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Memorandum M-2576

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

SUBJECT: BIWEEKLY REPORT FOR DECEMBER 18, 1953
To: Jay W. Forrester
From: Division 6 Staff

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Auth:	<u>DDJ58</u>
By:	<u>R. E. Smith</u>
Date:	<u>2/1/60</u>

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

Summary

Three extra demonstration days - two of them for Divisions 2 and 6 - limited the experimental work this biweekly period. Thirty-three hours of operations, including two 9-hour sessions, were involved this period. The System performed very well.

In a test of System antiaircraft capacity, 12 simulated tracks were passed on, and neither the Cape Cod AA Talker nor the Antiaircraft Operations Center showed signs of overloading.

Memos giving proposals for XD-1 Digital Information Displays and Track Situation Displays are being prepared. Material describing the XD-1 order code will be prepared soon.

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12-10-53

1.11 Equipment Engineering

(N.N. Alperin) (CONFIDENTIAL)

The modification on the light guns is proceeding on schedule.

The drawings for the light cannon have been brought up to date and are now in drafting.

(B. Morriss) (CONFIDENTIAL)

The week ending 5 December was spent at Eglin Air Force Base watching an IFF demonstration. The demonstration included a Mark X with SIF and SII (modifications for improved security and identification of friend from friend), and the air-to-air IFF system manufactured by Hughes Aircraft Company. An inter-office correspondence note to C.R. Wieser is being written describing the demonstration and presenting some thoughts on the automatic introduction of Mark X data into the computer.

Group 23 has borrowed a Mark X transponder which will be mounted in a truck and used for calibration. The computer must be used in conjunction because no other method is at present available for observing the Mark X output. The transponder has been borrowed for three weeks only.

Some time has been spent considering different methods for presenting to the tracking section information as to the areas mapped out by the radar mappers. Present thinking is along the lines of interrogating the mappers during one scan and introducing the information into the computer in a manner similar to the method to be used to introduce radar data through the buffer drum. Although the problem is somewhat complicated, by trying to save and store all incoming radar data during this scan, it appears to be quite feasible. To reduce the amount of data on the map it will be necessary to interrogate the radar map in a pattern which skips a large percentage of the quantization boxes. A program has been written by G. Young which makes it possible to try different sampling and display schemes using maps on the light cannon.

(G. A. Young) (CONFIDENTIAL)

The problem of transferring a picture of the mapped-out areas on the mappers to interested persons via the computer is being considered by myself and B. Morriss. A program has been written (but not checked) to simulate displays of a map by placing the map on the light cannon. The program has been made flexible so that several different displays may be formed by inserting constants into the program from frame E31.

The equipment in Room 222 and adjacent areas was checked out four times during the last biweekly period with the Air Force personnel manning the stations. A fifth test was not completed due to difficulties in the insertion switches.

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1.11 Equipment Engineering (Continued)

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

Installation of the monitor scope will be made on the next installation day. Thus far installation has been cancelled for the week of 21 December and may be cancelled for the week of 28 December.

The scheme for illuminating the CRT face was tried and showed considerable promise. However, the parts required for this scheme must be redesigned slightly to provide sufficient clearance between the safety glass and the CRT face.

At present I am working on circuitry for the new scan synchronizer.

1.12 Data Screening

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

Operation of the Cape Cod System occupied about half of my time during the past biweekly period because of the additional System demonstrations. These demonstrations have been particularly strenuous on the Air Force personnel who have had to sit in front of the scopes for as long as seven hours in one day. Orange cellophane is being put on all scopes in the TWS section to ease some of the eyestrain. A dropcloth is also being installed to help decrease room-light reflection on the TWS scopes.

Further testing of the new smooth and predict program revealed one tape-preparation error. I hope to be able to devote more time during the next few weeks to improvement of the smoothing parameters being used.

Training of the Air Force personnel in the TWS section is progressing. Investigation of initiators' troubles revealed two program errors - one being incorrect airbase coordinates for simulated interceptor scrambles and the second being incorrect scramble headings being given by the interception program to the simulated scrambles. Lack of information transfer from the WD section to the TWS section resulted in initiators not knowing about a SOP concerning real interceptor scrambles which has been in effect for three months.

As a further aid to the monitors an expansion without off-centering has been added to scopes G-11 and G-14. As an aid to the initiators an expansion with centering about the two scramble airbases may be added to scopes F-11 and F-12.

Some minor changes in phone lines in the TWS section were settled. These changes are mainly an interchange of some of the Tracking Officer and Combat Data Director lines.

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1.12 Data Screening (Continued)

(D.L. Bailey) (CONFIDENTIAL)

The buffer-drum test program has been successfully operated with data from a parameter tape and from the buffer drums. This program displays data coming into any of the radar data inputs on the drum (drum groups 0 and 1). The selection of inputs to be displayed is controlled from the Combat Data Director console. In addition, one set may be selected for expanded display and a simple displayed-and-printed data analysis.

A parameter tape has also been written to permit operation of this program (i.e., selection of sets, etc.) from test control. This tape is partially tested.

(H.E. Frachtman) (CONFIDENTIAL)

The analyses of the records of 4305 frames of data have documented what was already known about the System.

A program which records selected digits of all track monitor registers on magnetic tape has been written. It has passed the incomplete test to which it has been subjected.

Ideas for several types of System data-analysis programs are taking shape.

(J. Ishihara) (CONFIDENTIAL)

The entire Cape Cod Program of 30 November has been punched out on paper tape. These tapes are self-loading onto drum by groups and will be kept on "standby" basis at all times.

Some progress has been made in clearing up errors in the present program. It is requested that programmers receiving "Program Error Reports" give them top priority and return them within a week. Any suggestions in improving the trouble-shooting procedure will be welcomed by this author.

The previously reported error in the Mark X correlation program was traced to another program. An error in range quantization was detected and corrected during the next run. All further testing has indicated no further errors, and final tests with live data will be made when Mark X data is again available.

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SECURITY INFORMATION

1.12 Data Screening (Continued)

(J. Levenson) (CONFIDENTIAL)

H. Frachtman and I are making studies of possible analysis and evaluation programs for TWS functions. As a beginning I am writing a program to print out by scan one piece of information on the status of each track. This will show when the track is in trouble and what sequence of happenings usually occurs. From this information a more statistical study will be made.

H. Peterson and I have observed the monitors at work to see how well they understand what is expected of them and how effective the monitoring program is. We have already recorded some conclusions but refrain from distributing them until more observations are made.

(H. Peterson) (CONFIDENTIAL)

During this period I have had computer time on two nights. We experimented with the stops on the camera with the camera-control program and worked some more on the past-history program. Later it was recalled that there was a reset in master control that was affecting our program so we hope we can correct this trouble.

I also spent time evaluating the monitors' work.

(H.H. Seward) (CONFIDENTIAL)

A program to demonstrate the collection characteristics of the buffer drum for various field switching times has been written and awaits initial computer operation. Possible data-analysis programs were discussed with W. Wolf.

(E.W. Wolf) (CONFIDENTIAL)

After more than a month of postponements, the first calibration flight mission was carried out Friday, 18 December. Although this mission served the useful purpose of establishing the necessary coordination between the various people involved, no data sufficiently accurate for actually establishing any radar calibrations was obtained. The reasons for this were as follows:

- a. The aircraft was not equipped with either a bombsight or a driftmeter.
- b. The personnel manning the aircraft were insufficiently acquainted with the check points to recognize the various aiming points, and
- c. All but a few of the range data from S. Truro were odd numbered.

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1.12 Data Screening (Continued)

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

This had the effect of two-mile quantization.

The next calibration flight mission is scheduled for Tuesday, 22 December.

(W. Wolf) (CONFIDENTIAL)

Most of the past biweekly period was spent in writing and operating a "filter" program which allows the separation of tracks from raw radar data.

1.13 Tracking and Control

(J.A. Arnow)

See M-2577 (SECRET) for this entry.

(H.D. Neumann)

See M-2577 (SECRET) for this entry.

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SECURITY INFORMATION

1.14 Weapons Direction

(D. R. Israel) (CONFIDENTIAL)

A review of the operational use of the intercomm system in Room 222 had indicated some desirable changes. These changes will be written up by Orin Conant as a supplement to M-2187 ("Telephone Inter-communication System") and will be put into effect as soon as possible.

A review of the records and data taken in the past few months of operation has pointed out that several changes should be made in the log and summary sheets. C. Zraket and P. Cioffi have revised several of these forms and will issue them as a revision to M-2460 ("Non-Track-While-Scan Record Forms").

A proposal relative to the use of the Sector Command Post of the Cape Cod System has been prepared and issued as an inter-office memo for comment. It is recommended that the facilities of that room not be used at the present time for operation as a Sector Command Post but that the room be used for visitor demonstration and system evaluation until the Cape Cod programs are rewritten.

The preparation of memos describing the various functions of the 1953 Cape Cod System continues. Additional memos describing the standard operating procedures for personnel at various positions are also being prepared.

Progress continues on the preparation of proposals for evaluating the Non-Track-While-Scan functions of the Cape Cod System. Definite and detailed experimental programs are being set up. C. Zraket is coordinating this work.

We are continuing to receive suggestions and proposals for changes and revisions in the Weapons Direction section of the present Cape Cod program. Frank Heart is now collecting and integrating the various proposals. A decision on the date when the new program will be ready for operation has yet to be made.

On Monday, 14 December, a visit was made to Willow Run Research Center where various types of display equipment were viewed.

(H. Benington) (CONFIDENTIAL)

Five days were spent showing visitors through Room 222. It would be appreciated if any inter-office memos that deal with evaluation of the present system were shown to the guides. This should be one of the best ways of keeping abreast of the progress being made.

An edge-lit plastic label has been added to the FTU 5-inch scope at the P-station. Any comments on legibility or appearance would be appreciated.

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1.14 Weapons Direction (Continued)

(M. Brand) (CONFIDENTIAL)

Identification During this biweekly period the following proposals were submitted to D.R. Israel:

- a. Proposal for Semiautomatic Identification by the Digital Computer in the 1953 Cape Cod System.
- b. Proposal for the Evaluation of the Identification Section of the 1953 Cape Cod System.
- c. Proposal for the Integration of Proposed Computer Controlled ARTCC Systems with the AN/FSQ-7 System.
- d. Proposal for the Establishment of a Priority System of Identification.

Proposals a and d above concern themselves with an automatic evaluation of the identification situation with reference to correlation, geographical configuration, previous identity, and time in present identification. A score is computed on the basis of these four parameters and, in the case of a, the ID is changed automatically with a mandatory human override and in the case of b a priority score is indicated for each track.

The identification memo has been slightly rewritten to allow for the integration into it of the Georef to (x,y) conversion memo written by A. W. Curby. The drawings have been completed by the Drafting Room and are awaiting final acceptance of the memo.

It was hoped that the early warning feature of the Identification Section could be tested out this biweekly period. Arrangements had been made with Capt. Bergeson and Comdr. Hilgedick of the Navy to provide a picket destroyer to operate within our area of surveillance. The picket ship arrived but has been having trouble all this week with the teletype equipment aboard. It is hoped that the tests will be able to resume during this week.

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

The new TPS-10D height finder at South Truro is still not available for use. Truro Air Force personnel report that they are missing a vital part from the set. No firm availability date can be ascertained.

Maintenance at North Truro has kept the CPS-GE off the air most of this period. The MPS-4 at Nantucket is down for maintenance.

A calibration test run with the Pigeon Hill MPS-4 on 18 December showed that the weapon was fairly well calibrated in range and

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1.14 Weapons Direction (Continued)

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

azimuth but very poorly calibrated in height. An error of 4,500 feet in 10,000 feet was found at a range of 48 miles. Interested Group 22 people have been notified.

It is obvious that nothing worth while was accomplished with height-finding during this period.

Five AA-guidance missions were scheduled for this period. Four were canceled for lack of heavy aircraft.

On 11 December four tracks were simultaneously passed to the AAOC. The computer stopped while one track was still out of lock-on range. The other three tracks were acquired, and two were destroyed.

In an effort to overload the AAOC, 12 simulated tracks were passed on 17 December. The Cape Cod AA Talker handled the load well, and there seemed to be no signs of overloading at the AAOC. After some further experience of this sort has been gained, the track rotation interval on AA-guidance information will be dropped from 24 seconds to 12 seconds. New attempts will then be made to learn the load capabilities of the AAOC.

Several officers of the 15th Group, AAA, were present at each Cape Cod exercise this period. Their comments regarding the present and future systems are being considered.

(O. T. Conant) (CONFIDENTIAL)

Reports on operation of the intercomm system were obtained from Direction Center personnel (on report Form DL-843) and have been analyzed. A discussion of the system and desired changes was held with programmers and Air Force operators. In conjunction with D. R. Israel and C. Zraket, a major rearrangement of intercomm lines and facilities was decided upon; these changes will be accomplished as soon as possible and the intercomm system frozen for a period of months thereafter.

In addition to preparing the intercomm report form, some time was spent planning a similar report form for DID's and a procedure for monitoring the use of both these facilities in conjunction with the complete system evaluation which is now being organized by C. Zraket and others.

(F. M. Garth) (CONFIDENTIAL)

Difficulty encountered in the tracking of interceptors has brought about a revival of command tracking. Work has been resumed on

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1.14 Weapons Direction (Continued)

(F. M. Garth) (Continued) (CONFIDENTIAL)

this with consideration of how it might fit into the Cape Cod System.

While awaiting the arrival of critically needed data which will enable the Interception Group to go ahead with its derivation and verification of a minimum-fuel return-to-base equation, I have written a flow diagram and programmed in relative-address form a technique commensurate with the information thus far secured.

(C. Gaudette, S. Knapp) (CONFIDENTIAL)

The orders of three of the identification programs were classified according to five categories: indexing, logical, display setup and display, calculations, and master control references and parameters. It was then determined how many of each type are performed during any subframe as a function of the system's load. An inter-office memo was written describing this work and suggesting that the same tabulation be made for all NTWS subprograms.

Work was continued on the memo describing the NTWS program as a whole.

(C. Grandy) (CONFIDENTIAL)

An obscure logical error has been discovered in the display master-makeup program, giving incorrect "time-of-initiation" for interceptor tracks. After discussing this with the people using this information, it was decided to omit this function in the program. Consequently the "age of track" information on the DID's will be meaningless for interceptors until such time as the program is revised to include this feature again.

A review of the Cape Cod height finding has been undertaken preparatory to my assuming responsibility for the evaluation of this function in the Cape Cod System.

A large part of this past period has been devoted to showing the Cape Cod installation to various visitors.

(S. Hauser) (CONFIDENTIAL)

An analysis of the orders used in some of the identification programs of the Cape Cod System was made according to a formula devised by C. Gaudette. This analysis required detailed study of the programs.

With this knowledge I shall in the coming period assist M. Brand with an evaluation of the ID section of the Cape Cod System.

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1.14 Weapons Direction (Continued)

(F. Heart) (CONFIDENTIAL)

Preliminary consideration is being given to system modifications of the Cape Cod structure, primary attention being directed towards program logic. Redesign efforts are being based upon a greater similarity to an XD-1 system.

Some time has been spent doing guide work for the Cape Cod Direction Center.

Attempts have continued towards automatic order counts of the Cape Cod program. Certain technical aspects of the read-in program were neglected and caused trouble; further attempts will be made.

One day was spent giving technical assistance to W. P. Vogel, Division 2, in connection with production of a movie depicting the Transition System.

(W. Lemnios) (CONFIDENTIAL)

The following progress has been made relative to the return-to-base method mentioned in the last report. A recursion formula has been derived which will allow the computer to find the paths of minimum fuel consumption. A number of parameters such as maximum rate of ascent and descent, maximum altitude, etc., appear in this formula. Setting of these parameters and of different fuel characteristics will allow the minimum-fuel paths to be computed for any type of aircraft. A flow diagram has been constructed using this formula to compute the paths, and a program has been written in relative-address form. Receipt of fuel characteristics for various types of aircraft is eagerly awaited.

A proposal for the evaluation of the functions of the Intercept Director and the Intercept Technician and preliminary forms for this evaluation have been written.

A memo is being written explaining the climb characteristics of interceptors now in use and the simulation of these characteristics by the computer.

Some time was spent at the Intercept Director's position during last week's tests.

(L. Murray) (CONFIDENTIAL)

During the past biweekly period, a meeting at the General Electric Company, Electronics Park, in Syracuse, New York was attended. The agenda was the standardization of the General Electric data-link message function. An inter-office memo has been written concerning the outcome of this.

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1.14 Weapons Direction (Continued)

(L. Murray) (Continued) (CONFIDENTIAL)

The data-link tests held during this period have not been too successful. During the next two weeks it is planned to conduct tests with aircraft aloft using the mechanical message generator. An analytical study will be made of these results, and this will be given to A. Fullerton of Group 22 for recommendations.

A proposal has been written to evaluate the Radar Operator's control function. It is hoped that the data link will be operational so that such an evaluation can be made soon.

(J. Nolan) (CONFIDENTIAL)

The start of classes of the indoctrination program has been postponed until early in January. This was necessary since the Air Force personnel will not be available (due to extensive flight-test schedules and holiday leaves) until that time. Some time was spent working on the interception-program flow diagram, and rewriting has begun on the Weapons Direction and Assignment paper.

(G. Rawling) (CONFIDENTIAL)

During the past period the Teleregister installation program was established. J. Leary of Group 22 will finish the installation and checkout, and then cognizance will be transferred to J. O'Brien of Group 64. When it is operating successfully, a memorandum on its use will be issued by me.

Final draft of an equipment diagram of the Cape Cod System portraying data insertion, use of light guns, audible alarms and lights, special lights, link output, all types of data storage, and categories of 5-inch and 16-inch scope display, has been almost completed.

(F. A. Webster) (CONFIDENTIAL)

An inter-office memo has been written concerning two aspects of mechanisms for presentation and control in defense centers.

Reduction of decision field. It was pointed out that both the data presented to an operator and the field of possible action choices should be preselected along essential dimensions wherever practicable. More specific use of segregating, "clustering" and attention-getting devices was suggested. All complex fields should be structured along a number of distinctive dimensions, with a limited choice field in each dimension. Homogenous-appearing fields tend to cause confusion and delay. (The use of an action-indicating vibrator on the trigger of a light gun would be

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SECURITY INFORMATION

1.14 Weapons Direction (Continued)

(F. A. Webster) (Continued) (CONFIDENTIAL)

an example of functional clustering.)

Matching of communication symbolism. This aspect concerns the need to reduce insofar as practicable the transformations required to transmit instructions or data from person to person, machine to person, or person to machine. An example of matching symbolism in person-to-equipment transmission is the use of rotary switches for heading indications, the angle of the switch being made to correspond to the desired heading. (Verbal expressions of position or pattern are apt to be inefficient.)

An additional, previously discussed problem in this general area is the matter of time compression in displays. Events on scopes normally occur at rates far below those for which human perception of dynamic patterns are adapted. The evolution of a pattern, in other words, is far better evaluated when events are reviewed in speeded-up form. The use of such speeded-up reviews would also save a great deal of time for command personnel who must divide their attention along several channels.

A very rough General Communications Diagram (of the form of Cape Cod SB-56987) has been made of the Transition System. Since radical revisions are expected, this is for discussion purposes only.

(C. A. Zraket) (CONFIDENTIAL)

A heavy demonstration schedule for the Cape Cod System over the past two weeks resulted in a large amount of time being spent in conducting visitors through the Center. On the whole, equipment reliability and test results over the two-week period were very good although two power failures that occurred during the demonstration of 17 December nullified the continuity of that test.

The new log and summary and evaluation forms for the Cape Cod Center have been completed and will be put into use after the holidays.

A series of tests has been scheduled for this biweekly period for the purpose of checking the automatic ground/air data link. The message generator at WW, a monitor unit at Hanscom Field, and an F-89 equipped with an airborne receiver will be utilized for each test. The unit at Hanscom Field will monitor the transmissions. It is hoped that this series of tests will iron out the difficulties we have been experiencing in the reliability of the link and the airborne receivers.

An evaluation program for the Cape Cod System has been set up for the purpose of acquiring data which will aid in improving the System. The program will be effected by assigning a Group member to each station for the purpose of training personnel and monitoring operations during a test.

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1.15 Direction Center Operations

(P.O. Cioffi) (CONFIDENTIAL)

The following table summarizes the flight-test activity scheduled for the past period. Notice that, in the main, there has been a continued dearth of aircraft available for target purposes. A large portion of the scheduled tests did not go because of it.

The compilation of operations summary data has been held up unexpectedly due to a delay in the process of making the new versions of data and summary sheets available. This job should be completed for sure this next period.

The final-phase attack memo, "Final-Turn Intercept Equations," is also being readied for publication. It should be ready for issue before next year.

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DATE	T	SCHEDULED TEST		TEST ACTUALLY R		REASONS FOR CHANGES OR COMMENT
		A/C	Description	A/C	Description	
12/4	1300-1600	15	Combined Mission	-	Cancelled	Insufficient target a/c available
	1300-1400	1	Mark X Coverage	-	Cancelled	A/C Mark X inoperative
12/8	1300-1600	15	Combined Mission	-	Cancelled	Insufficient target a/c available
12/9	1300-1600	15	Combined Mission	-	Cancelled	Insufficient target a/c available
12/10	1200-1500	15	Combined Mission	-	Cancelled	Weather
12/11	1200-1500	17	Combined Mission	13	Held with only 3 target a/c	3 Target a/c aborted due to mechanical
12/15	1300-1600	15	Combined Mission	-	Cancelled	Insufficient target a/c available
12/16	1300-1600	16	Combined Mission	-	Cancelled	Insufficient target a/c available
12/17	1200-1500	16	Combined Mission	4	Held with only 3 target a/c	3 Target a/c aborted due to mechanical
12/18	1300-1600	1	Calibration	1	As Scheduled	

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1.15 Direction Center Operations (Continued)
 (P.O. Claff) (CONFIDENTIAL) (Continued)

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1.15 Direction Center Operations (Continued)

(E.W. Wolf) (CONFIDENTIAL)

The past biweekly period saw the Cape Cod System subjected to its severest test thus far. The 33 hours of operations included two periods of 9 consecutive hours each. This represents a new high for total hours of operations per biweekly period as well as for consecutive operating periods. The system performed smoothly throughout. The statistics follow:

	Last Biweekly Period		Cumulative Period (since 9/29/53)	
	Hours	Per Cent	Hours	Per Cent
Assigned Time for System Operations	33.3	100.0	118.3	100.0
Unrestricted Operating Time	23.3	70.4	52.4	44.3
Limited Operating Time	6.0	18.0	42.3	35.6
Down Time	4.0	11.6	22.1	18.6
Recovery Time	0.0	0.0	1.8	1.5

Time Lost (hours)	Limited Operations	Down Time	Limited Operations	Down Time
	Computer	0.0	3.3	0.0
Room 222	2.6	0.4	42.7	2.6
Radar and Input	6.1	0.0	34.4	0.0
Miscellaneous	0.0	0.0	22.8	0.0

(W. Vecchia) (CONFIDENTIAL)

Total Assigned Time	92 hours
Weapons Direction	0 hours
Track-While-Scan	24 hours 05 minutes
Combined	
N-T.W.S.	44 hours 45 minutes
T.W.S.	
Tracking and Control	11 hours 10 minutes
Total	80 hours
Time to Math Group	5 hours 20 minutes
Time to In-Out	50 minutes
Lost to Computer	5 hours 50 minutes
Total	12 hours
Grand Total	80 hours
	<u>12 hours</u>
	92 hours

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1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

December 7, 8, and 9 were devoted to discussions with representatives from Air Defense Command and ADES on the organization and related considerations of the Transition System. Discussions centered chiefly around the organization of the Combat Center and the definition of responsibility for weapons assignment and weapons direction. No definite decisions were reached, but a number of items requiring additional study were pinpointed.

The past two weeks have seen additional study of the XD-1 Digital Information Displays and Track Situation Displays. Firm proposals have been made for each and have been discussed with IBM. G. Conant and H. Benington are now preparing memos describing the proposals in full detail. M-2567, "XD-1 Display Information," (D.R. Israel) was prepared and issued during the past biweekly period.

M-2564, "XD-1 Order Code Studies," has now been supplemented by M-2572. This latter memo contains the final recommendations of Group 61 for the XD-1 order code. These proposals have been reviewed with IBM. Bill Lone will shortly prepare material describing the XD-1 order code as it will be used.

A number of studies concerning equipment requirements for XD-1 continue, but a firm floor plan and specification of various types of equipment still await review of the proposed organization of the XD-1 Center.

(H.D. Benington) (CONFIDENTIAL)

The proposals for track-situation display in the XD-1 system have been sufficiently fixed that an M-note is being prepared on use of MTC with the new Charactron tube to simulate XD-1 displays. This work should start in late January.

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

A joint Lincoln-Signal Corps Electronics Lab meeting was attended on 9 December in Belmar, N.J. The writer gave a talk on antiaircraft target designation results under Project Lincoln.

A liaison with SCEL staff members has been established for the exchange of information and suggestions regarding present and future (XD-1) AA guidance work. This was made easy by the fact that the SCEL-sponsored AN/GSQ-2 system of Improved Antiaircraft Operations will not appear in the area covered by AN/FSQ-7 until some time after the latter has been in operation.

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

(W.A. Clark) (CONFIDENTIAL)

With B. G. Farley a conversion program for the new MTC control equipment has been written and is to be punched directly from toggle-switch storage as soon as the machine is operating.

(O.T. Conant) (CONFIDENTIAL)

The proposal for digital information display which was prepared for and presented at the MIT-IBM Display meeting 4 December is being written up as an M-note; it is now in draft form and should be published early next period. More detailed decisions which affect DID System equipment design will be made as they are requested by Group 62.

Requirements for the AN/FSQ-7 intercomm system were discussed with L. Dorff and C. Smith of ADES (Bell Labs). An M-note by J. Bassett lists certain decision concerning AT&T - Bell Labs cooperation on communications-system design. A meeting of Group 61 personnel with H. Boehmer and R. Enticknap, Division 2, is scheduled for 21 December to discuss Enticknap's proposal for the intercomm system and Group 61's requirements based on Cape Cod evaluation.

(B. Morriss) (CONFIDENTIAL)

The question of light cannons or area separators for XD-1 has been discussed with members of Group 62 and a joint proposal made. The proposal is to treat light cannons exactly like other display consoles and to prevent the introduction of the same data to the input drum more than once by placing a shutter in the light-cannon display line which may be opened for one display scan at any time by a computer instruction. Operation in this manner places restrictions on the input drum which may be difficult to meet so that final consideration must wait for the design of the input drum.

An investigation has begun on what alarms should be available for XD-1. Any thoughts on this subject will be welcomed.

1.17 Associated Studies

(B. Smulowicz, W. I. Wells)

This work is reported in M-2577 (SECRET).

CONFIDENTIAL

SECURITY INFORMATION

1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

Efforts of the systems group during the past biweekly period have been largely concentrated on the task of cleaning up odd jobs with an eye to long-range improvement in system reliability and operating speed.

Many of the computer flip-flops are coupled to their loads through condensers, and it is necessary for the computer to pause occasionally to restore the charge on these condensers. The flip-flops in the parity register are being d-c coupled to their gate tubes. This change to d-c coupling will eliminate the need for restoration and will result in a decrease in memory access time.

The auxiliary-drum system has been giving some trouble due to spurious writing between the slots. This was partly due to power failures, but the system seems to be more sensitive than necessary to malfunctions of this type.

A new real-time clock is being installed in the computer room to take the place of the one now in Room 224. The new clock will have nineteen digits instead of the present fifteen. There will be provisions for reading out the most-significant- or the least-significant-fifteen digits, giving a coarse and a fine time-reference. The new clock will have provisions for marginal checking which should improve reliability of operation.

1.21 WWI Systems Operation

(N. L. Daggett) (UNCLASSIFIED)

Since no objections have been raised, the slight modification to the op order suggested by Helwig and Arden (in M-2560) will be installed on the next installation day.

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

A parity-register panel having d-c coupled flip-flop and cathode-follower circuits was installed as digit 1 of the parity register on 12 December. We will install these modified units at the rate of two or four per week depending on the work load of the systems group.

A replacement for the time-pulse-distributor output panel has been ordered. The unit in service has had several phenolic breakdowns due to silver migration between turret lugs. The new unit will probably be ready for service by 1 February,

1.21 WWI Systems Operation (Continued)

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

A timing difficulty on Time Pulse 1 of the bi order was corrected by the addition of a small delay and the modification of our Type II register-driver circuits.

Magnetic Tape

(E. P. Farnsworth) (UNCLASSIFIED)

Two samples of high-output mylar base Audiotape received from Audio Devices, Inc. have been installed on units 3A and 3B for testing and observation. Results so far indicate performance equal to MMM #120.

The proposal of Group 6345 to connect an FL Flexowriter to magnetic tape Unit 2 has brought understandably little enthusiasm from Group 64. The combination of two complicated mechanical devices subject to appreciable friction for each word processed, each requiring manual manipulation of a recording material, and having many necessary controls and buttons which do not lend themselves to completely automatic control is not an ideal output for a high-speed computer. It is hoped that efforts to speed up delivery of scope-camera output will reduce the load on delayed print-out equipment. It is worth noting, however, that the delayed print-out has been controlled by breadboard equipment since its inception except for a period of about one month, during which the shop-built control-register panel for the old-style Flexowriter was in service, until the changeover to new-style FL equipment was made. The final production FL control-register panel is now nearly ready for installation.

A print-out program alarm circuit has been devised which will detect the presence of more or less than one complete Whirlwind word per magnetic-tape reading cycle. A similar device to detect recorded "illegal" Flexo codes is also being considered.

Auxiliary Drum System

(K. E. McVicar) (UNCLASSIFIED)

We have had trouble with writing between the slots on several occasions during the past biweekly period. The effect of such spurious writing is to give intermittent read-out, and it is thought to be caused chiefly by two factors: (1) There have been several power failures of a type where the supply voltages to the drum are not turned off in the proper sequence. (2) The copper slug in the new head seems to confine the writing

1.21 WWI Systems Operation (Continued)

Auxiliary Drum System

(K. E. McVicar) (Continued) (UNCLASSIFIED)

flux somewhat more than was the case in the old plastic-mounted head. This fact, along with the smaller writing current used in the new head, decreases the spread of the flux pattern on the drum surface.

Modifications of power-supply control are now being considered to reduce the possibility of spurious writing due to improper sequence of power turn-off. The effect of variations in write-current amplitude and pulse width are being studied to see whether we can reduce the effect of any between-the-slot writing which should occur by adjustment of these parameters.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Demurjian has requested that the direct-output punch be modified to permit making short insertions in the tape through manual operation of the typewriter keyboard. We are now completing a panel for the typewriter table which transfers control of the punch to the keyboard only while the operator depresses a pushbutton.

To prevent overheating of the code magnet coils in our punches, we are modifying the direct-output punch and paper-tape verifiers by inserting 800-ohm resistors in series with each code magnet coil. Farnsworth will make similar modifications on the delayed-output punch.

1.22 Terminal Equipment

(R. H. Gould) (UNCLASSIFIED)

A new real-time clock or timing register will be built up of plug-in units and installed in rack E7 in about one month. The register will have 19 binary digits and will have a smallest time increment of 1/15 second as does the present register. The 19 digits will provide a maximum time count of about 9 3/4 hours for use with automatic program logging. The si address now used will read the 15 less significant digits of the timing register to the right 15 digits of the IOR. The present use of the timing register will not be affected. A new si address will read the timing register to the IOR also but will suppress the readout of the 4 least significant digits and read in their place the 4 most significant digits into digits 12 - 15 of the IOR. The unscrambling of the resultant number is easily programmed. WWI circuits and marginal checking will provide increased reliability of the timing register.

1.22 Terminal Equipment (Continued)

Display

(T. J. Sandy) (UNCLASSIFIED)

This biweekly period was spent designing and testing a balanced decoder.

MITE

(R. Paddock, A. Werlin) (UNCLASSIFIED)

The switch panel which changes MITE 3 with WWI to MITE 4 with the buffer drum is installed and operates satisfactorily. MITE 0 in L-1 is now complete and has run successfully with existing check programs for MITE.

Program T3182, Mod 9, has been run successfully, thus checking the satisfactory operation of MITE units 0, 4, 5, 6, and 7 with the buffer drum using computer-simulated data. Units 0, 6, and 7 have been used successfully with recorded data.

The special demodulator for MITE 0 has been installed in rack K-11, Room 156; this unit has been tested and should be connected into the existing permanent system some time during the week of 21 December.

Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

In a few places in the drum systems it seems necessary to use the 0.1- μ sec pulses supplied by the computer proper rather than convert them to the usual 0.5- μ sec pulses for which the drum circuitry was designed. A pulse converter-standardizer giving a variable width pulse -- < 0.1 to 0.6μ second -- at repetition rates of 200 kc or more has been built to determine the reliability of these circuits with various pulse widths. This converter-standardizer, built in breadboard form, is nearly debugged and will be ready for testing purposes soon.

Test data obtained from the flip-flop writer indicates that a few fairly simple circuit changes should prevent writing between slots when the power is turned off. Though these changes are not expected to affect normal operation of the circuit, the modified circuit will be tried in the drum system before final modifications are made.

1.23 Records of Operation (Continued)

Component Failures in WWI

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

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Tubes</u> (Continued)			
6AG7	1	17000 - 18000	Broken base
6080	1	0 - 1000	High screen cut-off
715B	1	0 - 1000	Mechanical
715C	2	0 - 1000	1-gassy, 1-short
7AK7	1	22000 - 23000	Low I _b
6145	3	0 - 1000	1-shield short, 1-broken envelope 1-low I _b
	4	1000 - 2000	3-short 1-grid emission
	1	4000 - 5000	Short
	1	1000 - 2000	High grid cut-off
7AD7	1	6000 - 7000	Leakage
	2	7000 - 8000	1-short, 1-interface
	2	8000 - 9000	Short
	3	17000 - 18000	Short
	1	18000 - 19000	Short
	1	20000 - 21000	Low I _b
	4	21000 - 22000	3-short, 1-low I _b
7	22000 - 23000	6-short, 1-low I _b	

1.24 General

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

The WWI +150-v, 50-amp d-c supply has been rebuilt, and the new regulator section is being tested.

Studies are being made to lengthen thyatron life in the larger supplies.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (CONFIDENTIAL)

One Charactron tube was reprocessed with a small-angle electrostatic-deflection system in the deflection-yoke region for character compensation, character position, and making vectors. This tube was evaluated by C. L. Corderman.

The work on the helical dag coating which permits a low voltage in the deflection region and a very high voltage at the phosphor screen has been progressing very satisfactorily.

Work on transparent phosphor films and electroluminescent coatings for Group 25 was continued during this period. Two research tubes were made for Dr. W. L. Gardner of Group 25 to evaluate self-sustained emission from magnesium-oxide films.

The IBM Tube Group at High Street worked two days with us at Cambridge the week of 7 December. During the week of 14 December one day was spent at Tung-sol on the 5998 tubes. One day was also spent at the Evans Signal Corps Lab on the 2D21. Two days were spent with the Tube Group of High Street at Poughkeepsie. We worked on reliable-tube problems.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

A 1/16-inch wide spiral line, five turns per inch, was successfully inked onto a 2-inch-diameter glass cylinder during this past week. The continuous length of this line approximately 35-ft long was limited only by the length of the cylinder used. The resistance of the line measured 800 megohms. Two samples were prepared to investigate effects of bakeout and application of chromic oxide onto this ink. An infinity reading of this line after bakeout indicated that the ink had been standing too long before application onto the glass. It was also noted that best results were obtained from baking the ink at 350 C before applying the chromic oxide. Therefore, additional samples will be prepared in our laboratory. We will use the lathe that has been recently obtained and readied for the purpose of applying ink helices onto the funnels of the Charactron tube blank.

Samples of phosphors and cadmium-sulphide sprayed onto stannic-oxide-coated plate have been prepared by a spray technique and will be available for evaluation after bakeout.

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SECURITY INFORMATION

SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

Outputs

(I. Aronson, H. Rising) (UNCLASSIFIED)

A one-register model of the phone-line buffer has been built and operated. Margins are not yet satisfactory, but it has been demonstrated that a core shift register may be read into by coincident current and read out serially.

Our schedule for the coming period includes adding another register and replacing the toggle-switch write control with flip-flops.

(R. C. Jeffrey, R. C. Hopkins) (CONFIDENTIAL)

A schedule for design of the output frame was presented by D. C. Ross of IBM and agreed upon at a joint meeting on outputs 18 December 1953. The schedule is based upon test and delivery of the output frame by 1 April 1955. Final performance specifications are to be furnished by 1 March 1954, and all circuit development is to be completed by 1 July 1954.

Mr. J. V. Harrington of Division 2 circulated for comment a proposal, PLJ-596, on "Automatic Output Circuits for FSQ-7," dated 7 December 1953.

It is anticipated that those groups in Lincoln who have primary interest and responsibility will set up such meetings with AN/FSQ-7 output users and other concerned parties as may be required to arrive at decisions on such items as phone-line bit rate, responsibility for supplying phone-line receiving equipment at the user end, information to be furnished certain outputs, etc. These decisions, insofar as they may affect equipment design, should be made in time to permit final performance specifications to be written by 15 February 1954.

Shift-Register Evaluator

(C. J. Schultz) (CONFIDENTIAL)

The system has been completely checked out and now automatically produces information which appears to be reliable enough to be used in determining the most desirable shift-register drive current and components combinations. IBM has sent us cores to be tested in their original register in order to observe the effect of variations in magnetic-core characteristics upon the operation of the register.

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2.12 Magnetic-Core Memory

64 x 64 Memory

(E. A. Guditz) (UNCLASSIFIED)

All of the memory planes for the Core Memory, Mod. II, are completed. One of these is now being tested in Memory Test Setup VI, and the others are being assembled into a memory stack.

Core Memory, Mod. II

(W. Gandy, J. Mitchell) (UNCLASSIFIED)

Power has been applied to the array tester. The system is being run with one 64 x 64 plane, the outputs of which look very promising.

Planar Core Switch

(J. Raffel) (UNCLASSIFIED)

Tests are being run to determine satisfactory means of sensing and inhibiting on a single multiturn winding.

The plugboard switch is being filled with additional cores to simulate 16 x 16 operation.

2.13 Vacuum-Tube Circuits

Magnetic Drum

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

Tentative agreement has been reached on a method for preventing the transient due to writing from blocking the read amplifier. For XD-1 when a field is selected both the read and write circuits are connected. If the field is then to be written on, the read amplifiers are disconnected.

The possibility of using a high-impedance head is being investigated. The head would allow the use of less current for writing and produce a higher playback voltage. It is hoped that sufficient data on this head and the ordinary head can be taken so that a decision can be reached soon.

2.13 Vacuum-Tube Circuits (continued)Magnetic Drum Write Circuits

(S. Bradspies) (UNCLASSIFIED)

Tests have been run on the 7AK7 and the 5998, the two possibilities for writing tubes. The tests consisted of applying 2- μ sec pulses every 10 μ seconds (20 per cent duty factor) to the grids of the tubes, for various values of pulse heights, plate-supply voltages, and in the case of the 7AK7 various suppressor voltages.

The current drawn by the plate and the current in the magnetic head were measured; also, in the case of the 7AK7, suppressor current was measured.

The results of these tests have not yet been evaluated.

Time-Pulse Generator

(H. Boyd) (UNCLASSIFIED)

Tentative agreement with IBM has been reached to replace the 13-bottle constant-volume amplifier time-pulse generator by the new 8-bottle time-pulse generator described in M-2561.

High-Speed Flip-Flop

(G. A. Laspina) (UNCLASSIFIED)

Various methods of eliminating the prf sensitivity of the input transformer when it is being driven from many inputs are being investigated.

The following input circuits with 10 inputs have been tried thus far:

1. Present input circuit.
2. All input diodes in parallel driving the input transformer through a 100-ohm resistor.
3. Same as 2 except that a diode replaces the 100-ohm resistor.
4. Present input circuit except that the diode and 560-ohm resistor in secondary were removed.

Of these, circuit 3 has operated best.

2.13 Vacuum-Tube Circuits (continued)Mod.VII Core Driver

(D. Shansky) (UNCLASSIFIED)

A prototype of the negative half of the driver has been designed and is presently being constructed. Design work on the positive half has been initiated.

Delay-Line Circuits

(J. S. Gillette) (UNCLASSIFIED)

Slight changes are being made to improve delay-line circuits, especially when being used at pulse rates higher than 1 megacycle. These changes reduce the prf sensitivity to less than a 3 per cent variation in the amplitude of the output pulse for bursts of input up to 2 megacycles.

The 4:1 transformers have arrived from Sprague, and work on the memory pulse distributor will be resumed.

Single-Shot Multivibrator

(H. J. Platt) (UNCLASSIFIED)

A single-shot multivibrator circuit has been found which has many features that will make it stable. The pulse-width stability is almost entirely dependent on the stability of the components forming the RC timing network. It uses three cathodes. The circuit is being designed to use 5965's and is about to be tested.

Gate-Tube Circuit

(H. J. Platt) (UNCLASSIFIED)

Memorandum M-2549, "The High-Speed Gate-Tube Circuit," has been sent to the Print Room for reproduction.

Typotron Display

(H. J. Platt) (UNCLASSIFIED)

A demonstration of a new character-display unit, the Typotron, is to be set up in MTC. The typotron is a 5-inch CRT which employs a character matrix and a storage surface. The character to be displayed is written once and stored on the phosphor in a manner similar to that used in the MIT electrostatic storage tube.

2.13 Vacuum-Tube Circuits (continued)

(H. J. Platt) (UNCLASSIFIED) (continued)

The major problem is to design a deflection amplifier so that all points on the character matrix will register on a point. A feedback amplifier with high forward gain is being designed.

Magnetic-Deflection Amplifier

(B. Remis) (UNCLASSIFIED)

Using the results of a transient analysis of the plate voltage at the output tube, a preliminary design of a deflection amplifier has been completed. The main feature of this amplifier is the replacement of the ~~6X50-A~~ or 6161 output tube by 5998's, thus eliminating the need for blowers.

2.14 Memory Test Computer

General

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

The computer has been shut down since 9 December for installation of new cables and logical units in central control. The installation was substantially complete by 15 December and is now being thoroughly checked.

Certain logical conveniences will be provided to facilitate display work: digits 13 - 15 of the accumulator will be available on display instructions for such purposes as selecting which scope to intensify. As soon as MTC is back in operation, tests of the Hughes Aircraft "Typotron" will commence. This tube requires an "erase" instruction, for which we shall temporarily use the "index camera" instruction since the camera control equipment is not yet installed.

Central Control

(P. R. Bagley) (UNCLASSIFIED)

The changes in central control, which were enumerated in the previous biweekly, have been completed. A thorough check of all changes is being made before power is to be turned on.

2.14 Memory Test Computer (continued)Read-In & Conversion Programs

(P. R. Bagley) (UNCLASSIFIED)

General agreement has been reached among those interested in the read-in program. A description of the read-in program and of the structure of input paper tapes will be published in the near future. W. Clark and B. Farley are working on a "stop-gap" conversion program, handling octal constants only, which will serve until a more comprehensive conversion program is ready.

Magnetic Drum

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

Wiring has been started on the coincidence-detector panel, and it should be ready for installation within a week.

Chassis are being built for the read amplifiers, special parts have been ordered, and drawings are being made by the Drafting Room.

A timing panel is being built containing a time-pulse generator and a read amplifier. The read amplifier will be used on the index track and will be strobed by the time pulses.

A preliminary layout of the crystal switch for reading is being made.

Ferranti Tape Reader

(B. Farley, R. Hughes) (UNCLASSIFIED)

The photoelectric tape reader has been sufficiently equipped with auxiliary circuits so that it could be tied in to the computer on a moment's notice; however, it is felt desirable to insert delay (of the order of 1 millisecond) in applying the brake so that tape feed will be continuous rather than intermittent for normal block read-in. This should reduce both noise and wear and will probably be completed in the next two weeks.

Panel Storage

(J. Crane) (UNCLASSIFIED)

Open wire lines connecting plugboard storage, toggle-switch storage, and the panel storage read-in gates to the A-register in MTC have been replaced by coaxial cables. This change reduced the setup time required for

2.11 Memory Test Computer (continued)

(J. Crane) (UNCLASSIFIED) (continued)

panel storage and also eliminated the serious noise problem that resulted from capacitive coupling between digit lines.

Automatic Memory Display

(J. Crane) (UNCLASSIFIED)

An arrangement for viewing the contents of any digit plane of the magnetic memory will be available in MTC. Circuits which enable the operator to choose any one of the 17 planes by the use of a 17-position switch on the console have been designed.

Power-Supply Control

(D. M. Fisher) (UNCLASSIFIED)

Discussion periods were held with MTC personnel and persons familiar with WWI's power-supply control concerning the system to be used in MTC. It was decided, because of new additions and restrictions that have developed since the first system was designed, that a new control was needed.

The block diagram for the new system is near completion. It is hoped that during the next period the new design will receive approval from all concerned.

MTC Installation

(R. Hughes) (UNCLASSIFIED)

Work is continuing on wiring for drum equipment and the new 64 x 64 magnetic memory. The "shower stall" frame is assembled, and several panels have been installed.

MTC Records

(L. Sutro) (UNCLASSIFIED)

Revision of MTC drawings is proceeding slowly but should accelerate as more help is assigned to it. The first of a series of charts has been prepared to show present and new drawing titles, and present and new drawing numbers.

2.14 Memory Test Computer (continued)

(L. Sutro) (UNCLASSIFIED) (continued)

The preparation of cards carrying the history of each panel is likewise proceeding slowly but should accelerate when a girl is assigned full time to this job.

MTC Logbook Summary

(B. Kollet) (UNCLASSIFIED)

Filament Clock Hours (A-C):	1878.7 to 1888.4	(9.7 total hours)
Plate Clock Hours (D-C):	1608.7 to 1616.0	(7.3 total hours)

Breakdown of D-C Hours

*Development:	1.8 hr
Installation:	.2
Routine Checking Programs:	3.6
Marginal Checking:	---
Trouble Shooting:	1.7
Programs:	---
Total D-C Hours -----	<u>7.3</u>

*Development: Charactron -----	.9 hr
Ferranti Tape Reader -----	.9

Total --1.8

2.15 Equipment Design and Schedules

(W. H. Ayer) (UNCLASSIFIED)

Detail design work on the XD-1 building is now under way, with Divisions 6 and 7 of Lincoln, IBM, Francis Assoc., and Cleverdon, Varney and Pike all contributing to the end result. Heat loads and physical dimensions of all frames and assorted card machines and consoles are being brought up to date before 1 January to allow Francis Assoc. to start their final cooling-equipment calculations at that time. Tentative floor layouts for the computer, drums, power supplies, and display frames have been reviewed at IBM and will be circulated at MIT before the final building plans are frozen 1 February 1954.

Preliminary discussions have also been held with Western Electric and Bell Labs on the requirements for future production buildings.

2.15 Equipment Design and Schedules (Continued)

(J. D. Bassett) (UNCLASSIFIED)

The first display-console mockup arrived at the Barta Building on 7 December and has been inspected by most of the interested persons in Division 6. A memo has been sent requesting visits from interested people in Division 2. Comments are being written up and evaluated for return to the IBM people in the near future.

A meeting was held with Mr. L. Dorff of ADES and Mr. C. Mankiewicz of IBM Vestal Lab on 8 December to discuss internal-communications panel design for the XD-1 display consoles. Results are written up in M-2559 (Restricted).

The Lincoln Lab Standards Subcommittee on Good Construction Practice met on 9 December. An abstract of minutes of this meeting is written up in memo LS-33.

In a trip to IBM Plant II last week to inspect methods used in printed-circuit fabrication, it was found that silver is deposited in drilled-thru holes before copper-plating. Several samples were brought back for testing. B. Paine's people will try to set up a test method for accelerating silver migration, in an attempt to determine if silver used in this process may be undesirable. Various possible materials for printed-circuit laminates are being investigated. IBM seems to prefer "EPOGLAS," a glass-cloth epoxy resin laminate, but final choice of a material has not been formally made yet.

(P. J. Gray) (UNCLASSIFIED)

Amendment 1 to the AFCRC Exhibit 1 covering general specifications for the XD-1 and XD-2 prototypes has been prepared in draft form and distributed for comment. It is hoped that this amendment can be presented to AFCRC in final form by the end of December.

IBM is spending considerable time generating detail time schedules for the remainder of the work on the prototypes. The work for the next three months is being scheduled with a high degree of detail. Later work is somewhat less detailed. Some of these schedules should be available here by 23 December.

(J. Giordano) (UNCLASSIFIED)

The construction progress reports of XD-1&2 will appear in the Biweekly Progress Report of the AN/FSQ-7 prepared by P. Gray. The first of such information will appear in the forthcoming issue.

2.16 Transistors

(D. J. Eckl) (UNCLASSIFIED)

The control unit for the accumulator has been changed from Burroughs test equipment to WW plug-in units. This results in a considerable saving in space and power. The accumulator has been in operation 9200 hours.

The fifth note on semiconductor physics should be available as M-2562. This deals with the differences in conductors, semiconductors, and insulators. The next note in the series will discuss "holes" and electrons. A series of notes is being prepared which will show the properties of the various types of transistors we have on hand.

2⁵ Counter

(E. U. Cohler) (UNCLASSIFIED)

The 2⁵ counter has been running for 408 hours since its last error. This circuit seems to be quite reliable. However, for simple counter applications it now appears that some simple circuit may prove to be as reliable and require only one transistor per stage. As work on such circuits progresses it becomes evident that transistors will not operate at the power levels at which vacuum tubes operate. This means that adequate precautions must be taken to eliminate extraneous noise. However, the power levels of the present transistors do not seem to make this an insurmountable problem. Reliability and stability can be increased by simple shielding and filtering, for instance. In several cases it has been noticed that pulses from adding machines and flickering fluorescent tubes have complemented flip-flops.

Current Flip-Flops

(E. U. Cohler) (UNCLASSIFIED)

Studies indicate that current flip-flops (that is, those employing current supplies and switching currents) are extremely reliable, work with practically any transistor, are fast, and are stable. Their design is simple since design and practice seem to correspond. Moreover, their high current output is excellent for shipping over lines. Their chief disadvantage lies in the unused power which must be dissipated to provide current sources. In present circuits this seems to be of the order of 1 watt per flip-flop. This still compares favorably to perhaps 12 watts in a vacuum-tube flip-flop.

2.16 Transistors (continued)Triggering Studies

(E. U. Cohler) (UNCLASSIFIED)

Jim Ahlgren has been conducting studies on the attributes of various triggering circuits for flip-flops. At present, the dependence of triggering upon the condensers involved in a circuit, the width of the trigger pulse, and the amplitude of the trigger pulse are being considered. Two or three different types of circuits will be tried with at least three different triggering schemes in this set of tests. It is then projected that maximum prf be correlated to the above tests. These results will be reported in a comprehensive note.

Diode Construction

(N. T. Jones) (UNCLASSIFIED)

Work is now being done on control devices for the last phase of my thesis. This consists of making small-area "storageless" bonded diodes. The control device under consideration at present is a limiter for the bonding operation. This device is intended to put out a large pulse when the control voltage goes below a set value. The control voltage is almost direct, an exponential with a time constant of about 0.2 second. The discrimination goal is 0.1 volt out of a total swing of 10 volts. Circuits considered to date have been unsuccessful although possibilities still exist.

Transistor Core Drivers

(S. Oken) (UNCLASSIFIED)

The delay-line-type core driver has been running continuously for the last 3 weeks at a read-write repetition cycle of 28 kc. Although the r_{CO} 's of the transistors dropped initially, they seem to have leveled off. This may have been due to the collectors being formed a little more by operation in the driver circuit. The α 's seem to stay constant. This test will continue for a few more weeks.

Work has begun on a junction-transistor core driver. The grounded-emitter connection seems the most promising since current gains of up to about 15 can be obtained. The main drawback is the low frequency response. By driving the amplifier way into the saturated condition, the output current can be stabilized and the rise time decreased, but a loss of gain results. The input pulse to the driver will come from a flip-flop. The problem of coupling the two circuits is being investigated now.

2.16 Transistors (continued)Transistor Gates

(C. T. Kirk) (UNCLASSIFIED)

Marginal parameter curves were taken of the transistor gate under development. In general the curves showed that the design values are quite satisfactory placing the normal operating point well away from the marginal operation locus.

A low $V_{c_{31}}$ was found to be a significant parameter in determining whether a particular transistor will operate in the gate circuit. Investigation showed that a low $V_{c_{31}}$ was a necessary condition in preventing what might be called a residual N curve from forming in the emitter circuit. If the N curve is present, triggering the gate will cause the circuit to try to switch to an unstable "on" condition. Under such condition the gate will give a small output pulse of unusable amplitude.

2.17 Display

(G. Corderman) (CONFIDENTIAL)

The first Charactron tube utilizing electrostatic compensation was evaluated during this period. While all parameters of the tube were not optimum, it was apparent that this scheme is feasible and should be used. The gain in character-writing speed will be utilized in reducing the display cycle time toward 2 seconds and/or relaxing the specifications on the magnetic yoke.

A Typotron tube (Charactron matrix plus Hughes direct-view storage surface) has been tested briefly. The registration, resolution, and writing time were found to be adequate for the DID application. Plans have been made for a life test of 8 tubes, and another tube is being tied in with MTC. A recommendation to use Typotron tubes in XD-1 must await the results of these two tests.

Final proposals for the TD and DID systems will be available in memos by the end of December. These proposals should be very close to operating specifications since they have been drawn up in close cooperation with Group 6L. Methods of display selection at the main display frame are being studied. It is felt that the power which must be supplied by tube cathodes can be reduced by using this method rather than providing display selection at each console. An additional saving could be obtained if a list of the display requirements at each console were available.

~~CONFIDENTIAL~~

SECURITY INFORMATION

2.17 Display (continued)

(M. Epstein) (CONFIDENTIAL)

Work on a memorandum about the newly proposed digital-display system was stopped because Group 61 is writing a report on the same system.

A study of a multiple-coordinate system for selecting digital-display slots was started. Detail evaluation of several variations will be continued to make a first approximation to the equipment required.

(J. Woolf) (UNCLASSIFIED)

A new decoder amplifier has been designed and tested. This amplifier converts a single-sided signal into a push-pull output with a gain of 2, for an input of 0-2 volts.

A d-c amplifier to drive several hundred feet of twin cable has been breadboarded. This amplifier will be tested in the coming period, with the objective of arriving at a figure stating how many feet of cable can be driven for a given output stage with a specified rise time.

Several schemes for generating vectors have been analyzed, and at present a breadboard is being built which will generate vectors in the four quadrants. The method used is to apply a half cycle of a sinusoid in phase to the x and y plates and modulate the amplitude of the wave with the vector decoder-output level.

(R. H. Gerhardt) (CONFIDENTIAL)

The digital-expansion switching circuit discussed in M-2537 was modified to blank the display scope if an operator made an improper selection and to allow the intensification-pulse gating to be done at the display frame. The most economical method of accomplishing the second item requires that

- a. Each console must have a separate intensification line from the display frame,
- b. The most significant digits of the x and y decoders must each have a separate line from the display frame, and
- c. The "1" side of all the deflection digits must be transmitted to the consoles on a "party-line" bus (26 lines).

Some time was spent with R. von Buelow discussing the word layout for the display drum and the logic for the display frame.

~~CONFIDENTIAL~~

SECURITY INFORMATION

2.17 Display (continued)

(L. B. Martin) (UNCLASSIFIED)

Facilities for demonstrating the Hughes Typotron tube have been completed.

Work is in progress for building a life tester for the Typotrons capable of testing 8 tubes. An array will be written on the tubes, held for 15 seconds, then erased.

Tube mounts have been electrically designed and partially mechanically designed. A tentative erase-gate circuit is about ready for breadboarding. The logic is drawn.

(R. von Buelow) (CONFIDENTIAL)

Group 61 agreed on their latest requirements for the display system. These include an 18th character, a new method of locating characters with respect to the point, a 7-bit vector decoder, plus some other small details. Specifications for the display system can now be written.

Opinions of all concerned persons on console design were collected and given to John Newitt who is preparing a memorandum for the guidance of the IBM personnel at Endicott in designing the next console mockup.

A proposal of a light-cannon system will be available next week.

~~CONFIDENTIAL~~

SECURITY INFORMATION

2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

The coordination of measurement techniques and the calibration of equipment took highest priority during the last biweekly period. Disagreement had become apparent among General Ceramics, IBM, and MIT. This disagreement had to be corrected before core testing for XD-1 could continue. At the same time, some clarification and minor revisions in the specifications are being made. A team from MIT devoted their time during the week of 14 December to the coordination of technique and calibrating of equipment at MIT, General Ceramics, and IBM (High Street).

A pilot-production lot of 20,000 memory cores is being processed here at this time. These cores should have usable characteristics. Results of sample tests should be available for the next Biweekly Report.

Study of Mn_3O_4

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

The relation between bonding type and magnetic exchange has been examined further. It is now believed that atomic orbitals can participate either in covalent bonding or in magnetic exchange, so that the two effects are complementary.

The forces that hold a cation in a certain crystal-lattice site are similar to those that form complex ions in solution, for in both cases they determine what configuration of molecules, atoms, or ions tends to surround the cation. Therefore, complex ions in solution are being studied extensively. Ordering in Mn_3O_4 is an electronic rather than ionic ordering. This means that the ordered distribution is disturbed not by ionic diffusion but by electrons breaking away from the positions in which they had been frozen. It is now believed that it is the covalent bonds which are responsible for holding electrons in definite positions.

Microstructure Study

(J. B. Goodenough, F. S. Maddocks) (UNCLASSIFIED)

Materials rich in manganese exhibit the Widmanstätten structure which was predicted for them on the basis of $2MnO_2$ precipitating on {101} twinning planes. (cf. M-2473). The compositions most sensitive to a N_2 atmosphere have yet to be more thoroughly investigated.

2.2 Group 63 (Continued)

Ferrite-Core-Data Analysis

(J. B. Goodenough) (UNCLASSIFIED)

Contour maps which summarize the work to date on B_s , R_s , H_s for cores fired at 1300 C, 1350 C, 1400 C, 1450 C are being drawn. Similar maps are being made for the refired cores.

Magnetic Anneal of Ferrites

(P. K. Baltzer) (UNCLASSIFIED)

Ferrite samples which had been given a magnetic anneal have been given another anneal without a magnetic field. It was found that the magnetic properties were all changed in a direction opposite to that change due to the magnetic anneal. Although the degree of reversibility varied considerably from composition to composition, these results do indicate that the effect of the magnetic anneal is to tend to increase the squareness. A more refined experiment has been initiated which will use control samples to ascertain the actual effect of the magnetic field.

RCA Ferrite Cores

(F. S. Maddocks) (UNCLASSIFIED)

In response to a request by RCA, a series of RCA cores of F-394 size from lots ZF-175, XF-357, XF-348, and XF-345 have been individually pulse tested and mounted for microstructure analysis, keeping the identity of each core for comparison purposes.

Results of these tests have shown no correlation between an individual core and its pulse response. It has not been possible to distinguish to which lot a core belongs by differences in microstructure, and cores of poor pulse response cannot be distinguished from those of good pulse response within the same lot.

(P. A. Fergus) (UNCLASSIFIED)

During the past biweekly period several lots of RCA cores were tested for delta. Lot XF-345, tested at 820 milliamperes and at 28 C, showed improvement over Lot XF-175 at strobe time but the peak delta values were larger. Since this lot meets specifications, it will be put into a plane. XF-345 is made up of a number of lots, of which two were tested, XF-348 and XF-357.

2.2 Group 63 (Continued)Ferrite-Domain Studies

(D. A. Buck) (UNCLASSIFIED)

Window-frame shapes are being cut from ferrite single crystals with easy directions of magnetization along the legs of the frame so as to achieve a very simple domain pattern. Similar experiments, reported by J. K. Galt of Bell Telephone Laboratories, have yielded data valuable to the study of domain-wall motion in ferrites. With such a simple domain pattern, the voltage transient associated with switching is expected to be a rectangular pulse since there is a simple wall-motion switching mechanism involved. We hope to actually see the path of the domain wall by using colloidal magnetite particles on the polished and lightly etched face of the window frame viewed through a microscope. The window frame must be cut from a single crystal slice which has been carefully oriented by X-rays to be a crystallographic (110) plane. Cutting is then done on Raytheon's Ultrasonic Machine Tool using a "cookie-cutter" die made in the proper shape. This last cut must also be X-ray oriented at the proper angle to give $[111]$ directions (the easy direction for most ferrites) along the legs of the window frame.

So far, two slices of a Linde nickel-ferrite crystal (with a small percent of zinc) have been run through the entire process along with several polycrystal practice slices. The practice frames came out very well, but the crystal slices shattered during cutting. One of the two, however, yielded a frame in two pieces, separated by clean breaks at the two sharpest corners of the diamond-shaped frame. Unfortunately, however, the two pieces remained in the abrasive slurry with the ultrasound turned on long enough to grind them so badly as to be unusable. The next runs will be done using thicker slices which should be less fragile. Also, polishing (a long, tedious process) will follow rather than precede cutting.

Round-Robin Calibration

(J. Childress, J. Schallerer) (UNCLASSIFIED)

During the last biweekly period, we made a calibration trip to General Ceramics, IBM (High Street), and IBM Plant 2 in an effort to correlate core-testing results.

It was discovered that General Ceramics' test setup was reading about 10-percent high. They have been subtracting 20 millivolts from their readings. This left them reading from 5 to 10 millivolts lower than the correct values. To remedy the situation, a 513-D scope was replaced with a 514-D, series A, and a correction curve for their meter was made. With these changes, they agreed with the standard setup within the accuracy of the measurements.

2.2 Group 63 (Continued)

Round-Robin Calibration (UNCLASSIFIED) (Continued)

(J. Childress, J. Schallerer)

Both IBM setups were found to be in satisfactory condition. Correction curves for the meters were made, and final results were similar to the results of General Ceramics.

The MIT setup was also checked, and after replacing a scope, the readings were in good agreement with the standard.

A set of three standard cores was measured initially at High Street. The results were checked out at Plant 2. These cores will now be checked at MIT and then sent to General Ceramics. These cores will continue to be transferred about so that a check can be made on all test setups.

Production Tests (E. J. Stevens) (UNCLASSIFIED)

Lot D-28 tested with total of 5,560 accepts in the 105-120 millivolt range and a total of 4,050 possible rejects. The lot ran high and therefore the 90-105 split was not run through. Lots D-79, D-80, D-98, and E-7 were sample checked. Lot D-79 gave a yield of about 60 percent, Lot D-80 had a yield of about 35 percent, Lot D-98 yielded about 22 percent, and E-7 produced about an 8-percent yield of good cores in the 90-120 millivolt range. Production test on Lot F-99 has begun with a total yield to date of 8,500 good cores in the 105-120 split. This lot should produce a yield of between 70-80 percent good cores when finished.

SECTION III - CENTRAL SERVICES

3.1 Purchasing and Stock

(H. B. Morley) (UNCLASSIFIED)

Many orders for tubes have been placed to take advantage of a seasonal lull in manufacturing. Deliveries in most cases are promised for 30 days instead of the usual 30-60-90 days, except for 5965's from GE which may become a difficult delivery item.

All requisitions received from the Test Equipment Committee have been placed. These include material needed for setting up the new test-repair section and all other general test equipment.

The industrial electronics market seems to be slowly changing to a buyers' market. Better delivery promises and some price reductions have been arranged recently. Persons contemplating requisitioning material should do so as soon as possible to take advantage of this lull.

Every need for office supplies should first be checked with the stockroom before making a purchase request. In the past the stationary buyer has found that of all material requested of him for purchase, approximately 50-60 per cent was located in stock. Many rush requisitions have been made in this department, only to have the material received and be around for weeks before being picked up. Personnel are reminded that "emergency" requests should be carefully checked to be sure they are actual "emergencies."

Personnel are again reminded that all requests for petty cash payments or purchases should be authorized by group leaders.

Allen-Bradley, manufacturers of resistors and power relays, has now entered the ferrite field. A contact has been established with their local office; further investigation of ferrites will be made by the interested engineers.

The number of orders placed in November 1953 showed a 24 per cent increase over November 1952.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 39 Construction Requisitions totaling 539 items satisfied since 4 December 1953, and there are 28 Construction Requisitions totaling 1841 items under construction by the Group 60 electronic shops.

For further information please call the Production Control Office (Ext. 3492).

3.2 Construction (Continued)

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There is one order now open with vendors totaling 9 items. Deliveries in the past biweekly period have totaled 332 items. Information on specific orders may be obtained from the writer (Ext. 3492).

3.3 Component Analysis and Standards

3.31 Component Evaluation

Tests in Progress

(B. B. Paine) (UNCLASSIFIED)

Life testing of four samples of Clare type K relays, used in WWI drum equipment, has shown that operate times increase by 40 to 100 per cent after 22 million operations.

Tests Planned

(B. B. Paine) (UNCLASSIFIED)

Several requested tests on junction diodes intended for XD-1, and a program to determine long-time changes in characteristics of diodes under various service conditions, are planned. An exhaustive series of tests on various relays intended for XD-1 has been requested by G. F. Sandy and will be run shortly. Several groups of plug-in electrolytic capacitors in 24-hour continuous service will be measured periodically to obtain data to determine optimum retirement age, if any, for these capacitors.

Power Supplies for Relay Test

(R. Jahn) (UNCLASSIFIED)

Two Raytheon power supplies have been connected in series and provided with cooling fans to permit peak currents of 40 amperes d-c for testing relay contacts. Heat-run tests are now in progress to determine the maximum duty cycle.

3.32 Component Failure Analysis

(B. B. Paine) (UNCLASSIFIED)

Investigation of several types of component failures with rather obscure causes is being conducted. These involve ERA pulse transformers from WWI drums, magnetic-tape heads and intermittent paper capacitors from WWI tape equipment, and rectifier plate caps from Whittemore power supplies.

3.33 Standards

(H. W. Hodgdon) (UNCLASSIFIED)

Additional copies of MRD Book binders have been received from IBM and will be available for issue as soon as all material has been put in them. Persons desiring copies (who have not previously requested them) should contact the Standards Office. A supply of Tube Application Manuals was also received and will be distributed as soon as lists are made up.

Lincoln Lab standards for fixed-composition and fixed-film resistors have been printed and are being distributed. A standard on fixed accurate wirewound resistors is being printed. Task groups working under direction of Division 6 Standards Chairman are drafting proposals for standards on mica capacitors, germanium diodes, and low-power pulse transformers.

3.34 Vacuum Tubes

(H. B. Frost) (UNCLASSIFIED)

On 8 December 1953, a meeting of JETEC 5.5 was held in conjunction with the joint computer conference in Washington, D.C. At this meeting tentative approval was obtained from the JETEC legal staff for inclusion of time-dependent characteristics in computer-tube formats. This approval opens the way for more effective control of interface impedance, grid emission, gas, and heater quality. Task forces on twin-triodes and multigrid tubes were placed on an inactive status, but new task forces on hot-cathode gas tubes and methods of pulse testing were set up.

A meeting with Eugene Peet of Tung-sol was held 14 December 1953 in Bloomfield, New Jersey, concerning an improvement program for the 5998 tube. The contemplated improvements include a change in bulb for adequate mechanical strength, additional limits on cutoff, intermittent-short control, and better control of characteristics on life.

3.34 Vacuum Tubes (Continued)

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

An analysis of 7AK7 tubes removed from the five-digit multiplier is now under way. This study was initiated to determine defects of the 7AK7 which should be remedied in the SR-1782A for the AN/FSQ-7 program.

We have received samples of Z2177's and 5687's using A-31 alloy cathodes. These tubes will be life tested to determine the applicability of this new alloy to computer tubes where long life is of primary importance. Preliminary tests of the 5899 tubes show considerable promise.

Pulse curves of the 7AK7 are now essentially complete. These curves will be compared with others taken by High Street and Emporium for correctness.

Thesis Research

(H. B. Frost) (UNCLASSIFIED)

Tests on RT 414 and RT 415 have been continued. RT 414 seems very satisfactory, but RT 415 is not satisfactory. RT 415 seems to have a distorted Grid 1 structure which interferes with my tests.

Professor Nottingham has raised some questions concerning the accuracy of my techniques for coating-resistance measurements. Theoretical and experimental studies of resistance-measurement techniques will be made in the next several weeks. It seems possible that my technique has some inherent error and gives apparent values somewhat below the actual ones.

A reevaluation of data on RT 413 and RT 414 has shown good agreement between theoretical and experimental results. In light of the comments above, such agreement may be circumstantial. However, it is likely to be correct. The errors in resistance measurements are probably not great enough to invalidate the agreement.

(T. F. Clough) (UNCLASSIFIED)

A preliminary analysis of the 5998 tube was given to P. Youtz and S. Twicken for their discussion this week with Tung-sol. The purpose of this discussion is the improvement of the 5998 tube type.

T. Cohen of the tube-test laboratory has been spending a major portion of his time assisting in obtaining characteristic data on the new test equipment in Room 026. The routine load is being carried by the other technicians assigned to the tube-test laboratory.

3.34 Vacuum Tubes (Continued)

(A. Zacharias) (UNCLASSIFIED)

The investigation of shorts in the 30,000-hour 7AK7's was continued. Progress in the determination of interelectrode leakage is evident.

The data on the 7AK7 characteristics has been completed. The curves are now being drawn up.

3.4 Test Equipment

Test Equipment Committee

(L. Sutro) (UNCLASSIFIED)

Two more units have been adopted as standard test equipment, the flip-flop plug-in unit, Model II, MTC and the three-channel delay panel, TE. The former is the high-speed flip-flop developed by Boyd for XD-1. The latter is an adaptation of the delay-line amplifier used in MTC. Twenty-eight of the former and 15 of the latter are to be constructed.

Test Equipment Headquarters

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

To make an accurate count of cores from the automatic testers Group 63 required the use of GE decade scaling units. Special repairs and tests were made to one unit to meet the requirements. Two more units will be prepared for that use.

3.5 Drafting

New AN/FSQ-7 Drawing Number Assignments

(A. M. Falcione) (UNCLASSIFIED)

Memorandum M-2565, dated 10 December 1953, was issued to interested Laboratory personnel. This memorandum describes the new production-drawing-number series which have been assigned by IBM for AN/FSQ-7 equipment.

Print-Room Procedures for Production Control

(A. M. Falcione) (UNCLASSIFIED)

Memorandum M-2571, dated 15 December 1953, was issued to the Production Control and Print Room groups. Production Control makes heavy

3.5 Drafting (Continued)

(A. M. Falcione) (UNCLASSIFIED) (Continued)

demand on service of the Print Room, which requires close liaison and involves considerable paper work. The memorandum outlines a more efficient system to simplify procedures and handling, for the benefit of both groups.

Distribution Procedures for Laboratory Memorandums

(A. M. Falcione) (UNCLASSIFIED)

The progress and degree of success of any Project requires that all interested personnel be kept informed on all phases of the latest engineering developments which may or may not affect their particular phase of work with relation to the end result. It is, therefore, very important that proper distribution procedures be established to insure that the proper interested personnel receive the latest available information without delay. A memorandum is being written which outlines current distribution procedures to be placed in effect for all laboratory memorandums.

3.6 Administration and Personnel

New Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Herbert Bello is a new Laboratory Assistant in the 6345 Group.
Donald Bowman is the new messenger boy.

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Frank Yates

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

1 Clerk Typist for Group 62
2 Electronic Technicians for Group 64
1 Messenger Girl
1 Senior Detailer