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Memorandum 6M-4014

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

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 18 NOVEMBER 1955

To: Jay W. Forrester

From: Division 6 Staff

Date: 28 November 1955

Approved: J. C. Proctor

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SAGE SYSTEM TEST AND PLANNING

(Group 61, J. F. Jacobs)

MASTER PROGRAM PREPARATION (H. D. Benington)

Program Design and Control Programs (A. R. Shoolman)

Nine new staff and RAND personnel have joined the subsection and have been assigned as follows:

Howard Metcalf (RAND), Marilyn Verdier (MIT), and Stan Hager (MIT) will work with Howard Briscoe on Situation and Digital Display programs.

Don Kiley (RAND) and Morrie Mineart (RAND) will work with Larry Collins on Table Design.

Gerry Schissel (RAND) and Mary Ferguson (MIT) will work with Bill Harris on Input-Output programs.

Frances Kelley (MIT) and Joe Guerrero (RAND) will work with Ray Olsen on Switch Interpretation programs.

Memorandum 6M-4003, "Description of Coding Specifications for an Individual Program which is Part of a System Program," by D. L. Bailey and A. R. Shoolman has been completed and will be issued the week of 28 November.

Utility Programs (C. H. Gaudette)

A first draft of the Lincoln Checker Operational Specification, 6M-3994, has been distributed. We are writing coding specifications and they will be available during the next biweekly period.

Compiler checkout progress has been delayed a few days. Magnetic tape units, which are required to assemble and to check out the compiler, could not be used effectively during a four-day period.

Administration of computer operators is now the responsibility of H. Rising's section. However, training and technical direction is still the responsibility of this section.

Publications on Programming (P. R. Bagley)

A revised programming manual for XD-1, entitled "IBM Instruction Manual PH45-00002, Theory of Programming, AN/FSQ-7 (XD-1, XD-2)," (CONFIDENTIAL), has been prepared by IBM and a shipment of 100 copies is expected soon. It supersedes the entire PM-8 series of Programmers Reference Manuals.

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OPERATIONAL SPECIFICATIONS FOR SAGE SYSTEM (C. A. Zraket)Air Surveillance (E. W. Wolf)

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The following documents have been issued:

6M-3826, Supplement 1, "Change in the Operational Specifications for Track Monitoring in the SAGE System," by Frona Brooks.

6M-3960, 2nd draft, "Mathematical Specifications for Radar Data Inputs in a SAGE Direction Center," by E. W. Wolf.

"The ASO-AST Station of a SAGE Subsector's Direction Center," by H. Gochman.

Weapons Direction (J. J. Cahill, Jr.)

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Mathematical Specifications: See Studies in Process.

Operational Specifications: Francis Garth, Ed Braude, and I have been discussing the operational specifications for Weapons Assignment and Intercept Direction before accepting the responsibility for interpreting them. A number of comments and suggestions on the operational specification for Intercept Direction have been received from Dr. D. B. Yntema of Group 3B. A reply will be made during the next period.

Identification and Simulation (J. Bryan, S. J. Hauser)

Rough drafts of the mathematical specifications for the Identification and Manual Inputs functions have been prepared and will be offered for concurrence. At the same time, we are logging detailed modifications which have come to light since the publication of the operational specifications. We shall issue the corrections to these specifications after concurrence with the draft of the mathematical specifications.

A meeting with ADC at Lincoln for concurrence with Iterim Operational Specification for Training and Battle Simulation, 6M-3899, resulted in some additions and corrections to the memorandum, but the meeting adjourned with one unsettled issue. Complete agreement was not reached on the exact method of safeguarding the live air-situation at times of simulation exercises. A method will be proposed and offered for concurrence within the next biweekly period. Another meeting with ADC at Lincoln will be necessary to complete the preparation of a revision to the memorandum.

Combat Center (W. Lone)

L. Hager has been transferred to the Program Preparation Section.

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OPERATIONAL SPECIFICATIONS FOR SAGE SYSTEM (continued)

Henry Frachtman and Elsie Morrione have been assigned to this subsection.

There will be a delay of approximately two weeks in the issuance of the first draft of the "Guide to Combat Center Operations," as there are unexpected problems to be solved.

Standby Computer Planning (A. Heineck) **CONFIDENTIAL**

Study and discussions of the material to be included in a "Guide to Standby Computer Operation" continue. We have determined that it is very desirable to have the tape units made switchable from one computer to the other for the standby, recording, and TBS functions, though perhaps not absolutely necessary for the standby function, as was suspected at one time.

The latest estimates for the amount of safe track data needed for startover is 6000 registers per computation frame at full load. If this estimate continues to increase beyond three drum fields per frame, some of our plans may need revision.

TRAINING (S. B. Hibbard, G. C. Reed)

The Air Training Command Cadre is actively engaged in writing the operator manuals for the Experimental Subsector. They have experienced some difficulty and delay due to lack of standard operating procedures, switch labels and symbology for situation and digital displays.

The SAGE Training Section has released Memorandum 6M-3986, "Results of Survey of XD-1 Operator Requirements," which points out operator shortage during equipment and program checkout and presystems tests. This shortage will be resolved under direction of the Experimental Subsector Personnel Training Committee.

DATA SIMULATION AND ANALYSIS (W. S. Attridge) **CONFIDENTIAL**

Russell Collmer has joined the section and is working with Dick Russo on the mathematical problems of data generation.

Simulation (R. Russo)

A study of projection systems, coverage points, and maneuvers, including climbs and speed changes, is in progress in preparation of the Data Generation Mathematical Specifications.

Recording (E. Lafferty)

The first draft of 6M-3989, "Interim Operation Specifications for

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DATA SIMULATION AND ANALYSIS (continued)

the Recording Function in the SAGE System," has been issued. Work is started on the mathematical specifications.

COMPUTER OPERATION, XD-1 (P. L. Guinard)

Program Checkout (Utility Assembly)		23:09
Down Time (In-Out Equipment)		
Tapes Malfunction	13:28	
Drum Parity	1:08	
Power Failure	<u>0:30</u>	15:06
Returned to IBM		<u>1:45</u>
Total Assigned Time		40:00
Extra Time Allotted		<u>1:38</u>
Total		<u>41:38</u>

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FSQ-7 PROTOTYPE DESIGN AND INSTALLATION

(Group 62, N. H. Taylor)

XD-1 INSTALLATION (J. A. O'Brien)

Construction (H. F. Mercer)

Division 1 will complete the installation of command post facilities. They will also prepare the lower level of the projection booth to house the XD-1 weather service equipment.

Acceptance Tests (J. D. Crane)

The LRI element and the crosstell element were used in two demonstrations each. Both elements performed the logical functions required by test specifications, with one minor exception caused by the drum manual test equipment.

XD-1 Weekly Schedule (J. D. Crane)

A concentrated effort is being made to obtain the most efficient use of XD-1 by careful scheduling. Requests for time should be sent to J. D. Crane, Room D-232.

LRI Monitor (J. McCusker)

The LRI monitor, which gives a PPI display of LRI data entering the computer, has operated satisfactorily in tests conducted with XD-1. AC pickup and hysteresis effects in the deflection coil, which limited reproducibility to 1 per cent, have been considerably reduced. The hysteresis effect was reduced by changing deflection coils.

MEMORY TEST COMPUTER (W. A. Hosier)

Magnetic Tape Installation

Spoken assurance has been given us by IBM that three tape drive units and a tape adapter frame will be furnished to MTC by 1 March 1956 or sooner; we have yet to learn specific delivery dates and whether or not the tape drive power supply is also coming from IBM. We are investigating such manufacturers as Acme and Power Equipment Company against the possibility that we may have to furnish our own power supply.

IBM has generously offered to put one of our engineers through their tape drive school in Poughkeepsie. This should materially reduce the time it takes us to familiarize ourselves with the units and get them operating after delivery.

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MEMORY TEST COMPUTER (continued)New Control Design and Construction

Gates and Ziegler have made detailed measurements of the MTC memory cycle, and have pretty well completed design of this part of control. Construction of the new frames is proceeding well: a panel of switched clock pulse output gates has been operated for about eight hours, and tailoring of the driving pulses to strobe these gates in groups of 16 have been satisfactorily completed.

Display

All components for the camera scope of the improved display system have been received and individually tested. Internal wiring of the scope and amplifier mount is more than half complete, and we should be able to begin testing the assembled system before the end of the month.

Ferranti Reader

After considerable experiment on the bench, Stockebrand and Ziegler have come up with the following modifications which should make the Ferranti photoelectric tape reader more reliable:

Lower filament voltage as mentioned in the previous Biweekly. Change in the operating point of the first amplifier stage to increase gain (allowing clamping of output levels) and draw less grid current.

Smaller light aperture hole (No. 4) in the feed plate of the reader under the sprocket hole of the tape (0.0625 to 0.045). This was done without making a new plate by plugging the original hole with a brass rivet. The new small hole was drilled on a center co-linear with the other seven. This may not provide the best phasing of the leading edge, but further experiment will determine this.

High-Speed Tape Punch

On talking with Mr. West, President of Soroban, at the recent Joint Computer Conference, we were informed that the Soroban GP-100 punch, originally promised for 15 November, would not be delivered until 1 February 1956. Therefore, Art Hughes, who had been planning the installation of this punch for MTC, has shelved it for the time being, and is studying details of the magnetic tape installation with John Crane.

Computer Operation

The use and reliability of MTC have continued much as previously.

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MEMORY TEST COMPUTER (continued)

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Bill Canty, together with personnel from Group 21 and from Western Electric, has made use of our cables running to Building F to connect radar data to LRI inputs. He has also made and checked a sample magnetic tape on which an LRI message generated by MTC is recorded serially by FM techniques through a DDT. Otherwise, operating time has been apportioned as follows:

	<u>Hours</u>	<u>Per Cent</u>
Analysis and Data Processing	92.5	40.4
Development and Testing	89.9	39.3
Maintenance and Marginal Checking	18.3	8.0
Reliability Check Programs	25.6	11.2
Interrupting Failures	2.6	1.1
Totals	<u>224.2</u>	<u>100.0</u>

Summary of defects found in tubes and components, 7 to 18 November:

<u>Tube or Component</u>	<u>Defect</u>	<u>Qty.</u>	<u>Hours Lost</u>
6145	Tap short	1	0
6145	Grid emission	1	0
6145	Low cathode emission	1	0
6145	Gone to air	1	0
6145	Gas current	1	0
Z2177	Gone to air	1	0.90
Totals		<u>6</u>	<u>0.90</u>

DISPLAY DEVELOPMENT (C. Corderman)

The deflection amplifiers for the electrical readout have been redesigned to give a total of 550 volts outputs. The vertical sweep will be redesigned for greater linearity.

A Typotron using a P-14 phosphor and an inactive storage mechanism was demonstrated in MTC. It is now installed in Building F in the TBS room. A P-14 Charactron is in the same console.

An M-note on the logic of the display equipment in MTC will be completed soon.

RECORDING CAMERA (L. L. Sutro)

Experiments with three kinds of film, exposed at eight different stops and developed in three different developers for four different

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RECORDING CAMERA (continued)

times have led to one satisfactory combination and may lead to more. Two conclusions have been reached: (1) The film will be Eastman Kodak Triple X. (2) The display should be contracted to 10"x10" because the corner characters become illegible in a larger display.

SAGE SYSTEMS OFFICE (H. E. Anderson)

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Auxiliary Data Processing Equipment

A memorandum, 6M-3978, has been prepared describing the operation of the auxiliary data processing equipment, including the information required to program for this equipment, a description of the error checks provided, and a brief guide for operators.

Semiautomatic Teletype Input for XD-1

An IBM 047 paper tape-controlled card punch has been installed in Room Y, Building F. The message composer has been used to send teletype signals to a receive-only typing reperforator (ROTR) which prepares a paper tape. The paper tape is then read by the 047. This system is automatic except for the transport of paper tape and of punched cards from one machine to another.

Talos Reply Back Study

Several systems have been investigated, including AN/TSQ-7, Teletype, Data Service, and IBM 65-66 data transceiver. A summary report is being written.

Bomarc Planning

Several trips were made by Systems Office personnel to surmise the present state of the Bomarc-SAGE planning. A new memorandum covering this area seems necessary as a result of information obtained. Results of discussions and informal agreements reached during the past fifteen months have not been included in 6M-2848-1. Air Force plans for use of Bomarc make some of our original Bomarc-SAGE planning for status input and guidance output equipment questionable. Also, a significant improvement in the level of detail of the specification appears necessary.

BASIC CIRCUITS (R. L. Best)High Speed Flip-Flop (MTC) (N. J. Ockene)

The redesigned Mod II, MTC flip-flop has passed all tests to date. In addition, it was successfully used in circuit logic provided by

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BASIC CIRCUITS (continued)

Herb Ziegler of MTC (4 mc operation). Complete test data is now being taken and will be incorporated into a report.

Half Amplitude Driver (Production Plane Tester) (D. Shansky)

This driver has been breadboarded and tested. It will furnish positive and negative half amplitude current pulses into an X or Y winding of a modular memory plane. The current pulses are variable in amplitude from approximately 350 ma to 500 ma. The amplitudes of both the positive and negative pulses (which may be varied independently) are independent of program. The maximum duty factor of either the positive or negative pulse is 50%. The output of the driver appears at ground level, at a single terminal so that only one wire need to be passed through the core (or cores). The rise and fall times of both current pulses are nominally 0.5 μ sec, while the pulse length and sequence is determined by external logic.

Gap Filler Sweep Circuit (B. W. Barrett)

In order to satisfy time requirements, this circuit has been modified to work with a transformer previously approved for another use in XD-1. The breadboard has been marginal-checked and the final version of this blocking-oscillator type sweep circuit is being packaged in a pluggable unit.

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

Three different follower circuits and their possible application to "hot" and "cold" probe use have been studied. The resistance-wire cold probe performance is very good. A study of the follower circuits has yielded considerable improvements in waveshape reproduction and an evaluation and comparison of the three circuits is currently underway.

Digital Data Receiver (E. B. Glover)

A major component of the slicer trouble was traced to the phase relationship between the synchronization pulse and carrier at the output of the DDT. The addition of a capacitor in the DDT circuit which slightly shifts the carrier phase has resulted in successful operation of the DDR under all conditions.

First margins taken with the above changes indicate considerable unbalance of synchronization, data, and timing margins. Data margins are inadequate although the others are larger than necessary. A slight rearrangement of components tending to equalize these margins should result in at least sufficient margins for all three.

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BASIC CIRCUITS (continued)

The circuit still has to be tested for 1300 cycle operation. It will also be tested with another phone line to ensure that the changes made did not result in a simple "tailoring" of the DDR to the particular phone line used.

Vector Generator (E. B. Glover)

A meeting with John Swatton of IBM was held last week for the purpose of supplying him with all available information on the vector generator needed for the MRD report. This report should be published in the near future and will be complete except for the final marginal checking data which is not available now.

Vector Intensity Decoder (R. B. Paddock)

The output amplitude, fall time and rise time are close to requirements, but PRF sensitivity is still a problem.

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

CHEMISTRY OF MAGNETIC MATERIALS (F. E. Vinal)Memory Core Production

Status of cores for the TX-0 memory is:

Double-tested cores	1,970,535
Single-tested cores	92,000
On hand for testing	113,000
On hand for firing	<u>660,000</u>
Total	<u>2,835,535</u>

Although core pressing will continue from time to time as a part of other development work and eventually will carry the total over three million, no further pressing of cores is planned on a daily production basis. (J. J. Sacco, R. C. Zopatti)

Inorganic Chemistry

Recent preparations containing nickel in more than one valence state have introduced severe analytical problems which are under investigation. (D. G. Wickham)

Crystallographic work is being applied to:

1. The $\text{CuFe}_2\text{O}_4\text{-Mn}_3\text{O}_4$ system,
2. Co substituted MnFe_2O_4 single crystals grown by the Verneuille method,
3. Thermistor samples from the Group 60 Power Section.
(W. J. Croft)

Cooperation from the Photo Lab of Division 7 has resulted in short strips of movie film which show the motion of domain walls in polycrystalline ferrites. Further improvement of this demonstration will be continued. (F. S. Maddocks)

Recent experiments with lithium ferrites indicate even more promise for the use of these materials in square-loop applications. (D. L. Brown)

PHYSICS OF MAGNETIC MATERIALS (J. B. Goodenough)Instrumentation

The 12-inch Varian magnet for the vibrating-coil magnetometer ar-

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PHYSICS OF MAGNETIC MATERIALS (continued)

rived Thursday, 16 November. Mechanical assembly of the vibrating unit will be completed the week of 21 November, and electrical testing should be well underway by the end of the next biweekly period. Most of the associated electrical equipment has been constructed. (D. O. Smith)

The helical-potentiometer current-drive unit for switching the flux has been installed in the dc fluxmeter. The x-y recorder has also been satisfactorily adjusted. As yet, however, the B-H loops which are traced do not close because of excessive drift due to less than infinite gain of the fluxmeter amplifier. A Nyquist plot of the phase-gain characteristics of the system will be made to eliminate the parasitic oscillations which now occur when the gain of the amplifier is increased. (R. A. Pacl, Jr.)

An r.f. bridge and associated equipment have been borrowed from the Component Evaluation Laboratory. A bias field power supply has been designed and built. It is planned to measure ac permeability vs. the bias field applied from remanence. (J. D. Childress)

In order to know the inherent speed limitation for a ferrite memory core, it is necessary to measure the maximum switching frequency a core can sustain before its magnetic properties deteriorate to a point where the core no longer can be used in a coincident-current matrix. Since the properties of the core as a function of temperature are readily measured with the new test equipment setup, an experiment has been designed to measure the core heating as a function of the frequency of switching. (J. D. Childress)

Theory

In preparation for the window frame experiments, it is necessary to calculate the domain wall energy for a wall in a (211) crystallographic plane. This calculation is underway. (N. Menyuk)

The investigation of the rickrack domain patterns of BiMn alloy indicate that the energy of the domain pattern varies quite sensitively with the amplitude of the pattern. Calculation of the best configuration will be completed the week of 21 November.

NEW COMPONENTS AND CIRCUITS (T. Meisling)Transistor Life Tests

The transistor life tests have now accumulated a total of 1.3 million transistor hours on a total of 286 transistors. (D. J. Eckl) Two failures have occurred, both during testing. If we count these, the failure rate is about 0.16 per cent per thousand hours. One of the

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NEW COMPONENTS AND CIRCUITS (continued)

two failures, however, was definitely accidental or "caused." The other may have been.

The 100-transistor, 8-digit shielded shift register has held a pattern to date for 3900 hours (23 weeks) and a similar unshielded unit has reached 1700 hours (10 weeks) without error. These units are operating on batteries. A TM-1 type register, operated on a transistorized power supply connected to the ac line has been losing its pattern overnight, but experience with this is slight.

Transistor Delivery

People anticipating the use of transistors should bear in mind that there may be a one- to two-month delay in delivery on many types and plan accordingly.

SBT Testing

Routine measurements are continuing on Philco SBT's. (P. A. Fergus) Of the 2500 transistors received, 600 have been completely tested, 100 partially tested, and 1800 are untested. Six hundred additional SBT's have been ordered from Philco and of these, 90 per cent yield is expected. Of these two groups, we are endeavoring to obtain 2000 transistors to be delivered for TX-0 on 27 December 1955.

An IBM card system is being set up to facilitate plotting the transistor parameter distributions.

SBT Turn-off Time vs. Operating Point

J. R. Freeman's tests of storage time as a function of the operating point in saturation have yielded some interesting results. An experiment was conducted on a simple inverter which had in effect a fixed collector load resistance and a variable collector voltage supply. A series of time measurements were made for a fixed base current in the on-condition. The transistor was turned off by grounding the base through a 1000-ohm resistor (with a mercury relay). The measurements show that any given collector current (less than that which is supplied in the saturated condition) is reached in a fixed time during turn-off, irrespective of the initial value of the collector current. For example, for a base current of 5.9 ma, it takes the same time (about 0.8 μ sec) for the collector current to diminish to 0.2 ma for any initial (saturated) value of collector current between 1 and 6 ma. These measurements will be pursued further.

Hughes Sample Transistors

We have received samples of a Hughes medium-power transistor. Its

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NEW COMPONENTS AND CIRCUITS (continued)

electrical characteristics are very promising. It will dissipate 300 mw in free air, 500 mw in a clip (supplied with the transistor), and 1000 mw when the clip is attached to a heat sink. The measured rise and fall times are about 0.2 μ sec. The β at 100 ma is about 250 and at 400 ma about 100 (measurements by G. Davidson).

Silicon Diode Component Tests

We have asked the Components Section to include silicon diodes in their tests. Cohler will advise them on any special tests.

MEMORY (J. L. Mitchell)Experimental Switch and Plane

The new switch-driver-current regulators were received from the shop and are now installed and operating. The "jitter" and the output of the switch drivers was eliminated by the above change. Tests were conducted to measure the effect of feeding the inhibit winding by means of a coaxial cable. It was found that the effect of the cable was negligible.

Cooling and Supplies

The construction of the walls in the basement of Building A is essentially complete and the air conditioning ducts have been installed in the computer room. The installation of the ceiling should start in about a week. A delivery date on the Westinghouse air conditioning units is not yet available due to the Westinghouse strike.

256² Construction

Sixty 64 x 64 memory plane modules have been accepted. The memory plane tester has not been in operation for the past two weeks due to the installation of a standard plane. The design of the small bench-type memory plane tester is in the construction stage. An improved plane-wiring procedure, which should reduce the number of broken cores, is being tried. Results should be available in the next week or two.

Some Belden Nyclad wire has been ordered as a replacement for the Formvar wire now used in the construction of memory planes. The engineering data we have on this wire indicates that it should be equal to the Formvar wire in all respects and that it is not subject to the crazing reported in the last Biweekly.

The design of the memory stall is essentially complete. Construc-

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MEMORY (continued)

tion of both the rack and the memory stall is scheduled to begin immediately. The first plug-in units are now in the Wiring Shop.

Advanced Development

Bradspies' sense amplifier was tested on the 256 x 256 plane and the results are encouraging. The main problem now appears to be further improvement of the pulse transformer.

A conference was held between Davidson, Baker, and Rediker where the requirements on the transistor switch for a 64 x 64 x 17 memory were formulated. These requirements are available from Davidson. The three experimental Philco transistors could not be tested in the switch circuit due to the low voltage ratings.

SYSTEM DESIGN (K. H. Olsen)

TX-0 Packaging

The last several biweekly periods have been spent studying packaging for TX-0. The arguments were the same as those we have considered several times before. A few types of plug-in units are possible if the units are simple and small, but would necessitate a complex panel wiring and many contacts. A simpler panel wiring with large plug-ins would require a very large number of types as in XD-1. Because production simplicity is so important to us, we decided to use a very small plug-in package and plan to have a very few types. We are simplifying our panel wiring by making it in small pieces that can be wired on a bench by several people simultaneously.

TX-0 Block Schematics

Chet Norman is converting Wes Clark's block diagram into block schematics and from these he is laying out the computer.

TX-0 Power Supplies

Bob Hughes has underway several prototype transistor-regulated power supplies for TX-0 and has designed one to replace the batteries that now supply the life tests.

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AN/FSQ-7 AND CAPE COD DIRECTION CENTER

(Group 64, S. H. Dodd, Jr., E. S. Rich)

CAPE COD ENGINEERING (L. L. Holmes)WWI Computer Operation

Scheduled Computer Hours:	336.0
Interrupting Incidents:	16.0
Hours Lost:	3.3
Per cent Good Time:	99.0
Mean Time Between Failures in Hours:	20.8

Five of the 16 interrupting incidents accounted for 50% of the down time. These incidents were a result of the blowing of the ac power fuse to a photoelectric paper tape reader. The troubles were caused by an intermittent short in a poorly designed lamp connection. A new method for connecting power to the lamp has been devised.

Computer Display System

Our section has been requested by the S & E C Group to investigate the undesirable noise that distorts the displays during the operation of certain programs. C. S. Lin and A. N. Blumenthal have begun working on it. They have discovered that the noise appears to be repetition frequency sensitive; the slower the display rate, the greater the noise.

XD-1 and WWI Crosstelling

The crosstelling equipment at the Barta Building has been undergoing daily marginal checking for the past couple of months and it appears to be in excellent condition. The program to be operated at WWI during the equipment tests with XD-1 has been written by E. W. Pughe, is almost completely debugged, and will be made operational during the coming biweekly period.

Computer Alarm Reports

The computer alarm reporting system is being revised. At the present time, we are using three forms that are supplemented by pictures of the flip-flop indicators made with a land camera and a post mortem of the contents of core memory and/or drum storage existing at the time of the computer malfunction. The new system will utilize only one simple form in addition to the photograph and post mortem.

Remote Computer Alarm Indicator

A remote alarm indicator panel has been installed in Room 251, occupied by Group 22. When connected to the computer, the panel will

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CAPE COD ENGINEERING (continued)

provide an audible and visual indication of computer stoppage. Group 22 feels that the indicator will eliminate superfluous phone calls and trips from the office to the computer area.

Buffer Drum Group-Erase System

A system to erase a group (16 tracks) at a time is being devised by L. D. Healy. It will employ relay switching to connect the heads of the 16 tracks in series. Tests using Group II have not indicated crosstalk due to the added wiring.

Fairchild Camera

L. H. Norcott has continued his investigation of the failures of the camera's solenoid to index following the performance of several hundred operations in rapid succession. A camera that failed in this manner was modified by removing a shim from the main drive assembly. The unit was then bench-tested and gave no indication of the trouble. It will be returned to computer operation in the modified condition where it will be closely watched for additional signs of trouble.

Cape Cod Direction Center (CCDC)

During a recent mission conducted by Group 22, the newly installed CCDC camera system was used to record radar data on a scan-by-scan basis. Only four of the available seven camera installations were requested for this mission. The camera equipment functioned without obvious incidents of interruption. Before the camera system is again used by Group 22, several minor adjustments will be made at the Subsector Commander's console to improve the quality of the photographs made of all radar data.

One of the two 14-channel Ampex tape handling units has been modified to reduce tape slippage. A sandblasted capstan was substituted for a smooth capstan. The change appears to be successful, so a new capstan will be procured for the other Ampex unit.

SYSTEM TEST PLANNING AND COORDINATION (K. E. McVicar) CONFIDENTIALEquipment Program Services Committee (R. P. Mayer)

There are now 20 people on EPSCOM. In addition, the following people from Group 62 are or will be contributing their services: Art Hughes will complete a program before going on with MTC. Alex Vanderburgh will be available for documentation work soon, and Paul Murphy will be available after completing a programming course.

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6M-4014

SYSTEM TEST PLANNING AND COORDINATION (continued)

Memorandum 6M-4010, which brings 6M-3876 up to date and clarifies the kinds of programs to be written by EPSCOM, has been drafted and should be issued the week of 21 November.

Rough drafts of 6M-4008 and 6M-4009, "EPSCOM Program Catalog and Schedule, Parts I and II," are being circulated to the test teams for comment. They tentatively outline 61 programs and a manpower schedule for writing them. The program numbers used below which begin with "E" are the same as in this catalog.

MTC DDT/DDR/GFI

A. Werlin and J. Mazza have made successful runs in testing the GFI equipment with MTC using various azimuth jitter patterns. The program for checking the pattern generated by an external GFI site is still being debugged. An M-note describing the operation of the program for both checking the DDT and DDR and checking GFI is being written.

Radar Pattern Checking

W. J. Marston spent the past two weeks in debugging the program, but it was largely wasted because of trouble with the "trace" program, which was giving trouble with the bsn and csw instructions.

Success was obtained with those portions of the Radar Pattern test program that have been run. Further tests are necessary to make certain all features work.

B. Beatty has written a program which will clear the error display periodically. The display clearing program also contains the option of clearing by manually pushing the activate button on the display console. These have been coded and punched on cards but not yet checked out.

Outputs Programs

R. C. Mayberry has been checking out the XD-1 program for crossteling with WWI. He also wrote a ground-to-air program for putting messages on the output buffer (OB) drum. The OB drum will then be disconnected from the computer, and these messages will be sent out from the drum continuously (without being "erased").

Outputs (C. W. Watt)

An MTC program has been prepared for coding that will send a variety of G/A messages to the Barts Building for recording on magnetic tape. Since it now appears that the XD-1 output buffer drum will be avail-

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SYSTEM TEST PLANNING AND COORDINATION (continued)

able for use sooner than was expected, our efforts will be directed during the next few days toward finishing our XD-1 program that will record the desired G/A message.

A meeting of the G/A Test Team was held on Wednesday, 16 November. A schedule of G/A data link tests was presented and accepted with slight modifications. The responsibilities of the G/A data link test team were defined and agreed upon. The minutes of the meeting are available as an interoffice memo.

XD-1 Single Track

EERX 040 (old number: GSRD 0000) - A program by C. S. Sherrerd to generate simulated track and noise radar data for use by tracking and/or display programs is completed and operating.

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VACUUM TUBES

(Group 65, P. Youtz)

TUBE TECHNIQUES (J. S. Palermo)

The innumerable variables introduced with the production of 5-inch Charactrons from "salvaged" Typotron tube components have presented a cathode problem. However, the initial observations and data recorded during the processing of this latest tube (CHT-133), together with the preliminary test data, indicate that considerable progress has been made towards the solution of this problem.

The bariated-nickel cathode program has produced an adequate number of available sintered bariated-nickel cathodes for the preliminary assignment. The fabrication of additional cathodes is planned in order to establish better control (e.g., dew point of both gases during sintering). A careful microscopic examination (144X) of the prepared cathodes revealed only slight traces of "blooming." This "blooming" characteristic is a white powdery surface film on sintered cathodes which may be indicative of absorbed water vapor. However, further study is necessary of this seemingly important factor.

CHARACTRONS AND TYPOTRONS (P. C. Tandy)

Four MIT 19-inch tubes and seven Convair Charactron tubes have completed between 236 and 6838 hours on life test. Of the six new Charactrons started, the currents of O189 decreased appreciably and those of O288 increased during the first 165 hours. Of the four MIT tubes, the matrix current of CHT-75 dropped from 111 to 70 μ a between 6136 and 6746 hours, and CHT-80 increased from 127 to 225 μ a between 5986 and 6594 hours.

The helical-accelerator resistance has not shown appreciable change during life test. All changes are probably within the accuracy of measurement.

The screen capacitance and dissipation factor of nine tubes decreased an average of 13 and 21 per cent, respectively, over a 1300-hour period. Some of this change might be due to differences in test conditions (changes in aluminum disc, spacing of disc from glass, and leads between tube and bridge).

Fourteen cathode-study tubes have completed between 3040 and 4420 hours on life test. Test results have indicated no significant changes.

Nine bariated-nickel cathode-study tubes are also operating. Of three triode and six diode tubes on test, about half have improved.

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CHARACTRONS AND TYPOTRONS (continued)

CT-130 was very poor after about 1000 hours life with a maximum current of 2.65 μ a with 14.7 volts applied between the diode elements. This tube had been operated at 4 ma current by A. Zacharias. Eight Typotrons are continuing to operate on life test.

RECEIVER TUBES (S. Twicken)

The IBM group, P. Youtz, and I attended a meeting at Raytheon, Newton, on the progress of development of a second source of the AN/FSQ-7 low-power twin-triode. Cooperation between G.E. and Raytheon is hopelessly bogged down in competitive animosity, past history of cooperation and financial fees. It appears highly unlikely that G.E. will supply any information of practical value to Raytheon during the initial period of development when it is most needed. This is not an insurmountable problem to Raytheon, but it will delay their program. Raytheon's plans for the procurement of parts are progressing according to schedule except for cathode sleeves. Superior Tube Co., the sole supplier, had apparently given Raytheon unreasonably long delivery dates.

At the request of Raytheon, an IBM representative, P. Youtz, and I visited Superior with the Raytheon project engineer. The sleeve scheduling problem was ironed out and a program arranged to supply Raytheon with (1) sleeves of existing materials from which an interim choice will be made, and (2) sleeves of many ingots of various chemical constituency, long-term evaluation of which will yield a final cathode alloy. An inspection of the mill was made to gain insight into the problems of cathode fabrication from ingot to sleeve.

Potential revisions in the quality portions of the 0528 specification are being considered in anticipation of a G.E. proposal which would go into effect upon militarization of the tube type. G.E. will initiate a request for a MIL specification for the 0528 within the next six weeks.

A meeting of the JETEC Task Force on Computer Gas Tubes was held at the Barta Building. This group has now almost completed fitting the 2D21 to the trial format.

COMMERCIAL TUBES (T. F. Clough)

The Lincoln tube processing specification for the cathode study tube program has received considerable attention during this period. These specifications are being written with close attention to detail in order to adequately specify and control processing variations from one tube to another in this series.

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PRODUCTION COORDINATION OFFICE

(Group 66, B. E. Morriss)

POWER (J. J. Gano)

SAGE System M-G Evaluation

This investigation is reported in memos 6M-3946 "Transient Analysis of Direction Center Power Supply without Motor-Generator Sets," by Jackson and Moreland; and 6M-3947, "Effect of Power Transients on Computer Reliability." The Jackson and Moreland report covers the probable frequency of a range of voltage transients on the generating buses. Memo 6M-3947 covers the transfer characteristics of the dc supplies and the margins of the computer for simultaneous variation of the dc voltages using XD-1 equipment. The correlation of these results indicates that in an AN/FSQ-7 installation having no utility tie and no M-G sets, generating bus transients will cause approximately one error per year for both computers (non-simultaneous). Calculations are based on separated generating buses with two or three 650 kw diesel generators connected to each bus. On the basis of this study, it is recommended that the M-G sets be eliminated in order to increase reliability, simplify the system, and reduce installation and operating costs. We have already reviewed the draft of a proposal by IBM to this effect.

Jackson and Moreland's report completes the series of studies on transients in power generating systems.

Building Requirements and Power Generation

Six AFIRO representatives spent a day at Lincoln absorbing background information for the SAGE System. The opportunity of seeing equipment in operation should give them a greater appreciation of the decisions they are called upon to make.

XD-1 (S. T. Coffin)

Investigation of several XD-1 dc power supplies has shown daily variations in their output voltage of 3 to 4 per cent over a period of several weeks. In many cases, this drift is caused by load changes and insufficient gain in the feedback loop.

FACILITIES (W. H. Ayer)

Efforts are still underway to transfer responsibility for some of the various facility design functions from the Laboratory to the various operating organizations in the field; primarily IBM and WE-ADES. Meetings with these organizations in the last month have resulted in a decision to divide the cooling system design recom-

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FACILITIES (W. H. Ayer)

mendations into two parts. IBM will now supply directly to WE-ADES all information on heat loads, air quantities, and pressure drops for their equipment. Lincoln will simply state certain recommendations for the overall system concepts. Memorandum, 6M-2921-3, has been prepared with this view in mind and is now being coordinated with WE-ADES and IBM.

The Lincoln effort on the direction center and combat center building redesigns is now complete. ADC and Lincoln Laboratory have stated to WE-ADES and the Project Office that this design meets the operational requirements of the SAGE System and recommended its adoption. WE-ADES is now engaged in an extensive coordination effort with AMC and AFIRO in an attempt to acquire engineering and construction funds for the new design.

EQUIPMENT (W. H. Ayer)

Release of manpower from the facilities effort and the fortuitous return of P. J. Gray to the Laboratory have allowed more concentration on the coordination and release of XD-1 and FSQ-7 equipment specifications than was previously possible. At the present time concurrence with TIR's revising the XD-1 and FSQ-7 specifications and an FSQ-7 Master Reference List is being sought. Various minor display changes and several equipment lists for FSQ-7 are also being coordinated in preparation for release.

OPERATIONS (H. J. Kirshner)

Personnel have been requested of IBM to aid in the preparation of specifications for the Standby Computer Program and to assist Group 61 with the programming information service.

COMMUNICATIONS (H. J. Kirshner, C. J. Carter, F. E. Irish)

A meeting was held on 7 November with representatives of AT&T to discuss the ESS teletype network. As a result of this meeting, several changes, including the use of large-size type on machines behind plotting boards, have been made in the teletype system. Orders reflecting these changes will be issued shortly.

The white-on-black designation strips for the console key units have been completed and will be installed as soon as possible.

Tests of the XD-1 telephone key units indicate that the line lamps are too bright for operational use and we have conducted experiments to determine an easy way to dim them.

On 17 November representatives of BTL were here to demonstrate squawk

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COMMUNICATIONS (continued)

boxes for the computer maintenance intercom system. The equipment was left here so that further tests could be conducted throughout the coming month.

Memorandum 6M-3275-3 was issued.

The revision of telephone circuit orders to reflect changes in terminations on service dates is underway.

A trip was made with Jack Cahill of Group 61 to the Charlestown Navy Yard on 15 November 1955 to observe a teletype page projector. This page projector is being considered for use in the AAOC.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

New Staff

William E. Ball, Jr., has returned to work in Group 61.

Philip Gray has returned to work in Group 66, PCO.

COMPONENT EVALUATION (H. W. Hodgdon, C. Morrione)

We visited Sylvania's Transformer Plant in Ipswich with members of the Standards Committee for the purpose of discussing specifications and testing of the proposed new transformers for Lincoln stock. The mechanical sample we saw looked very promising; samples for testing will be coming shortly.

The component evaluation laboratory now has a new binocular microscope with magnifications from 10 to 150 to supplement its existing equipment for evaluation and dissection of components.

SECURITY INVENTORY (A. M. Falcione)

It is expected that the freeze on return of classified documents to the Division 6 Document Room will be lifted on or about 1 December for CONFIDENTIAL only. SECRET documents will have to be retained until Phase II of the security inventory check is completed by the Security Office.

ENGINEERING (A. R. Smith)

Capsulated Transistor Circuits

The list of vendor bids for fabrication of 3000 caps is nearly complete; promising a delivery within two weeks after receipt of order. Therefore, the completion date for 3000 assembled units is now based on component delivery and availability of finalized drawings for construction shop to start assembling.

Azimuth Drive Handset

The existing handset crank mechanism for Barta Building display room mappers has been redesigned to provide an extended, smoother, and uninterrupted service packaged in a much smaller area. Production of thirteen units will begin immediately following acceptance test, to be undertaken this coming week.

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ENGINEERING (continued)

Glass Lathe Steady-Rest

A steady rest to support a 19" Charactron tube during dag pen striping operation has been fabricated and installed. It was interesting to note that there are no accessories available for glass lathes such as commonly associated with metal working lathes, nor are they readily adaptable, each request necessitating design and fabrication.

Dag Pen Assembly

A new motor-driven dag pen striper assembly, incorporating MIT and Convair previous design, has been fabricated and is to be installed this week. The new design provides (1) the opportunity to generate a helix in either direction; (2) a better method of keeping the pen in contact with the glass envelope, and (3) an adjustable pen opening to accommodate variable dag viscosities.

TEST EQUIPMENT (L. Sutro)

The preventative maintenance testing of test equipment in Barta Building fell behind schedule last summer after the technician assigned to that work left us. Martin McMahon took his place, learning the art of testing and repairing standard test equipment from A. Bille and A. Kyrikos during the late summer and fall in Lexington. He will now go to Barta to work until all standard test equipment there has been tested. A. Bille will spend half of his time there until all of the scopes have been tested. Testing of the meters is a problem being considered with Division 7 instrument room.

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STUDIES IN PROCESS

<u>Study</u>	<u>Responsibility of</u>
<u>GROUP 61</u>	
Digital Data Display Program Specs	H. Briscoe
In-Out Program Specs	A. Shoolman, A. Ginsberg
Radar Input OPS Specs	F. Brooks
Situation Display Program	A. Schwartz
Switch Interpretation	R. Olsen
Table Storage Requirements	L. B. Collins
Track Scan	F. Ogg, P. Strait
XD-1 Inactivity Alarm Proposal	M. Feldstein, P. Vance
XD-1 Startover Program OPS Specs	P. R. Vance
Lectures, AD Programming Course	A. R. Shoolman
OPS Specifications	A. R. Shoolman
<u>Training</u>	P. R. Bagley
<u>Subject</u>	<u>Status</u>
Compiler Manual	ready for publication
OPS Specs for Checker	draft being revised
Checker Manual	preliminary outline
	completed
	9 Dec.
Programming Data Sheets, Part 1 of 2	draft two-thirds complete
	16 Dec.
<u>Mathematical Specifications</u>	J. J. Cahill
Antiaircraft	rough draft issued
Intercept Direction	rough draft expected week of 21 Nov.
Weapons Assignment	" " " " " " " "
Raid Forming	6M-3973 (Dan Ladd) first draft issued. Second draft for concurrence expected to be issued during next biweekly period.
<u>ESS Planning (over-all)</u>	C. Grandy
Task inventory	T. Callahan
Test program requirements	R. Lusher
Operating procedure reqmts.	A. Thomas
<u>Staff Training</u>	A. P. Hill
AD Indoctrination Lectures will be conducted at Murphy Hospital through 9 December as outlined in 6M-2972.	
<u>Data Analysis</u>	J. Slagle

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STUDIES IN PROCESS (continued)

GROUP 62

Memory Test Computer	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
High-Speed Punch Installation MTC	A. D. Hughes
Return-to-Base Air Navigational Systems	C. Corderman

GROUP 64

<u>EPSCOM Programming Procedure</u>	H. I. Rundquist
Program to Print Errors	B. Beatty
Tracking Program, ETRX 0101	C. S. Sherrerd
Tracking Program, ETRX 0100 (nearly complete)	C. Sherrerd, S. Thompson, H. Rundquist
Simulated RD Program	W. Vollmer, J. Blandon
Height Finder Eq. Test Prog.	J. J. Maroney
Reliability of Magnetic Tape for Recording Phone Line Messages	C. W. Watt and WE-ADES personnel

GROUP 66

Filament Cycling, Thermistor Breakage	G. F. Sandy
Power Flow and Cabling Diagrams	J. D. Clarke
Release of OPS Specs by TIR	F. F. Manning
Plans for and Status of ESS	J. J. Carson

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GLOSSARY

AA	antiaircraft
AAOC	AA Operation Center
AD	Air Defense
ADC	AD Command
ADES	AD Engineering Service
AEW	Airborn Early Warning
AF	Air Force
AFB	AF Base
AFCRC	AF Cambridge Research Center
AFIRO	AF Installation Requirements Office
AMC	Air Materiel Command
ARDC	Air Research and Development Command
ASC	Air Situation Coordinator
ASO	Air Surveillance Officer
AST	Air Surveillance Technician
ATC	Air Training Command
ATCF	ATC Facility
BTL	Bell Telephone Laboratories
BSO	Battle Simulation Officer
CAA	Civil Aeronautics Administration
CC	combat center
CCDC	Cape Cod Direction Center
CAT	category
CCS	Cape Cod System
CER	change evaluation request
CHT	Charactron tube
CP	Command Post
CPO	command pulse output
CRT	cathode ray tube
C&E	communications and electronics
DAB	display assignment bit
DC	direction center
DD	digital display
DDG	DD generator
DDR	digital data receiver
DDT	digital data transmitter
EADF	Eastern Air Defense Force
ECM	electronic counter measure
ECP	engineering change procedure
EMAR	experimental memory address register
EPSCOM	Equipment Program Services Committee
ESS	experimental SAGE subsector

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FGD	fine grain data
FF	flip-flop
FM	frequency modulation
FORX	FGD orientation with Raydist and calibrated Mark X
G/A	ground to air
GFI	gap filler input
GSR	group selection register
IBM	International Business Machines Corp.
INS	interceptor simulator
JETEC	Joint Electron Tube Engineering Council
LPO	Lincoln Project Office
LRI	long-range radar input
LTPS	Lincoln Tube Process Specification
MAR	memory address register
MEL	minimum equipment list
M-G	motor-generator
MISF	Manned Interceptor Simulation Program
MITE	multiple input terminal equipment
MTC	Memory Test Computer
NAS	Naval Air Station
NET&T	New England Telephone and Telegraph Co.
NRL	Naval Research Office
OB	output buffer
OPS	Operations
OT	Overlap Technician
PIUMP	plug-in unit mounting panel
PPI	planned position indicator
PRF	pulse repetition frequency
PT	Plotting Technician
RAFD	Rome AF Depot
RAND	Research and Development Corp.
RC	register containing
RD	radar data
ROTR	receive-only typing-reperforator
S&EC	Scientific and Engineering Computation
SAGE	Semiautomatic Ground Environment
SET	surface barrier transistor
SAR	storage address register

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SD	situation display
SDG	SD generator
SDV	slowed down video
SIF	selective identification feature
SC	Signal Corps
SCEL	SC Engineering Laboratory
SOP	standing operating procedure
SO	Systems Office
STP	System Training Program
TBS	training and battle simulation
TD	track data
TIR	Technical Information Release
UHF	ultra high frequency
VHF	very high frequency
WE	Western Electric Co.
WISE	Whirlwind I SAGE Evaluation
WWI	Whirlwind I
XT	crosstell

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I M P O R T A N T N O T I C E

Please be advised that copies No. 2 through No. 50 of IBM Manual entitled "Pre-Preliminary Manual PM 8-13, Tapes & Miscellaneous, IO Units", has been upgraded from unclassified to Confidential as of 30 September 1955.

The MIT number assigned to this document is IBM-799. All holders of this document should advise the Division 6 Document Room as soon as possible in order to comply with existing Security Regulations.

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DOCUMENTS ISSUED

(Frances Christopher)

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ADMINISTRATION & SERVICES (Group 60)			
3963	Div. 6 Staff	Lincoln Lab. Personnel List 1 Nov. '55	U
3983	Div. 6 Staff	Biweekly Report 4 November 1955	C
SAGE SYSTEM TEST & PLANNING (Group 61)			
3765-1	R. R. Reed	Digital Display Slot Assignment for AN/FSQ-7 and XD-1	C
3826 S#1	J. Ishihara	Operational Specification for Track Monitoring in the Sage System	C
3828-1	H. Frachtman	Operational Specification for the Height Finding Function in a Sage Direction Center	C
3899	J. Levenson	Interim Operational Specification for Training and Battle Simulation in the Sage System	C
3899 C#1	J. Levenson	Same Title	C
3928	F. Brooks P. Strait	Comparison of Track Sorting Methods for the Correlation Program in an AN/FSQ-7 (XD-1) Air Defense Program	C
3972	A. P. Hill	Air Defense Indoctrination Lectures	U
3976	A. Shoolman	Organization of Coding Specifications for the Direction Center Active Program (DCA)	U
3980	C. A. Zraket	Current Listing of Operational and Mathematical Specifications for Sage Direction Center	C
FSQ-7 PROTOTYPE DESIGN & INSTALLATION			
2877 S#8	R. H. Gerhardt	Changes in Display Specifications	U
3940	J. Crane	Results of the System Test (Phase II) Performed on the AN/FSQ-7 (XD-1) During July, August & Sept. 1955	U
3965	C. L. Corderman	Cathode Life Test Program	U
3970	R. D. Buzzard	Proposed Remote Controls for the Large Board Projection Equipment in the Command Post	C

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3990	J. Giordano	Minutes of the IBM-LL/SO Concurrence Meeting #44 Held at Lincoln Lab. November 10, 1955	U
ADVANCE DEVELOPMENT (Group 63)			
3906	E. U. Cohler	A Novel Method for Measuring Hole-Storage Charge in Diodes	U
3984	L. Jedynak	Circuit Application of the Avalanche Phenomenon in Junction Transistor M.T.P.	U
PRODUCTION AN/FSQ-7 & CAPE COD DIRECTION CENTER (Group 64)			
3962	E. W. Pughe C. S. Lin	Change of Drum Address of the Cross-tell Input System	U
PRODUCTION COORDINATION OFFICE (Group 66)			
3000 S#2-1	C. J. Carter	Specifications for AN/FSQ-7 (ID-1) Dial Exchange and Associated Equipment	U
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5066	E. O. Martin	Summary Report of the 1953 Cape Cod System Tests	S

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IBM-855	P. Mancuso	Bit Assignment for Marginal Checking Control Words	U
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