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Memorandum M-2749

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

SUBJECT: BIWEEKLY REPORT FOR MARCH 26, 1954

To: Jay W. Forrester

From: Division 6 Staff

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

1.1 Group 61

1.10 General

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

A major portion of the Group's activity continues to be the completion of an evaluation of the 1953 Cape Cod System and of plans for the 1954 Cape Cod System.

The Raydist data-reduction program is now operating and will be used to convert all present data to X,Y co-ordinates with respect to North Truro for comparison with data obtained from that set.

Calibration data for 5 gap-filler radars indicates no range error relative to the South Truro radar. Multiple returns make it difficult to determine whether or not small azimuth errors exist.

Raid-size tests with 500-foot separation show considerable increase in discrimination ability over that for 50-foot separation. The influence of aspect (nose-on, etc.) seems to be of greater importance than formation and separation.

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112 Data Screening

(D.L. Bailey) (CONFIDENTIAL)

Seward and I are continuing to investigate program improvements for Track-While-Scan. These have resulted in a preliminary proposal for improving crossing-track situations and for locating different types of radar data (e.g., gap-filler data, "heavy radar" data) differently at the processing stage. Some time will be spent on the computer during the next period to determine the usefulness of these ideas.

(H. Frachtman) (CONFIDENTIAL)

A large amount of time has been spent sifting the data collected during the last 3 months for the quarterly progress report. This has indicated a need for a revision of the radar-data statistics programs, which is being done.

(J. Ishihara) (CONFIDENTIAL)

Memorandum M-2734, "Computer Operator's Manual for Cape Cod System," has been issued. Persons desirous of using the Cape Cod Program recorded on magnetic-tape unit 0 should contact me for up-to-date check-lists. Since changes are constantly being made, a new list should be obtained for each run.

(J. Levenson) (CONFIDENTIAL)

Changes have been made in some of the display lines of the TWS stations. In particular, a Mark X display symbol appears on scopes F11, F12, G11, and G14, and the Georef display formerly shown at each of these stations has been removed. Programmers who use these stations should note the change. Other display-line changes were necessitated by the addition of Mark X symbols to scopes in both TWS and Weapons Direction sections.

To aid System evaluators, scope Q12 has been equipped with displays of all radar data and past history of correlated and uncorrelated radar data. In line with System evaluation I have been attending flight tests and attempting to tie in observations with recorded track history. A new, expanded track-history program will provide more information on tracking for the evaluation of design of the present program as well as statistics on track behavior.

W. Attridge and I have been conducting training classes with the personnel of the TWS section. We have arranged to give a written quiz each week on the lecture of the previous class. Thus far, results of these quizzes have shown the need for repetition of information and frequent review.

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1.12 Data Screening (Continued)

(H. Peterson) (CONFIDENTIAL)

The program showing the past history of a track has been checked out and is available for incorporation in the Cape Cod System if desired.

The Monitor's manual has again been rewritten and is being typed for further approval.

(H. Seward) (CONFIDENTIAL)

Improvements in the logic of the processing of radar data and the monitoring of close or crossing tracks are being studied by Bailey and myself. In order to evaluate some possibilities, a test run will be made on the computer next week.

(E.W. Wolf) (CONFIDENTIAL)

Useful calibration data have now been obtained from the Scituate, Londonderry, Clinton, Halibut, and Chestnut Hill gap-filler radars. None of them have any range errors relative to S. Truro. It is possible that some or all of them have a small error in their zero azimuths. It is difficult to determine the exact extent of this error because these radars give multiple, usually double, returns for almost all aircraft. This effectively increases their azimuth quantization by a factor of at least two. This matter is being further investigated.

(W.M. Wolf) (CONFIDENTIAL)

A Radar-Mapping Supervisor's manual is being completed.

I attended the CS course given by the S&EC Group.

Pictures at 15-minute intervals were taken of data from S. Truro, Derry, and Halibut during the morning of a chaff mission.

1.13 Tracking and Control

(W. Lone) (CONFIDENTIAL)

In conjunction with C. Gaudette, I reviewed the specifications of the selection and input-output control frame for XD-1.

Certain problems involving a backspace and writing end of file on the XD-1 magnetic-tape units have arisen, and the tape needs of Group 61 in the light of additional equipment are being evaluated.

The octal to binary XD-1 conversion program is being continued.

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1.13 Tracking and Control (Continued)

(A. Mathiasen) (CONFIDENTIAL)

The Raydist data-reduction program is now operating and will be used to convert all present data to x,y co-ordinates with respect to North Truro for comparison with data obtained from that set.

The present program uses the Newton-Raphson method for solving for x,y in the equations

$$\begin{aligned} \sqrt{x^2 + y^2} - \sqrt{(x - x_1)^2 + (y - y_1)^2} &= V_1 \\ \sqrt{x^2 + y^2} - \sqrt{(x - x_2)^2 + (y - y_2)^2} &= V_2 \end{aligned}$$

where (0,0), (x₁,y₁), (x₂,y₂), (x,y) are the co-ordinates of the master station, the 2 slave stations, and the aircraft, and V₁ and V₂ are the Raydist inputs, the parameters of the hyperbolas involved. For known constant height no large complication is introduced by height correction.

A direct solution, suggested by Arnow, essentially in polar co-ordinates, while somewhat more complicated than the method mentioned may be faster because of its noniterative nature. This will be programmed by B. Stahl.

The tracking section of the tracking-analysis program (see biweekly of 12 February) has now been written. While mainly a flexible tracking program, it also simulates noise of a simple type and performs several tracking parameters.

(H.D. Neumann) (CONFIDENTIAL)

See entry in SECRET supplement, M-2750.

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Collaborative planning for...
See entry in SECRET supplement, M-2750.

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1.14 Weapons Direction

(M. I. Brand) (CONFIDENTIAL)

In conjunction with S. J. Hauser, I prepared a memo on the evaluation of the Identification (ID) Section covering two periods October - December 1953 and January - February 1954. I prepared a detailed proposal complete with logic equations, diagrams, and test cases for degree-selected automatic identification. Consistent with this proposal, I have prepared a complete flow diagram for this program. In conjunction with S. J. Hauser, planning has progressed on the over-all planning for the 1954 Cape Cod System Identification Section. It is composed of some 17 individual programs of varying size including Digital Information Displays.

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

Several manual calculations have been made to check the ATABE program. Results seem satisfactory and coding will begin early next week.

Captain Roy Enemark, USA, Liaison Officer from AAA to the 32nd Air Division, visited the Laboratory on 26 March. He showed a film and gave a talk on the Nike I missile to Group 61, IBM, and Air Force personnel.

Two AA-guidance missions were performed this period. On 16 March, 6 tracks (corresponding to 5 strikes) were passed to AAA. All 6 were locked-on and assigned for engagement. Only 2 were splashed, the others breaking lock-on. In every case, TWS had dropped the track, so that in only one case (a reinitiation) was Cape Cod able to put the battery back on target. In that case, lock-on was broken again.

On 18 March, 6 tracks (again corresponding to 5 strikes) were passed. Only 2 were locked-on, the other 4 being dropped by TWS. Both strikes locked-on were assigned for engagement, but only one was splashed. The second strike broke lock-on.

A successful raid-size exercise was performed on 23 March. See C. Grandy's report for details.

(F. M. Garth) (CONFIDENTIAL)

Collaborative planning for saturation-type evaluation tests was done with L. Murray and J. Nolan. The saturation test part of a memorandum written about the 3 types of evaluation tests - saturation, final-turn, and raid-size - was contributed to, and the record forms to be used for this type of test were prepared for inclusion in this memorandum.

Experience gained thus far in 1953 Cape Cod System operation has shown the need for a revision of several Non-Track-While-Scan record

1.14 Weapons Direction

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

forms. These revisions have been completed, and a memorandum including explanations and precautions in the filling out of the forms is being completed.

Study has been started in preparation for work in the Identification Section to which I have recently been assigned.

(C. H. Gaudette) (CONFIDENTIAL)

C. Grandy and I have prepared a syllabus for the Cape Cod Familiarization Program which will be given from 29 March through 7 April and again from 26 April through 5 May. The syllabus is given in M-2726-Supplement 1, "Syllabus for the Cape Cod Familiarization Program."

The Identification Officer's section of the action-analysis program has been written and is being checked out.

S. Knapp and I are preparing a proposal for the 1954 Cape Cod Simulation Program. This proposal will be followed by proposals for the Master Control Program and the Data Recording and Analysis Programs of the 1954 Cape Cod System.

(C. C. Grandy) (CONFIDENTIAL)

A report has been completed in draft form presenting the results of the analysis and evaluation of the Height Finding Section of the Cape Cod System. In general, the performance has not been up to expectations with serious deficiencies in most aspects of operation. We received replies to only 1821 of the 2985 requests for information made during the period October 1953 to February 1954. Thus the success of height finding is 61%. Causes for a considerable number of negative replies have been determined, but the unexplained negatives still amount to 26% of the requests. Operation-timing studies showed that excessive time (more than 36 seconds) was taken to process 48% of the requests. Accuracy was satisfactory but very inconsistent from day to day. Average error was 1300 feet (900 feet for the MPS-4 sets and 2100 feet for the CPS-6B) and 90% of the MPS-4 errors were between \pm 2000 feet. However, on several days, average errors of only 400 feet were recorded, and so considerable improvement in accuracy should be possible. Height information was available to other sections of the Direction Center when they needed it only 63% of the time on tracks within height-finder range. But tracks of importance were within range only 60% of the time when information was required. Hence the over-all availability of height information in the System was a meager 38% (including the effect of limited radar coverage).

A number of changes in the height-finding system for the 1954 Cape Cod System will be made in an attempt to improve the performance of the System.

1.14 Weapons Direction

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

A special raid-size test was held on 23 March 1954. Results of this test were similar to those reported in the last biweekly report. Three aircraft flew several different formations (at 500-foot separation between airplanes) through the coverage of the Nantucket MPS-4. Special data collected indicated a marked increase in ability to discriminate aircraft at this large separation over that for minimum separation (50 feet). The influence of aspect (nose-on or tail-on) and of range was still pronounced and seems to be of greater importance than formation and separation. Complete results are reported in an inter-office memo to D. R. Israel.

(S. Hauser) (CONFIDENTIAL)

A summary of the evaluation of the Identification Section was prepared with statistical data and comment. This will later be published in memo form with other evaluations.

Specifications of the DID have been proposed. Specific proposals for scoring in the automatic identification program are under discussion. In the next biweekly period, something definite should be agreed upon.

(S. Knapp) (CONFIDENTIAL)

A new section of the recording program has been written at the request of the Weapons Direction Section. This program records, once per scan, the positions and velocities of target and interceptor for any 5 interceptors specified via parameter tape. A section which prints this data on the delayed-printing unit has been added to the analysis program. This program should be ready to use during system tests sometime this week.

A memo outlining the proposed simulation program for the 1954 Cape Cod System has been started. Similar memos for the Recording and Master Control programs will be written. This work is being done in conjunction with C. Gaudette.

(W. Lemnios) (CONFIDENTIAL)

A detailed summary of all attempted interceptions from 1 October 1953 to 28 February 1954 has been prepared and issued in an inter-office memo. The results were obtained by analyzing the log sheets. Copies are available from the author.

Two days were spent with J. Nolan at the Bell Telephone Laboratories, Whippany, N. J. For a summary of the discussions held there, see the biweekly report of J. Nolan.

The flow diagram of the Interception Calculations for the 1953 Cape Cod System has been prepared by J. Nolan. Copies have been made and

1.14 Weapons Direction (Continued)

(W. Lemnios) (CONFIDENTIAL) (Continued)

are available. Included with each copy is a description of all the symbols and all the equations used.

(L. Murray) (CONFIDENTIAL)

Three F-89's with reliable ground-to-air Data Link (D/L) equipment are now available. From all appearances, 5 D/L equipped F-89's should be ready for Cape Cod tests within the coming month.

A visit to Project Broad Jump indicated that there is no advantage in testing our D/L equipment in their operation. The nature of these tests precludes securing much of the information which is needed.

A proposal for the evaluation of the 1953 Cape Cod System has been written. F. Garth, L. Murray, and J. Nolan contributed a section on the evaluation of the Intercept Teams for saturation-raid conditions.

(J. Nolan) (CONFIDENTIAL)

W. Lemnios and I spent two days of the past biweekly period at the Bell Telephone Laboratories, Whippany, N. J. . Here we reviewed the results of the initial attempts of the BTL people at simulating the vectoring stage of interception control as it is done in the Cape Cod System. Some discussion was held and suggestions made for more realistic parameterization of this simulation in the remaining portion of their initial simulation program. The results obtained so far indicate:

1. An extremely high percentage of successful intercepts for lock-on occurring as low as 4 miles. "Successful" is here meant to mean the satisfaction of the primarily computed vectoring-error limits.
2. The necessity for the use of physical quantization in the simulation process rather than the proposed use of a Gaussian noise distribution. A large portion of the tests must be rerun with the quantizes.

Additional time during this period has been spent in completing the initial equipment and program requirements for the Weapons Assignment and Direction (WA/D) station in the 1954 Cape Cod System.

Some assistance, limited by the intervening trip to Whippany, has been given to P. Cioffi in planning the proposed final-turn tests and to F. Garth and L. Murray, to a lesser extent, in planning the proposed saturation tests.

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1.14 Weapons Direction (Continued)

(G. Rawling) (CONFIDENTIAL)

A survey of the display-selection switches has been commenced to aid in changes for the 1954 System. The switch listings will incorporate all changes to date: Title of displays, scope panel and switch number, addresses and matrix pair numbers.

Charts for display-selection switches and indicator-light listings are being prepared as well as standard pictorial illustrations of panels and stations.

(C. Zraket) (CONFIDENTIAL)

In conjunction with D.R. Israel and W.S. Attridge, and others, a memo giving a detailed description of the flight test program for the Cape Cod Direction Center for the next 2 1/2 months was prepared. Along with tracking-evaluation studies, three types of tests will be conducted: saturation tests, final-turn intercepts, and raid-size assessment tests. The M-note will be issued this week.

The summary figures and the results of evaluation studies of the Weapons Direction section of the Cape Cod System for the period 11 November 1953 - 1 March 1954 have been collected from the responsible people. Following a review by D.R. Israel, an M-note will be issued.

Specifications for the Weapons Direction stations of the 1954 Cape Cod System are being reviewed with H. Benington. An inter-office memo describing these specifications will be issued in order that a basis for program design may be available.

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1.15 Direction Center Operations

(C.Zrakat, W. Attridge, P.Cioffi, R.Davis) (CONFIDENTIAL)

The following is a brief summary of the operation of the Cape Cod Direction Center during the past biweekly period. Detailed reports on any tests are available from P. Cioffi. Radar-calibration data is available from E. Wolf.

16 March - A live tests was cancelled when the FPS-3 at S. Truro was shut down for maintenance. Computer time was used to run a training mission for operational personnel utilizing simulated data. IBM personnel were given a demonstration on the operation of the Center during the latter part of the test.

17 March - A radar-calibration mission utilizing a B-29 equipped with bombsight was conducted.

18 March - A demonstration for visitors from various Air Force and Navy agencies was conducted. Five single-aircraft raids of B-29's on Ops Plan 12 were available. Five F-89's equipped with Mark X and 2 F2H's were available as interceptors. An AAA mission was run on the targets concurrent with the interceptions.

Four interceptions were attempted from Bedford, one by automatic ground-to-air data link. All resulted in successful tally-ho reports although target-interceptor track cross-over troubles continued. One out of 2 attempted interceptions from South Weymouth was successful; the second was aborted because of inability to track the interceptor.

19 March - A radar-calibration mission utilizing a B-29 equipped with bombsight was conducted.

23 March - A raid-size assessment test utilizing a raid of 3 B-29's was conducted. The height-finder at Nantucket was the only one available for the test; hence, only legs 2 and 3 of Ops Plan 13 were used for the target flight path. Three F-89's, one F2H, and one F9F were available as interceptors. The interceptors were utilized for combat air patrol and return-to-base tests. No AAA mission was run.

The test was held up by computer alarms resulting from a failure to check test-storage contents. Once the test started, tracking of aircraft in the northeast sector was affected by mapped-out areas due to bad weather.

A large amount of significant data on raid-size assessment was obtained from the use of the PPI, RHI, and A-scan scope presentations at the height-finder site. In addition, successful return-to-base tests utilizing the automatic ground-to-air data link were conducted using the F-89's from Bedford.

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1.15 Direction Center Operations (Continued)

(C.Zraket, W.Attridge, P.Cioffi, R.Davis) (CONFIDENTIAL) (Cont'd)

24 March - A radar-calibration mission was cancelled because of bad weather. Computer time was used for program analysis.

25 March - A live test was cancelled because of bad weather. The time was used for a training mission for operational personnel using simulated data.

26 March - A radar-calibration test utilizing a B-29 equipped with bombsight was conducted.

No report on aircraft scheduling and missions flown will be included this week. A summary for the last quarter will be included in the next report.

(A. Morriss) (CONFIDENTIAL)

Indicated below is the statistical breakdown of the equipment-reliability reports for the Cape Cod Systems Operations for the period of 15-26 March, 1954. Data for the cumulative period are also included. A new column for telephone troubles is also included.

	Last Biweekly Period		Cumulative Period since 9/29/53	
	Hours	Per Cent	Hours	Per Cent
Assigned Time for System Operation	10.5	100%	207.1	100%
Unrestricted Operating Time	7.3	69.5	116.3	56.2
Limited Operating Time	2.7	25.7	58.3	28.1
Down Time	0.5	4.8	30.3	14.6
Recovery Time	0.0	0.0	2.2	1.1
Time Lost (Hours)				
Computer	Down Time	Limited Operations	Down Time	Limited Operations
Room 222	0.5	0.0	27.3	0.0
Radar and Input	0.0	0.0	2.6	48.7
Misc.	0.0	2.7	0.3	43.7
	0.0	0.0	0.0	25.3
Telephone Trouble, Room 222	3.6 hours			

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1.15 Direction Center Operations (Continued)

(W. Vecchia) (CONFIDENTIAL)

Computer Operations:

Total Assigned Time 85.5 hours

Weapons Direction	3 hours 05 minutes
Track-While-Scan	19 hours
Combined Operations	
WD	13 hours
TWS	
Tracking and Control	6 hours 55 minutes
Equipment Check	3 hours 10 minutes
(Guy Young)	<hr/>
	45 hours 10 minutes
Time given to Math Group	29 hours 30 minutes
" " " In-Out	4 hours 35 minutes
" " " Magnetic Drum	2 hours 30 minutes
Time lost to computer	3 hours 45 minutes
(malfunction)	<hr/>
	40 hours 20 minutes

1.16 AN/FSQ-7 XD-1 Support

(G. Rawling) (CONFIDENTIAL)

Various floor plans for the equipment layout of the Air Defense Center are being redrawn.

(F. Webster) (CONFIDENTIAL)

The preparation of tests for pseudorandom generators is being continued. A program which tabulates the distribution of samples has been checked out on MTC.

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

There has been a minor reorganization in Group 64 with the shifting of some responsibility and a change in the procedure to be followed by engineers who wish to make cable or wiring changes or add equipment to WWI or the terminal equipment. This new organization will help to co-ordinate the activities of the In-Out and Systems Sections and to centralize responsibility for changes.

Henceforth, all additions to, or changes in, wiring, cables, or equipment, which affect WWI, must be requested on the appropriate forms. If the proposed work affects the central computer, it must be initialed by Al Roberts or Larry Holmes; if it affects Room 222, it must be initialed by Bob Gould; and if it affects Room 156, it must be initialed by Ken McVicar. After a request has been initialed by the proper person, it should be authorized by Larry Holmes who will act as central clearing house for all system changes and additions.

Computer reliability has remained high during the past biweekly period. The transfer-check alarms previously reported seem to have been caused by several defective crystals and tubes in the operation matrix, most of which have been found and eliminated.

The new MITE units, working with the buffer drum, have been operating reliably, and removal of the old MITE units is being considered.

1.21 WWI System OperationCore Memory

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

The majority of the transfer-check alarms have been eliminated by the replacement of several tubes and crystals in the operation matrix. There still appears to be some intermittent trouble in the TPD counter panel. Scope post mortems have proved extremely valuable in tracing the cause of the alarms.

Several changes are in progress in clock-pulse control to improve circuit reliability. The major change is the replacement of the matrix driver 6V6 tubes with 6L6's. This will provide better cutoff of the CPC gate tubes.

The magnetic-tape system is now being maintained by the Systems group. Any questions about the system or any difficulties encountered should be referred to Larry Holmes, Al Roberts, or Al Perry.

1.21 WWI System Operation (Continued)

Marginal Checking

(S. E. Desjardins) (UNCLASSIFIED)

The automatic-alarm check program now functions as designed and has been incorporated in the new consolidated test program.

The consolidated test program now contains all the test programs that are used daily by the system group. By writing them in a standardized form, most test programs can be included in the consolidated test program.

Voltage Interlock Panel

(D. A. Morrison) (UNCLASSIFIED)

The plastic cover for the voltage-interlock panel has arrived.

Voltage-interlock-panel drawings have been turned over to Drafting to be drawn up. The proper changes have been incorporated in the line diagram, power supply control, WWI (D-32017-17). The change notice has been written.

Work is continuing on material for the WWI Service Manual.

Magnetic Tape

(A. X. Perry) (UNCLASSIFIED)

The 2 reels of Audio-tape brown-oxide tape have been removed from service because of excessive wear of oxide surfaces and elongation. These have been replaced with 3-M green-oxide tape.

The toggle-switch "Unit 0 Rewind" on the console table will be replaced by a pushbutton to increase operating efficiency.

The remainder of panels necessary to complete the Unit 2 delayed print-out system will be ready by 6 April 1954; it is hoped that by the next biweekly it will be in operating condition.

A design change in the head circuits of the read-record switch and reading amplifiers is now being made in the 3 spare units. This change will bring the voltage level from 150 volts down to 0 volts, enabling the unit-selector amplifier to be eliminated from the system and decrease the insulation break downs of read-record heads.

1.21 WWI System Operation (Continued)

Flexowriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Two new FL Flexowriters have been delivered by the manufacturer. A third is scheduled for delivery shortly. One machine was equipped with a defective punch which has been returned to the manufacturer for replacement. Work of modifying these 2 FL machines for use at Whirlwind is now underway.

Gears on 2 of our short-carriage Flexos have been changed to drive the translator about 3 per cent faster than the readers. This change was made to eliminate timing troubles with these older machines.

1.22 Terminal Equipment

Cape Cod Control Center

(R. H. Gould) (CONFIDENTIAL)

A modified alarm panel has been installed at the H station. This panel has no buzzer but flashes its red alarm light to attract the operator's attention. The rest of the alarm panels will be modified if this one proves satisfactory.

A second 16-inch CRT which was removed from service because of grid emission was RF bombed. It suffered a large loss in cathode emission but recovered partially after use. The grid emission no longer caused visible spots on the screen, but measurements of tube electrode currents showed that the grid was still emitting. Further tests will be made.

CRT Filter System

(S. B. Ginsburg) (UNCLASSIFIED)

All of the plug-in units to be used in the system have been received from the shop. They are presently being tested. The complete wiring schedule of the system has been finished.

Marginal-Checking

(T. Sandy) (UNCLASSIFIED)

The entire marginal-checking system of the in-out element is being investigated. The first problem has been a systematic method of assigning marginal-checking lines.

1.22 Terminal Equipment (Continued)Magnetic Drums

(K. E. McVicar) (UNCLASSIFIED)

Reliability of both drum systems has been good during the past biweekly period. Some inconvenience to operators has occurred due to the work currently being carried on in the drum bays. The technicians making circuit and cabling changes must do this work during system operation, but every effort is being made to minimize interference with computer operation.

The bay wiring for the electronic write-group selection in the auxiliary drum is now being installed and the chassis are under construction by the production department. The temporary cables which connected the drum systems to test setups are being removed.

Work is in progress on the buffer-drum system on minor circuit changes which should improve the operating margins. The write pulse will be widened to increase the writing current. A new level setter for the enables is being designed, and work is in progress on a gated power supply for the writer plates which should eliminate our trouble with writing between the slots.

(H. L. Ziegler) (UNCLASSIFIED)

Final tie in of the auxiliary-drum system for write-switching of heads requires the delivery of at least 15 new type-3 chassis. Present outlook is that these will not be available until late May when the necessary transformers are promised for delivery. In the meantime, wiring except for final tie in will be completed, probably during the coming biweekly period.

The new monitor system for the magnetic drums and the PETR is complete except for final installation of the panel. This is planned for 29 March.

Addition of a parity digit to Groups 4 - 7 of the buffer drum has been worked out, and the necessary prints and wiring schedules drawn up. Work has already started on this job which should take several weeks to complete.

Buffer Drum

(L. D. Healy) (UNCLASSIFIED)

A pair of level setters were built to drive 6BL7 cathode followers driving crystal gates in the buffer drum. These are ready for test with the drum.

1.22 Terminal Equipment (Continued)Buffer Drum

(L. D. Healy) (Continued) (UNCLASSIFIED)

A circuit was built to reduce the voltage output from the +200-v regulator supplying the writing amplifiers to a low value when these amplifiers are not in use. The voltage reduction necessary to disable the amplifiers has not been determined.

MITE

(A. M. Werlin) (UNCLASSIFIED)

Work is continuing on the construction of additional MITE's for the 1954 Cape Cod System. These will operate with Group I of the buffer drum. It is also planned to incorporate mapper-control panels to permit flexible monitoring of all the input data. The new MITE's associated mapper controls, monitor-selection panels, and demodulator auxiliary panels will occupy the racks in Room 156 in which the old MITE's with flip-flop storage are now located. The buffer-drum MITE system has been operating reliably during the past 2 weeks, and it is hoped that the old MITE's and its flip-flop storage may be removed in the near future.

Ferranti Photoelectric Tape Reader

(F. E. Irish) (UNCLASSIFIED)

The brake mechanism of the Ferranti PETR caused a reduction in tape speed by binding the friction-drive cylinder. Apparently, this resulted from the tightening of an adjusting screw that determines how far from the cylinder the brake shoe will normally rest. The entire brake-clutch mechanism of this reader has been removed to permit its complete overhaul. It has been replaced by a spare.

Lately, there have been a great number of program tapes which have failed to read in or have read in intermittently. Part of this trouble was caused by a layer of dust on the exciter lamp of the reader which lowered its intensity and reduced the signal amplitudes out of the reader, but the elimination of this source of trouble has not greatly improved the reliability of the read-ins. The remaining troubles seem to be caused by dirty tapes (chaf and dust) and by tapes that have been punched on a tape improperly inserted into the punch.

1.22 Terminal Equipment (Continued)

Radar Inputs

(H. J. Kirshner) (CONFIDENTIAL)

The new-type demodulator for Clinton data has been installed and is operating.

A second demodulator of this type will be used with Nantucket data to test transmission on a "C-carrier" (single sideband) telephone circuit to the Nantucket site.

Data Link

(H. J. Kirshner) (CONFIDENTIAL)

Robert Paddock has been assigned responsibility for the ground/air data-link equipment.

Pathfinder

(A. V. Shortell) (UNCLASSIFIED)

In order to meet the installation schedule for the new mappers, the previous scan-synchronizer design has been dropped in favor of a design which will combine some of the better features of the Division 2 and the IBM designs and which will allow maximum use of standard WW circuits.

A free-running, variable-frequency gas-tube pulse generator has been designed. The pulse-generator frequency will be controlled by a d-c voltage obtained by integrating a flip-flop-gate waveform. The flip-flop will be turned on by an azimuth pulse and turned off by every fourth gas-tube pulse (the pulse-generator frequency will be four times the azimuth-pulse frequency).

(N. N. Alperin) (UNCLASSIFIED)

The prototype mechanical azimuth drive supplied by Al Smith was tested and found to be very satisfactory. It allows true and mechanical north to be synched initially within a degree.

A circuit was designed that will inhibit the sweep when a north sync is initiated until true north and mechanical north line up. An automatic north sync will take place in the monitor scope whenever a site is selected by the operator, thus keeping tracks off the scope until true and mechanical north are in sync.

1.22 Terminal Equipment (Continued)Pathfinder

(N. N. Alperin) (Continued) (UNCLASSIFIED)

Because of shop load the sweep circuit and phototube pickup were sent to outside vendors to be constructed.

Some work was done on the prototype model this past biweekly period. However, when the drafting is completed on the control chassis, work will begin in earnest.

A manual containing instructions and pictures for the Pathfinder dismantling has been started. A similar one for the reconstruction will be written while the prototype mod is being done.

Block Diagrams

(G. A. Young) (UNCLASSIFIED)

The "ready reference" list of si addresses (drawing C-55565) has been revised and been reduced. Some of the special test addresses are not included in this list. The list which describes computer actions if an unassigned si address is used in a program is also being revised.

The revision of E-466, "Operation of the In-Out Element," has been distributed. If anyone desires copies of this note but was not on the list, please notify me.

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 12 - 25 March 1954:

Number of assigned hours	147
Usable percentage of assigned time	96
Usable percentage of assigned time since March 1951	87
Usable percentage of assigned time since September 1953	93*
Number of transient errors	9
Number of steady-state errors	4
Number of intermittent errors	4

* Dependence on two banks of magnetic-core memory

1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 12 March 1954:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Crystals</u>			
1N34A	2	0 - 1000	Low R_b
1N92	2	1000 - 2000	Drift
D-359	2	20000 - 21000	1 shorted; 1 drift
D-358	1	21000 - 22000	Drift
<u>Resistors</u>			
680-ohm, 1-watt +10% carbon	2	0 - 1000	Burned out
<u>Tubes</u>			
5046	1	0 - 1000	Short
5687	1	8000 - 9000	Short
5881	1	0 - 1000	Low I_b
	1	4000 - 5000	Short
5963	1	2000 - 3000	Low I_b
	1	10000 - 11000	Short
6080	3	3000 - 4000	Gassy
6145	3	0 - 1000	2 short; 1 open filament
	2	1000 - 2000	1 short; 1 leakage
	3	4000 - 5000	1 short; 2 leakage
	1	5000 - 6000	Low I_b
7AD7	1	8000 - 9000	Short
	2	10000 - 11000	Low I_b
	2	11000 - 12000	Short
	6	16000 - 17000	1 low I_b ; 4 short; 1 leakage
	1	22000 - 23000	Short
7AK7	4	23000 - 24000	3 short; 1 low I_b
	1	0 - 1000	High cutoff
2D21	1	9000 - 10000	Broken envelope
	2	no clock hours	High firing voltage
	2	1000 - 2000	High firing voltage

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)			
3E29	1	2000 - 3000	Low I _b
	4	4000 - 5000	Low I _b
	1	10000 - 11000	Low I _b
	1	15000 - 16000	Low I _b
	1	23000 - 24000	Leakage
6L6	2	8000 - 9000	Low I _b
	1	10000 - 11000	Low I _b
	1	23000 - 24000	Low I _b
5Y3	1	0 - 1000	High arc drop
6AG7	1	22000 - 23000	Short
6BL7	1	2000 - 3000	Low I _b
6V6	1	23000 - 24000	Low I _b
6Y6G	2	10000 - 11000	Short
VR150	1	1000 - 2000	No regulation
	1	15000 - 16000	Poor regulation

1.24 Power

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

The capacity of the WWI +90-v supply has been increased from 10 amperes to 25 amperes.

A temporary -30-v supply is being built for WWI, so that the present -30-v WWI supply may be removed for redesigning.

Power Distribution at Lexington

(R. C. Jahn) (UNCLASSIFIED)

The a-c and d-c distribution systems are being planned for maximum flexibility to take care of any reasonable alterations and special power considerations. We are planning to install pull boxes for d-c wiring on every even-numbered column instead of only those requiring power at this time.

A special group of 230-v, 3-phase power transformers is to be installed for the ceramics lab to enable the ovens to reach maximum temperature.

The memory racks will have a separate line to insure uninterrupted service during long data runs.

1.3 Group 651.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

Most of the effort of the Group continues to be expended on problems concerning the 19-inch Charactron and the 5-inch Typotron tubes. Two tubes were constructed this period to improve the electron optics for better registration. One tube, XT-77, was designed to evaluate a square cross-section beam on the character matrix. The second tube, XT-78, was designed to evaluate the Hughes flood gun that is used in the Typotron tube. Tubes constructed the previous biweekly period for study of the shadowgraph principle were tested and evaluated by Frank Rodgers and Peter Tandy. One tube, XT-76, was designed to test the field erasure of dark-trace tubes; this was tested and evaluated by Frank Rodgers.

John Koda of Hughes Aircraft brought two new Typotron tubes east, so that they would be available for the test and evaluation period on 16 March 1954. John Koda spent 2 days, 15 and 16 March, in the Laboratory discussing the Typotron program, the test program, and assisting C. L. Corderman at MTC. C. L. Corderman and Group 25 joined in all the discussions.

Dr. A. V. Haeff, in charge of the Tube Division of Hughes Aircraft, visited us on 23 March 1954 to discuss the Typotron program. A meeting was held in New York City on 24 March 1954 with Dr. Haeff and members of his group to continue the discussion on the Typotron. H. M. Smith and G. Smith of the Hughes Tube Group, who were attending the MIT Physical Electronics Conference, visited the Laboratory on 26 March 1954 to discuss the Typotron work.

A 14-pin stem for a 1 7/16-inch neck is not available commercially. This stem will be needed for the 19-inch Charactron. The Tube Group initiated a program to develop a 14-pin stem. The dies have been designed and are under construction in the Machine Shop. We expect to complete this development during the next period. Then the commercial glass firm of Ryan, Velluto, and Anderson will be asked to set up and produce the stems.

L. E. Record and C. W. Hamaker, of the General Electric Cathode-Ray-Tube Division and of the Government Sales Division, respectively, visited the Laboratory on 19 March 1954 to inquire about our work on Charactrons and Typotrons. C. D. Cillie, also of the GE Sales Division, joined the discussion. J. A. Klein and J. S. Palermo came into the meeting later in the day to discuss aluminized screens, P7, P14, P19 phosphors and nonreflective coatings.

Group 65 continued to work with G. C. Sponsler of Group 25 to operate an automatic electron-trajectory tracer in co-operation with the MIT Dynamic Analysis and Control Laboratory. This work must be completed this next period, because the equipment in DACL has been assigned to other work.

1.31 Activities of Group 65 (continued)

Work on helical dag coatings continues.

A trip was made to Sylvania on 18 March 1954 to review progress on the improved 7AK7 tube.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

Our efforts during the past 2 weeks have been primarily directed toward equipment design and construction and the materials requisition necessary to continue the program of research and development of techniques for the display tubes. In the meantime our experiments on helical dag coatings with Tektronix ink continue to supply inconsistent data. Therefore a different conductive, Acheson cathode-ray-tube wall coating has been used in an effort to evaluate helical dag coatings for the post acceleration. Our data on these preliminary samples show that a uniform 0.040-inch-wide line more than 90-feet long has a resistance of 8.5 megohms after bakeout.

In view of these results, we will prepare additional samples of helical dag coatings. A report of this series will be presented in the next Biweekly.

(P. C. Tandy) (UNCLASSIFIED)

A research storage-tube mount has been modified to accommodate tubes similar to the Typotron for electron-optic tests. The test results are contained in a Biweekly written by F. A. Rodgers of Group 25.

SECTION II - AN/FSQ-7

2.1 Group 622.11 SystemsOutputs

(I. Aronson, J.S. Gillette) (CONFIDENTIAL)

The SDU modulator and demodulator have been set up with the necessary logic for transmitting sync and data pulses at various repetition rates.

We have operated the equipment long enough to become familiar with it and are now ready to start measuring margins.

Output-Section Development

(H. Rising) (CONFIDENTIAL)

A full-size 25-position switch and 4 cores of buffer-storage have been added to the output-shift registers. The equipment has been reconnected to allow 30 disturbs on each nonselected core. Tests on a single core show driving-current margins of 90 to 140 milliamperes and on all 4 selectable cores 106 to 133 milliamperes, the difference in margins being due to nonuniformity of cores. Further tests will be made to show the effects of time-sharing the information gates.

2.12 Magnetic-Core MemoriesLexington (E.A. Guditz)

The floor-plan layout of our new quarters in Lexington has been completed. The necessary special power requirements have been submitted to R. Jahn and ventilation requirements to Grant Bagley of Div. 7.

Convention

Discussion with representatives of wire manufacturers at the IRE exhibits in New York indicates that our choice of wire for memory-plane construction cannot be improved upon considering presently available products.

A new printed-circuit connector demonstrated by H. H. Buggie, Inc., of Toledo, Ohio, looks very promising for use in making temporary connections to memory planes for test purposes.

2.12 Magnetic-Core Memories (Continued)

Sensing-Amplifier Design

(S. Fine) (UNCLASSIFIED)

A ferramic H toroid using a 15:1 turns ratio is presently being used as the input transformer to an experimental 2-tube sensing amplifier. Rectification using T-6 diodes is being accomplished in the secondary of this transformer. With a 5-turn primary a gain of 8 is obtained in the transformer. The small number of primary turns results in loading of the sensing winding but also reduces the delay of signal through the transformer.

The sensing amplifier consists of 3 stages of pulse amplification and a cathode follower.

External Register Selection

(J. Raffel, G. Davidson) (UNCLASSIFIED)

Further experimental work was continued on the 2-core-per-bit memory.

The 256-position switch has been installed and awaits the completion of the 16 x 16 x 16 memory it is to drive.

64-Position Switch

(A.D. Hughes) (UNCLASSIFIED)

Some of the unselected positions of the switch will deliver small, but significant, currents to their memory lines. The signal which these currents may induce on the memory sense winding has been calculated and found to be no more than about 10% of a ONE signal (at strobe time). Very pessimistic estimates were used for all parameters in the calculation.

Work on the physical layout and construction design has begun; pluggable units are being considered for parts of the switch.

XD-1 Core Memory

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

The etched-circuit prototypes of the digit-plane driver and sensing amplifier are now working. During the next few weeks these units are to be evaluated.

2.12 Magnetic-Core Memories (Continued)MTC Core Memory, Mod. II

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

Some tests were run on the core memory, and the results were plotted in the form of the so-called "shmoo". The results obtained when the machine was running with the inchworm program were similar to those obtained from the 32 x 32 core memory. The inchworm can probably be considered a program of average difficulty.

Additions have been made to the double-complemented pairs-checkerboard bootstrap program tape (MP 60) so that it can be run in a closed loop. We now plan to test the memory with this difficult program. The results of this test should be available in the next few weeks.

2.13 Vacuum-Tube Circuits (UNCLASSIFIED)Schedules

(R.L. Best) (UNCLASSIFIED)

A preliminary schedule for this Section has been made. Since most of our work is for other Sections of Group 62, our schedule will be revised as the schedules of these other Sections are completed.

Typotron Display

(H.J. Platt) (UNCLASSIFIED)

The Typotron display was successfully demonstrated on 16 March. A program written by P. Bagley was used to show a typical display.

On the basis of this demonstration, it was decided to continue with the development of the Typotron.

Universal Amplifier

(H.J. Platt) (UNCLASSIFIED)

A basic voltage amplifier was designed. Phase-attenuation analysis showed that the amplifier would be unstable when feedback was added. Design of a proper interstage network will be carried out which will make the resultant basic amplifier stable.

2.13 Vacuum-Tube Circuits (Continued)

(H.J. Platt) (UNCLASSIFIED) (Continued)

An analysis was carried out on the Charactron magnetic-deflection driver to determine this circuit's phase-attenuation characteristic when this circuit is driven by the basic voltage amplifier, with feedback taken from the cathode of the driver, the resultant circuit should be absolutely stable.

Similar work is in progress for the line driver.

Thesis

(S. Bradspies) (UNCLASSIFIED)

A proposal has been written in rough form. An appropriate title has not yet been found, but the thesis will consider a magnetic-core memory in which selection and information storage are performed by different cores. A thesis supervisor is being sought.

Magnetic-Matrix Switch Driver

(D. Shansky, E.B. Glover) (UNCLASSIFIED)

Time has been spent designing a circuit which will deliver a current gate of specific shape and amplitude to drive a magnetic-matrix switch. The gate is to be of such shape as to produce a square gate from the secondary of the core. An adding circuit was used in an attempt to add 2 waves to obtain the desired shape. However, experiment has proved that a better method is to use negative feedback from a similar core. This method is presently being tried.

XD-1 Drum Circuits

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

Data on the drum switch circuits and writing circuits are being taken so that the circuits will be ready for approval in the event the diode-switch scheme is approved for XD-1.

"C" Flip-Flop

(J.S. Gillette) (UNCLASSIFIED)

An investigation has been started to determine how many drum read-write circuits can be driven with one "C" flip with various time between the set and clear pulses.

2.13 Vacuum Tube Circuits (Continued)

Blocking-Oscillator Core-Drive Investigation

(E. Anfenger) (UNCLASSIFIED)

A rough model is in operation for the bit driver. Adjustment of parameters to meet the requirements is in process. A discussion has been arranged with Frost to discuss maximum tube ratings for this application.

2.14 Memory Test Computer

General

(W. Ogden, W. Hesler) (UNCLASSIFIED)

Planning on the reconstitution of MTC after moving it to Building B is still a major effort with many ramifications, but the layout is finally coming into focus in a shape that seems to make everyone reasonably happy. Moving d-c power supplies to the basement has simplified the cooling problem and provided bench space for a technician force which is bound to increase. Requests of prospective users (see Bagley's write-up of Arnow's requests, below) can apparently be met without any radical dislocation. Circumstances will probably demand that MTC stay in Whittemore until late in May, but considerable useful work, particularly on the display and drum efforts, can be put in before then.

Gradual cleanup of margins is beginning to bear fruit; sensing-amplifier bias margins now cover a span of more than 25 volts, as compared with 20 when the 64 x 64 memory was first installed. Immunity to noises on power lines has also improved: all lines except the -180 (which is a special case that can probably be eliminated) can be shorted to ground through an 8-microfarad condenser without disturbing computer operation.

The Typotron program has progressed, including a demonstration on 16 March; installation is about 80 per cent complete for the forthcoming test of digital expansion circuits.

Needs of Group 61 with Respect to MTC

(P.R. Bagley) (UNCLASSIFIED)

Jack Arnow of Group 61 has outlined the needs of Group 61 for use of MTC. As a result of discussions based on Arnow's presentation, we are contemplating the addition of several new instructions to MTC in order to simplify programming certain operations:

2.14 Memory Test Computer (Continued)

(P.R. Bagley) (UNCLASSIFIED) (Continued)

1. Provision for Shifting Left. We would like to avoid, if possible, the addition of 64 gate tubes which would be required if MTC were to perform a "shift left" instruction identical to that in WW1. A current suggestion is a variation of the cycle-right instruction: "short cycle," which would cycle only 31 bits, leaving the sign digit undisturbed. This would simplify the programming of a genuine shift left to 3 instructions, and the single instruction could frequently suffice as a substitute for "shift left."

2. Rounding Off. Optional rounding off a number to 15 numerical digits will be provided as a variation of the regular shift and cycle instructions.

3. Difference of Magnitudes. This instruction would correspond to the WW1 dm. Since it simplifies programs dealing with magnitudes, and since it costs relatively little in the way of equipment, we plan to install it.

4. Transfer Address. Having on MTC the equivalent of the WW1 ta ("transfer address") instruction would simplify the use of subroutines for the programmer. The execution of this instruction, however, requires a register which retains the reading of the program counter at the time the most recent "transfer of control" instruction (tr, tn, tro, tno, or to) is performed. We propose that live register 2 be used for this purpose, but that it be loaded only by a transfer of control instruction which is in core or drum memory. Hence the ta instruction would not normally be useful in programs stored in panel memory.

Storing in live register 2 the contents of the program field register along with the contents of the program counter would mean that the programmer would have available both the field number and address to which control was to be returned after a subroutine. No one has yet advanced a plan, however, for making use of this field number that requires significantly less effort than the present method of specifically storing a field number in advance of entering a subroutine. Unless a good plan is found, this latter feature of the "ta" instruction will probably be omitted.

5. Block Transfers between Drum and Core Memories. No block transfer instruction is contemplated. We do plan to change the drum "interleave" so that successively numbered addresses will appear under the read-write heads at intervals of approximately 160 microseconds. This interval is sufficiently long so that a block-transfer subroutine can deal with words at successive drum addresses.

At 160 μ seconds per word, a transfer of one field (2048 words) between drum and core memories will require a little longer than 0.3 second.

2.14 Memory Test Computer (Continued)

(P.R. Bagley) (UNCLASSIFIED) (Continued)

6. "Extract" ("multiply digits" or "logical multiply" and "Merge" ("deposit" or "replace selected digits"). Often data occurs in large quantities not requiring full 16-bit precision; to conserve memory space, it is desirable to "pack" several short items into one register, "unpacking" one at a time as desired; but the advantage of such operation is nullified if the process is too awkward. Hence Arnow requested us to add "extract" to perform the "unpacking" and indirectly, through a dozen-instruction subroutine, the "packing." It is feasible, Hosier has pointed out, to provide a "merge" instruction that would fill the accumulator with digits taken either from memory or from LR2, according to whether the AC digit initially held a "1" or a "0." With LR2 clear, this would perform "extract"; otherwise, followed by a "store," it provides the equivalent of "deposit."

MTC Basic-Conversion Program

(P.R. Bagley) (UNCLASSIFIED)

The basic-conversion program (Tape UP-64-9) has passed all its tests and is ready for programmers' use. In order to uncover any obscure errors which may still be present in the program, I would like programmers to submit to me for checking the first few converted tapes which are prepared by this program.

Marginal Checking

(J. Crane) (UNCLASSIFIED)

New locations for marginal-checking fuses, switches, and terminals which will be used at MTC's new location have been decided. Future installation of marginal-checking lines in control will utilize the new system for distribution.

Hardware

(J. Crane) (UNCLASSIFIED)

A melamine strip to support bus wires on the back of an MTC PIUMP has been designed.

2.14 Memory Test Computer (Continued)

12 1/2-Inch Display Scope

(J. Crane) (UNCLASSIFIED)

Methods of increasing the intensity on the 12 1/2-inch display scope are being studied. Intensification amplifiers designed by Henry Zieman will be used with this unit.

Marginal Checking

(R. Hughes) (UNCLASSIFIED)

Margins on the equipment in the control element have been considerably improved during the last week by adding buffers and correcting termination problems.

While running the inchworm program + 10 per cent variations were made on the power supplies; all except two supplies (-150 volt and -180 volt) could be varied to this extent.

Core Memory

(R. Hughes) (UNCLASSIFIED)

Core memory has now a 25-v margin spread while running either the inchworm or the checkerboard-bootstrap program.

MTC Power-Supply Control

(D. Fisher) (UNCLASSIFIED)

Work is continuing as rapidly as possible to complete the over-all block diagram of the new system. Several changes were made recently in sequencing on and off the d-c voltages, which caused a delay in the final completion. It is expected that work will begin shortly on the circuit wiring of the various units contained in the power-supply control system.

2.15 System Liaison

(A. P. Kromer) (UNCLASSIFIED)

A meeting was attended at which representatives of IBM presented to Project ADES a general outline of IBM's organization, their plans for release of engineering information on the duplex central for manufacturing, and a general schedule for the manufacture, test and delivery of the initial duplex centrals. It is expected that a series of such meetings will continue throughout the time period covered by this activity.

ADC representatives (Project group for ADES) presented a revised program for the Transition System at a meeting held at Lincoln. This program had previously been approved by ADC Headquarters and was accepted by Lincoln and ADES as a basis for planning with respect to the Transition System. Minor changes in the quantity and geographic boundaries of subsectors, divisions and forces are involved.

Work on the preparation of a proposal for the building required for the FSQ-7 duplex is continuing in combination with ADES, IBM, and Francis Associates representatives. Layouts for both floors of Building F at Lexington for XD-1 are being firmed up for use in planning the installation work.

At the request of AFCRC, exhibits for both XD-1 and the duplex central are in process.

(J. D. Bassett) (UNCLASSIFIED)

Detailed plans for the move to Lexington are being drawn up for Group 62. With the exception of the MTC Section, these plans should be completed early next week.

Samples of several epoxy-glass laminates from different manufacturers have been received by J. Hauser of IBM. These samples should be compared with a view toward providing a better etched-wiring base for the circuit cards in the FSQ-7 production system. Means for setting up such a test-evaluation program will be investigated.

(W. H. Ayer) (UNCLASSIFIED)

A series of meetings has been held with representatives of ADES, IBM, MIT and Francis Assoc. to further the planning of FSQ-7 installations and facilities. Floor plans, equipment layouts, power-supply and cooling requirements, and the necessary power-house facilities were reviewed.

2.15 System Liaison (Continued)

(W. H. Ayer) (UNCLASSIFIED) (Continued)

The proposed cooling-equipment control system was reviewed with an equipment supplier in order to receive his comments and to make up a preliminary cost estimate.

A review of the present thinking on the lighting problems in an FSQ-7 installation has been undertaken with the aim of keeping the system as simple and inexpensive as possible consistent with operational requirements.

(P. J. Gray) (UNCLASSIFIED)

Amendment 2 to the AFCRC-1 Exhibit is nearing its final form. It provides a brief description of each of the various frames, consoles, etc., in AN/FSQ-7 (XD-1). It is planned to publish this as an M-note in the near future.

A new Exhibit, AFCRC-17, is being prepared to describe the duplex central in a manner similar to AFCRC-1 which describes XD-1. Target date for the first draft is 1 May.

I have been sitting in on duplex-central planning meetings as an aid in preparation of the above mentioned Exhibit and for transmission of necessary information regarding the duplex central to interested agencies outside of Lincoln.

(P. Bragar) (UNCLASSIFIED)

Drawing E-58233-1, 22 March 1954, XD-1 Second Floor, Bldg. F, layout of the operations floor, has been submitted for EDO-SO concurrence.

Drawing 5001-31005-C, 23 March 1954, showing XD-1 computer floor layout has been concurred in as revised.

A sketch of the preliminary layout of the computer area of the duplex central is available for inspection in W3-420.

2.16 Transistors

(D. J. Eckl) (UNCLASSIFIED)

The IRE convention provided an opportunity to arrange meetings with several transistor manufacturers with highly satisfactory results.

2.16 Transistors (Continued)

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

Texas Instruments Inc. will supply for our evaluation 50 of their type 102 hermetically-sealed point-contact transistors. They feel that these may be too slow for our applications so will later supply units with 1-mil spacing if we desire. They are also sending samples of some of their junction devices. They have indicated that they would be very happy to co-operate with us in life tests.

General Electric promised a visit shortly with some sample point-contact units. The delivery date on their sample pnp junctions is still 15 April.

RCA indicated a continuing interest in point-contact transistors and would like to work closely with us. We are sending them data on their TA-165 and TA-165K transistors. A visit from them is expected near the end of April.

Transistor Products has promised to expedite the delivery of 60 transistors which were promised for testing and evaluation.

Transitron is making power transistors and is interested in higher-speed applications of such devices. They are only making junction transistors.

Radio Receptor people are planning a visit to Lebow's group and will probably visit us at the same time. They are producing hermetically-sealed pnp junction transistors.

Germanium Products will send us some npn units selected for high frequency as replacements for other transistors which had defects.

Westinghouse is making power junctions but no information was available. They appear to be low-frequency devices.

Transistor Magnetic-Core Drivers

(S. Oken) (UNCLASSIFIED)

The problem of designing a transistor-driven diode-matrix switch was investigated during the past biweekly period. Coupling circuits must be used between the flip-flops and the diode matrix. The coupling circuit investigated was a junction-transistor grounded-emitter stage. The rise time of this circuit can be increased by running the stage as an over-driven amplifier although the fall time will be slow because of hole-storage effects.

The M-note on junction-transistor core drivers has been completed except for the diagrams and final draft.

2.16 Transistors (Continued)

APC (Counter)

(E. U. Cohler) (UNCLASSIFIED)

The test setup for the transistorized APC was completed and is now undergoing test. It was decided to run this circuit and the counter from MTC power rather than from a separate supply. This means quite a waste in power, but the total power is still small. The junction (npn) transistors for use in the test circuit were received and tested. Since we will become more and more involved in junction work in the future, the alpha tester was converted to accept npn types as well as pnp's.

Transistor Gates

(C. T. Kirk, Jr.) (UNCLASSIFIED)

The design of a time-pulse distributor has been completed. This time-pulse distributor employs the gate discussed in the previous biweekly (3-12-54) in a whiffletree circuit. Such a circuit arrangement requires that as many as 5 gates be connected to one side of a flip-flop.

In order to check the operation of 5 gates from one side of a flip-flop, an experiment was performed in which 5 gates were being sensed simultaneously, while controlled from a flip-flop being complemented at a 1-mc rate. The gates seemed to operate quite satisfactorily with no undue effect on the flip-flop.

Diode Construction

(N. T. Jones) (UNCLASSIFIED)

A Marconi pulse generator has been located in Bldg. 22 to drive the reverse-recovery measurement of the diodes to be constructed. A jig for the construction of the diodes in the micromanipulator is now being built. For speed and convenience, the jig for construction includes means for static and reverse-recovery measurements as soon as catwhisker and bonding are completed, without handling the diode or movement of the micromanipulator.

Diode Storage

(N. T. Jones) (UNCLASSIFIED)

Storage-spike amplitude and turn-off times are being measured in the large group of diodes recently tested. The storage in the new Hughes 1N116 (20 were tested) is somewhat worse than Sylvania's that they replace. Even at that, however, the storage probably will not affect circuit operation of these diodes. The summary of the diode test results will be tabulated shortly.

~~CONFIDENTIAL~~
UNCLASSIFIED

2.16 Transistors (Continued)

Transistor Storage

(N. T. Jones) (UNCLASSIFIED)

Storage coefficients are being calculated for all the transistors included in the recent series of storage measurements. Several curves of storage are being plotted also.

2.17 Display

(C. Corderman) (CONFIDENTIAL)

The decision has been made to use Typotron tubes as DID indicators in XD-1. This decision was based upon a demonstration of satisfactory performance, initial life-test data, and estimates of future procurement and cost.

The present life test of Typotron tubes will continue and tubes of more recent design (i.e., having an auxiliary collector screen) will be installed as they become available.

(L. B. Martin) (UNCLASSIFIED)

The 4 tubes in the Typotron life test have been running about 800 hours. Tube 291 is being withdrawn from life test because of deterioration of storage surface and replaced by 280. The surface was probably poisoned by a vacuum leak during processing.

The life test has been down for 2 days for modification of the mounts. The range of collector voltage variation has been increased to 300 volts (0 to 300), and the focus voltage can be changed by a toggle switch to accommodate either old or new guns.

Another mount has been finished and two more tubes (319 and 326) will start life test either 27 or 28 March.

As of 28 March, the following tubes will be on life test:

Tube	Approx. hours
268	800
265	820
292	800
280	10
319	10
326	10

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UNCLASSIFIED2.17 Display (Continued)

(J. W. Schallerer, B. M. Gurley) (CONFIDENTIAL)

The use of magnetic cores for storage in the situation-display generator continues to look feasible. Experiments during the last biweekly period have indicated no basic difficulty. Five-hundred metallic cores have been ordered from Magnetics Inc., for the breadboard model of this memory. Eli Anfenger from Best's group has started investigation of a single-cathode core driver.

A block schematic of the category matrix is being prepared. This section should be completed during this biweekly period.

(R. H. Gerhardt) (UNCLASSIFIED)

M-2740, "Proposed Character Positioning Circuit for the XD-1 Display System," has been written and will be issued during the next week.

A memo which describes the digital-expansion-system has been written. This should be issued within the next biweekly period.

Work is continuing on the block diagram of the timing and control for the situation-display generator.

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

During the past 2 weeks, layout and construction of the digital expansion system was begun. This will be incorporated in the Charactron display system for test with MTC. As planned, the system will be in operation 12 April for evaluation.

Prints on the 2^{10} decoder for use in the magnetic deflection of the Charactron have been released to the shop. Construction of this unit has begun, and a tentative commitment of 5 weeks has been made by the shop. This schedule will have to be modified to meet the April 12th date on digital expansion.

Marginal-checking information taken on the 2-cathode- and 3-cathode-stage decoders by A. Grennell indicate that the 3-bit decoder has an equivalent cathode resistor of 171 megs and the 2 cathode stage of 11.5 megs. This verifies the theoretical computations previously made.

Parallel computations have been made with Herb Platt on the magnetic deflection driver for utilization in prescribing the transfer function of the universal amplifier; a similar effort will be made on the line drivers.

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2.17 Display (Continued)

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

The vector-generator decoders will be modulated by a saw-tooth wave rather than a sinusoid as previously planned. The circuitry is being modified, and the engineering involved appears simpler than the previous method.

Prints on a push-pull attenuator differential video probe have been released by Drafting. The attenuator has steps of 1-1, 1-4, 1-12, 1-40, 1-120. The amplifier introduces an attenuation of 0.4. This factor has to be multiplied into the above ratios.

(R. Fallows) (UNCLASSIFIED)

Work in the past 2 weeks has continued to center on laying the groundwork for central display activity. M-2732, "Proposed Program of Activity on XD-1 Display," outlines the scope of work and the expected approach. Information on design and release procedures followed by IBM has been accumulated. Data on established etched-card and plug-gable-unit designs are still incomplete. The schedules have been reworked twice, making additions and revisions; release is expected by 2 April.

(M. Epstein) (CONFIDENTIAL)

A timing diagram for the DID system was drawn up. It seems that there is sufficient time for all equipment to operate when certain minor changes are made.

Changes in the specifications have been proposed and accepted which will save much equipment. Preliminary drawings are being made using this saving. The erasure problem is not yet fully solved but should be solved in the next biweekly period.

(R. Callahan) (UNCLASSIFIED)

The effect of the diode-capacitor gate on the OFF margins have been investigated, and the results are very encouraging.

2.18 Scheduling

(T. R. Parkins) (UNCLASSIFIED)

1. Basic Circuits - R. L. Best

A schedule is being generated which will be correlated with

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2.18 Scheduling (Continued)

(T. R. Parkins) (UNCLASSIFIED) (Continued)

the IBM basic-circuits program. The schedule will be issued during the week of 29 March.

2. XD-1 Installation - H. Wainwright

A biweekly progress report is issued by the Installations Office. Information in this report is available on request to persons who have a genuine concern. An XD-1 installation schedule will be issued 29 March 1954.

3. Central Display Frame - R. S. Fallows, C. L. Corderman

A detailed schedule combining central display frame and display circuits will be issued by 2 April 1954.

4. Systems Test, XD-1 - J. A. O'Brien

A schedule will be issued by 2 April 1954 showing preparations and plans for testing the XD-1 system.

5. MTC - W. Ogden, Jr.

A tentative schedule of MTC activities will be issued by April 2, 1954.

(B. Morriss) (CONFIDENTIAL)

The release and production time schedule developed by IBM has been studied by S. H. Dodd and myself and a rough time schedule developed for design. The manpower requirements necessary to meet this schedule have been considered. The schedule is extremely tight and requires considerable effort during the next few months. A source of the necessary engineering manpower has not been discovered.

The function of the standby computer and the technique for implementing this function when the two computers are operating in parallel was discussed in a series of meetings. An inter-office note to S. H. Dodd describes these meetings. Copies of this note are available from me.

A general checking and maintenance procedure must be developed during the next period because without such a procedure the various possibilities for the equipment common to both computers can not be evaluated.

2.2 Group 63 (Magnetic Materials)

(D. R. Brown) (UNCLASSIFIED)

A 64 x 64 plane is being constructed from cores made here. Preliminary tests, conducted with only the X-wires and Y-wires in place, indicate satisfactory performance.

Improved techniques for the preparation of ferrite for molding are being incorporated in lots of memory cores now being processed. These improved techniques apply to the methods used for adding binder, agglomerating, screening, etc.

Experimental confirmation has been obtained for an area in the MgO.MnO.Fe₂O₃ compositional diagram which theoretically should have good squareness but which previously had yielded only poor squareness.

Memory cores for the second FSQ-7 memory bank have been produced at General Ceramics. An order from IBM is expected in the near future.

Temperature Dependence of the Coercive Force

(J. B. Goodenough) (UNCLASSIFIED)

According to a theory of the coercive force which has been previously worked out (cf. Lincoln TR-40) in this Laboratory, the temperature dependence of the coercive force in a stress-free, polycrystalline material should be

$$H_c(T) = a_1 \sqrt{AK/a} I_s + a_2 I_s$$

where a is the lattice parameter, $A \approx kT/a$ is the so-called exchange parameter, $K = K(T)$ is the anisotropy constant, I_s is the spontaneous magnetization, and a_1, a_2 are temperature-independent, dimensionless parameters of order of magnitude $(1 + P^{2/3})10^{-4}$ and $\sim 0.5 \times 10^{-3}$, respectively. P is the percentage of precipitate present in the material which forms large enough granular inclusions for closure domains to form about them.

Independent measurements of $K(T)$, $I_s(T)$, and $H_c(T)$ are available in the literature for annealed iron and nickel carbonyl. These values were substituted into the above equation. Excellent agreement was obtained between the theoretical and experimental curves when a value $a_2 = 0.33 \times 10^{-3}$ was taken for both metals and $a_1 = 0.7 \times 10^{-4}$ for iron and $a_1 = 0.96 \times 10^{-4}$ and 1.14×10^{-4} for two different specimens of nickel carbonyl.

2.2 Group 63 (Continued)S_w Measurements

(N. Menyuk, P. Fergus) (UNCLASSIFIED)

The switching coefficient of 1/8-mil, 1/4-mil, 1/2-mil, and 1-mil 4-79 mo-Permalloy tapes are being investigated as a function of temperature. To date, measurements have been made at -60 C, 26 C, 77 C, 155 C, and 255 C. The results show a drop in S_{w}° , S_{w}^T and the threshold field H with increasing temperature. This is in accord with the theoretically predicted results.

Vacuum Equipment

(N. Menyuk) (UNCLASSIFIED)

The vacuum equipment designed for low-temperature measurement of magnetic and electrical properties of ferrites has been assembled; preliminary tests indicate satisfactory operation.

Magnetic Anneal of Ferrites

(P. K. Baltzer) (UNCLASSIFIED)

A large series of ferrites from the $MgO.Mn.Fe_2O_3$ triaxial composition diagram have been given a magnetic anneal. The compositions selected were of equal mole percentages of MgO and Fe_2O_3 , but varied in the percentage of MnO . The effects of the anneal are now being measured. Considerable care has been taken in this experiment to permit evaluation of the annealing process, with and without an applied magnetic field.

Investigation of Testing Procedures

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

Twenty-four hundred cores, comprising 1 percent of General Ceramics' production since 1 January 1954, are being selected on the production tester according to the existing specifications. Both the accepted and rejected cores are being evaluated for their B-H loop and pulse responses in order to obtain quantitative data on the selection processes presently used. Results indicate an improvement in characteristics of the accepted cores on all tests. However, it is believed that cores of similar quality can be selected more efficiently.

2.2 Group 63 (Continued)

Life Tests

(J. D. Childress) (UNCLASSIFIED)

The ferrite-memory-core life test has been resumed. The metallic-core life test should be put back into operation sometime during the week of 29 March.

As soon as time is available for testing cores, a life test at elevated temperatures will be initiated.

Core Testing

(E. J. Stevens) (UNCLASSIFIED)

Semiautomatic core tester 2 (new) logic was checked for inherent delays pertaining to accuracy of strobe-time measurement. A delay of approximately 0.06 μ sec was found to exist between scope reading of read-driver output and core output. The sensing preamplifier presented a 0.05 μ sec delay; the voltage calibrator, a 0.01 μ sec delay.

Time was also devoted to checking and becoming familiar with the array tester.

Production of Ferrite Cores

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

Alterations and repairs to equipment have been completed, and the production of memory-core material has been resumed. A 1-kg batch, DCL-2-416, will be ready for pressing on 29 March. Several test firings are to be made before the optimum firing conditions can be determined.

A comparison of memory-core materials processed by RCA, IBM, General Ceramics, and DCL has been made. Results show DCL processed material to be equal or better in flow characteristics.

Firing of D-262 cores has been resumed and data on several of the new systems should be available within a week.

SECTION III - CENTRAL SERVICES

3.1 Purchasing & Stock

(H. B. Morley) (UNCLASSIFIED)

The order has been placed for the Flexowriters for use by Group 61 at Lexington. The order for the 150-kva transformers for Lexington has been placed with Westinghouse. The Colton Press (ceramics) order is being held pending Air Force approval.

The Kardex stock-control system is being further streamlined. Each card is being revised to include the complete ordering description, making it in effect a revolving requisition. This should save buyers' time and help to eliminate errors and needless copying.

<u>Month of March</u>		
<u>Total Orders Received - 396</u>		
Received on time	164	41%
Received 1-7 days overdue	115	29%
Received 8-14 days overdue	44	11%
Received 15-22 days overdue	33	8%
Received 23-30 days overdue	17	4%
Received 1-2 months overdue	14	4%
Received 2-3 months overdue	5	2%
Received 3 or more months overdue	4	1%
	396	100%

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 35 Construction Requisitions totaling 362 items satisfied since 12 March 1954, and there are 33 Construction Requisitions totaling 1408 items under construction by the Group 60 Electronic Shops.

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

3.2 Construction (Continued)

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There are 4 orders now open with vendors totaling 161 items. Deliveries in the past biweekly period have totaled 61 items. Information on specific orders may be obtained from the writer (ext. 3492).

3.3 Lincoln "Construction Practice" Handbook

(C. W. Watt) (UNCLASSIFIED)

Active work has now begun on the preparation of a shop practice manual for all Lincoln technicians. A group of technicians, representative of the various Lincoln divisions, has been enlisted as critics and suppliers of information, and a technical writing organization has been retained to edit and publish the book. It is hoped that this book will be of great help to all people doing construction work. We hope it will be ready by July 1954.

3.33 Standards

(H. W. Hodgdon) (UNCLASSIFIED)

The construction shop recently reported difficulty caused by terminals in nylon-base phenolic loosening after soldering. Tests were made by the Component Test Section which resulted in the conclusion that nylon-base phenolic is impractical for use in terminal strips. For this reason, nylon has been discontinued, and we have returned to use of Grade LE, linen-base phenolic. Search will be continued for a laminate with better electrical characteristics which still retains the advantage of good mechanical properties.

A Lincoln Laboratory standard for molded tubular paper capacitors has been issued and supersedes Division VI standard of the same title. As before, these capacitors are approved for experimental and breadboard use only and should not be used in final equipment. The Lincoln Laboratory standard on hermetically sealed, metal case, tubular paper capacitors is now being printed. When published, it will supersede the Division VI standard.

3.34 Vacuum Tubes

(H. B. Frost) (UNCLASSIFIED)

Studies on the characteristics of aged 7AK7 tubes have been continued. Reasonably good correlation have been found between age and characteristics.

Sylvania has ceased production of all Octal tubes at Emporium. As a consequence, the 7AK7 and 6145 no longer are being made there. Where the 7AK7 will be made in the future is in doubt, as well as the quality of any future production. Our stock of 7AK7 tubes is ample for the present. If production of 7AK7's is not satisfactory in the future, these tubes can be replaced by SR-1782A tubes (with a socket change); this procedure will not be arduous because of the low-failure rate of the 7AK7.

Thesis Research

Tests have been run on RT 410 and RT 411. Both of these tubes show satisfactory, although not exact, agreement with diffusion-theory predictions.

Preliminary tests of RT 426 after life tests show a great deal of nonuniformity of the cathode. Results capable of good interpretation have not yet been obtained.

A series of calculations were made using transient times to determine the diffusion constant of the donor centers. The times seem to scale with the square of coating thickness, as predicted, and the diffusion constant seems to be about 1×10^{-6} at 800 K.

(S. Twicken) (UNCLASSIFIED)

A trip was made to Sylvania at Emporium, Pennsylvania, to check on the status of the SR-1782A tubes and the new pulse-life racks. Sylvania has run into processing problems on both the SR-1782A and the 2420 (octal 7AK7). No tubes have been shipped for several weeks, and probably none will be shipped for another several weeks. Flicker-short rejects have been running less than 0.5%. The incidence of bulbs cracking around the metal shell was reported to Sylvania for action. The problem of broken keys does not seem to be capable of early solution; this trouble has occurred before with the brittle low-loss base.

Sylvania is no longer making 7AK7's and 6145's. Although they have a large inventory of 6145's, they have no 7AK7's on hand. Our reserve of both types is sufficient to carry us for quite a while. At present, Sylvania is not sure where or when these types will be made again. We have received samples of the 6197, an RCA 9-pin miniature with characteristics of the 6145. These tubes will be evaluated in the Whirlwind flip-flop by Dick Best.

3.34 Vacuum Tubes (Continued)

(A. Zacharias) (UNCLASSIFIED)

The analysis of the aging of 7AK7's under WWI conditions has, in my opinion, been completed. This period was devoted to testing a number of 7AK7's which were obtained from the electrostatic-storage-tube output circuits and which had lives of 17,000 hours. A discussion of the results of all the tests will be held with H. B. Frost and S. Twicken, after which a report will be written.

(T. F. Clough) (UNCLASSIFIED)

The floor layout for tube-test facilities at Lexington has been completed and approved. It is now in Drafting.

Samples of the 5965 failures caused by a cracked bulb are now being examined by General Electric. We expect to receive notification soon from the factory as to disposition of these failures.

Two days were spent at the IRE Convention in New York City discussing new developments and some of our special requirements with the tube-company representatives.

3.4 Drafting

Electrical-Symbol Stencils

(A. M. Falcione) (UNCLASSIFIED)

A new electrical-symbol-stencil drawing (D-56226) was developed with the intention of making it possible for draftsmen to produce homogeneous electrical drawings. The stencil produces symbols which are standardized in type as well as in size. It relieves the draftsmen of practically all difficulties in constructing circuit schematics and block schematics, except for general layout and over-all appearance. The stencil also includes the latest standards for use in XD-1 drawings. A limited supply of these stencils is available to individual engineers and will be issued for temporary periods of time upon approval of the group leader concerned.

Electrical-Symbol Stencils for Engineering Sketches

Within the next week, a stencil will be available in the Stockroom for issue to engineers who have need of a stencil for making quick sketches of electrical and block schematics. This stencil is the "Electroneer", a standard stencil quite different from the type designed here.

3.5 Administration and Personnel

Transfers

(J. C. Proctor) (UNCLASSIFIED)

Edward P. Farnsworth has transferred from Division 6 to Division 4 of Lincoln.

Terminated Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Lorraine Bruzzese
Arnold Klayman
Robert Zepperneck

Open Non-Staff Requisitions

1 Electrical Detailer
2 Secretaries for Group 61
1 Secretary for Group 64