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Memorandum M-2528

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

SUBJECT: BIWEEKLY REPORT FOR NOVEMBER 20, 1953  
To: Jay W. Forrester  
From: Division 6 Staff

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

A very satisfactory demonstration of the Cape Cod System was held on Friday, November 13. Nine interceptions were completed, and about 20 tracks were in the System at one time. The demonstration on the following Thursday was quite poor by contrast, primarily because of weather conditions which resulted in excessive sea clutter and a low blip-scan ratio on fighters.

In addition to efforts to improve current operations, the Weapons Direction Section is beginning preparations for a large-scale modification of the programs in early spring.

The number of tests per week will be reduced since our recent rate of aircraft use has exceeded maintenance capabilities.

The Mark X conversion unit was operated this period. Solutions to various problems associated with Mark X equipment and operation are being worked out with Group 23.

Studies of XD-1 card-machine and display requirements are being made. Two scale models of a proposed XD-1 installation have been made and a first-floor plan will be made as soon as building design is frozen.

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1.11 Equipment Engineering

(E.S. Rich) (CONFIDENTIAL)

Detailed planning for the installation of additional radar mappers in Room 228 has been started. On November 10 a visit was made to IBM to review their mapper designs to see if any of their circuits or ideas could be utilized in this new installation. In some places it will be possible to use their circuits. A decision has been made to order 10 Raytheon Pathfinder Indicators identical to the four we now have, and a purchase order for them has been requested. It is expected that many details of their modification and installation can be changed to improve mapper performance and give more flexible operational features.

(N. Alperin) (CONFIDENTIAL)

The light cannon will be modified on Nov. 23 so it will give more reliable operation. Dust accumulation in the region around the perimeter of the CRT is believed to be one of the reasons for poor operation in this region.

It is planned that the new light-gun amplifier circuits will be put in plug-in units. At present I am running some tests on the XD-1 Model A pulse stretcher to see if it can be used on the light-gun amplifier panel.

(H.J. Kirshner) (CONFIDENTIAL)

I have assumed responsibility, formerly held by Arnow, for the telephone-communication system within the Air Defense Center. All trouble reports and requests for changes in service should be directed to me in writing.

The complete Mark X-Digital Radar Relay (DRR)-Mite 3-computer link has been checked and is operative. The auxiliary display scope associated with the DRR has been giving trouble as usual, but it is currently operative. The major difficulty with this display scope is its extreme sensitivity to tube selection. Since the scope is not an integral part of the link, no major redesign of the equipment will be undertaken to improve the scope's reliability.

Direct radio-teletype transmission from a picket ship has been received at the Air Defense Center. This circuit will be turned over to the Identification Section for operational use in obtaining early-warning data.

Vito Augello has joined this section in the capacity of Technician.

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1.11 Equipment Engineering (Continued)

(B. Morriss) (CONFIDENTIAL)

The newly installed conversion unit for introducing Mark X data was operated three times this period. Test patterns were read into and displayed by the computer. A suspected difficulty was confirmed when a program was operated which tracked a single aircraft and typed out all returns with time of return. Serious jitter was observed when returns would jump back and forth through two and sometimes three azimuth units, but the frequency of jitter was not accurately determined because none of the aircraft were reported with any consistency. Discussion with H. Logemann of Group 23 revealed that a consistent video picture existed so that apparently the data was being lost in the target-detecting and beam-splitting equipment. It was suspected that the loss was due to the equipment being kept busy by returns resulting from the other Mark X ground transmitters in the area, although this difficulty had not been observed before.

C.R. Wieser, R.L. Walquist, and I met with S.N. Van Voorhis and H. Logemann to discuss the Mark X. The problems discussed were lack of consistent returns from scan to scan, jitter in returns, calibration, scheduling of operations, variations in antenna speed, and the installation of a direct phone line to the Mark X equipment. Reasonable solutions seem to be available for all of the problems except the lack of consistency of returns from scan to scan; this will have to be further investigated since it could have been due to a peculiar malfunction.

(D. Neville) (CONFIDENTIAL)

The mechanical test-message generator is now transmitting continuously on D/L when AFCRC is not on the air and when D/L is not being used by WWI. No successful D/L flight tests have yet been accomplished. Troubles have been at either Prospect Hill, Group 22's equipment, or the pilot.

(J.H. Newitt) (CONFIDENTIAL)

This period has been devoted mostly to gathering data for XD-1 console design. I have issued Memorandum M-2521 entitled "Preliminary Outline of Things to be Considered and Decisions to be Made for XD-1 Console Design." This is a preliminary check list which will be modified and added to as the investigation of the many system requirements continues.

I visited the IBM Vestal Laboratory (with others from Group 61 and 62) to attend a design conference on the XD-1 console. This conference was successful in fixing the features to be included in a mock-up console. Two identical mock-ups will be made; one will be shipped to us about Dec. 7. The detail decisions reached at this conference were quite fruitful and will no doubt be covered in a forthcoming report from Kromer's group.

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1.11 Equipment Engineering (Continued)

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

All preliminary planning for the monitoring scope is complete. Installation will be made as soon as the switch panel is received from the shop.

All necessary parts for illuminating labels on all panels in Room 216 are on order and will be installed soon. This will include labels for the MITE switch-indicator-light panels which are being installed November 20.

Sketches for necessary parts for the scope-face lighting arrangement are being made.

(G.A. Young) (CONFIDENTIAL)

During the last biweekly period the equipment in Room 222 and adjacent areas was checked out four times with the aid of the Air Force personnel.

A program has been written for checking the light cannon. This program will display points along a circle about one-half inch inside the calibration circle. The number of points displayed as well as the number of returns missed are both displayed on the scope of the light cannon.

The test-procedure manuals and test programs include all recent changes in the Group 61 equipment.

1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

Mark X data has been displayed and typed out on the delayed printer using the calibration program written by E. Wolf. The one time this was tried, however, the blip-scan ratio for the Mark X data was surprisingly low. A brief conference was held between S. Van Voorhis and H. Logemann of Group 23 and C.R. Wieser, B. Morriss, and myself concerning the Mark X. It was decided that before any calibration tests are run, a mistake in the beam-splitting logic should be corrected. As a result, the Mark X will be down the first half of the next biweekly period. It was also suggested that a truck-mounted beacon might be a very good way to calibrate the Mark X.

Further checks on the calibration of the FRS-3 at S. Truro have been held up due to unavailability of the proper aircraft and to weather. Our plan to calibrate by using a B-29 with a bombsight requires good visibility; so far, our scheduled calibration runs and good weather have been at odds.

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1.12 Data Screening (Continued)

(R.L. Walquist) (CONFIDENTIAL) (Continued)

The modification of the TWS program to include Mark X data has been completed but not yet checked out on the computer. Inclusion of this modification has required changes and expansion of the TWS drum storage. As a result, the TWS program is being changed so that it will now use drum group 10 on the auxiliary drum.

The camera-control program has been modified so that numerical information is displayed as a series of dots rather than by using the character generator. This appears to be the fastest way of improving the poor photographs we have been obtaining. The Systems Group is aware of our problem (that successive lines of characters appear on the photograph with widely differing intensities) but is not quite sure how to solve it.

The data-analysis program by H. Frachtman is finally approaching completion. It should be possible to obtain useful numerical results from this program in the near future.

One additional modification to the Smooth and Predict subprogram still needs to be made. This modification (being programmed by W. Attridge) should be completed during the next biweekly period.

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

I have started to rewrite the Smoothing and Prediction program in order to incorporate new breakpoint calculations.

Operations in the Air Defense Center have not been as good as they could be. This is the opinion of several people and is due to several factors. One factor has been organizational; however, this snafu is slowly being corrected. The Combat Data Director has been given authority over all people in the Air Defense Center. Another factor is the far from optimum operation by some of the personnel. This is true in the TWS operating positions, and steps are being taken to train these people better. The airmen concerned have for the most part been cooperative and have offered some constructive criticism.

(D.L. Bailey) (CONFIDENTIAL)

A program for incorporating Mark X data into the Cape Cod System has been written by J. Ishihara and myself and is now being checked.

A program is being written for use with the buffer drum.

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1.12 Data Screening (Continued)

(H. Frachtman) (CONFIDENTIAL)

The program which computes some statistical parameters of the track-situation data is in fine shape.

Some progress has been made on the miss-sequence statistics program.

(J. Levenson) (CONFIDENTIAL)

The program for delayed printout from the drum, T-3379m2, has been checked out and used successfully during this biweekly period. The parameter to allow printout of octal constants as well as orders has been checked out, and a combined tape will be made. Instructions for using this will also be issued.

A program to punch out a 5-56 tape for the contents of drum registers was operated. The 5-56 tape will load the drum when read through the PETR. In testing this feature I uncovered an error in the read-in program which does not interpret an "si block" for direct drum transfer. F. Helwig is planning to correct this error so that the above program will be operative as soon as this is done.

An interoffice memo was issued containing proposed additions and changes in the display lines of the Track-While-Scan stations. These changes have been approved and made. All interested persons have been notified.

At present I am planning to test for parameter insertion to the drum a new program which recognizes orders as well as numbers and will accept consecutive registers without repeated addresses.

A study of H. Frachtman's Data-Analysis Program has been made, and I am contemplating further analyses which might be useful.

(H. Peterson) (CONFIDENTIAL)

It was found impossible to read the photograph of the symbols made by the symbol generator in the program for poor data display; the whole program has been rewritten with a point-character display. Again a large part of my time was spent in supervising the Monitors and Initiators and in representing Track-While-Scan at equipment check out. My trouble-track display suddenly developed an error, and a day and a half was spent in analysis before it was determined to be a computer difficulty.

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1.12 Data Screening (Continued)

(H.H. Seward) (CONFIDENTIAL)

The contents of several drum groups were checked out with D. Bailey. The correlation program for the incorporation of Mark X data into the system is also being checked out.

(E.W. Wolf) (CONFIDENTIAL)

The calibration program mentioned in the last Biweekly Report has been completed and is fully operational. A new calibration program is now in preparation which will track an aircraft from each of two radars simultaneously (S. Truro and any one gap filler). The program will store, for delayed printout, the values of x,y,r, and  $\theta$  for all returns from both radars on the aircraft being tracked, as well as the time (EST) to the nearest second at which these returns were received. The x and y values from the gap filler will be converted to the corresponding values from Truro for comparison purposes.

(W. Wolf) (CONFIDENTIAL)

A notebook has been started to log what type of data is on the ten tape recordings. By type of data is meant the quality of data, quantity of tracks as well as stationary clutter, and notation of unusual circumstances (crossing tracks, etc.). Three recordings are logged at present. The notebook will be helpful in deciding which recording(s) to rerecord.

A five-circle calibration program has been written which displays 160-mile circles about centers at 0 and about the centers of each quadrant.

The initial startup program stored on Group 0 is being revised to include the Grid Calibration, the Parameter Insertion, and the Equipment Check Programs.

(J. Ishihara) (CONFIDENTIAL)

The Correlation Subprogram for the 1953 Cape Cod Program, modified for Mark X data, has been completed and is now being tested. In order to accommodate this program in the present allocation of registers, a part of the Data-Analysis subprogram has been left out.

A complete printout of the present combined program was made. After checking is completed, a "final" recording of this program will be made on magnetic-tape unit 0.

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1.13 Tracking and Control

(J. Arnow) (CONFIDENTIAL)

The first portion of this biweekly period was spent at ADC Headquarters, Colorado Springs. A brief description and explanation of programming a digital computer was given to representatives of various sections of the Command.

Additional reporting is given in M-2529 (SECRET).

(W. Lone) (CONFIDENTIAL)

Familiarization with guided missiles has continued. A proposal for the equipment necessary for a missile controller at an Air Defense Center will be written.

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

The radar-accuracy test program (see the Biweekly Report of 10/23/53) has been written but not yet tested. In connection with this program a conference was held with G. Harris and I. Resnick of Group 22 concerning present plans and future use of Raydist to check out Truro. The exact details of tying in Raydist with Whirlwind have not as yet been determined, so it is not known if the present program can be adapted or not.

E. Reich of Rand Corporation visited the Laboratory, and some details of tracking were discussed with him. Some of the results of our tracking-accuracy studies are to be sent to him. It is also planned to test his suggested modification of the tracking equations.

(H.D. Neumann) (CONFIDENTIAL)

See M-2529 (SECRET) for this entry.

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1.14 Weapons Direction

(D. R. Israel) (CONFIDENTIAL)

The flight test on November 13 was the first satisfactory large-scale operation and demonstration of the various Weapons Direction Programs. There were several reasons:

- a. Proper calibration of the various radars;
- b. Very satisfactory tracking of both targets and interceptors;
- c. Highly satisfactory performance by the Air Force personnel at the various operating positions.

Only two additional modifications will be made to the Weapons Direction Programs as they operated on the 13th: (a) the final-turn calculations, which have been undergoing a series of tests and checks and (b) several minor changes in the displays.

The efforts of Group 61 in connection with the present version of the Cape Cod Programs are twofold. First, attempts are being made to improve present operation, particularly with respect to the operating personnel. At the same time, attempts will be made to measure various parameters relating to the current operation of the System and to evaluate the procedures and provisions of the present Program. Study of performance of the Intercept Direction teams is currently under way. An evaluation of the present telephone intercommunication system is typical of the various studies under way. The second major effort is the planning and preparation for a revised version of the Weapons Direction Programs. It is expected that this will be a large-scale modification of the Programs and that it will require a limited amount of equipment changes and relocation. Although these changes are not expected to be made until early spring, it is imperative that the planning and programming get under way immediately.

Equipment operation during the past two weeks has been satisfactory. Checking of the teleregister is under way, and it is hoped that this equipment will be available for use during the week of November 23.

The largest deterrent to the conduct of flight tests in recent weeks has been the lack of sufficient target aircraft.

(H. D. Benington) (CONFIDENTIAL)

The display toggle switches will be revised once more before being frozen. Several minor changes will be made (i.e., only those essential for operation).

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1.14 Weapons Direction (Continued)

(H. D. Benington) (CONFIDENTIAL) (Continued)

Several aspects of future revisions to be made in Cape Cod operation, particularly the weapons-assignment scheme and simplified display-switch control, have been studied. An inter-office memo is being prepared.

Two more guided tours were conducted. A schedule for four simultaneous guided tours in Room 222 both before and during operation has been issued. Since several justifiable complaints have been received concerning factual errors relayed to the visitors, spare time is being used in getting accurate information.

(M. I. Brand) (CONFIDENTIAL)

A memo describing our recent trip to IBM at Poughkeepsie was written in conjunction with M. A. Geraghty and S. J. Hauser. In this memo a description of the modified IBM 026 key-punch machine is given. As an example of the use of the modified 026 as a manual input device to the AN/FSQ-7 details of the insertion of weather data are given. The problem of verification of input data prior to computer read-in is discussed.

In conjunction with A. W. Curby work was continued on the memo describing the identification function of the 1953 Cape Cod System. This memo is virtually completed. It is expected that a rough draft will be available for limited distribution for the purpose of comments next week.

During this biweekly period I gave a lecture to the Air Force personnel assigned to the Cape Cod System, describing the Identification function of the Cape Cod System.

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

Two Anti-Aircraft Guidance exercises were run during this period. During the mission of November 10, information was passed to the Anti-Aircraft Operations Center on three simultaneous strikes entering the system in tandem from the northeast. All three strikes were acquired and engaged early and "splashed" outside the Bomb Release Line. The Operations Officer on duty remarked that the tandem attack is usually considered troublesome.

On November 19, an attempt was made to pass information on a single strike, despite the poor condition of the data. This was done chiefly because of the interest expressed by Colonels Stanton and Morrow of G-3, Headquarters, Army Ground Forces. These gentlemen were present at the exercise through the instance of R. A. Nelson and Col. W. L. McNamee, U.S.A., the latter being Lincoln AGF Liaison Officer. The track was scrubbed for lack of radar data before acquisition.

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1.14 Weapons Direction (Continued)

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

During the demonstration of November 13, I noted two rather serious instances of a breakdown in the flow of altitude information from the computer to the fighter aircraft. C. A. Zraket was notified on November 13, and a meeting with interested Air Force personnel for the purpose of locating and eliminating the difficulty is projected.

Examination of the Height Finder records, especially of the last two weeks, shows the existence of sporadic and apparently erratic gross errors in altitude reports from all three sites. Due to the serious nature of the errors, the attempt to accelerate the H-F system has been abandoned until they are eliminated. Stricter adherence to correlation tolerance limits and use of the previous altitude information to check on radical changes have been advocated.

Lt. Carrol, AF, who is in charge of the Height-Finder personnel at North Truro, was present in Flight Test Control during the exercise of November 19. He understands the problem associated with the above-mentioned gross errors in altitude. He will initiate the logging by his operators of all altitude reports together with any explanatory notes which may apply to ambiguous reports.

The efficiency of North Truro on November 10 and 13 was greatly reduced due to the fact that the cables bearing data from the vertical lower beam and data combined from all three vertical beams were interchanged.

The over-all percentage of successful altitude reports per total number of requests now stands at 62 per cent. Of requests for tracks known to be in trouble or in blind spots or eliminated, the figure is 69 per cent. If negative replies from sites known to be operating at greatly reduced efficiency are eliminated, the figure is 79 per cent.

(O. T. Conant) (CONFIDENTIAL)

The Cape Cod telephone intercommunication system is to be frozen soon for a period of several months and permanent edge-lit labels provided for all comm boxes. Any changes desired from the present arrangement of phone lines must be made immediately. Reports on phone operation will be secured from operating personnel on a monthly or biweekly basis and the information used in planning the XD-1 system as well as any future Cape Cod changes.

(A. W. Curby) (CONFIDENTIAL)

In addition to writing a section on flight-plan data for the revised memo, "The Identification Function of the 1953 Cape Cod System," I have been preparing a memo on conversion between the Georef coordinate system and the rectangular coordinate system used in the Cape Cod Programs.

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1.14 Weapons Direction (Continued)

(M. A. Geraghty) (CONFIDENTIAL)

Due in part to a trip to Poughkeepsie at the end of the last biweekly period, no report was submitted. The trip, for the purpose of studying IBM card readers as a means of manual input to Cape Cod and to the XD-1, was fairly successful. A memo on the trip has been written and will be distributed shortly.

Some time was devoted to attending Cape Cod flight tests. Their results are described in J. Cahill's report. A memo describing in full the height-finding function for Cape Cod is being written and should be ready in the next two weeks.

(W. Z. Lemnios and F. Garth) (CONFIDENTIAL)

The final-turn program has been completely checked out with simulated data and is now ready to be incorporated into the Cape Cod System.

Some time was spent studying reports on return-to-base methods.

A start has been made in obtaining a mathematical formulation for the minimum-fuel path. This has led to a request for fuel-consumption data which should aid this work.

(C. C. Grandy) (CONFIDENTIAL)

The geography displays in the Cape Cod System have been revised during the past biweekly period, and the new programs are checked out. The geography displays now include the following:

- a. Airbases, Height Finder Sites, and ADIZ Boundary
- b. Georef
- c. AA Circle
- d. Identification Geo. Check Points

The displays combined in a, above, are easily separated program-wise; however, switches and gates are not readily available at the various consoles for the separate displays.

The track-display make-up program has been altered to properly label interceptors returning to Quonset Point Naval Station with a lower-case "q." This replaces the return-to-base to Logan. This program has also been modified to display (on the track-situation display) an indication of Track Monitor assignment when pending and friendly tracks are in tracking difficulties. This feature formerly applied only to hostile and unknown tracks.

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1.14 Weapons Direction (Continued)

(S. J. Häuser) (CONFIDENTIAL)

A revised geography display was written. The display adds ID (Identification) check points and ADIZ (Air Defense Identification Zone) to the old geography display. The program was checked out and written into the Cape Cod display system.

(F. E. Heart) (CONFIDENTIAL)

Additional time was spent assisting in the operation of the Cape Cod Direction Center.

M-2516 was issued describing "Input and Distribution of Weather Data, Aircraft Types, Radio Frequencies and Data Link Addresses for the Cape Cod System." This memo includes a description of the conversion processes required to insert wind data and aircraft-type data into WWI.

Some work was done on preliminary "filtering" of various sets of Library Accessions Lists. This activity is directed primarily toward an improved literature survey of certain technical problems in the weapon-direction field.

With several other members of the group, some time was spent considering revisions in current Cape Cod record forms.

(L. Murray) (CONFIDENTIAL)

During the past biweekly period, Data Link relay tests have started. From these it is now known that messages can be relayed from WWI to a receiver and be properly displayed. Unfortunately, the reliability of the transmitting equipment is not satisfactory. In view of this, it is planned to transmit messages from a message generator located in the Barta Building but independent of WWI. These messages will be received and decoded by receivers located on the ground at Bedford and in aircraft aloft. The transmitting equipment will thus be checked, and any weak links can be corrected.

A visit to A. Fullerton of Group 22 uncovered a misunderstanding between the actual operation of the Data Link receivers and the programmer's interpretation of the same. At present, the Attack Heading is displayed when the time-to-go is zero. It had been assumed the Attack Heading would be displayed when the time-to-go was 30 seconds. During the next biweekly period another visit will be made to Lexington to resolve this and other questions.

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1.14 Weapons Direction (Continued)

(L. Murray and J. Nolan) (CONFIDENTIAL) (Continued)

The training program for Air Force personnel has continued in the development of a better understanding of the operation of the Cape Cod System. The classes held have included the following talks:

- a. TWS Operation, by W. Attridge,
- b. Track Initiation and Monitoring, by J. Levenson,
- c. Identification Section Operation, by M. Brand,
- d. Height Finding and AAA, by J. Cahill,
- e. Interception Calculations and Logic, by W. Lemnios.

In addition to the above, talks have been given by the authors on the operation of those elements of the in-out equipment which are basic to the operation of the system (intervention registers, character and vector generators, etc.). In conjunction with this topic, a second programming problem has been assigned. The problem consists of constructing a scope display which is controlled by the insertion switches and activate button at one of the consoles.

The completion and operation of these programs will terminate the general introductory course work. After this point, the class will be of a more formal character and will be restricted to those men working in the Weapons Section.

(J. Nolan) (CONFIDENTIAL)

In addition to work on the training program in conjunction with L. Murray, time has been spent preparing an interoffice memo on the operation of the WD (Weapons Director) and COO (Combat Operations Officer) positions. This memo is nearly completed.

The Weapons Assignment Display programs have been modified to box the track upon which the display is requested. In order to include this modification into NTWS2, it was necessary to remove the possibility of requesting displays on flight-plan aircraft. The use of the request button labelled "Flight Plan" will now result in action identical with that of the button labelled "Clear".

(C. A. Zraket) (CONFIDENTIAL)

System testing of the Cape Cod Air Defense Center has continued during the past biweekly period with increasingly better results. Nine successful interceptions were conducted during the demonstration of November 13. One interception conducted late in the afternoon was successful because

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1.14 Weapons Direction (Continued)

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

of tracking anomalies in the computer program. The last two test days of the biweekly period were somewhat unsuccessful because of poor radar data on each day. The latter was attributed to temperature inversion which resulted in large amounts of clutter being transmitted to WWI.

Concurrent with the foregoing tests, the UHF ground-air data link has also been tested. Results were somewhat erratic. Transmission of data from the computer to a ground monitor unit near Bedford via the Prospect Hill transmitter were at times successful and at times unsuccessful. The troubles during the unsuccessful tests were either at the transmitter at Prospect Hill or at the receiver at the ground-unit location. So far, completely accurate transmission has not been attained from the computer to an airborne aircraft. Tests will continue during the next biweekly period.

The log and summary records for the past four-weeks operation of the Cape Cod Center are now being reviewed by P. Cioffi. A summary report along with a description of the inadequacies of the forms will be issued when the study is completed. This report will be used as the basis for a study of new types of forms.

A committee (set up by D. Israel) of C. Gaudette, S. Knapp, and C. Zraket will review all of the proposed major changes to the Weapons Direction programs for possible inclusion in the Cape Cod System next January. The present program will be frozen next week.

The training program for Air Force personnel has been consolidated into a school for the Intercept Teams at the suggestion of D. Israel. L. Murray and J. Nolan will initiate the program after the Thanksgiving holidays.

It has been decided that the calibration checks of the height-finder radars will be done concurrently with the checks on the tracking radars. J. Cahill is coordinating with E. Wolf on this matter.

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1.15 Direction Center Operations

(P.O. Cioffi) (CONFIDENTIAL)

The table below summarizes the scheduled flight-test activity for the past period. We experienced in this period the after effects of the repeated use of aircraft since starting system operation in October-that is, aircraft out of availability for maintenance. The availability situation is made even more critical by the concurrent use of these Bedford-based aircraft by other groups at MIT. Two, or possibly three in some cases, tests per week are planned for future operations. It is felt that a schedule of this kind will help to alleviate the availability situation and present better problems to the Center for test purposes.

The test records compiled to date have been reviewed, and summary data is being organized. This data will be available from the author early next period. As a result of this review, certain suggestions relating to the nature and amount of data recorded on the available forms came to mind. This matter is expected to be discussed with all Center personnel next period.

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1.15 Direction Center Operations (Continued)

(P. Dolan) (CONFIDENTIAL)

DATE	TIME	SCHEDULED TEST		TEST ACTUALLY RUN A/C	Description	REASONS FOR CHANGES OR COMMENTS
		A/C	Description			
11/6	1300-1400	1	Data-Link Test	1	Same	
	1400-1600	12	Coverage & Intercepts	2	Coverage	Weather and aircraft unavailable
11/10	1200-1300	1	Data-Link Test	0	Cancelled	Aircraft unavailable
	1300-1600	13	Coverage & Intercepts	10	Same	Mechanical and availability
11/13	1300-1600	17	Demonstration	17	Same	
	1300-1500	8	Coverage & Intercepts	5	Coverage	Only one target aircraft available
11/17	1500-1600	4	Data-Link Test	3	Same	One aircraft-mechanical
	1300-1500	8	Coverage & Intercepts	1	Cancelled	Only one target aircraft available
11/18	1500-1600	4	Mark X Test	0	Cancelled	Ground equipment inoperative
	1200-1500	14	Coverage & Intercepts	8	Same-(for two hours)	Only two target aircraft available; no Navy fighters available

\* Added to schedule during week of test

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1.15 Direction Center Operations (Continued)

(E.W. Wolf) (CONFIDENTIAL)

Equipment reliability for the Cape Cod System operations, while not quite as good as for the preceding biweekly period, was still above average. The decrease in Unrestricted Operating Time was chiefly the result of difficulties with telephone connections. There was a power failure of 4-minutes duration at Nantucket on Nov. 19, and Truro was unable to pick up targets between 65 and 110 miles on Nov. 13. The statistics follow:

	Last Biweekly Period		Cumulative Period (since 9-29-53)	
	Hours	Per Cent	Hours	Per Cent
Assigned Time for System Operations	14.2	100.0	74.8	100.0
Unrestricted Operating Time	1.8	12.8	19.2	25.7
Limited Operating Time	10.0	70.2	36.3	48.5
Down Time	2.4	17.0	17.6	23.5
Recovery Time	0.0	0.0	0.7	2.3
Time Lost (hours)	Limited Operations	Down Time	Limited Operations	Down Time
Computer	0.0	2.0	0.0	15.7
Room 222	7.7	0.4	40.1	2.0
Radar & Input	3.6	0.0	28.3	0.0
Misc.	9.3	0.0	22.8	0.0

(F.A. Webster) (CONFIDENTIAL)

During the past two weeks, time has been spent on the following:  
 (a) plotting aircraft paths during flight tests (Flight-Test Assistant function);  
 (b) revision of simplified general communications diagram of Cape Cod System (SB-56987), together with planning for a diagrammatic representation of specific message sequences during System operation; and (c) preparation of some simplified diagrams of real-time computer operation for use in indoctrination and the introduction of nontechnical personnel to certain basic operating principles.

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1.15 Direction Center Operations (Continued)

(W. Vecchia) (CONFIDENTIAL)

Group 61 Computer Operation

Assigned Time		77.5 hours
TWS	20 hours 25 minutes	
NTWS	5 hours 45 minutes	
Combined Groups		
NTWS	18 hours	
TWS		
Tracking and Control	<u>23 hours 5 minutes</u>	
Total Used Time	67 hours 15 minutes	
Time to Math Group	1 hour 45 minutes	
Time to In-Out	1 hour 30 minutes	
Lost to Computer	<u>7 hours</u>	
	10 hours 15 minutes	
	67 hours 15 minutes	
	<u>10 hours 15 minutes</u>	
Grand Total	77 hours 30 minutes	

1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

A preliminary study is being made of the IBM card machine requirements for the XD-1 Card Preparation Room.

Additional studies of the present proposals for the Track Situation Displays and digital information Displays are under way. Following recent revisions, the current Track Situation Display proposal appears to be quite satisfactory and sufficiently flexible for future needs. Several additional details regarding feature selection and intensification control require further study. The question of flexibility in the format of individual DID's is currently under consideration. A highly flexible format is proposed by B. Epstein in M-2503. It is my current feeling that this proposal entails more flexibility than is required and will be very expensive from a programming viewpoint.

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

(H. Benington) (CONFIDENTIAL)

Discussions have continued on AN/FSQ-7 situation displays. Considerable progress has been made. At present, the recent decisions on AN/FSQ-7 are being incorporated into the past estimates.

(G. Conant) (CONFIDENTIAL)

Two types of Digital Display presentation are being considered. A fixed-format scheme suggested by D. Israel would require that every display be fitted into a 40-character (4 x 10) vertical block, and that eight drum registers be reserved for each display. A scheme suggested by M. Geraghty and proposed by M. Epstein in M-2503 would be similar to the Cape Cod displays, providing considerable flexibility both in format and in drum storage. Geraghty is assisting in a study of programming and storage requirements.

Consideration of internal telephone communications has been set off by a discussion with C.R. Wieser, S. Dodd, H. Kirshner, and R. Enticknap (Div. 2), who has made a preliminary estimate of requirements. Planning will be based on Cape Cod operating experience, but more flexible equipment will be provided.

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

A memo was written describing our recent trip to Poughkeepsie, giving the information obtained there on program card inputs and making recommendations for equipment to be procured for the XD-1 Card Preparation Room.

A proposal which suggests a method for analysing the orders in the present Cape Cod Program was written. The purpose of such an analysis would be to suggest new orders for XD-1.

(C. Grandy) (CONFIDENTIAL)

Several floor plans for the XD-1 installation have been made, and two scale models have been set up, one in Building B, Lexington, and one in W3-437. No final decision has been made about the use of the space because the location of the stair wells, air handlers, etc., has not been frozen. As soon as the building design is frozen, a final floor plan for the installation will be made.

A trip was made to the IBM Vestal Lab during the past period for the purpose of considering the console design for the XD-1 system. Certain features of the mechanical and electrical design are fairly well fixed; however, before the design is frozen, IBM will send a wooden mock-up to MIT for our consideration. Until this mock-up arrives, the author has a drawing of the console and will welcome comments from Group 61 staff members concerning the design.

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

(S. Hauser) (CONFIDENTIAL)

A summary of information on a manual-input system studied at IBM, Poughkeepsie, was incorporated in a memo written in cooperation with M. Brand and M. Geraghty.

1.17 Associated Studies

(B. Smulowicz, W. Wells)

See M-2529(SECRET) for this entry.

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

During the past biweekly period progress has been made on several matters which should further increase the self-checking done by the computer on its storage references, make this checking more reliable, and make living conditions in Room 222 more tolerable.

Low parity-register margins, which have caused Core Memory Control (CMC) alarms during block orders, have been improved by a circuit change.

Installation of the parity system for the auxiliary-drum system is nearing completion and should be in operation by the week of November 23. This includes changes in the logic of the block orders which have been made to facilitate the parity check. The computer changes which were necessary for the parity check have been finished and await the installation of the drum parity digit which is scheduled for completion this week end.

Work is also being done on the magnetic-tape system to improve its operation. The problems of head wear and head contamination and servomechanism stability, which have adversely affected reliability of the magnetic-tape system, are being studied.

The temperature control in Room 222 has been improved by the addition of new air-conditioning equipment. The cooling capacity originally intended for the storage-tube laboratory has been connected to provide additional cooling for Room 222 on a temporary basis.

The new MITE unit for use with the Mark 10 equipment has been installed and tested and is ready for use by Group 61. This MITE unit has been connected so that it can be used with the old MITE units or switched over to be used with the buffer drum.

1.21 WWI System Operation

Core Memory

(N. L. Daggett) (UNCLASSIFIED)

Intermittent CMC alarms during block orders have been eliminated by modifying the cathode-follower circuits of digit 0 of the parity register. The alarms were caused by clamp-circuit difficulties which were aggravated when one cathode follower was replaced by a new tube having particularly high plate current. Once again overshoot on a clamped waveform was the cause of trouble. In this case d-c coupling the cathode-follower output fixed the situation.

1.21 WWI System Operation (Continued)

Core Memory

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

On Monday, November 16, the logic of the block orders bi and bo was revised. One timing problem was encountered that was temporarily corrected with cabling changes. A permanent solution will be placed into effect in the near future.

Also on November 16 the equipment of the computer room proper was modified to include the magnetic drums in the parity-check system. The drum equipment will be ready on Monday, November 23.

Low margins within the pulse generator and the parity register have been corrected. The pulse generator required extensive modifications. The parity-register difficulty was encountered in digit 0 and temporarily corrected by d-c coupling the cathode-follower outputs. Plans are being made to d-c couple the flip-flop and cathode followers of the entire register.

(S. E. Desjardins) (UNCLASSIFIED)

The last biweekly period was spent in writing a core-memory test program. This program will store an array in CM such that all the delta noise is additive, resulting in the worst possible readout when information is obtained from storage. The program will check all digits simultaneously, any combination of digits simultaneously, or each digit individually. This is tape # T-3387-3.

(D. A. Morrison) (UNCLASSIFIED)

The time has been divided between working with the core memory group (WWI) and on the new Voltage Interlock Panel.

Auxiliary Drum

(K. E. McVicar) (UNCLASSIFIED)

Operation of the auxiliary-drum system has been quite good during the past biweekly period. We have had no reports from operators of any equipment failure during this time.

Installation of the parity digit for the auxiliary system should be completed this week end. The parity system will then be checked and can be expected to be in operation by the middle of the week of November 23.

1.21 WWI System Operation (Continued)Magnetic Tape

(E. P. Farnsworth) (UNCLASSIFIED)

Difficulties experienced by the operators with the delayed-output equipment because of errors in some programs are still being blamed on the equipment. A check list and trouble-report form is being made up to insure more precise logging of suspected magnetic-tape-system troubles. This will serve the double purpose of aiding the system technicians in pinpointing the trouble and giving the magnetic-tape group sufficient information to analyze or reproduce the difficulty since we still spend considerable time locating programmers' errors for them. Some tend to blame the equipment until their programming errors are pointed out to them.

A Magnicorder reel-drive panel has been adopted for use with Raytheon spline type and triangular-hub reels as well as standard NAB reels to permit convenient filling of reels and transferring of tapes. Machine-shop work done here for the foregoing was so successful that duplicate parts are now being turned out to convert unit 2 to triangular hub reels at a fraction of the time and cost quoted by Raytheon.

Minnesota Mining's Boston representative is working to get a sample of tri-acetate base tape from their development laboratory as a substitute for mylar. Another vendor is being considered as a possible source of mylar tape.

The noise existing in the servo loop of unit 0 which caused small random movement of the reels and slack take-up mechanism has now been shifted to unit 2 by interchanging servo-amplifier chassis. The noise amplitude is now smaller and does not occur until unit 2 has been running for several hours. The trouble will be easier to track down now that it is in the least critical tape unit.

The remaining cross talk which was caused by the MTC unit-select switching transient getting into the delayed-printout system has been cleared up by introducing a 50-microsecond time constant into the unit-select line from IOS. Considerable effort was expended to keep this voltage out of the printout system rather than change the MTC switching circuitry, but slowing down the switching waveform proved to be the only solution.

The occasional reading difficulty experienced with unit 0 during this period was traced by marginal checking to the read/record head. Microscopic investigation of this head revealed contamination by foreign particles; the reading difficulty cleared up after the head was thoroughly cleaned. In addition the problem of head wear, regrinding, polishing, etc., and the effects of this work on the reading-head magnetic air gap are being studied. Microscopic investigation has already produced some significant results.

1.21 WWI System Operation (Continued)

Magnetic Tape

(E. P. Farnsworth) (Continued) (UNCLASSIFIED)

The problem of head reliability is also being undertaken by B. Paine, who is investigating the apparently inadequate electrical insulation in the Raytheon read/record heads and will take up the problem with the manufacturer.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

During the past two weeks we have had several complaints that one of our FL typewriters fails to carriage return properly while printing from magnetic tape. We have not been able to produce this failure in the shop, however, when operating the typewriter either manually or from paper tape. Farnsworth and I will again try this typewriter on magnetic tape in an attempt to track down the cause of this trouble.

1.22 Terminal Equipment

(R. H. Gould) (UNCLASSIFIED)

Two new types of film for use with the Fairchild scope camera were tested. They both have better contrast than the film now in use but are so much slower that the frame-counter number is not recorded. The new camera control designed by N. L. Daggett will cure this trouble, and sharper, clearer pictures will be the result.

A method of having fixed-scope gain position and intensity of different values available on a rotary switch is being devised. One setting would be for numbers formed of spots and the other for the smaller, dimmer numbers formed by the character generator. There is some risk of introducing more noise onto the deflection lines, but care will be taken to avoid it.

In-out system troubles in the last two weeks have consisted in part of a loose video cable, power-wiring error, junction-box wiring error, and three timing troubles introduced by changes associated with the drum parity check. Equipment failures have been few.

Marginal Checking

(S. B. Ginsburg) (UNCLASSIFIED)

A means of marginal checking the activate registers has been designed, and the panel is being built in the shop.

1.22 Terminal Equipment (Continued)

Marginal Checking

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

The "Holding and Driving Circuits for Display-Switch Bias Control" panel was received from the shop and bench tested. This panel will be used in conjunction with a voltage-variation panel, designed by Ferrell Sandy, to marginal check the insertion registers. A program is now being written by Guy Young to determine the margins on these registers.

MITE

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

MITE 3 has been completed using only modified plug-in units; it has been tested and operates very successfully with good margins. The test program is contained on Tape 3397-1.

A new MITE 0 for operation with the buffer drum is nearing completion in position L-1 of Room 156 and should be ready for testing during the week of November 23. Cables for this unit will be ordered early in the week.

A switch panel will be installed to allow MITE 3 to operate either with WWI directly or with the buffer drum.

Some time has been spent during this past period gaining more familiarity with the buffer-drum logic and circuits.

Buffer Drum

(K. E. McVicar) (UNCLASSIFIED)

The buffer-drum system is now connected to, and has been tested with, three MITE units. These tests have revealed several minor troubles which have been corrected, and operation of the system is now fair.

We are preparing to test the buffer drum with the computer in a mode of operation which will cause simultaneous recording and reading on opposite drum fields. This should give us an idea of what troubles, if any, we may expect from circuit crosstalk..

In the meantime connection of the buffer-drum MITE units in parallel with the original MITE units is progressing. When this is completed, we will be able to test the MITE-buffer drum system with recorded data which will simulate actual operation.

1.22 Terminal Equipment (Continued)Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

Emphasis has been shifted from the buffer monitor system to increased testing activity on the buffer drum-MITE combination. The coincidence-detector chassis which will aid in testing needs only the d-c voltages to the plug before it is put into operation.

Reading amplifiers removed from service because of lower-than-normal margins are now being investigated in the test rack. After this work is completed adjustment of group-selector relays will be resumed.

Vector Generator

(F. E. Irish) (UNCLASSIFIED)

Considerable difficulty has been experienced while trying to align the switch-tube units of the vector-generator decoder. The symptoms of this misalignment are vector displays in which the vectors are semicircular lines.

One of the conditions which has to be satisfied in aligning the generator is for all the tubes in the switch-tube decoder units to have approximately the same control-grid cutoff voltage. The tubes used normally do not satisfy this condition.

The only solution which has come to mind so far has been to place a variable resistance in the cathode of each tube. By varying this resistance the effective cutoff voltage of each tube can be made equal. The drawback to this solution is that twenty tubes are involved, and the use of twenty potentiometers is not appealing. Any suggestions on a solution to this problem will be appreciated.

Ferranti PETR

(J. P. Stirman) (UNCLASSIFIED)

The final breadboard model of the Ferranti Photoelectric Tape Reader has been completed and tested. Its final test in WWI will be delayed until the associated equipment can be constructed and the existing circuits modified.

The tests consisted of plotting the output levels of each channel with the tube voltage as a variable. In this way the marginal performance of the circuit was checked. In addition, the output waveforms were observed on an oscilloscope, with a tape input to the reader. The waveforms indicate that the performance of the unit will be satisfactory although there is no data available as yet on the effects of crosstalk between channels.

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 November 6-20, 1953:

Number of assigned hours	153
Usable percentage of assigned time	93
Usable percentage of assigned time since March 1951	86
Number of transient errors	10
Number of steady-state errors	5
Number of intermittent errors	9

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since November 6, 1953:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Crystals</u>			
D-357	7	19000 - 20000	Drift
D-358	1	19000 - 20000	Drift
1N34A	6	1000 - 2000	Low back resistance
	2	0 - 1000	Low back resistance
1N38A	2	7000 - 8000	Low back resistance
<u>Resistors</u>			
220 ohm, 1/2 w, +10% carbon	1	4000 - 5000	Short
9K, 1/2 w, +1% Nobleloy	1	4000 - 5000	Above tolerance
<u>Tubes</u>			
5696	1	1000 - 2000	Short
5U4G	1	1000 - 2000	Open filament
OC3/VR-150	1	15000 - 16000	Loose base
	1	1000 - 2000	Arcing
12AU7	1	7000 - 8000	Short
6Y6G	1	21000 - 22000	Short
6AN5	1	0 - 1000	Low plate current

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)			
6SH7	2	1000 - 2000	Low plate current
7AK7	1	7000 - 8000	Grid emission
	1	21000 - 22000	Short
C16J	1	6000 - 7000	High arc drop
	1	11000 - 12000	High arc drop
6AS7G	1	0 - 1000	Short
	1	9000 - 10000	High screen cutoff
5687	1	0 - 1000	Short
6080	2	1000 - 2000	Low $I_p$ ; short
6L6G	2	2000 - 3000	Low plate current
	1	3000 - 4000	Low plate current
	1	21000 - 22000	Short
5881	3	0 - 1000	Low plate current
	1	1000 - 2000	Low plate current
	1	2000 - 3000	Low plate current
7AD7	1	2000 - 3000	Short
	1	3000 - 4000	Low plate current
	3	7000 - 8000	Leakage; short; low plate current
	2	14000 - 15000	Short
	3	20000 - 21000	Short
	6	21000 - 22000	Short
6145	2	0 - 1000	Short
	4	1000 - 2000	Short
	2	2000 - 3000	Short
	3	3000 - 4000	2-short; 1-leakage
	1	4000 - 5000	Short
6V6	1	5000 - 6000	Low plate current
	2	20000 - 21000	Low plate current
6SN7	1	15000 - 16000	Short
	1	20000 - 21000	Short

1.24 General

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

Work is nearly completed on the new +250-v, 50-amp Whittemore Building d-c supply. When finished this supply will be temporarily installed in WWI as +150 volts, in order to remove the present +150-v supply for re-designing. Tests indicate that good performance can be achieved with much less output capacitance than has previously been used.

WWI D-C Standby Generator

(R. C. Jahn) (UNCLASSIFIED)

A breadboard regulator is being constructed for the generators. Preliminary compensation networks and coupling circuits are being synthesized to give optimum regulator performance.

1.3 Group 651.31 Activities of Group 65

(P. Youtz) (CONFIDENTIAL)

Trips to Tung-sol and Sylvania were made this period in support of the reliable-receiver tube program. Sylvania's progress with the SR-1782A (an improved version of the 7AK7) has been satisfactory.

A trip was made to the Corning Glass Works with members of Group 25 to investigate possible new types of bulbs for the Charactron tube. We were seeking the largest possible square display area with the smallest possible deflection angle. After the visit the group recommended a 19-inch round bulb and a 52-degree display angle. Corning can meet this request by using their regular 19-inch face panel and spinning a new 52-degree funnel. This order can be met within eight weeks after they receive a purchase order.

A trip was made with the display group to IBM's Vestal Laboratory to discuss the bulb sizes that Corning can provide and the display-console design.

Together with members of Group 25 I visited RCA's Research Laboratory to discuss their techniques for sublimating cadmium sulphide. Group 25 is interested in these coatings for their work on electroluminescent storage tubes. J. S. Palermo has already produced very satisfactory cadmium-sulphide coatings in our laboratory.

Group 25 has been doing some work on transparent phosphorescent films. These sublimated films have less light scattering than the powdered phosphor screens of the ordinary cathode-ray tubes. These new films will give considerably more contrast than ordinary "crt" screens and use considerably less intense electron beam. A trip was made with Group 25 to General Electric's Research Laboratory at Schenectady to discuss with L. R. Koller his work in this direction.

C. L. Corderman pointed out in a previous Biweekly Report that the display time for Charactron tubes might be halved by redesign of the electron optics of the present Charactron. At present a correction signal must be applied through the magnetic-deflection yoke to compensate for each character selected. A small-angle electrostatic deflection system might be put in the yoke region for character compensation, character position, and making vectors. One Charactron tube with multiband post-acceleration was reprocessed with this electron optics. This tube is ready for evaluation. Test results on this tube will indicate the direction this work should follow.

The problem in post-acceleration is to get sufficient accelerating voltage without serious loss of deflection sensitivity. Tektronix has developed a helical dag coating which permits a low voltage in the deflection region and a very high voltage at the phosphor screen. J. S. Palermo has started a program to reproduce these coatings. His initial results were successful. As soon as a technique is developed, one Charactron tube will be reprocessed with a helical coating between the charactron matrix and the deflection yoke.

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1.31 Activities of Group 65 (continued)

If this method of acceleration is unsatisfactory, the technique will be extended so that a helical coating can be put in the funnel of the bulb.

Two research tubes were constructed and one was processed for the cathode studies of H. B. Frost.

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SECURITY INFORMATION

SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

(J. F. Jacobs) (CONFIDENTIAL)

Control Redesign

The central control is being redesigned by Larry Sarahan's Group to take advantage of the cathode savings which can be gained by (1) the use of the 5998 cathode follower, and (2) the increase in the "end of life" back resistance of diodes. This redesign should result in a saving of about 300 cathodes.

Arithmetic Element

Four hundred bottles can be saved in the right and left arithmetic element by the use of the 7AK7 cathode follower. Larry Sarahan is of the opinion that if he were to do the redesign to incorporate these followers he would like to take advantage of the space saving he can make by physical rearrangement.

Program Control

The model of the 3-digit delay-line adder which is to be used in the program-control element of XD-1 is now completely wired. It will be placed on test as soon as it is checked.

Light Cannon

A group to study and propose a method for automatic initiation and automatic crosstabling has been set up. It consists of B. Morriss from Group 61, R. Mayer from the Systems Section, and R. von Buelow from the Display Section. This group will propose, by December 1, a method for doing this job. The Display Section will be responsible for recommending and developing the kind of electronic device which should be used.

Outputs

A proposal for the output buffer drum was presented. This proposal, M-2525, is now being distributed for comment. The deadline on changes is December 1, 1953.

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2.11 Systems (Continued)

(J. F. Jacobs) (CONFIDENTIAL)

A program for developing a shift register to load phone lines has been started.

(Irving Aronson) (UNCLASSIFIED)

Several Mo-Permalloy cores have been tested to find one suitable for the matrix switch part of the phone-line buffer. The core that comes closest to what I would like is the 1/4-mil 1/4 x 1/8 x 50 wraps of Magnetics Inc., with a flux of 1.3 microwebers per turn (20 per cent more flux would be desirable).

This core is now being wound by Group 63 personnel to make sure the required number of turns can be put on by machine.

Design work has been started for an 8-position model of the matrix switch to be built during the next two weeks.

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

Specifications for the output buffer drum were presented at a meeting on 17 Nov. 1953. The specifications called for three drum fields, random access, and use of one-word "slots". They were tentatively accepted pending circulation of M-2525 which gives the proposed specifications and includes explanatory comments on each point. The specifications are scheduled to be turned over to IBM on 1 Dec. 1953 for implementation.

Output Shift Registers

(H. K. Rising) (CONFIDENTIAL)

It is felt that this output device should be developed in two steps. First a small switch will be built to drive a few short registers in the memory. As this circuitry is being cleaned up, a full-size switch and several full-length registers of memory will be built. Enough data can be obtained from these two setups to tell whether or not a full-size system will be practical.

Cores have been obtained from Dave Brown for the matrix switch and the memory. Bob Freeman is ready to begin testing the cores for the memory. Irving Aronson has been testing various switch cores to obtain a suitable core for this application. The shift-register circuit is being optimized so that it will be ready when the switch-driven memory is working.

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2.11 Systems (Continued)Input Counters

(H. K. Rising) (CONFIDENTIAL)

A meeting was held between Raytheon and MIT-IBM engineers to discuss some of the details of the input-counter system. Raytheon is drawing up several proposals for input-counter systems which they could build with their magnetic-core circuits. Raytheon, MIT, and IBM will concur on the best proposal for bread boarding at Raytheon.

Circuit Application Manual

(A. Heineck, R. Callahan) (UNCLASSIFIED)

Grade B approval (concurrence by MIT and IBM Basic Circuits Groups) has been obtained on the following items: 1) High-Speed Flip-Flop, 2) Low-Speed Flip-Flop Model C, 3) Gate Circuit Model A, 4) Pulse Amplifier Models A & B, 5) Register Driver Model A, 6) Design Procedure for Diode Circuits, 7) Logical Diode Circuits, 8) Standard Cathode Followers, 9) Inverter, and 10) Level Setter.

In about one month the final reports on these circuits will be ready for insertion in the Circuit Application Manual.

2.12 Magnetic-Core MemoriesMiscellany

(W. Papian) (RESTRICTED)

The core memory in WWI continues to operate very well; tests of its margins continue as the WWI schedule permits.

Heavy collateral effort to investigate new designs for the AN/FSQ-7 memory-sense amplifier and selection-gate generator are under way.

The 64 x 64 memory for MTC is coming along nicely. The duplicate pieces of hardware may start coming in soon; if so, they will be installed in MTC so that only the memory stack (array) will have to be moved upstairs when rastering tests are completed.

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2.12 Magnetic-Core Memories (continued)

64 x 64 Memory for MTC

(E. A. Guditz) (UNCLASSIFIED)

Twelve of the 19 planes for the 64 x 64 Core Memory, Mod. II, are completed. Eight of these are ready for use, four are being inspected, and seven are under construction.

All of the driving panels for the memory have been installed and will be checked out when the power wiring is completed.

All items have been received except the driving transformers.

Selection Plane Drivers

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

We have received all the panels from the shop, and we are now testing these panels. The excellent cooperation given us by Production Control and the shop has helped us keep this effort moving on schedule. Satisfactory pulse-transformer samples have been received from Sprague, and partial delivery of the finished transformers is expected this week.

Sense Amplifiers and Digit-Plane Drivers

All units for Core Memory, Mod. II, have been resistance and voltage checked and are now ready for video checking.

Core Switches

(J. Raffel) (UNCLASSIFIED)

A test setup using cores mounted for insertion in 9-pin tube sockets has been built. Tests have been run simulating an 8 x 8 position switch and are very encouraging.

The design for the final 16 x 16 switch is almost complete, and arrangements are being made to have cores tested.

Tests are being run on one of the old matrix switches to obtain information for H. Rising to be used in design of a stepping-register switch.

2.12 Magnetic-Core Memories (continued)

Switch Cores

(A. D. Hughes) (UNCLASSIFIED)

The thesis proposal has been published as Memorandum M-2514. An attempt is being made to determine the effect of different load resistances in series with a simulated 32-plane memory on regulation and waveshape of the memory driving current as produced by a metallic switch core.

2.13 Vacuum-Tube Circuits

(R. L. Best) (UNCLASSIFIED)

It appears that the use of a 7AK7 cathode follower in the high-speed registers would save 400 tubes and 1100 cathodes. This promising economy is being weighed by Sarahan at IBM against the difficulty of making the change at this time.

A 3-cathode version of the high-power cathode follower is being used in control. One 5965 and one-half of a 5998 are used in the circuit.

A simple feedback circuit has been developed for driving the magnetic-shift register. It operates from a flip-flop waveform and uses both halves of one 5998 tube.

A new model of the memory read-write gate generator is being experimented with. Instead of getting constant current by bleeding it through a large resistor, a feedback circuit is employed.

5998 High-Power Cathode Follower (3-Cathode Version)

(B. R. Remis) (UNCLASSIFIED)

The circuit has been modified to guarantee a lower output level of -30 volts for tubes between + 25 per cent and -40 per cent and for components at outer limits of purchase specs. Marginal-checking circle diagram curves are now being taken at IBM to establish the merit of the +250-v supply as a checking voltage. The 3-cathode circuit appears quite able to drive the worst load demanded of it in the control frame.

2.13 Vacuum-Tube Circuits (continued)

7AK7 Medium-Power Cathode Follower

(B. R. Remis) (UNCLASSIFIED)

An evaluation of the savings in tubes in the arithmetic element that would result from the substitution of 7AK7 tubes for the 5965's presently used in the flip-flop output cathode followers indicated a net saving of 400 bottles or 1100 cathodes. The 7AK7 CF cannot fall quite as fast as can the 5965, due to the increased bias buildup of that tube. However, it can be designed to fall past -15 volts in 0.25  $\mu$ second.

Mod. VII Core Driver

(D. Shansky) (UNCLASSIFIED)

Because of the difficulty of stabilizing the amplifier and still maintaining adequate band width to insure fast enough rise times, this circuit has been redesigned so that there will be fewer stages in the feedback loop. This circuit is presently being bread boarded and will be ready for debugging in the next biweekly period.

5998 Power Cathode Follower (4-Cathode Version)

The marginal-check data thus far collected on this circuit has not been boiled down into a useable form because of lack of time.

Delay-Line Circuits

(J. S. Gillette) (UNCLASSIFIED)

An M-note has been written on delay circuits and will soon be distributed. No more work has been done on the memory pulse distributor because we are still waiting for pulse transformers from Sprague.

Shift-Register Core Driver

A core driver using one 5998 tube is being developed. Its regulation should be within minus 35 per cent and plus some undetermined percentage. The output tube is biased at - 100 volts, thus keeping the cutoff plate current to a minimum.

2.13 Vacuum-Tube Circuits (continued)

Read-Write Gate Generator Core Memory, Mod II

(D. Shansky) (UNCLASSIFIED)

A new circuit to do this job has been designed, bread boarded, and debugged. This circuit makes the individual selection-plane drivers look like cascode amplifiers. The regulation over an ordinary cascode amplifier is improved by means of feedback. This development was sparked by the recent trip of Messrs. Mitchell, Canty, and Ogden to ERA.

One of the difficulties we have been experiencing with this circuit results from the large amount of capacity the circuit is required to drive (1600 pf). Transient-wise, this capacity effectively isolates the driver tube from the current-regulating system. A possible solution to this difficulty exists and will be investigated in the next biweekly period.

High-Speed Gate-Tube Circuit

(H. J. Platt) (UNCLASSIFIED)

An M-note describing the findings concerning this circuit is in the process of being written.

Single-Shot Multivibrator

Investigation of this circuit continues. The RC differentiating and integrating types of multivibrators seem to have the same number of possible variables other than R and C. The tuned-circuit idea is very good in that the timing would be dependent only on the parameters of the tuned circuit. The difficulty with this idea is that the required inductances are prohibitive.

Magnetic Drum

(H. E. Anderson) (UNCLASSIFIED)

The timing track is now being used to control reading and writing on the drum. Preliminary strobing tests on the read amplifier look very encouraging. The drum can be moved to the computer room in the near future. Present plans call for making 1 digit work with many fields (perhaps 11). This will permit a study of the switching circuits sooner than the original plan for one field of 17 digits.

2.13 Vacuum-Tube Circuits (continued)

High-Speed Flip-Flop

(S. Bradspies) (UNCLASSIFIED)

Tests on the input circuit for a high-speed flip-flop have been finished and the following conclusions were arrived at: we consider only the magnitude of the pulse right at the primary of the input transformer for 40-v input pulses and for 10 extra diodes shunted to ground.

<u>Circuit</u>	<u>Voltage of First Pulse</u>	<u>Voltage of Last Pulse</u>
1. Circuit now used	36	25
2. All remaining circuits have secondary damping removed.		
a. 100 $\Omega$ in primary	32	28
b. 560 $\Omega$ in primary	23	21
c. 1000 $\Omega$ in primary	18.5	16.5
d. one diode in primary	32	28
e. two diodes in primary	28	27

From this data it would seem that the best change would be to either 2a or 2c. Other cases in 2 give better p. v. sensitivity, but the voltages are too low.

Drum Circuits

(Hal Boyd) (UNCLASSIFIED)

Enough bench and simulation experience has been obtained on the new read-amplifier for XD-1 and MIC to give assurance of reliable performance in system use. Tests on its input transformer indicate a very satisfactory design and excellent characteristics. A bogy read-amplifier will perform satisfactorily even without its gain-of-5 input transformer.

Combined read-write switching offers a seemingly unsurmountable problem in the form of nonblocking read circuitry. Such a scheme would also cause a great loss in the efficiency of the write circuits. Hence, at least for the present, only separate write and read switching will be considered.

2.13 Vacuum-Tube Circuits (continued)

(Hal Boyd) (UNCLASSIFIED)

A timing-pulse generator has been designed which employs a principle entirely different from that heretofore considered, with a view to obtaining the utmost in reliability and performance. Even so a substantial tube saving appears possible.

Slave Flip-Flop Life Test

The breadboard equipment necessary for this test will be ready for installation within the next week. The characteristics of the 80 diodes to be used have been taken, and the special transformers that are required for the slave are now being potted at the lab. All phases of the work should be completed within the next week, at which time the tests will begin.

Sense Amplifier

(C. A. Laspina) (UNCLASSIFIED)

Measurements of gain stability in the MTC sense amplifier were made. At 500 kc with the gain of one stage down 50 per cent, the over-all gain of the amplifier changes per cent. The sense amplifier with a 6072 as the input stage has about the same gain stability.

A sense amplifier using a transformer and diodes has been tried and operates very well. This amplifier uses diodes to produce unipolarity pulses and is not a difference amplifier. Because the amplifier operates with unipolarity pulses the grids can be clamped, eliminating the long time constant necessary in the MTC sense amplifier. This amplifier will probably use fewer cathodes than the MTC amplifier. The use of diodes at low levels and the recovery time of the transformer are still to be investigated.

2.14 Memory Test ComputerGeneral

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

An effort is being made to revise block diagrams and block schematics where necessary to anticipate the future state of MTC as of, say, Feb. 1, 1954, when installations now under way will probably be complete. Most of this is covered in Bagley's contribution below. Another revision long overdue will be made in the Alarm System as indicated by the new block schematic SE-53569-4. This should help materially in reducing average instruction time, probably shaving the former 16.5 microseconds of ca to something more like 15 microseconds.

With the new 64 x 64 memory it was feared that the instruction ra (replace address, corresponding to WWI td) would require a double memory cycle; the reason for this was that the pulse-transformer drive contemplated, with average d-c output of 0, presumably could not stand a wait between read and rewrite of more than  $\frac{1}{2}$  microsecond or so. (Such a double cycle is planned for the XD-1.) Recent measurements by Mitchell, however, have indicated that 3 microseconds and possibly more can be tolerated between read and rewrite without noticeable deterioration of the write-current waveform. Therefore, ra will be tried with a single memory cycle.

The three new instructions affecting Group and Field Control have had their names changed as indicated below by Wes Clark; this should make description and analysis of programs a little easier.

A block schematic of Group and Field Control is available as SD-56909-1.

Classes for technicians in the functioning of MTC have been resumed, and it is intended to make these an integral part of the over-all MTC program.

(W. A. Clark) (UNCLASSIFIED)

With the concurrence of interested members in Groups 61, 62, and S&EC, the names and abbreviations of the three new instructions affecting Group and Field Control have been changed from "field transfer," ft, "field transfer on negative," fn, and "field select," fs, as reported in the last biweekly, to "transfer out," tro, "transfer on negative out," tno, and "select operation field," sof.

The complete instruction code is available in single-page form as SA-56946-1.

2.14 Memory Test Computer (Continued)

General (Continued)

(P. R. Bagley) (UNCLASSIFIED)

M-2527, "Memory Test Computer Programming Manual," is in the process of preparation.

SD-47011, "Proposed Block Diagram, MTC," has been brought up to date. It now contains a listing of nearly all the block diagrams and block schematics pertaining to MTC.

SC-37460, "Block Diagram, Pulse, Control, MTC," has been brought up to date and includes the changes necessary to accommodate the forthcoming magnetic core and drum memories and associated controls.

The following additional block diagrams have been issued or revised in the last biweekly period:

SD-47039 Simplified Block Diagram, MTC

SD-47038 Block Diagram, Group and Field Control, MTC

SD-56291 Block Schematic, Interim Drum Storage System, MTC

A wiring diagram of Drum Control has been drawn.

Drum Circuits

(H. W. Boyd) (UNCLASSIFIED)

A prototype plug-in unit of the read-amplifier has been built, and, upon completion of the necessary tests, sketches will be sent to the Drafting Room.

A plug-in gate-buffer was designed and tested which will take either a ground-level gate or a +10-v gate voltage. The output characteristics for the two input types are identical. The unit can drive up to 100 ft of coax.

The special panel for the Angular Position Counter-Drum Address Register (APC-DAR) coincidence detector should be received from the shop within the next week.

Work will be begun in the near future on a plug-in dual buffer that will operate from either a Mod. I or Mod. II gate tube.

A time-pulse generator employing an entirely different principle from the one heretofore considered has been designed in an effort to obtain better reliability and performance. Breadboard tests are now under way.

2.14 Memory Test Computer (Continued)

General Circuits

(J. Crane) (UNCLASSIFIED)

An interwiring schematic for Group and Field Control, MTC, is now complete.

Memory Display Scope

(J. Crane) (UNCLASSIFIED)

Amplifiers used in the 10-inch memory-display scope are now constructed. Testing of these amplifiers will be done during the next biweekly period. The final system will employ amplifiers similar to those used in the Charactron, and the scope will serve a dual purpose -- memory display and display as called for in the display order for MTC.

Input-Output Equipment

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

A proposed control block diagram has been drawn for the Ferranti Photoelectric Tape Reader.

Several panels are under construction for this unit, and testing will probably start at an early date.

MTC Power Supplies

(D. M. Fisher, R. G. Farmer) (UNCLASSIFIED)

All MTC power supplies are now in operating condition.

The current capacity of the -150-v supply is being increased from 19.2 amperes to 27.6 amperes. To meet this demand another 10-amp rectifier is being constructed to operate in parallel with the two already in operation. It is hoped that the increase in capacity will be completed before the first of the year.

Computer Operation

(R. Hughes) (UNCLASSIFIED)

Operation has been free of error and component failure during the last biweekly period. The MTC power supplies are all connected to the computer now and are working quite well.

2.14 Memory Test Computer (Continued)

Input-Output Equipment

(R. Hughes) (UNCLASSIFIED)

The IBM output printer is now working very well. Relay timing trouble is suspected on this unit, and an effort will be made to make the unit more reliable.

MTC Records

(L. Sutro) (UNCLASSIFIED)

Changes are being made which will eventually make MTC records as complete and reliable as is now desired. A record of how the computer's time was spent is presented in this biweekly. In the MTC Service File prints are in their proper places. All the prints of the accumulator have been marked to show the revisions known to have been made. Drafting will now revise these drawings. Later, inspectors will check them against the actual circuits to make sure they are correct.

Two record cards are being prepared for each panel or plug-in unit. One will show the tube complement and the reason for every tube failure; the second will show the history of the panel or plug-in unit. The latter will record the date, filament hours, and plate hours when the unit was installed, removed, modified, and a tube or other component was replaced. To make this record possible, a filament-hours clock has been installed in MTC with an initial setting 15 per cent greater than the plate-hours clock.

MTC Logbook Summary

(B. Kollet) (UNCLASSIFIED)

Filament Clock Hours (A-C):	1749.0 to 1814.6	(65.6 Tot. Hrs.)
Plate Clock Hours (D-C):	1507.7 to 1557.8	(50.1 Tot. Hrs.)

Breakdown of D-C Hours.

*Development:	31.4 hrs.
Installation:	.8 "
Routine Check Problems:	8.7 "
Marginal Checking:	7.8 "
Trouble Shooting:	1.4 "
Programs:	-----

Tot. D-C Hrs.            50.1

* Development:	Charactron-----	27.9 hrs.
	Control Switch-----	.5 "
	IBM Printer-----	3.0 "
	Total-----	31.4 hrs.

2.15 Equipment Design and Schedules

(J. Giordano) (UNCLASSIFIED)

A meeting with the Production Control group at Project High is planned for the coming week. The purpose of the meeting is to initiate a series of progressive reports on the status of physical construction of XD-1 and XD-2.

(A. P. Kromer)

See SECRET supplement to biweekly, M-2529

2.16 Transistors

Summary

(D. J. Eckl) (UNCLASSIFIED)

The transistor accumulator has been in operation for a period of 8600 hours. Changes are now being made in the control unit to provide 0.25- $\mu$ sec pulses to the unit. This should relieve a critical situation with regard to the input transistor stages. The frequency response of the average transistor is such that triggering with a 0.1- $\mu$ sec pulse is difficult.

Intensive work on two-transistor flip-flops is continuing. Ed Cohler now has the assistance of J. Ahlgren, a part-time student, for some of the routine checks. Tests are being made on three flip-flops: the one in the accumulator; the one described in Cohler's note E-557 "The Design of a Two-Transistor Saturating Flip-Flop"; and a nonsaturating variety designed by A. W. Carlson of AFCRC. Several methods of triggering will also be investigated. The results of these studies, together with some theoretical work by Cohler, will be incorporated in a report on two-transistor flip-flops by Cohler and myself.

The gate problem is being studied by C. Kirk, and to date he has a circuit in operation which should be an improvement over that now used in the accumulator. A detailed analysis of the circuit has been carried out which indicates that peak power could be a problem. This will be investigated further in a series of life tests.

The problem of using transistors as cores drivers is being studied by S. Oken. To date he has shown that it is possible to drive a core around the hysteresis loop using regenerative point-contact transistor circuits. It is also possible to select cores when several drivers are used. However, the point-contact transistor has several disadvantages in this type of operation, the foremost being its limited power-handling capabilities. The junction transistor seems likely to prove more satisfactory since it can handle large amounts of power. The frequency limitation on junction transistors seems to be improving. Further efforts

2.16 Transistors (Continued)Summary (Continued)

(D. J. Eckl) (UNCLASSIFIED)

will be directed toward junction-transistor circuits.

A new set of life tests will be initiated in the near future in an attempt to obtain data on peak power dissipation and high-current operation of transistors. This information is not available from the manufacturers and is important in the operation of many types of circuits. The power supplies which have delayed the start of these tests for some time are now available. Only the initial processing of the transistors remains to be done.

Transistor Gates

(C. T. Kirk) (UNCLASSIFIED)

The analysis of the transistor regenerative gate has been completed. In some respects the gate is quite satisfactory. It has an average collector dissipation of less than 50 milliwatts, a relatively high input impedance, and does not require any abnormal values for transistor parameters. Unfortunately it requires transistors of high frequency response.

The load which the gate is required to drive is quite heavy, and as a result high peak powers are encountered in the transistor regions.

Transistor Counter

(E. U. Cohler) (UNCLASSIFIED)

Reliability tests are in progress on the counter. It was set in operation on 27 Oct. 1953 and operated without error until 30 Oct. 1953. It was then moved to a new location and again set in operation whereupon it made an isolated mistake. Operation was then immediately resumed and continued errorless until 11 Nov. 1953. The errorless run was well over 250 hours. At that point the fourth flip-flop began making errors, so operation was halted and a thorough check made of the parameters of each of the transistors in the counter. This revealed that the only significant change was in the parameter  $r_{CO}$  which had decreased from its original value in each case. However, the  $r_{CO}$  decrease in no case should have been great enough to have affected the operation of the counter. The transistors were then replaced in the counter on 12 Nov. 1953 and have operated properly ever since. This is disturbing, though not completely discouraging, and attempts will be made to determine the origin of such failures.

2.16 Transistors (Continued)Transistor Counter (Continued)

(E. U. Cohler) (UNCLASSIFIED)

Since 30 Oct. 1953 margins have been taken on the counter daily and will be continued as one aid to locating the source of such trouble. In addition, we will start measuring  $r_{CO}$  daily when the manpower is available.

Point-Contact Flip-flops

(E. U. Cohler) (UNCLASSIFIED)

In conjunction with the work on the counter and flip-flops in general some tests and calculations are being made to describe more fully the transient operation of the flip-flops. This has two objects at present. First of all, it will determine the peak collector and emitter dissipation during the transient. Secondly, it will aid in the development of improved triggering methods.

Transistor Core Drivers

(S. Oken) (UNCLASSIFIED)

The regenerative transistor core driver was tested with different transistors. Many transistors did not give a suitable output waveform because the wave exhibited a long hump of about  $\frac{1}{2}$  the full amplitude after it should have dropped to zero. This is probably due to the bad "hole storage" characteristics of the transistors. The actual correlation of poor output with transistors having bad "hole storage" properties is being studied.

In the test 107 transistors (RCA TA165's and GELLA's) gave an output current of from 12.12-13 milliamperes with a pulse width of from 6  $\mu$ seconds to 7.5  $\mu$ seconds. The minimum width is designed to be at least 6  $\mu$ seconds.

The problem of back voltage across the cores on the driver is being investigated. The problem is greatly aggravated by the use of small currents and 10 turns per winding. By paralleling drivers, the equivalent impedance presented by the cores to the driver can be reduced by a factor of 4.

2.17 Display

(M. Epstein) (CONFIDENTIAL)

Work was started to fix much of the logic of the digital display. I hope to have part of the system temporarily frozen in the next biweekly period.

Comment is awaited on M-2503 which outlines a more flexible display system. We hope to have estimates in the near future of the effect of this scheme on programming time.

(R. H. Gerhardt) (CONFIDENTIAL)

An M-note describing a system for digital expansion of the track-display expansion of the track-display scopes is being written. Each console will have two rows of 15 push buttons, one for x selection and one for y selection; a 3-position switch which selects the linear expansion ratio, x2, x4, or x8; and a 2-position switch to select expanded or normal displays.

(R. von Buelow) (CONFIDENTIAL)

Group 61 has generally accepted the display system proposed by the IBM-MIT display groups. They are, however, still making some changes in the requirements such as increasing the number of characters per slot, superimposing characters, providing the ability to bypass feature selection, etc. Some additional changes have been brought about by the revision of the defense sector.

Some time was spent in assisting R. Gerhardt with digital-expansion switching.

(L. B. Martin) (UNCLASSIFIED)

Preparations are about 70 per cent complete for a limited Charactron display in Barta Building.

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

Further modifications have been made to the magnetic amplifier in order to stabilize the amplifier. Initial investigation is under way for the design of decoders to be used in positioning the characters on the face of the Charactron tube and for character selection. In line with this project, current sources are under investigation.

The Charactron display system was demonstrated to some Air Force personnel this past week.

~~CONFIDENTIAL~~

SECURITY INFORMATION

2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

Core testing for the Core Memory, Mod. II, is complete.

Core testing for XD-1 is underway at High Street. Enough cores for one memory bank have been shipped from General Ceramics. RCA has been unable to duplicate its previous good batch.

Pilot production of cores similar to General Ceramics cores is being studied here.

Pilot Plant Production of F-394 Cores

(J. Sacco) (UNCLASSIFIED)

F-394 cores from batch DCL-3-70 have been fired and tested. The pulse characteristics of this composition are quite similar to batch DCL-2-281. However, the driving current is slightly high, and another firing is now under way in order to remedy this condition.

D-262 cores from another series on the MnO.MgO.Fe<sub>2</sub>O<sub>3</sub> ternary diagram have been fired and are now being tested. Another new series<sup>3</sup> is in the final stages of processing and will be ready for firing within a week.

(R. A. Maglio) (UNCLASSIFIED)

F-394 cores of the DCL-2-281 composition have been fired in the Harper furnace and have been tested. Test results for these cores have indicated the following:

1. Before refiring there is a correlation between coercive force and temperature of firing. (A temperature variation of 25 C exists at 1450 C within the Harper furnace muffle.) This correlation was upset after refiring the cores.

2. The setter plate (plate upon which the cores are fired) is a very important factor in the firing of magnetic-memory cores. Cores which were fired upon setter plates coated with ferrite were consistently lower in squareness than those fired upon an uncoated alumina setter. Fred Maddocks has been studying the crystal structure of these cores in an effort to determine the diffusion mechanism.

(F. S. Maddocks) (UNCLASSIFIED)

A series of F-394 size cores of DCL-2-281 material, fired in the Harper furnace has been examined. Cores fired on the plain alumina setters have grains of uniform size with no distinguishable change in grain size near the setter, indicating no appreciable diffusion of material from the alumina

2.2 Group 63 (Continued)

(F. S. Maddocks) (Continued) (UNCLASSIFIED)

setter to the core. Apparently, however, material from the core is diffused into the setter.

Cores fired on alumina setters which had been coated with ferrite material of a different composition from that of the core in contact with it showed diffusion of material from the setter to the core (or vice versa) to a large degree, altering completely the grain structure of the core. Electrical tests show these cores to be unsuited for memory applications.

Cores of known composition and similar firing conditions are being examined to find similar grain patterns and precipitate distribution in an attempt to show the mechanism of the diffusion process.

Differential Thermal Analysis of  $MnO.Fe_2O_3$ 

(R. A. Maglio) (UNCLASSIFIED)

Curves have been obtained for chemicals which may be used as starting materials in the preparation of ferrites. The energy transformations existing in these materials during heating and cooling have been identified through a series of runs in nitrogen and in air.

A stoichiometric mixture of  $MnO.Fe_2O_3$  has been prepared from  $MnCO_3 + Fe_2O_3$  and fired in air and nitrogen. Attempts are now under way to determine the reason for losing the large endothermic peak for the calcination of  $MnCO_3$  at 500 C when the mixture of  $MnCO_3 + Fe_2O_3$  is fired in air.

Stress Effects and the Switching Mechanism in Ferrites with Nonsquare Loops

(N. Menyuk) (UNCLASSIFIED)

The theory of the switching coefficient has been generalized to permit its application to ferrites with nonsquare hysteresis loops. An experiment on a ferrite under various stresses has been performed, and the resultant data used to check the validity of the theory. A report covering this study is being written.

Magnetic Anneal of Ferrites

(P. K. Baltzer) (UNCLASSIFIED)

Preparation has been made for an experiment involving the cooling of ferrites through and below the Curie point in a magnetic field. Cores of several compositions from the  $MnO.MgO.Fe_2O_3$  triaxial diagram have been tested and mounted in an annealing boat.

2.2 Group 63 (Continued)

Curie Point Measurements

(P. K. Baltzer) (UNCLASSIFIED)

It is planned to measure the Curie point of ferrites utilizing the phenomenon of an abrupt change in the initial permeability just below the Curie point. Unwound slugs of ferrite will be placed in a fixed coil in furnace, and the change in coil inductance plotted versus temperature on a speedomax recorder. The necessary electrical equipment is being constructed.

The Covalent Bond in Spinels

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

The Stark effect due to the crystalline fields in the spinel lattice is being examined. It is hoped this will give some insight into the reason why certain spinels are normal and others are inverse. Consideration is also being given to the mechanism responsible for the valencies of the various transition elements.

Grain-Size Effects

(J. B. Goodenough) (UNCLASSIFIED)

It has been predicted for some time that grain size has an effect on both the coercive force and the squareness of the ferrite bodies. Preparations are under way to examine the electrical properties of a magnesium-manganese ferrite as a function of grain size.

Core Drivers

(J. D. Childress) (UNCLASSIFIED)

Core drivers Mod. V and Mod. VI have been modified to give a current-pulse rise time less than 0.2  $\mu$ second, amplitudes to 1.2 amperes, and amplitude constant (flat top) into a resistive load.

Also, the bias on the output tubes of the Mod. VI was changed so that the Mod. V could not turn on the Mod. VI.

SECTION III - CENTRAL SERVICES

3.1 Purchasing and Stock

(H. B. Morley) (UNCLASSIFIED)

For the month of October 1953, 452 new purchase orders were placed as compared with 391 for October 1952.

A purchasing analysis of telemetering tape made in cooperation with H. J. Kirshner will result in a cost saving of 60 per cent to the Project for material equivalent to that previously supplied by a different manufacturer.

The order for additional Flexowriters (for Group 61) has been placed. Delivery is promised for six months, but negotiations are under way with the vendor to try to advance this date.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 29 Construction Requisitions totaling 467 items satisfied since November 6, 1953. There are 23 Construction Requisitions totaling 1557 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 3 orders now open with vendors, totaling 364 items. Deliveries in the past biweekly period have totaled 328 items. Information on specific orders may be obtained from the writer (Ext. 3492).

3.3 Component Analysis and Standards

3.33 Standards

(H. W. Hodgdon) (UNCLASSIFIED)

Division 6 Standards rough-draft proposals for the following items have been prepared and will be submitted to the Standards Committee

3.33 Standards (Continued)

(H. W. Hodgdon) (Continued) (UNCLASSIFIED)

next week for consideration:

Pulse Transformer Core (Ferrite)	6.193-15
Pulse Transformer (Ferrite Core), 1:1	6.193-16
Pulse Transformer (Ferrite Core), 3:1	6.193-17
Miniature Selenium Rectifier	6.134-1

The Lincoln Laboratory Standards numbering system will differ radically from that now in use in this Lab. For this reason, each item now in use in Division 6 will have to be carefully and accurately cross-indexed when it is superseded by an item in Lincoln Laboratory Standard Stock. The method proposed for accomplishing this is outlined in detail in M-2526 being prepared by A. M. Falcione.

Component Evaluation

(B. B. Paine) (UNCLASSIFIED)

A variety of special tests have been performed for members of the Division. Life testing of Clare Type K relays, which are used in group-selector relay chassis in magnetic-drum equipment, is proceeding to determine whether these relays are suitable for our use over long periods of time. Junction diodes have been specially tested for the WWI magnetic-tape equipment. Consultation with members of the Division to decide upon proper components for specific applications takes a large portion of our time, and engineers are urged to bring their component requirements to us.

Purchase specifications have been written for a variety of popular components by a joint IBM-MIT ad-hoc committee, which has since been dissolved. Further work on components at IBM is being handled by the new Components Group headed by D. J. Crawford. The MIT Components Section is attempting to follow this activity, and an up-to-date file of component drawings and specifications will be maintained here.

Work with the Lincoln Laboratory Standards Committee is increasing, preparatory to the establishment of their Test and Evaluation Laboratory. I expect that the Division 6 Components Section and the new Test and Evaluation Laboratory will merge eventually, serving all of Lincoln Laboratory, in order to obtain the most efficient utilization of men and equipment. A variety of measurement and test equipment is being assembled in the Whittemore Building to facilitate the activation of such an interdivisional laboratory.

It now appears that the life-test work on and general knowledge of germanium diodes both here and at IBM may not be sufficient to enable accurate prediction of changes in diode characteristics during long life.

3.33 Standards (Continued)Component Evaluation (Continued)

(B. B. Paine)

Insufficient data is available even to decide what manufacturers' products are most stable. The various methods for determining reverse recovery time give greatly different results. Interest in high-forward-current junction diodes is increasing rapidly, but few tests have been made on them.

A proposal now being prepared which outlines the work which might be conducted by the Division 6 Components Section during the coming year will stress the need for an intensive program of diode life testing and data collection from other agencies. Tests and study of various delay lines, relays, and switches also seem important. Work on capacitors and resistors has progressed to the point which will allow us to concentrate on other problems, until failure information on XD-1 and XD-2 accrues. IBM is pursuing an intensive study of the life of these components. The efforts of the Components Section will be directed toward filling the gaps in component information at hand for AN/FSQ-7 design, toward testing and supplying newly developed components to Division 6 installations, and toward closer cooperation with the Lincoln Laboratory Standards Committee and members of other Divisions.

3.34 Vacuum Tubes

(T. F. Clough) (UNCLASSIFIED)

A program for dissecting 5998 and Z-2177 tubes was started during this biweekly period. An initial comparison of materials, parts, construction techniques, and processing procedures will be made.

In the near future we plan to analyze the 5965, 7AK7, and SR-1782 tubes in a similar manner.

Representative or unusual failures at test or during life will also be the subjects for analysis. This is another program to assist in improving the reliability of electron tubes.

During this period I accompanied P. Youtz of Group 65 and W. L. Gardner and F. A. Rodgers of Group 25 to the Corning Glass Works to discuss the fabrication of a new envelope required for the display program of AN/FSQ-7.

(S. Twicken) (UNCLASSIFIED)

The new console tube tester has been debugged and placed in Room 026 in the Barta Building. Pending completion of an amplifier for

3.34 Vacuum Tubes (Continued)

(S. Twicken) (Continued) (UNCLASSIFIED)

the General Radio bridge and various adapters for the intermittents detector, the tester will be used for static testing and the determination of characteristic curves only.

A program has been undertaken to obtain pentode, tetrode, and triode-connected characteristic curves of the 7AK7 and to reach an agreement with Sylvania as to their accuracy. Curves previously taken here in the positive grid region using low duty-factor techniques in some respects differed considerably from those taken by Sylvania by means of d-c techniques of several seconds duration per curve. The consensus here is that some characteristics are markedly changed by this method of test.

Curves are to be taken here and checked at IBM on equipment using a different pulse technique. Correlation will then be sought at Sylvania where pulse equipment is being set up. The tubes and curves should be on their way to IBM during the week of November 23.

(H. B. Frost) (UNCLASSIFIED)

A meeting of the JTC-5.5 task force on short testing was held on November 10 in Newark, New Jersey. At this meeting a prepared definition for a short circuit in tubes for computer use was formulated. This definition follows the performance curve of our new equipment, is capable of test, and excludes most tubes that can cause trouble. The definition now awaits action by the main JTC-5.5 subcommittee on computer tubes. Frost and Twicken attended this meeting.

A second meeting with Tung-sol was held the afternoon of November 10. MIT and IBM representatives outlined the 5998 requirements of the XD-1 system. We hope to sponsor an improvement program at Tung-sol for this tube. Primary changes needed are improvements in cutoff uniformity, new bulb (T 12 requested), and better manufacturing processes. Tung-sol is now examining our requirements.

With the completion of debugging and checking on the Model III tube tester, work is now progressing on tubes for XD-1, primarily the Z-2177 and SR-1782A. Life tests will be initiated on these tubes in the near future. Pulse curves for the 7AK7 will be checked and additional curves will be prepared. A method for measuring  $G_1$  pulse current is now in operation.

To provide additional space for division of facilities, the pulse-test equipment is being moved to Room 026, the old storage-tube test area. The interface bridge will probably be moved in the near future.

3.34 Vacuum Tubes (Continued)Thesis Research

(H. B. Frost) (UNCLASSIFIED)

Continued tests on RT 413 have shown that plots of cathode-surface potential against saturated collector current for the same grid voltages are linear. This observation means that the voltage drop across the cathode coating may be determined from such plots. The nonlinearity of surface potential in grid-current plots probably results from nonuniform current distribution on the cathode.

A re-examination of the theoretical results has shown a functional relationship between the direct-current emission limit of a cathode, the pulse-emission limit, and the coating resistance. This relationship assumes all parameters to be measured at the same temperature. Results thus far show fairly good correspondence between theoretical and experimental values for RT 413. Experimental work is now in progress to check the relationship for other tubes. The above result, if proven, is a very important and basic addition to the theory of oxide cathodes.

RT 414 was constructed and processed on November 11-14. Tests on this tube were delayed somewhat by experimental work on RT 413. Preliminary tests made on November 20 indicate that this tube is highly satisfactory. Extra precautions taken during processing allowed this tube to be used without additional aging.

Analytical and programming work in the diffusion equation has been proceeding satisfactorily. Some results must now be evaluated by a calculator, as slide-rule calculation of the functions involved is very inaccurate. A computer run for one parameter value has been completed. The time required was nearly 5 hours. This run revealed an objectionable truncation error in addition to the excessive length of the program. I have rewritten the program with the object of shortening it as well as reducing the truncation error. A modified square-root subroutine using a new criterion for ending the iteration and a new test method devised by Denman have been included. The estimated running time of the new program is 45 minutes.

(A. Zacharias) (UNCLASSIFIED)

During this period S. Twicken and I completed the alignment of the new console tube tester.

Work has been started on equipment for obtaining the pulsed-current tube characteristics.

### 3.4 Test Equipment

#### Test Equipment Committee

(L. Sutro) (UNCLASSIFIED)

The coming move to Lexington has raised the possibility of cooperating with Division 7 instrument room which issues approximately the same quantity of equipment as Test Equipment Headquarters and has approximately the same staff. The Committee visited the Division 7 instrument room in Building 22, their shop at the Vassar Street Building, and the Lexington location of both the Division 7 instrument room and the Division 6 Test Equipment Headquarters. At its meeting on November 20, the Committee decided to combine with Division 7 in the repair of meters. Further merger of services does not appear practical.

The Committee approved purchase of equipment necessary for repair of meters. The two expensive items are a Magnet Charger at \$490.00 and a Weston Model 431 Voltmeter at \$186.00. The latter provides a standard for the range 0-30, 0-75 volts. Other standards needed were acquired in previous years.

#### Test Equipment Headquarters

(L. Sutro) (UNCLASSIFIED)

The circuit improvements devised by J. Childress are being incorporated in Model V and Model VI Core Drivers. These have largely eliminated the overshoot on the negative-going portion of the Model VI waveform, removed the wrinkles from the flat top of both Model V and Model VI waveforms, and reduced the jitter in the Model VI.

One of the technicians in Test Equipment Headquarters, Nelson Savoie, is training to be instrument repair man for all of Lincoln Laboratory. He is repairing Division 6 instruments now. When he finishes he will start on those belonging to the other Divisions.

### 3.5 Drafting

#### Component Standards for WWI

(A. M. Falcione) (UNCLASSIFIED)

The transition from DCL Component Standards to Lincoln Laboratory Standards requires close liaison between the Standards Committee and the WWI Bill of Materials Section in the determination of acceptable Lincoln Laboratory Component Standatds for use in WWI.

Memorandum M-2526 which is being written gives a detailed explanation for the special handling of components for WWI.

3.5 Drafting (Continued)

Multilith Reproduction Procedure

(A. M. Falcione) (UNCLASSIFIED)

In order to acquaint all secretaries with the new special multilith master, Administrative Memorandum A-128, Supplement #2, is being written and will be distributed to all secretaries within the next few weeks. A secretarial meeting will be held to discuss the new master so that proper instructions will be given on the procedure to be followed.

3.6 Administration and Personnel

Terminated Staff

(J. C. Proctor) (UNCLASSIFIED)

Jerome Dintenfass  
Peter Stephan  
Robert Garrett

New Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

James Ahlgren is an MIT student working part time in the Transistor Section of Group 62.

Andrew Bowen has returned again to work in the Memory Section of Group 62 on a part-time basis.

Bessie Cachauni is a new messenger girl in the Whittemore Building.

Archie Lemieux has joined the Inspection Department.

Lucy MacFarland has returned to work in the Print Room.

Thomas Murphy is a new member of the Construction Shop.

Anthony Musi is a new member of the Inspection Department.

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Mildred Clark  
Gordon Morse

3.6 Administration and Personnel (Continued)

Open Non-Staff Requisitions

1 Clerk-Typist  
1 Laboratory Assistant for Group 63  
1 Laboratory Assistant for Group 6345  
1 Messenger Girl  
1 Photographer's Helper  
2 Technicians for Group 64  
1 Technician for the Inspection Department  
1 Senior Detailer