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Memorandum 6M-4361

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

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 1 JUNE 1956

To: Jay W. Forrester

From: Division 6 Staff

Date: 11 June 1956

Approved: J. C. Proctor

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SAGE OPERATIONAL PLANNING

(Group 61, D. R. Israel)

WEAPONS INTEGRATION

BOMARC (R. S. Fallows)

A ten-day meeting at Boeing, called by ADC, resulted in the preparation of a document, "Employment of BOMARC (IM-99) in the SAGE Era," which spells out the tactical employment plan for BOMARC as it is presently seen.

A report for ARDC (BOMARC Weapon System Project Office) on a possible integration plan for AN/GPA-35 with SAGE has been completed and a Lincoln management letter of comment has been sent to Boeing.

The first group of Boeing people to work on the integration of BOMARC will arrive at Lincoln this month. Boeing is now actively hiring people in the Boston area to work on this program.

F102A

The study of the problems associated with the integration of the F102A interceptor in SAGE has been completed. The report of this study will be completed by mid-June.

It is not clear at this time how and when the Convair or Hughes people plan to continue their part in this integration program.

A meeting is scheduled for the week of June 21 at ADC to arrive at an F102A employment plan.

Talos

A study of the problems associated with the integration of the Talos missile in SAGE has been started. It is not yet apparent how long this study will take.

A meeting is scheduled for the week of June 4 at RCA. This is an ADC meeting to prepare an employment plan similar to that described above for BOMARC.

TRACALS

A study of the problems associated with the integration of the TRACAL (Traffic Approach Control and Landing) System with SAGE for the return to base of manned interceptors has not been scheduled yet. Preliminary discussions with the CRC group working on

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WEAPONS INTEGRATION (continued)

TRACALS have taken place. A meeting with the G.E. group working on the TV SAGE display link for preliminary investigation of hand-over from SAGE took place on 24 May. In this matter we are acting as a contact point at Lincoln for the TRACALS people.

DUPLEX STANDBY (J. Groce)

The "Operational Specifications for Duplex and Standby Computer Operation at a SAGE Direction Center" have been completed in draft form and will be published within the next biweekly period.

J. Groce is now spending a large portion of his time in the Weapons Integration area. All correspondence in regard to Duplex Standby should be directed to H. P. Bridge at MAH 137A, ext. 242.

DATA SIMULATION AND REDUCTION (W. S. Attridge)Data Reduction

A specification is being written describing the various data reduction program outputs. This will incorporate ideas from others in Groups 61, 64, and 22 and will serve as the guide for our program preparation.

Simulated Data Generation (J. Levenson)

Coding and parameter checkout of all parts of the Simulated Data Generation Program are proceeding smoothly. The following sub-routines are now checked out: Scaling, divide, square root, arc-tangent, sine-cosine, floating point add and subtract. Almost all the subprograms for handling data input cards are also checked out.

MTC Operation (D. Bancroft)

Operation for the period 21 May to 1 June:

	<u>Hours</u>	<u>Per Cent Scheduled Time</u>	<u>Per Cent Used Time</u>
Scheduled	13.50	100.0	
Available	11.46	84.9	
Used	10.94	81.0	100.0
Satisfactory Operation	10.32	76.4	94.3

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ESS DC IMPLEMENTATION AND COORDINATION

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

EXTERNAL EQUIPMENT AND COMMUNICATIONS (I. Aronson)

Wire Communications (F. Irish, C. Carter, W. Glass)

Work has begun on writing operating instructions for the communications facilities at external sites. When they are completed, a trip will be made to each site to test the circuits and to check the accuracy of the operating instructions.

A record-keeping system and a trouble-reporting procedure for ESS are being provided.

DESIGN CONTROL (W. A. Hosier)

AN/FSQ-7 Improvement (W. A. Hosier)

The "short term" measure to enable XD-1 to meet operational specifications by the time it is put into operation (namely, the doubling of core memory capacity), now seems just about inevitable. As mentioned in the 18 May BIWEEKLY, the repackaged and "shrunk" memory is favored for this, but can hardly be viewed at the solution until a prototype of it, using the combined SA-DPD plug-in units, has been built and operated. It is anticipated that specific plans to do this will be initiated at the IBM-Lincoln coordination meeting on 6 June. There is also the question of whether such an installation on XD-1 must precede the one at McGuire.

With regard to any more remote improvement, the ceiling in the crystal ball has closed in and visibility is about 0-0, what with the recent retardation of master program schedules.

Parity Rate Alarm for AN/FSQ-7's (J. D. Crane)

A change of specifications for the parity rate alarm as described in the LRI specifications for AN/FSQ-7's is being considered. Data on phone line errors and results of error rate studies were requested by IBM. S. B. Ginsburg is representing the DCO in this study.

Technical Control In ESS (J. Giordano)

Memorandum 6M-4284 and its supplements 1, 2, and 3, which propose a method of technical control in ESS, are being submitted to interested Lincoln personnel for approval and/or comment as an initial move toward establishing an adequate technical control system in ESS.

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DESIGN CONTROL (continued)

New CER's (A. A. Rich)

<u>CER No.</u>		<u>Originator</u>
178	Change to General Display System Specifications for AN/FSQ-7 and -8, S-29-1. Clarifications and items that will be included in DC-1.	IBM
179	Change to General Display System Specifications for AN/FSQ-7 and -8, S-29-7. TD and RD change.	IBM
180	Problem of Viewing Film from the Four Types of Cameras. An investigation on projecting film taken by AN/FSQ-7 cameras.	MIT
181	P-216-2, Supplement to "Input and Output" Converters, XD-1. Proposal for converters for crosstell inputs and G/G outputs in XD-1 for automatic crosstelling with other centrals.	IBM
182	P-299, Proposal to Unlock Tape Drive Select Switches on XD-1. Proposal intended to facilitate maintenance and programming routines.	IBM
183	D-35-4, Change to the GPI Mapper Counter Frame, AN/FSQ-7. Relaying to the specs. to allow 4-10 rpm synchronism.	IBM
184	S-17-2, Change to Tape Element Specifications, AN/FSQ-7 and -8. This change will allow any operation, including a rewind, to be programmed after the 10 interlock is cleared following an <u>operate (rewind)</u> instruction.	IBM
185	D-108-1, Change to 6M-2921-3 Cooling System for AN/FSQ-7 DC's. Change for allowance for growth and flexibility.	IBM
186	D-60-1, Change to Input Channel Switching Specs. for AN/FSQ-7. Variation in the general scheme of crosstelling between DC and CC at a combined site.	IBM
187	Change in Crosstell Parity Disable for XD-1 and XD-2. Proposes only one parity disable switch for controlling both crosstell channel parity circuits.	IBM

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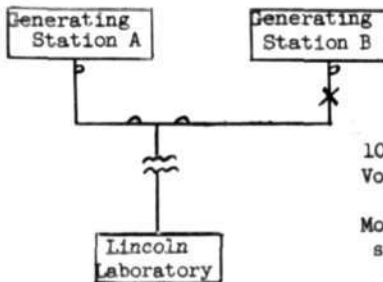
DESIGN CONTROL (continued)

<u>CER No.</u>		<u>Originator</u>
188	P-52-1, Change in Loop Test Specs. for XD-1 and XD-2. Modification to allow generation of the new 5-bit sync pattern when loop-testing LRI.	IBM
189	P-233-1, Change in LRI Monitor Console Specifications, XD-1. Proposal for adding line drivers for the LRI breadboard control frame.	IBM

POWER (J. J. Gano)

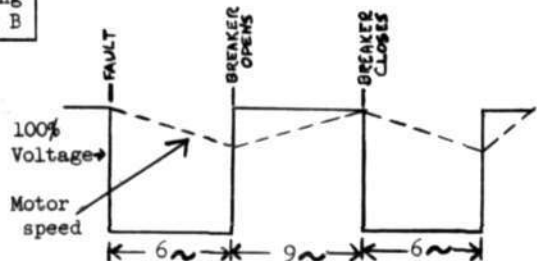
XD-1 (J. J. Gano)

At a meeting with Boston Edison engineers attended by Swope and Gardner of Divisions 7 and 1, respectively, and Leavitt, information on the utility network, breaker operating times, and types of faults was secured. Swope is modifying his old diagram of the network by including the new Lexington substation. In regard to breaker operation, a bolted short circuit will open breakers after six cycles of 60 cps and isolate the fault. Nine cycles later the breakers reclose. If the fault has not cleared, the breakers open again after six more cycles. If the fault does not recur before 15 seconds, the relaying is reset.

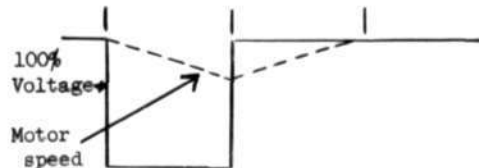


Example of network

Voltage and motor speed at Lincoln Lab. when fault persists:



Voltage and motor speed when fault is cleared:



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POWER (continued)

Lightning faults usually result in single-phase grounds. Many faults due to snow are caused by an accumulation about an insulating bushing, again grounding one phase.

The breaker times indicate that our motor-generator sets should override utility faults, even if they are triple-phase. Single-phase faults should offer no difficulty on overriding. This information will be transmitted to IEM who is analyzing the system.

MTC

Specifications are being drawn up for two 150-volt thyatron power supplies to be purchased for MTC to replace the present +150 and -150 volt series tube supplies. They will have capacities of either 40 or 50 amperes. (S. T. Coffin)

The -270 volt power supply, no longer needed for the MTC tape system, has been converted to a -48 volt, 5-amp, unregulated supply, replacing an oversized Raytheon rectifier. Since germanium rectifiers are used, the obvious 5-minute warm-up time that was required by the Raytheon unit has been eliminated. (R. C. Jahn)

TX-0

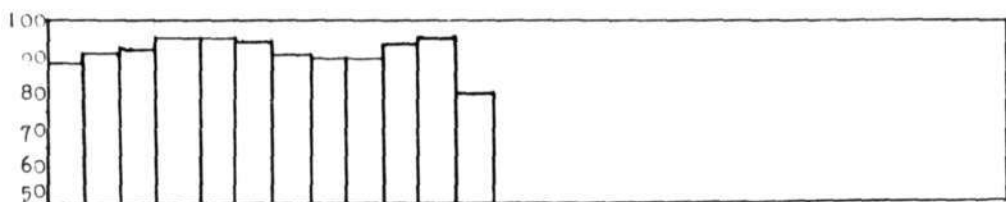
A transistorized TX-0 marginal-checking amplidyne regulator has been constructed and is being tested for transient response. (S. T. Coffin)

Magnetic Amplifiers

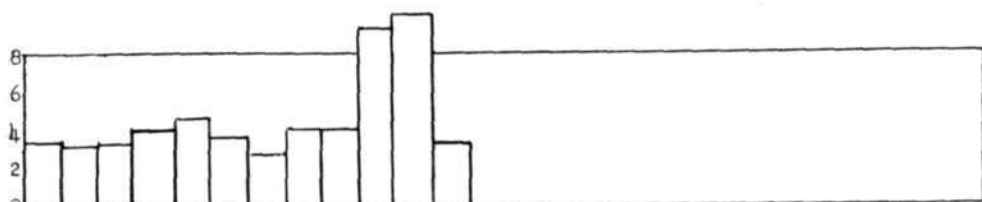
Westinghouse has submitted a CYPAK (trade name for their magnetic amplifier logic system) logic diagram that is supposed to be equivalent to the present PCD relay control circuit of XD-1. This diagram is being analyzed and corrected, after which the circuit will be set up on the CYPAK simulator and operating margins will be taken. (G. F. Sandy)

I am investigating the problem of designing a magnetic amplifier for maximum power output, using a core of specified area, material, and lamination thickness. Limiting factors are coil resistance, the number of turns one can squeeze on a core, saturation inductance, the behavior of the B-H loops for various frequencies, etc. The best compromises are sought for conflicting requirements (large number of turns versus saturation inductance and coil resistance). The effect of frequency on power output will also be studied. Limiting factors here are an increase in coercive current and losses in the core. (R. C. Jahn)

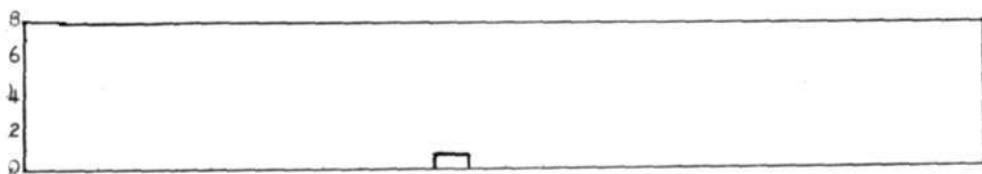
AN/FSQ-7(XD-1) SYSTEM RELIABILITY



PERCENTAGE OF USEFUL ASSIGNED TIME



MEAN GOOD TIME BETWEEN FAILURES OR INTERRUPTIONS IN HOURS



AVERAGE LOST TIME PER LOST TIME INCIDENT IN HOURS

DEC 3  
DEC 17  
DEC 31  
JAN 14  
JAN 28  
FEB 11  
FEB 25  
MAR 9  
MAR 31  
APR 14  
APR 28  
MAY 12



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CIRCUIT SUPPORT (R. J. Callahan)

Remote Equipment Maintenance Survey (R. B. Paddock)

A routine maintenance test of the crosstell subsystem was run successfully on Monday, 25 May; two other scheduled tests were cancelled due to trouble with the XD-1 computer. The successful test proved out a revised conference setup and also showed the feasibility of short tests for maintenance of most subsystems. Further tests on the crosstell system will be run and the information gathered will be used for designing similar tests for other subsystems.

Building F Tours (R. Murphy)

<u>Period Covering</u>	<u>No. Trips</u>	<u>No. People Escorted</u>	<u>Man-Hours Spent</u>
Sept. 55 thru March 56	110	1071	108.75
April 1956	18	150	24.0
May 1956	<u>23</u>	<u>275</u>	<u>24.5</u>
Total	<u>151</u>	<u>1496</u>	<u>157.25</u>

ANALYSIS AND SCHEDULING (P. B. Harris)

Reliability figures from now on will be somewhat lower than in the past due to the new definition of lost time which went into effect May 1st. Lost time occurring during scheduled operation now includes any scheduled maintenance time used to repair or troubleshoot a failure which occurred during that operational time. Under the old system, the only downtime reported was that which occurred during scheduled operational time - all maintenance time being useful.

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

MAGNETIC MATERIALS (J. B. Goodenough)

Memory Core Testing (R. C. Zopatti)

There have been approximately 60,000 F-397 cores double-tested and 64,000 single-tested by this section to date. There are also 80,000 F-398 untested cores on hand.

A new 10-ton air conditioner is now being installed in this section, temporarily holding up further testing.

Chemistry

Nickel Chromite (D. Wickham, W. J. Croft)

Three samples of nickel chromite have been prepared:

- (1) By igniting to 950°C the coprecipitated hydroxide
- (2) By reacting anhydrous  $\text{NiCl}_2$  with  $\text{Na}_2\text{Cr}_2\text{O}_4$  at 900°C
- (3) By igniting sample (2) to 1350°C.

Samples (1) and (2) were found to be cubic spinels. Sample (2) remains cubic down to a temperature of 10°C. This is the present lower limit of temperature measurement. Sample (3) is tetragonal at room temperature and exhibits a transition to the cubic modification at about 26°C. The c/a at R.T. is 1.021.

NiO-V<sub>2</sub>O<sub>5</sub>

All attempts to prepare a solid solution between  $\text{Ni}^{++}\text{O}$  and  $\text{V}^{++}\text{O}$  have yielded a material containing metallic nickel and a higher oxide of vanadium.

Lectures

A paper on "The Preparation and Properties of Square-Loop Lithium-Nickel Ferrites" by D. L. Brown and a movie by F. S. Maddocks showing domain-wall motion in polycrystalline ferrites using colloidal-magnetite techniques were given at the 24th Symposium on Ceramic Dielectrics at Rutgers University.

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MAGNETIC MATERIALS (continued)

Thermistors (D. L. Brown)

Experimental thermistor bodies are being fabricated and heat-treated for Group 62. The problems being studied are the elimination of "hot spots" and the prevention of cracking during testing.

Physics

Instrumentation

A transistor differential amplifier has been constructed which will amplify all frequencies from d-c to 50 kilocycles. This unit has less than two degrees of phase shift and relatively constant amplitude. It will be used as a preamplifier for the integrator now employed in the 60-cycle fluxmeter. (R. A. Pacl)

The vacuum-coating unit for thin films has arrived and is being installed. The auxiliary apparatus designed to go inside the bell jar to prove an orienting field and heated substrate is expected this week. The first films from this new setup should be available in the next biweekly period. (D. O. Smith, F. S. Maddocks)

The vibration stabilization feedback unit for the vibrating-coil magnetometer has been redesigned incorporating a 34-cycle peaked amplifier unit which has just been received. The stabilizer now has an over-all gain of twenty, and has been reconstructed as a permanent unit in the system. (N. Menyuk)

Experimental

Using the apparatus originally designed to measure the pulse response of thin films, preliminary measurements of the initial permeability have been carried out to 2000 megacycles. Quantitative results are not yet available, but the expected dispersion in the permeability is not yet complete at this frequency. (D. O. Smith)

MEMORY (J. L. Mitchell)

256<sup>2</sup> Memory

To date, 508 64 x 64 modules have been accepted. Except for the sense-winding interconnections, 28 256 x 256 planes are complete. The first plane is operating, and the first stage of the testing is complete. The installation of the sense-winding interconnection wires will begin the week of June 4th. The margins taken on the first plane indicate the series connection of the sense winding is the best, and that is the one that will be installed. The first

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MEMORY (continued)

plane has held all the common test patterns (ones, zeros, and the checkerboard) with good margins.

The 256 x 256 memory was connected to its own power supplies last week.

Advanced Development

The breadboard of the transistor selection system is now operating and being tested. The delay in the selection system is the first problem that will be investigated.

A 64 x 64 plane has been constructed using the 50-30 mil cores. Measurements to determine the electrical characteristics of this plane are under way.

More instrumentation is being set up for the plated wiring experiments.

BASIC CIRCUITS (R. L. Best)

Index Register Memory

All circuits have been designed for this memory and it is ready for packaging.

DISPLAY (C. L. Corderman)

Remote Display

The first draft of the remote display proposal has been completed. Further definition of the core memory and the transistors will be added before the report is issued.

Character Legibility Test (R. Gould)

An error was finally found in the punched card for the legibility test patterns, and correct patterns are now displayed. Computer trouble prevented the running of tests during the two assigned periods in the past week. Four periods have been assigned us during the week of June 4th for testing.

Line Drivers (H. E. Zieman, J. Kriensky)

Supplement 1 to the M-note on the display line driver, 6M-3284, will be ready for distribution during the week of June 4th. Theoretical and experimental work on supplement #2 is in progress. An experimental setup to check deflection yokes is nearly completed.

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SYSTEM DESIGN (K. Olsen)

TX-0

During the past two weeks, Chet Norman has spent several hours each day instructing the technicians in the operation of TX-0. It is hoped that soon there will be several technicians capable of operating and trouble-shooting the computer, so that others already familiar with TX-0 may devote full time towards building TX-2.

The process of modifying and improving TX-0 has continued. A new photoelectric tape reader panel has been installed. The live register has been put into operation, and new panels containing the pulse transformers have been installed.

TX-2 (Expansion of TX-0)

We have been studying what modifications of TX-0 circuitry should be made for TX-2. Changes in the register driver and uses for the improved SBT are under consideration. The packaging for TX-2 logical circuitry has tentatively been decided upon.

TRANSISTORS (D. J. Eckl)

Life Tests (R. L. Burke)

The shielded shift register continues to run without error and on June 8 will have held its pattern continuously for one year. At that time we will shift from battery operation to transistorized power supplies operating from the a-c line.

There were three failures, all appearing as emitter-collector shorts, found at the last measurement of the life test transistors. These units have been dissected but so far no plausible reason for failure has been found. The history of the units is as follows:

Shelf-life test	8625 hours, 2 failures
RC-coupled shift register	9136 hours, 1 failure

Tetrodes (E. U. Cohler, R. Hudson)

Hole storage measurements indicate that the Texas Instruments 501's have low hole storage, but long switching time relative to an SBT. However, it was observed that applying a negative potential to Base 2 of the tetrode (w/r to Base 1) speeds the switching considerably. This effect was not found in all of the samples and further investigation is under way.

A saturated grounded-emitter flip-flop is in the initial development

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TRANSISTORS (continued)

stage. A rise time of 40-50  $\mu$ secs has been achieved, but the fall time is on the order of 2-3  $\mu$ secs. It is believed that the fall time can be improved by negative bias as mentioned above. This may require on-active operation as compared to the more usual on-off or active-off modes.

Random Bit Generator and Diode Breakdown  
(E. U. Cohler, R. Hudson)

No changes have been made in the present model, but some time has been devoted to correlating the data which have been obtained in order to verify some theoretical aspects. An experiment to study the photosensitive qualities of the breakdown was performed. The metal shell of one unit was carefully removed and the silicon body was irradiated with ordinary light (tungsten or day). It was observed that, with light shining on the silicon, the frequency of breakdown increased greatly and the amplitude of the sawtooth waveform decreased correspondingly.

A statistical study of the theory proposed for this phenomenon has revealed that the intervals between breakdowns should be distributed as

$$P(t) = kt \exp\left(\frac{-kt^2}{2}\right)$$

where  $t$  is the interval length and  $P(t)$  is the probability density of that length. An empirical study is being made to verify this relationship, and the theory is being applied to determine the worth of a random generator made from this device.

Thermal Tests (E. U. Cohler, R. Hudson)

Nothing further has been done on the thermal tests of the SBT's since the proper pulse generator is unavailable. However, some information was received from Philco on tests which they made. Their tests applied the burnout power by "dumping" the charge on a condenser through the transistor. While the experiments are not exactly comparable, their results confirm ours so far.

The Theoretical Relationship of Storage Coefficient to Physical Parameters of the Transistor (C. T. Kirk)

Ebers and Moll have derived a storage coefficient (which is essentially the cutoff frequency response of a saturated transistor) of the form

$$\frac{\alpha_n \alpha_1 (1 - \alpha_n \alpha_1)}{\alpha_n + \alpha_1}$$

\*Ebers, J.J. and Moll, J.L., "Large-Signal Behavior of Junction Transistors, "I.R.E., Vol. 42, No. 12 pp. 1761-1772, Dec. 1954.

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TRANSISTORS (continued)

where

$\omega_n, \omega_i$  are the active grounded-base cutoff frequencies for the normal and inverted configurations of the transistor, respectively, and

$\alpha_n, \alpha_i$  are the grounded-base current gains for the normal and inverted configurations of the transistor, respectively.

Through mathematical processes of substitution and definition, we can state that

$$\frac{\omega_n \omega_i (1 - \alpha_n \alpha_i)}{\omega_n + \omega_i} = \frac{1}{2\tau_{\text{eff}}}$$

This last form of the relation of Ebers' and Moll's storage coefficient to the effective lifetime of the holes in the base suggest the interesting possibility that the storage coefficient for alloy and grown junction transistors can be obtained by making the one measurement  $\tau_{\text{eff}}$ , rather than the four and somewhat difficult measurements  $\omega_n, \omega_i, \alpha_n,$  and  $\alpha_i$ .

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ESS TEST PLANNING - WWI MTC OPERATION

(Group 64, E. S. Rich)

WHIRLWIND I (L. L. Holmes)WWI Computer Operation

Scheduled Computer Hours	322
Interrupting Incidents	14
Hours Lost	7
Per Cent Good Time	97.8
Mean Time Between Failures in Hours	22.5

The WWI system reliability degenerated during this period. One lengthy, frequently occurring malfunction rendered the computer inoperative for a period of five hours (71% of the total downtime). The trouble was traced to a faulty cathode follower tube in the angular position counter for the auxiliary drum while the system was recovering from a day of computer installation work.

It has been determined that seven of the interrupting incidents were due to defunct tubes. The failure to marginal-check the crosstabling equipment the day of a subsystem test resulted in 35 minutes of downtime due to a faulty flip-flop tube. The other tube failures weren't the type to be located by marginal checking. This period saw the retirement of 56 tubes through the use of the marginal checking facility.

WWI-XD-1 Crosstabling

There were five WWI - XD-1 crosstabling subsystem tests scheduled for this period. Two tests were canceled because XD-1 was inoperative. One other test was lost because of the fault mentioned in the WWI Computer Operation summary above. The remaining two tests were plagued with intermittent failures such as XD-1 core memory alarms, XD-1 output ground-to-ground parity alarms, and improperly adjusted DDR and DDT equipment in the subsystem. The DDR and DDT difficulties were corrected by adjustments at WWI, but C.S. Lin and W.A. Karlsen are investigating WWI - XD-1 phone line signals in order to determine if the actual trouble is with improper settings at XD-1.

The crosstell input equipment at WWI has been modified to accommodate the 5-bit sync phone line message required for future ESS operations. The change was engineered by P. J. Murphy and required the addition of a flip-flop and a gate tube to our input system.

P. J. Murphy is in the process of redesigning our crosstell output test message generator. The new scheme will permit DDR and DDT



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WHIRLWIND I (continued)

adjustments made with the test-message generator to be satisfactory for live subsystem operation.

Personnel

J. J. Lynch has been transferred from the WWI section to the MTC section. Jim takes with him approximately eight years of WWI experience.

Flexowriter Keyboard Input to WWI

A decision has been reached to install a Flexowriter keyboard input facility at WWI. The installation will probably be available for operational use in the latter part of this month. The Flexo keyboard input will be usable both in the CCDC and in the test control room. Potential users of this installation desiring any further information may contact L. H. Norcott and O. C. Wheeler who are engineering the project. A memo will be issued at a later date describing the new facility.

Room 156 Equipment

The South Truro-WWI and the Montauk-WWI subsystems using SDV data have been discontinued. The associated equipment at WWI has been removed from service. There will be six adjacent unoccupied racks in K-row following the recent equipment removals and the transfer and the consolidation of some of the remaining equipment.

MITE 14 has been modified so that the two least significant digits of the A-counter are loaned to the B-counter when marginal checking the G.E. G/A system. This was required following the elimination of the LR MITE for Montauk which was formerly used as a testing device for the G.E. G/A equipment during closed-loop marginal checking.

MEMORY TEST COMPUTER (H. L. Ziegler)

Results of the recently concluded survey of MTC power supplies are summed up in memo 6M-4351 by N. J. Ockene. As recommended in this memo, specifications are being prepared for the purchase of two new power supplies to be used as the +150V and the -150V supplies. Present equipment released by this purchase will be used to increase the current capacity of the +250V and -300V supplies. These changes will relieve our present overloads and also provide some spare capacity for future needs.

The magnetic tape system is now in the "shakedown" stage - use by programmers is probably the most efficient way of uncovering the

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MEMORY TEST COMPUTER

remaining subtle troubles sure to be present. Please notify us immediately of any difficulties you may have in using magnetic tape.

Marginal checking and other special testing techniques are being reviewed in hopes of improving their effectiveness and efficiency. Marginal checking lines are being rearranged and revised to adapt them to recent changes and additions to the computer circuitry. Test programs are also receiving a fair amount of attention with some special programs being written for timing measurements on in-out equipment such as the IBM card machine.

The problem of adequate testing of diodes is being tackled by Tom Callahan. After consultation with many Lab people who have previously worked on one aspect or another of diode testing, Tom has arrived at a sort of composite circuit to test for dynamic characteristic, pulse drop, and reverse recovery. This circuit should be ready for trials during the coming biweekly period. The ultimate goal of the project is a tester that is reasonably small and portable, and adequate for predicting diode behavior in actual computer circuitry.

Failure of the display system was eventually traced to internal breakdown of the cathode high-voltage supply purchased from Northeast Scientific of Cambridge. At the suggestion of Dr. Clement Moritz of Northeast Scientific, a similar supply was borrowed from TX-O while ours is being reworked (without charge to us) at Cambridge.

The pace that the technicians set for themselves in the technicians' training course has been somewhat slower than desirable, but it is hoped that it can be increased in the near future. We will try more frequent and less lengthy self-educating assignments.

By 18 June the MTC programming staff expects to gain a new permanent staff member, and a summer staff employee. There will be a 3- to 4-week programming course for them and for anyone else who is willing to devote essentially full time to the study of MTC programming, and the MTC utility and subroutine library programs. For details concerning the MTC programming course, see A. Vanderburgh, Jr., B-149, ext. 116.

The following is a list of new programs available to MTC users:

Binary card read-in and automatic start by Ray Olsen  
Binary card punchout of specified range (with control col. optional) by A. Vanderburgh  
Binary card read-in and stop by A. Vanderburgh

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MEMORY TEST COMPUTER (continued)

4-6-6 conversion to binary cards by A. Vanderburgh  
Hollerith card decimal punchout by C. Burgess  
MTC operations check by W. Holst  
Binary card read-in (plugboard) by Lewis and Holst.

Jim Lynch (Technician) has transferred from WWI at Barta to the  
MTC section.

ERRATUM

Under ESS SHAKEDOWN PLANNING, Exercise Design, mention was made  
of memorandum GM-4332. Should have been GM-4223.

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VACUUM TUBES

(Group 65, P. Youtz)

TUBE TECHNIQUES (F.H.Caswell, L.W.Nelson, J.S.Palermo)

Bariated-Nickel Cathode Program

Six cathode tubes with zirconium hydride activators were processed for the cathode study program to be tested and compared with similar cathode tubes having oxide cathodes.

Two tubes were made to investigate some favorable results obtained from aluminum and silicon activators with unabraded cathodes.

Display Program

The final tube of a group of fourteen 2-inch tubes for the phosphor studies of Group 63 was completed and ready for evaluation. Some technical difficulties were encountered when the Division 7 shop tried to heliarc-weld the 19-inch Colortron panel for the phosphor study tube of Groups 63 and 38. Solutions to these problems should be reached during the next two weeks.

Solid-State Display

A tube to bombard CdS with electrons has been successfully processed for Group 24. It has been necessary to process these tubes without vacuum baking in order to protect the desirable properties of the CdS. Meanwhile, the oxide-coated cathodes deteriorate quickly with this type of processing. A demountable tube is being fabricated and will be sent to Group 24 for use on their vacuum system.

Ferromagnetic Evaporated Films

An ion gauge for condensable materials was delivered to Group 63 and used successfully by them.

CHARACTRONS AND TYPOTRONS (D. V. Mach, P. C. Tandy)

Seven MIT 19-inch tubes have completed between 255 and 11,148 hours and eleven Charactrons have completed between 779 and 4547 hours. Charactron #455 has been rejected after 575 hours for low pulse matrix current. The tube first showed less than 50- $\mu$ a matrix current after 381 hours when its pulse zero-bias matrix current was only 35  $\mu$ a. No significant changes in helical accelerator resistance or screen backing capacitance and dissipation factor have been noted.

The one MIT 19-inch tube with a bariated-nickel cathode gave only

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CHARACTRONS AND TYPOTRONS (continued)

300- $\mu$ a d-c cathode current at the start of life. It was operated at zero-bias for about a day before it gave 500  $\mu$ a and has now operated about 230 hours at that rate. It stabilized after about 90 hours of operation to deliver 500  $\mu$ a between 25 and 28 volts bias. Another transfer characteristic curve will be taken shortly to indicate pulse current changes.

Twenty-six oxide-coated cathode study tubes have completed between 1020 and 10,018 hours. The 24 tubes on the present program have accumulated up to 3080 hours. One tube has been rejected for excessive leakage and two tubes for grid emission since the last report. The first three tubes in the bariated-nickel cathode lot were built but they failed to pass the cathode uniformity test during preinstallation test.

Fifty-seven bariated-nickel cathode tubes have operated up to 3080 hours. Sixteen of them do not give 500- $\mu$ a d-c cathode current, and they should be retired from life test.

Thirteen triode and five diode bariated-nickel tubes have operated between 3277 and 5542 hours. No data has been taken since the last report.

Eighteen Typotrons have completed between 3178 and 9791 hours. Some of these tubes would not pass specifications, but they will be continued on life test until extinction or until replacements are provided.

COMMERCIAL TUBES (T. F. Clough)

The 6161 deflection driver tubes in the XD-1 display console have, during use, developed a film on the silver contact surfaces which increases the contact resistance. Investigation disclosed that RCA has had other complaints about this and has determined that a commercial protective process is available to minimize the effects of this film. RCA life tests on this product are only up to 300 or 400 hours but are due to be continued. This information has been relayed to the IBM people concerned and they are investigating the possible use of this product.

At a meeting at Tung-Sol on 31 May it was reported that they are awaiting material and tools for the new grid design which they state are necessary for processing the final design DT-438 tubes. During the next two weeks, the first of a series of plant inspections will be made to survey their progress in effecting the changes proposed by the IBM-MIT survey committee.

I attended the RETMA Symposium on Reliable Applications of Electron

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COMMERCIAL TUBES (continued)

Tubes in Philadelphia on 21 and 22 May. The two papers on AN/FSQ-7 circuitry, one by Boyd of MIT and the other by Hofler of IBM, were among those which stimulated the most discussion.

RECEIVER TUBES (S. Twicken)

The alleged inadequacy of the 6888 (SR-1782A) gate tube in one of the AN/FSQ-7 timing circuits has been determined to be nonexistent. At a 40-volt signal input, the minimum output voltage had been taken as the average of a particular lot of tubes by the test people at Kingston without allowance for variation between lots. The transfer curve ( $i_b$  vs.  $e_{c1}$ ) is not controlled in this region, but rather is controlled to insure unity gain for a 20-volt signal. The possibility of control at 40 volts drive to insure a minimum output of 25 volts is under consideration. This will be added to the specification only if we are convinced that the existing control at 20 volts drive does not afford, by itself, sufficient control at 40 volts drive.

Extensive pickup problems have been encountered in the electrometer unit now completed. Debugging continues.

A group of interface-laden 5963's is being prepared at the request of ASTM for a round-robin test of measuring equipment accuracy. This test is under the statistical supervision of Bell Labs.

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SAGE DC AND CC SITES

(Group 66, B. E. Morriss)

SITE PLANNING (K. E. McVicar)

The BTL-WE-Lincoln group that is working on a system test philosophy has completed its first month's work. This effort has resulted in a draft of the broad outlines of a procedure for initial and final system tests for the SAGE subsectors. Only with the steady-state tests to be expected in the 11th subsector have been covered; the subject of what is sometimes called "design testing," will be studied by another group.

EPSCOM (R. P. Mayer)

A catalog and schedule of EPSCOM programs required by Western Electric Company at the sites is being prepared. Maroney and McHenry (WE) have visited the duplex centrals in Kingston and are studying the switching arrangements which must be taken into account when rewriting EPSCOM programs for SAGE.

Further details on all of the EPSCOM programs can be found in the EPSCOM Biweekly Report, 6M-4359.

EQUIPMENT (W. H. Ayer)

Operational Supplies

Efforts to establish an agency to be responsible for providing operational supplies in the SAGE System are continuing.

A wide variety of expendable and nonexpandable items is required. Included may be such things as special plotting boards and tables, projectors, etc., and also grease pencils, fluid for use in radar mapping, special maps, and a large number of other things.

Lincoln feeling is that a survey of the requirements for this kind of time should be conducted by a single responsible organization. To do this, liaison would have to be maintained with many of the agencies involved in the SAGE implementation effort. The required items must be defined and summarized to determine which are standard and commercially available. For nonstandard items, it is necessary for the organization to visit possible suppliers and negotiate with them on any development work which may be required. The suppliers would provide the needed item and formulate a procurement specification based on the requirements data gathered.

As a result of discussions held with AMC and ARDC representatives in the ADES Project Office, present thinking is that Western Elec-

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EQUIPMENT (continued)

tric will be asked to handle the definition of requirements for operational supplies.

Testing efforts in the first month

An interim BTL-WE-Lincoln committee has been formed to study the testing effort required in the first module of the SAGE System, i.e., McGuire, Stewart, and the Combat Center at Syracuse. The committee will also study the "steady-state" tests planned for later subsectors; it is believed that the later sites, after the first, but before the tenth module, will require some of the tests currently under study.

The additional testing efforts include some design testing not possible in ESS, equipment-program compatibility tests to be conducted at the sites, and verification of the parameters and tolerances in the test methods. Also under study are maintenance testing, record-keeping, and test-failure analysis.

When coupled with the documents defining the "steady-state" tests, the study will provide a measure of the total testing effort which will be required at McGuire, Stewart, and Syracuse.

The committee first conducted a study and compilation of all the tests planned for the ESS and examined those tests believed to be necessary before Air Force acceptance of the first module. No effort is being made to study areas under consideration by other groups.

Since no plans have yet been formulated for testing of the Combat Center at Syracuse, all the tests considered necessary at this site are being included.



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PROGRAM PRODUCTION

(Group 67, J. A. Arnow)

CENTRAL PROGRAMS (D. L. Bailey)

Assembly Test Operation

Carmichael and Marshall are organizing a subsection which will be responsible for machine operation of tests of the assembled DCA program. The immediate job of this subsection consists of establishing procedures for assembling and "null-testing" the basic package DCA programs. Null-testing includes verification of:

1. Program sequencing
2. Environment control (proper tables, new storage for each component DCA program)
3. Switch, activate, and light guns properly read and stored
4. Frame and subframe timing
5. Operation of basic package programs under null (no load) conditions.

The design of specific tests to verify this behavior is the responsibility of a program operation subsection under Harris; the responsibility for implementation and execution of the tests rests with the test operation subsection of Marshall and Carmichael. It is expected that initial tests of the sort described will begin early in July.

PROGRAM ASSEMBLY (A. R. Shoolman)

Administrative

Mel Field has left the section to begin specification of output instrumentation facilities in the central testing section. John Carson has taken over the adaptation subsection, which has been augmented for the current effort by the addition of Gerald Tolpin and Arthur Bancroft (until 15 June) from the documentation section.

Program and Table Design (L. B. Collins)

Environment Control

Nancy Hood and Ann Lyon are presently responsible for all Environment Control processing. Henry Howell will provide assistance when necessary. Bob Steinert has carried the Com Pool through the initial high-load processing required to bring it up to strength; he is now working with H. Rundquist on special programs.

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PROGRAM ASSEMBLY (continued)

Use of ComPool Section IV for Environment Control Checking: ComPool Mod 05 is now on tape; further mods have been delayed due to computer difficulties. Mod 05 has a complete Section IV for all presently active programs. A complete Section IV provides a check on the environment data gleaned from individual program specifications and processed by Program Design. This check is implemented by the read-in program which checks all indexable and non-indexable (table and program) tags to see if the tag is listed in Section IV for the program being read in. If no such tag is listed, read-in prints a pertinent logging note. Since Section IV is complete for each program according to Program Design's information, such a note logged by read-in provides an error signed to Program Design and initiates a check into the various steps in the environment control process.

Sequence Control

PEC and its tables have been redesigned to allow specification of real-time transfers (synchronized with real-time, rather than with the program sequence) through a parameter table (RTPO). The real-time parameters allow specification of a transfer occurring at any time after the beginning of a frame or subframe; in addition, the transfer can be controlled to occur only after the completion of some specified program unit or transfer, if such specification is desirable.

Table Design and Documentation

Morrie Mineart and Lyle Haas have assumed all responsibility for table design processing and documentation; Judith Stone has joined the sequence control effort having processed the great initial volume of IMR and TMR forms and produced over 120 table documents.

Adaptation (J. J. Carson)

Initial drafts of adaptation design notes for all programs of the basic package have been completed. All available values for the adaptation of the basic package have been collected, and program sheets are being prepared so that the necessary cards may be punched. These cards will contain the parameter values and the necessary recompiler instructions for adapting the various programs to ESS. The sheets should be available to the card room on Monday, 4 June.

It has been necessary to specify "dummy" values for many of the ESS adaptation items in the basic package. In other cases, no values of any type are available and zeros will be inserted in the pro-

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PROGRAM ASSEMBLY (continued)

gram. Such discrepancies will be documented to facilitate the insertion of the actual values when they become available.

The organization memo for the adaptation subsection has been completed and will be issued next week. This memo contains a schedule for the adaptation tasks and an example of the design notes and other coding specification documents to be issued.

Special Programs (H. I. Rundquist)

The keyboard input simulation (KIS) and track data simulation (TDS) programs are coded and presently in various stages of checkout. The tape merge and control program (TMC) which combines the two outputs on a single magnetic tape is specified, though not coded. Bob Steinert is beginning work on a simulation program for use in checking program sequencing. Work continues on the assemble sequence parameters program.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

Staff

New

Richard C. Jeffrey, assigned to Group 63, received his M.A. in Philosophy from the University of Chicago. Since Mr. Jeffrey is working on his Doctorate degree at Princeton University, this is a summer appointment.

Terminations

Torben H. Meisling, formerly of Group 63, is now employed by the Stanford Research Institute in Standford, California.

Chauncey W. Watt, formerly of Group 62, is now employed by the Consolidated Electro Dynamic Corporation in Pasadena, California.

Nonstaff (W. A. Kates)

New

Harriett Robinson	Office	Group 60
Oscar Lemieux	Office	60
Doris Pearsall	Office	67
Rita Pearsall	Office	67
George Armstrong	Stk. Clk.	60
Barbara Marnie	Office	60

Terminations

G. Foster Truesdale	Techn.	60
John Little	Office	67
Ruth Ferran	Office	60
Gilbert Jaynes	Draftsman	60
Gerald Robinson	Techn.	60

Transfer

Raymond R. Quinn	Stk. Clk.	60 to 12
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GENERAL ENGINEERING (A. R. Smith)

Fire Annunciator

The design phase, including working drawings, will be consummated this week, assuming the manufacturer's representative for the smoke indicator, after personally inspecting and evaluating environmental conditions, submits a favorable reply to the proposal for its application.

A sample breadboard construction, to validate circuitry design as well as illustrate the final product, will be fabricated this week independent of the smoke indicator conclusion.

Sound Conditioning - A-058

An investigation has been undertaken to study the principal causes for the objectionable noise level, particularly in the key punch area. Lack of available measuring equipment has limited factual analysis; however, a design based on the anticipated major frequencies involved is in progress, aimed at a speedy, effective, and economic installation. Concrete data and design is expected to be complete within the next period.

Vacuum Deposition Equipment - Magnetic Materials Section

The coil forms, arrangement stand, and mu metal shields, are in fabrication and delivery is expected by 7 June. The micro-manipulator and film depositor currently in fabrication by the Model Shop, should be complete this week. Meanwhile, the operating control details will be finalized and fabricated concurrently over the next two weeks.

"Square" Mu Metal Shield

Design, for this shield, to be used in conjunction with the strip time test equipment, will start this week and is not likely to be complete before the middle of the month.

Helium Dewar Dos Magnetometer

Drawings of the redesigned dewar have been submitted to the vendor and thus far, we have not been advised of impracticability or a revision in the originally stipulated fabrication period of four weeks. Expected receipt of the special materials to be used in fabrication is still 7 June, after which shipment will be made to the vendor.

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DOCUMENT ROOM (A. M. Falcione)

In order to centralize control, the Document Room will be happy to obtain classified material required by Division 6 personnel from non-Lincoln organizations.

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(M. M. Ferguson)

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<b>ADMINISTRATION &amp; SERVICES (Group 60)</b>			
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4344	H. W. Hodgdon	Test Equipment Committee Meeting 4 May, 1956	U
4347	Div. 6 Staff	Biweekly Report for Week Ending 18 May, 1956	C
<b>SAGE SYSTEM TEST &amp; PLANNING (Group 61)</b>			
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3980-2	C. A. Zraket et al	Final Listing of Master Operational and Mathematical Specifications for Sage Direction Center	C
3989-1 C#1	E. L. Lafferty	Interim Operational Specifications for the Recording Function in ESS	C
4242	S. Hauser et al	ESS Weather Facilities and Test Concepts	C
4257 S#1	R. R. Reed (Hazeltine)	Category and Display Assignment Bit Assignments for AN/FSQ-8 Situation Display Consoles	C
4337	E. Braude-IBM et al	Initial Program Specifications: Math. Specs. for Intercept Direction in the Sage System	C
4340	E. Braude-IBM et al	Initial Program Specifications: Math. Specs. for Weapons Assignment in the Sage System	C
4342	R. L. Carmichael (BTL)	Pseudo Control Cards for UCP	U

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4284 S#3	C. W. Watt	Establishing Technical Control in ESS: Proposed Space for the Maintenance Coordinator in Building F	U
4284 S#5	C. W. Watt	Establishing Technical Control in ESS: Proposed Space for the Maintenance Coordinator in Building F	U
4313	J. H. McCusker	Long Range Radar Monitor, Breadboard	U
4338	S. T. Coffin	Summary of D-C Power Supply Evaluation Studies, AN/FSQ-7	U
4346	D. R. Meng-(BTL)	Long Range Radar Subsystem Testing Team Progress Report Week Ending May 13, 1956	C
4348	J. Giordano	Minutes of the IBM-DCO Concurrency Meeting #62, Held at Lincoln Laboratory 27 May '56	U
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5320	ESS-PCC J. C. Watson et al	Long Range XD-1 Time Allocation Schedule	C
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5331	R. D. Buzzard	ESS Boundaries	S
5333	H. F. Mercer	ESS-PCC Status Report for Week Ending 25 May 1956	U
5334	J. C. Watson	Orientation of Gap Fillers in ESS	U
PRODUCTION COORDINATION OFFICE (Group 66)			
4339	P. J. Gray	Sage System Meeting, 14 May '56	C
4349	P. J. Gray	Sage System Meeting, 21 May '56	C
4355	P. J. Gray	Sage System Meeting, 28 May '56	C
COMPUTER PROGRAM PRODUCTION (Group 67)			
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3633-2	A. Rupp	AN/FSQ-7 Console Equipment and Label Layouts Part II Room S	C
4341	J. Berman	Nomenclature for Consoles and Operating Positions in AN/FSQ-8	C
4343	J. Berman	AN/FSQ-8 Core Matrix Assignments	C
IBM DOCUMENTS ISSUED			
987	N. Jacobs et al	KMFD Engineering Performance Spec- ification: Marginal Checking System Specs. for AN/FSQ-7 Com- bat Dir. Center AN/FSQ-8 Combat Con. Center	U
988	R. J. Whalen	Progress Report: AN/FSQ-7 and 8 May 1, 1956	C

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LL-DR DOCUMENTS ISSUED			
DR-657 (P-182-6)	F. A. Behnke	Concurrence on P-182-6 entitled Supplement to Command Post Digital Display Desk Specifications on XD-1	U
DR-658 (P-192-2)	F. A. Behnke	Concurrence on P-192-2 entitled Automatic Branch on Alarms of XD-1	U
DR-659 (P-216-1)	R. C. Marden	Input and Output Converters P-216-1	U
DR-660 (P-265-1)	J. D. Crane	Concurrence on P-265-1 Testing of Clock Register for XD-1	U
DR-661 (D24-4)	R. A. Imm	Changes to DC Output Systems Specifications; D24-4	U
DR-662 (D-24-5)	M. C. Portanova	Changes to Duplex Central Output System Specifications D-24-5	U
DR-663 (D-101-4)	W. S. Squire	Concurrence on Specifications for the AN/FSQ-8 Combat Control Central Sup. 2, 6M-4106 Sup. 2 D-101-4	U