Memorandum M-2795

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

SUBJECT: BIWEEKLY REPORT FOR APRIL 23, 1954

To: Jay W. Forrester

From: Division 6 Staff

CONTENTS

SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

Memos describing the results of the operation of the Identification, Antiaircraft, Height Finding, and Interception Sections of the 1953 Cape Cod System have been written and are being reviewed.

Memos discussing the track-while-scan stations and operations are being written. Those covering Track Monitors, Radar Mappers, Radar Mapping Supervisor, correlation program, and calibration of the Cape Cod System have been written and are being revised.

Detailed analyses of each Cape Cod test are now available in inter-office memo form. A formal memo on results will be issued about every two months.

It has been decided to have a version of the 1954 Cape Cod Weapons Direction program with which automatic target and battery evaluation and other weapon assignment programs may be tested.

A series of meetings of weapons direction and track-while-scan personnel has been begun to discuss problems of mutual interest.

1.10 General (Continued)

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

The Bell Laboratories proposal for a test program for the Cape Cod System was discussed in a two-day meeting with BTL representatives.

Recent meetings indicate that ECM (Electronic Countermeasures) capability for the 1960 era will be far below anything which could be expected to cause serious trouble to the Transition System.

1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

During the last biweekly period, several meetings have been attended on various aspects of our work. One meeting was with the people working on AN/FSQ-7; discussion centered on equipment switching between computers and preventive maintenance of computer terminal equipment (especially scope consoles). It was tentatively proposed that maintenance of scope consoles should be done on the operating machine and that all scopes should be switched as a single unit to the standby machine.

A second meeting, covering two days, was with Bell Laboratories personnel; discussion centered on the Bell Laboratories proposal for a test program for the Cape Cod System. In regard to data screening, the tests covered: analysis of radar data; comparison of machine with operator at radar set as regards track accuracy, track continuity, and initiation; accuracy of mapping function; load saturation of the various parts of the Cape Cod System. Agreement was reached on what the various tests should involve, but there is still the problem of obtaining the necessary manpower to program the computer, run the tests, and evaluate the results.

A meeting was also held with the Weapons Direction Section of Group 61 to discuss problems of mutual interest to the WD and the TWS programmers. Display scale size interceptor initiation, interceptor tracking, use of cross-telling and early-warning reports, hostile-aircraft tracking, and detection of raid splits were all discussed. Additional meetings are being scheduled to cover several other points of interest. H. Benington and J. Ishihara are responsible for writing up the minutes of these meetings.

Memos covering the Track Monitors, Radar Mappers, Radar Mapping Supervisor, correlation program, and calibration of the Cape Cod System have been written by various members of the TWS Section and are in the process of being revised. These memos should be issued in the near future. Memos on the Track Initiators, Tracking Officer, Combat Data Director, and a general discussion of TWS are in the process of being written.

1.12 Data Screening (Continued)

(H. Frachtman) (CONFIDENTIAL)

The TWS statistical-analysis program has been completely revised and should be of much greater utility.

(F. Heart) (CONFIDENTIAL)

Consideration is being given to various modifications and additions to track-while-scan techniques and their interrelation to weapons direction.

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

(J. Levenson) (CONFIDENTIAL)

A training manual is being written for Air Force personnel in the TWS Section which gives general information about the Direction Center, the functions of track-while-scan, and the use of the equipment. It is designed as an introduction to operation in TWS for men at all positions. The manual for the Track Initiator station is being revised.

Tracking information for each of the missions is being saved on magnetic tape. Within several weeks statistical analysis of this information will begin.

(H. Peterson) (CONFIDENTIAL)

The past two weeks have been spent in conferences on the 1954 System, mostly with Ishihara and Bailey.

(E.W. Wolf) (CONFIDENTIAL)

The calibration programs are now operating through the buffer drum. This improves the operating procedure when the gap-filler radars give multiple returns from the target aircraft but has the disadvantage that data do not reach the computer in the exact time sequence in which they are received from the radar site.

(W. Wolf) (CONFIDENTIAL)

During the past biweekly period some time was spent with other members of TWS discussing proposals for the 1954 Cape Cod System.

1.12 Data Screening (Continued)

(W. Wolf) (CONFIDENTIAL) (Continued)

A group of IBM personnel was guided about the present Cape Cod System installation as part of an informal (Thursday) tour.

The Radar Mappers' and Mapping Supervisor's Manuals are being put in final form.

Pictures of raw radar data and the associated maps are being taken in the Radar Mapping Room.

1.13 Tracking and Control

(J. Arnow) (CONFIDENTIAL)

A meeting of the ECM (Electronic Countermeasures) committee was attended on 12 April. The purpose of the committee and a program for future ECM work were discussed.

Dr. Skolnik of Sylvania was here on 20 April and discussed various forms of ECM for the 1960 era. In brief, the ECM capability for that period appears to be far below anything that could be expected to cause grave trouble to the Transition System.

A beginning has been made towards outlining the programming for simulation of the manned interceptions.

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

All Raydist data has been converted and is being plotted against the radar track. While good correlation was found, there was an error in one direction. Upon checking, it was learned that the radar was off one unit in azimuth during this period. With this correction, correlation is excellent.

(A. Mathiasen) (CONFIDENTIAL)

The tracking-analysis program has finally been checked through the tracking stage. Errors still remain in the error computation, however. There is also an error in a noise-generation section which is partly caused by a faulty random-number generator.

The first half of the program which analyzes the tracking errors in the above program has been written but cannot be checked out to any large extent until the above program is completely operative.

(H. D. Neumann)

See M-2796 (SECRET).

1.14 Weapons Direction Section

(D.R. Israel) (CONFIDENTIAL)

Four memos describing the results of the operation of the Identification, Antiaircraft, Height Finding, and Interception Sections of the 1953 Cape Cod System between 1 October 1953 and 1 March 1954 have been completed and are now being reviewed by C.R. Wieser pending publication.

The rough draft of M-2785, "Flight Test Program for the Cape Cod System," (D.R. Israel, C.A. Zraket) has been reviewed, corrected, and lengthened considerably during the past biweekly period. It is now being typed for distribution.

On 22 April, the results of recent raid-size tests were discussed with Cahill, Favret, Grandy and representatives of Groups 22, 23, and 24. A program of future tests was outlined at this meeting and will be described in detail in a forthcoming memo by Cahill, Favret, and Grandy. In general the effort will be concentrated on the combined use and comparison of PPI, A-scan, and RHI displays at S. Truro.

With the completion of the work of the memos described above, the major effort of the Section is now concentrated on the preparations for the 1954 Cape Cod System. Of major importance is the preparation of final and detailed plans for the installation, location, and wiring of the intervention switches. It is hoped that this work can be completed by 30 April. Another item to come under immediate consideration will be that of displays and the intercomm system.

Discussions of the past week have led to revisions in the plans for the ID section of the 1954 Cape Cod System and to the preparation of a list of basic items to be included in the 1954 program or deferred for future action. These items will be issued in the form of an M-note by Benington, Garth, and Hauser.

The first of the series of joint meetings between the Weapons Direction and the Track-While-Scan Sections was held on Friday, 24 April. Attending were: Attridge, Benington, Gaudette, Heart, Ishihara, Israel, Knapp and Zraket. Under discussion were a number of items affecting both Sections in the preparation of the 1954 Cape Cod System. These meetings will continue at weekly intervals; the agenda and results will be prepared in inter-office memo form by Benington and Ishihara.

A proposal for the simulation program of the 1954 Cape Cod System has been prepared by Gaudette and Knapp. This memo, M-2775, will be issued very shortly.

Another indoctrination program for Group 61 and outside visitors will begin on Monday, 26 April. The contents of this course are described in M-2726, Supplement #2.

1.14 Weapons Direction Section (Continued)

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

On Thursday, 15 April, I attended the Joint Lincoln Laboratory-Signal Corps Engineering Laboratories Quarterly Meeting. On Wednesday and Thursday, April 21 and 22, I attended meetings with Herckmans and Ennis of BTL concerning the BTL proposal for the Cape Cod test program.

An inter-office memo has been written by W. Lemnios describing a processing program for preparing expanded pictures of the results of computer-conducted interceptions. The program will be written by F. Webster.

(H. Benington) (CONFIDENTIAL)

Specifications for all WD stations of the 1954 Cape Cod System have been written and will be reviewed in detail during the next period. After this, program responsibilities and storage allocation can be started. Zraket and I have been responsible for collecting this information.

A meeting was held with the Tracking Section to discuss common problems. Such meetings will be held every Friday during the 1954 Cape Cod planning stage.

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

One AA-guidance mission was performed this period. On 15 April, six tracks were passed, four were locked on by AAA, one was dropped by TWS, and one was not locked on despite consistently good tracking by TWS. No explanation was available from AAA for this failure. The four tracks locked on were assigned by the WD, and three were splashed. The failure of AAA to engage the fourth target is likewise unexplained.

It has been definitely decided to have a version of the 1954 Cape Cod Weapons Direction programs available with which ATABE and other weapon-assignment programs may be tested. This fact removes some of the urgency of testing ATABE, so work will be deferred a few weeks so that the writer can perform more pressing duties. The program was discussed with Maj. J. DeRosa, as Liaison Officer to the Cape Cod System, and other officers of the Fifteenth Group, AAA, during this period. The program logic was explained, and the operational people agreed that the program, as designed, would function in substantially the same manner as an AA Intelligence Officer making battery assignments.

The Ft. Banks AAOC was visited on 21 April to show the center to A. Favret and to discuss past and future exercises with the different AAA officers involved in them.

A meeting was held on 22 April to discuss raid-size estimation with representatives of Groups 22, 23, and 24. This is reported on in

1.14 Weapons Direction Section (Continued)

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

an inter-office memo from the writer to C. R. Wieser, which will be distributed to interested persons.

(O.T. Conant) (CONFIDENTIAL)

List of telephone requirements have been received for all stations in the 1954 Cape Cod System. Final decisions are to be made on 28 April, and necessary orders will be sent to the telephone company immediately.

(A.G. Favret) (CONFIDENTIAL)

I have prepared a flow diagram and relative-address program as a tentative proposal for the antiaircraft portion of the 1954 Cape Cod System. This proposal includes provision for automatic selection and dropping of the tracks to be passed to the AAOC in addition to the manual functions previously performed.

I observed raid-size test on 13 April from Pigeon Hill Height Finder Station. A visit was made to AAOC (Antiaircraft Operations Center) with J. Cahill at 15th Group Headquarters, Ft. Banks, Mass., for familiarization with equipment and procedures currently in use.

I am preparing to take over from C. Grandy the duties of collecting all height-finder data in forthcoming tests.

(F.M. Garth) (CONFIDENTIAL)

Further work has been done on obtaining the principles, logical features, DID's, situation displays, and switches which will be incorporated into the identification program of the 1954 Cape Cod System. Rough drafts of these have been completed up to the input-data switches.

(C. Grandy) (CONFIDENTIAL)

Rewriting work on M-2784 , "Results of Operation of the 1953 Cape Cod System Height-Finder Section, Oct. 1953-March 1954," was completed, and this report is ready to be printed. Work on the memo was delayed to the extent that it was not issued during this biweekly period; however, it should be available in the forthcoming period. A. Favret is assuming much of the responsibility for the operation-analysis program for the Height-Finder Section and will continue the work reported in M-2784 .

1.14 Weapons Direction Section (Continued)

(C. Grandy) (CONFIDENTIAL) (Continued)

A successful raid-size discrimination test was held on 13 April. Results of this test corroborate earlier results of this special test program. This test concludes the current series of such tests; however, resumption of the test programs is scheduled in the near future. A complete report of results of the current series of tests will be made by inter-office memo during the week of 26 April.

The "Cape Cod Familiarization Program," M-2726, has been revised slightly for the program starting 26 April 1954. M-2726-2, "Cape Cod Familiarization Program: Revision 1," describes the changes and presents the revised schedules.

(W. Lemnios) (CONFIDENTIAL)

As discussed in the last Biweekly Report, the final-turn program used in the interception calculations makes use of an iterative procedure to calculate the command headings of the interceptor. This process is not always a stable one. The instability can arise from a great many sources, but by far the most important source is the one in which the interceptor is beyond the offset point and has not yet started a turn. An analysis made in the last biweekly period indicates that for each set of final-turn parameters, there exists an area which the interceptor cannot enter before reaching the offset point without making the calculations unstable. The area is quite complicated for programming; however, it has been found that 78 per cent of all unstable cases arising from this cause can be eliminated if, before the offset point is reached, the interceptor is not allowed to enter a circular area of radius 12 miles centered about the final collision point.

A proposal has been written for a program which will recreate interceptions and photograph them. This program will replace the current manual plotting of intercepts.

The analysis of the interception data from 1 October 1953 to 28 February 1954 has been completed.

(L. Murray) (CONFIDENTIAL)

A summary of the Collins G/A D/L tests is now being written. This will include the results of the tests and a proposal for the utilization of the Collins G/A D/L in the 1954 Cape Cod System.

One saturation test was conducted during the past biweekly period and was moderately successful. Two out of three interceptions were completed with the interceptions taking place within one minute of

1.14 Weapons Direction Section (Continued)

(L. Murray) (CONFIDENTIAL) (Continued)

each other. A detailed study of the print-out of the switch-analysis program is now being made. This will be summarized and combined with the evaluator's impressions of the test and issued as an inter-office memo.

(J. Nolan) (CONFIDENTIAL)

Time during the last period has been spent in work on saturation tests (see L. Murray) and in reviewing the final-turn calculations of 1953 Cape Cod. A program is being written to check the stability of these computations.

(G.Rawling) (CONFIDENTIAL)

A pictorial summary of indicator-light registers was completed and distributed giving full information on current allocation and use. The drawing of data-insertion registers, C-57686-1, was corrected and brought up to date. Wiring notices for A station were processed. New phone labels were prepared and installed.

Some time was spent in lectures on preparation as a guide of the System.

Reallocation and change of data-insertion registers for Identification and Training-and-Battle Simulation Sections were made.

(F.A. Webster) (CONFIDENTIAL)

Three days were spent at the Information Networks Symposium in New York. Work was started on a memo dealing with the testing of pseudorandom number generators with a digital computer.

(C. Zraket) (CONFIDENTIAL)

The memo on the Cape Cod flight-test program for the next two months, written with D.R. Israel and members of the Group, has been completed and will be issued this week.

The memo on the results of the Cape Cod intercept tests for the period 1 October 1953 to 1 March 1954 has been completed and is awaiting C.R. Wieser's approval.

In addition to the log and summary sheets kept by operating personnel and observers, detailed analyses of each Cape Cod test are now available in inter-office memo form. A formal memo on results will be

1.14 Weapons Direction Section (Continued)

(C. Zraket) (CONFIDENTIAL) (Continued)

issued approximately every two months.

A standard procedure for the scrambling of multiple interceptors simultaneously (i.e., about 20 seconds apart) has been set up. Such a procedure is required for intercept-saturation tests. A supplement to M-2611, "Experimental Operating Procedures for Interceptors in the 1953 Cape Cod System," (Attridge and Zraket) will be issued.

With members of this Section and the Track-While-Scan Section, detailed plans for the 1954 Cape Cod System are being formulated.

1.15 Direction Center Operations

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

Following is a brief summary of the Cape Cod Direction Center operations for the past biweekly period. Details on any of the System 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.

13 April (Tuesday) - Systems-operationstest was run as a combination height-finding and raid-size exercise and final-turn intercept measurements. The raid group of 3 target aircraft (B-29) for height work was flown in the eastern area. Three other targets were flown on separate courses to the south, clear of the raid group for intercepts. No intercepts were made - area of operation did not permit effective Mark X tracking. The raid-size assessment test was successful.

14 April (Wednesday) - One F-89 was flown for data-link (D/L) testing. One B-29 was flown for radar and height-finder calibration.

15 April (Thursday) - Systems-operations test was run with five target aircraft and six interceptors for demonstration. Bedford interceptors were D/L controlled. Five final-turn intercepts were completed satisfactorily. One intercept was unsuccessful.

16 April (Friday) - D/L and calibration testing cancelled because of weather. Computer time was used for program analysis.

20 April (Tuesday) - Scheduled systems-evaluation test cancelled because of unsatisfactory radar and computer operation (probably caused by postponement of the usual Monday maintenance).

21 April (Wednesday) - One F-89 flown for D/L testing. One aircraft used for radar and height-finder calibration.

22 April (Thursday) - Systems-operations test held with three target and six interceptor aircraft. Two final-turn intercepts were completed successfully. Systems operation delayed two hours due to unsatisfactory computer operation.

23 April (Friday) - D/L and calibration testing cancelled because of weather. Computer time was used for program analysis.

1.15 Direction Center Operations (Continued)

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

Summary of Biweekly Operations:	1st Quarter 1954	Week (13 & 14) Last Period	Week (15 & 16) This Period
System Operational Test Sorties			
Requirement	325	50	50
Scheduled	312	27	17
Flown	88	10	10
Per Cent Flown (of required)	27	20	20
System Evaluation Test Sorties			
Requirement	156	24	24
Scheduled	168	36	30
Flown	95	14	17
Per Cent Flown (of required)	61	58	71
Calibration Sorties			
Requirement	13	2	2
Scheduled	25	3	4
Flown	15	3	2
Per Cent Flown (of required)	115	150	100
Per Cent Flown (of scheduled)	60	100	50
Data-Link Sorties			
Requirement	0	0	0
Scheduled	77	12	12
Flown	25.5	6	2
Per Cent Flown (of scheduled)	33	50	17
Total Sorties			
Requirement	494	76	76
Scheduled	582	78	63
Flown	223	33	31
Per Cent Flown (of required)	45	43	40
Per Cent Flown (of scheduled)	38	42	49
Per Cent Scheduled (of required)	118	103	86

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	11.6	100	236.7	100
Unrestricted Operating Time	8.9	77	140.7	59.5
Limited Operating Time	0.4	4	59.5	25.1
Down Time	2.0	16	33.7	14.2
Recovery Time	0.3	3	2.8	1.2

Time Lost (Hours)	Down Time	Limited Operations	Down Time	Limited Operations
Computer	2.0	0.0	30.7	0.0
Room 222	0.0	0.4	2.6	49.9
Radar & Input	0.0	0.0	0.3	43.7
Misc.	0.0	0.0	0.0	25.3

No Telephone Troubles

(W. Vecchia) (CONFIDENTIAL)

Computer Operations:

Total assigned time	86 hr 15 min
Weapons Direction	4 hr 45 min
Track-While-Scan	6 hr 35 min
Combined Operations	
Weapons Direction and Track-While-Scan	13 hr 10 min
Data Screening	1 hr 05 min
Tracking and Control	18 hr 05 min
Equipment Check	1 hr 40 min
Time Given to Math Group	25 hr 15 min
Time Given to In-Out	2 hr
Time Lost to Computer (Malfunction)	10 hr 25 min
Grand Total	86 hr 15 min

1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

The ADES floor plan for the operations area of AN/FSQ-7 has been reviewed, and an inter-office memo with comments has been prepared and given to P. Bragar.

(H. Benington) (CONFIDENTIAL)

Memorandum M-2774, "Group 61 Proposal for Changes in the XD-1 DID System," was issued by Conant and myself.

Several informal meetings were held with Group 62 members on the new display specifications, indicator lights, etc.

(J.J. Cahill) (CONFIDENTIAL)

A joint Lincoln-Signal Corps Engineering Laboratories meeting, held on 15 April in Cambridge, was attended by the writer.

(C.T. Conant) (CONFIDENTIAL)

During the next period an investigation of Typotron erase-and-rewrite timing for DID's will be carried out with MTC. The program has been written by Inez Hazel. The results should permit determination of the number of erase circuits required for DID scopes in the XD-1 center.

(G. Rawling) (CONFIDENTIAL)

The second floor plans were completed with P. Bragar.

1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

Minor troubles have continued to interrupt computer operation during the past biweekly period. In many cases the malfunctions would have been quickly found had they occurred alone, but compounded by wiring errors and cold soldered joints, or being of an intermittent nature, they caused trouble incommensurate with their severity.

A parity check has been installed on the auxiliary-storage section of the buffer drum. It has revealed an unexpected number of bad transfers from groups 4-7, in the form of spurious "ones" being read into the in-out register. The source of these spurious pulses has not yet been determined.

1.21 WWI System Operation

Core Memory

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

A considerable amount of time was lost during the past biweekly period as a result of sudden tube failures. An intermittent short in a buffer amplifier in clock-pulse control which provides synchronizing pulses for the in-out system resulted in a loss of approximately 12 hours. An open filament in a cathode follower in one of the in-out matrices caused intermittent program alarms. Several hours were spent locating the source of this trouble. As a result of these failures, considerable thought is being given to improving in-out trouble-shooting techniques. Additional checking facilities may be required to improve the situation.

Some time was lost because of core-memory parity alarms caused by tap shorts in tubes in the digit-plane drivers.

Loss of power to one of the racks was traced to an unsoldered connection on an Allied plug-in relay. An investigation of 200 of these relays was made. Eight relays were found to have unsoldered connections. All the relays of this type in the system will be checked on the next installation day.

The buffer drum is now operating with a parity check.

Magnetic Tape

(A. X. Perry) (UNCLASSIFIED)

Reliability of the delayed print-out has been excellent during the last biweekly period, much of it due to the marginal-checking facilities recently installed. Some instances of reported failures were caused by programming difficulties.

1.21 WWI System Operation (Continued)

(A. X. Perry) (UNCLASSIFIED) (Continued)

All panels necessary for operating Unit 2 as a delayed printout have arrived and will be made ready to operate shortly. Unit 2 has been converted to make use of the triangular-hub type reels and is in operable condition. Some mechanical faults have been observed but are not of a serious nature. Efforts to correct these conditions are already in progress.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Two Flexos were given routine periodic inspection and overhaul, and the last new Flexowriter was modified for use with Whirlwind during the past two weeks.

Aluminum paper guides have been installed on the back of several Flexos. These guides have been affixed with banana plugs so that they can be easily removed to permit access to the tape cans.

1.22 Terminal Equipment

(R. H. Gould) (UNCLASSIFIED)

R-F bombing of the control grid has proven to be an effective method of removing the spurious emission in the 16-inch CRT's without adverse effects. All CRT's showing the spurious emission will be treated.

Circuits to provide computer control of the output-printer motor will be installed soon. Operation will be similar to the control of the photoelectric-reader motor. The proper si address will turn on the motor and insert a delay to let it attain full speed. The motor will remain on for a short while after the printer has been deselected and then turn off. This time will be determined from experience with the automatic control. The operation of the manual switch on the printer will not be affected.

Modifications to in-out control to simplify the operation of block control and the block orders will be postponed for a week because of a heavy load of modifications in the rest of the computer. They should be done in two weeks. Programs using these orders will not be affected.

CRT Filter System

(S. B. Ginsburg) (UNCLASSIFIED)

All of the preliminary work has been completed on the new system. The plug-in units have been bench tested, and the mounting panels

1.22 Terminal Equipment (Continued)

(S. B. Ginsburg) (UNCLASSIFIED) (Continued)

have been completely wired. The system will be installed in K-row of Room 156 as soon as the existing MITE's have been removed.

Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

Parity check for groups 4-7 of the buffer drum has been in operation for the past week and appears to be entirely satisfactory.

To lessen trouble-shooting difficulties when the fairly large electronic head-switching system of the auxiliary drum is put into service, a method has been worked out to permit changeover of one digit at a time. An additional advantage is that the changeover initially requires only one-half the full complement of Type 3 gate-writing amplifiers. Because of this modified requirement, changeover of digits will begin next week (26 April) instead of being held up until about 1 June as originally thought necessary.

An erasing scheme that is simple, sparing of equipment, and easy to use has been devised for the magnetic-drum systems. Preliminary tests are encouraging.

MITE

(A. M. Werlin) (UNCLASSIFIED)

All of the filter-control panels, the demodulator auxiliary panels, and most of the new buffer-drum MITE's have been completed and will soon be installed in K-row. Some of the cabling in K-row is being revised so that the present filter system will not be disabled upon the removal of the old MITE's. The calibration and strobe marks will be derived from the buffer drum MITE's in L-row. The cabling of the new MITE's in L-row is being revised so that it will be simpler and have less load than formerly.

All of the drawings pertinent to the MITE's have been brought up to date and are in the service file in Room 155. It is expected that the removal of the old MITE's and the insertion of the new panels will take place on or about 1 May.

1.22 Terminal Equipment (Continued)

Data Inputs

(H. J. Kirshner) (CONFIDENTIAL)

Tests were made on one of the two 14-track recorders and the results forwarded to Ampex. Ampex will attempt to evaluate these results for the purpose of advising us how best to improve the performance of the recorders' tape-transport mechanism.

The use of three private-line telephone circuits to North Truro has been discontinued, and one circuit from South Truro has been removed from the Cape Cod switchboard and installed at the South Truro Height Technician's station.

M-2777, "Proposed Operating Specifications of a Tactical Voice Telephone Communication System for AN/FSQ-7 (XD-1)," has been issued. Comments are solicited.

A power amplifier for the new radar-mapper scopes has been designed and is being constructed.

One of the new demodulators supplied by Group 24 has been modified, according to their instructions, for the purpose of improving automatic gain control action. A further modification, which will improve slicer performance, is anticipated.

Data Link

(R. B. Paddock) (CONFIDENTIAL)

The "32-position switch and indicator-light register" panel has been received, and a test setup is nearly complete for checking the operation of both the matrix and the register. It is expected that testing will be completed and that the panel will be put in service within the next two or three weeks.

Tape 3166-M4 has been prepared by G. A. Young so that D/L can now be checked out from the computer through to the aircraft indicators using the same packaged messages as those sent by the mechanical test-message generator. This check will be made daily.

The D/L has been operating very successfully except for the following:

A sudden increase in the output of the 28-v power supply has caused failure of the D/L monitor in Room 224. Since this convenience does not affect the D/L system operationally, it will be repaired when time permits.

1.22 Terminal Equipment (Continued)

(R. B. Paddock) (CONFIDENTIAL) (Continued)

Failure of the mechanical test-message generator to transmit the six standard messages caused some confusion on one D/L test mission until it was determined that the received messages duplicated the actual transmitted messages. The generator was readjusted; however, an investigation is in progress concerning a commercially available multiple-cam switch for improving the present generator.

Erratic insertion of occasional digits during the late afternoon seems attributable to increased ambient temperature of the coder. Until this is verified, a blower has been installed to maintain low ambient temperatures of all coder tubes and transistors.

Pathfinder

(N. Alperin) (CONFIDENTIAL)

The prototype Pathfinder mod will be completed 23 April. Since the phototube pickup and scan-synchronizer drive have not been delivered, a complete test of the unit cannot be made at present. However, an ohmmeter and voltmeter check will be made, and if the unit checks satisfactorily it will be sent to the construction shop so that work can commence on the rest of the units.

Light Gun

(N. Alperin) (CONFIDENTIAL)

Some tests were made in the lab on the IBM light gun. These tests indicated that the gun was ready to be installed in Room 222 for evaluation.

CRT Filters

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

Present work on the scan-synchronizer design is directed toward extending the range of frequency over which the device is to operate, improving the margins, and coupling the generated flip-flop waveform to the amplifier which will drive the synchronous motor.

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 9-22 April 1954:

Number of assigned hours	148
Usable percentage of assigned time	86
Usable percentage of assigned time since March 1951	87
Usable percentage of assigned time since September 1953	92*
Number of transient errors	3
Number of steady-state errors	14
Number of intermittent errors	3

* Dependence on two banks of magnetic-core memory.

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 9 April 1954:

Components	No. of Failures	Hours of Operation	Reasons for Failure
Crystals			
1N34A	3	1000-2000	Low R_b
	1	3000-4000	Low R_b
	3	5000-6000	Low R_b
Tubes			
6V6	4	23000-24000	3 low I_b; 1 cracked base
7AK7	2	0-1000	Low I_b
	1	2000-3000	Low I_b
	1	11000-12000	Leakage
6SN7	3	23000-24000	Low I_b
6145	2	1000-2000	1 high cutoff; 1 unbalanced
	3	3000-4000	1 leakage; 2 short
	1	5000-6000	Unbalanced

1.23 Records of Operation (Continued)

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

Components	No. of Failures	Hours of Operation	Reasons for Failure
Tubes (Continued)			
2D21	1	no clock hours	High firing point
	1	1000-2000	High firing point
	1	4000-5000	High firing point
3E29	2	23000-24000	Low I_b
5U4G	1	5000-6000	Open filament
5881	2	2000-3000	Low I_b
6080	1	1000-2000	Low I_b
6080WA	1	1000-2000	Gassy
5963	2	1000-2000	Low I_b

1.24 Power

WWI Power Supplies

(D. M. Fisher) (UNCLASSIFIED)

The new -450-v, 5-amp power supply is now ready for service. The supply will be installed in a temporary manner until the old supply has been dismantled from the mounting rack. The new supply should be permanently installed within two weeks.

General

(D. M. Fisher) (UNCLASSIFIED)

A new 10-v, 10-amp lab power supply for the laboratory in Lexington is being assembled. This supply will be installed shortly after testing has been completed.

1.25 AN/FSQ-7

Duplex Design and Planning

(B. E. Morriss) (UNCLASSIFIED)

The number of people working on the duplex planning and design has continued to increase. Seven people are now spending the major portion of their time on this activity, and several people are spending part time consulting. A report has been started by all hands which will represent current thinking. The report will contain a solution and alternatives for most of the areas of uncertainty and will serve as an invitation for criticism and a jumping-off point for the preparation of detailed specifications.

Most of the period was spent discussing the material to be contained in the report mentioned above. Discussions were held on the problems and possibilities for the various inputs, outputs, power supplies, and maintenance procedures.

AN/FSQ-7 Schedules

(T. R. Parkins) (UNCLASSIFIED)

New Schedules. On 16 April, W. Ogden issued a schedule of MTC activity including preparation of MTC areas in Building B. The section of this schedule concerning the move to Lexington will be submitted on 23 April to authorities in Division VII for confirmation.

On 21 April, Irving Aronson and I drafted a preliminary schedule for digital-data transmitters and receivers. After a review by other Group 62 engineers, the schedule should be issued by 30 April.

Schedule Revisions. R. G. Mork's schedule on the display consoles has been revised and correlated with the central display frames schedule.

Since Building F approval appears to be imminent, the XD-1 installation schedule items concerning construction will be revised during the next period.

Other schedules to be revised:

Central Display Frames
System Testing, XD-1

Posted Schedules. IBM posted schedules will be issued on 23 April.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

The week of 12 April was spent at Convair and Hughes Aircraft. F. A. Rodgers, T. F. Clough, and I reviewed the progress of these Corpoations and discussed our own work with them. We carefully evaluated their construction facilities and processing techniques. C. L. Corderman joined us for one day at each plant to discuss the electron optics of the tube and their future plans. In general, Convair's and Hughes' progress is satisfactory. Convair is rather slow in getting their tube-production facilities compatible with their development and production needs.

One day was spent at Sylvania. Saul Twicken took some pulse-test equipment to Emporium, so that Sylvania could produce tube characteristics under pulsed conditions compatible with the IBM-MIT results. At the present moment Sylvania is having cathode trouble with the SR-1782A tube. A vigorous program has been initiated at Sylvania to correct this trouble.

An IBM-MIT group visited Du Mont to discuss and investigate a 16-inch display tube for the video mapper and the photomultiplier tubes to be used with the mapper and in the light gun. This was a successful trip.

The Group put special effort on the helical-dag coatings to be used on the 19-inch Charactron bulb. George Sponsler's work on the electron-trajectory studies indicated that the helical-dag coating should be used. Convair is depending on MIT to develop a production technique for applying the helical-dag. Most of this technique is under control. A few of the first tubes made this period using this technique had faults not attributable to the dag. By the end of this period the tubes were very satisfactory. This program will be given top priority during the next period.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

A new series of helical-dag, 16-inch cathode-ray tubes has been assigned to supplement two tubes, CX-68 and CX-69, which were sent to the Test Group as scheduled. A tentative schedule for the daily construction of one 16-inch helical-dag CRT has been planned in order to obtain adequate data for the evaluation of helical dag for post acceleration and to perfect the many techniques involved in the construction of these tubes.

The mechanical tilt table for liquid settling of luminescent screens and the processing of lacquer films onto phosphor screens was received 22 April.

1.33 Research and Development (Continued)

(J. S. Palermo) (UNCLASSIFIED)

Another phase of our program has been the preparation of research tubes for the evaluation of lacquer-film formation for aluminizing. Two aluminized CRT's have been prepared for further processing. Some difficulty has been encountered with the lacquer films because of shrinkage. However, our latest formula has produced lacquer films that have good gloss, are tough, and have high elongation. Evaluation and study of this technique and process will continue together with our helical-dag program.

(P. C. Tandy) (UNCLASSIFIED)

One Charactron and several helical-dag tubes have been tested during the past two weeks.

The symbols of the Charactron remained fairly well defined even at zero bias. A splashing of electrons at zero bias, however, caused the symbols around the desired symbol to be illuminated also. A curve of cathode current vs. grid-cathode voltage and a curve of matrix plus screen current vs. focus voltage at several values of grid-cathode voltage were obtained for this tube.

The first helical-dag tube tested broke down when more than 2kv was applied across the helical coating; this tube was probably gassy. The next tube tested operated with 10.5kv across the helical coating. The cathode of this tube did not give satisfactory emission after a few hours of operation and would not respond to reactivation. Tests on helical-dag tubes will continue.

SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

XD-1 Logic

(R. P. Mayer) (UNCLASSIFIED)

Memorandum M-2761, "Outline of a System of XD-1 Design Notes," describes a group of documents which are being prepared in an attempt to describe the over-all XD-1 system in a coordinated way. Currently available are: SA-56937-2, "XD-1 Design Notes, Outline," and SC-47111 to SC-47114, "XD-1 Design Notes, Block Outline." Note: Drawing number SC-47103 (4 sheets) is obsolete and is replaced by drawing numbers SC-47111 to SC-47114.

The XD-1 logical training group meets twice a week and discusses the XD-1 design note drawings as they become available. The purpose of the group is to provide training in the details of the XD-1 system. There have been 18 meetings, with an average attendance of 9 people per meeting. Five people have attended over 70 per cent of the meetings, 7 others have attended half of them, and an additional 15 people have attended at least one meeting each.

2.12 Magnetic-Core Memories

Miscellany

(W. Papian) (UNCLASSIFIED)

The Advanced Development Group of RCA, Camden, now has a core memory operating "very well" in the shakedown run of their new computer. Their memory is in two banks, each 32 x 32 x 7, and has about a 20-μsec cycle time; in other respects it bears a strong functional resemblance to the present WWI core memory (from which it was copied). Other items of interest regarding their activities are that they are "jigged up" and able to wire a 32 x 32 plane in 2 days (about half of our time), and that their future directions appear to be toward switch-core driver, nonsquare arrays of the same type International Telemeter is playing with.

We are about to investigate the feasibility of extending our present (Core Memory Mod. II) techniques one step (squared) further to a 128 x 128 memory.

2.12 Magnetic-Core Memories (Continued)

IBM Trips

(W. J. Canty) (UNCLASSIFIED)

Four days during the past biweekly period were spent with the memory group at High Street helping to debug the array tester. Trouble-shooting in the addressing system (matrix output amplifiers and selection-plane drivers) occupied most of the time. It should take at least one more week of debugging before the array tester can be used for testing of planes.

MTC 64 x 64 Array

(W. J. Canty) (UNCLASSIFIED)

A program has been written which will transfer the contents of Field 3 (drum storage) to Field 1 (magnetic-core memory). This program will be useful when taking "shmoo" plots on the core memory using the "checkerboard bootstrap program" (MP60).

XD-1 Array Tester

(J. L. Mitchell) (UNCLASSIFIED)

Two days were spent in Poughkeepsie helping the IBM people to get their array tester running. Most of the time was spent trouble shooting the MAR units which are packaged in some "triple-decked" 701 plug-in units. A change in layout was suggested which should improve the reliability of the MAR units.

The main source of trouble in the "shower stall" was a parasitic oscillation in the matrix-output-amplifier cathode follower. When this trouble was repaired the stall seemed about ready to run.

MTC 64 x 64 Memory

(J. L. Mitchell) (UNCLASSIFIED)

A new memory-address-register cathode follower has been breadboarded, and the testing is almost complete. This unit uses about one-half the number of tubes in the present panels. As soon as the testing is completed the present panels will be modified to conform to the new circuit.

2.12 Magnetic-Core Memories (Continued)

Register Switch and Memory

(J. Raffel) (UNCLASSIFIED)

The 256-register, 16-digit memory driven by the 256-position core switch is operating successfully. Logic and circuits will be worked on so that an evaluation of the system can be made.

64-Position Core Switch

(A. D. Hughes) (UNCLASSIFIED)

The back voltage caused by driving a number of switch-cores into saturation was determined with the rise times desired for the switch, for set and reset, and for bias drivers. On the basis of these determinations plus previously determined load values, specifications for driver design were given to Dave Shansky.

Serious consideration of a 4^3 switch is being made. Considerable saving in core windings is effected at the expense of adding one diode per bias driver.

Thesis - Magnetic-Core Memory with External Selection

(S. Bradspies) (UNCLASSIFIED)

A number of cores have been wound for use in the memory. The test panel has been built, and the building blocks have been connected. The memory has not yet operated successfully however. The tests so far have not been very exhaustive and I have spent only a few minutes on them.

Memory Test Setup VI

(E. A. Guditz) (UNCLASSIFIED)

Considerable work is being done on Memory Test Setup VI to facilitate data taking. Logic has been added which automatically rewrites the pattern in the plane under test when the parameter being varied is returned to within its operating range.

Modifications have been made to the selection-plane-driver panels so that address-skipping logic may be employed. This will permit taking several sets of margins per plane to eliminate the possibility that one or two cores are seriously limiting the margins.

2.12 Magnetic-Core Memories (Continued)

(E. A. Guditz) (UNCLASSIFIED) (Continued)

A fan and associated ductwork are being added to the memory rack so that air can be pulled down through the stack of planes. At present, only room air is available. Consideration is being given to means of getting cool air before warm weather seriously interferes with plane testing.

Transformer-Input Sensing Amplifier

(S. Fine) (UNCLASSIFIED)

The experimental sensing amplifier has been built as a plug-in unit exchangeable with present MTC sense amplifiers.

The unit consists of an input transformer with 10 to 1 stepup. Transitron T-6 diodes in the secondary result in a unidirectional signal to the grid of a pentode type 6136 pulse amplifier. One half of a 5965 is used as a second pulse-amplifier stage, while the other half is a cathode follower which feeds the suppressor of a 7AK7 gate tube. Cathode degeneration is used in both pulse-amplifier stages. An over-all gain of 1000 is obtainable.

At present this amplifier has 0.1-μsec more delay than the MTC type. The total cathode count is 3 compared to 10 for the MTC amplifier. Further evaluation is being conducted.

2.13 Vacuum-Tube Circuits

General

(R. L. Best) (UNCLASSIFIED)

The Basic Circuit Groups at both IBM and MIT have concurred on the following basic circuits: Model B flip-flop, Model C flip-flop, Model B single shot, d-c inverter Model A, level setter Model A, Model B gate tube, Model B level setter, drum-read amplifier, core-matrix output amplifier, and power cathode followers Models F, G, H, J, K, L, and M.

Core-Memory Sense Amplifier

(C. A. Laspina) (UNCLASSIFIED)

The vacuum-tube circuits for use with an input transformer as a sense amplifier are being checked. Aging and marginal-check data is being taken.

2.13 Vacuum-Tube Circuits (Continued)

Magnetic-Core-Matrix Switch Driver

(D. Shansky) (UNCLASSIFIED)

A preliminary investigation of the use of a 6293 in the final stage of the driver has indicated its feasibility. Design work is awaiting more detailed information concerning corona discharges in the core-matrix switch itself, since it is felt that the presence of corona would limit the voltage excursions of the driver-tube plate.

Magnetic Drum

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

Marginal-checking voltages have been selected for all circuits related to the diode switch. All special cases of "short fields," "non-switched writers," etc. have been resolved for XD-1. The result is 5 basic circuits not including the switch.

Display Generator Buffer Storage

(E. Anfenger) (UNCLASSIFIED)

A bit-driver blocking oscillator has been completely built up which meets input and output requirements and doesn't exceed maximum tube ratings. Curves of minimum trigger voltage vs. plate voltage and output vs. plate voltage have been plotted.

A word-driver has been completely built up and operates satisfactorily. Margins have not as yet been taken.

The read-out driver is being built up; the breadboard worked satisfactorily.

Bit and word drivers can be improved by spanning 600 volts rather than +250 to -150. A +600-v supply is now available.

Universal Amplifier

(H. J. Platt) (UNCLASSIFIED)

Final layout drawings were made, and an experimental breadboard is now being built.

While waiting for the construction to be completed, some thought is being given to marginal checking such an amplifier.

2.13 Vacuum-Tube Circuits (Continued)

"C" Flip-Flop

(H. J. Platt) (UNCLASSIFIED)

This circuit needs to have a writeup for the MRD Book. I am undertaking to complete this work. Some time was spent in getting familiar with the circuit and trying to correlate my technique with the techniques of my predecessors.

Gated Variable Pulse-Width Generator

(H. J. Platt) (UNCLASSIFIED)

This unit will provide pulses with variable widths from 0.06 microsecond to about 0.2 microsecond with amplitudes in excess of 40 volts. It will help to adequately check other pulse-operated circuits.

Phone-Line Demodulator

(E. B. Glover) (UNCLASSIFIED)

The difficulty experienced in finding a handle for marginal checking the first two stages has been overcome by tying both screens through a dropping resistor to +90. Using a common resistor did away with the problem of degeneration. This, however, resulted in a low-frequency oscillation when a signal voltage of just below minimum was applied. It was felt that this small margin was not sufficient, so the screens were tied to +90 separately through resistors. The resulting degeneration was overcome by sufficient bypassing. All tests on this particular arrangement have revealed no appreciable difference in circuit operation.

Effort is now being concentrated on checking the margins of the next three stages, using the plate voltage as a handle.

2.14 Memory Test Computer

General

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

Two very welcome additions have been made to the MTC staff in the persons of Earl Gates and Carl Schultz. Gates is undertaking a much needed revision of MTC terminal equipment; Schultz is working on the moving and reconstruction of the arithmetic element and plans to understudy Anderson and Boyd on the drum so he can take over as they transfer their main effort to XD-1.

2.14 Memory Test Computer (Continued)

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

Installation of XD-1 type high-speed flip-flops in vital spots like the A-Register (a step which we had intended to postpone until after moving) has been accomplished, since it seemed both desirable and convenient. This has made necessary several corollary modifications which have cut into operating time; but the remaining available operating time has so far been sufficient to meet demands, and whatever we can achieve now in such installation and testing is just so much time gained in getting back on the air after the move. A new accumulator is under construction to make this same conversion to the +10-v flip-flops.

A propos of this, we will ultimately have over 100 of the old MTC Mod. I plug-in flip-flops released and would be delighted to transfer them to anyone in the laboratory who can use them. Their output suring is 0 to -40 volts at the plates; they require standard negative trigger pulses; in general, they are quite compatible with standard test equipment. (Circuit Schematic is Dwg. No. C-52583.)

Programming Manual

(P. R. Bagley) (UNCLASSIFIED)

A revision of the MTC Programming Manual is nearly complete and will be issued shortly as Memorandum M-2527-1. This will include all the changes planned for installation before 15 July 1954.

Terminal Equipment

(E. Gates) (UNCLASSIFIED)

The past two weeks have been spent learning how the MTC in-out equipment functions and comparing this with Whirlwind circuitry.

We will incorporate some WW ideas and make other changes in order to make our equipment more reliable.

Moving Preparation for MTC

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

Construction of new equipment to be installed in MTC is progressing as scheduled. Actual installation of the new A-register and live-register #2 flip-flops is completed.

2.14 Memory Test Computer (Continued)

Accumulator Change in MTC

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

A new accumulator using Hal Boyd's high-speed flip-flop is now being made. Installation of the new accumulator was undertaken at this time because enough panels are available to allow building and testing of this unit without using very much computer time.

Carl Schultz is also working on this change.

2.15 System Liaison

Duplex Central

(C. W. Watt) (CONFIDENTIAL)

Four days were devoted to study and meetings on duplex central planning. Much effort is being put forth to get the 1 May proposal in shape.

2.16 Transistors

α vs. I_e tester

(D. J. Eckl) (UNCLASSIFIED)

R. Burke has started work on the development of equipment to present a plot of α vs. I_e for transistors. This is a continuation of some work which was originally started by S. Valdez, a part-time student with the Group.

Meeting with RCA

(D. J. Eckl) (UNCLASSIFIED)

As a result of discussions concerning M-2721 on the RCA TA-165 transistors, several people from RCA are planning a visit to discuss point-contact development. The meeting is tentatively set for 7 May. Arrangements are being made to have other groups in Lincoln participate.

Characteristic Plotter

(D. J. Eckl) (UNCLASSIFIED)

The conversion of the characteristic plotter to handle both p-n-p and n-p-n junction transistors has been completed. Some difficulty was encountered with the VR tubes in the emitter circuit, but this has been remedied. Two sigma relays were replaced after about a year and one half of satisfactory operation.

Tetrode Transistors

(D. J. Eckl) (UNCLASSIFIED)

Two Germanium Products Wallace tetrodes have been loaned to us by S. Schwartz for testing in gate circuits.

Transistor Sensing Amplifier

(S. Oken) (UNCLASSIFIED)

A first model of a transistor sensing amplifier has been designed and built. It consists of a 30:300:300-turn center-tapped transformer followed by a two-transistor stage combination rectifier and amplifier. The over-all gain is about 100. The unit has an output of 10 volts which is enough to drive a transistor gate. Another stage could be added if a larger gain is desired. The transistors used in this amplifier should have an $f_{\alpha\beta}$ of about 2 megacycles so that the rise time of the output pulse is small enough to be usable.

2.16 Transistors (Continued)

Transistor Magnetic Switch

(S. Oken) (UNCLASSIFIED)

A breadboard model of a transistor driver for a four-position magnetic switch has been built. The flip-flops employed to bias the switch are connected as a counter. Some trouble has been encountered with the gate between the two flip-flops, because the output voltage is too small to trigger the second flip-flop.

Transistor X and Y Plane Drivers

(S. Oken) (UNCLASSIFIED)

The transistor X and Y plane drivers are at present designed to supply a 12-ma pulse of current to the cores which have 8 turns per winding. The possibility of using an 8:1 stepdown transformer between the driver and the cores will be investigated. This would make it possible to use one of the metallic memory planes already built. As the output impedance of the driver is in the order of 1 megohm, the reflected impedance of the driver with the transformer would still be fairly high. The problem of overshoot will probably be difficult to solve.

Transistor Gates

(C. Kirk) (UNCLASSIFIED)

The test program to evaluate transistor gate circuits has started. Breadboards of the various gate circuits are now under construction. Testing is expected to begin during next biweekly period.

Transistor Equivalent Circuit

(C. Kirk) (UNCLASSIFIED)

An equivalent circuit for the small-signal transient response of a point-contact transistor has been obtained using the method of Suran and Chow (I.R.E., September 1953). This method assumes that the diffusion process by which the minority carriers travel through the base region of a transistor may be represented by a current generator driving a low-pass RC network and an ideal delay line. The advantage of using such an equivalent circuit is that the transient analysis of a pulse amplifier may be handled quite easily by Laplace Transform techniques. Average values for the rise time of the RC network and the delay have been obtained for G 11 A point-contact transistors, being 0.04 μsec and 0.045 μsec, respectively.

2.16 Transistors (Continued)

Diode Construction

(N. T. Jones) (UNCLASSIFIED)

About twenty diodes have been constructed and tested for reverse recovery. This group included three sizes of whiskers but only a low-resistivity sample of germanium. Because of the germanium the quality of these diodes has been low. The intention is to use a variety of both germanium and whiskers to prove the current theories of diode storage and to establish feasibility of this type of diode construction.

Diode Storage

(N. T. Jones) (UNCLASSIFIED)

Lengthy consultations have been held with various laboratory personnel with respect to the characteristics of diodes now being received for evaluation.

2.17 Display

(C. Corderman) (UNCLASSIFIED)

I visited Convair and Hughes during this period to discuss Charactron and Typotron progress.

The Charactron program is generally satisfactory. The only aspect causing some apprehension was the low rate of tube production. They have been concentrating on various portions of the tube, such as phosphor settling and aluminizing, without making complete tubes. It was pointed out that the processing of tubes will have its problems as well as the other features they are working on and that it would be highly desirable to become acquainted with these problems as soon as possible. In addition, tubes produced now would be very helpful to their engineers who are studying the electron optics.

At Hughes we discussed changes in their gun design to minimize changes in spot size as a function of grid drive. It appears that an additional masking aperture is needed. We also observed a tube with a separate screen-grid connection which was being pulsed on the collector and contrast grids to improve contrast. With the separate screen-grid lead this pulsed mode of operation is quite effective in improving contrast without loss of resolution, and it has been adopted for use in XD-1.

2.17 Display (Continued)

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

The digital-expansion system was put into operation and performed as per design objectives. During test the system experienced trouble caused by the Hughes diodes IN 117. The diodes were checked and found to have a low back resistance, less than 10K. Those that checked out good had a back resistance greater than 1 meg.

The 2^{10} decoder is undergoing tests for long time stability. The drift measured is the absolute current change and the change in current between digits.

The study of feedback amplifiers has developed a technique that shows promise of marginal checking these units with a go-no-go test. In the differential amplifiers used in the display system the common voltage to the grid resistors is varied until the system is caused to fail. The voltage change necessary to do this job will depend on the condition of the tubes in the amplifier. It is proposed to measure the voltage necessary to put the amplifier in a nonlinear region, rather than measure the change in gain for change in voltage. Herb Platt will investigate this technique in conjunction with his development of the universal amplifier.

Several circuits to generate a ramp function and modulate the decoder are being investigated. It is expected to have the final form of the vector generator this biweekly period.

The following units are to be constructed and installed in MTC: selection and position decoders, line drivers, universal amplifier, and vector generator. John Crane will lay out these panels when supplied with the necessary schematics.

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

The past biweekly period was spent in becoming familiar with the plug-in-unit construction of XD-1. A first try at putting the DID into plug-in units is almost finished; it will be used to point out the equipment design necessary before final drawings can be started.

(L. B. Martin) (UNCLASSIFIED)

The following are tubes and their times for Typotron life test:

#265	1469
#268	1459
#291	1459
#280	651
#319	651
#326	651

2.17 Display (Continued)

(L. B. Martin) (UNCLASSIFIED) (Continued)

A 1500-hour Typotron life test progress report has been written. Work is in progress toward modifying the mode of character display and expanding the capacity of the life test.

Digital Expansion and Off-Centering

(R. H. Gerhardt) (UNCLASSIFIED)

A cursory test of the expansion and off-centering circuitry was performed during the past biweekly period. A program, written by P. Bagley, displays a grid of 225 numbers; each number is at the center of an off-center position selectable on the x 8 scale. Hence, by looking at the numbers, a check can be made on the intensification gating.

Timing and Control for XD-1 Situation Display Generator

(R. H. Gerhardt) (UNCLASSIFIED)

The general aspects of the logic of the control for the XD-1 SDG have been worked out. Many details remain to be examined.

Pulse-Diode Gate

(R. Callahan) (UNCLASSIFIED)

It appears likely that the type-Z diode will be used in the pulse-diode gate. It has tentative ratings of 80 volts back voltage and over 100-ma forward current. Its rather poor recovery time (30 microseconds) will not bother us.

An MRD report describing two pulse-diode gates suitable for use with the C flip-flop has been written and will be forwarded to IBM for publication.

Display-Generator Unit

(R. Callahan) (UNCLASSIFIED)

A study of various types of logic for the DGU has been made with B. Gurley, J. Shallerer and D. Fallows. This study consisted of a comparison between core logic, d-c logic, and pulse-diode logic, and resulted in a decision to use pulse-diode gates in the situation-display-generator unit.

2.17 Display (Continued)

(R. Fallows) (CONFIDENTIAL)

The basic logic for the display system is nearly complete. Several important decisions (not yet concurred on) were made in the past two weeks which permitted clarification of some major areas of the central display-frame equipment. As a result of these decisions, preliminary frame layouts have been made. These layouts will be used to generate preliminary pluggable-unit block diagrams which, in turn, will permit preliminary power and component estimates.

A review of the situation-display-selection system resulted in the conclusion that selection at the consoles is practical and requires fewer tubes and diodes than selection in a central frame. This type of selection, which was proposed by IBM last December, is now practical because of the simplifications in display-selection requirements as visualized by Group 61. As a result of this decision the situation-display-selection element has been eliminated from the central display equipment.

A review of the problems of console maintenance in the duplex central resulted in the general conclusion that test patterns can be generated by the operating computer during slack hours and that this facility should be adequate for console maintenance. Since it will be necessary to provide protection of the central display equipment from console failures, it was concluded that a single distribution system for display signals will suffice, and all consoles (except maintenance consoles) can be switched in a group. As a result of these considerations, the various line drivers and cathode followers in the central display frames will be designed to supply the power required with no grouping of consoles for maintenance switching. Thus, all display drivers will be duplexed in the duplex central.

One part of the situation-display-generator element involves the temporary storage of four 32-bit words from the drum. For the past five or six weeks the circuitry for this storage has been evaluated in terms of core storage and flip-flop storage with pulsed-diode gates. This work had advanced to the point where circuits could be evaluated in consultation with Dick Best last week. The evaluation indicated that both methods are practical in terms of components and circuits. A detailed analysis of tube requirements indicated a slight preference in favor of the core method, but a slightly higher diode count was expected. In view of these considerations and the additional circuit development indicated if cores were used, it was decided to use flip-flops with pulsed diodes. Work on core circuitry has been terminated.

In view of the many proposed changes in the operation and design of the XD-1 display -- situation and digital -- the display specifications are being rewritten. A preliminary draft has been distributed for comments. It is expected that the revised specification will be released in the next report period and will be the basis for concurrence on all changes made in the past month.

2.17 Display (Continued)

(R. Fallows) (CONFIDENTIAL) (Continued)

A review of the schedule for the central display frame indicates that pluggable-unit design work and block schematics are roughly a month behind schedule. We should be further ahead than we are to meet the 1 August production date for starting pluggable-unit assembly, but we are not as far behind as it appears. The task to be performed has been reduced by the simplifications in logic which have been made since the schedule was drawn up. Block schematics and pluggable-unit layout work will be started in the next report period. Our file of information on IBM card and pluggable-unit designs was only last week completed to the point where layout work could be started here. With concerted effort we should be able to meet our final design delivery dates. A review of the schedules in the next biweekly period will clarify the situation.

2.2 Group 63 (Magnetic Materials)

Memory-Core Production

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

Hysteresis-loop results for recent test series of new compositions have shown a very high degree of rectangularity and low values of coercive force. In some cases R_s maximum values as high as 0.93 have been obtained without resorting to atmosphere control or secondary heat treatments. Switching times for these cores run four to five microseconds, and in many cases the pulse-response curves are good, being similar in appearance to pulse responses in the present memory cores.

Pilot-Plant Production of F-394 Cores

(R. A. Maglio) (UNCLASSIFIED)

Test firings are under way for three production batches, DCL-3-75, DCL-2-416, and DCL-2-417. The firings will be completed within this week.

The core-sorting machine has been modified and is undergoing testing in order to ascertain the reliability of the new design.

A continuous mill for use in preparing the ferrite powder for pressing has been constructed. A new batch of DCL-3-75 composition is being processed for testing this new mill.

D-C Hysteresigraph

(R. Pacl) (UNCLASSIFIED)

Work on the d-c hysteresigraph has been initiated. Preliminary testing is expected to begin some time during the first week in May.

Special Tests Equipment

(J. D. Childress) (UNCLASSIFIED)

The electrometer circuit for measuring high resistances has been constructed and qualitatively checked. It will be calibrated during the next period.

2.2 Group 63 (continued)

Special Tests

(J. D. Childress) (UNCLASSIFIED)

After about 100 hours of shelf life at 500 C, a group of memory cores shows no large or nonuniform change in characteristics.

Memory-Core Testing

(J. R. Freeman, J. McCusker, P. Fergus) (UNCLASSIFIED)

Effort is being directed toward the simplification of memory-core selection testing. As a result of information obtained from the current-voltage characteristics of acceptable and rejected memory cores, an operating current of 850 ma with 490 ma WRITE disturbing pulses and 425 ma READ disturbing pulses has been suggested. Cores will be rejected for low disturbed-ONE outputs and high disturbed-ZERO outputs. One-hundred percent tests will be made to test the effectiveness of these specifications.

Covalent Bonds in the Spinels

(J. B. Goodenough, A. L. Loeb) (UNCLASSIFIED)

It has been proposed that the tetragonal spinels are distorted from cubic symmetry by an ordering of four, coplanar covalent bonds in the octahedral sites. The other two octahedral-site bonds are ionic. It has further been proposed that above the ordering temperature, at which the lattice becomes cubic, the covalent bonds resonate between the three biaxial planes of an octahedral site. If this is so, then below the ordering temperature the lattice parameter 'c' should be a measure of the ionic bond length, the parameter 'a' a measure of the covalent bond length, and above the ordering temperature the bond length of the cubic cell should be $(2/3)a + (1/3)c$. This relation is found valid after correction for the thermal expansion of the lattice.

Free Energy Model of the Hysteresis Loop

(A. L. Loeb) (UNCLASSIFIED)

The hysteresis loop calculated on the basis of the free energy model (see E-559) was programmed for display on MTC. In order to photograph the display, the program was made to cycle, displaying a complete loop in each cycle. The results were partly satisfactory in that a good

2.2 Group 63 (continued)

Free Energy Model of the Hysteresis Loop (continued)

loop was displayed in a large number of cycles. However, after a number of cycles (this number varied) the curve changed into a Lissajous figure of decreasing amplitude. While the existence of such a figure is readily explained, the reason for the transformation is not yet apparent.

Evaporated Cores

(Dudley A. Buck) (UNCLASSIFIED)

The Corona group, with whom we maintain close contact, has succeeded in evaporating rectangular-loop 80 Permalloy cores. Hysteresis-loop photographs have been placed on the Group 63 bulletin board. Deposited on a heated substrate in a magnetic field, these films are 2500 angstrom units thick and have a coercive force of 1.6 oersteds. This method of fabrication, while in its infancy, reduces core uniformity to a problem in geometry and as such holds great promise.

Ferroelectrics

(Dudley A. Buck) (UNCLASSIFIED)

M-2778 has been issued as a report of my trip to Bell Labs., Glenco, Professor Pulvari, Naval Ordnance Laboratory, NSA, RCA, and others. It contains a summary of recent work on ferroelectrics.

Cryotron

(Dudley A. Buck) (UNCLASSIFIED)

Probe number 8, now under construction, is a demountable cryotron, designed to allow the tantalum-wire element (plate circuit) to be placed inside the copper-wire solenoid (grid circuit) and then removed for annealing and other changes. The magnetic field of the solenoid will be measured with a magnetometer flux meter on loan from John Houston of the MIT Physics Department. An oscillating magnet at the end of a long 1/4-inch diameter rod measures only the longitudinal component of flux in the solenoid, unlike most moving-coil flux meters which measure the radial component. This instrument is available to anyone in the lab wishing to measure the flux in a solenoid.

SECTION III - CENTRAL SERVICES

3.1 Purchasing & Stock

(H. B. Morley) (UNCLASSIFIED)

It has been decided that IBM is to assume responsibility for the purchase of the two Westinghouse 500 KVA transformers which we now have on order. Negotiations are now in progress to transfer the order to IBM. This is being co-ordinated with the IBM Purchasing Department.

Bids have been received for the installation of the equipment-conditioning system for Rooms 216 and 222, Barta Building, and the order is now being processed.

A list of 6345 equipment that will be needed at Lexington is being prepared in order that transfer may be requested.

Most of our records and catalogs have been transferred to 5-drawer files in order to conserve space in our new location at Lexington.

Additional racks are being provided for the Barta Stock Room to accommodate larger stocks of components.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 22 Construction Requisitions totaling 316 items satisfied since 9 April 1954, and there are 41 Construction Requisitions totaling 1634 items under construction by the Group 60 Electronic Shops.

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

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There are 7 orders now open with vendors totaling 94 items. Deliveries in the past biweekly period have totaled 116 items. Information on specific orders may be obtained from the writer (ext. 3492).

3.3 Component Analysis and Standards

Trip to Conference on Reliability of Electrical Connections

(C. W. Watt) (UNCLASSIFIED)

Paine and Watt attended a conference at the Illinois Institute of Technology in Chicago on 15 and 16 April. This was sponsored by the RETMA and was devoted to the subject of wire-connection reliability. In general we were satisfied that the methods of soldering, solderless connection, and inspection used in Division 6 are good compared to the methods and techniques used in industry. A report on the conference will be written here, and the Proceedings will soon be available.

3.31 Components

(R. J. Jahn) (UNCLASSIFED)

Drawings for d-c power distribution in Lexington have been completed. Some Raytheon power supplies are being simplified and rewired for use in Building 10 at MIT. These supplies will be used by thesis students.

3.34 Vacuum Tubes

(H. B. Frost) (UNCLASSIFIED)

On Thursday, 22 April, a JETEC 5.5 meeting was held in Newark, New Jersey. Acceptance has been obtained for formats describing twin triodes and pentodes for computer application. These formats will be used by the various tube manufacturers in descriptions of new computer tubes.

The discussion brought out considerable interest in short-testing techniques. Another JETEC committee has been requested by the military to develop a specification for shorts testing which is much more satisfactory than the present polyphase neon method universally used by tube manufacturers. Several requests for additional information on our techniques have been received. A more satisfactory technique in general use would tend to improve the general quality of vacuum tubes produced today and would be greatly to our advantage.

Thesis Research

Intensive work during the past period has resulted in a considerable amount of new information. It has been discovered that there is only a slight change in the resistance of an oxide cathode when d-c current is drawn, provided that the cathode is maintained at a constant temperature. This experimental fact contradicts my theoretical analysis; in addition, a subtle but basic flaw was found in my analysis. I have been able to put Nergaard's analysis in a new form; it also does not fit the experimental data.

3.34 Vacuum Tubes (Continued)

(H. B. Frost) (UNCLASSIFIED)

With my active cathodes, it is possible to develop only 0.2 volt in IR drop across the cathodes before d-c emission is limited.

I am presently exploring slightly different cathode models in order to explain the results that I have obtained. I also expect to explore in more detail the dependence of cathode emission upon the amount of d-c current through the cathode.

(T.F. Clough) (UNCLASSIFIED)

During the week of 12 April a visit was made to Convair and Hughes Aircraft with P. Youtz of Group 65 and F. A. Rodgers of Group 25. Construction procedures and processing techniques for the Charactron and Typotron tubes were examined and evaluated. A report was made to P. Youtz.

A part-time MIT student is being trained to assist the tube shop.

(A. Zacharias) (UNCLASSIFIED)

On 13 April a trip was taken to IBM Plant 2 for the purpose of installing our high-speed shorts tester from the Mod. III console.

The remainder of the period was devoted to the assembly and construction of units comprising pulse equipment for taking SR-1782A characteristics under G_1 pulse conditions. This work was completed, checked out, delivered to Sylvania, and installed.

3.4 Test Equipment

Test Equipment Committee

(L. Sutro) (UNCLASSIFIED)

Memorandum M-2793, addressed to all members of Division 6 from the Test Equipment Committee, is now available. It describes the three sources of test equipment, namely, the Test Equipment Headquarters, the source in Barta Building (Test Equipment Technician, John Doyle), and the Lincoln Laboratory Instrument Room. It announces that users of commercial test equipment will be required to sign for the equipment they check out, and users of both commercial and standard test equipment will be required to report transfer of equipment to another user. Finally the memo asks your help in returning equipment that you do not need and in locating units of missing equipment listed there.

3.6 Administration and Personnel

New Staff

(J. C. Proctor) (UNCLASSIFIED)

Armen S. Chopourian is working as a DDL staff member and has been assigned to Group 60. Mr. Chopourian received his BS from Northeastern and until recently was employed by the New England Power Service Company.

Staff Transfers

(J. C. Proctor) (UNCLASSIFIED)

Hawley K. Rising has transferred from Group 62 to Group 64.

Alexander Vanderburgh has transferred from a DIC staff member in 6345 to a DDL staff member in Group 62.

New Non-Staff Personnel

(R. A. Osborne) (UNCLASSIFIED)

Jean Harris is a new secretary in the General Engineering Section of Group 60.

Mary Heywood is a new member of the Drafting Department.

George Kebler is another new member in the Drafting Room.

Stanley Olsen has joined the Electronic Construction Shop.

John Pierce is an MIT student working part time in the Tube Testing Lab.

Francis Shaw is a new laboratory assistant in Group 6345.

Terminated Non-Staff

George Maynard

Open Non-Staff Requisitions

6 Jr. Electronic Technicians for Group 62

2 Secretaries for Group 61

1 Secretary for Group 62