

Memorandum M-2835

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DIVISION 6 - LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE 39, MASSACHUSETTS

SUBJECT: BIWEEKLY REPORT FOR MAY 21, 1954

To: Jay W. Forrester

From: Division 6 Staff

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

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

Equipment specifications for the 1954 Cape Cod System are being forwarded for scheduling and action. In addition, work is progressing on more detailed plans for the programming involved.

A plan has been adopted for the use of Raydist data with the Cape Cod System this fall.

Utility programs for XD-1 are now being checked out with the IBM XD-1 simulation program.

A study of the XD-1 system indicates that the time required for the computations involved in 125 final-turn intercepts and 75 interceptors on return-to-base would be 1.73 seconds. If further sophistication is added to the programs, the time would be 2.6 seconds.

Block diagrams are being prepared for the manned-interceptor simulation program.

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1.12 Data Screening

(R.L. Walquist) (CONFIDENTIAL)

Programming responsibilities for Track-While-Scan in the 1954 Cape Cod System have been delegated as follows:

1. Radar-Data Input - W. Clark, E. Wolf, W. Wolf
2. Tracking - D. Bailey, J. Ishihara, H. Seward
3. Monitoring - H. Frachtman, F. Heart, H. Peterson

Clark, Bailey, and Peterson will be in charge of their particular groups and will be responsible for submitting proposals of how the program will function. J. Ishihara will supervise all of the TWS programming and will be responsible for co-ordinating the programming activity of the Data Screening Section with the Weapons Direction Section.

Considerable time has been spent on the operations-area floor plans for FSQ-7. The major difficulty was a lack of sufficient floor space in the Air Surveillance Room. Relocation of some of the corridors and a reduction in the size of the Combat Center allowed an increase of about 40 percent in the size of the Air Surveillance Room. This additional floor space has been used to advantage in adding a few overlooked display consoles and in positioning consoles to give the operating personnel more room and a better arrangement of equipment.

Bert Green (Group 38) has finished his tests on the benefits of angling the display consoles at the Monitor positions. The tests indicate that there is very little difference between the angled-console arrangement and the nonangled arrangement when cross-referencing between two display consoles. However, for the eight Air Force personnel tested, there was a unanimous personal preference for the angled-console arrangement. Because of this preference, the Monitor consoles in the FSQ-7 will be angled at about 30° (the same as in XD-1).

In order to accommodate the extra field of auxiliary memory on the buffer drum and still keep a parity check on the auxiliary-memory fields of this drum, it was necessary to reduce the length of the radar-data-input fields to 14 binary digits each (instead of the normal 16 bits used throughout WWI). Fourteen bits was chosen since it allows the data from the gap-filler radars to be stored in the usual fashion (gap-filler radars use 8 bits for azimuth and 6 bits for range). However, the long-range sets and Mark X will no longer fit into a single 14-bit field. Instead, data for each of these sets will be stored in two fields; azimuth bits will be stored in one field and range bits in the second field. Such an arrangement will allow for the storage of data from 8 gap-filler radars and 4 long-range sets (including Mark X).

It has been proposed that the boundaries of the mapped-out areas should be shown to the operating personnel in the Cape Cod System. Present plans are to install the necessary equipment sometime in July 1954, for one long-range radar with SW-type transmission. This will

1.12 Data Screening (Continued)

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

allow us to determine just how valuable such information is and the conditions under which it is used.

Two reports have been issued by the Data Screening Section this last biweekly period:

1. "Cape Cod Radar Network Calibration" (M-2809, Eric Wolf)
2. "Radar Mapping Supervisor's Manual for the 1953 Cape Cod System" (M-2819, William Wolf).

Two additional reports, a Monitor's Manual and a Radar Mapper's Manual, will be issued during the early part of the next biweekly period.

(D.L. Bailey) (CONFIDENTIAL)

A program which records the time required for each subprogram of the 1953 Cape Cod System has been completed and is available. Data has been taken concerning TWS times for varying amounts of radar data and tracks. This will be available in graph form early next week.

A proposal for the tracking phase of the Data Screening Section in the 1954 Cape Cod System is being worked out by Ishihara, Seward, and myself, and will be completed during the next biweekly period.

(H. Frachtman) (CONFIDENTIAL)

The past two weeks have chiefly been spent in planning for the 1954 System.

Two programs have been checked, and two trivial errors have been found.

(F. Heart) (CONFIDENTIAL)

Consideration is being given to various modifications and additions to track-while-scan techniques. Several joint TWS-Weapons Section meetings have been attended.

Some time was spent assisting in demonstration of the Cape Cod Direction Center.

On 13 and 14 May, I attended a symposium on "Automatic Programming for Digital Computers" sponsored by the Navy Mathematical Computing Advisory Panel (Washington, D.C.).

1.12 Data Screening (Continued)

(J. Ishihara) (CONFIDENTIAL)

Equipment specifications for the Tracking Section of the 1954 Cape Cod System have been completed and forwarded to G. Rawling for processing.

I have been continuing work connected with program planning for the 1954 System.

(J. Levenson) (CONFIDENTIAL)

W. Attridge and I have decided on the equipment, display lines, and actions for the TWS Evaluator's station of the 1954 Cape Cod System. We are also planning the recording program which will be used for post-operation analysis of TWS.

Some time was spent as a guide for a Thursday demonstration and in preparing for that task.

(E.W. Wolf) (CONFIDENTIAL)

The two calibration missions flown during the past biweekly period were used to check the calibration accuracy of the Clinton and Londonderry gap-filler radars. No errors were detected.

Most of the time is being spent planning the radar-data-input section of the 1954 Cape Cod TWS program.

1.13 Tracking and Control

(W. Lone) (CONFIDENTIAL)

The XD-1 octal-to-binary conversion program appears to be operating satisfactorily. Using the IBM simulation program of the XD-1, it will be put through further tests.

A program is being written which will compare both core storage and drum storage, before and after a program has operated, printing out any registers that change. Since changes in orders during program operation are rare, the printout will be as an octal constant. This then eliminates the need for specifying by means of a control card which part of storage contains orders and which part contains constants.

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

Plots have been made of the target vs. radar data. As indicated in an earlier report, a good correspondence was found although with a consistent bias. This is attributed partly to a known error in azimuth calibration at South Truro. Further analysis is being undertaken

1.13 Tracking and Control (Continued)

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

to determine whether there is also a constant range error. An inter-office memo, forthcoming shortly, will discuss the findings in greater detail.

A meeting was held, with Harris, Kirshner, Mathiasen, and Stahl attending, to discuss plans for installation and use of Raydist in connection with Cape Cod flight tests this fall. One plan for installation and co-ordination with Whirlwind was agreed upon and adopted, subject to the limitations imposed by practicality. A report of this meeting is available from Mathiasen.

(H.D. Neumann) (CONFIDENTIAL)

During the first week of this biweekly period the following block diagrams for the manned-interception simulation program were prepared: target simulator, interceptor simulator, command computer.

During the second week a filter-design procedure was programmed with W.I. Wells. This program is now ready and will be tested.

1.14 Weapons Direction

(D.R. Israel) (CONFIDENTIAL)

At the present time we have fully defined and specified the various information regarding equipment for the 1954 Cape Cod System and have forwarded this information to Group 64.

The joint Track-While-Scan/Weapons Direction meetings have continued, and conclusions have been reached on most major items. Still under consideration, but not of pressing urgency, are further definitions of the simulation program, the master-control program, and the recording program. A description of the conclusions reached in the joint meetings is being prepared by Benington and Ishihara.

Preparations for the actual programming of the 1954 System continue with the next goal to be the detailed specification of data storage (TDS, ATDS, FDS, etc.) and program storage. Progress along these lines has been delayed to a considerable extent because of the efforts which have recently been devoted to the preparation of summary reports and to the forthcoming ADC Commander's course.

The 1953 Cape Cod flight-test program continues. Results of saturation tests have been rather discouraging from an aircraft-availability point of view. This situation is now bad enough so that a decision has been made to cancel the saturation part of our program and to concentrate on the final-turn testing.

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1.14 Weapons Direction (Continued)

(J.J. Cahill) (CONFIDENTIAL)

There were no AA-guidance missions this period.

Some time was spent in assisting the ADES people in preparations for taking data required in their evaluation of the Cape Cod System Surveillance System.

A meeting was held on 13 May with C. Grandy, A. Favret, representatives of Groups 22 and 24, and the writer present. Results of operation of the Height Finding Section of the 1953 Cape Cod System were discussed, with mutual benefit. A meeting will be held in the near future to discuss proposals for the 1954 System. The recent meeting was described in detail in an inter-office memo by C. Grandy to D. Israel.

Some time has been spent studying a Burroughs report on the MATABE (Multi-weapon Antiaircraft Target-and-Battery Evaluator) to be used with the AN/GSG-2 system, for possible future application to the CCS.

A SCEL proposal for a test program for AN/GSG-2 has been abstracted for distribution to interested Group 61 members.

Meetings were attended on 10 May at SCEL Field Station No. 4 Ft. Meade, Md., and on 11 May at Evans Laboratory, SCEL, Belmar, N.J., with A. Favret, H. Sherman, Group 24, and members of SCEL, the Army, and Johns Hopkins Operations Research Office. The AN/GSG-2 system and other Project 414 developments were discussed, and some insight was gained into Army requirements for a system similar to AN/GSG-2. The meetings will be described in detail in a memo from A. Favret and the writer to C.R. Wieser when our notes are forwarded from SCEL.

(P.O. Gioffi) (CONFIDENTIAL)

A proposed outline for an AF training program is being studied. The outline was prepared by the Officers of Section C and presented in a Group 61 meeting this period for consideration. This outline is to form the basis for a comprehensive study and training program for all AF personnel assigned to Cape Cod Air Defense Systems operation.

In connection with present Systems operation, intercept data since last summarized in a memo by W. Lemnios is being organized and studied for analysis.

I attended a meeting this period at Bldg. B with representatives of the 6520th Wing and the Lincoln Flight Test Coordinator. A review of Group 61 Systems-test operating procedures and objectives was made. Conclusions reached were accepted as clarification of Group 61's flight-testing objectives.

An original draft of a memorandum is being simplified for distribution primarily to the supporting bases' flight personnel. This memo will, in addition to providing a description of Cape Cod System's structure and operations, serve as a manual of established standard operating procedures for CC System flight testing.

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1.14 Weapons Direction (Continued)

(O.T. Conant) (CONFIDENTIAL)

Group 61's order for the 1954 Cape Cod telephone system has been sent to Group 64, along with the floor plan and layout. Group 64 will schedule the telephone company's work to co-ordinate with the other Direction Center changes. Permanent comm-box labels will be ordered soon.

Consideration has started concerning the optimum division of logical program features for 1954 Cape Cod between the master make-up program (MM) and individual station programs. Situation display, digital display, and the WD Section's blocks of track-data storage will be among the primary responsibilities of the MM program. Work on MM will continue during the programming phase of the 1954 Cape Cod System design.

(B.G. Farley) (CONFIDENTIAL)

In collaboration with W.A. Clark, a paper on simulation of self-organizing systems by digital computer has been submitted to the September Information Theory Symposium.

(A.G. Favret) (CONFIDENTIAL)

On 10 and 11 May 1954 I travelled with J. Cahill to Ft. Meade, Md., to observe AN/GSG-2 (414A) equipment and installations; thence to Evans Signal Laboratory, Belmar, N.J., to discuss Army requirements and latest proposals for future development of AA Fire Direction Systems. Results of this trip will be reported in an inter-office memo.

Height-finder records for March 1954 were checked and summarized. Timing checks of height-finder operations were conducted during flight tests.

(F. Garth. S. Hauser) (CONFIDENTIAL)

Discussions on the 1954 identification program have resulted in the writing of a first draft of a memo on the results of these discussions of the principles which are expected to guide the planning of identification programs of the 1954 Cape Cod and the XD-1 Systems.

The details of the programming changes to be effected in the 1954 identification program are being studied. The new features to be incorporated in the 1954 program are expected to be added without significant additional computer storage.

(I.B. Hazel) (CONFIDENTIAL)

Most of the time has been spent familiarizing myself with Cape Cod 1953 and Cape Cod 1954. I plan to assist H. Benington in assigning matrix pairs and si addresses for the Cape Cod 1954 System.

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1.14 Weapons Direction (Continued)

(S.C. Knapp) (CONFIDENTIAL)

Several meetings have been attended to discuss plans for the 1954 Cape Cod System; in particular, I have been devoting my time to studying problems connected with the simulation, recording, and master-control programs. A different scheme for presenting simulated radar data to the TWS program has been suggested by members of the TWS Section; this method would involve computing the data via a non-real-time program, storing it on magnetic tape, and reading it in scan by scan during operation of the System. In addition to studying this method to determine whether any savings in time or storage would be gained, I have written an inter-office memo describing a system of assigning simulation reference numbers to tracks being carried by TWS. This problem sometimes becomes involved, for instance in the case of crossing tracks, radar noise, etc. It is very important in some aspects of System operation that all simulated tracks be identified as such.

A proposal that the master-control program be so simplified that it can fit into test storage has been made by several members of the Group. I have been considering the proposal from the standpoint of the actual programming details; as soon as some concrete ideas are developed on it, an inter-office memo describing the program will be issued for suggestions and criticisms from Group members.

(W.Z. Lemnios) (CONFIDENTIAL)

The functions which approximate the climbing characteristics of interceptors have been recalculated to fit the data more precisely. These functions have been graphed and will be issued in a memo.

An analysis has been made of the time required for the intercept computations in the XD-1 System. It was concluded that for 125 interceptors on final-turn intercepts and 75 interceptors on collision-course return-to-base, all conducted simultaneously, the required time would be 1.73 seconds if no more sophistication were required of the program. With more sophistication and the same prevailing conditions, the time could be as much as 2.60 seconds.

(L. Murray) (CONFIDENTIAL)

The testing of the Collins G/A D/L has been giving very satisfactory results. This program will be discontinued within the coming month. At present there are five operational G/A D/L receivers installed in F-89's. This number should be increased to seven by the end of this biweekly period.

The results of the saturation test of 29 April 1954 have been published. No saturation tests were conducted during the last two weeks because of weather cancellations.

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1.14 Weapons Direction (Continued)

(J. Nolan) (CONFIDENTIAL)

The past biweekly period has been spent on final-turn flight tests. The results of two missions held on 11 and 13 May have been summarized in an inter-office memo.

(F.A. Webster) (CONFIDENTIAL)

A program to sort, index, and store recorded interception data is almost complete. This is to be combined with a program that will display the data in several forms suitable for photographic recording of important quantities and relations.

(C.A. Zraket) (CONFIDENTIAL)

A summary of the operations in the Direction Center is given in the following section. Because of prevailing weather conditions and aircraft unavailability, test activity was restricted during the past biweekly period. Cancellations during the past month and a half because of weather conditions and aircraft unavailability make the completion of the flight-test program by 15 June doubtful. Tests have, therefore, been scheduled for three days per week instead of two for the next month in order that the flight-test program may be completed before the system is shut down. The usual amount of visitors to the Direction Center were accommodated during the last period.

M-2611-1, "Experimental Operating Procedures for Interceptors in the 1953 Cape Cod System" (Attridge, Zraket) was issued last week. This supplement defines the procedures to be used for the scrambling of up to five separate interceptor flights simultaneously from an airbase.

In the 1954 Cape Cod System the series of meetings between the Track-While-Scan and Weapons Direction Sections was continued during this period. The following items were worked on and discussed: recording of data, master-control program, interceptor-tracking procedures, command tracking, tracking-merit digit, displays, and track numbering. Results will be summarized in a memo by Benington and Ishihara.

Indicator lights, light guns, and display-line requirements for the WD Section have been specified. Work on data storage will begin during the next period.

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UNCLASSIFIED1.15 Direction Center Operations

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

Following is a brief summary of the Cape Cod Direction Center operations for the past biweekly period. Details on any of the Systems tests are available from P. Cioffi. Results of radar calibration and automatic ground/air data link are available from E. Wolf and L. Murray, respectively.

11 May 1954 (Tuesday) - A systems-evaluation test to study final-turn-intercept accuracy was run. Interceptor (with AI) availability limited the number of attempted intercepts to 3. Of these, 2 were completed (one AI, are visual). Excessive mapped-out clutter in the Boston-Weymouth-Provincetown area and the late appearance of the ground Mark X equipment (Lex.) for use restricted Systems operation.

However, TWS action was effective in making a good test.

12 May 1954 (Wednesday) - Two F89's scheduled for D/L testing were cancelled - Barta ground equipment inoperative. A B-29 scheduled for radar calibration was cancelled because of weather.

13 May 1954 (Thursday) - A scheduled systems-evaluation test with 5 target aircraft was modified to be run for final-turn-intercept studies because of an insufficient interceptor availability. Actual operational results were unacceptable for intercept-accuracy evaluation purposes. Lexington Mark X equipment was inoperative. Three attempted intercepts were completed.

14 May 1954 (Friday) - One of two scheduled F89's was flown for D/L testing (the other not available). A B29 scheduled for radar calibration was not run (cancelled by Group 61).

18 May 1954 (Tuesday) - Systems-evaluation test for final-turn-intercept accuracy studies was cancelled. F89's were grounded by the AF at Bedford pending an investigation of all F89's after an accident involving one.

19 May 1954 (Wednesday) - One of two F89's scheduled for D/L testing was flown. The other was not available.

One C-47 was flown for radar calibration.

20 May 1954 (Thursday) - A scheduled live test for formal demonstration of Direction Center operation was cancelled because of weather. The test was run with simulated data on the radar background for the demonstration.

21 May (Friday) - D/L and radar-calibration aircraft scheduled were cancelled because of weather.

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(D. R. Israel) (CONFIDENTIAL)

The large part of the first week of this biweekly period was spent in preparation of a detailed report outlining the methods and costs for Combat Center displays as presented in the ADC Memo, "Status and Tactical Situation Display in the Transition System," presented to the Lincoln Laboratory at a meeting on 5 May. Following some modification and extension to this report, it is to be issued as an M-note in the near future.

On Tuesday and Wednesday, 18 and 19 May, the problems of the Combat Center displays were discussed at a large meeting attended by representatives from the Headquarters ADC, ADES, and the Lincoln Laboratory. The general results of this meeting indicate that the displays for personnel in the Combat Center will be prepared and presented by a separate computer, one which is not serving a Direction Center.

On Thursday, 20 May, the floor plans for the operational areas of the FSQ-7 were discussed in an extension of the joint meeting described above. No major changes in the layouts of individual rooms were made, although the orientation of the rooms was changed, and it was possible to define in more detail the equipment in the Subsector Command Post. The better definition of the Subsector Command Post will now cause several minor changes in the XD-1 floor plans as given in E-58233.

The allocation of intervention switches as outlined in M-2720-1, "Equipment Estimates and Allocation for XD-1 Operating Procedures," is being reviewed again with the hope of eliminating some switches or specifying the exact nature of switches previously labelled "unspecified."

Preparations have been made for the Symposium for ADC Advisory Committee for the Transition System to be held next week. The burden of preparing this program is being assumed by Group 61.

(I.B. Hazel) (CONFIDENTIAL)

Display programs have been checked out on the MTC computer (1) using the Charactron tube to simulate an XD-1 situation display, and (2) using the Typotron to simulate an XD-1 DID display. An inter-office memo has been written describing purpose and operational procedures of programs.

(J.H. Newitt) (CONFIDENTIAL)

Console design is progressing well, and we hope to be able to issue a complete console-design specification shortly for general approval and criticism. This specification will be quite detailed. It will indicate proposed materials, physical configuration (with drawings), facilities, special features, maintenance provisions, and other pertinent details.

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UNCLASSIFIED1.16 AN/FSQ-7 (XD-1) Support (Continued)

(J. H. Newitt) (CONFIDENTIAL) (Continued)

The industrial stylists have contributed considerably to the attractiveness of the console without sacrificing technical or operational considerations. Most of the serious problems have been solved, although a number of unresolved considerations remain. Typical of the latter are:

1. The elimination of a number of PIU's presents the possibility of sloping the rear of the console and thereby reducing its bulky appearance. Various complications may prevent this idea from reaching fruition, however, but the possibility is being studied.
2. The means for gaining air-conditioning and cable access to the bottom of the consoles is still undecided. We have entertained a number of schemes for this, and, while several were suitable for XD-1, most were not suitable for the production buildings. This situation has been changing almost weekly as opinions of ADES, Western Electric, and Lincoln progress thru various stages of decision with regard to the production building. Once these decisions are firm, we can design our console base to meet the requirements.
3. We have set aside a panel area (approximately 4" x 17") on our consoles for the telephone facility, and we are awaiting a decision from BTL - ADES - Lincoln regarding its adequacy for the intended operation. If this turns out to be an inadequate provision, considerable redesign of the console might be involved. We feel, however, that this provision should be more than adequate for the intended job as we understand it.
4. IBM is considering the use of telephone-type switch mechanism for their side-frame modules. The advantage of such a move would be to reduce the size of the sideframes (and the effective width of the console position) and make the individual switch rows more accessible to the operator (rows will stack closer). An incidental advantage is that the telephone switch mechanisms are well engineered and time-proven, whereas the IBM design has not reached the production stage. This decision can affect the over-all dimensions of operating positions. If acceptable, this will result in a decrease in presently quoted over-all dimensions.
5. Room lighting vs. console design is being given some study. Francis Associates has asked to have the scope faces tilted an added 10° to the vertical to reduce the glare from the light-colored egg-crate ceiling which they intend to use. This would involve a considerable redesign of the front panel (to maintain present console height), and I feel that there are many objections to this proposal. The angle of the console front was carefully worked out and decided upon months ago, and I do not feel

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that the frequent changes of thinking on room lighting that have taken place and the admitted uncertainties of the expected results should dictate a redesign of the console at this time. Further, by making the console face more vertical, the glare from room facilities (contrast of objects and actual light sources) will become increasingly apparent. It would seem, therefore, that following the above suggestion would amount to simply changing the source of the scope glare at the expense of console redesign. The use of a flat implosion cover will reduce glare considerably and since this is a relatively simple change it will probably be included unless there are practical objections (such as light-gun operation or operator inconvenience). If a curved implosion cover is maintained, ceiling glare cannot be avoided even if the scope face is tilted 10° forward to the vertical.

Plans have been made and meetings have been scheduled to resolve these problems within the next few weeks.

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1.2 Group 64

(S. H. Dodd) (UNCLASSIFIED)

During the past biweekly period computer reliability was very good. The usable percentage of assigned operation time was 99 according to estimates by computer operators. This is the highest figure attained during any biweekly period since the beginning of our records in March 1951.

Work by the Systems Section is currently confined to routine maintenance and improvement in marginal-checking and trouble-shooting techniques. The terminal-equipment section is in the midst of several changes and additions, including the installation of a second photo-electric tape reader, new MITE units and video mappers, and two additional groups of auxiliary storage on the buffer drum.

1.21 WWI System Operation

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

Of 1834 Allied plug-in relays which were recently checked, 115 were found to have poorly soldered connections. All relays of this type in the system have now been inspected.

Two of the new-type sensing amplifiers are now operating in core memory.

The second magnetic-tape printout system should be ready for use about 1 June. It would be appreciated if any tapes which produce faulty printouts or punchouts were saved for examination by the Systems Group.

(D. A. Morrison) (UNCLASSIFIED)

The WWI voltage-interlock panel has been modified to ensure that voltage-interlock control (relay K6) does not operate if an attempt is made to cycle on power when voltage is on any of the positive voltage busses.

An approved schematic is in work in the Drafting Department.

Work is continuing on the WWI computer-reliability study.

1.21 WWI System Operation (Continued)

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

A recent rash of carriage-return troubles with the delayed printer seems to have been cured by increasing the pickup time of one relay in the magnetic-tape printout control register.

A complaint that the delayed-punchout system intermittently dropped #3 code hole continued even after the punch was changed. This fact, plus a close examination of the original punch and defective tapes, convinces us that the trouble was not caused by the punch itself. Similar programs have since been recorded on magnetic tape and punched out properly.

Fairchild Camera

(L. H. Norcott) (UNCLASSIFIED)

Contacts have been installed on the footage indicators of four camera magazines. These contacts will be used with a proposed system which will give an alarm when the supply of film is running low.

1.22 Terminal Equipment

Magnetic Drums

(H. L. Ziegler) (UNCLASSIFIED)

Changeover from relay switching to electronic switching of heads for writing in the auxiliary drum is proceeding slowly and without incident. Work is about on schedule, and the three digits converted so far are performing satisfactorily.

An effort is being made to "streamline" the testing and maintenance of drum chassis. A test setup both larger and more flexible is being planned. To aid in this work, standardization of pin assignments on the chassis is being investigated. Changes required to effect this standardization do not seem excessive for the simplification of test setups obtained.

(L. D. Healy) (UNCLASSIFIED)

The auxiliary-drum checking procedure was tested and has been modified accordingly.

Work was begun on a similar checking procedure for the buffer drum.

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1.22 Terminal Equipment (Continued)MITE

(A. M. Werlin) (UNCLASSIFIED)

The installation of the new MITE and mapper control is continuing in K-row, Room 156. Plans are under way to revise the marginal-checking lines for all the MITE's. The switch panel used for switching special MITE 3 to either IOR or the buffer drum has been removed so that MITE 3 data must be stored on the drum before being processed by the computer. All superfluous plug-in units, cables, and wiring associated with the switch are also being removed.

All drawings pertaining to MITE with FF buffer storage are being obsoleted.

Ferranti PETR

(F. E. Irish) (UNCLASSIFIED)

The newly installed production model of the Ferranti PETR amplifier now appears to be operating satisfactorily. It gave some trouble for a few days when one of the information-channel amplifiers started putting out spurious signals. They were traced to what appeared to be a microphonic 5695 dual triode used in that particular channel amplifier.

The final decision on how the reader will be mounted on the console table has not been reached. Operators, in general, seem to be dissatisfied with the present mounting. Any opinions on how it should be mounted would be appreciated.

Data Inputs

(H. J. Kirshner) (CONFIDENTIAL)

All items having to do with the new video mappers are in the hands of Production Control. These items are either under construction or will be shortly.

Considerable time was spent discussing XD-1 telephone circuits and ground-air radio circuits with members of ADES and others.

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1.22 Terminal Equipment (Continued)

Data Link

(R. B. Paddock) (CONFIDENTIAL)

The coder was inoperative during the early part of this period; failure was caused by a marginal relay and an inoperative transistor in the index memory. A modification has been started which should correct the relay trouble. Since the failure, the data link has operated very successfully.

Pathfinder

(N. N. Alperin) (CONFIDENTIAL)

The Pathfinder mod manual was finished. Work has been started on all phases of the mod by the construction shop. The first complete unit will be delivered for test 26 May.

The monitor-selection-switch panel and remote-scan-synch panel were designed and sent to drafting.

Azimuth-Drive Units

(A. V. Shortell) (CONFIDENTIAL)

Drafting on the azimuth-drive amplifiers is well under way. The layout of these drive amplifiers and associated plug-in units in racks K-14 and K-15, Room 156, has been planned, and wiring of the FIUMP's is in progress.

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 7 - 20 May 1954:

Number of assigned hours	162
Usable percentage of assigned time	99
Usable percentage of assigned time since March 1951	87
Usable percentage of assigned time since September 1953	92
Number of transient errors	1
Number of steady-state errors	4
Number of intermittent errors	3

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1.23 Records of Operation (Continued)

Component Failures in WWI

(L. O. Leighton) (UNCLASSIFIED)

The following failures of electrical components have been reported since 7 May 1954:

<u>Components</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Tubes</u>			
5963	1	1000 - 2000	Low I_b
	3	2000 - 3000	2 - low I_b ; 1 short
	1	8000 - 9000	Low I_b
6SN7	1	0 - 1000	Short
3E29	1	24000 - 25000	Short
6AU6	3	0 - 1000	2 short; 1 leakage
	1	5000 - 6000	Short
6AN5	1	0 - 1000	Leakage
	1	3000 - 4000	Leakage
5855GL	1	3000 - 4000	High arc drop
7AK7	3	2000 - 3000	1 low I_b ; 2 leakage
6145	1	1000 - 2000	Leakage
	1	2000 - 3000	Short
8008	1	4000 - 5000	High arc drop
5687	1	1000 - 2000	Short
	1	2000 - 3000	High cutoff
2D21	1	0 - 1000	High firing point
	1	7000 - 8000	High firing point
6AL5	1	7000 - 8000	Low I_b
6136	1	0 - 1000	Gone to air
7AD7	2	24000 - 25000	2 short

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1.23 Records of Operation (Continued)

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

<u>Component</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reasons for Failure</u>
<u>Capacitor</u>			
0.02 μ f ceramic disc	1	0	Shorted
<u>Circuit Breaker</u>			
Heineman 0411H 5-amp 125-v d-c	1	0	Short
<u>Potentiometer</u>			
25-watt 1000-ohm w/w \pm 10%	1	0	Open
<u>Rectifier</u>			
10-ma selenium	1	438	Short
<u>Relay</u>			
Clare relay No. 11 143-20	1	1823	Stack short
<u>Switch</u>			
DFDT	1	0	Intermittent

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1.24 Power

D-C Power Supplies

(S. T. Coffin) (UNCLASSIFIED)

A 15-amp, 300-v thyatron d-c power supply is being redesigned to replace the present WWI 10-amp -300-v-series tube supply in order to provide greater capacity.

General

(D. M. Fisher) (UNCLASSIFIED)

The -200-v auxiliary supply, discussed in the last report, has been installed in the new 10-v, 10-amp power supply with satisfactory results. The output ripple of the 10-v supply has been reduced from 300 millivolts to 38 millivolts.

Tests are continuing on this supply to determine whether any drifting is present.

1.25 AN/FSQ-7

Duplex Central

(B. E. Morriss) (CONFIDENTIAL)

During this period IM-91, "Draft of Proposal for AN/FSQ-7 Duplex Central," has been issued. This draft presents the results of a joint effort between planning groups at IBM and Lincoln during the past two months. It has been issued as a first draft for comments and as a starting point for more definite specifications. It is hoped that as many people as possible will find time to read it and submit comments before the second draft is prepared. Actual writing of the second draft will begin in about three weeks.

Some time has been spent working on a general procedure for Lincoln concurrence and approval for the duplex and on dividing the work to be done into general areas of responsibility. The IBM-Lincoln relationship is expected to remain essentially the same as that established for work on XD-1. Towards this end I have joined the Lincoln Systems Office, and a system of briefs has been established and keyed to the XD-1 briefs.

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1.25 AN/FSQ-7 (Continued)Duplex Central

(B. E. Morriss) (CONFIDENTIAL) (Continued)

There are now five people working full time in the AN/FSQ-7 production-unit section. Insofar as Lincoln has responsibility they are working on the following areas. Hawley Rising has been setting up the duplex system of briefs and will work on general concurrence and approval. Dick Jeffrey is working in the area of inputs and outputs for the duplex and will work with Group 61 on their needs. Syl Desjardins is working on checking and maintenance equipment and procedures and will also work on co-ordination with the Transition Planning and Control Office. Chan Watt is working on general engineering practices and the effects of the duplex switching requirements. and with the production-engineering division of Project High. Although working only part time on the duplex, Joe Gano will carry the work on power requirements. It is expected that these areas will change considerably as the work to be done is more clearly defined.

Duplex Planning

(H. K. Rising) CONFIDENTIAL)

A proposal is being written describing a way to handle the sign-off and approval of the elements of the AN/FSQ-7 duplex central. In general, the approval procedure will be similar to that used for the XD-1 equipment. A system of briefs is being set up which will be keyed to the XD-1 briefs for similar pieces of equipment.

Duplex-Central Inputs, Outputs, and Displays

(R. C. Jeffrey) (CONFIDENTIAL)

During the next several biweekly periods I will be working on duplex central:

- Display,
- Outputs,
- Miscellaneous radar inputs,
- Cross-telling,
- Differences in equipment for different centrals.

I will try to contact everyone interested in these areas, especially in Group 61.

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1.25 AN/FSQ-7 (Continued)

AN/FSQ-7 Schedules

(T. R. Parkins) (Unclassified)

During this period, Project High progress reports and posted schedules were distributed to persons concerned.

A conference at High Street was held to negotiate improvements in the monthly progress reports.

Schedules Due but not Issued:

IBM	Central Computer Maintenance Console Test Memory Card Machines
	Basic Circuits
MIT	Basic Circuits

Power

(P. Morrill) (Unclassified)

Electrical-design drawings for Building F Contract No. 1 are 90 per cent complete. Electrical Contract No. 1 specification is nearly complete. Specifications for power equipment for the duplex unit have been started.

The prime-power-supply report on production units has been finished.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

During the week of 17 May 1954, C. L. Corderman, J. S. Palermo, and I visited Convair and found that they had made excellent progress with the 19-inch Charactron during the past five weeks. They had three tubes ready for shipment to IBM, as required by their contract. Two tubes will be shipped to Endicott and one to MIT. We examined these tubes in Convair's test rig and found that the registration was excellent. Convair has scheduled work during the next four weeks on their phosphor-settling and aluminizing techniques, improving the electron optics, deflection yoke, convergence coil, and developing a production-type matrix and gun assembly. The latest report from Corning is that the new 19-inch Charactron bulbs will be ready for shipment the week of 14 June.

We also visited Hughes Aircraft and found that they were making satisfactory progress with the Typotron. Three tubes have gone over 2000 hours on the life-test rack. Corderman brought three Typotrons from the west coast. One marginal Typotron was shipped by a common carrier to test the shipping crate; it arrived safely. Hughes Aircraft is making satisfactory progress with their production building and facilities which they expect to occupy in June.

At Willys-Kaiser in Berkeley, California, Ross Aiken demonstrated a 21-inch cathode-ray tube which was only 3 inches thick. The gun was mounted on the side of the face panel instead of in back of the face panel. This type of construction has some interesting possibilities.

A one-day trip was made to Tung-Sol to discuss an improvement program on the 5998. Satisfactory progress is being made in this direction.

Five members of the Group made a one-day trip to IBM to discuss methods of keeping tube records for MTC and XD-1.

Group 65 continued the work on phosphor, aluminizing processes, and nonreflective coatings.

1.33 Research and Development

(J. S. Palermo) (UNCLASSIFIED)

During the past few weeks we have studied the cascade method of preparation of P7 screens. We are presently adopting this method in our Chem Department.

1.33 Research and Development (Continued)

(J. S. Palermo) (UNCLASSIFIED) (Continued)

Our work on the masking techniques for aluminized tubes indicates the desirability of a mechanical mask. Toward this end a design for this type of masking will be started immediately.

Our work on helical dag continues. We are presently engaged in preparing a series of tubes with a dag line 0.020-0.030 wide and a similar width in the spacing of successive lines.

(P. C. Tandy) (UNCLASSIFIED)

Since the last Biweekly, five helical-dag tubes have been life tested. These tubes were rejected after from $4\frac{1}{2}$ to $11\frac{3}{4}$ hours of operation; three tubes were rejected for poor cathodes, while the other two were rejected for unusable light output. These screens were considered satisfactory at the beginning of the test. A tube now on life shows no sign of deterioration after $4\frac{1}{2}$ hours of operation. The two tubes mentioned in the last report which developed voltage breakdown with less than 2 hours of life test were found to have cracked at the base.

Work on life-test equipment for these tubes is progressing. A voltage-distribution panel has been completed, and a voltage-control panel is nearly completed. Individual tube voltage-control boxes have been started; when they are completed, two or three tubes at a time may be life tested. Further expansion of life-test facilities depends upon delivery of transformers for the necessary power supplies.

(H. B. Frost) (UNCLASSIFIED)

On 11 May 1954, a meeting was held at IBM on the tube records for MTC and XD-1. The records system will be tried on MTC in order to test the flow of data. The tubes in MTC will be Z-2177's in an operational life test. Results of the conference showed that Sanders at IBM had provided a system which, with minor modifications, is flexible enough to handle the tube records and provide data for life analyses. A. Zacharias is writing up the results of this meeting.

Study has continued on the lot of Z-2177 tubes using A31 cathode alloy. Although these tubes have low plate currents in the usual Class A operation region, they appear to have good cathodes. Pulse tests show them to be quite similar to other Z-2177 tubes and 5965's. So far, the reason for the low plate currents remains something of an enigma.

A method for marginal checking of thyatron circuits has been proposed by one of the circuit engineers at IBM, who was formerly

1.33 Research and Development (Continued)

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

associated with the High Street Tube Group. This method, which requires individual measurements on the circuits, will tell old tubes from new tubes; however, both kinds of tubes appear to work well in the circuits (at least as far as present tests go).

Thesis Research

I have written a rather complete outline of my thesis. This outline has been discussed in part with Professor Thomas; it is, in general, satisfactory.

A lot of 5687 tubes which have been life tested have been analyzed. The cutoff sections of these tubes show considerable droop. They also show much lower emission than the "on" sections, as well as more sensitivity of emission to direct current.

(T. F. Clough) (UNCLASSIFIED)

A meeting of the MIT Tube Group was held at IBM-High Street with F. A. Ordemann and J. J. Sanders to discuss the proposed record-handling procedure for the XD-1 tube complement. The data handling of the Z-2177's will be co-ordinated with the procedure proposed for the XD-1.

Dissection and analysis of the mount structure confirms that the K1211 photomultiplier tube requires a more rugged structure and a much more careful mount assembly in order to minimize the tendency of this tube to have short-circuited elements.

We have received a new shipment of 6145's, and sample quantities are now being preburned in preparation for the quality check of the entire lot.

(S. Twicken) (UNCLASSIFIED)

I made a trip to Tung-Sol with P. Youtz and members of the Project High Tube Group at IBM in connection with the improvement program on the 5998. The discussion was concerned primarily with design changes and facilities to be provided. Tung-Sol will resubmit another proposal in more financial detail, after which the program should get under way speedily.

The FSQ-7 circuit pulse generator, Model C, has been bread-boarded to look into the suggested method of marginal checking the 2D21 thyratron, viz, the voltage on the shield which is connected to cathode

1.33 Research and Development (Continued)

(S. Twicken) (UNCLASSIFIED) (Continued)

through a 2K resistor. New tubes show a negative voltage pulse, while an old tube with high firing voltage shows a positive voltage pulse. The circuit, however, works with both tubes. Further investigation will have to be made.

The 5965 life test has reached 4000 hours. There is no appreciable interface impedance on either cutoff or conducting sides, but four of the five conducting cathodes show a 10-15 per cent droop in plate current at zero-bias on transition from pulsed to d-c operation. This type of droop has been observed in other types and is currently under thesis investigation by Frost.

Plate-characteristic curves have been taken on the 6072 at low plate voltages (less than 60 volts) for use in very low-noise, low-level circuits. These curves are available on SA-40578.

(A. Zacharias) (UNCLASSIFIED)

On 11 May 1954, I made a trip to IBM, where the procedure for record keeping and tube handling for the Z-2177's to be installed in MTC was completed. An M-note has been written describing the procedure in detail.

During the remainder of the period, information on the Z-2177's with cathaloy cathode sleeves was obtained by pulse testing. No analysis has yet been made of the data. These Z-2177's have been put back on life test.

Currently, a report on the findings of the life characteristics of the 7AK7's from the multiplier is being written.

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SECTION II - AN/FSQ-7

2.1 Group 62

2.11 Systems

SDV Demodulator

(I. Aronson) (CONFIDENTIAL)

With the exception of the slicers, the circuit work is almost completed for this device. Marginal-checking lines, excursions, and power-supply information has been obtained and forwarded to the parties concerned. Component approval is well under way.

Digital-Data Receiver and Transmitter

(I. Aronson) (CONFIDENTIAL)

Some preliminary thought has been given to physical design of the receiver. A pair of 9-tube pluggable units seems to be the most convenient packaging arrangement.

A breadboard of the transmitter will be set up during the next period in order to begin proving out the circuit.

Thesis

(W. Klein) (UNCLASSIFIED)

A study of an M.S. thesis, "A Method for Design of Sequential Switching Circuits" by E. J. McCluskey, Jr., has given me some ideas which have proved of some use in my thesis work.

XD-1 Logic

(R. Mayer) (UNCLASSIFIED)

The "XD-1 Design Notes" frame drawings are progressing fairly rapidly. The program-element drawing is finished. The selection-frame drawing is finished but is being redrawn in a more simplified form. The arithmetic-frames drawing is done but being checked. The instruction-frame drawings are nearing completion. IBM drawings are available for the drum frame, but work on the "XD-1 Design Notes, Drum Frame" drawing has not been started.

2.12 Magnetic-Core Memories

MTC Memory

(W. Canty) (UNCLASSIFIED)

Five sensing amplifiers, Mod. IV, MTC, have been delivered from the shop and were installed. These amplifiers appear to be working satisfactorily. Since MTC is shutting down for a few months, further evaluation of these units will have to be postponed.

A program has been written and successfully run to check the maximum base-line shift at the suppressor grid of the Mod. II sense-amplifier gate tube. The maximum shift at this point is approximately 8 volts.

MTC 64 x 64 Memory

(J. Mitchell) (UNCLASSIFIED)

A test was run on the MTC memory in order to determine if a core output would deteriorate because of heating or other reasons when pulsed at high prf rates (166 kc). This would be the case if the computer should sit on one particular core-memory address. I was not able to observe any change in the core output after it had been pulsed for periods of minutes.

Automatic "Shmoo" Plotter

(J. Mitchell) (UNCLASSIFIED)

The design of the main "shmoo" plotter decoder has been completed, and the breadboard has been constructed. Debugging of the unit will be delayed until the necessary test equipment is assembled. The assembly of the standard test equipment needed for this unit is under way and should be completed in the next few weeks.

Memory Test Setup VI

(E. A. Guditz) (UNCLASSIFIED)

The automatic address-skipping equipment has been installed and checked out. It works very well and should be of considerable help in quickly locating poor cores in memory planes.

A frame for a 128 x 128 experimental plane has been constructed, and wiring will soon be started. The plane should be finished in about a month.

2.12 Magnetic-Core Memories (Continued)

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

The construction of a 128 x 128 prototype plane frame which could be used in a complete memory is under way. Results to date appear very satisfactory.

An M-note is being prepared which describes the results of initial tests on the 64 x 64 memory plane which contains DCL (Group 63) cores.

Single-Coordinate Read

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

The past biweekly period was spent finishing a thesis on the one-dimensional-read system for a magnetic-core memory.

64-Position Core Switch

(A. D. Hughes) (UNCLASSIFIED)

The physical wiring for a 4-position plug-in unit was designed. Sixteen identical units will comprise the 64-position switch. One plug-in unit was wired and is being tested.

External Bit Selection

(S. Bradspies) (UNCLASSIFIED)

The memory unit has operated erratically for two possible reasons. In the first place, the logic that I have been using is very poor, and core-driver outputs which should occur simultaneously in time are separated by as much as 0.2 microsecond. Art Hughes has suggested a logical scheme which could operate far more satisfactorily. I shall try it as soon as it is completely thought through.

Another difficulty may be that the switch cores in the memory unit are being switched before the core-driver currents have reached their final values. All core drivers were modified in accordance with M-2755, so that they can rise faster.

2.13 Vacuum-Tube Circuits

Sense Amplifier

(C. A. Laspina) (UNCLASSIFIED)

Six units of the new sense-amplifier design, which incorporates diodes and transformers, have been built and are now used in MTC for evaluation.

More complete marginal-check data on the XD-1 sense amplifier is being taken.

Magnetic-Core Memory Driver

(D. Shansky) (UNCLASSIFIED)

A note detailing a proposed new memory-driver selection system is being prepared.

Magnetic-Core-Matrix Switch Driver

(D. Shansky) (UNCLASSIFIED)

The parasitic oscillations in this driver have been eliminated.

Universal Amplifier

(H. J. Platt) (UNCLASSIFIED)

The universal amplifier has been dropped as of last week. The main reason is that in dropping this circuit there can be effected a saving of 3000 tubes. A full discussion of this problem is contained in M-2826.

Some measurements were taken on the Typotron in MTC in order to determine the d-c impedance presented by the deflection plates. With 300 volts between the deflection plates, the current drawn was as much as 0.10 milliamperes for Typotron No. 349. It is hoped that these current figures will be the same or less for all Typotrons.

Phone-Line Demodulator

(E. B. Glover) (UNCLASSIFIED)

All preliminary checks for marginal-checking voltage excursions and failure points have been completed. It has been found that a redesign

2.13 Vacuum-Tube Circuits (Continued)

(E. B. Glover) (UNCLASSIFIED) (Continued)

of the slicer circuits will be necessary since their output is a direct function of the triggering level. This is especially serious in the data slicer since at the triggering level for data the output is below the minimum allowable.

Present efforts are toward replacing all nonstandard components with standard ones and rechecking marginal data.

Co-ax D-C Isolating Box

(E. Anfenger) (UNCLASSIFIED)

Measurements are being made for the coupling box between a pulse amplifier and a gate tube which isolates the d-c level of the two cables.

2.14 Memory Test Computer

General

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

This was the last two weeks of operation for MTC in the Whittemore Building. Beginning Monday, 24 May, dismantling of the computer will proceed, with actual moving to Building B scheduled for 7 June. Preparation of the new site is under way, including installation of cooling ducts; this appears to be on schedule.

The new accumulator using Mod. II flip-flops was installed a week ago and looks generally good; there is, however, some cross-talk and noise which will be reduced before the computer goes back on the air again.

If all goes according to schedule, operation should be resumed late in July.

Magnetic Drum

(H. Anderson) (UNCLASSIFIED)

The drum system with its final hardware was tested in a preliminary fashion. Several minor wiring errors were found and will be corrected during the moving period. The present timing track on the drum is closed.

2.14 Memory Test Computer (Continued)Accumulator

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

The new accumulator for MTC has been tested and installed. Some simple programs were run and margins taken. The problem of finding optimum loads for gate circuits has been worked on during the time the accumulator has been in MTC.

MTC Power Supplies

(D. M. Fisher) (UNCLASSIFIED)

MTC is presently obtaining its -300-v d-c source by floating a 150-v supply beneath the -150-v supply. In order to increase the -150-v capacity, a separate 400-v rectifier and 300-v regulator will be installed.

This installation will be completed when the computer is moved to Lexington.

Power-Supply Control

(A. Chopourian) (UNCLASSIFIED)

A redesign of all panels of MTC's power-supply control has been undertaken to conform to the presently accepted system. Much of the redesign is the result of new conditions brought about by the moving of MTC to its new location in Lexington.

The d-c interlock panels are at Drafting, while the remainder of the panels are nearly completed in design.

D-c and a-c distribution boxes to handle power for the computer and its power supplies have been designed and are presently in Drafting.

Camera Control

(L. Sutro) (UNCLASSIFIED)

The camera-control panel is being laid out by Drafting. The 28-v, 5-amp d-c supply required to index the camera is being developed by R. Jahn. Two camera magazines have been modified under the direction of L. Norcott, so that if there is no film in the magazine, or the magazine is lacking, the "index camera" instruction will cause an alarm.

2.16 Transistors

Transistor Decoders

(D. J. Eckl) (UNCLASSIFIED)

Initial studies have shown that it is feasible to use transistors in a digital-to-analogue decoder. How much accuracy will be obtainable with present transistors is the subject of further study. From the standpoint of simplicity a "voltage source" type of decoder looks attractive. Recent advances in gold-bonded diodes have removed some former difficulties with this type of decoder. The "current source" type of decoder puts more stringent requirements on the transistor. Variations of I_{CO} , the cutoff current, with temperature present a problem in this case. The answer may be the silicon transistor.

Silicon Transistors

(D. J. Eckl) (UNCLASSIFIED)

Texas Instruments has recently announced availability of n-p-n grown-junction silicon transistors. These will operate over a temperature range of 25-150C. I_{CO} is of the order of 10 microamperes at 150 C. This is the same order as obtained with germanium transistors at room temperature. At 25 C the value of I_{CO} ranges from 10^{-7} to 10^{-8} microamperes. Frequency cutoff is in the 1-7-mc range.

(E. Cohler) (UNCLASSIFIED)

The APC and checking circuit have been shut down for much of the time because of work being done on MTC. Apparently the final check on this equipment will have to wait until MTC gets settled in its new home.

The junction flip-flop has been undergoing further development. With the aid of a special type of transformer coupling, we have been able to run a junction flip-flop at 500kc. However, we hope to be able to better this figure with an improved transformer.

This last week I have been briefed by Hawley Rising on core circuitry and have arranged to inherit some of his equipment. Right now the core work is still in the state of familiarization.

Donald Thomas from Bell Labs gave a very enlightening talk on transistor instabilities to Lincoln this last week. He confirmed many things we suspected on observing transistor characteristics with our plotter. Moreover, he gave partial explanation for the negative-resistance regions found in these characteristics.

2.16 Transistors (Continued)Junction-Tetrode Transistor

(C. T. Kirk) (UNCLASSIFIED)

Considerable time was devoted to developing a model for the junction-tetrode transistor and examining the solution of the diffusion equation for this model. Unfortunately, the solution of the diffusion equation does not exist along the emitter boundary, and the results of the mathematical solution are limited. However, an electrical analogue of the junction tetrode was derived from the diffusion equation from which solutions of the diffusion equation along the emitter boundary can be obtained.

Transistor Storage

(N. T. Jones) (UNCLASSIFIED)

Two interesting facts have been observed in comparing the storage characteristics of collectors as diodes and as transistors. At low values of collector-diode forward current, whether supplied by the αI_e current generator ($\alpha I_e > I_c$) or by real forward current, the recovery characteristics are almost identical. The "recovery buildup time" (the time required for the hole-density distribution to reach the steady state) of the collector is the same whether it is acting as a diode or transistor.

Diode Storage

(N. T. Jones) (UNCLASSIFIED)

An excellent correlation has been made between the forward resistance of diodes and the storage time, as theoretically predicted. High-forward-resistance diode types have shorter recovery times than the low-forward-resistance types.

Diode Construction

(N. T. Jones) (UNCLASSIFIED)

The order of 0.0005-inch bare drawn gold wire has been received. A variety of germanium wafers have been mounted on bases for use in diodes. These samples include resistivities from 0.4 to 10 ohm cm with hole lifetimes from 10 to 150 microseconds.

2.17 Display

(C. Corderman) (CONFIDENTIAL)

The decision has been made to use centralized driving for the analogue voltages needed in Charactron and Typotron tubes. Considerations affecting this choice are outlined in M-2826. Breadboards of line drivers are being made, and low-capacitance cables are being investigated.

The latter part of this period was spent at Convair and Hughes. A significant amount of progress was in evidence at Convair. They have made a sufficient number of tubes to satisfy their contract requirement of 3 sample tubes by 15 May, and one of these samples has been received at Whittemore for test and evaluation. This tube is complete with a 2-inch deflection yoke, convergence coil, and a mount for these two items. The tubes are not being aluminized at the present time because of difficulties experienced in preparing the phosphor for this film. This technique is being developed, and the problems should be overcome within several weeks. Envelopes for prototype tubes should be available near the end of June at which time the finalization of tube specifications can begin.

At Hughes we discussed changes in the electron gun to make Typotron adjustment less critical and the possibility of adding a third set of electrostatic plates to the tube. Tubes with a gun redesign and with the extra set of plates will be sent to us for evaluation.

(R. Fallows) (CONFIDENTIAL)

Work on frame, pluggable-unit, and etched-card layouts is continuing. The over-all logic of the DD and SD generator elements is complete -- no further changes of major importance are anticipated.

Layouts of six pluggable units and their associated cards are essentially complete, and all materials for experimental PU construction have been on order from IBM for two weeks.

Most of the cathode-follower problems (with proposed solutions) have been submitted to R. L. Best for evaluation.

Our schedules call for the release of pluggable-unit designs this month to meet the August production date. It appears now that we will be three to four weeks late in these releases. The effect of this delay depends directly on the actual lead time required by production as compared to the twelve weeks previously estimated.

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(R. H. Gerhardt) (UNCLASSIFIED)

A block schematic showing the complete logic of the situation-display-generator timing and control section has been made. It still is necessary to calculate the resistor values for the "and" and "or" gate circuits and cathode followers. The diagram shows 20 low-speed flip-flops (Model B or C), 26 gate tubes, 22 pulse amplifiers, and a minimum of 100 cathode followers. This logic avoids cascaded cathode-follower stages as much as possible, hence the large number of cathode followers.

Category Matrix

(J. Schallerer) (UNCLASSIFIED)

The category matrix has been designed and is now being packaged. It is a 32-position, two-level switch with a 12.5- μ sec rise time. The packaging should be completed in the next few days.

Situation-Display-Generator Unit

(R. Callahan) (UNCLASSIFIED)

A rough frame layout for the DGU has been finished. In order to spread the drivers (xy, category, DAB, etc.) over a number of modules so that the heat-dissipation requirements of an individual module do not become excessive, registers are placed horizontally instead of vertically.

Design of etched-card and pluggable units for this frame layout has started.

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

A new line driver is to be developed which will drive approximately 1000 feet of cable and feed 70 consoles in parallel. The total load represents 0.01 microfarad shunted by 2 K resistance. Preliminary design considerations indicate that seven 6146's per side will be required in order to achieve the desired rise time and swing. This output stage will be packaged in a 9-tube plug-in unit.

A character-compensation voltage is required to correct for the finite area of the matrix. A scheme has been proposed which used a resistive network to add voltages from the selection and position lines which will give the required compensation voltage. Briefly, the idea consists of two resistor-voltage dividers connected by a common resistor. The output from the common point is a superposition of the two inputs.

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2.17 Display (Continued)

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

This is the desired property. However, the variation of one parameter effects the other input circuit. If by a judicious selection of parameters we could minimize this effect, the compensation problem in Charactron would be greatly simplified.

The vector generator has approached the stage where it will be assembled in a plug-in unit and margins taken on the completed system.

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

Work is progressing on the digital display. Most of our cards are laid out, and the plug-in-unit wiring diagrams are being drawn. Element numbers for the digital display were allocated, and a logic diagram was drawn using these numbers. We are now waiting for equipment ordered from IBM so we can start plug-in unit testing.

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2.2 Group 63 (Magnetic Materials)

The Covalent Bond in Spinel

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

If an O^{2-} ion bonds covalently in a spinel lattice, it usually does so with cations in only one type of site. If covalent-bond formation is with tetrahedral-site cations, the lattice remains cubic. If it is with octahedral-site cations which hybridize square, coplanar (dsp^2) orbitals, the lattice becomes tetragonal with axial ratio $c/a = 1.16$. In some lattices, such as $ZnMn_2O_4$, covalent-bond formation occurs between the O^{2-} ions and the cations which occupy both tetrahedral and octahedral sites. In order that this be possible, however, the O^{2-} ion must excite some of its $3s$ electrons to form hybrid orbitals which are a mixture of (sp^3) and p^3 . If a reasonable admixture of these states is assumed, the observed axial ratio $c/a = 1.14$ is predicted.

Correspondence with Verwey and van Santen of Philips, Eindhoven, Holland, has confirmed the fact that these investigators have considered the spinel lattice to be primarily ionic. As they have expressed interest in our work, A. L. Loeb is arranging to visit their laboratory while he is in Holland this year. Whatever exchange of information is possible from this quarter should be rewarding.

RCA Cores

(P. A. Fergus) (UNCLASSIFIED)

Evaluation of the last several RCA lots was made to determine the best lot produced to date. The data, which indicated that XF-634 was the most desirable lot, was presented at a meeting held at RCA in Camden, N. J. At this time it was decided that RCA should try to duplicate this lot to fill the remainder of the order of 12,000 cores to be delivered to IBM. Sample evaluation of these lots will be made at IBM and at MIT, and a plane will be constructed by IBM.

High-Current Pulse Generators

(F. W. Sarles) (UNCLASSIFIED)

The two high-current, fast-rise-time pulse generators are now operating satisfactorily. An M-note is in the process of being written describing these generators. One of the generators has been installed in a test setup and is now being used in the measurement of switching coefficient at high current amplitudes.

Circuitry for use in a permeameter is being investigated.

2.2 Group 63 (continued)High-Resistance Bridge

(J. D. Childress) (UNCLASSIFIED)

The electrometer detector for the high-resistance (up to 1000 megohms) bridge has been built and tested. The circuit has sufficient sensitivity for use with 100 volts across the bridge. The detector is now being shielded to give stability with very high resistors in the electrometer tube grid.

Delivery of special resistors has not yet been made, so the complete bridge cannot yet be built.

D-C Hysteresigraph

(R. Pacl) (UNCLASSIFIED)

Initial testing indicates a difficult stability problem with regard to thermal emf's and shock. Careful construction with regard to electrical connections, placement, and thermal lagging should ameliorate the present difficulty with the thermal problem. A concrete foundation will probably be necessary to minimize shock transients, however.

Synthesis of Ferrites

(F. S. Maddocks) (UNCLASSIFIED)

Firing of experimental ferrite cores has been interrupted to permit installation of new muffles in the Burrell furnaces. The work has been completed, and a new series, DCL-4-19 to DCL-4-34, will be fired beginning Monday, 24 May. Another series, DCL-4-40 to DCL-4-52, is now being processed.

A chemical analysis of a firing of magnetite bars and toroids made on 13 May is in progress. Results show 49.5 mol percent of FeO to 50.5 mol percent Fe₂O₃, indicating good quality for the samples.

Preparation of Memory Cores

(J. J. Sacco) (UNCLASSIFIED)

Four runs have been made in the Harper furnace on F-394 cores from batch DCL-2-418. These were all at a temperature of 1350 C, but the length of firing was gradually increased from 4-1/2 hours to 9 hours. Two more firings are scheduled in order to complete the data. Accurate measurements will then be taken in an attempt to determine the effect of increased firing on output, switching time, and coercive force.

SECTION III - CENTRAL SERVICES

3.1 Purchasing & Stock

(H. B. Morley) (UNCLASSIFIED)

The orders have been placed for the equipment-cooling systems for MTC at Lexington and for Rooms 216 and 222, Barta.

Anyone calling for information on outstanding orders should mention the purchase-order number, as the expediting file is arranged numerically. This number may be obtained from the originator's copy of the purchase requisition.

Stocks of components in the Barta Stock Room are being expanded in anticipation of the move to Lexington.

3.2 Construction

Production Control

(F. F. Manning) (UNCLASSIFIED)

There have been 33 Construction Requisitions totaling 440 items satisfied since 7 May 1954, and there are 31 Construction Requisitions totaling 1809 items under construction by the Group 60 Electronic Shops.

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

Outside Vendor

(J. V. Mazza) (UNCLASSIFIED)

There are 8 orders now open with vendors totaling 185 items. Deliveries in the past biweekly period have totaled 136 items. Information on specific orders may be obtained from the writer (ext. 3492).

3.3 Component Analysis and Standards

Lincoln Laboratory "Standards and Specifications" Book

(C. W. Watt) (UNCLASSIFIED)

During the next two weeks the new "Standards and Specifications" book produced by the Lincoln Laboratory Standards Committee will be distributed. This volume will eventually supersede the existing Lincoln "Electronic Parts Catalog" and in most cases will supersede the Digital Computer Lab Standards Book.

3.3 Component Analysis and Standards (Continued)

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

At the time of issuing, the sections on resistors and capacitors are nearly complete, as is the section on general hardware. The book is divided into 10 sections, numbered from 000 through 900. The subjects covered are as follows:

- Class 100 - Resistors
- " 200 - Capacitors
- " 300 - Tubes and semiconductors
- " 400 - Indicators, batteries, and protective devices
- " 500 - Rotating machinery and switchgear
- " 600 - Conductors and insulators
- " 700 - Inductors and transformers
- " 800 - Electrical hardware
- " 900 - Miscellaneous
- " 000 - General hardware

Technical information, procurement information, and recommended test procedures for each type of component are included in the appropriate sections. In general, the format of the application-information sections and their content is similar to the Military Reference Data Book of IBM, which has been widely distributed in Div. 6.

It will be noted that the part numbers apply both to Lincoln and Div. 6 stocks. All parts stocked by Div. 6 that are covered by the Lincoln book will be stocked under the Lincoln numbers, and these will be used on all Div. 6 parts lists and drawings. Special parts applicable only to Div. 6 will probably retain their present numbers.

3.31 Components

(B. B. Paine) (UNCLASSIFIED)

The recording of component-failure data on IBM cards has been initiated on a trial basis, starting with a group of diode failures. It is already apparent that the method is effective and will enable us to compile and report this data rapidly. It is thought that the body of data to be recorded is large enough to warrant the IBM method, particularly since card-handling equipment is available in Lexington through the courtesy of Group 61.

Work on a uniform component-failure report and record form is proceeding.

Component-test reports on pulse transformers, crystal diodes, and hook-up wire have been issued during this period and are available from the Components Section.

3.31 Components (Continued)

(B. B. Paine) (UNCLASSIFIED) (Continued)

Pulse amplifiers for life tests have been designed and sent to the shop for construction. These will be used in tests of diodes and for silver-migration tests of silvered-mica and ceramic capacitors.

A thorough examination of the WWI TPDO panel, removed because of many phenolic dielectric breakdowns, has been made, and a report attempting to document silver migration in WWI will be issued shortly.

Whittemore Building D-C Power

(R. Jahn) (UNCLASSIFIED)

During the move to Lexington, the present power supplies will be replaced by some temporary unregulated Raytheon supplies. These supplies are now being rebuilt for this service and for eventual use in Building 10. Bleeders from the high voltages will supply -15, -30, and +10 volts. Three of the six supplies have been completed.

Circuit-breaker boxes and extension boxes are being installed at Lexington.

3.4 Test Equipment

Test Equipment Committee

(L. Sutro) (UNCLASSIFIED)

At its meeting on 19 May, the Committee welcomed a new member, decided what voltages shall be made available in Jones receptacles at Lexington, approved a new piece of standard test equipment and modification of another. The new member is S. Twicken who replaces C. Corderman as representative of Group 65. The voltages to be brought out to the Jones receptacles are the same as those now used in Whittemore, including +10 volts on pin 5 and -450 volts on pin 1. Distribution of +600 volts, needed for display, will be decided at a later meeting. The new piece of standard test equipment is the six-channel pulse amplifier, Mod. II, which will be used in testing XD-1. It differs from Mod. I, developed for the same purpose, in having the shields of its input jacks floating and capable of being biased to -15 volts, instead of being tied to ground. The modification that the Committee approved is the substitution of a 270-ohm resistor in place of a 470-ohm resistor in the damping circuit of the RIC peaker in the Burroughs gate and delayed-pulse generator.

3.4 Test Equipment (Continued)

Test Equipment Headquarters

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

To obtain information on how to test General Radio products, we called on Mr. Alexander, test engineer of that company. He gave us detailed advice on how to inspect and test their equipment and agreed to supply us with test specifications for each unit.

3.5 Drafting

Spare Drafting Boards

(A. M. Falcione) (UNCLASSIFIED)

From time to time, many drafting boards from the Drafting Department have been loaned to various individuals. In view of the fact that the Laboratory is planning to move to Lexington in the near future, drafting boards which have not been planned for use should either be returned to Drafting or notification given to me so that proper allocation of space may be made to absorb the additional drafting boards now scattered throughout the Whittemore Building. As far as I have been able to ascertain, drafting boards now in use by various individuals have been incorporated into their new layout for the Lexington move.

Security Information on Drawings

(A. M. Falcione) (UNCLASSIFIED)

There have been several instances where engineers have brought in to Drafting drawings containing confidential or secret information without notifying us that the drawing was classified. It is very important that engineers who supply sketches containing security information to Drafting notify the personnel involved that the drawing is classified and the grade of classification which it contains.

Print-Room Reproduction

(A. M. Falcione) (UNCLASSIFIED)

During the past several weeks, we have been seriously handicapped by the shortage of machine time on print reproduction in the Print Room because of the large number of drawings being received from IBM. It is expected that this deficiency will be solved when we move to Lexington, where we will be able to make use of the reproduction facilities of Div. 7, which has available a large automatic machine. The backlog of IBM drawings,

3.5 Drafting (Continued)

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

plus the large number of print requests and the current work load, has overburdened this department quite badly. I have taken steps to alternate the machine operators during the noon hour, so that we get a full 9-hour machine-time operation of both machines.

3.6 Administration and Personnel

Staff Termination

(J. C. Proctor) (UNCLASSIFIED)

Saul Fine

New Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

Eileen Barrett is a new secretary in Group 61.

Bernard Gardner is a new clerk who will run one of the Ozalid machines in the Print Room.

Donald Haff is a new technician in the Construction Shop.

Robert Kyle has returned to Group 6345 on a part-time basis.

Morris Sadofsky is another new technician in the Construction Shop.

Manual Spector has also joined the Construction Shop as a technician.

Non-Staff Terminations

(R. A. Osborne) (UNCLASSIFIED)

Katherine Campbell
Roseanne Gillette
Daniel Lynch

Open Non-Staff Requisitions

(R. A. Osborne) (UNCLASSIFIED)

6 Jr. Electronic Technicians for Group 62
1 Laboratory Assistant (Female) for Group 62
1 Secretary for Group 64