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Memorandum 6M-4107

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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 13 JANUARY 1956

To: Jay W. Forrester

From: Division 6 Staff

Date: 20 January 1956

Approved: J.C. Proctor

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SAGE OPERATIONAL PLANNING

(Group 61, D. R. Israel)

DIRECTION CENTER (J. Ishihara)

Identification, Manual Inputs, TBS (J. Bryan, S. Hauser)

The identification and manual inputs mathematical specifications, 6M-4028 and 6M-4032, have been issued. Preliminary schedules for the WISE function have been established. It is expected the TBS mathematical specifications will be issued the week of 16 January.

Duplex Standby Activity (A. Heineck)

Drafts of 6M-3980-1, "Operational Specifications for the XD-1 Start-over Function," and 6M-4087, "Utilization of Magnetic Tape Units at a SAGE System Direction Center," have been issued.

A "Guide to Duplex and Standby Computer Operation" is now being prepared. The guide will serve as a reference document in the preparation of operational specifications for duplex and standby computer operation and will contain the operational principles for obtaining maximum reliability of a direction center with the use of duplexed equipment.

DATA SIMULATION AND ANALYSIS (W. S. Attridge)

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Data Generation (R. Russo, R. Collmer)

Preparation of the mathematical specifications for the Simulated Data Generation Program is proceeding.

An analysis of errors due to approximations in the formulas issued is being conducted.

Recording (E. L. Lafferty, S. Tower)

A first draft of 6M-4086, "Mathematical Specifications for the Recording Function in ESS," has been issued.

Data Analysis (M. Clark, J. Slagle, S. Tower, E. Lafferty)

This subsection has begun a cooperative effort with the ESS Planning and Operation Section to prepare a memo describing data reduction and analysis requirements. We are essentially "lending" our people to work on this with Grandy for the next few weeks.

MTC Programming (R. Olsen)

We have written a symbolic address conversion program for MTC which is working now, but needs a few improvements to make it useful. A memo describing its capacity and how to use it will be issued shortly.

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COMBAT CENTER (W. Lone)

A "Guide to Combat Center Operation," 6M-4031, will be distributed in a few days. A supplement which describes additional situation displays for the use of the Weapons Allocation personnel is being prepared.

Preliminary consideration is being given to the operational specifications for Air Surveillance, Weapons Allocation and Crosstelling.

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ESS DIRECTION CENTER IMPLEMENTATION AND COORDINATION

(Group 62, J. A. O'Brien)

POWER (J. J. Gano)

Power Generation - SAGE

IBM did not wish to comment on the electronic loads and special distribution lines for nonregulated ac to the computer and maintenance equipment in memo 6M-3074, "Power Generation and Distribution for the SAGE System Combat and Direction Centers." Since minor variations of load at the load frames do not have an appreciable effect on the overall generated load and Western Electric usually contacts IBM to acquire up-to-date information on special lines, we are going ahead with a TIR. In addition to stating the requirements for the first combined site which will have seven 1250 kw diesels generating at 2300 volts, it recommends generation at 460 volts with nine diesel units of 000 kw for future sites. The report completes the series of Lincoln memos on load, performance and distribution requirements for SAGE System power plants.

DC Supplies

As the start of a program on the application of transistors to large load power supplies, Coffin has applied a two-stage push-pull transistor amplifier to the magnetic power section of the -30 volt supply of XD-1. Load regulation looked good, but more operational data will be obtained.

Control Circuits

Westinghouse has developed for commercial use a set of magnetic amplifiers to accomplish logic functions similar to those of electro-mechanical relays, (and, or, not, memory). These units use the Ramey circuit to operate within 1/2 cycle of the supply frequency. They are mainly intended as substitutes for relays which operate millions of times because they eliminate vulnerable contact points. Sandy will investigate their application in power control circuits where the number of operations is relatively small but high reliability is required. Jahn will look into possible use in computer selection circuits that now use thyratrons or vacuum tubes and where several milliseconds for operation is tolerable.

BASIC CIRCUITS (J. H. McCusker)

Search-Radar Mapper-Sweep Circuit (B. W. Barrett)

This circuit has been completed and installed at South Truro. An M-note will be released the week of 16 January.

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BASIC CIRCUITS (continued)

Centralized Probe System (A. Hingston, W. Santelmann)

Slight distortions in waveshape of the 6197 follower were investigated and were found to be caused by grid current in the 6197 on positive peaks and by oscilloscope defects. The grid current of a dozen samples over the entire operating range of the follower circuit were observed and the circuit was altered slightly as a result so that all tubes operate between 5×10^{-9} A and 1.2×10^{-7} A grid current, a value which can cause no more than 1.0% distortion. The Tektronix 541 oscilloscope was found to exhibit 10% overshoot due to interface in its 6AW8's, which developed in 800 hours of use, and to a misaligned distributed amplifier.

A connector pair containing 11 pins built around a WE coax plug and jack has been built and sent to C. R. Bading of IBM.

Charactron Vector Intensity Decoder (R. B. Paddock)

A change to a smaller plate load plus the addition of two type 5998 tubes has brought the rise and fall times close to specifications. The breadboard will now be cleaned up for use in a simulated "system" test in another week or two.

DESIGN CONTROL

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Records (J. Giordano)

The Design Control (formerly Systems Office) briefs and specifications have been moved to B-121 from B-209. All records and personnel are now located in the B-121 area.

The new brief numbering system is now in effect. Memorandum 6M-3449-2 describes and lists the new system.

Teletype Inputs (R. H. Gerhardt)

Memorandum 6M-4091, "Study of the Use of Teletype Circuits for Low-Rate Data Transmission to AN/FSQ-7," has been completed.

WIRE COMMUNICATIONS (C. J. Carter, F. E. Irish, W. O. Glass)

A meeting was held in Washington on January 6th with the CAA to discuss Lincoln's requirements for ESS telephone and teletype circuits at Air Route Traffic Control Centers. Mutually satisfactory arrangements for installing these circuits were worked out. We are now waiting for a confirming letter from the CAA before placing circuit orders with the telephone company.

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WIRE COMMUNICATIONS (continued)

A siting party visited the Scituate and Clinton sites on January 11th to verify deficiencies in telephone equipment which are causing operational problems at many gap filler sites. Orders will be placed for equipment to correct these deficiencies. All other sites will be visited soon.

A meeting was held on January 6th to discuss the ESS circuits terminating on TT-2. The discussion was directed toward determining whether or not the existing equipment on the tower could be used to terminate ESS circuits. It was decided that with some modification, the equipment could be adapted. RAFD, who is responsible for the installation, would require authorization from ADC to do the job. Group 23 is requesting this authorization for RAFD.

It was also decided that Lincoln would purchase the teletype machine which is needed by us on the tower, and then turn it over to EADF. Lincoln does not want to own and maintain equipment located on the tower.

A meeting was held on January 10th with NET&T Co. to discuss their proposed method of terminating the TT-2 leased telephone circuits at No. Truro. Their proposal seems adequate, but its final acceptance must depend on what the RAFD can provide for telephone service on the tower.

On January 7th, the Wire Communications Test Team began its checkout of the ESS Direction Center internal communications system. Work will be continued on January 21st.

Work continues on compiling information for ATC on the operation of the ESS communications system.

EPSCOM (R. P. Mayer)

Two documents, 6M-4008 and 6M-4009 have been issued and list the programs planned by this section and the estimated completion dates. A schedule showing the people assigned to the various programs and the future areas in which they will be working are also included.

(H. I. Rundquist)

An XD-1 program is being written to display the geographic boundary of the New England area on the situation display console. It is to be used in conjunction with the combined track test program for ESS(820300) written by C. Sherrerd. (A. Werlin, J. Mazza)

The ESS basic tracking program ETRX0300 (820300) has been tried out several times in conjunction with LRI system tests. Several minor cor-

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EPSCOM (continued)

rections and modifications were necessary, and a feature permitting initial estimated speed and heading insertion via keyboards upon re-initiation was added. The deck of cards were brought up to date and reassembled on 12 January.

Work has begun on a modification of 820300 to permit data count and range-azimuth printouts of the number of radar returns processed from each site and the correlated returns, respectively, every 12-second program cycle. This modification is for the benefit of LRI system checkout.

Work has also begun on another modification of 820300 for height finding system checkout. At present, this modification has just reached the study phase, with incorporation of 820300 with 810200 the principal objective. The height request and printout routine, 810200, is being written by John Maroney for the height finding test team.

The modification of 820300 with 810200 for height finding system checkout will also require the addition of a routine which will permit conversion of target locations in the subsector rectangular coordinate system into target locations in terms of latitude and longitude, and which will print them out every few minutes. Work has not yet begun on this routine. (C. S. Sherrerd)

That portion of the height finder decimal print program which prints the crosstell error is completed and has checked out successfully twice. We have run this program as a self-contained unit and are currently modifying it to remove several built-in features which were necessary for our test purposes, but which must be deleted when the program is incorporated with the equipment check program written by Costello and Maroney. It is hoped that both programs will be assembled together and run during the week of January 16th as a further check on their performance.

The print program is also currently being converted to the compiler mode, which is hoped will eventually make use of the editor subroutine.
(G. Cox, F. Sweeney)

TEST TEAMS (W. J. Canty)

G/A Test (I. Aronson)

The first drafts of the acceptance test specification and the memo on test concept have been written. These are now being revised to incorporate the suggestions received from interested parties. Arnold Bailey, WE, is working on the specification and I on the test concept memo.

A second test pattern is now available for the G/A data link. It con-

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TEST TEAMS (continued)

sists of the original G/A program with new constants, and is known as G/A Test Message, Package #2.

Height Finding Subsystem Test (T. Sandy)

Two live height finding tests, using WWI and South Truro, were scheduled. Both tests had their aircraft canceled because of weather. Error-rate tests, which use all of the subsystem except the height radar, were substituted.

During the first error-rate test, the equipment at the site was inserting many wrong message labels. The rest of this test was canceled to allow the site to correct the trouble.

During the second error-rate test the search radar channel at the site was operating incorrectly, so we were unable to multiplex the height replies and the search radar data. Before the search radar channel trouble could be found, the range-height indicator of the height channel quit and the remaining portion of the test was canceled.

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

MAGNETIC MATERIALS (N. Menyuk for J. B. Goodenough)

Physics

Equipment

The linearity and phase-gain characteristics of the amplifier presently in the dc fluxmeter have been measured. A new amplifier, with the same phase-gain characteristics, but improved linearity, is now being tested. (R. A. Pacl)

The vibrating-coil magnetometer is now working well enough to permit routine measurements of magnetization at fixed fields as a function of temperature. Such measurements have been delayed due to the secondary problem of providing a suitable sample holder and generating the desired temperature (room temperature to liquid nitrogen). The required dewar, heater, and sample holder should be ready during the next bi-weekly period. Meanwhile, the VCM is being steadily improved in order to make measurements requiring a high degree of sensitivity. The ultimate performance of the instrument can be studied only when all superficial difficulties such as cable capacitance, 60-cycle noise, and system grounds have been cleared up. Continued progress is being made in this direction. (D. Smith, N. Menyuk)

The mechanical apparatus required for the evaporation of thin magnetic films has been designed and construction will start next week.
(D. O. Smith)

Theory

A study has been made of the effects of geometry upon the peak current-average power requirements of memory drivers. The limits of variation by this means have been determined, and a memorandum, 6M-4089, written.
(J. D. Childress)

Chemistry (W. J. Croft)

Experimental Ferrites

The search for a suitable method for the analytical determination of lithium is continuing.

S_w values for selected cores from previously reported lithium-nickel ferrite and lithium-nickel-zinc ferrite series were greater than 1.3 oersted-microseconds. An investigation has begun to determine the effects on S_w of small additions of cobalt ferrite to lithium ferrite and lithium-nickel ferrite.

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MAGNETIC MATERIALS (continued)

In the series $(17.67 \text{ Li}_2\text{O} \cdot 82.33 \text{ Fe}_2\text{O}_3)_{1-\alpha} + (51 \text{ NiO} \cdot 49 \text{ Fe}_2\text{O}_3)_\alpha$; $\alpha = 0$ to 1, R_s values of ~ 0.77 were found between $\alpha = 0.05$ and 0.20 . For this region, H_c sat was ~ 1.8 oersteds and $B_s \sim 2700$ gauss. The H_c sat and B_s values are slightly greater than those found in the routine firings of the $(\text{Li}_2\text{O} \cdot \text{Fe}_2\text{O}_3) + (\text{NiO} \cdot \text{Fe}_2\text{O}_3)$ series, whose compositions lie on the stoichiometric line between lithium ferrite and nickel ferrite.

A series of compositions between $16.67 \text{ Li}_2\text{O} \cdot 83.33 \text{ Fe}_2\text{O}_3$ ($\text{Li}_{0.5}\text{Fe}_{2.5}\text{O}_4$) and $50 \text{ Li}_2\text{O} \cdot 50 \text{ Fe}_2\text{O}_3$ showed that the composition containing $40 \text{ Li}_2\text{O}$ was still magnetic, $50 \text{ Li}_2\text{O} \cdot 50 \text{ Fe}_2\text{O}_3$ was nonmagnetic. As Li_2O was increased, generally the coercivity increased, the flux density and the maximum squareness ratio decreased. (D. L. Brown)

Analytical Chemistry

Development of a colorimetric method for determination of traces of CoFe_2O_4 in $\text{MnO} \cdot \text{MgO} \cdot \text{Fe}_2\text{O}_3$ is in progress. (F. S. Maddocks)

Refiring

The changes in the chemical composition of memory cores during the refiring process are small. Greater analytical accuracy than has so far been attained will be required for a reliable estimate of the magnitude of these changes. (D. G. Wickham)

It has been observed that there is an increase in the unit cell dimensions with increased refiring temperature in the memory core composition. X-ray measurements are being made to determine if there is any type of ordering change brought about by refiring. (W. J. Croft)

Memory Core Production

Production of F397 memory cores has been resumed. Two batches have been test-fired and a full-capacity firing is now underway. To date 2,450,000 cores have been produced and the remainder of the requested 2,850,000 should be completed within a month. (J. Sacco)

Memory Core Testing

The total number of memory cores double-tested by this section to date for the $256 \times 256 \times 37$ memory is 2,392,985. There are also approximately 60,000 untested cores on hand, making a grand total of approximately 2,452,985.

TRANSISTORS (D. J. Eckl)Transistor Life Tests

As of December 14 a total of 3 million hours had accumulated on 444

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TRANSISTORS (continued)

SBT's in life test circuits and 480 in TM-1. There have been three failures, of which two might have been avoided. This is a failure rate of about 0.1 % per 1000 hours. A complete report on the life test data to this date is now being typed.

The shielded 8-digit shift register has now run for 5248 hours at 1.0 megapulses/second without loss of pattern. The run is continuing. The unshielded unit has now operated 942 hours since its last error.

Switching Speeds in
Direct-Coupled Circuits (C. T. Kirk)

The following expression for the maximum switching speed of a transistor in a direct-coupled circuit resulted from initial studies to obtain a figure of merit for performance in this type of circuit:

$$T_{max} = \frac{1}{(1-\alpha_0)\alpha_{c\alpha}} \left\{ 1 + \alpha_{c\alpha} \frac{r_b' C_c}{P.G.} \ln \frac{\beta_0/P.G.}{(\beta_0/P.G.)-1} \right\}$$

where P.G. is the dc power gain available from the stage when saturated. It is interesting to note that this equation is independent of power, voltage, and current levels of the transistor, except as these factors affect β_0 . There are two limiting cases:

$$\text{As P.G. approaches } 0, T_{max} \rightarrow \frac{1}{(1-\alpha_0)\alpha_{c\alpha}}$$

$$\text{As P.G. approaches } \beta_0, T_{max} \rightarrow \frac{r_b' C_c}{P.G.} \ln \frac{\beta_0/P.G.}{(\beta_0/P.G.)-1}$$

The latter goes to infinity at P.G. = β_0 .

The maximum switching speeds of various types of transistors can be computed from their small signal parameters with the above expressions. By comparing the value of T_{max} for various transistors, their relative performance in high-speed switching circuits can be predicted. The lower the value of T_{max} , the faster the transistor will switch.

Diode Noise Generator (E. U. Cohler)

A noise generator has been built to supply random bits for certain computer problems. The present generator is capable of generating equal numbers of zeros and ones in arbitrary 5- μ sec intervals. However, further work must be done to improve stability and test higher-order correlations.

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TRANSISTORS (continued)

New Transistors

Twelve transistors with nominal maximum oscillating frequencies in the 90 megacycle/second area have been received from Philco. These will allow further studies on a high-speed saturating flip-flop.

SBT Studies

Distribution curves are being plotted on 100 SBT's for $f_b C_C$, f_{max} , and α_0 . A distribution of calculated values of f_{CO} will also be made. At present, these measurements are too tedious to make on all transistors.

MEMORY (J. L. Mitchell)

Cooling and Supplies

The computer room in the basement of Building A is now complete. Dc power has been installed, and we will start to move in equipment next week. The air conditioning installation is progressing satisfactorily. However, there is still no new information on the availability of the compressors. All the dc power supplies have been received from the vendors.

256² Construction

The sixteen modules of the first production 256 x 256 plane have been soldered together and inspected. Thirty-four magnetic-core, switch-core, plug-in units are complete and ready for test. The equipment for EMAR control is being assembled. The pluggable-unit tester is being tested and put into final operating condition. The three-bay rack will be ready to move into the computer room on January 17. The construction of the memory stall is being expedited so that it will be available when the three-bay rack is operating.

Advanced Development

A well-registered set of peg holes have been punched in a 4 x 4 printed plane board. Guides are being made which will enable this work to be duplicated. One sample switch-driving transistor was received from Philco. It has not yet been tested for high current gain, but it did have good gain at low current.

SYSTEM DESIGN (K. Olsen)

TM-1

The TM-1 8-digit multiplier (about 600 transistors) has run 3,725 hours with only one transistor failure and with no measurable decrease

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SYSTEM DESIGN (continued)

in margins. It has run 24 hours a day for the last 27 days (648 hours) without a malfunction.

New Circuits

We are working on a new set of inexpensive circuits to be used in the 500 Kc range. The TX-O circuits are fast and have wide tolerances, but their parts and transistors are expensive.

LOGICAL DESIGN (W. A. Clark)

Jim Forgie has started on the design and construction of an analog-to-digital converter and associated switching circuitry to make speech sounds directly available to WWI. This equipment, in conjunction with a bank of filters at the Acoustics Lab, will allow the computer to obtain a complete 3-dimensional (energy, frequency, time) representation of a speech wave. The equipment will operate by repeatedly scanning a 2-second speech sample stored on a loop of magnetic tape. Before the analog-to-digital conversion takes place, the filter output will be full-wave rectified, smoothed, and passed through a logarithmic circuit. The digital output will then be approximately proportional to the energy in the filter band. The presently available filters split the speech spectrum into 35 bands. The read-in process for the 2-second sample of speech will thus require 70 seconds. This time appears short compared to the time required to produce an equivalent spectral representation by calculating a Fourier or other transform of the speech wave. At each pass, the output of one filter will be sampled, converted to digital form, and stored in the computer. Since the filters and the computer cannot be handily brought together, an intervening stage of tape recording will be necessary.

Logical Design Course

Supplements 4 and 5 to 6M-3938, "The Logical Structure of Digital Computers," have been issued. Both deal with the synthesis of Boolean machines and include a restatement of the procedures developed earlier by Jeffrey and Reed.

SPECIAL STUDIES (T. Meisling)

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CFAR Computer

Division 4 is studying several proposals for filtering of radar data at the radar site. Preliminary block diagrams for one such system, a digital constant-false-alarm-rate (CFAR) computer, have been drawn and evaluated.

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ESS TEST PLANNING - WWI MTC OPERATION

(Group 64, E. S. Rich)

WWI OPERATION (L. L. Holmes)

Scheduled Computer Hours:	282.5
Interrupting Incidents:	17.0
Hours Lost:	9.1
Percent Good Time:	96.8
Mean Time between Failures (Hours)	16.1

Several types of equipment breakdown contributed to 9.1 hours of down time:

1. The enable gate of the readout tubes for groups 2 and 3 of the buffer drum was found to be shorted to ground by a piece of solder. The short introduced six known failures for a total of 4.3 hours of lost time. The enable gate usually swings from -20V to +15V, but being shorted to ground, it permitted the strobing of groups 2 and 3 whenever groups 4 to 7, inclusive, were selected. The outputs of the readout gate tubes were small whether groups 2 and 3 or 4 to 7 were selected.
2. A drum system cathode follower tube with open heaters resulted in the loss of one hour.
3. An unbalanced flip-flop used to control the photoelectric paper tape reader's clutch led to a 1/2 hour loss of assigned time. It was discovered that the marginal checking circuits for the flip-flop were not being varied in the daily marginal checking routine.
4. There were 45 minutes lost because of a sticky idler spool on a Raytheon magnetic tape unit.
5. Two incidents of interruption resulted in two hours of down time during the use of the Cape Cod System computer program. The source of the trouble was not determined.

WWI and XD-1 Crosstelling

No crosstelling tests were performed this period because of insufficient XD-1 computer time, and to reorganize the test team and improve the XD-1 program used during the subsystem tests. Crosstelling tests will be resumed in the next period.

General Electric G/A Data Link

Our section completed a one-week study of the WWI equipment, manpower, and time requirements for the design, installation, and test of a WWI

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WWI OPERATION (continued)

system that would be compatible with G.E. equipment at Prospect Hill. The proposal was introduced at a meeting of personnel representing Groups 22, 311, and 64. The plans offered for adoption were acceptable to the people present, and we are awaiting a final approval from management.

The WWI system would employ an additional 370 tubes and would probably be available for subsystem operations one month after the granting of authorization to proceed.

MEMORY TEST COMPUTER (W. A. Hosier)

Magnetic Tape Equipment

As the presumed date of receipt, February 1, of the IBM tape adapter frame and two 728 tape drive units draws nigh, there are the usual details to attend to: air for cooling the units, intercabling, etc. Intercabling is somewhat awkward because holes are not cut so freely in the concrete floor of Bldg. B as in the wooden floor of Bldg. F. However, it appears that wireways can be run along the floor behind the units. Maintenance of plug-in units for the tape adapter frame, which might have been combined with those of XD-1, is complicated by the fact that our frame will be an FSQ-7 production frame, and the plug-in units are different (on the style of the XD-1 auxiliary drum frame).

New Control

The assignment and wiring of output lines mentioned last period are still proceeding. As it approaches completion, Ed Glover will take over checkout of the new unit, leaving Gates and Ziegler free to concentrate on necessary modifications of panels already in the computer. Exactly when MTC will be shut down for tape and control installation is contingent upon the delivery date of the IBM tape equipment. It is felt that parallel installation of both units is the best way to reduce down time (which is estimated as between two weeks and a month). We hope to witness the incarnation of the paper transfer of Norm Ockene into the MTC section in time for him to assist Glover with control checkout.

Display

A new mounting plate for the Fairchild camera, centering the scope raster properly on the film frame, has been received and should be the last step, prior to receipt from DuMont of new P11 tubes, in making an operating scope camera installation. The mounting rack for the console direct-view scope has also been received and when it has

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MEMORY TEST COMPUTER (continued)

been wired up and installed, that scope also will have the benefit of the sharper focus and better light output provided by the new circuits.

Corderman will move the prototype Charactron console to B-031 to make room for magnetic tape equipment; but he is not severing its connection to MTC, for several long coaxial lines will connect the two. He would like us to keep a 5-inch photographic Charactron in MTC for monitor and printout purposes, but several display console circuits must first be repackaged for rack mounting.

Publications

Vanderburgh has begun a manual on operation of existing MTC utility programs.

Tape Preparation

Making Flexowriter tapes for MTC has become a rather thorny issue for several reasons:

1. The card room would prefer to dispense with it.
2. Space, personnel, and auxiliary equipment (tape comparators, etc.) are lacking to set up a real Lincoln tape room.
3. Use of the Barta Building facilities is inconvenient and would probably require additional personnel there.
4. The future of tape versus cards on MTC is cloudy.

Presumably TX-0 and whatever grows out of it will be jointly interested with us in this tape question.

Operation and Reliability

Most of the slightly excessive lost time this period has again been ascribable to the card machine. After a thorough going over by one of IBM's men, however, it has run O.K. for the past five days. Tape sawing into the guide studs of the Ferranti reader has necessitated replacement of these studs by something harder than the original brass in the old reader.

Distribution of time this period has been as follows:

	<u>Hours</u>	<u>Percent</u>
Analysis and Data Processing	98.3	43.0
Development and Testing	59.6	26.1
Reliability Check Programs	27.8	12.2
Maintenance and Marginal Checking	26.1	11.4
Interrupting Failures	<u>16.6</u>	<u>7.3</u>
Total	<u>228.4</u>	<u>100.0</u>

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MEMORY TEST COMPUTER (continued)

Defects in components for the period 2 to 13 January 1956:

<u>Component</u>	<u>Defect</u>	<u>Qty.</u>	<u>Hours Lost</u>
7AK7	gone to air	1	0
7AK7	grid emission	2	0
6145	cut-off (control grid)	1	0
Toggle Switch	open	<u>1</u>	<u>.01</u>
	Total	<u>5</u>	<u>0.01</u>

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VACUUM TUBES

(Group 65, P. Youtz)

TUBE TECHNIQUES (J. S. Palermo)

The design and fabrication of the necessary jigs for the construction of electron optical systems with deflection plates using multiform glass supports is in process. These jigs are needed to produce special electron optic assemblies to support C. L. Corderman's special studies for a high-speed and high-character-density display tube. The optical assemblies produced will be similar to the type of assembly used by Hughes Aircraft Company in the Typotron tube.

The following summary represents the present status of the bariated-nickel program:

1. Completion and edition of the necessary LTPS for bariated-nickel cathode.
2. Construction and process evaluation of a number of triodes using the diffusion type of cathode.
3. An adequate evaluation of Ti and ZrH₂ activated cathodes.
4. Reproducibility of a number of Ti activated cathodes.

As a result of the above progress, we have formulated a new schedule and started to prepare a series of preliminary cathode study tubes for evaluation in the cathode life test program. These cathodes will be operated at $E_h = 5.0$ volts ac, but otherwise tested as per 6M-3965.

The cathode study program outlined in 6M-3965 has been started at the rate of one tube per day. The first group of tubes processed in this group showed excessive A₂ leakage. Studies indicated that a modification in the bulb preparation would eliminate the problem area.

A series of Pyrex and photo-sensitive glass plates have been processed with a transparent conductive coating for continued studies of electro-luminescent storage devices for Group 25.

A five-inch Charactron-type display tube with a P11 phosphor and a new Gurley matrix was processed for C. L. Corderman's projection studies.

RECEIVER TUBES (S. Twicken)

The program for investigation of the electrode currents of the SR-1782A/2420 as a function of grid geometry has begun to bear fruit. A subtlety of considerable importance has been found: The relative proximity of the maximum of the i_p-e_{c1} transfer curve to the +10V e_{c1} test condition. The data is being drawn up for transmittal to Sylvania. Preliminary results have been given to Sylvania with a request for construction of a small test sample.

6M-4107

RECEIVER TUBES (continued)

The first samples of Bendix' TE-40 (second source SR-1782A) have been received. Bendix is in the right ballpark, but will have to increase the plate currents by about 20%.

Preparations are in progress for a GE-IBM-MIT meeting on January 18 at Lincoln for discussion of a MIL specification for the O528. It is hoped that all remaining differences of opinion will be ironed out at this meeting.

COMMERCIAL TUBES (T. F. Clough)

Saul Twicken and I attended a meeting at ADES in New York City which was called to allocate the 1782A (improved 7AK7) production in the best interests of the overall Air Defense Program. Air Force, Western Electric, IBM, Burroughs, and Sylvania representatives also attended.

The temporary changes in specification which were agreed to at the recent meeting of the IBM-MIT tube groups with Sylvania at Emporium were reviewed especially with regard to their improvement of shipments. The significance of the plate current median control was thoroughly discussed.

The shipments for January were allocated. Lewyt and Burroughs will receive all of their requirements after they have notified Sylvania of their acceptance of the specification waiver. The balance of the shipments will go to IBM. According to present plans, there should be no shortage of these tubes after next April.

CHARACTRONS AND TYPOTRONS (P. C. Tandy)

Four MIT 19-inch tubes and twelve Charactron tubes have completed between 707 and 8014 hours on life test. With the latest test results received, one MIT tube (CHT 113) and one Charactron tube (393) failed to give 50 μ a beam current after 4210 and 362 hours on life test. If the next test results still do not show 50 μ a, these tubes will be rejected. Three tubes, 392, 0287, and 0288 are now operating at pulse zero-bias because they failed to give 50 μ a current at the 20% duty cycle used during life test. Processing of the photographs of the latest transfer characteristic curves of matrix current vs. grid bias voltage has not been completed so that currents at the transfer characteristic test condition are not known. Grid emission on tube number 580 was easily seen after 685 hours on life test. Leakage tests and gas tests on the tubes which have completed over 1000 hours have indicated no significant changes in gas pressure and no leakage currents approaching test limits were found. The helical accelerator resistance of 392 has been measured at 1280, 833, and 1275 megohms at 0, 169, and 518 hours, respectively. Other resistance measurement changes were within the test accuracy.

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CHARACTRONS AND TYPOTRONS (continued)

Eight cathode study tubes have completed between 4368 and 5748 hours. The pulse zero-bias beam current of all the tubes have dropped. At the last test, two tubes failed to give 50 μ a current. If similar results are obtained at the next period, the tubes will be rejected.

Twenty-one bariated-nickel cathode study tubes have completed between 94 and 2066 hours. One tube which had not given much beam current over a long period was taken off life test to make room for a new tube. The currents of the good tubes have remained fairly constant while the current on tubes which have started poorly have in general increased.

Four tubes on the cathode life test program, as proposed in 6M-3965, and the first two bariated-nickel cathodes in the two-inch cathode tube bulb have been received for test. Only two of the six tubes initially passed the specified leakage test. The principle difficulty appeared to be field emission from A_3 to A_2 , although one tube showed leakage when either A_1 or A_3 was positive 3.5 KV to all others, and another tube showed leakage with A_3 at positive voltage. Steps have been taken to prevent A_3 field emission on future tubes.

Eighteen Typotrons have completed up to 6567 hours on life test. The tubes are now being set up on life test. As soon as the set-up is completed, transfer characteristic curves will be taken.

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SAGE DC AND CC SITES

(Group 66, B. E. Morriss)

EQUIPMENT (W. H. Ayer)

An arrangement has been set up with WE-ADES in New York for handling "problem areas" in the system that do not fall into the category of research and development or operations. Under consideration by WE-ADES at the present time are such items, as procurement of the Command Post Liaison Desks and the choice of photographic development facilities at SAGE sites that will process films from the console and monitor cameras.

The WE-ADES systems people, who are handling this work, are also beginning to participate in the change procedures for AN/FSQ-7 and AN/FSQ-8. Bulletin 1-2A, issued by the ADES Project Office, describes the AN/FSQ-7 and -8 change procedure, including Western Electric's responsibilities for scheduling of engineering change proposals and resolution of disagreements on implementing of proposed changes. Several proposals are under consideration for their participation in the change procedures including aid to Lincoln Laboratory in compilation of master reference lists and familiarization with changes at an early stage.

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PROGRAM PRODUCTION

(Group 67, J. A. Arnow)

UTILITY AND CHECKOUT (P. R. Vance)

Programming Information (P. R. Bagley)

This new subsection is concerned primarily with supplying information on computer programming for SAGE and with documenting the utility and checkout efforts. Mr. T. A. Puorro of IBM has joined us. His duties, as well as the rejuvenated activities of the SAGE Programming Information Service are detailed in 6M-4076.

The PM-8 series of IBM Programmers Reference Manuals is entirely superseded by the IBM document, "Theory of Programming," PH 45-00002 (Conf.). Because of the many errors in the PM-8 series manuals, programmers are advised to discontinue using them. "Theory of Programming" is not error-free, but every effort is being made to prepare supplementary documents to correct and amplify it wherever possible.

CARD PREPARATION ROOM (H. Newhall)

XD-1 Operation Time

Program Checkout (Utility Assembly)		34:20
Down Time:		
In/Out Equipment	9:01	
Computer Malfunction	<u>1:30</u>	10:31
Returned to IBM		<u>2:35</u>
Total		<u>47:26</u>

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

New Staff

Assigned to Group 61

Richard C. Miller received his B.A. in Philosophy and BS in Mechanical Engineering from the University of Rochester. For two years he was with the U. S. Marine Corps.

Assigned to Group 62

William E. Holden received his B.S. in Electrical Engineering from MIT, where he worked part time in the Instrumentation Laboratory and the Dynamic Analysis and Control Laboratory. He formerly was with the Electronics Corporation of America.

COMPONENT EVALUATION (H. Hodgdon, C. Morrione)

Prototype transformers have been tested for the proposed Lincoln standard stock. The units submitted passed the electrical tests satisfactorily and with minor mechanical improvement, are being recommended as acceptable. This program will be continued as prototypes are procured until the full line of transformers and chokes is completed.

We attended the Second National Symposium on Quality Control and Reliability in Electronics held in Washington D.C., on 9 and 10 January. Copies of the Proceedings are available in the Components Section office, D-239.

GENERAL ENGINEERING (A. R. Smith)

IBM Punched Card Facility Rooms

The original completion date, January 15th, for this area in the basement of Building A has been revised to read 19 January. The unfortunate delay experienced last week because of joint staff meetings may repeat itself as a result of press conferences during this week. At present, all of the equipment and personnel in C-168 is scheduled to move Thursday into the basement of Building A. Additional equipment being shipped from IBM will be moved directly into the area as received. First shipment of card reader, tape, and control unit is expected any time after 16 January. The plan for relocating Group 61 personnel in Building C will be seriously effected should further delay be encountered.

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GENERAL ENGINEERING (continued)Command Post - Building F

With the knowledge we have at hand, the factors leading to a scheduled operational date are as follows: This section has procured, and is currently revising, a mobile lifting table which will be prepared to move all consoles into the diaz 24 January. The Kelvin & Hughes camera sheet metal modifications, and special sling for lifting, will be completed this week and the unit moved from Building B to the Projection Room on 23 January. The projection hoist will be available for lifting equipment up to 2000 pounds after that date. The Kelvin & Hughes camera will be mechanically operative on 1 February when the service lines have been connected. Unless otherwise corrected, it is assumed that our participation in this program will be terminated 1 February. Work orders have been submitted and await execution for installation of the K & H vent pipe and the cable hole for the SD console. The design fabrication and mounting of signal relay, power supply interconnector and control chassis is being supervised by R. J. Callahan; the interconnector signal cables and power lines to the K & H, power supply and SD consoles is a joint effort by Callahan and E. Reardon.

TEST EQUIPMENT (L. Sutro)

On 11 January, the committee visited the factory of Edgerton, Germeshausen & Grier in Boston to view a very wideband oscilloscope. They observed a shocked-line transient with oscillations at 100 mc, displayed on a 3" CRT. Using no vertical amplifier, sensitivity is obtained by a very small spot size and a magnifying glass for the observer. The EG&G CRT attains its bandwidth by means of a traveling wave deflection structure. Present development promises a bandwidth of 2000 mc.

At its meeting on 6 January, the committee approved purchase or construction of the following:

<u>Qty.</u>	<u>Item</u>	<u>Mfr.</u>	<u>Mod.</u>	<u>User</u>	<u>Grp.</u>
1	Foot Lambert Meter, 0-60, 300	Weston	759	D. Mach	65
3	Ammeter, dc, 0-1.5 amps.	Weston	931	D. Buck	63
20	High-speed Flip-Flop (MTC)	Lincoln Lab.		Groups	62 & 63

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STUDIES IN PROCESS

GROUP 61

Weapons Direction Specifications	J. J. Cahill
Math specs for:	
Antiaircraft - 6M-3982, 2nd draft expected week of 23 Jan.	
Intercept Direction - 6M-3927, 1st draft expected week of 23 Jan.	
Weapons Assignment - 6M-3926, 1st draft expected week of 16 Jan.	
Raid Forming - 6M-3973, final draft issued.	
OPS specs for:	
Interim AA - 6M-3739-1,C1, final draft expected week of 23 Jan.	
Intercept Direction - 6M-3786-1,C2, 1st draft expected week of 16 Jan.	
Weapons Assignment - 6M-3744-1,C2, 1st draft expected week of 16 Jan.	
Raid Forming - 6M-3720-1,C1, 2nd draft expected week of 16 Jan.	

GROUP 62

Power	J. J. Gano
XD-1 Power System Debugging	G. Piantoni
TX-0 Power System Design	J. Clarke
MTC Tape Power Supply	R. Jahn
WWI Refrigeration Memo	R. Jahn
Appl. Thermistors to Filament Cycling	G. Sandy
MTC	W. A. Hosier
Card and Symbolic Address Assy.	B. G. Farley
Flight Test Analysis (for grp. 22)	G. Harris, C. Uskavitch
Pattern Recognition (for grp. 24,34)	G. Dineen, O. Selfridge et al
Simulation (grp. 22)	H. Neumann, B. Stahl et al
New Control Design, MTC	E. Gates, H. Ziegler
MTC Utility Programs (6M-3834)	A. Vanderburgh, Jr.
Design Control	
Timing on Tape Instructions	J. D. Crane
Output Sections (750-pps; 60-100 wpm)	S. B. Ginsburg
AN/TSQ-9 System	S. B. Ginsburg

GROUP 67

Utility and Checkout	P. R. Vance	
Programming Information:	P. R. Bagley	<u>Exp. Comp</u>
Partial OPS-Coding Specs for master tape loading, library merge, library output programs		20 Jan
Corr. to 6M-3994, Checker OPS Specs		27 Jan
Rev. to 6M-3964, Compiler Manual		27 Jan
Corr. & Suppls. to PH45-00002, Theory of Programming		3 Feb
Outline for documentation of utility and checkout efforts		16 Jan

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(Frances Christopher)

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A-188 4085	J. W. Forrester Div. 6 Staff	Reorganization of Division 6 Biweekly Report for Period Ending 30 December 1955	U C
SAGE SYSTEM TEST & PLANNING (Group 61)			
3733-1	P. R. Bagley	Documents of Interest to XD-1 Programmers	U
3780-1 C#1	J. Bryan	Operational Specifications for Identification Function in Sage	C
3936	S. Hauser L. B. Collins	Table Design for the Sage Direction Center Active Program	U
3960	E. W. Wolf	Mathematical Specifications for Radar Inputs in a Sage Direction Center	C
3989	E. L. Lafferty	Interim Operational Specifications for the Recording Function in the ESS	C
4032	S. Hauser F. Garth	Mathematical Specifications for Manual Data-Inputs Function in Sage	C
4041 & C#1 4065	P. R. Bagley W. F. Harris	Editor Subroutine System Summary of Direction Center Switch Actions	U C
4069	B. J. Kollett H. Newhall	Procedure for Use of Card Process- ing Facility	U
4073	P. Bragar	Programmer Training Course #5	U
4076	P. R. Bagley	Sage Programming Information Service	U
4082	D. L. Bailey	Initial Program Specification (IPS) List	U
4088	C. C. Grandy T. R. Callahan	Specification for Air Force Operator Proficiency Required Required Dur- ing ESS Shakedown, Revision and Verification Exercises	C
4098	A. P. Hill	Air Defense Indoctrination Series (Third Series)	U

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3149-3	J. Giordano	Current Systems Office Brief Index Listings	U
4008	R. P. Mayer	Epscom Program Catalog and Schedule Part 1	C
4009	R. P. Mayer	Epscom Program Catalog and Schedule Part 2	C
4080	W. J. Ganty	Test Pattern Generator for AN/FST-2	U
4084	L. L. Sutro	Test Equipment Committee Meeting of 19 December 1955	U
4092	L. B. Prentice	Alteration of S. D. Console for Use with S. D. Recording Camera, XD-1	U
4095	J. Giordano	Minutes of the IBM/LL-SO Concurrence Meeting #50 Held at Lincoln Laboratory 5 January 1956	U
4100	J. D. Crane	Results of the System Tests (Phases V & VI) on the AN/FSQ-7 (XD-1) During November 1955	U
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4099	C. W. Watt	ESS Crosstelling Tests During December 1955	C
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3189-5	E. D. Lundberg	Summary of Lincoln Laboratory Technical Information Releases Pertaining to the Sage System Issued by the PCO Office. (Cumulative List through 31 December 1955)	U
4072	E. D. Lundberg	Sage System Meeting 19 December '55	C
4079	J. J. Carson	Talos Conference of 21 December 1955 at Wright Air Development Center	S
5300	E. D. Lundberg	ESS Planning Coordination Center	U

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896	N. Christian	Project High Semimonthly Report #67	C
897	B. A. Winchell	Project High Engineering Report-- Proposal Testing Procedures for Test Cells at Kingston	U
898	R. E. May	Project High Engineering Report-- Investigation of Autofab Production Sequencing on the 704 Computer	U
899	C. J. Hesner	Project High Engineering Report-- Maintenance Program Identification Code	U
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901	R. F. Cunningham	Project High Engineering Report-- Electrical Drawings Released for AN/FSQ-7 Combat Direction Central	U
902	C. J. Kraus J. E. Wilford	Project High Engineering Report-- GFI Unit Test Report for AN/FSQ-7 (XD-1)	U
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906	-----	Project High Engineering Report--- Central Reference Room Bulletins	U
907	J. Diaz	Project High Engineering Report--- Magnetic Deflection Amplifier	U
908	E. J. Lewis	Project High Engineering Report--- Model A Data Conversion Trans- mitter	U
909	W. M. McMillan	Project High Engineering Report--- Unit Test of Manual Input Element of AN/FSQ-7 (XD-1) Combat Direction Central	U
910	G. F. Duffy	Project High Library Report--- Establishing and Maintaining a Coordinating and Scheduling Group as a Part of a Product Engineering Machine Release Program	U

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573	R. C. Marden	Concurrence on Supplement to Command Post Digital Desk Specification for XD-1. P-182-5	U
574	R. C. Marden	Second Floor Layout of Building F Drawing E-58233-12. P-250	U
575	R. C. Marden	Concurrence on 6M-4017. Specifications for Utilizing the Kelvin & Hughes Rapid Processing Photographic Projector System in the XD-1 Command Post	U
576	W. R. Peavy	Change to Crosstelling Input Specifications, Duplex Central	U
577	L. V. Ruffino	Emergency off Switches	U
578	W. R. Peavy	Change to Fundamental Technical Requirements for Digital Data Transmitters, Receivers, and Associated Equipment.	U
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580	H. J. Barton	Change to the Specifications for the Duplex Maintenance Console	U