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Memorandum M-2476

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

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To: Jay W. Forrester
From: Division 6 Staff

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

(C.R. Wieser) (CONFIDENTIAL)

Operating reliability of the Cape Cod System equipment has been considerably better during this period. Attempts at full operation including weapons control during the first week gave poor results because of the short duration of target tracks and inability to get good interceptor tracks. As a result, the second week of the period was devoted to program debugging and reconsideration of the tracking parameters.

Several experiments in tracking simulated targets (simulated data is sampled and quantized) indicated that the tracking worked well. Minor improvements were made by parameter adjustment, but these may actually make the tracking slightly worse in the presence of noise. The tests indicate that the tracking trouble arises from the difference between real and simulated radar data. Some of the difficulty may have been caused by slowed-down-video (SDV) timing trouble (see Kirshner's report). Also, low blip-scan ratio has led to a good deal of tracking trouble. The tests with simulated data

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1.10 General (Continued)

(C.R. Wieser) (CONFIDENTIAL) (Continued)

indicate that the dynamic response of the smoothing equations is (and has to be) much slower at long ranges because of the large azimuth quantum (about 4 miles). Because of this, the loss of a single radar return on a long-range maneuvering target can cause loss of tracking. Modification of the smoothing to help this situation greatly increases vulnerability to loss of a track because of noise.

As a result of the difficulty with "seeing" interceptors, automatic insertion of data from the Group 23 Mark X is being pushed. About three weeks' work is needed to get and debug the equipment to insert the data.

I visited the FPS-3 site at South Truro with Howard Boehmer on Oct. 23. The set was working very well, and Group 22 is making every effort to improve it. Sensitivity time control had just been put into use, and the Moving Target Indicator (MTI) looked very good. Both the lower and the upper beam (which has no MTI) showed consistent tracks and very little clutter. The use of both beams combined now looks all right, provided that there is not a temperature inversion, which causes severe clutter on the upper beam.

During the next two weeks we will resume attempts to get good system operation with live aircraft. The crew at the South Truro site is willing to cooperate in experiments with selection of the radar beams and adjustment of the clip level. Changes should not be made more often than necessary, preferably only at the beginning of a test.

Summary

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

In about two weeks Group 24 will have the necessary equipment to modify two of the present SDV data links to use the form of data transmission that is planned for XD-1.

Consideration is being given to obtaining a second demodulator for use with the Truro radar in case of equipment failure.

A block diagram has been prepared for equipment to make the insertion of Mark X data into WWI possible. Methods for illuminating a brush or other objects on the radar-mapper surfaces by polarized light are being investigated.

Memorandum M-2472, "Programs for Checking the Equipment in Room 222 and Adjacent Areas," describes the programs for checking the Cape Cod equipment and gives the procedure for selecting the programs desired.

A program for simulating crossing tracks with blip-scan ratios of 0-100% is available.

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1.10 General (Continued)

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

A flight test was held using the M-33 tracking radar at Belmont (AAA) and five search radars. Since the error in the data is less than 30 yards, a good yardstick for measuring errors in tracking with one-half mile quantized radar data is provided.

A training program for the Air Force personnel in the Weapons Direction Section has been started.

Operation of the computer and equipment in Room 222 has improved considerably during the past biweekly period.

Several small programming errors have been discovered in the combined Cape Cod Program and are being corrected. Possible short-term and long-term modifications of smoothing are being studied.

Attempts to conduct interceptions this period were unsuccessful due to a lack of satisfactory radar data and tracks on either targets or interceptors.

A review of the floor-space estimates in L-113 indicates that they would be sufficient for the proposed Operations Building to be constructed in Lexington.

1.11 Equipment Engineering

(E.S. Rich) (CONFIDENTIAL)

Further modification was required on the azimuth drive units of the radar mappers to make them function properly on gap-filler data. It was found that the frequency of the jitter in the azimuth-change pulses from two of the sites was close to the natural oscillation frequency of one of the feedback loops in the drive units, so the units were forced out of sync when used with these sites. A modification was found which effectively increased the damping in the feedback loop so operation is now satisfactory for all inputs.

In about two weeks, Group 24 will have the necessary equipment built to modify two of the present SDV data links to use the form of data transmission that is planned for the XD-1 system. At the Barta Building it will be necessary to substitute new demodulator panels for the sites which are to be converted. Installation of the new equipment is for the purpose of evaluating the performance of the new circuits.

Sincere reliable data input from the Truro radar is highly important for the Cape Cod System operation, consideration is being given to obtaining a second demodulator for this data so a spare will be available in case of

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1.11 Equipment Engineering (Continued)

(E.S. Rich) (CONFIDENTIAL) (Continued)

equipment failure. It is proposed that two of the gap-filler demodulator panels plus a few of our standard plug-in units be used to make up the replacement unit.

(N. Alperin) (CONFIDENTIAL)

The second 14-channel Ampex unit will be placed in operation on October 26. The one presently being used will then be modified.

Some complaints have been received that certain light guns do not operate. This usually can be corrected by leaving the intensity setting at maximum.

Progress is being made in the attempt to get the same signal from all light guns regardless of phototube. A little more juggling should do it.

(H.J. Kirshner)

On October 13, 14, and 15 intermittent trouble developed with timing signals from South Truro. In the process of determining the cause of the trouble two cold-solder connections and two tap-shortened 6 AC7's were found in the Truro demodulator timing units. The source of the original trouble was finally located at South Truro modulator zero. Apparently the transmitted timing signal was intermittently falling below its normal level relative to azimuth and target pulses. As a result of this difficulty, data recorded on Tape 4 is in error; this tape will be used for rerecording.

On October 20 South Truro developed another trouble which manifested itself as the transmission of north marks on two successive azimuth pulses. This trouble puts South Truro data on Tape 8 in error. The other data on the tape pertains to a test with the Belmont Hill AA site so this tape will be retained.

Recorder #2 is now fully installed and will be placed in service while recorder #1 is being modified.

Earphone-microphone headsets requested from Group 22 have been received. The poor-quality carbon microphones in these units will be replaced by crystal microphones.

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1.11 Equipment Engineering (Continued)

(B. Morriss) (CONFIDENTIAL)

A block diagram has been prepared for equipment which will make possible the insertion of data from a Mark X beacon into WWI. The Mark X at Building B, Bedford, will be used with the Digital Relay Link formerly used with the Bedford MEW radar. The equipment to be built by Group 64 for converting the data into a form identical to that of the data from the SDV unit, and to temporarily store the data until read into the computer, is roughly equivalent to one of the present MITE units without its buffer storage. A note is being prepared describing the equipment.

Work on the checking of the equipment in Room 222 and the programs for the checking has continued. Details may be found in G. Young's report.

A small amount of time has been spent investigating how the in-out instructions may be modified to facilitate the installation of the parity check of the magnetic drums.

(D. Neville) (CONFIDENTIAL)

The UHF coder has been successfully tested out with WWI.

A tryout using test messages sent by WWI and received by aircraft equipment should be accomplished by the end of October.

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

Schemes for illuminating the surface of the cathode-ray tube with polarized light are being investigated. The purpose of the light is to illuminate the operator's brush or any object on the scope face without interfering with the persistence of tracks.

All checkouts and equipment changes are being logged in the Room 224 Equipment Log.

(G.A. Young) (CONFIDENTIAL)

The programs for checking the Cape Cod equipment have been placed on magnetic-tape unit O. A memorandum, M-2472, "Programs for Checking the Equipment in Room 222 and Adjacent Areas," describes the programs and procedures for selecting them. This memo will be distributed next week.

The equipment in Room 222 was checked out four times during the last biweekly period with Air Force personnel manning the stations. The time for each check varied between 45 minutes and 80 minutes, depending on the troubles encountered in scope calibration.

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1.11 Equipment Engineering (Continued)

(G.A. Young) (CONFIDENTIAL) (Continued)

Work is continuing on a Master's Thesis entitled, "Digital Techniques for Sorting by Areas in a Plane." In this thesis the use of a digital memory to store radar-clutter rejection patterns is being investigated.

1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

Operation of the computer and equipment in Room 222 has improved considerably during this past biweekly period. The radar-mapping scopes also seem to be much more reliable than previously. The "light cannon" (automatic initiation scope) has been the major bottleneck to obtaining full operation of all of the equipment in the Air Defense Center. Towards the end of the biweekly period, the problem of scope jitter was vastly improved over what it has been during the past few months. The engineers responsible for the operation of the large amount of equipment used by Group 61 are to be commended for listening so patiently to all of our complaints and for curing equipment difficulties so rapidly.

Several small programming errors have been discovered in the combined Cape Cod Program. Two errors in the Weapons Direction Programs have caused several arithmetic-check alarms in the past two weeks. These errors have been located and are being corrected. Three errors were found in the Track-While-Scan Programs; these errors did not cause computer alarms, but rather were logically incorrect. These also are in the process of being corrected.

At the request of Israel, a method of rotating the track numbers used for newly initiated tracks has been included in the Track-While-Scan programs. Previous to this addition, a newly initiated track was always stored in the empty track position with the lowest track number. With the low track life which we have been experiencing, track number "0" was continually reappearing as a new and unidentified track. The modification for rotation of track numbers overcomes this objection.

Due to the poor results which we have experienced with tracking aircraft, the smoothing and prediction program which we are now using was critically examined to see if there were any logical mistakes in it. As far as could be determined, the program operates as expected. A test of the program on simulated data did indicate that some of the parameters might be adjusted differently. However, operation with these new parameters on live data gave no improvement over the parameters we have been using. The reason for this is the combination of a low blip-scan ratio for tracks seen by the FPS-3 and fair amount of noise or random prints. Since simulated

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SECURITY INFORMATION

1.12 Data Screening (Continued)

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

data does not include these conditions, optimum parameters for simulated data do not necessarily give optimum parameters for live data. Modification of the method of smoothing is being studied on both a short-term, quick-fix basis and a long-term basis.

A calibration test was run for the FPS-3 near the end of the biweekly period. Previous to the test, the azimuth orientation at S. Truro was changed by a few degrees as a result of tests made by Division 2. The results of our tests using a test aircraft over two different check points agree closely with the correct values. There is still a suspicion that the azimuth may be off by about one quantization unit, however. A check of this will be made in the near future. A check on height-finder calibration (primarily range and azimuth) will also be made.

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

The new start-over program has been checked out and is being used in our daily operations. I am working on modifications to insert other utility programs.

I have devised and programmed a new way to calculate breakpoints in the smoothing process. This method takes advantage of the fact that the projections on the x or y axis of quantization boxes are not equal and in fact are a function of the opposite coordinate:

$$\begin{aligned} \text{x projection} &= R\Delta\theta \sin \theta + \Delta R \cos \theta \\ &= \frac{|y|}{40} + \cos \theta \end{aligned}$$

$$\text{and y projection} = \frac{|x|}{40} + \sin \theta$$

The actual formula used in the program is

$$BP_x = |y| m + K \quad \text{in the range } |y| \geq r_b$$

$$\text{or } BP_x = p \quad \text{in the range } |y| < r_b$$

(but the zero is the value of r_b used, so this equation is not used at present).

1.12 Data Screening (Continued)

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

Initial tests indicate a marked improvement over the previous breakpoint calculations. Initial values used were:

$$r_b = 0, \text{ range break}$$

$$m = \frac{1}{40} \text{ (slope of breakpoint line)}$$

$$K = 1 \frac{1}{8}$$

$$R = \text{range}$$

$$\theta = \text{azimuth from x-axis}$$

$$BP_x = \text{breakpoint in x}$$

(J. Levenson) (CONFIDENTIAL)

At present I am writing several utility programs. Tape 3267 has been completed. It is used for the insertion of parameters onto the drum before the Cape Cod System is started up. Its operation and use have been described in an inter-office memo to be issued soon. Another program has been written for magnetic-tape storage of contents of any parts of the drum for a delayed print out. This program has not been tested yet. A third program is in the process of being written. It will store information on the drum for a delayed punch out of a 5-56 tape which, when read into the PETR (Photo-electric Tape Reader), will store the contents of the registers directly on the drum.

(H. Frachtman) (CONFIDENTIAL)

The system data-analysis programs have been tested on the computer. The recording program seems to be satisfactory but a few errors still remain in the analysis program.

(D. Goldenberg) (CONFIDENTIAL)

The memo on the earth's curvature problem is still in preparation.

The quarterly summary report on the earth's curvature problem has been revised to include a summary of the final procedure for converting radar data from each of the radars in the Cape Cod System into a common plane of rectangular coordinates.

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1.12 Data Screening (Continued)

(D. Goldenberg) (CONFIDENTIAL) (Continued)

As an aid to calibrating the radars of the System, coordinates of several radio stations in this area have been computed for C. Zraket.

(J. Ishihara) (CONFIDENTIAL)

The Track-While-Scan (TWS) Program has been modified to "cycle" track numbers; i.e., the track number of a dropped track is not made available for a new track until after a delay of fifteen minutes (timesubject to change). If at any time tracking capacity is reached, all "delayed" tracking positions are immediately made available for initiation. "Delayed" track positions are at all times available for "initiation with assigned track numbers."

A parameter to count drum transfers for system studies has been prepared.

(H. Peterson) (CONFIDENTIAL)

Still the biggest use of my time has been acting as a monitor or instructing others in monitoring and representing the weapons-direction programmers during Ben Morriss' equipment check out.

I have written a program to take pictures of the uncorrelated data with a count of amount from each radar and the symbols \square for no trouble, Ξ for excessive data, L for lack of data, $|$ for large increase, and \square for large decrease. The choice of taking a picture is determined by contents of changeable constant register 2637. The following table indicates what a "one" means in each place.

Register 2614

0	always take picture	7	Gap Filler #2	} Increase
1	} Omit	8	Gap Filler #1	
2		9	Truro	
3	} Too Much	10	Gap Filler #2	} Decrease
4		11	Gap Filler #1	
5		12	Truro	} Lack
6		13	Gap Filler #2	
	14	Gap Filler #1		
		15	Truro	

I have one half of a program written to show a past history of "n" scans of data both correlated and uncorrelated.

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1.12 Data Screening (Continued)

(H. Seward) (CONFIDENTIAL)

The re-editing of E. Wolf's magnetic-tape recording program was completed. Consideration of thesis topics continues.

(E.W. Wolf) (CONFIDENTIAL)

The three programs dealing with the magnetic tape, mentioned in the last biweekly report, have been written and are fully operational.

(W.M. Wolf) (CONFIDENTIAL)

A program has been written to calibrate the five-inch scopes equipped with expansion and step-wise off-centering controls at the TWS stations. Dee Neville and I used the program to calibrate the scopes such that the normal position of the expansion control allows the equivalent of the 160-mile circle on the scope.

A program awaiting computer time displays the gap-filler sites. The program was written to check the off-set coordinates of the gap-filler sets.

Some time was spent with the Air Force personnel in the Radar Mapping Room.

1.13 Tracking and Control

(J. Arnow)

This entry is contained in M-2477 (SECRET).

(S. Best) (CONFIDENTIAL)

The program which tries out various smoothing coefficients for the velocity-heading method of smoothing is believed to be working at last, but no important results have been obtained yet owing to the failure of the camera to index properly.

The program which simulates crossing tracks has almost worked; one small error was detected by analyzing the output data. Anyone who is interested in studying the crossing-track problem by using this program should contact S. Best. A large variety of conditions can be simulated, including blip-scan ratios from 0 - 100%.

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1.13 Tracking and Control (Continued)

(S. Best, H. D. Neumann)

This entry is contained in M-2477 (SECRET).

(M. Frazier) (CONFIDENTIAL)

Work is being done with A. Mathiasen on obtaining more detailed data on NLS-2c parameters and how well they work.

The present NLS-2c parameter-study program will be modified to study the use of x and y, rather than range information in determining breakpoints.

(M. Frazier, A. Mathiasen) (CONFIDENTIAL)

A modification, as yet untested, has been written to an earlier program which compared the merits of various smoothing routines in order to obtain further data on the worth of the new NLS-2c parameters as reported in the September 11 biweekly and to compare these with the older set commonly in use.

(W. Lone) (CONFIDENTIAL)

A modification to the simulated program for use by the Flight Test Umpire has been made. As described in the past biweekly it is now possible to generate data for interceptors, the speed and heading guidance being provided by the interception program. This modification has been checked out and is working.

The simulated program was used October 20 to evaluate present tracking methods. From an initial position three runs of different headings with speed of 250 knots were made followed by the same headings with speed of 500 knots. After four minutes of flight an abrupt 90° turn was made on each flight. A variation of C. Gaudette's magnetic-tape print out was used to gather track information.

(A. Mathiasen, B. Stahl)

On October 20 a flight test was held using the M-33 tracking radar at the Belmont AAA site, and search radars at Foxboro, Derry, Scituate, Clinton, and Halibut Point. The plane flew in a quadrilateral whose corners were Framingham, Dracut, Danvers, and Squantum. The frame numbers of photographs of the range, azimuth, and elevation dials of the M-33 were recorded on tape

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1.13 Tracking and Control (Continued)

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

simultaneously with the data from the search radars. The pictures were taken every 10 seconds. A mechanical plot was also obtained. Since the error in the data is less than 30 yards, a good yardstick is provided with which to measure the errors in tracking with half-mile quantized radars. This work is being done with the cooperation of G. Harris of Group 22.

Several graphs of the distribution of tracking errors for a number of simulated flight paths have been drawn. This work is not yet completed.

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1.14 Weapons Direction

D.R. Israel (CONFIDENTIAL)

Attempts at conducting interceptions during the first week of this period proved unsuccessful due to a lack of satisfactory radar data and tracks on either targets or interceptors. The same factors prevented adequate testing with height finders. During this past week, interception flight-test plans were cancelled, and the computer time was spent in checking the results of the smoothing program and in testing the calibration of the search and height-finding radars.

Examination of the smoothing program by several members of this Section during the past week has resulted in the specification of several changes in parameters and constants used as well as slight modifications to the over-all method. These changes have since been tested in the program, and it is now felt that the smoothing is very close to the optimum that can be obtained with the present values of quantization and scan time. The only further step recommended is the adoption of the scheme for smoothing in the aircraft coordinates of speed and heading rather than X and Y coordinate velocities. It is not felt that there is much to be gained by attempting this smoothing method at the present time inasmuch as the present tracking difficulties are more directly attributable to the radar data.

The experience of the past four weeks makes it quite evident that the radar coverage of interceptors must be supplemented by beacon responses, as might be afforded by MK X. Steps are now being taken to provide such data (see section by B. Morriss); until such time as this is available, all interceptor flights will consist of a pair of aircraft and all scrambles from Bedford and Otis will be conducted on fixed headings for the first 20 miles. These procedures should assist the Track Initiators.

Flight-test activity of the past several weeks indicated the possibility of a lack of calibration of the various radars. Checks made during the past week apparently indicate that the FPS-3 is calibrated and that the apparent calibration errors are not arising from the computer program. Preliminary tests indicate that the 6-B at N. Truro and the two nodding-beam height finders are not correctly calibrated in range and azimuth. Additional tests during this coming week are intended to eliminate calibration errors. The current method of calibration involves the use of flight-test aircraft over specified check points and careful coordination and measurement at the various radar sites and at the Direction Center. This method is slow and tedious; inasmuch as it appears that a complete calibration check should be made at least once a month, a shorter and more accurate method is desired.

During the past two weeks several changes and modifications to the NTWS (Weapons Direction) programs have been made. The final-turn calculations have now been checked out and it is hoped that this and the other modifications will be joined with the present program. Under present plans NTWS-2 will not undergo additional changes, with possibly one exception, after October 28. This single exception is the Geography and Georef display, which, at the present time is being modified to include the displays of additional fixed points in the ADIZ boundary.

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1.14 Weapons Direction (Continued)

(D.R. Israel) (Continued)

The brightness and clarity of the Digital Information Displays on the 5-inch scopes has been improved during the past two weeks and now appears to be satisfactory at most operating positions. The Teleregister equipment has yet to be installed.

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

Some time has been spent assisting at exercises of the Cape Cod System. During the course of these, a consistent difference between the location of an aircraft as given by WWI and as given by the height finders was noted. This led to an attempt to calibrate the FPS-3, which in turn led to the discovery of an error in azimuth of about T° . A later H-F test seemed to indicate that there is a residual error, not in FPS-3. Efforts are going forward to locate the difficulty. A special H-F Flight Plan will be executed the next day weather permits which should clearly establish the type or error that exists. Meanwhile, the program has been double-checked to see that it functions properly. The only inaccuracies found were unavoidable round-off errors.

(O.T. Conant) (CONFIDENTIAL)

During the last two periods, various details concerning Digital Information Display (DID) Programs and the telephone intercommunication system have been worked out and some time has been spent on consideration of proposed future changes in quadrant positioning of DID's.

Most of my time has been spent on XD-1 planning as reported under that heading.

(A.W. Curby, M.I. Brand) (CONFIDENTIAL)

Tests of the combined system have shown that the ID (Identification) Programs operate satisfactorily when run in conjunction with the track-while-scan and other weapons direction programs. Some modifications have been made to them in the past week, mostly in the interests of greater sophistication. One enables the Flight Plan (FP) Extrapolation Program to utilize a register containing the number of scans missed by the computer, in order to bring flight plans up to data after a shut down. Another interchanges the effect of the left- and right-turn input switches, in line with a suggestion of J. Degan. A third modification makes it possible to insert flight plans into the system at a time later than their activation time and brings them up to their correct present position. These modifications have been provisionally checked out in operation with other weapons direction programs.

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1.14 Weapons Direction (Continued)

(A.W. Curby, M.I. Brand) (Continued)

A new plotting map is being used in the ID Section and is much more satisfactory than the old one. The ID data input-switch panels have been repositioned in accordance with recommendations by J. Degan and M. Brand, and it is anticipated that the change will make for more rapid insertion of FP data.

(F. Garth, W. Lemnios) (CONFIDENTIAL)

Attempts to complete the checking-out of the final turn have continued. The attempts were not successful, because the program still gives rise to an overflow. It is hoped that the cause of the overflow will be discovered and remedied within the next biweekly period.

The climbing characteristics of the F-89C, F-94C, and F-3D-1 have been plotted. They will be ozalided and distributed to interested persons.

(C. Gaudette) (CONFIDENTIAL)

With W. Lone and A. Curby a program which prints out once per scan via the delayed printer all tracking and smoothing data for a selected track has been written and operated successfully. At present this program can be used only with the simulated data produced by W. Lone's Flight Test Umpire (FTU) Program.

The new Identification (ID) Programs are nearly checked out. They should replace the old ID Programs in the combined TWS Weapons Direction Program by October 30.

The latest version of NTWS-2a (Independent Weapons Direction Program) is now recorded on magnetic tape. An inter-office memo describes exactly what is on the tape.

(M.A. Geraghty) (CONFIDENTIAL)

Further tests of the Height-Finder-Anti-Aircraft (HF-AA) Program have disclosed no errors in production of R, θ for the three H-F sites, but a slight error in Georef for AA. Also, a + zero velocity produced an anomaly and a 600-mph velocity appeared on the AA display, since the Radius Vector Subroutine produces -0 when entered with +0. The program is accurate within necessary limits, however.

(C. Grandy) (CONFIDENTIAL)

During this biweekly period several modifications were made to the Display Master Make-Up Program altering the operation of the identification and the display sections of the program. The mods are checked out and the Program (Tape No. 2820 m2) is fully operational.

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1.14 Weapons Direction (Continued)

(C. Grandy) (Continued)

A number of changes in the wiring of the display switches on the consoles in Rooms 222 and 250 have been made, thus modifying some information listed in M-1999-1, Revised Display Categories and Assigned Scope Displays. People directly affected have been informed of the changes, and until such time as corrections to M-1999-1 are published, M.A. Geraghty and I have up-to-date copies of this memorandum for reference.

Some consideration has been given to the geography displays in the Cape Cod system and S. Hauser and I are studying suggestions made by the Air Force personnel, concerning these displays. S. Hauser has written a geography-display test program incorporating all suggestions, and we will use this to study which specific displays and what combinations of displays can be best provided.

(J. Hayase) (CONFIDENTIAL)

Diagrams showing the relationship between the weapons direction programs and the equipment involved are being studied. These diagrams are being simplified so they may be used to brief visitors.

(F. E. Heart) (CONFIDENTIAL)

A study was initiated to determine order frequencies in Cape Cod programs. One program was tested which analysed order frequency in the present weapons direction program (NTWS-2A). Very preliminary results give the instructions cp, sp, ts, ca, ad, and ao a clear lead, with ca out in front. More sophisticated testing programs are under consideration.

I continued working on the preparation and description of various Cape Cod weapons direction record forms. Additional time was spent studying, discussing and describing Cape Cod pre-flight-test procedures for data input to WWI and data dissemination in the Direction Center.

Some time was spent in continued testing, operation and minor modifying of various Cape Cod Programs, particularly the Identification Section.

With G. Rawling and J. Hayase, preliminary work was done to pictorially depict information flow at various stations of the Cape Cod Direction Center.

(W. Lemnios, F. Heart) (CONFIDENTIAL)

A conference was attended with four people from the University of Michigan. The conference was in relation to low-altitude air defense. The results are summarized in an inter-office memo which may be obtained from R.J. Horn or the above authors.

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1.14 Weapons Direction (Continued)

(S. Hauser) (CONFIDENTIAL)

A test program of Geography display was written. The program will be used to determine revised displays for the various stations of the Cape Cod System.

(L. Murray, J. Nolan) (CONFIDENTIAL)

A training program for the Air Force personnel has been started. This program is being conducted by L. Murray and J. Nolan. A general outline of the program is as follows:

1. General introduction to WWI;
2. Binary and octal number systems;
3. Introduction to programming;
4. Outline of the program sequence in the September System;
5. More specific consideration for programs with which the personnel are concerned;
6. Lectures on tracking and interception calculations;
7. Problems and drill exercises to familiarize the officers and airmen with their Digital Information Displays (DIDS) and input switches.

It should be noted that this sequence is more of a guide than a rule. The program will be adapted to the needs and time limitations of the instructor and the student.

The results from this program should be as follows:

1. A clear understanding of the function of each officer and airman in the Weapons Direction Section;
2. A general feeling for the equipment used in the system;
3. A general feeling for programming and related problems;
4. A clear picture of the system as a whole from which constructive criticism may be obtained.

To date six hours of class have been conducted. The binary and octal systems have been discussed and problems have been assigned. The general structure and logical operation of WWI and external equipment have been described. The class is preparing a program which will be run in WWI to familiarize them with in-out equipment.

(G. Rawling) (CONFIDENTIAL)

In the past period work has consisted mainly of modification of titles and labels on panels in the Air Defense Center, and preparation of rough-draft switch and button illustrations for edge-lit panels for all stations.

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1.14 Weapons Direction (Continued)

(G. Rawling) (Continued)

Flow sheets for the basic functions of the individual components of the Weapons Direction Section of air defense are being prepared in conjunction with Frank Heart and J. Hayase. Several revised forms have been completed.

(C.A. Zraket) (CONFIDENTIAL)

A test to check the calibration of the FPS-3 at South Truro was held on October 22. Results of the test showed that the set may be reading about 3 azimuth units less than the correct value. These tests will be extended to check the calibration of the height-finder sites at Pigeon Hill, North Truro, and Nantucket.

A training program for the Air Force personnel associated with weapons control in the Cape Cod System has been initiated. At present, L. Murray and J. Nolan have been conducting classes each morning from 10-12.

The second test of the final-term interception program on the computer gave encouraging results. It is expected that the next test will check out the program.

All of the aircraft characteristics (F-89, F-94, F-3D, F-86) needed for the Cape Cod programs, with the exception of the F2H, have been obtained. At present, F-94 characteristics are being used for the F2H.

Consolidation of the Cape Cod programs and the writing of appropriate descriptive material is being effected during the present period. Also, a meeting with A. Fullerton of Group 22 has been set up on the use of AFCRC's UHF ground-air data link and the assignment of data-link addresses.

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1.15 Direction Center Operations

(M. Brand) (CONFIDENTIAL)

The following is a summary of computer operations for the last biweekly period.

Total Assigned Time	78 hr.
Combined Group (TWS-Weapons Direction)	35 hr.
TWS	15 hr.
Weapons Direction	7 hr.
Tracking and Control (2 hr. lost to WW)	6 hr.
Computer	5 hr. + 2 above
Not used	<u>12 hr.</u>
Total	80 hr.

(E.W. Wolf) (CONFIDENTIAL)

There has been a considerable improvement in equipment reliability affecting the operation of the Cape Cod System during the last biweekly period. Most of this improvement stems from better operation of the magnetic-tape units and of the light guns. The statistics are as follows:

	Last Biweekly Period		Cumulative Period (since 9-29-53)	
	Hours	Per Cent	Hours	Per Cent
Assigned Time for System Operation	18.2	100.0	41.9	100.0
Unrestricted Operating Time	5.4	29.4	7.1	17.0
Limited Operating Time	9.3	51.3	19.0	45.4
Down Time	3.0	16.5	14.1	33.6
Recovery Time	0.5	2.8	1.7	4.0

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1.15 Direction Center Operations (Continued)

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

Time Lost (Hours)	Limited Operations	Down Time	Limited Operations	Down Time
Computer	0.0	3.0	0.0	12.6
Room 222	11.5	0.1	25.0	1.6
Radar and input	8.3	0.0	22.1	0.0
Miscellaneous	9.0	0.0	12.0	0.0

The only major piece of equipment that is still giving trouble is the automatic initiation scope. This has been one of our major causes of "limited operations" in Room 222.

(F.A. Webster) (CONFIDENTIAL)

Time has been chiefly divided between work at the FTU position during flight tests and the preparation of memos on communications analysis. A small amount of time has been spent on preliminary familiarization with MTC.

(P.O. Cioffi) (CONFIDENTIAL)

The following table summarizes the flight-test activity for this period. Live testing of the System was kept to a minimum in order to allow more time for tracking study. Usually the existing air traffic is sufficient for this purpose.

The tracking experienced for the few scheduled tests was pretty much that same as that for the previous period except for the one held on 16 October. During this test the tracking was markedly better than ever though aircraft turns even when not in clutter areas were not always detected.

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1.15 Direction Center Operations (Continued)

(P.O. Cioffi) (CONFIDENTIAL) (Continued)

DATE	TIME	SCHEDULED TEST		TEST ACTUALLY RUN A/C	Description	REASONS FOR CHANGES OR COMMENTS
		A/C	Description			
10/13	1300-1600	10	Coverage, Calibration and Intercepts	10	As Scheduled	
10/15	1300-1600	6	Coverage, Calibration and Intercepts	6	As Scheduled	
10/16	1300-1600	3	Coverage, Calibration and Intercepts	3	As Scheduled	
10/20	1000-1200	1	AAA Calibration	1	As Scheduled	
10/21	1300-1500	1	Calibration (FPS #3)	-	Cancelled	Weather
10/22	1500-1700	1	Calibration (FPS #3)	1	As Scheduled	
10/23	1300-1500	1	Height Finder Calibration	-	Cancelled	Weather

* Added to schedule during week of test

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1.16 AN/FSQ-7 XD-1 Support

(D.R. Israel) (CONFIDENTIAL)

C. Grandy and I have reviewed the floor space estimates of L-113. This work indicated that the floor space as outlined in L-113 would be sufficient for the proposed Operations Building to be constructed in Lexington.

Current proposals for the Situation Displays and the Digital Information Displays are being studied with the hope of reaching more detailed specifications in several weeks.

(H.D. Benington) (CONFIDENTIAL)

Except for several days spent in continuing familiarization with XD-1, the past biweekly period was spent on vacation.

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

An inter-office memo containing general proposals for programming Height Finding in the Transition System and listing the equipment needs dictated by programming needs, has been directed to P.B. Sebring (Group 24) O.V. Fortier (Group 22), and B. Widrow (Group 62). Some time was spent in preparing this memo and in discussing various schemes for automatizing HF with Sebring and Widrow. It seems likely that a workable system, compatible with XD-1 in-out equipment can be found. Sebring will shortly prepare a proposal for such a device. At the moment, the chief obstacle to agreement on a scheme is the fact that it seems most advantageous, from a programming point of view, to have the reply from a given HF trigger the next request; while from an equipment point of view it seems advantageous to have the second request to a given HF trigger the reply to the first request.

(W.A. Clark) (CONFIDENTIAL)

The joint memorandum on the GE data-link analysis written with I.S. Reed and G.P. Dinneen of Group 24 ("A Study of the Holding Time for a Family of Transmitters") has been issued as M24-25.

Some additional assistance has been given to Dinneen in the preparation of the programmed simulation of the Sequential Observer.

(O.T. Conant) (CONFIDENTIAL)

During the last two periods I have been familiarizing myself with existing proposals for the XD-1 system. A study of Digital Information Display has been undertaken in conjunction with M. Epstein. Several

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

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

proposals for mechanizing digital display have been considered and a first estimate of drum storage space has been arrived at.

Discussion with D.R. Israel has shown the need for an exact determination of the variety of characters and symbols required and a decision on the number of distinct displays and types of format required. This study will be conducted during the next period, and consideration of telephone intercommunication facilities in the XD-1 center will be started.

(B.G. Farley) (CONFIDENTIAL)

During this period I visited the Derry site to get an idea of the day-to-day operation of a typical radar and its SDV. The set was generally providing what appeared to be usable SDV data except during periods of adjustment.

The new register indicator designed in cooperation with W. Clark is being tested.

(C. Grandy) (CONFIDENTIAL)

A decision concerning space available for the XD-1 installation has been indicated and work on the detailed floor plan will be renewed in the coming biweekly period. A preliminary study of equipment requirements at each of the various types of operating stations in the Direction Central has been made, and this information will be converted into sketches of the operating stations.

Considerations of the mechanical design and layout of the general-purpose display console are proceeding, and although no full scale models are yet available some general features of the console are fairly well fixed. Some notes concerning the variety of equipments and operating stations to be used in the Direction Central were delivered to IBM personnel for their general information.

From the sketches mentioned above and the general console design it will be possible to specify with some exactness the floor-space requirements for each of the various operating positions and for the installation as a whole. A tabulation of this space will be made.

1.17 Associated Studies

(B. Smulowicz, W.I. Wells)

This entry is contained in M-2477 (SECRET).

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

The magnetic Core Memory is now installed in its permanent position with new air ducts.

The trouble with the auxiliary drum, mentioned in the last biweekly report, was corrected by replacing a relay chassis. It is assumed that wire chips found in the old chassis were the cause of the trouble. A new auxiliary drum has been installed to replace the old one on which several tracks had been damaged.

The scope noise has been reduced, and the problem is still being worked on for further improvement. More manpower has been put on the magnetic-tape system to insure that it is kept in operation.

1.21 WWI System Operation

Core Memory

(N. L. Daggett) (UNCLASSIFIED)

Now that the Core Memory has been moved to its final position, and a new air-conditioning duct installed, the work of putting in permanent video and power wiring can begin. The Core Memory Control has already been mounted in rack EO with complete marginal-checking coverage available. Transfer of the control was accomplished very smoothly thanks to the fine job of preparation done by the various systems technicians involved.

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

On October 15, Core Memory was moved to the former ES Control area. Permanent air conditioning was installed on the 17th. During the regular installation-day period, October 19, we transferred the Core Storage Control equipment to rack EO.

The installation of permanent wireways, video cabling, and power wiring in the Core Memory region will be done on regular installation days and will probably be completed by November 9..

Drum Parity-Check System

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

At the conclusion of the installation day of November 2, the necessary changes to the present system to include a parity check of

1.21 WWI System Operation (Continued)

Drum Parity-Check System

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

the magnetic drums will be completed. Room 156 changes might not be done at that time.

The former Read-In Interlock panel has been converted to the IOR Aux., Mod II, and will be located in rack C3. The Parity Aux. panel will be replaced by a plug-in-unit mounting panel.

WWI Service File

(D. A. Morrison) (UNCLASSIFIED)

Another extension to the WWI Service File has been set up. Room 222 has been supplied with a file cabinet to hold drawings pertinent to the equipment located in Room 222. Libby Leighton will supervise the filing of the drawings. Requests for drawings in Room 222--WWI Service File--should be made to Julie Dickie.

Test Programs

(S. E. Desjardins) (UNCLASSIFIED)

The last biweekly period was spent in developing a five-order read-in program for use in the five flip-flop registers. This program blocks in a leader tape placed in front of the test tape to be read in. The leader tape contains a read-in program which then reads in the tape in question. If the regular read-in program is used, the leader tape is ignored, and the test program is read in.

Work was also done on an "inchworm" program combining the inchworm facility with a Core Memory test program. More work needs to be done on this.

Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

After several days of concentrated effort by Phil White, all relays on one Group Selector chassis were induced to operate and release within the required time limits. This chassis, originally removed from service because of faulty operation, performed quite satisfactorily when returned to service in the auxiliary drum. A second chassis is now being tested and adjusted in the Test Rack.

1.21 WWI System Operation (Continued)

Magnetic Drums

(H. L. Ziegler) (Continued) (UNCLASSIFIED)

Because of the maintenance difficulties, poor reliability, and the not-too-great life expectancy (computer-wise) of these relays, various alternate methods of group selection are being considered. At present the straightforward method of individual writers for each group seems most practical.

Work has been started on a monitor system for the buffer drum.

(K. E. McVicar) (UNCLASSIFIED)

The replacement auxiliary drum has been installed in the system and has been thoroughly tested. The heads have all been readjusted by an ERA representative, and we now get uniform readout signals. Preliminary checking indicates that the new copper-clad head pieces do not expand significantly with temperature variations, and no attempt is being made to temperature-control the new drum.

Work on a parity system for the auxiliary drum is proceeding satisfactorily. The necessary hardware has been ordered or is being made in the shop. The electronic assemblies are now being constructed, and the bay wiring is being started. It has been decided to do group selection of the parity digit by means of crystal selection of separate writers instead of using the relay-switching system used in the information digits. This decision was the result of the previously reported trouble we have been having with the relays and the estimated relay life based on latest data concerning programming needs for group switching.

A review of relay switching for group selection is being made in light of the expected relay life and time consumption with present program requirements. Consideration is being given a complete switchover of all the information tracks to a system similar to that used in the buffer system for group selection and the resultant elimination of relays.

(F. W. Stephan) (UNCLASSIFIED)

I checked the proposed drum parity system. It seems to work correctly.

I changed and rewrote a few drum programs.

The remaining time was spent installing the new auxiliary drum and modifying and testing the buffer drum.

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1.21 WWI System Operation (Continued)

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

The past two weeks were spent on preventive overhaul and maintenance of our Flexowriters.

Fairchild Camera

(L. H. Norcott) (UNCLASSIFIED)

Recent intermittent failures of the Fairchild Camera to index were apparently caused by a faulty tube in the automatic camera-control panel. No failures have been logged since the tube was replaced.

1.22 Terminal Equipment

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

A considerable reduction in the display noise has been made by balancing the current drawn by the decoder amplifier output stages and then feeding these stages through a dropping resistor from +150 volts instead of the noisy +90-volt bus.

A design for the panel-illumination circuits for Room 222 has been completed, and several models have been constructed. A few of the consoles will be wired for light next week.

A method of inserting the MK 10 information into the System has been decided upon, and the details are being worked out. Construction and testing will follow, and completion is expected in one month.

(R. H. Gould) (CONFIDENTIAL)

Cores for the 5-inch display scopes have been designed and ordered. All controls will be screwdriver adjustments accessible through holes in the cover. Adjustments will be made only by authorized screwdriver-holding persons. Midget "Twist lock" connectors have been put in the power cords of the 5-inch scopes so that replacement of a faulty scope by a spare may be quickly effected.

The Ground-Air-Link coder and control has been tested by means of programs written by Guy Young. It now remains to be tested by using the actual radio link.

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1.22 Terminal Equipment (Continued)

(R. H. Gould) (Continued) (UNCLASSIFIED)

The blocking-oscillator tube in the display-scope camera control was replaced, and no further trouble has been reported. A new control is desirable in the interests of circuit simplicity, but the present control is sufficiently reliable for anyone's use.

Room 222 Installation

(G. F. Sandy) (UNCLASSIFIED)

It is planned to modify the existing fuse-indication scheme to eliminate the objectionable transients on the power-supply buses whenever a fuse blows.

The following work should be completed by Monday, October 26, 1953:

1. The additional 16-inch scope in Room 250 will be installed.
2. Teleregister panels will be wired.
3. Edge lighting for three complete stations installed.

Junction Box and Control Room Modifications

(F. E. Irish) (UNCLASSIFIED)

During the past biweekly period an extensive modification was made to Station "C" in the Control Room. To complete this modification, it was necessary to remove all of the wires in the junction box pertaining to Station "C" and then to replace them while at the same time incorporating the mod. The nature of the mod was such, however, that the changes could conceivably have been made in the program which uses this station.

One change which was requested in this mod could not be accomplished by making a simple wiring change, but upon investigation it was determined that the same change could be done by making a two-order modification to the program. This example is mentioned to demonstrate that the idea of a program modification is not always being considered.

The problem in general is whether or not it is feasible and practical to make changes in the program instead of in the junction box. It may not always be more feasible, but it seems that this possibility should always be considered.

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SECURITY INFORMATION

1.22 Terminal Equipment (Continued)

Display

(T. J. Sandy) (UNCLASSIFIED)

Possible changes in the deflection system of the Cape Cod display system are being investigated. It is planned to construct and test a balanced double-ended system all the way from the decoders to the scope yokes.

MITE

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

Two more "MITE for Buffer Drum" units have been built in racks L6 and L7; another similar unit having a larger B-count (to 256) has been started in rack L1.

A new unit to supplement the existing system has been designed and designated as MITE III; the block schematic and layout have been drawn up, and a wiring assembly is being made so that construction of MITE III in rack L5 can begin immediately with an anticipated completion by early November. It will be possible with the present design to transfer this unit with a minimum of modification to the Buffer-Drum System when and if such a transfer becomes desirable.

Modification of GT-BA units has been started in the shops. A similar modification of BA-BA units has been settled and will be made as soon as the work load permits.

Pulse testing of new MITE units will continue as new units reach completion.

Buffer Drum

(K. E. McVicar) (UNCLASSIFIED)

A representative from ERA has been with us for the past biweekly period to reset the heads on the buffer and auxiliary drums and to consult on problems which have arisen in the buffer system.

Resetting the heads on the buffer drum has increased the operating margins on the information-storage groups to the point where they are about equal to the margins obtained on the auxiliary system.

1.22 Terminal Equipment (Continued)Buffer Drum

(K. E. McVicar) (Continued) UNCLASSIFIED

Operation of the buffer drum with MITE has not been entirely satisfactory to this time. The major source of trouble has been the operation of the status tracks. We have been having trouble with improper status transfers. The malfunction is prf sensitive and seems to result in marginal transfer. The source of the difficulty has more or less been traced to timing troubles resulting from delays encountered by the record-sense pulse. A haywire correction seemed to increase the reliability of operation.

Probably as troublesome as anything have been the numerous bugs which seem to crop up in the buffer system. Bad tubes, spurious writing in the status tracks, prf sensitivity, and other minor matters keep cropping up to impede the progress of system testing.

Punch-Card Input via Buffer Drum

(E. P. Farnsworth) (CONFIDENTIAL)

The trip to IBM at Poughkeepsie was highly successful and productive. Modifications being made to a standard IBM type-026 key-punch console were discussed, and its operation was observed. It appears that only minor problems will be encountered in installing such a modified machine in WWI; this installation will have the advantage of providing Group 61 with the identical equipment and programming problems similar to those they will encounter in XD-1. The modified punch machine will put out a 7-digit column count in addition to the 12-digit IBM code from the card reader on the console. The latter can be compressed into a simple 7-digit binary code using diodes external to the punch console, so that one column of information plus the column number can fit into a Whirlwind register. Further details are yet to be discussed with Milton Brand, Mike Geraghty, and Steve Hauser.

Ferranti PETR

(J. P. Stirman) (UNCLASSIFIED)

Preliminary tests on the tape reader have been satisfactory so that a breadboard is now being constructed for testing in WWI.

The brake and clutch circuits are able to stop the tape, from maximum speed, in less than one millisecond. Tests on the reader circuit have shown that the circuit is insensitive to parameter variations within +25% of nominal values. These conclusions are derived

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1.22 Terminal Equipment (Continued)

Ferranti PETR

(J. P. Stirman) (Continued) (UNCLASSIFIED)

from performance curves which plot tolerance vs. supply voltage. The minimum performance level was set at a signal-output level of at least +1 volt and a no-signal output of less than -20 volts.

If the performance of the tape reader in WWI proves satisfactory, three models will be built for permanent installation, two for WWI, and one for MTC.

Magnetic-Tape System

(E. P. Farnsworth) (UNCLASSIFIED)

The reel of acetate-base tape on unit 3B has broken repeatedly under normal operating conditions, and the original mylar reel was replaced. Although some improvement in acetate strength is gained by maintaining it in an atmosphere of high humidity, all users of the Raytheon Tape Units seem to have the same tape-breakage trouble. 3M is continuing efforts to obtain 1200-foot by 1.5-mil mylar sheets from Dupont on a priority basis so that they can supply us with additional spare reels.

Programmers making "permanent" recordings on unit 0 are being requested to make duplicate recordings on a spare reel of tape on unit 1. Since units 0 and 1 are now interchangeable by means of the newly-installed locking switch, the existence of a duplicate recording for unit 1 will eliminate any inconvenience which could be caused by failure of the read/record head or tape on unit 0.

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 October 9 - 22, 1953:

Number of assigned hours	136
Usable percentage of assigned time	87
Usable percentage of assigned time since March, 1951	85
Number of transient errors	21
Number of steady-state errors	4
Number of intermittent errors	27

1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since October 9, 1953:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Capacitors</u>			
.01 μ f, 300 v mica	1	0 - 1000	Short
<u>Condensers</u>			
4 μ f, 450 v electrolytic	1	0 - 1000	Short
<u>Rectifiers</u>			
10MA, 130 v selenium rectifier (Type: 147H6P1)	1	0 - 1000	Short
<u>Resistors</u>			
220 ohm, 2w, \pm 10% carbon	1	0 - 1000	Overheated and cracked
<u>Tubes</u>			
6072	1	4000 - 5000	Low I_b
6BL7	1	1000 - 2000	Short
5696	1	0 - 1000	Short
2D21	1	10000 - 11000	Short
SR-1407	1	2000 - 3000	Low I_b
6CD6G	2	0 - 1000	Low I_b ; short
715C	2	0 - 1000	Leakage; low I_b
5963	2	4000 - 5000	Low I_b
5687	1	5000 - 6000	Short
	1	6000 - 7000	Short
	1	7000 - 8000	Short
6080	3	0 - 1000	Short
	1	1000 - 2000	Short
6145	7	0 - 1000	Short
	2	1000 - 2000	Short; gassy
	1	2000 - 3000	Low I_b
	2	3000 - 4000	Leakage

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)			
7AD7	5	2000 - 3000	1-Low I _b ; 4-short
	2	6000 - 7000	Short
	4	7000 - 8000	1-Leakage; 3-short
	1	10000 - 11000	Short
	6	12000 - 13000	4-Short; 2-low I _b
	1	21000 - 22000	Gassy

1.24 General

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

The new +250-v, 50-amp regulated d-c supply is now operating in WWI on the unregulated a-c line. This supply has a high-gain, high-speed, wide-band regulator and should reduce any voltage variations on the +250 bus caused by load or line variations to about 20% of their former value.

The WWI +150-v and +90-v supplies will be improved next.

Equipment Conditioning WWI

(R. E. Garrett) (UNCLASSIFIED)

A new duct has been installed in the computer system for cooling the memory.

WWI D-C Standby Generator

(R. C. Jahn) (UNCLASSIFIED)

I am measuring the magnetization curve, load regulation, inductance, and resistance of the standby exciter and generator. A regulator similar to those used for the filament alternators will be built for this machine.

1.3 Group 651.31 Activities of Group 65

(P. Youtz) (CONFIDENTIAL)

This biweekly period was the scheduled vacation for most of Group 65. Those persons who had taken a previous vacation did maintenance work in the tube lab. Most of the storage and research tubes that could not be used in WWI were destroyed.

Several members of Group 65 attended the National Conference on Tube Techniques in New York City on October 13, 14, and 15, 1953. This conference was sponsored by the Sub-Panel on Electron Tubes of the Office of the Secretary of Defense. A copy of the abstracts of the conference are on file in the library at the Whittemore Building.

I attended conferences with the IBM Tube-Analysis Group on October 16. I visited Tektronix, Inc. on October 19 with members of Group 25. We studied a new type of coating for cathode-ray tubes to permit high post-acceleration with high-deflection sensitivity. After a period of experimentation we will be prepared to make these coatings.

On October 20 we visited Hughes Aircraft to observe their progress on the Typrotron. The Typrotron is an all electrostatic display-type storage tube with a Charactron-type matrix for writing characters on the storage surface.

On October 21 we visited the Research Department at Motorola to discuss improvements on their Deflectron--an internal electrostatic-deflection yoke. Motorola will incorporate these improvements as soon as Group 25 prepares the necessary drawings.

Together with other members of Division 6 and IBM, I visited General Electric at Owensboro, Kentucky, on October 22 and 23. We discussed the progress on the Z-2177--a more reliable 5965. Progress on this new tube is very satisfactory at the present moment.

1.32 TestTelevision Demonstrator

(A. Zacharias) (UNCLASSIFIED)

During the past biweekly period time was spent deciding which storage tubes should be kept and which should be destroyed. The tubes that we are keeping will be checked at the TVD.

The ion gauges in the vacuum-tube lab were examined, and defective tubes were replaced.

~~CONFIDENTIAL~~

SECTION II - AN/PSC-7

2.1 Group 62

2.11 Systems

Magnetic-Core Circuits

(R. C. Jeffrey) (CONFIDENTIAL)

Raytheon has submitted to IBM for approval a block diagram of the magnetic-core part of the input counters, which is to be developed by Raytheon.

The comparative test of IBM and MIT designs for the magnetic-core counter is proceeding. The MIT version, which is already constructed, has been running error-free at night for the past week, but sensitivity to line transients produces about 10 errors per day during working hours. This equipment is being decoupled from the power supplies. The IBM version of the counter is partly constructed.

An automatic stepping-register evaluator has been constructed and is being debugged. This equipment will automatically plot the margins of a stepping register for variable amplitude and width of the drive current pulses. This evaluator allows a fast empirical optimizing of circuit components.

It appears that relays are too slow to be useful as a means of storage for the manual inputs. Rising and MacMillan propose a system using core storage, making the manual inputs operate similarly to the radar inputs.

Phone Lines

(R. C. Jeffrey) (CONFIDENTIAL)

M-2436, a report on the phone-line meeting of September 24, is out. Aronson plans to work with Paul Rosen of Division 2 in setting up a system to decide whether there is a significant difference in the reliability of the SDV equipment and phone lines when the data rate is increased from 750 to 15000 bits per second.

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SECURITY INFORMATION

2.11 Systems (Continued)Outputs

(R. C. Jeffrey) (CONFIDENTIAL)

A scheme for taking all outputs directly from the display drum has been investigated and rejected as being too inflexible to justify the equipment saving. Attention is being concentrated on two systems using a separate output buffer drum. The requirements of the various outputs on drum capacity and phone-line capacity are now well enough known to allow a fairly realistic comparison of possible systems, although further information on cross telling and AAOC's is desirable.

Hopkins attended the GE Data Link meeting at Hughes.

Reductions in Cathode Count

(R. C. Jeffrey) (CONFIDENTIAL)

A quick review of the operation register and control-matrix timing indicates that it will be possible to increase the setup time of most of the control matrix from 1 to 2 microseconds. This should result in a large saving of cathodes. Heineck and Callahan will devote the next biweekly period to a study of write-amplifier switching for the drums.

Quick estimates were made of the savings that would result from having 4000 or 8000 register drum fields. This would compress the present 6 physical drums onto 2 or 1. It could be done either by increasing drum diameters or increasing density of information on the drum surface (by nonreturn to zero recording) or both. Savings of 5000 or 6000 cathodes seem to be possible in this way without loss in machine capacity. However, the outlook for nonreturn to zero recording doesn't seem very bright.

Equipment savings resulting from elimination of the index registers or the in-out break system are in the hundreds rather than thousands of cathodes and cost an appreciable amount of machine capacity.

Marginal Checking

(R. C. Jeffrey) (CONFIDENTIAL)

Pfaff is continuing work on the division of computer control for marginal-checking purposes. The major effort on marginal checking is being made by IBM. Pfaff has been spending about half his time in Poughkeepsie. Reports M-2459, "Marginal Checking for Circuit Designers," and M-2469, "Marginal Checking Without Shutdown," have been written.

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Memorandum M-2476

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2.11 Systems (Continued)Marginal Checking (Continued)

(R. C. Fallows, R. Pfaff) (UNCLASSIFIED)

The major effort on marginal checking is being made by IBM. R. Pfaff has been working about half time at Poughkeepsie. In the past biweekly period Reports M-2459 on "Marginal Checking for Circuit Designers" by R. Pfaff and M-2469 on "Marginal Checking Without Shutdown" by R. Fallows have been written.

R. Pfaff has continued work on the division of computer control for marginal checking.

Alternative Drum Systems

(R. C. Jeffrey) (CONFIDENTIAL)

As part of survey the current of possibilities for reducing the AN/FSQ-7 cathode count, the following modifications of the drum system were examined or reexamined.

Elimination of in-out break system.

(Clark, Cypser, Mayer and Jeffrey) (CONFIDENTIAL)

Equipment saved: 600 - 700 cathodes, by eliminating IO Buffer, IO Register, Drum Control Register, Word Counter, Address Counter, a transfer path from L A Register to L Memory Buffer, and miscellaneous cathodes in the control element. Cost in information-handling capacity: 3/4 second per 10-second frame.

Doubling or quadrupling number of registers per field.

(Mayer and Jeffrey) (CONFIDENTIAL)

This might be done by increasing drum diameter or increasing information density on drum surface (by using a nonreturn-to-zero system of recording) or both. Ignoring the question, whether this is possible in the AN/FSQ-7 time schedule, results were as follows: Equipment saved -5500 cathodes \pm 1000, since one or two physical drums would be sufficient. Cost in capacity - nothing.

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SECURITY INFORMATION

2.11 Systems (Continued)

Circuit-Application Manual

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

Four reports received from IBM are ready for distribution.
They are:

- a. Revised writeup of High Speed Flip-Flop;
- b. Single Shot Multivibrator;
- c. Pulse Stretcher;
- d. Design of Logical Diode Circuits.

Several more reports are near completion at IBM.

Control Matrix

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

A quick review was made of the timing involved in the operation register and control matrix. It seems quite possible to increase the set-up time of 55% to 75% of the control matrix from 1 to 2 microseconds. The result should be a large saving of cathodes. A proposal for such a change has been sent to J. Jacobs.

Drum Switching

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

The next biweekly period will be spent in reviewing the switching involved when writing on drums. The prime objective, again, is to reduce the number of cathodes needed.

Outputs

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

The output group during the reporting period has summarized output requirements and explored the possibility of taking all outputs directly from the display drum. It appeared on this first round that such a scheme might be too inflexible and result in too much interdependence to be satisfactory. Attention was therefore returned to preparation of a tentative proposal for a separate output buffer-drum system. After some discussion of this proposal, information-handling capacity and output requirements of the system will be refined further. Specifications for the drum and system are to be produced by 1 December 1953.

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2.11 Systems (Continued)Data-Link Conference

(R. C. Hopkins) (CONFIDENTIAL)

I attended a coordinating conference on the GE Ground-Air Data Link at Hughes Aircraft during the reporting period. Application of the data link to the various using devices, standardization of messages, and allocation of data-link frequencies were discussed. The latter two problems were referred to a subcommittee for the working out of final recommendations.

Input Counters

(H. K. Rising) (CONFIDENTIAL)

Raytheon has submitted to IBM for approval a block diagram of the magnetic-core part of the input counters which Raytheon will develop. This development is to be carried on in parallel with the present development at IBM.

It was decided at the input-output meeting, that emergency changeover of radar inputs will be done by a combination of phone-line switching and demand-line switching. This decision will allow McMillan at IBM to fix the number of counters necessary for an installation.

An IBM-type magnetic-core counter is being built here for a determination of margins. The stepping register for this counter has already been tested for sensitivity to drive-pulse variations.

An MIT-type magnetic-core counter on life test has been running error-free at night for the past week. The test electronics is still sensitive to line transients which account for about 10 errors each day during working hours. This equipment is being decoupled from the power supplies.

The Automatic Stepping Register Evaluator has been set up and the electronics is being debugged. This equipment will automatically plot the margins of a register for variable amplitude and pulse width of the drive current. All components in the register are variable so that margins may be maximized.

Manual Inputs

(H. K. Rising) (CONFIDENTIAL)

The problems of the manual inputs were discussed with McMillan at Poughkeepsie. The proposals made so far employing relay switching in the consoles have made it fairly apparent that relays are too slow and more storage is needed for an efficient system. It has been proposed,

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Memorandum M-2476

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2.11 Systems (Continued)

Manual Inputs (Continued)

(H. K. Rising) (CONFIDENTIAL)

therefore, that some consideration be given to magnetic-core storage without relays so that the manual inputs will operate similarly to the radar input system.

A Study of High-Speed Multipliers

(W. A. Klein) (UNCLASSIFIED)

It is still likely that R-223 will be ready for printing by approximately November 6.

Outputs

(I. Aronson) (CONFIDENTIAL)

Several trips were made to Building B in connection with weapons outputs, crosstelling, SDV, and telephone lines.

In order to gain a working knowledge of the SDV equipment, one day was spent observing and taking part in the debugging of two demodulators.

A report on the telephone-line meeting of September 24 has been written in collaboration with H. K. Rising and will be available shortly as M-2436.

Tentative plans have been made to work with Paul Rosen of Division 2 in setting up a system to test the relative reliability of the SDV equipment and phone lines in transmitting 16-digit words at 750 and 1500 bits per second.

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2.12 Magnetic-Core MemoryMiscellany

(W.N. Papian) (RESTRICTED)

Work on the 64 x 64 memory for MTC is coming along reasonably well. Production Control has been very cooperative on the critical panels. The test setup and racks are being readied. December 1 still looks like a reasonable target date.

The memory-cycle time for AN/FSQ-7 has been under some discussion during the last two weeks. The present nominal time is about $7 \frac{3}{4}$ μ sec; final length of the cycle can only be determined experimentally because it is the minimum possible length that is so desperately wanted. Some preliminary information will become available when the new MTC memory goes into operation.

Core Memory, Mod. II

(W. J. Canty) (UNCLASSIFIED)

A block diagram (SC-47015) and a block schematic (SD-56702) of the 64 x 64 Core Memory, Mod. II, MTC are now available in the print room.

Pulse Transformers

(J. L. Mitchell) (UNCLASSIFIED)

We are approaching the final design of the memory driving-pulse transformer, and we are now arranging to have the Sprague Electric Co. manufacture this item for the Core Memory, Mod. II.

All other Core Memory, Mod. II, equipment is now in the shop or in the hands of an outside vendor.

Switch Cores

(A.D. Hughes) (UNCLASSIFIED)

Work was discontinued on the effect of core geometry on an equivalent circuit for metallic cores pending arrival of more large-size cores.

Preliminary work was begun for a Master's Thesis on a 64-position "Olsen" switch. A 16-position metallic switch designed by A. Katz is being tested.

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2.12 Magnetic Memory (continued)

Test Setup V

(R.S. Di Nolfo) (UNCLASSIFIED)

The block diagram for Memory Test Setup V has been modified and redrawn. All the logic has been cabled and checked and is operating properly. As soon as the MAR (Memory Address Register) flip-flops and cathode followers arrive the indicator lights and display decoder will be wired in. This decoder was checked out two weeks ago, and therefore no trouble is expected with it.

Switches

(J. Raffel) (UNCLASSIFIED)

A 16-position switch is under construction using MF-1312 cores. This switch is of the coincident-current type.

Consideration is being given to the possibility of constructing a 1024-position matrix switch using one or two bias turns and relying on linear transformers for the large bias currents needed.

Preliminary tests are encouraging.

64 x 64 Memory for MTC

(E. A. Guditz) (UNCLASSIFIED)

Two planes for the 64 x 64 Core Memory, Mod. II, are completed and 9 are partially completed.

The logic of Memory Test Setup V has been modified and checked out.

The Memory Rack with its wing extension is in position beside Memory Test Setup V.

The x and y crystal matrices are completed and ready for installation.

Sensing Techniques

(S. Fine) (UNCLASSIFIED)

The cause of ringing on the sensing winding and its reduction is being investigated. The sensing-winding inductance has been determined analytically and experimentally with results correlating.

An investigation into noise reduction through the application of an external noise generator is being undertaken.

2.13 Vacuum-Tube Circuits

(R.L. Best) (UNCLASSIFIED)

Anderson and Boyd have returned from Poughkeepsie with the drum that they have been helping to test down there. I was with them for two days, discussing drum circuits and also some basic-circuit problems.

In the course of reviewing all circuits to determine where tube savings might be made, N.H. Taylor proposed using the 7AK7 as a cathode follower. It could replace a maximum of three 5965's in this use. Sylvania will be contacted to see if they will add the controls that would be necessary to allow this use of the tube.

A Model VII Core Driver being constructed for production core testing is to have no overshoot.

An experimental magnetic-deflection amplifier for display is being designed that, if successful, will allow the use of 5998 tubes in the output instead of high-power tubes such as the 4X150A or 6161. The trick used involves having the tubes handle only the transient power, while a resistor dissipates most of it when the deflection is not being changed.

Register Driver

(S. Bradspies) (UNCLASSIFIED)

A system has been found by IBM which cuts the diode current in the input circuit of the Register Driver (RD) from the neighborhood of 160 ma peak to less than 50 ma peak. The input pulse loses no amplitude and its waveshape is still virtually perfect.

It was found that using this circuit, the input transformer which gave the best results was a 1:3 stepup; this was better than a 1:2.5 which in turn gave better voltages than 1:2.

Drum Circuits

(Hal Boyd) (UNCLASSIFIED)

The past biweekly period was spent for the most part at IBM in connection with the MTC drum and the proposed drum circuits. While there I suggested several modifications on the existing read-amplifier, and it tested out very satisfactorily. Mathematical analyses of several forms of differentiators and amplifiers proved most enlightening and valuable in reducing tube and component count in the amplifier. The tube complement has been reduced from 4 1/2 to 3 bottles (5965's), and several unnecessary components have been omitted. After returning to MIT some more modifications were made in the interest of reliability and performance. A bread-board is now being built for tests with the MTC drum.

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

(D. Shansky) (UNCLASSIFIED)

Debugging work on this unit is presently in progress. The unit when completed will furnish pulses of +1.1, +.5, -1.1, and -.5 amp, with rise times variable from .2 μ sec to .5 μ sec and pulse widths variable up to 2 μ sec. The pulse shape requires the presence of no overshoot.

Magnetic Drum

(H. E. Anderson) (UNCLASSIFIED)

A preliminary read amplifier and write circuit were obtained for experimental work at MIT. The IBM drum was brought here on October 22. Signals that were recorded at Poughkeepsie were played back here, indicating that no damage or maladjustment has been caused by the move.

An experimental test-equipment setup for writing patterns on the drum has been made and will be used in the near future.

5998 Power Cathode Follower

(D. Shansky, B. Remis) (UNCLASSIFIED)

Memorandum M-2466, "Power Cathode Follower", covering this circuit has been issued. The work of determining the absolute circuit margins is now in progress.

7AK7 Medium Cathode Follower

(D. Shansky, B. Remis) (UNCLASSIFIED)

A triode-connected 7AK7 circuit is being investigated for use as a medium-power cathode follower.

Delay-Line Circuits

(J. S. Gillette) (UNCLASSIFIED)

The best results have been obtained with a tetrode 7AK7 driving a delay line (0.2 to 2- μ sec long) which is driving a pentode pulse amplifier or a gate-connected 7AK7. The variational delay due to tubes and voltage variation is less than +10 millimicroseconds and -5 millimicroseconds.

2.13 Vacuum-Tube Circuits (continued)

Memory Pulse Distributor

(J. S. Gillette) (UNCLASSIFIED)

An "MPD" is almost completed and will be completed when pulse transformers arrive from Sprague Electric Co.

Magnetic-Deflection Amplifier

(C.A. Laspina) (UNCLASSIFIED)

A circuit is being designed for magnetic deflection of CRT's which makes use of 5998's in the output stage.

Sense Amplifiers

(C.A. Laspina) (UNCLASSIFIED)

The 5965 in the first stage of the sense amplifier was replaced with a 6072 because of the large microphonics of the 5965. Redesign of the loop-gain and stabilization networks in the feedback portion of the amplifier is necessary because of the different parameters of the 6072.

Pulse Transformers

(E. Gates) (UNCLASSIFIED)

The core for the transformer to drive the magnetic memory has been decided upon. It will be the F-415, Ferramic H, Toroid. This core was chosen because of a shorter magnetic-path length which resulted in a more efficient transformer.

Sprague Electric Co. has agreed to make the transformers and deliver 150 units within 5 weeks.

2.14 Memory Test Computer

General

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

Development and construction of general circuitry was continued. This includes work on the drum, Charactron, display system and group selector (now referred to as the Storage Field Switch).

A second live register was added to MTC to provide more flexible operation while awaiting installation of the drum and magnetic-core-storage systems.

The console was repackaged in larger cabinets to make room for further expansion.

The 115-volt alternator is now permanently installed although the three-phase load needs balancing.

Tube tapping at weekly intervals was continued and three tubes were replaced during the last biweekly period because of apparent shorts.

Second Live Register

(R. Hughes) (UNCLASSIFIED)

During the past biweekly period a second flip-flop storage register was installed in the computer to enable better Charactron programs to be written. This register employs the high-speed flip-flop, Mod. II. The register margins are:

Flip-flops	'1' side	'0' side
	+47 v -42 v	+47 v -42 v
Out gates	-71 > +80	
In gates	-65 +66	

Component Failures

(R. Hughes) (UNCLASSIFIED)

There have been no component failures during the last biweekly period. Three 6145 tubes were replaced during tube-tapping tests.

2.14 Memory Test Computer (Continued)

Alternator

(R. Jahn) (UNCLASSIFIED)

The alternator is now supplying power to MTC. A 40-amp unbalance in the line currents causes 60-cycle noise in the feedback loop, and increases steady-state load regulation. Balanced load currents should reduce feedback rectifier noise to a reasonable value.

Power Supplies

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

Testing has been completed on most of the MTC power supplies. The voltages which are now being supplied to the computer from the new units are: +250, +150, +90, -150, -300, and -15.

Two -150-v supplies are being converted to supply -180 v, and -40 v. These are new voltages to MTC. A new rectifier is being built for the -30-v supply. It will be about 2 weeks before this supply is in operation.

Drum Circuits

(H. Boyd) (UNCLASSIFIED)

The major portion of the past biweekly period was spent at IBM in an effort to familiarize myself with the drum and associated proposed circuits. Several modifications were made on the present read-amplifier, and it tested out satisfactorily. A breadboard of the latest proposed read-amplifier is being made at MIT and will be tested with and by the MTC drum.

General Circuits

(J. Crane) (UNCLASSIFIED)

The Memory Control Matrix, which will be used for selecting the type and field of storage in MTC, has been designed and drawings necessary for construction are complete.

Installation and testing of the Charactron Decoder Panel has been completed.

A display scope is now being designed for use with the 64 x 64 x 17 memory for MTC.

2.14 Memory Test Computer (Continued)

Equipment Cooling

(R. E. Garrett) (UNCLASSIFIED)

The contract has been completed as of October 23, 1953. We plan to provide an automatic condenser water-dumping system soon.

2.15 Equipment Design and Schedules

(A. P. Kromer) (CONFIDENTIAL)

The streamlined program for issuance of purchase specifications covering electronic components to be bought by IBM for the construction of the AN/FSQ-7 prototype models has made specs available for the principal components of the computer. Similar treatment has resulted in selection of mechanical components and fastening details.

Assistance has been given to IBM for preparation of their cost estimate and reply to the Air Force bid request for the contract which will cover the balance of the development work, construction, installation, and testing of the two prototype models.

A conference regarding mechanical design and packaging resulted in some modification of previously agreed upon plans regarding the rack module design. A modified module unit will be used which will house several vertical stacks of plug-in units. Each such module will have the section which serves as an air plenum chamber completely enclosed in order to avoid serious air leaks where module units abut each other. The above plans do not affect the planned arrangement to have digit rows run horizontally and registers stacked vertically.

(W. Ayer) (CONFIDENTIAL)

A major step has been taken in the planning for the basement of Building A. All of the operational functions, including the TWS, Direction, SDV, FTU, Height Finding, and Identification areas have been tentatively located in a new building that we hope to erect off the west end of Building A. Plans call for a prefabricated structure containing a 17,000-square-foot operational area with an 18-foot ceiling and a two-ply wood floor. All air and cable connections would come through this floor, leaving the area above the consoles free of obstructions, as is strongly desired by the lighting people. A 12-foot-high crawl space is directly below the operational area, with sufficient room for air and wire ducts, air-handling equipment, SDV and display generator frames, and any refrigeration equipment that may be necessary.

The basement of Building A now contains all the power-supply equipment, including two 500-KVA transformers, the M-G sets, and the d-c power supplies; the drum and computer rooms; telephone and output areas; maintenance space; and all the air-handling equipment required to supply cool air to the units in the basement. A revised basement floor plan is under preparation at the present time, but will not be finished until the number and size of the drum frames are determined more accurately.

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2.15 Equipment Design and Schedules (Continued)

(J. D. Bassett) (CONFIDENTIAL)

A visit to High Street during the week of October 12 indicated that good progress is being made in the preparation of mechanical-components standards sheets and related technical info on application of these components.

The groundwork is being laid for writing specifications on materials and processes, but as yet none have been issued.

A reluctance to proceed with the present SDV demodulator program was expressed by IBM on the grounds that there is insufficient information available on its performance with the probable characteristics of the variety of phone lines to be encountered in actual service. A check with Paul Rosen of Group 24, designer of the demodulator, revealed that unipolar SDV signals will be piped in to the Barta Building during the next month. Recordings of these signals will then be available for further testing of the SDV demodulator under realistic input-signal conditions.

A meeting was held on October 22 to discuss the output-display-console development. Represented at this meeting were IBM Vestal Lab, Consolidated Aircraft, Groups 61, 62, 38, and Francis Associates. Many difficulties were resolved by the airing of views and requirements from the various groups. Minutes of this meeting will be published in the near future.

(J. Giordano) (UNCLASSIFIED)

A meeting at Poughkeepsie is planned for next week with W. S. Cornett of IBM to review drafting procedures in order to further clarify and coordinate activities between IBM and MIT.

Military Reference Data Books have arrived and will soon be distributed. Future distribution at MIT of all MRD material will be administered by Howard Hodgdon.

Procurement

(C. W. Watt) (UNCLASSIFIED)

The seemingly unrewarding work of writing purchase specifications for IBM so that really reliable components may be procured has continued. The job is bigger than was anticipated by the High Street group, and hence has taken longer than they hoped. A great number of vendor discussions have been required. Trips to Sprague Electric Co. at North Adams and Surprenant Wire at Clinton have been made during the past two weeks. Much valuable information has been collected and is being put in shape.

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2.15 Equipment Design and Schedules (Continued)

(C. W. Watt) (Continued) (UNCLASSIFIED)

It is expected that the High Street group will provide more help for this phase of the work, so that Paine and Watt can spend less time in Poughkeepsie.

Actual procurement has not advanced very far. The time from specification to purchase is quite long, for although Dan Lawrence at High Street has worked very hard on the problem of determining quantities and values for the components needed, the fluidity of the design at this time makes this job difficult.

Tubes

(R. Fallows) (CONFIDENTIAL)

October 14-16 were spent with H. J. Geisler in Poughkeepsie. The division of work between MIT and IBM in the AN/FSQ-7 tube program was established. IBM will perform routine tests on all tubes bought for Project High, including 100% incoming inspection, 500-hour lot acceptance, 10,000-hour life tests, and analysis of all field returns. MIT will assume the major burden of evaluating tube-development work on the SR1782A and Z2177 and will probably have to perform nonroutine tests as they come up.

The basic information needed for mechanical design and procurement was accumulated. A program to prepare for the IBM tests was put in motion.

System Manual

(R. Fallows) (CONFIDENTIAL)

Work was started with R. P. Mayer on a system manual to describe the current design of the XD-1 system. This manual is intended to provide a convenient, up-to-date survey for reference purposes.

Scheduling

(P. J. Gray) (UNCLASSIFIED)

Progress is being made on the revision of E-562. Issue is awaiting new information about the preparation of Building A. It is expected that this will be completed in the near future. The schedules as they exist now are contained on Drawing No. B-55458.

A new diagram showing the time phasing now contemplated between XD-1 and XD-2 has been prepared and is available as Drawing No. B-56670. These drawings, when revised, will constitute the bulk of the information to be included in E-562.

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2.16 Transistors

Transistor Accumulator

(D. J. Eckl) (UNCLASSIFIED)

A counter has been constructed of vacuum-tube plug-in units to aid in the control for the accumulator. Originally the installation of this unit gave a considerable improvement in operation. However, intermittent errors which appear to be due to this counter have again been occurring. This is after a week of continuous operation.

A plug-in transistor flip-flop has been constructed using printed circuits. This first experimental model is rather large but will be tested completely. This unit, which uses Cohler's FF, and a gate designed by Kirk are expected to form the basis of a revised version of the accumulator.

Some time has been spent reviewing an article by F. C. Williams in the July 1953 issue of the Proc. AIEE. This deals with transistor circuits using current sources. Of particular interest is an adder circuit described. On a visit to this laboratory Prof. Williams said that the circuits had proved successful in operation with small numbers of transistors. Evaluation of this type of circuitry might prove a good thesis topic.

Minority Carrier Storage

(N. T. Jones) (UNCLASSIFIED)

The forward-conduction delay observed in the Westinghouse Electric grown junction diodes was determined to be due to transistor action because of anomaly in manufacture. Instead of being a simple p-n junction, these particular units are actually p-n-p-n devices. This was discovered by opening one of the diodes and probing the germanium bar with a cat's whisker.

A standardized set of diode measurements been set up for hole-storage correlation purposes. The sample diodes are now being measured by D. Smith using this scheme.

Transistor Core Drivers

(S. Oken) (UNCLASSIFIED)

The problem of stabilizing the delay-line type driver was undertaken during this biweekly period. Transistor parameter values for good operation in the circuit have been experimentally determined. The theoretical calculation for these parameters will be worked on next.

The next step will be to parallel several core-driver circuits so as to obtain a large current through the core being driven.

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2.16 Transistors (Continued)

Transistor Gates

(C. T. Kirk) (UNCLASSIFIED)

A meeting with Prof. R. B. Adler of the Electrical Engineering Department was held in which we discussed the possibilities of doing a master's thesis on transistor gates.

A promising arrangement for a gate employing a point-contact transistor consists of a diode gate driving a regenerative pulse amplifier with voltage feedback from collector to emitter. During the next biweekly period, requirements of the circuit will be investigated to determine criticalness of the circuit parameter.

Minority Carrier Storage in Point-Contact Types

(E. U. Cohler) (UNCLASSIFIED)

In the past biweekly period some effort has been made to substantiate the details of a model for the "turn-off time" in point-contact transistors. At present the results are very discouraging. Two transistors were examined carefully, and the results were different enough so as to make either refutation or verification of the model impossible. Part of the difficulty lies in the small sample of transistors used. However, the time-consuming nature of these tests prohibits the collection of sufficient statistical samples. Perhaps the greater uniformity in junction-type transistors will make them more amenable to this sort of empirical treatment, and attempts will be made in the future to fit a model to them.

2.17 Display

(C. Corderman) (CONFIDENTIAL)

This period has been devoted completely to Charactron display testing with MTC. O. F. Hamann from Convair has been here the past week for discussions concerning Charactron setup procedures and operation.

The two most serious problems encountered are those of character registration over the entire tube face, and post-acceleration. It has been determined that the misregistration was partly caused by nonlinearity in the magnetic-deflection amplifiers. Changes have been made and others are in progress to minimize this distortion. Post-acceleration in the multi-band 19" tubes is somewhat better than in tubes having a single A3 band. However, the sharp funnel taper to the neck of the 19AP4 envelope makes the tube quite poor for post-accelerator operation.

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2.17 Display (Continued)

(R. von Buelow) (CONFIDENTIAL)

Memorandum M-2453, "Track Situation Scope Displays for XD-1," was completed during this period.

Work was done with R. H. Gerhardt on the control and switching of the display. The details of special types of displays were considered and inserted in the control.

The Charactron matrix has been revised to better adapt it to the display system with the least amount of associated equipment.

A discussion was held by all concerned on the design of the console. Minutes are available.

(M. Epstein) (CONFIDENTIAL)

A preliminary summary of slot allocation was finished by M. Epstein and O. Conant. An investigation was made of having the computer program the displays with increased flexibility; a report is being written about this.

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

The output stage of the magnetic amplifier has been redesigned in order to correct for nonlinearities with respect to position and gain. The 4 x 150 is being utilized as a triode. The socket of the 4 x 150 has a built-in screen capacitor of 3500 μf . This capacitance was removed by breaking the contactors of the socket which make electrical connection to the center ring of the tube. With triode operation the feedback voltage is only a function of coil current. Therefore, greater linearity and faster response should be obtained. A second modification permits one to change the quiescent coil current readily.

A second Charactron display system has progressed to the point where all the essential construction is nearly completed. Debugging of the units will be continued with the hopes of having a second system in operation in the near future. At present the intensity-level control for dim and bright characters and vectors is in operation. The defocus gate has to be redesigned due to falling off of the flat top. Several schemes are being considered. A simulated vector generator for the Charactron has been completed and is capable of writing vectors within intervals of 25-150 μsec .

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2.17 Display (Continued)

(R. H. Gerhardt) (CONFIDENTIAL)

Agreement with IBM concerning the logic of Feature (i.e., Track No., Altitude, Status, etc.) Selection and Category Selection was reached. Feature Selection will be accomplished by turning on or off a time level at the console. Categories may be selected by turning on a level from the category matrix. The Feature and Category levels will supply the current flowing through the back resistance of 8 and 32 input "or" gates. The "Power Cathode Follower" can be used for this application. Work on the general logic of the Display System is continuing.

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2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

We have obtained 65,826 good cores for Core Memory, Mod. II, and the balance of the cores required are expected by the end of the month. As soon as core testing for the MTC memory is complete, core testing for AN/FSQ-7 will begin.

RCA Victor plans to have 10,000 cores like their best previous lot XF-175 by November 4. From these cores a 64 x 64 plane will be constructed to permit a better evaluation.

Ferrite-Core Pulse Test

(J. W. Schallerer) (UNCLASSIFIED)

To date we have accepted 89,769 good cores, 23,943 of which have been used for the WWI memory. 59,192 cores have been turned over to Group 62 for construction of the 64 x 64 memory planes.

Work has started on setting up a new semiautomatic core tester. It is expected that all the electronics will be ready by November 1.

No testing has been done since October 19 because of the lack of cores. A round-robin calibration was made during the down period and results were fairly good. Voltage calibration seemed to be several percent off while the current measurement was in nearly exact agreement with the standard (one part in four hundred).

(J. D. Childress) (UNCLASSIFIED)

Round-Robin Calibration

Calibration curves have been prepared for the core test equipment at General Ceramics, RCA Victor, IBM High Street, and IBM Plant #2. These curves have been sent to the users.

Plans and preparations are being made by R. West of IBM and J. Childress of MIT for the next calibration tour. R. West will conduct the tour beginning October 27.

(E. J. Stevens) (UNCLASSIFIED)

The period was used for evaluation of MF-1326-B, four RCA cores, and two DCL cores. Measurements were continued on peak values and deltas. Correlation of results will be made in the near future. Time was also spent on refinement of the core-evaluation logic. XF-175 seems to be the best RCA core. The noise voltages and the driving current are somewhat higher than those for the General Ceramics core, MF-1326-B.

2.2 Group 63 (Continued)

Ferrite-Core Pulse Test (Continued)

(R. Pacl) (UNCLASSIFIED)

The new automatic core handler is nearing completion and should be operating shortly.

Ferrite-Core Synthesis

Pilot-Plant Production of F-394 Cores

(R. A. Maglio) (UNCLASSIFIED)

New Stokes press compacting dies, including one set of carbide-tipped punches and one set of completely chrome-plated stainless-steel parts, have failed in the first attempt. In both instances the shank material collapsed when subjected to the required forming pressure for F-394 cores.

An extremely important fact^{††} was learned as a direct result of these tests. General Ceramics material requires a lower forming pressure than most of the good materials we have prepared. Our latest composition DCL-2-281, which was derived from chemical analysis of the General Ceramics material, is the greatest exception to the above statement. Material of this composition has produced the most satisfactory formed core from this laboratory, and in many ways resembles the General Ceramics material. A number of firings will be made of this material in the F-394 and F-262 core sizes.

Cores of the F-394 size have been pressed from DCL-2-134 composition. This composition has given the best electrical results up to date in the F-262 size. Firing of this composition will be carried along with the DCL-2-281 material.

(J. Sacco) (UNCLASSIFIED)

Cores from the latest $MgO.MnO.Fe_2O_3$ series have been fired at several time-temperature schedules. Squareness² and coercive force results already received correlate very closely with other compositions in the same area of the ternary diagram.

Two new batches have been prepared for the production of F-394 cores. These cores are now being pressed and will be fired within the next few days. It is believed that this material will be superior to the previous batch and may be comparable to the General Ceramics material.

2.2 Group 63 (Continued)Differential Thermal Analysis Study of the MgO.MnO.Fe₂O₃ System

(R. A. Maglio) (UNCLASSIFIED)

Test runs have been made using Florida Plastic Kaolin since the thermal curve for this material is well established. The curve which was obtained was almost in exact duplication of that in the literature except for a slight deviation due to an exothermic reaction at 980 C. There is a possibility that the deviation was caused by an impurity in the clay sample since inert materials tend to reduce the exothermic reaction. This possibility is being investigated.

Equipment is undergoing modification in order to eliminate electrical "pick up" on the differential and recording thermocouples. An effort is also being made to increase the deflection of the differential thermocouple recorder at temperatures of 1000 C and higher.

(F. S. Maddocks) (UNCLASSIFIED)

A chemical analysis of MF-1331 microwave gyrator body material (General Ceramics) has been undertaken. Due to continued difficulty with one of the methods or reagents used, this will be a preliminary analysis.

Basic Study of FerritesThe Switching Coefficient

(N. Menyuk) (UNCLASSIFIED)

In Engineering Note E-532, "Nucleation Domains of Reverse Magnetization and Switching Characteristics of Magnetic Materials," by J. B. Goodenough and N. Menyuk, the switching coefficient S_w in ferrites was found to be

$$S_w = (H - H_0) \tau = \frac{I_s \Delta d}{(\Delta^2 + I_s^2 \delta^2)} \sqrt{\frac{K}{A}}$$

In a material with a square hysteresis loop, all the quantities on the right-hand side of the above equation are constants, so the applied field H and the inverse switching time $1/\tau$ are linearly related. However, the maximum distance the domain walls move, d , will vary as a function of the applied field in the nonsquare materials. Assuming an output voltage in the form of a Gaussian distribution function, d has been found to be proportional to the magnetization I . The value of I as a function of the applied field can be obtained from an initial magnetization curve.

An experiment to check this hypothesis is in the offing, and a re-evaluation of the physical significance of the experimentally observed values of S_w and H_0 in nonsquare materials will be made on the basis of this corrective factor.

2.2 Group 63 (Continued)

Basic Study of Ferrites (Continued)

Studies of Hausmannite and of the Valence Bond in Spinel

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

A double-well potential has been used as a mathematical model to calculate the magnitude of the conductivity to be expected in Mn_3O_4 via the double-exchange mechanism if Mn^{2+} and Mn^{4+} ions are ordered on the B sites. The formulation of the problem has been completed. Numbers have not yet been substituted into the formalism.

A consideration of the role of the valence bond in the spinel lattice is being investigated in the hope that this alternate method of thinking about the bonding electrons will give some new physical insights.

Dimensional Effects on the Magnetic Properties of Toroidal Cores

(P. K. Baltzer) (UNCLASSIFIED)

In order to ascertain the validity of fundamental interpretation of the macroscopic phenomena of toroidal cores, it is necessary to consider the effect of core geometry on the magnetic properties.

The static loop has been considered first, and a method derived for obtaining the intrinsic static B-H loop from macroscopic data. The intrinsic loop is independent of core geometry and thus is a function of the material only.

It has become apparent that much of the static phenomena observed to date can be shown to be caused by dimensional effects, and thus can not be given a fundamental interpretation.

SECTION III - CENTRAL SERVICES

3.1 Purchasing and Stock

(H. B. Morley) (UNCLASSIFIED)

Work has begun on a physical rearrangement and inventory of the basement reserve stock area to parallel the logical system in use in the regular stockroom.

The Purchasing Department of this laboratory under the chairmanship of H. B. Morley is sponsoring the next meeting of the MIT buyers' group to be held October 28. Paul V. Cusick will be the principal speaker.

The buying group of this office attended the October 15 meeting of the New England Purchasing Agents Association to hear an analysis of the management function of purchasing, an address by the Association's National President.

Both of these groups can be very useful by helping us to get a broader view of general procurement problems and improved methods of operation.

Ward-Leonard deliveries continue to be the worst of our many vendors. Engineers are again asked to allow not less than 3 months for delivery of any large quantity (50 or more) of Ward-Leonard's JAN-type power and non-inductive vitreous-enamel resistors. Alternate suppliers have been actively sought for more than 6 months. Hardwicke-Hindle is now being favorably considered as one of the few manufacturers able and willing to try to meet our up-graded specifications for this item.

The Sprague order based on the up-graded specification for plug-in tubular capacitors in "Telephone Quality" was partially resolved after more than 2 months of negotiation. The material Sprague shipped was not "Telephone Quality," as specified in the order, but a style and line of components Sprague calls "high quality," which can easily be assumed to be "Telephone" grade.

We were able to reduce the cost of this order by nearly 50% below the vendor's original estimate because the item was "high" rather than "Telephone" quality. The "high quality" items shipped were accepted by component test.

Mallory has now been asked to provide samples of their "Telephone Quality" line.

Our experience in the up-grading problem now makes it clear that several months of exact technical and procurement effort must go into each individual component. Therefore, Standard Sheets containing revised up-gradings can be issued only after each component involved has been thoroughly studied on an individual basis and a firm conclusion reached.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 30 Construction Requisitions totaling 141 items satisfied since October 9, 1953, and there are 28 Construction Requisitions totaling 1764 items under construction by the Group 60 electronic shops.

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

Outside Vendor

(G. A. Murdoch) (UNCLASSIFIED)

There are 11 orders now open with vendors, totaling 1528 items. Deliveries in the past biweekly period have totaled 377 items. Information on specific orders may be obtained from the writer (ext. 3476).

3.3 Component Analysis and Standards

3.33 Standards

(H. W. Hodgdon) (UNCLASSIFIED)

Standards Sheets issued this period were:

Index and Cross Reference
6.037-1 thru -3 Coil Forms

The section on Electron Tubes has been completed except for tube-connection diagrams and proof-reading.

Distribution of IBM Military Reference Data Books for AN/FSQ-7 will be handled by this office. Binders have been received and will be distributed as soon as they can be indexed and the distribution lists set up.

The draft Standards proposal on Fixed Composition Resistors submitted to the Lincoln Standards Committee was adopted with little modification and will be printed and distributed as soon as the final printing format is approved. Lincoln Laboratory Standards will supersede Division 6 Standards as they are issued. It is expected that the changes will be gradual, and we hope that they can be absorbed with a minimum of inconvenience. A proposal on Fixed Film Resistors has also been prepared and submitted to the Committee.

3.5 Drafting

MTC Units Transferred to WWI

(A. M. Falcione) (UNCLASSIFIED)

The drafting room has received a list of units which were transferred from MTC to WWI to replace storage. In cases where all units have been transferred, the drawing titles will be changed on the originals to designate WWI. For units which are common to MTC and WWI photacts will be made of the original, and new drawing numbers assigned to the photacts for WWI.

Drafting Procedures for AN/FSQ-7

(A. M. Falcione) (UNCLASSIFIED)

A memorandum has tentatively been written on drafting procedures on AN/FSQ-7 but has been held up because of additional changes regarding procedure between IHM and MIT. It is expected that the memo will be published before the next biweekly period.

New Multilith Masters

(A. M. Falcione) (UNCLASSIFIED)

The attention of all secretaries is called to the new form multilith masters which are now available in the stock room. This form is made by Multilith and is pre-printed with non-reproducible ink having the proper image area for typing reports, memos etc. The dotted image is to be used when a report is being written for two-sided printing; this image applies to even-numbered pages. A more detailed memo will be written to all secretaries regarding this subject in the very near future.

3.6 Administration and Personnel

New Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Tilda Finocchio is a new secretary in the Purchasing Department.

Roseanne Gillette is a clerk who has transferred from the Bursar's office to work in the Print Room.

Michael Solomita is a new Laboratory Assistant in Group 6345.

3.6 Administration and Personnel (Continued)

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Vincent Cuzziere
Robert Kyle
Lois Rutland
Marlene Wise

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

1 Clerk Typist
3 Technicians for Group 64
1 Technician for the Construction Shop
2 Technicians for the Inspection Dept.
1 Laboratory Assistant for Group 63
1 Senior Detailer