary to say that the dynamic operation of the tape system depends upon many factors, one of which is the care of the reels of tape. From now on, reels of tape will not be removed from the control-room area. When not in use, all reels will be stored in their respective slots in the metal boxes which have been provided for each group.

Until a training program for all systems technicians is initiated in the near future, no one is authorized to perform any mechanical adjustments or changes on the tape mechanisms except the writer.

Typewriters and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Modifications have been completed on two of the three FL Flexowriters which we received a few weeks ago. The third is now being modified and will be ready in about a week.

1.21 WWI Systems Operation (Continued)Typewriters and Paper Tape

(L. H. Norcott) (Continued) (UNCLASSIFIED)

A recent occurrence points out the importance of properly logging all cases of equipment failure. Apparently, operators have been experiencing difficulty over a period of about a month with the delayed-output punch dropping code holes, but it was only brought to our attention a few days ago. The cause of the trouble has not been located definitely yet but appears to have been caused by a faulty thyatron or relay in the magnetic-tape print-out control register.

1.22 Terminal EquipmentMarginal Checking

(T. Sandy) (UNCLASSIFIED)

The work on the reassigning of marginal-checking lines in the in-out element is continuing.

The intervention registers are being manually marginal-checked every week now.

A marginal-checking system for the display system and the indicator-light registers is still under investigation.

Some of the low margins in the in-out element have been traced to low filament voltage on the in-out-switch matrix output cathode followers.

Magnetic Drums

(K. E. McVicar) (UNCLASSIFIED)

Some trouble was experienced with the buffer-drum system during the past biweekly period. The symptom was failure to select the proper drum group. Trouble-shooting was difficult because the malfunction was intermittent, and we could not aggravate the condition by varying voltage margins on any of the pertinent drum lines. The error was finally traced to the combination of a weak gate-buffer plug-in unit and failure of a gate level to rise sufficiently. These troubles were in in-out control and in circuits not usually checked during the marginal-checking routines. This oversight has now been corrected.

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1.22 Terminal Equipment (Continued)Magnetic Drums (Continued)

(L. D. Healy) (UNCLASSIFIED)

A pair of level setters for the 6BL7 cathode followers driving the XTAL gates in the buffer drum and a circuit to reduce the voltage output from the regulator supplying plate voltage to the writing amplifiers when these amplifiers are not in use have been tested and are to be installed 12 April for trial with the drum at some future date.

Work has been started on some sections of a technician's manual for the drum systems.

(H. L. Ziegler) (UNCLASSIFIED)

Installation of the new magnetic-drum-PETR monitor system took place on 29 March as expected. Except for a few minor items still to be checked, this system is now complete, and all prints are being brought up to date.

The parity digit for buffer-drum groups 4-7 should be in operation sometime during the coming week (April 12-18). All that remains to be done are several installation day "tie-ins" and a chassis modification.

Testing of magnetic-drum chassis was resumed during the past biweekly period because of the growing backlog of faulty chassis. Though this diversion of help necessarily slows progress on the wiring of electronic head switching in the auxiliary drum, it is felt that this wiring is well ahead of the expected delivery date of type 3 chassis needed for the head-switching system.

Data Inputs

(H. J. Kirshner) (CONFIDENTIAL)

Satisfactory progress is being made in all phases of the program for installation of new type video mappers for the 1954 Cape Cod System.

Operation of all equipment in Room 224 was normal during this period.

Three data circuits to Montauk Point, New York, are in the process of being installed by A. T. & T. Co.

Modifications to the telephone intercom system in the Cape Cod Direction Center will be completed by 13 April.

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1.22 Terminal Equipment (Continued)Data Link

(R. B. Paddock) (UNCLASSIFIED)

The past period has been spent becoming familiar with and at the same time familiarizing Bob Barry with the data-link (D/L) system as it now exists. Barry and I spent one day last week on a familiarization tour of D/L facilities at Lexington and Prospect Hill. Much was learned about the data link, especially about the present monitoring equipment; the tour also afforded us an opportunity to meet the people with whom we ordinarily conduct D/L business.

Our first attempts to connect the meter indicators of the cockpit mockup to the monitor system have been largely unsuccessful, the T-T-Go meter being the only one to respond so far.

A "32-position switch and indicator-light register" panel is due out of the shop during the next period; after testing, this panel is expected to provide a reliable monitor for our system now and to become later the first step in a continuous automatic checking system for D/L. Methods of providing this automatic check are now being investigated.

Pathfinder Mod

(N. N. Alperin) (CONFIDENTIAL)

A dismantling manual was completed and sent to the construction shop. Dismantling of the indicators will begin on 12 April. I am presently working on the prototype mod and the accompanying manual.

Light Guns

(N. N. Alperin) (CONFIDENTIAL)

I spent some time this past week with J. Elkind of Division 38 discussing their new light-gun package. I also spent some time with C. Corderman testing the IHM light gun.

CRT Filters

(A. V. Shortell) (UNCLASSIFIED)

The new scan-synchronizer design has been debugged to a point where it is merely necessary to make a judicious choice of integration and lead network time constants to give the desired insensitivity to jitter and missing pulses consistent with good stability.

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1.22 Terminal Equipment (Continued)

Test Programming

(G. A. Young) (UNCLASSIFIED)

The three auxiliary-drum test programs used in PMC have been changed to operate with the buffer drum. These programs will check the buffer-drum circuits used with groups 4 through 7 of that drum.

The Room 222 equipment-check programs have been modified to include a check on the timing register. The programs have yet to be checked and will go into effect during the next biweekly period.

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 26 March - 8 April 1954:

Number of assigned hours	165
Usable percentage of assigned time	87
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	5
Number of intermittent errors	5

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 26 March 1954:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Capacitors</u>			
0.1 $\mu$ f 500-v mica	1	22000 - 23000	Leakage
10 $\mu$ f 500-v mica	1	22000 - 23000	Leakage

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

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>Crystals</u>			
1N34A	1	5000 - 6000	Low $R_b$
1N38A	2	no clock hours	Shorted
	1	1000 - 2000	Low $R_b$
1N68	1	0 - 1000	Open
1N92	1	no clock hours	Drift
<u>Tubes</u>			
5687	1	1000 - 2000	Leakage
	1	5000 - 6000	Drifting $I_b$
6080	1	0 - 1000	Open heater
6145	6	0 - 1000	3 short, 1 low $I_b$ 1 leakage
	1	1000 - 2000	Leakage
	1	2000 - 3000	Short
	1	5000 - 6000	Short
2D21	1	no clock hours	High firing potential
C3J	1	0 - 1000	High arc drop
6AN5	1	0 - 1000	Leakage
	1	2000 - 3000	Leakage
	1	6000 - 7000	Leakage
6J5	1	4000 - 5000	Short
715C	1	no clock hours	Low $I_b$

1.24 Power

WWI Power Supplies

(D. M. Fisher) (UNCLASSIFIED)

The new -45-v, 5-amp power supply is now being assembled. Delivery of the rectifier unit from the construction shop is expected in a few days. The supply will be installed into the WWI system after the routine tests have been completed.



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(S. Coffin) (UNCLASSIFIED)

The WWI -30-v supply is now being redesigned and will be returned to WWI later this month. It will have less ripple, faster transient response, and fewer components.

1.25 AN/FSQ-7AN/FSQ-7 Production System

(B. E. Morriss) (CONFIDENTIAL)

A number of people have been spending part time on the duplex system. J. Jacobs and R. Jeffrey spent two days at High Street with S. Dodd and me discussing some of the possibilities for inputs. They will both continue to spend part time on the duplex, primarily working with the Display Groups to insure that the XD-1 display system will be compatible with duplex switching, checking, and maintenance requirements. J. Gano will continue to spend some time considering the power-supply requirements. N. Daggett has spent some time with Dodd and me discussing checking and maintenance requirements for a continuously operating system.

An evaluation of the possibilities of the non-duplicated equipment is being held up while the general requirements for checking and maintenance are being developed. The development of these requirements during the coming period is expected.

XD-1 Schedules

(T. R. Parkins) (UNCLASSIFIED)

The following schedules were issued last period:

XD-1 Installation  
XD-1 Systems Test  
Central Display Frames

A schedule from the MTC Section is ten days overdue; it is expected on 12 April.

The Basic Circuits Section is reluctant to issue a schedule until the other Sections in Group 62 issue schedules.

Irving Aronson is collecting data for a schedule of phone-line modulators and demodulators.

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1.25 AN/FSQ-7 (Continued)

AN/FSQ-7 Power Supply

(P. Morrill) (UNCLASSIFIED)

Preliminary sketches for power system for Building F are in design.

General schematics for power supply for duplex system and for prototype layouts are under discussion.

### 1.3 Group 65

#### 1.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

More attention than usual was directed to the reliable receiver-tube program this past period. One day was spent with the IBM Tube Group at Endicott, New York, discussing the tubes to be used in the display system. Four days were spent with the IBM Tube Group at Poughkeepsie, New York, on the general problems of the reliable receiver-tube program. We were able to discuss our problems with representatives from Sylvania, GE, and Tung-Sol. Also, a visit was made to Edgerton, Germeshausen and Grier, Boston, Mass., to discuss methods of marginal checking of the 2D21 and XD-1.

However, most of the effort of the Group continues to be expended on problems concerning the 19-inch Charactron and the 5-inch Typotron tubes. Two electron guns were received from Hughes Aircraft for electron-optical studies using the shadowgraph principle. These tubes are undergoing evaluation and analysis by F. A. Rodgers and P. C. Tandy.

A trip is planned for the week of 12 April to Convair and Hughes Aircraft. F. A. Rodgers, T. F. Clough, and I are making this trip to more carefully evaluate their construction facilities and processing techniques. C. L. Corderman will join us later in the week to discuss the electron optics of the two tubes.

J. A. Klein and J. S. Palermo are continuing their studies of phosphor aluminizing and nonreflective coatings. Special emphasis was placed this period on the nonreflective coatings.

G. C. Sponsler completed his electron-trajectory studies temporarily at the MIT Dynamics and Control Laboratory.

#### 1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

During this past period J. Klein of Group 25 and I visited the American Optical Company in Southbridge, Mass., for the purpose of discussing the techniques and characteristics of AO-131 and AO-157C-50 nonreflective coatings. Coatings produced at American Optical have an overall reflectivity of about 0.3 per cent for white light and about 0.1 per cent per surface for the optimum wavelength.

CX-68, -69, and -70 were prepared this week for vacuum-tube laboratory processing. The first of this series will be given to the Test Group for evaluation during the next period.

1.33 Research and Development (Continued)

(J. S. Palermo) (UNCLASSIFIED) (Continued)

The mechanical tilt table for the liquid settling of luminescent screens is also expected from our Machine Shop during the next period. At this time tubes with aluminized luminescent screens will be prepared for processing and testing.

(P. C. Tandy) (UNCLASSIFIED)

During the past two weeks I have made several tests on Charactron and Typotron tubes.

A test on a modified Typotron tube, which had two flood guns, determined that a flood gun designed by F. H. Caswell would operate in a Typotron tube and give the desired screen coverage. The gun designed by Caswell had a different grid-drive characteristic than the other gun which was of the Hughes design. The cutoff of both guns was the same.

A test on a Charactron tube with a square aperture mounted in Grid 2, slightly behind the top aperture, demonstrated that an electron beam with square cross section could be obtained in the matrix plane.

Tests on Hughes Charactron guns will continue.

## SECTION II - AN/FSQ-7

## 2.1 Group 62

2.11 SystemsGeneral

(R. von Buelow) (UNCLASSIFIED)

The memory specification has been concurred in by the EDO-SO, and a Lincoln approval letter has been written. There has also been concurrence on the procedure for transmitting information on the progress of AN/FSQ-7 schedules, on the first-floor false ceiling, and the use of Hygrol as a dehydrator.

Because of the use of one of the spare drum fields for miscellaneous radar input and addition of another spare drum field since only one is necessary for DID, the drum fields have been rearranged. One drum now has 2 spare, 1 IC, 1 XT, 1 DID, and 1 MI fields. Another drum has 3 OB, 2 RI, and 1 MRI fields. The other drums are unchanged. Both spare fields are readable by address only.

The second-floor plan is being revised to indicate spare units and to number each of the pieces of equipment. Some rearrangement is taking place.

An estimate was made by Group 61 of the load to be on the indicator-light lines. It is estimated that 36 will have a single neon light, 100 will have 2 or 3 neon lights, and 120 will have a neon light plus a buzzer or some other load.

(R. C. Jeffrey) (CONFIDENTIAL)

A preliminary formulation of XD-1 camera requirements has been worked out with Gaudette and Lone of Group 61 and Davis of Group 22. R. P. Mayer will represent the systems office in future discussions of camera specifications.

Time was also spent in meetings here and at High Street on the Duplex Central "big switch" problem, and in learning the XD-1 display system from that point of view.

Between now and the fall I will be working full time in the Duplex Central Group.

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2.11 Systems (Continued)

Outputs

(R. C. Hopkins) (CONFIDENTIAL)

Logical designs for possible control circuits of each required type of output-storage section were made to assist in evaluating core-storage schemes. It was decided on 8 April to propose use of ferrite-core arrays in the output-storage element.

Mark X, FGD, and Automatic Height-Finder Inputs

(R. C. Hopkins) (CONFIDENTIAL)

A letter was issued 29 March declaring the intention to use these inputs with XD-1. A schedule for producing specifications for these inputs was published as M-2735. May 1 is the target date. A decision and agreement was reached 2 April to place data from these inputs on one of the spare drum fields.

Digital-Data Transmitters and Receivers

(I. Aronson) (CONFIDENTIAL)

My efforts in this area have been directed toward setting up a program for providing this equipment. On the output side, it is clear that I am to provide five digital-data transmitters with the logic necessary to drive them from the output-storage element. Sufficient information has been obtained to write a firm schedule for this part of the work during the next biweekly period.

The input equipment, digital-data receivers, has not been pinned down yet. As soon as the number of miscellaneous radar inputs is known I shall proceed to draw up a schedule. It is hoped that this can also be done during the coming biweekly period.

XD-1 Testing

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

A time schedule of the XD-1 testing effort has been written. At present the schedule is little more than a list of areas in which work has to be done, with timing based only on data from IEM delivery schedules.

An estimate of the number and types of people required to operate the XD-1 system from a maintenance point of view has been prepared for the Personnel Office, and this has been approved as a basis for

## 2.11 Systems (Continued)

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

obtaining the help required. Job descriptions have also been prepared to aid in this.

It appears that maintenance space will be at a premium in Bldg. F. There are only two small maintenance rooms in the building. These rooms will not accommodate all of the people, benches, parts, and test gear. We will have to put some functions in unused spaces on the main floor and in place of spaces presently assigned to spare frames. The details on this have not been worked out at present.

From time to time it will be necessary to construct special test equipment in the shop to test XD-1 frames. The shop is now constructing special amplifiers with floating output jacks to be used in connecting standard test equipment to XD-1 frames for testing at Poughkeepsie. The shield of coax in XD-1 is usually tied to -15 volts.

## 2.12 Magnetic-Core Memories

### Memory Test Setup VI

(E. A. Guditz) (UNCLASSIFIED)

The first data have been taken on memory plane C25 which contains cores (DCL-1-180) made at this laboratory. Results show that the plane has almost as good margins as present MTC planes when operating at optimum currents for the MTC planes; the outputs are slightly lower for the DCL plane. The optimum driving currents for the DCL plane are about 100 milliamperes higher than for the MTC planes, and at these currents the margins are as good as those for the MTC plane. The cores do not seem to be as sensitive to current variation as are the MTC cores.

More data has been taken on plane C24 which has RCA cores. The complemented pairs-checkerboard pattern was checked both with and without the post-write-disturb pulse at optimum driving current. The PWD increased the margins of the pairs-checkerboard with ONE's in the corner by 30 per cent. It increased the margins of the complement of that pattern by 20 per cent.

Production drawings for the memory-frame connector were completed during this period and the first connector received from the shop. It looks very promising. If satisfactory, the plane replacement time in the array tester will be reduced by a factor of 10.

A scheme has been proposed for constructing memory planes using printed-circuit techniques. Some of the assembly problems are quite difficult, however, and would require special tooling. The study is being continued as a spare-time project.

## 2.12 Magnetic-Core Memories (Continued)

### Two-Core-Per-Bit Investigation

(J. Raffel) (UNCLASSIFIED)

Experimental work on the two-core-per-bit memory during this biweekly period indicates that information is destroyed when the cores are disturbed in an unfavorable way by the combined excitations provided by a partially-selected switch core (during the write) and the digit-plane current. There are two apparent solutions to this difficulty, both of which would probably also eliminate some of the most desirable features of this type of memory:

1. Resistance could be inserted in the switch core secondary, thus reducing partially-selected switch-core outputs.
2. If 2:1 selection is used instead of 3:1 there will be no digit-plane current tending to destroy information.

### Sensing-Amplifier Design

(S. Fine) (UNCLASSIFIED)

Two models of a transformer-input sensing amplifier have been constructed. One uses a triode as its first vacuum-tube stage, while the other has a 6096 pentode stage. Both models consist of a linear input transformer with 15 to 1 gain and diode rectification in the secondary. Transitron T-5 diodes have been found to give satisfactory results for rectification. Two stages of pulse amplification and a cathode follower complete the circuit. Further improvement of both models is continuing with emphasis on the pentode version. Results thus far are promising.

### MTC 64 x 64 Memory

(W. J. Canty, J. L. Mitchell) (UNCLASSIFIED)

A series of "shmoo" plots has been taken to determine the usefulness (or uselessness) of the post-write-disturb pulse. Preliminary data indicates that the post-write-disturb pulse serves no useful purpose in the MTC memory when it is operated with normal X and Y driving currents and at a 7.5- $\mu$ sec memory cycle. When the length of the memory cycle is decreased to approximately 5  $\mu$ sec, however, use of the post-write-disturb pulse with MP60 (the checkerboard-bootstrap program) is detrimental to operating margins. It is felt that this effect is caused by an inability of the sense amplifiers to completely recover from the large post-write-disturb noise pulse before the next bit of information is read out from the memory.



## 2.12 Magnetic-Core Memories (Continued)

### Marginal Checking the Selection-Plane Drivers

(J. L. Mitchell, W. Canty) (UNCLASSIFIED)

The XD-1 marginal-checking system for the selection-plane drivers was tested in MTC. We were able to find a 50%-down 5998 by lowering the B+ to the 5998 when the bias on the sense amplifier was not set near the failure point. When the bias was set to its normal position the margins did not change when bad tubes were plugged in. A 6072 was substituted for a 5965 in the matrix output amplifier, and the margins on the B+ to the driver again changed only when the sense bias was set near the failure point. This means the sense bias will probably have to be set near one of its failure points during marginal checking.

### 64-Position Core Switch

(A. D. Hughes) (UNCLASSIFIED)

When a magnetic core is driven from remanence into saturation, some flux is changed. Calculations and recent experiments show the back voltage, because of this changing flux, to be several times greater than originally anticipated. A higher back voltage means a worse driver problem and has given rise to some reconsideration of the design of the 64-position switch as a unit.

Magnetics Inc. delivered 195 metal cores, 128 of which will be selected for two 64-position switches.

## 2.13 Vacuum-Tube Circuits

### Magnetic Drum

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

The diode switch was approved at a joint IEM-MIT meeting held here 8 April for inclusion in XD-1. Rough drafts of MRD reports on the circuits involved are being prepared, and marginal-checking data is being taken. Space will be made for 2 parallel diodes (with resistors) for the switch. Crago of IEM expressed a desire for IEM to take over this area of work as soon as possible. In accordance with this, we will maintain close liaison with the interested parties.

### 2.13 Vacuum-Tube Circuits (Continued)

#### Phone-Line Demodulator

(E. B. Glover, I. Aronson) (UNCLASSIFIED)

Experiments with the demodulator have disclosed unexpected difficulties when operating with certain test patterns. The troubles were promptly cleared up by incorporating modifications originated by Paul Rosen of Div. 2. One source of errors was eliminated by changing the specifications to require that the data box immediately preceding the reference pulse be left vacant. The other discrepancy, variation of reference-pulse amplitude with a variation in test pattern, was eliminated by minor circuit changes. It is felt that the reliability of the demodulator has been boosted considerably by these changes.

We are now concentrating our efforts on devising a method of marginal checking but have not been successful as yet. The major problem has been in trying to vary the screen-to-cathode potential on a pentode whose screen is grounded. Since XD-1 marginal-checking system does not provide for inserting a variable voltage in series with ground, we will have to look for some other solution.

#### Universal Amplifier

(H. J. Platt) (UNCLASSIFIED)

At a meeting at Vestal Labs, it was decided that the tube line-up for the universal amplifier (UA) would be one 6072 for the input stage, two 6136's for the second stage, and two 6136's for the output stage. There will also be a 5965 for two constant-current sources in the cathode circuits of the first and second stages. In addition, there will be a 6308 for voltage reference.

Also at this meeting, the specifications for the amplifier were laid down and agreed upon. These specifications are detailed in an inter-office memo.

A new amplifier was designed and analyzed on paper. The proper networks were added to insure frequency stability. Drawings of the amplifier have been sent to the Drafting Room as a first step in the construction of some experimental models.

#### Display Generator Buffer Storage

(E. Anfenger) (UNCLASSIFIED)

A bit-driver blocking oscillator is in operation which meets input-output specs and does not exceed limitation on tube (5965) voltages

### 2.13 Vacuum-Tube Circuits (Continued)

(E. Anfenger) (UNCLASSIFIED) (Continued)

and currents. A smaller transformer is being made to see if it operates as well. J. Schallerer has a small system set up for system check.

A word driver in same status as above consists of a blocking oscillator similar to above driving at 6293 from cutoff to bottoming. Output variation is about 5 per cent from no load to full load.

The read-out driver is to be the same as the word driver. Parameters are to be changed to deliver 150 volts at 1-amp pulse for 1 microsecond. A transformer is being made.

#### Pulse Transformers

(E. Gates) (UNCLASSIFIED)

I have been working with E. Anfenger on the design of blocking oscillator and output transformers for use in magnetic-core buffer-storage circuitry.

The rest of the time has been spent studying the MTC and XD-1 memory circuitry for work with the Systems Group.

#### Magnetic-Core-Matrix Switch Driver

(D. Shansky) (UNCLASSIFIED)

An investigation of a driver which used current feedback from a tertiary winding of the magnetic-core-matrix switch has indicated that this scheme offered no great advantages over the simpler scheme of shaping the required current pulse -- namely the original core in the driver-tube cathode. Therefore the tertiary winding idea has been abandoned. The output stage of the driver has been redesigned to handle the back-voltage load presented by the switch. Initial current rise times are now too slow because of the added capacitance; therefore, the capacitance driving cathode follower in the driver is being redesigned.

#### Thesis

(S. Bradspies) (UNCLASSIFIED)

A thesis proposal, "A Magnetic-Core Memory with External Selection" (M-2762), has been issued.

Work has been done in building equipment necessary for the thesis investigation and in finding suitable magnetic cores for use.

## 2.14 Memory Test Computer

### General

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

Implementation of test schedules for the immediate and less immediate future has continued: hardware is assembled for the digital-expansion test and should be completely checked out by 12 April; a substantially complete list of equipment for testing vector generator, prototype Charactron, and display console has been agreed on. Installation of the latter is planned to take place after the move to Lexington but can be temporarily rigged before then if the MTC move should be delayed. It is felt that MTC will be shut down no earlier than 17 May and moved no earlier than 1 June. If the move is this early, the computer should be back on the air about 15 July.

The logic of the new instructions mentioned in the 26 March bi-weekly has been laid out and by the week of 12 April should be incorporated into specific physical units.

A slight control change, enabling the memory-read to be initiated earlier and compensate for delay in selection-plane-driver circuits, has shaved the memory cycle to under  $5\frac{1}{2}$  microseconds and gives MTC a speed, with "add" type instructions, of 91,500 instructions (183,000 memory cycles) per second.

### Digital-Expansion Test Program

(P. R. Bagley) (UNCLASSIFIED)

A program (DP-75) has been prepared, at Corderman's request, to be used in testing the digital-expansion equipment in connection with the Charactron.

### MTC Control Block Diagram and Block Schematics

(P. R. Bagley) (UNCLASSIFIED)

A revised drawing of the MTC Control Block Schematic (Dwg. SE-53580-6) has been prepared by Hosier. The corresponding block diagram, including all planned modifications, has been drawn by Bagley.

### MTC Basic-Conversion Program

(P. R. Bagley) (UNCLASSIFIED)

Several more errors in the MTC basic conversion program have been brought to light and are in the process of being corrected.

2.14 Memory Test Computer (Continued)

Drum

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

Another timing track has been written on the drum. A small amount of debugging remains before the drum can be used for programs again. It is still in breadboard form; however, the final equipment is beginning to come in, and it is hoped that all of it will be available by 1 May. The goal is to have this equipment operating before the move to Lexington.

Moving Preparation for MTC

(J. D. Crane) (UNCLASSIFIED)

In order to expedite the installation of MTC at its new location, new panels, cables, and associated hardware are being built and should be completed before 17 May 1954.

An estimate of the work load to be encountered in moving the A-frame, console, and marginal-checking portions of MTC has been made. Also, interwiring drawings for the A-frame and marginal-checking units are in sketch form.

MTC Power-Supply Control

(D. Fisher) (UNCLASSIFIED)

The block diagram for the new power-supply-control system has been completed, and work has begun on designing the individual units connected with the system.

All circuit prints of the power supply are now in Drafting being brought up to date.

Drawings and Records

(L. Sutro, B. Kollet) (UNCLASSIFIED)

Thirty-five drawings have been requested of Drafting since November when we started our effort to have MTC completely represented by drawings. A request for approximately twelve more will be made when Drafting completes the first thirty-five. Then they will be asked to re-draw the many sketches in the MTC file.

#### 2.14 Memory Test Computer (Continued)

(L. Sutro, B. Kollet) (UNCLASSIFIED) (Continued)

During the week of 12 April, information from the MTC log will be copied out daily for use in Biweekly Reports and record cards. To make this possible, the technicians have been briefed on what data is wanted in the log, and the Records Office has prepared a form to hold all the information that needs to be taken out each day.

#### 2.15 System Liaison

(A. P. Kromer) (UNCLASSIFIED)

Work in connection with preparation of AFRC Exhibit 17, which will cover the Duplex AN/FSQ-7 Central, is continuing so as to provide an initial draft of this Exhibit to be circulated for comments and modification on approximately 1 May.

Work with the Bell Telephone Laboratories, Western Electric Company, and ADES organization has included discussions regarding siting for the initial centrals (after XD-1 and 2); review and extension of the details for programming FY56 budget funds; and further development of the proposed design and layout of the building for the duplex central.

(J. D. Bassett) (UNCLASSIFIED)

Most of the detail work for the move to Lexington has been completed in Group 62. Final drawings and data should be on file by 15 April in the office of the Division moving co-ordinator.

IBM has requested a circuit-printing facility to be set up at the temporary Kingston production plant, with the intention of producing about half of the pluggable-unit cards themselves. Mr. Vermilyea, Project High tooling manager, and I are going to visit the circuit-etching facility of the Formica Company during the next biweekly period to find out if they can handle any or all of the portion to be "farmed out." This section is planning to assist Irv Aronson in the problem of packaging the digital-data transmission and demodulating equipment to be built for XD-1.

#### 2.16 Transistors

##### Transistor Evaluation

(D. J. Eckl) (UNCLASSIFIED)

We have received and tested 20 each of Transistor Products 2F and 2C point-contact transistors. The characteristics of these transistors

## 2.16 Transistors (Continued)

(D. J. Eckl) (UNCLASSIFIED) (Continued)

in general look good, but the rise times and storage coefficients are somewhat disappointing. A memorandum will be published listing the distribution curves.

E. Dillaby of Group 35 has agreed to mount 25 bead-type 1760 point-contact transistors from Western Electric in standard headers so we will be able to handle them more easily. He found the  $\alpha$ -cutoff of the first one to be above 50 megacycles. These transistors should work well in nonsaturating flip-flops if we can keep them from oscillating. They probably have poor storage coefficients.

The information on 300 RCA transistors which we have tested has been sent to RCA. We are expecting a visit from them towards the end of April to discuss future developments.

### Diode Construction

(N. T. Jones) (UNCLASSIFIED)

A micromanipulator jig for making and measuring diodes has been 90 per cent completed. The micromanipulator has been shock mounted to minimize mechanical vibrations.

An order has been placed for Wollaston and bare drawn gold wire for use as whiskers.

### Diode Storage

(N. T. Jones) (UNCLASSIFIED)

Work has been done on the illustrations for memoranda, and ultimately a thesis, on storage in various types of diodes.

### Transistor Storage

(N. T. Jones) (UNCLASSIFIED)

Storage coefficients for all types of transistors that this Group has measured have been averaged and summarized. This summary is going to be included in a memorandum by S. Schwarz of Group 35. This memo is intended to summarize the general characteristics of all currently available transistors.

2.16 Transistors (Continued)Transistor Magnetic-Core Drivers

(S. Oken) (UNCLASSIFIED)

The design of a matrix switch to select an address in a coincident-current type of memory was undertaken. The study revealed that, because of the low impedance level into which the matrix must work, the d-c power rating of the transistors in the selecting flip-flops should be higher than that obtainable in present transistors.

The design of a four-position magnetic-type (Olsen) matrix switch was therefore undertaken since it need only supply a pulse of high power. The cores used were  $\frac{1}{4}$ -mil,  $1/8" \times 1/8"$ , 10-wrap Mo-Permalloy (20-turn primaries, 40-turn secondaries). A driver was built which approximates a voltage source and can supply 50 milliamperes with a rise time of about 1 microsecond. When two of the above cores were switched continuously with two drivers the output voltage from each core working into a 1K resistive load was 5.7 volts in amplitude and 3 microseconds in width. The theoretical output should be a 10-v pulse of 0.5- $\mu$ sec duration. The discrepancy between the actual and calculated output can be attributed to the driver approximating a voltage source rather than a current source. Since the drivers work off the flip-flops in the switch, they will never be required to switch cores. The main requirement on these drivers is to be able to supply the bias with a medium rise time. The rise time is only important in that long rise time would limit the maximum speed of the switch.

Another driver is being developed which will supply 50 milliamperes and approximate a current source. The transistor in the output stage of this driver is rated at 500 milliwatts. This driver will be required to switch a core in the matrix switch.

Transistor Gates

(C. Kirk) (UNCLASSIFIED)

An experimental breadboard of a transistor eight-line pulse distributor has been completed. Some debugging will be necessary and will probably be done during the next biweekly period.

A meeting was held with Bob Rediker of Group 35 and Don Eckl of this Group with the result that Bob Rediker agreed to make one alloy junction-transistor tetrode for testing in an experimental gate circuit.

A survey of possible transistor gate circuits is fairly well completed. During the next biweekly period a test program to evaluate these circuits will be initiated.



~~CONFIDENTIAL~~  
UNCLASSIFIED2.16 Transistors (Continued)Angular Position Counter

(E. U. Cohler) (UNCLASSIFIED)

The wiring has been completed on the test setup for the APC, and the final changing and polishing of the circuitry is being accomplished at present. There have been no major difficulties to date.

Flip-Flops

(E. U. Cohler) (UNCLASSIFIED)

Some more work is being done on the mathematical analysis of the point-contact flip-flop. This is the same job that I gave up some time ago because of its inherent complexity. However, with more experience it seems that some more simplifying assumptions are justified and may permit some solution. The chief added assumption is that the speed of the transistors is infinite in the active state, and it does seem that the rise and fall times are not what limit the maximum frequency of the saturating type of flip-flop.

The new transformer-coupled flip-flop which I described some time ago has also been tried with junction transistors at Lincoln (by Dick Baker) with evident excellent results.

Gates

(E. U. Cohler) (UNCLASSIFIED)

The use of the new nonregenerative gate with the single-transistor current flip-flops opens some interesting possibilities. The new gate acts as an amplifier and thus does not suffer from hole-storage problems. Moreover, the level input is isolated from the pulse input and is direct coupled. Thus the gate does not suffer from prf problems. Finally it presents very little load to the flip-flop so that many may be attached to one flip-flop. This leads to the interesting thought that perhaps a complementary gate may be developed so that when both types are connected to the same collector (as with a single-transistor flip-flop) one can obtain both 0 and 1 gates. This is being investigated.

2.17 Display

(C. Corderman) (CONFIDENTIAL)

A meeting was held 30 March at the IBM Vestal Lab to write operating specifications for the analogue equipment within a display console.

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2.17 Display (Continued)

(C. Corderman) (CONFIDENTIAL) (Continued)

Preliminary estimates of voltage levels and controls for Charactron and Typetron tubes were made.

A proposal to eliminate the situation-display selection frame, and return display selection to the consoles, is under consideration. The logical compatibilities of centralized vs. remote selection with the Duplex Central will be examined in a meeting on 12 April, and a choice between the two systems will be made on 13 April.

The equipment necessary to check the digital-expansion system proposed for XD-1 has been assembled. Tests will be in progress during the week of 12 April.

I plan to spend one day each at Convair and Hughes Aircraft Co. during the week of 12 April. Discussions will be held concerning the present status of Charactron and Typetron tubes with regard to the changes we have requested in these tubes for XD-1 use.

Core Schemes for Display Generator Unit and Display Selection Unit

(B. Gurley, J. W. Schallerer) (UNCLASSIFIED)

It has been decided to abandon the core scheme for the display-selection unit in XD-1. However, a memo is being written as a possible basis for future work.

A memo is also being written on the core proposal for the display-generator-unit buffer storage. A four-bit, two-word model has been constructed. Tests on this model have not been made as yet.

(R. H. Gerhardt) (CONFIDENTIAL)

The memo on the digital expansion and off-centering circuits proposed for XD-1, "Logical Description of Digital Expansion and Off-centering for the XD-1 Situation Display," has been completed and should be issued during the next biweekly period.

Work has continued on the timing and control for the XD-1 situation-display system. The block diagram should be completed within 2 weeks.

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2.17 Display (Continued)

(B. R. Remis) (UNCLASSIFIED)

Work has been started on the pluggable unit layout of the digital-information-display frame.

(M. Epstein) (CONFIDENTIAL)

An up-to-date set of DID logic diagrams was finished. A meeting was held with IEM at which they were told about necessary changes in the pulses reaching us. All the DID logic is now rather firm except for the number of separate erase lines. Further changes in DID logic will probably mean advancing the DID frame completion date.

Basil Remis and I have started working on the problems of putting the DID into pluggable units.

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

A trip was made to Vestal Lab to discuss the universal amplifier. A new tube lineup for this amplifier was chosen to get a better gain-bandwidth product. The new lineup consists of a 6072 for the low noise input stage, four 6136's for the second stage and the output stage, one 5965 for a constant-current source for the first two stages, and one 6308 for voltage regulators. Herb Platt has completed a preliminary design using this lineup.

The drawings for the vector generator for Charactron have been completed and are being checked. The drawings on the line driver have been completed and checked.

The  $2^{10}$  decoder for the Charactron console has been completed and is ready to be cabled to the digital-expansion system.

The remainder of the digital-expansion system is well on the way to completion and should be operating the early part of the week of 12 April.

Some thought has been given to marginal checking of the d-c amplifier in Charactron. Woolf went to Poughkeepsie to get further information on recent thoughts there.

(R. Fallows) (UNCLASSIFIED)

Effort has been concentrated on the basic logic of the central display frames in order to finalize the general design and permit drawing of element block diagrams and preliminary frame layouts. Evaluation of

2.17 Display (Continued)

(R. Fallows) (UNCLASSIFIED) (Continued)

the various approaches to situation-display selection has resulted in the cessation of work on core-selection circuits -- this decision was based on a tube count comparable to diode selection plus considerable circuit development.

Work on block schematics has not advanced to the pluggable-unit packaging stage pending receipt of pluggable-unit block schematics from IBM. A review of basic circuit and tube counts for the display frames has been made. Rough frame layouts and power estimates are in process.

2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

Tests on the completed 64 x 64 memory plane indicate satisfactory performance. This is the first memory plane to employ cores made at MIT.

A sample of General Ceramics memory-core production which includes a small random sample from each production lot is being used to assist in a re-examination of the specifications for the memory core. Some simplification is expected. Both quality and quantity of production at General Ceramics have been good and stable since the first of the year. Continued stability will permit gradual improvement of yield and adequate production rates for future requirements.

Evaluation of General Ceramics Memory Cores

(E. J. Stevens) (UNCLASSIFIED)

Sample testing of General Ceramics lots M-14, L-72, M-90 for evaluation of present and future core-testing specifications is being carried out. Under present specifications a number of cores from lot M-14 (low-grouping lot) were rejected on the 740-ma test after having first passed the 820-ma test. These cores were rejected on the basis of having an output lower than the present spec of 75 millivolts. If a lower limit of 70 millivolts were to be used, the acceptance figure would be raised by 15-20 percent. In reality the figure of 70 mv at 740 ma for  $V_1$  coincides better with the 100 mv at 820 ma and 130 mv at 900 ma for lower-limit core acceptance.

Life Tests

(J. D. Childress) (UNCLASSIFIED)

The life-test equipment is again in operation with tests on ferrite and metallic cores being continued.

Additional tests on General Ceramics, RCA, and DDL cores will be initiated.

Temperature-Cycling Effects

(J. D. Childress and P. Fergus) (UNCLASSIFIED)

A study is being made of the effect on core pulse response of subjecting the cores to elevated temperatures for periods of time.

2.2 Group 63 (continued)Magnetic Anneal

(P. K. Baltzer) (UNCLASSIFIED)

An experiment concerning the effect of a magnetic anneal on a compositional series of ferrites in the  $MgO.MnO.Fe_2O_3$  triaxial diagram has been completed. A preliminary correlation can be made from the raw data. In general the application of a magnetic field while cooling slowly from above the Curie point to room temperature had no effect. A significant improvement in the squareness of unfired ferrites was found due to the slow cool from a temperature of only 500 C without a magnetic field applied. The fired ferrites were essentially not changed by the experiment.

S<sub>w</sub> Measurements

(N. Menyuk) (UNCLASSIFIED)

Switching-coefficient measurements have been taken of 4-79 mo-Permalloy cores of 1/8-mil, 1/4-mil, 1/2-mil, and 1-mil thickness at seven temperatures ranging from -196 C to 270 C. The eddy-current contribution to  $S_w$  is proportional to the square of the thickness as predicted. The eddy-current effect changes by a factor greater than 2 over the temperature range considered, while the relaxation effect varies by less than 20 percent. Both the eddy-current and relaxation effects decrease with increasing temperature as expected. No anomalous effects occur over the range. The data are now being correlated quantitatively with theoretical considerations.

The Switching Time and Core Fabrication

(J. B. Goodenough) (UNCLASSIFIED)

It has been shown that if the theory of nucleation of domains of reverse magnetization is valid, then of the three methods of obtaining square B-H loops, viz. (1) grain orientation and/or magnetic anneal, (2) application of tensile or compressive stress, and (3) variation of  $\sigma/I^2$  by a variation of the chemistry, the first will permit the lowest value of  $S_w/(H_m - H_c) = \tau$  for any given  $H_m$ . The metal tapes are made square by method (1); the ferrites are made square by methods (2) or (3).

Memory-Core Production

(F. S. Maddocks, J. J. Sacco, R. A. Maglio) (UNCLASSIFIED)

From a 1-kg batch of memory core material, 105,000 F-394 cores have been pressed. Several preliminary firings have been made and seem to indicate that this material may have a slightly longer switching time than batch DCL-1-180. Other electrical properties are comparable, but on

2.2 Group 63 (continued)

Memory-Core Production (continued)

the basis of the plane test results of batch DCL-1-180 it has been decided to fire the latest cores at a higher temperature in order to increase the outputs. It is expected that this increase in the firing cycle will result in cores more comparable to those being supplied by outside contractors.

SECTION III - CENTRAL SERVICES

3.1 Purchasing & Stock

(H. B. Morley) (UNCLASSIFIED)

Since 1 March this department has been operating with a smaller work force. In spite of the fact that two buyers and two clerks have been eliminated, approximately 20 per cent more orders were placed in March than in the preceding month. This represents a considerable work overload --although it is expected that situation will be eased by the move to Lexington.

Approval for the Colton Press has been received and the order has been placed.

The germanium-diode shortage is still with us, but the situation is expected to improve shortly.

An inventory of all standard electronic components is now in progress.

Personnel are again reminded that all Petty Cash Vouchers should be approved by the Group Leader. Also, all borrowed catalogs should be returned to this office as soon as possible.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 34 Construction Requisitions totaling 325 items satisfied since 26 March 1954, and there are 29 Construction Requisitions totaling 1747 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 5 orders now open with vendors totaling 116 items. Deliveries in the past biweekly period have totaled 123 items. Information on specific orders may be obtained from the writer (ext. 3492).



3.3 Component Analysis and Standards

3.31 Components

(R. Jahn) (UNCLASSIFIED)

D-c distribution layouts in Buildings B and D are almost complete.

An extension box has been designed for locations which are more than 12 feet from a breaker box.

3.34 Vacuum Tubes

(H. B. Frost) (UNCLASSIFIED)

A life test of special 5687 tubes has completed 1000 hours. These tubes contain cathodes based on A31 alloy, which contains tungsten as a strengthening and activating agent. In most respects, these tubes are much more stable than the usual 5687's. However, there is a considerable amount of grid emission. Checks have not yet been made for interface impedance, but previous tests with this alloy show no interface impedance.

I have reviewed the results obtained by A. Zacharias in his examination of the old 7AK7 tubes. This work appears to be ready for writeup.

Samples of a new rectifier, the 5AW4 (Hytron), have been obtained for experimentation. This tube is similar to the 5U4G, but it has a higher cathode power, a lower tube drop, and higher peak and average current ratings than the 5U4G.

Liaison work has continued between MIT, IBM, and the tube companies participating in development programs for the XD-1. Negotiations have started between Tung-Sol and IBM concerning the improvement of the 5998.

Thesis Research

During this past period a series of tests have been run on RT414. These tests were primarily made to determine accurately the amount of increase in cathode-coating resistance as current flows through the cathode. Reduction of cathode temperature, caused by the removal of energy by emitted electrons, was found to be a major perturbing effect. Control of cathode temperature by adjustment of heater power was possible on a steady-state basis; this control allows the determination of the total change in coating conductivity with current flow. However, sufficiently accurate control could not be maintained during transients.

3.34 Vacuum Tubes (Continued)

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

Accurate measurements were also made of the diffusion constant for donor centers. The value seems to be about  $1.5 \times 10^{-6}$  cm<sup>2</sup>/sec at 850 K.

(S. Twicken) (UNCLASSIFIED)

A life test of 5687 engineering samples with A31 cathaloy cathodes has reached 1000 hours, one side conducting and the other cut off. The difference in plate current between on and off side is quite small in these tungsten-nickel alloy cathodes in comparison with previous life tests on commercial tubes of this type. Some grid emission has begun to develop. The life test is continuing.

Cutoff distribution curves have been taken on the 5998 for comparison with the proposed specification and for circuit-design work.

A trip was made to the GE plant to check on progress of samples subsequent to mutual agreement on desired characteristics. Five lots of samples had been made, and sufficient data should be available prior to the next general meeting for most spec limits to be set.

Several days were spent with the Tube Group at High Street. An H-note will shortly be published with a plate characteristic family of the Z-2177. A meeting was held with Tung-Sol on the improvement of the 5998. Tung-Sol will submit a detailed proposal in two weeks. Requirements for a 16-inch CRT and phototubes were discussed and plans made for a follow-up with Du Mont.

(T. F. Clough) (UNCLASSIFIED)

Arrangements have been made with Corning Glass Works for shipment of several special 19-inch color-type glass envelopes for Group 65's work on Charactrons.

(A. Zacharias) (UNCLASSIFIED)

Further analysis was made on the 7AK7 data. In addition, 9 rejects from WWI were added to the tubes already tested. These tubes had hours ranging from 7000 to 25,000.

Drawings were made for the rotating tapper sockets for the Mod. III console tube tester and were given to Production Control. Delivery is expected early next week.

3.4 Test Equipment

Test Equipment Committee

(L. L. Sutro) (UNCLASSIFIED)

The Committee has approved for construction as standard test equipment a rack d-c control panel which contains a switch for all d-c voltages and a fuse for each. The panel can be used where the interlock of a Burroughs rack power control is not needed. The Committee has dropped from its list of standard test equipment the following:

Register Panel (A-C Coupled)  
Restorer Pulse Generator  
Sweep Calibrator

Test Equipment Headquarters

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

A summary of the week's work follows:

	<u>Check Only</u>	<u>Repair &amp; Check</u>
Plug-In Test Equipment	17	9
Standard Test Equipment	7	6
Oscilloscopes	2	11
Indicating Instruments	--	12
Other Commercial Equipment	3	--
Total	<u>29</u>	<u>38</u>

The work of the previous week was approximately the same. In addition, extensive data has been taken on three new high-speed flip-flop plug-in units to aid Hal Boyd in comparing new production against old.

3.5 Drafting

Display Frames for XD-1 Drawings

(A. M. Falcione) (UNCLASSIFIED)

Many engineers are now working on the planning stages for card drawings and pluggable units to be used in the display frames for XD-1. A definite procedure has been established by IBM with regard to the number and type of drawings which are to be made, in order to agree with their manufacturing procedures. The details of the drawing procedures will be issued as a memorandum within the next two weeks. If any engineers have questions regarding drawings for this system, it is suggested that they contact the writer so that they may receive a briefing on the procedures required. The necessary form drawings for the system are now available.

3.5 Drafting (Continued)

Thesis Drawings

(A. M. Falcione) (UNCLASSIFIED)

All drawings for theses to be submitted this term must be completed by Drafting on 7 May 1954 in order to have sufficient time for the necessary processing required for Multilith reproduction. Engineers should submit their thesis drawings to Drafting as soon as completed; they will be handled on a first-come, first-serve basis. There are 12 candidates this term.

3.6 Administration and Personnel

New Staff

(J. C. Proctor) (UNCLASSIFIED)

Solomon Manber is working as a DDL staff member and has been assigned to Group 61. Mr. Manber received his BS from MIT and until recently was a Lieutenant in the Navy.

Staff Transfer

(J. C. Proctor) (UNCLASSIFIED)

Phillip Morrill has transferred from Division 3 of Lincoln to Group 60 of Division 6.

Staff Terminations

(J. C. Proctor) (UNCLASSIFIED)

Milton I. Brand  
Jack S. Gillette

Non-Staff Terminations

(R. A. Osborne) (UNCLASSIFIED)

Donald Bowman  
Gloria Clark  
Robert McClellan  
Marian Oken

3.6 Administration and Personnel (Continued)

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

- 1 Electrical Detailer
- 6 Jr. Electronic Technicians for Group 62 (MTC)
- 1 Secretary for Group 60
- 2 Secretaries for Group 61
- 1 Secretary for Group 62