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

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 4 MAY 1956

To: Jay W. Forrester

From: Division 6 Staff

Date: 11 May 1956

Approved: J. C. Proctor

CLASSIFICATION CHANGED TO:
Auth: DOD 5
By: CRE
Date: 3-22-60

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SAGE OPERATIONAL PLANNING

(Group 61, D. R. Israel)

DIRECTION CENTER OPERATIONAL TEAMS (J. J. Cahill, Jr.)

All the specifications in the weapons direction area, referred to in the last report, are presently being typed. A memo from C. Zraket, listing all the firm specifications for the Direction Center, is expected in the next period.

COMBAT CENTER (W. Lone)

"AN/FSQ-8 Console Equipment and Label Layout," 6M-3732-1, by J. Burrows, J. Christie, H. Frachtman, R. Miller, J. Plante has been issued.

Rough drafts of six of the combat center operational specifications are nearing completion.

DUPLEX STANDBY (J. Groce)

Mr. R. A. Onanian of RAND has joined the Duplex-Standby activity and has begun rewriting and correcting 6M-4141, "Guide to Duplex Standby Computer Operation".

Mr. C. E. Diss of IBM is returning to Kingston to organize the Standby Operational Programming Group.

Rough drafts of the duplex-standby operational specifications have been completed with the exception of a listing of startover data. Present plans are to publish these specifications on schedule.

DATA SIMULATION AND REDUCTION (W. S. Attridge)

Tom Hibbard has joined the section to replace Bert Persell.

Caroline Lumbard has joined the section.

Data Generation (R. Russo)

Coding of the Data Generation Program is proceeding on schedule. Some of the subprograms have been assembled and are now being checked out.

Data Reduction (R. Olsen)

Coding of the Station History Program is proceeding smoothly.

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DATA SIMULATION AND REDUCTION (continued)

MTC Operation (D. Bancroft)

Satisfactory operations (and happier programmers) are upon us. The only major roadblock remaining is the magnetic tape availability.

...ration for the period 23 April to 4 May:

	Hours	% of Scheduled Time	% of Used Time
Scheduled	12.5	100%	
Available (and used)	15.53	124%	100%
Satisfactory operation	13.73	110%	88%

INTEGRATION

Bomarc (H. Anderson)

The first draft of the AN/GPA-35 study group report, prepared by Boeing, has been received and reviewed by interested parties here at Lincoln. I plan to visit Seattle during the week of May 7th to discuss our comments with Boeing and help prepare a final draft.

F102 A (L. Jeffery, F. Garth, D. Ladd)

Initial study is continuing. A report spelling out the tasks involved is being prepared. The target date for completing this report is 30 May.

TALOS (J. May)

A study of the problems involved will get under way during the next biweekly period. J. May and H. Boyd attended a preliminary meeting at ADC on May 1-3.

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ESS DC IMPLEMENTATION AND COORDINATION

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

EXTERNAL EQUIPMENT AND COMMUNICATIONS (I. Aronson)

Long-Range Radar Subsystem (W. J. Canty)

The LRI test team has been performing acceptance tests on the XD-1 LRI subsystem, generating the necessary test specifications and procedures, and making engineering analyses and reports of test results to be incorporated or considered for SAGE.

The first subsystem tested, located at South Truro, consists of the FPS-3 radar, a fine grain data (FGD) machine, Lincoln-type digital data transmitters and receivers (DDT, DDR), the LRI frames, monitor, and drums of XD-1. This subsystem uses a 32-bit phone line message. It has been only recently that any real progress seems to have been made. Due to the difficulty in scheduling the South Truro site equipment, the XD-1 computer, the Memory Test Computer, and other items of test equipment and delay in obtaining debugged test programs, progress has been slow. Approximately 90% of the test work on the South Truro subsystem has been accomplished and the team is now to the point of making overlap tests which are being performed with gap-filler sites since there is only one long-range site.

Reliability of equipment has not been as good as expected and something in excess of 66% has been considered as downtime. Trouble has occurred in nearly all of the portions of the subsystem at one time or another. The two major equipments causing downtime have been the FGD machine at South Truro and the XD-1 computer. Some of the downtime was also attributed to the debugging of the computer test programs.

As of 1 May, the team has satisfactory test patterns from MTC, programs to process the data in XD-1 (a test-tracking and a comparing program), trained personnel, data recorded on Ampex tape, and the required experience to operate the subsystem. If enough time can be scheduled and the equipment operates reasonably reliably, the South Truro site should be ready for Group 64 or Group 67 use before the LRI test team starts at Bath.

Since the Bath site uses a production word of 52 bits, changes in the MTC programs are required and should be completed by 15 May. The MTC programs provide data for use in subsystem testing which has such definite, known characteristics that the engineering and trouble-shooting phases can be pursued at a good pace. It is anticipated that the test team will be ready to test the Bath subsystem by the time it is accepted by Group 21 and turned over to our control - Approximately 1 June.

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EXTERNAL EQUIPMENT AND COMMUNICATIONS (continued)

Among the several inspection and training trips which have been made by team members are: An FGD course at South Truro, a 4-day course on the AN/FST-2 at Paioli, Pa., an inspection trip to IBM at Kingston, to see the production computer, and an inspection trip to the Bath site to observe the service test model of the AN/FST-2.

Height Finding Subsystem Tests (T. Sandy)

Subsystem error-rate tests have started between South Truro and XD-1. The test on 27 April gave us one error for every twenty messages.

Subsystem accuracy tests are continuing between South Truro and WWI. The tests to date seem to indicate an accuracy of $\pm$ 800 ft. 50% of the time and $\pm$ 2000 ft. 90% of the time. The larger errors seem to occur at ranges over 100 miles.

Crosstell Subsystem Tests (T. Sandy)

The crosstell test of 1 May between WWI and XD-1 gave us one error in 7600 messages.

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

A study was made and a proposal has been written on how the Maintenance Coordinator's Office should handle trouble reports for ESS leased telephone circuits and equipment. A record keeping system was also proposed.

A meeting was held on 26 April to discuss ESS scramble circuits to ADC interceptor bases. It was concluded that many problems, both technical and operational, still exist, and that the Telephone Company and the Air Force would pursue them further.

A meeting was held on 3 May with representatives of Group 23 to discuss implementation of Mission Operations Center in Bldg. F. It was concluded that equipment could be provided for this purpose, but that Group 23 must crystallize their operational plans before this equipment can be spelled out in detail.

One group of Bell System visitors was guided through Building F.

DESIGN CONTROL (W. A. Hosier)

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

The file of possible machine changes (about 30 different proposals, which go all the way from simple things like shortening the cycle of a single instruction to such radical things as eliminating the

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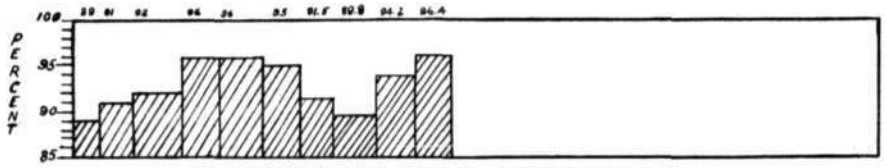
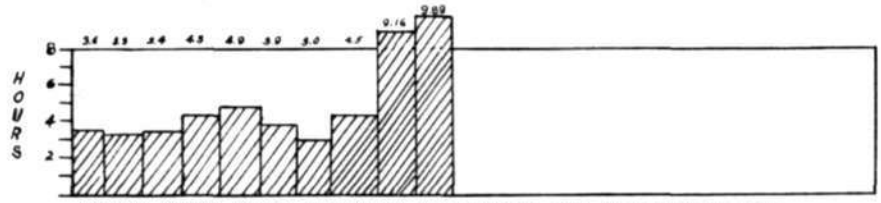
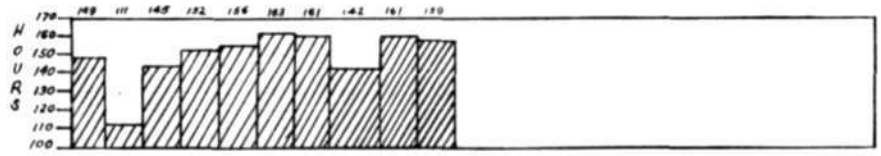
AN/FSQ-7(XD-1) SYSTEM RELIABILITY



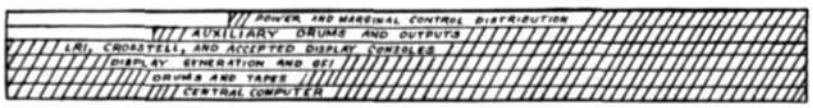
PERCENTAGE OF USEFUL ASSIGNED TIME



MEAN GOOD TIME BETWEEN FAILURES OR INTERRUPTIONS



TOTAL ASSIGNED TIME



EQUIPMENT INCLUDED IN RELIABILITY STUDIES

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DESIGN CONTROL (continued)

in-out break system) is just about as complete as Shur and I can make it without more specific information from Group 67 on the operational program. A meeting next week with some Group 67 people is expected to lay the groundwork for obtaining most of this information.

Meanwhile IBM personnel under Cypser, Walston, and Housman are putting concentrated analysis into two of the most likely improvements: one "short term", the addition of two more 64 x 64 memories; and one long term, the overlap of OT and PT cycles involving two memory buffer registers and considerable changes in the timing and control of command pulses.

Manual Data Input Room Card Machines (R. H. Gerhardt)

Two representatives of the IBM Cambridge Sales Office will visit the laboratory Monday, 7 May, to discuss the use of the Type 047 tape-to-card punch. Personnel from Group 61 who are planning the MDI room activities will attend.

An RECI to change the AN/FSQ-8 MDI room equipment to two 020 card readers-punch and one 026 card punch has been sent to IBM. Previously two 026's and one 020 had been specified and a failure of the single direct-entry card reader (the 020) would have disabled operations in the MDI room.

XD-1 Master Reference List (J. Giordano)

"Master Reference List of Equipment Specifications for XD-1", 6M-3851-2, SL, which lists all concurred with specifications from 9 March 1956 through 23 April 1956, has been released by the DCO. This, together with the original 6M-3851-2, now contain all concurred with specifications which Lincoln Laboratory recommends for XD-1 designs as of 23 April 1956.

Addition of an Input Maintenance Console for XD-1 (J.D. Crane)

The addition of a maintenance console in the input area of XD-1 might be a solution to the problem of centralizing switches and indicators already in XD-1 and also for equipment additions to be made in the future. A study is being made by the DCO to determine the feasibility of adding such a console.

Card Conversion (J. D. Crane)

IBM has suggested that the card thickness be changed from .009 inch to .0065 inch to make SAGE installations compatible with other card machine installations. This change would cause MIT programmers

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DESIGN CONTROL (continued)

difficulty because the cards used at XD-1 could not be used at other sites. This problem is being investigated by the DCO and the programming groups.

NEW CER's (A. A. Rich)

CER #		Originator
157	S-18, Direct-Entry Card Machines for AN/FSQ-7 and AN/FSQ-8. Review of a rewrite of specifications.	IBM
158	P-265-1, Testing of the Clock Register, XD-1. Proposal for a quick method of testing the clock register by use of operational instruction PER 14.	IBM
159	P-192-2, Automatic Branch on Alarms. Change for provision to start in test memory address (20,010 octal) on automatic branch on alarms.	IBM
160	S-47, Display Manual Data Input WL LC and Distribution Unit Specifications for AN/FSQ-7 and AN/FSQ-8. A review of a rewrite of specifications	IBM
161	S-34, Internal Power Distribution Specifications. A review of a rewrite of specifications.	IBM
162	S-76, Maintenance Intercommunications Specifications for FSQ-8 when Combined with FSQ-7. A review of a rewrite of specifications.	IBM
163	S-54, Maintenance Intercommunications Specifications for FSQ-7.. A review of a rewrite of specifications.	IBM
164	Add Standard A Type Status Label to E-23, XD-1. Group 67 Change to Identify Console as "Display Console Tester". RECI submitted to IBM to request incorporation of this at manufacturer's convenience.	
165	Word Format Problem. A study to correlate and pre- sent XD-1 and FSQ-7 formats in accordance with equipment design.	D.C.O.-MIT
166	Provide one 026 Card Punch and two 020 Card Punch machines for the FSQ-8 MDI room instead of two 026's and one 020. Change proposed in order to attain more reliability. RECI submitted to IBM to incorporate this change.	IBM
167	GFI Mapper Console Change to 5-10 RPM, FSQ-7. Investigate to see if specifications requirements could be changed from 2-10 RPM to 5-10 RPM.	W. Lone and H.K. Rising

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ARRANGEMENT OF BITS ON INPUT AND OUTPUT DATA LINES (L. Sutro)

A memo now in preparation will give the arrangement of bits on data input and output lines and associated drums. Charts will show the arrangements of bits both now and ultimately for both XD-1 and FSQ-7. The information collected for this memo has already helped one lost soul.

POWER AND CONTROLS (J. J. Gano)

XD-1

The recent weekend thunder storm exercised the ability of the power system to override utility transients. Again it failed. On this occasion some of the equipment-cooling motors dropped out. We have submitted a CER to IBM requesting a study for the purpose of making recommendations. Although the SAGE System centers have self-generation, some of the problems with transients will arise, although much less frequently and IBM should get acquainted with them. They have been requested to investigate the switchgear controls, the d-c supply contactors, the 48-volt supply which is not supplied by the motor-generator, the drum motor contactors, and the equipment-cooling motor contactors and controls.

It is expected that IBM will soon assume complete responsibility for the AN/FSQ-7 d-c power supplies, and Lincoln will no longer be involved in studying their design. I am preparing a memo documenting the Lincoln reports relating to the design and performance of the d-c supplies to send to IBM. I am also planning a report on the most recent drift study in XD-1. During this test, two voltages varied enough to operate the 10% sensitrols, and two interrupting component failures occurred. All other voltages varied more than the specified amount. (S. T. Coffin)

Magnetic Amplifiers

We are making a test rack for checking the operating margins of the Westinghouse CYPAK magnetic amplifier circuits.

WWI Equipment-Cooling

WWI equipment-cooling drawings have been reworked in preparation for a memo describing the operation of this system.

CIRCUIT SUPPORT (R. J. Callahan)

Charactron Vector Intensity Modulator (R. B. Paddock)

Marginal checking of the breadboarded circuit indicated a nonlinearity which required a couple of modifications. Otherwise the results of marginal data looks promising and the checking continues.

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CIRCUIT SUPPORT (continued)

Recently we have acquired the additional job of laying out the pluggable unit and associated cards for this circuit, preparatory to the actual packaging.

Remote Equipment Maintenance Survey

Jim Wong of RAND (EPSCOM) has been assigned with me for the first pass on this survey. We have interviewed representatives of all ESS test teams, sat in on all recent pertinent meetings, and have attended several subsystem tests. With the information currently available, it appears to us that the complexity of the problem will require that a long time, or many people, or both, will be required for this survey and for proposing reasonable solutions to the troubles uncovered by it.

LRI Monitor (B. W. Barrett)

The hardware and logical changes to the breadboard system, necessary to accomodate the Bendix consoles, are being installed.

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

MAGNETIC MATERIALS (J. B. Goodenough)

Memory Core Testing (R. C. Zopatti)

The total number of memory cores double tested by this section to date for the 256 x 256 x 37 memory is 2,997,000. In addition there are 45,000 single tested cores and 25,000 cores returned from Kodh for retesting. These 70,000 cores will be double-tested to finish the required number of cores for this project.

Chemistry

Thin Films Project (F. S. Maddocks)

Samples have been successfully prepared on thin microscope cover slides. An attempt will be made to determine the structure and orientation of the films by X-ray diffraction analysis.

Experimental Chemistry (D. Wickham)

Zinc oxide, ZnO, GeO_2, $CoCO_3$, and Mn_2O_3 when ground together in the proportions, 1:1:2:1, and ignited at a temperature of 900°C in the air yield a black crystalline material with the spinel crystal structure. The composition, presumably, can be represented as $Zn^{++}_{1/2}\ Ge^{++++}_{1/2}$ $(Co^{++}\ Mn^{+++})O_4$; this corresponds to a 50-50 solid solution of Co_2GeO_4 and $ZnMn2O_4$ and is in this way analogous to the magnetic solid solutions between Fe_2GeO_4 and $ZnFe_2O_4$. Magnetic measurements will be made.

Physics

Instrumentation (D. O. Smith)

The induction heater for the thin film evaporation unit has been received and is being set up. The equipment within the laboratory has been shuffled to make room for the thin film program.

D-C Fluxmeter (R. A. Pacl)

Three transistor regulators have been incorporated into the d-c fluxmeter for precise control of all filament and battery voltages. Since the B+ supplies are also regulated, voltage-dependent drift has virtually been eliminated.

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MAGNETIC MATERIALS (continued)

VCM (N. Menyuk)

Bandpass filters for the fundamental and first two harmonics of the vibrating-coil magnetometer frequency have been constructed. Their characteristics appear to be sufficiently sharp to permit the magnetic field tracking of the instrument.

256^2 Memory

To date, 449 64 x 64 memory plane modules have been accepted. Testing of the planes is now ahead of schedule and ahead of the construction and core replacement facility. Therefore the night shift was discontinued on May 7th.

Twenty-four, 256 x 256 memory planes have been shimmed together and the digit wiring connections have been completed in the first twenty. Testing of the first plane has been held up due to the fact that we have had 21 type 5998 tubes go bad. The cutoff voltage on these tubes has changed since they were initially tested which caused the tubes to leak current when they were in the off-state. The tube shop is investigating the problem.

The sense amplifier now appears to be in good shape, except for the fact that the characteristics of the channels are somewhat different and are being investigated.

Advance Development

A plastic mold for assembling 64 x 64 planes using 50-mil cores is under way. Additional experiments are being conducted with alternate construction methods.

The results of the experiments on making a plane with plated wiring continues to be encouraging.

"Parameters of The GE 2N136 PNP Alloyed Junction Transistors", 6M-4304, is ready for publication.

The problem of constructing an all-transistor memory is being investigated.

SYSTEM DESIGN (K. H. Olsen)

TX-0

A magnetic-core, toggle-switch storage system, which uses no diodes, has been built and installed in TX-0. The circuits were designed by John Ackley in his thesis. The cores are driven by ten Western

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SYSTEM DESIGN (continued)

Electric transistors, which are in turn driven by G. E. 2N123 transistors. The circuit is now functioning on a 6.5 μsec. cycle. One live register has been designed and is being constructed.

Most of the work on the computer has been directed toward polishing the in-out equipment. Several modifications have been made on the photo-electric tape reader and associated circuitry, and the reliability has been greatly increased. Noise transients are still being introduced from the a-c line.

DISPLAY (C. Corderman)

Development

A system is being proposed for the remote display console in which the vector is replaced by a directional symbol and four characters. This remote display is being designed to accept the present G/G message from the output system of XD-1. It will display any combination of tracks up to 63, (directional symbol plus 12 characters), or information messages (8 characters). An attention display will be displayed about eight times longer than a normal display. Group 38 is writing a program for MTC to observe some features of this display.

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

An M-note describing the individual stages of the line drivers (6M-3284 Supp. #1) is ready for final typing. The theoretical analysis of the line driver (part of 6M-3284 Supp. #2) is completed. Supplement #2 will also include experimental results.

Character Legibility Studies (R. H. Gould)

Equipment troubles in Bldg. F have held up the tests by Group 38 on the XD-1 Charactron legibility. The switches required for the test pattern are available on only one console in the TBS room and this console has suffered repeated breakdowns.

Equipment for the first of the "flicker" frequency tests on various CRT phosphors is nearly ready and several test CRT's have been received from the Barta tube shop.

TRANSISTORS (D. J. Eckl)

Surface-Barrier Transistor Life Tests (R. L. Burke)

A complete summary of the SBT life tests going on in the transistor

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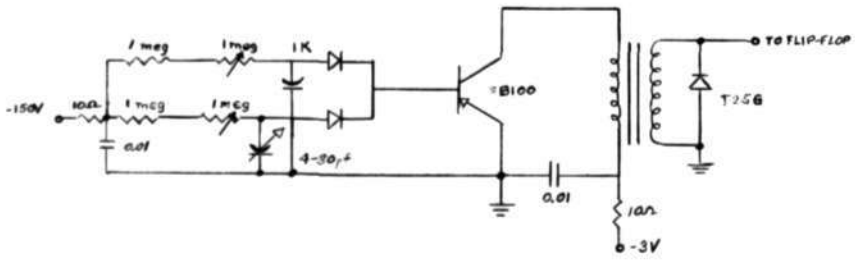
section follows:

Test	No. of Transistors	Operating Hours	Transistor Hours
FF 1 and 2	8	12,575	100,600
FF 3 thru 6	16	11,780	189,880
Control for above	9	3,745	33,705
Shelf life	16	8,425	134,800
Direct-coupled shift reg.	16	8,948	143,168
Diode-coupled shift reg.	16	7,989	127,824
RC-coupled shift reg.	16	8,896	142,336
Shielded double-rank SR	99	9,240	914,760
Unshielded double-rank SR	99	7,897	781,803
Single rank shift reg.	149	3,787	564,263
Total	444		3,133,139

There were two transistor failures, both of which occurred during parameter testing which corresponds to a failure rate of 0.06% per 1000 hours. It should be pointed out that both failures were of the "accidental" variety and so possibly should not be counted at all. An even more noteworthy performance from a reliability standpoint is the fact that the 99-transistor shielded shift register has been operating since 8 June 1955 without loss of pattern - i.e., without a single transient error. This represents a continuous error-free run of 7,930 hours. The unshielded unit has been holding its pattern since 5 December 1955. The single-rank shift register, running from a transistorized power supply connected to the a-c line, has held a pattern since 18 January 1956.

Silicon Diode Random Bit Generator (E. Cohler, R. Hudson)

The following schematic is the latest design for a TX-0 random bit generator:



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TRANSISTORS (continued)

Two diodes are used to find a double series of independent pulses. This gives us a greater assurance of randomness, and lessens the criticalness of adjustments.

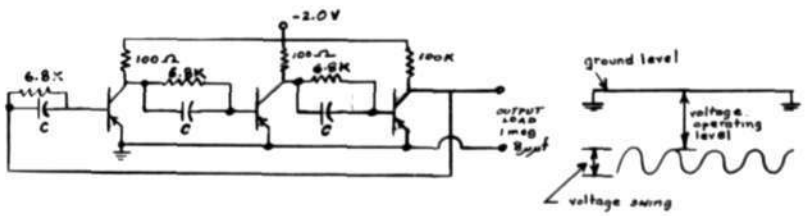
Suggestions by Dr. A. C. English of G. E., Lynn, Mass., have led to some interesting theoretical possibilities for the random noise. The variation in breakdown may be just the variation in electron-arrival times at the avalanched section of the junction. The calculated rate of electrons entering the junction is of the proper order of magnitude $600\left\{\frac{\text{electrons, or holes}}{\text{microsecond}}\right\}$

Tetrode Circuits (E. Cohler)

Measurements have been made on the high-frequency TI-501 tetrodes and they show certain unusual difficulties. The end resistances are extremely high, on the order of 1000 Ω or more. The variation in α and I_{co} is excessive, i.e., while most units run about 0.99 and 2.0 μa, several of the units were much lower in α and higher in I_{co}. This seems to indicate that the process is not in good control, and in the case of I_{co} at least, the specifications have been set to include the large number of poor units as well as the achievable good units. The variation of α with base voltage is different than that found in low frequency tetrodes and is being investigated further.

Surface-Barrier Evaluation (J. R. Freeman)

The three-stage ring oscillator shown has been designed for speed with the types of surface-barrier transistors listed in the table.



The values of the circuit parameters shown in the schematic are optimum for all types with the exception that the SB100T runs faster with collector resistors of 150 ohms instead of 100 ohms.

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TRANSISTORS (continued)

Type	C in pf	Collector-Voltage Operating Point	Collector Voltage Swing peak-to-peak	Frequency of Oscillation	Double Propagation Time
L5122	57	-1.5V	1.0V	13.3mc	25 mμs/stage
SB100T	33	-1.5	0.6	11.8	28
L5117	82	-1.65	0.3	20.0	16.7
L5131-1	47	-1.5	0.4	20.0	16.7
L5131-2	69	-1.5	0.9	14.8	22.5

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ESS TEST PLANNING - WWI MTC OPERATION

(Group 64, E. S. Rich)

ESS SHAKEDOWN PLANNING (C. C. Grandy) CONFIDENTIAL

Exercise Design

The 150 questions contained in the draft of 6M-4281 "General Shakedown Test Requirements," have been organized into a testing sequence and the time required to carry out the testing has been established. A total of 55 successful 4-hour exercises are required to answer the 150 questions. At least 27 exercises must be completed before evaluation tests can begin. The total time required for the 55 exercises is estimated at 23 weeks with no allowance for unforeseen difficulties. (A. Roberts, M. DiCarlo-Cottone, R. Watters, W. Johnson)

Work in Process

Sample Test Specifications by W. Johnson - draft should be completed during next biweekly period.

Test Concepts for SAGE Production Installations by R. Watters and A. Roberts.

"ESS Shakedown Simulated Planning Design," 6M-4278 by D. Coyne and R. Lawrence - issued.

"Schedule for Experimental Subsector System Testing by Groups 64 and 22," 6M-4223 - recent schedule adjustments necessitate further revision. This should be issued in the next biweekly period with an accompanying memo stating operating personnel requirements.

"General Shakedown Testing Requirements," 6M-4281 - draft being revised and publication expected week of 14 May. Detailed testing requirements are being prepared.

Supplement 1 to 6M-4203, "Initial Data Reduction Requirements for ESS Shakedown Exercises," will be issued the week of 7 May.

Status of Operational Handbooks for the ESS Sites, being prepared by the Manual Subsector Test Team (Facilities), is as follows for the various subjects:

Weather, Ground Observer Corps, AACC - drafts completed
LRI's, GFI's, Interceptors, AMIS - manuscripts prepared
AEW, Picket Vessels, ADDC, ADCC, Air Sea Rescue,
Bombardment Aircraft - not yet started.

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ESS SHAKEDOWN PLANNING (continued)

Test Concepts for Subsystem Testing the Manual Operating Areas - preliminary proposal made to AAOC.

Personnel

T. R. Callahan has transferred to the Memory Test Computer (MTC) section of Group 64. W. Feely, Western Electric Co., has joined the Manual Test Team.

WHIRLWIND I (L. L. Holmes)

Computer Operations

Scheduled Computer Hours	326
Interrupting Incidents	10
Hours Lost	4.4
Percent Good Time	98.6
Mean Time Between Failures in Hours	32.2

Inexperienced personnel working a night shift required three hours to locate a faulty video cable connection. This incident followed our recent monthly installation day and it contributed to 67% of the period's down time.

There were no interrupting incidents attributed to tubes and 22 tubes were retired from service through the use of marginal checking.

Personnel

Paul Murphy (staff) has been transferred from Group 66 to our section. He is working with E. W. Pughe, Jr. on WWI - XD-1 crosstelling.

John Q. Johnson (technician) has rejoined our section following a several month assignment with Group 63.

Delayed Printout Equipment

The new and more flexible control system and the third delayed printout facility are now being used for applications work. All of the electronic equipment is in service, and the new Flexowriter tables with their new enclosure will be added during the coming biweekly period. L. H. Norcott and O. C. Wheeler were very successful with this project and completed it one week earlier than expected.

WWI-XD-1 Crosstelling

On Tuesday, 1 May 1956, the crosstell subsystem tests between XD-1 and WWI were resumed. During the 1.5-hour test period, no equipment

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WHIRLWIND I (continued)

failures occurred at WWI and one unexplained error was introduced at XD-1. The new XD-1 computer program functioned much better than the version used during the tests of December.

Test Programming

D. A. Morrison has released a new version of the marginal-checking program, programmed for the central computer. The control routine for the program is similar in nature to that used in the Room 156 marginal checking program. He is now planning to expand the arithmetic element check program to include a check of our toggle-switch storage.

Core Memory

A. N. Blumenthal discovered that the digit plane drivers are not adequately marginal-checked. When the gain of the amplifier decreases below a certain level, the marginal checking voltage varying the negative feedback circuit no longer has effect on the unit's output. The difficulty will be remedied by adding a new marginal-checking circuit to the output stage.

MEMORY TEST COMPUTER (H. L. Zeigler)

Reliability of the power supplies continues to be excellent, indicating the effectiveness of our recent "cleanup" and of our present maintenance schedule. Modifications now in progress or under consideration are expected to make easier the task of maintaining the present high degree of reliability.

The marginal-checking system is being overhauled to make it more effective. Circuits are being rearranged and revised to provide better coverage of circuitry. Response and regulation of the amplidyne are very poor and must be improved before accurate margins can be taken on MTC circuits.

Most existing test programs have been revised to operate with the new instructions and the new control. As expected, there were a fair number of low margins in older sections of the computer. With these low margins removed, the overall reliability of the computer has gone up considerably -- closely approaching the pre-shutdown level.

Checkout of the magnetic-tape system is proceeding slowly because of some rather weird troubles that have cropped up. A prime example was one mode of operation that performed correctly only in the dark! Eventually this was traced to a combination of a wiring error and a light-sensitive thyratron pulse generator. MTC engineers will continue to work nights and weekends until the magnetic tape system is in full operation.

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MEMORY TEST COMPUTER (continued)

A pre-shutdown trouble source is still with us -- the Panel Memory. Though used for several years in a memory cycle of about 6 μsec, it contained circuits which, under certain switch configurations, had time constants between 10 and 20 μsec. Careful juggling of circuitry has corrected this somewhat, but a completely new design may be necessary from the standpoint of reliability. Study on this is continuing.

Air conditioning of the MTC area may be a problem in the coming months. Several days of the past few weeks overloaded the system in its normal condition. It became necessary to close off the by-pass of air through the heating coil section to obtain the necessary room cooling. Though no heat was called for on those days, some of the coming summer days will definitely need it for humidity control. An evaluation of the system and its load is in progress; and temperature sensing elements are being installed in critical areas to provide an overheat alarm.

Work on probes, intercoms, and other auxiliaries is progressing slowly due to the press of other work. The necessary speakers for the intercom are on order. The probe system is nearly complete with switching at the scope being the remaining problem. Diode mixer designs (mechanical) are being evaluated for use in new control circuitry, existing and planned.

During this biweekly period Tom Callahan, staff, and Bill Meade, technician, joined the MTC section.

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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

Beam uniformity of B-N cathodes was evaluated further by processing eight LTPS B-N cathodes which displayed 90-100% surface uniformity. Additional cathodes have been scheduled to supplement this data.

Display Program

The 2-inch tubes for the phosphor studies of Group 63 are nearly completed and ready for evaluation. In the meantime, the techniques for the deposition of equal areas of six different phosphors onto a 19-inch panel have been successfully developed. The experimental panel used in this work was also aluminized in order to complete the study. As a result, processing of the panel for the 19-inch phosphor study tube (Groups 63 and 38) has been started.

The 5-inch flat-face CRT for projection study has been prepared and scheduled for tube processing.

Evaporated Films (Group 63)

Another ferromagnetic evaporated film sample was prepared with Fred Maddocks in our demountable vacuum system. The initial model of a demountable ion gauge for condensable materials to be used by K. Shoulders has been designed and is in the process of fabrication and assembly.

Solid-State Display (Group 24)

A tube to investigate electron beam bombardment of CdS is in process for W. L. Gardner.

RECEIVER TUBES (S. Twicken)

0528 Raytheon

The first development samples of Raytheon's 0528's for FSQ-7 have been received and investigated. The characteristics were not centered because of high μ and low contact potential. Subsequent discussions with Raytheon have been held. Changes in geometry and contact potential are now reported to have centered the characteristics squarely. If this is the case, future production at Raytheon should proceed well in view of the manufacturing techniques and methods set up for this program.

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RECEIVER TUBES (continued)

0528 General Electric

Present 0528 production at GE is proceeding well. If anything, shrinkage is so low that the present high rate of production will have to be cut back to normal long-range requirements. Some evaluation of GE's major production difficulties of last year were tied up in the problem of contact potential.

6888(SR-1782A) Sylvania

The IBM-MIT Tube Group met with Sylvania relative to the SR-1782A gate tube. A RETMA number for this type, #6888, has been obtained. Dimensional changes, within the range Sylvania calls "normal", have had to be made at the Brookville plant in order to meet the specification and desired characteristics. This has resulted in markedly reduced shrinkage at Brookville. Production at Emporium continues to be fairly good. It is now generally agreed that it will be impossible to increase the pulse plate current (which will increase circuit margins) without increasing the zero-bias plate and screen currents and perhaps the cutoff as well. Sylvania is to make more sample lots of tubes having a greater area of cathode coating in order to determine quantitatively what changes will be required in the specifications to accommodate the higher-pulse plate current. Circuit-wise, the zero-bias plate current is of no concern in FSQ-7. It is, however, of concern in the Burroughs equipment and Burroughs will have to be consulted before any production changes are agreed upon. In addition, our own circuits people will be asked to evaluate tubes of the proposed design before the final decision.

DT-438 Tung-Sol

I attended a meeting set up by IBM with Tung-Sol management to express dissatisfaction with progress on the DT-438 program. It is hoped that more progress can be generated at Tung-Sol by this official expression of dissatisfaction as well as IBM's refusal to put more money into the program. Tung-Sol has agreed to meet the financial burden of carrying the program through to successful completion after its present funds are expended.

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

Six MIT 19-inch tubes have completed between 1553 and 10,523 hours of life test and 13 Charactrons have completed between 153 and 3291 hours. Latest test results show CHT-75 gave less than 50-μa matrix current after 10,329 hours of life. The tube will be rejected if similar results are obtained at the next testing period. Other test results show no significant changes in leakage, screen capacitance or dissipation factor, and helical-accelerator resistance.

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CHARACTRONS AND TYPOTRONS (continued)

Thirty oxide-coated cathode study tubes have completed between 542 and 8235 hours. The 28 tubes on the present program have accumulated up to 2391 hours. Four tubes with between 256 and 1095 hours were rejected from life test, three for leakage and one for low pulse A_3 current. A report on this program is being issued.

Forty-two bariated-nickel cathode tubes have operated up to 2391 hours. Many of the latest tubes have featured uniform cathodes, an encouraging sign of progress.

Thirteen triode and five diode early bariated-nickel cathode tubes are continuing on life test. Data on this tubes will be taken shortly.

Eighteen Typotrons have completed between 2507 and 9119 hours. Monthly data on these tubes are being taken.

COMMERCIAL TUBES (T. F. Clough)

It was proposed on 24 April 1956 by IBM (and accepted by Tung-Sol) that a committee of IBM-MIT engineers be appointed to study and analyze Tung-Sol's DT-438 (improved 5998) manufacturing procedures. I was asked to serve on this committee. On 1 and 2 May, we visited the Tung-Sol plant and began the study and analysis of their manufacturing procedures. Another meeting is scheduled at Tung-Sol for 7 May 1956. On the basis of these studies, the committee will make recommendations to IBM.

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SAGE DC AND CC SITES

(Group 66, B. E. Morriss)

SITE PLANNING (K. E. McVicar)

Group 66 Manpower Requirements

A study has been made of Group 66's RAND manpower requirements through February 1958. This analysis included the ESS and SAGE site personnel required to adapt and check out the Master Program for SAGE and the preparation of such things as checkout specifications, problem generation, and special checkout facilities required for program checkout. An interoffice memprandum giving the results of this study has been circulated for comment.

SAGE System Test

A group has been organized to write a preliminary SAGE System Test Specification. This group is composed of representatives of Bell Telephone Laboratories, Western Electric Company, and Lincoln Laboratory. As a preliminary goal the group will produce a first draft of a test specification by 1 June which Lincoln will release by TIR.

Among the ground rules used in preparing this first draft are the restrictions that it concentrate on the final tests, that there be no saturation testing and no evaluation of personnel proficiency. A preliminary pass has been made on this initial draft and several basic test questions and parameters have been established. The group is now starting a skeleton design of the system test based on these questions and parameters.

EQUIPMENT (W. H. Ayer)

Conference on Failure and Status-Reporting in the SAGE System

The main purpose of this meeting, held in New York on 3 May, was to bring together interested organizations for discussion of the problems involved in failure and status-reporting and to determine a course of action. There appear to be two distinct but relative problems here:

1. In order to properly record, process, analyze, and take action on reliability and maintenance problems for all units in the SAGE System, a unified system of reporting troubles to the management level of SAGE must be developed.

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EQUIPMENT (continued)

2. In order to provide the operating command (ADC) with the necessary information to make tactical decisions based on the availability of the various units comprising the Air Defense System, a means for transmitting, compiling, and reporting this information to the proper personnel must be established.

Nine organizations participated in the conference as follows: ADES-Project Office, IBM, Burroughs, RAND, Lincoln Laboratory, Rome AFD, Hq., AMC, and Hq., ADC. Different methods presently used for failure-reporting and record-keeping were presented by IBM, Burroughs, and ADC and discussed. A study group was proposed, one of whose tasks would be to examine the various recording forms to determine what information is required from a systems point of view.

As a result of this conference, a committee was formed, composed of representatives of each organization present at the meeting, to outline the problem areas, lines of study, scope, time required, and the number of people necessary for the study group. The committee will make a report of their findings to the ADES Project Office, by 1 June, for their action regarding information of the study group to do more detailed work on these problems.

Delay in Delivery of Consoles

IBM reported at a recent IBM-Lincoln Laboratory coordination meeting that console delivery at McGuire would be late. They therefore asked Lincoln to establish a priority list indicating the order in which Lincoln wished to have them installed. IBM supplied expected delivery dates as follows:

1. Situation display consoles from 1 August 1956 through 1 October 1956.

2. Auxiliary consoles from 15 September 1956 through 1 November 1956.

By adding two weeks to the scheduled delivery dates, an installation date was established which will not affect the final operation date. IBM has verbally agreed that these dates would be met.

Three new WE programmers, D. A. Dalin, J. P. Flanagan, and D. L. Greenhalgh have joined EPSCOM. Bill Vollmer and Ken Brock (both WE) have left EPSCOM for other assignments. Western Electric is making arrangements to leave some of their people in EPSCOM on a more permanent basis, although some of their men will rotate through EPSCOM for experience. The EPSCOM manpower now stands at 38 people. This includes Paul Coakley (BTL) who is on loan to Group 67 but who will return to EPSCOM on 15 May. Further details on all of the EPSCOM programs, including a summary chart, can be found in the EPSCOM Biweekly Report, 6M-4323.

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PROGRAM PRODUCTION

(Group 67, J. A. Arnow)

DCA PROGRAMS (J. P. Haverty)

Simulation (F. Ogg)

Robert Gardner has started the MSA (data association) program formerly referred to as Simulation II. Estimated length of the program is 500 orders.

Peggy Strait has been transferred from the miscellaneous operational program section to the assembly checkout section under Al Shoolman. Height input will be taken over by Paul Guinee and Simulation I by Louis Thomas.

Coding (J. Leavy)

Coding is approximately 98% completed on the intercept calculation section of the WIN program. About 2200 instructions have been coded. The output make-up portion of WIN is expected to require about 400 additional instructions.

Coding of weapons assignment (WWA) has been completed. The program contains 1750 instructions compared to the estimated number 1500. The increase is primarily due to a requirement that WWA generate return-to-base data for deployment (DEP), combat air patrol (CAP), and interception (INT) missions. Modification of the coding specifications and preparation of a detailed flow chart are progressing.

Display (H. Briscoe)

Five display programs had been released to the card room by 4 April. These programs include track SD, track histories, air surveillance SD, alarm DD, and track DD.

In addition to the programs released to the card room, first drafts of the following programs have been completed: Miscellaneous SD, raid/group and warning crosstell SD, special expanded display for the IDO.

The display subsection is now concentrating on the completion of the last three digital display preliminary coding specifications (control and warning light program, slot allocation program, and geography DD program).

A review of all coding specifications for displays aimed at publishing dates of reliable table requirements is also under way.

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DCA PROGRAMS (continued)

Tracking (J. P. Haverty)

All of the tracking programs are in the process of parameter checkout. The smooth and predict (TSA) and smooth and trouble detect - dead reckoned tracks (TSD) are nearing the completion of parameter checkout. June 1st has been set as the target date for the completion of parameter checkout for all the tracking programs.

PROGRAM ASSEMBLY (A. R. Shoolman)

Program and Table Design (L. B. Collins)

Personnel

Julian Dowski (IBM) has joined the subsection and is working on sequence and in-out control.

Storage Allocation and Com Pool

A new communication tag pool is incorporated in the master tape - 803 item tags, 124 table tags, and 36 program tags satisfying tag and dynamic core storage allocation (DCSA) requirements for 36 programs. The com pool now contains coding information necessary in using the table simulation program to provide simulated table data for parameter and assembly checkout. The table simulation program allows item-by-item insertion of data specified in semi-operational terms (i.e., track position may be specified in miles, not as an octal number), and using an entirely symbolic address.

The latest drum storage requirements are as follows:

Programs	56,779
Tables	29,788
Total	86,567

Table Documentation

The new glossary is being published and should be available the week of 7 May. The first issue contains all item and table tags and -- hopefully -- a helpful and legible description of each. Program tags are not yet included; they may be obtained in Administrative Notes published by the Documentation Section.

Program Design Studies

Mary Ferguson has been investigating and clarifying several system elements with regard to system capacity, reference systems within

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PROGRAM ASSEMBLY (continued)

the program and without, parameter tables used for reference conversion, and other such matters. Design Notes have been or are being published on Airbases, Squadrons, and Radar and H/F sites.

Other studies include a survey of the use of table channels to insure zeroness when "empty", a note on the possible effects of confusion in the use of plus zero and minus zero, both by M. Ferguson; and a definition of the Redesignated Interceptor cycle by R. Richmond.

Sequence and In-Out Control

Gerry Schissell and Julian Dowski are designing a model sequence and in-out system for the 17 programs in the first package for Assembly Test. This design will act as a pilot for setting up methods and documentation of sequence and transfer parameters.

Documents in publication by G. Schissell include notes on operation of the Program Environment Control program and on in-out time requirements for peripheral transfers (not programs or central tables; e.g. radar inputs, display image output, etc.)

A new summary of in-out interlock time is being prepared by Tom Puorro and Nancy Hood and will be available next week. This study is based on a model DCSA using actual requirements and allocations for the "first-package" programs.

Special Programs (H. I. Rundquist)

Special programs which have been started are a keyboard input simulation program and a data simulation program. Another program required immediately is the tape merge program, which will combine the tapes of these two programs on one magnetic tape. Lower priority programs to be written in the future are those for static display generation and coordinate conversion and translation.

Adaptability (M. D. Field)

During the past biweekly period plans have been formulated for the collection of adaptation parameter information and the eventual completion of section 3.0 of the coding specifications. It is intended that the necessary parameters for the basic package will be compiled initially. The values for ESS will be converted to program language and integrated with the programs. The parameters for the remaining programs will then be specified.

All parameters must be converted from operational to program terms. In an effort to determine the form in which the parameters must be

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PROGRAM ASSEMBLY (continued)

specified for use by the programmers, data has been collected from the sections working on the TRI, KTB, and KSI programs. It is intended that similar information will be coordinated with the Group 61 people working on the Master Program adaptation specifications to insure completeness.

An outline of parameters required for the basic package programs has been completed. An outline of section 3.1 of the coding specifications has also been written.

UTILITY AND CHECKOUT (R. P. Vance)

Utility (P. R. Bagley)

The extensive computer trouble during the week of April 30-5 May has made that week a dismal one for the utility subsection. An experimental master tape containing version II of the utility system (as defined by 6M-4229-1, "Description of the Lincoln Utility System II") was recorded on 30 April. Since that time, however, essentially no shakedown operations have been possible (due both to computer troubles and to lack of available time).

Provisions for control of the utility system by special control cards was installed several weeks ago to facilitate testing of the utility system. Because the use of control cards has proved extremely useful and has increased operating efficiency, regular use of control cards wherever possible is recommended.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

Staff

New

James J. Croke, assigned to Group 66, received his BS in Electrical Engineering from the University of Pittsburgh. He was formerly employed by the Bell Aircraft Corporation.

Transfers

Howard J. Kirshner has transferred from Group 64 to Group 67.

Terminations

Robert A. J. Gildea of Group 67 and Joseph M. McCusker of Group 62 are now employed by RCA in Waltham, Massachusetts.

Norman N. Alperin of Group 66 is now employed by RCA in Morristown, New Jersey.

Daniel C. Lynch, Jr., of Group 65 is now employed by Raytheon Tube Manufacturing Company in Newton, Massachusetts.

Nonstaff (W. A. Kates)

New Personnel

James Robinson	Office	Group 67
Charles Waniak	Office	Group 67
Jeannette Strickland	Office	Group 67
Eleanor Cagnina	Office	Group 67
William Meade	Technician	Group 64
Barbara MacLennon	Office	Group 66
Claire Hiscoe	Office	Group 64

GENERAL ENGINEERING (A. R. Smith)

Experimental Light Box

The light box has been assembled and is ready for test by PCO.

Sheet Metal Fabrication

All outlets for fabricating sheet metal parts are loaded to capacity.

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GENERAL ENGINEERING (continued)

All orders for sheet metal parts, regardless of size or complexity may be expected to require three weeks' lead time. Where subsequent processing is required, such as painting, two additional weeks will be required. New accounts are being developed as rapidly as time allows. This condition can be expected to prevail for some time.

Vacuum Deposition

Design of the D. O. Smith model, Phase I, is complete and ready for fabrication. The K. Shoulder model will receive a concerted effort by the design group in the coming weeks in order to supply an acceptable unit by the first of July.

Fire Annunciator

Selection of components and circuitry have been agreed upon, leaving the design of a display board to be determined which is dependent upon the need for (1) flexibility to accomodate future alterations, and (2) clarification and ease of communicating the pertinent data to the observer.

COMPONENTS (H. W. Hodgdon)

Component test reports issued this period:

Job #	Subject	Author
001-031	Power Reactor Failure	V. P. Tessari
031-012	Nicrome Wire	H. Atlas

New jobs started this period include work on Zener diodes and on junction power transistors.

Hodgdon and Morrione attended the Components Symposium in Washington, D. C., on 1 and 2 May. A paper by Bell Labs people on examination of contact surfaces presented some interesting possibilities, and will be investigated further.

Test Equipment HQ (C. Morrione)

Test equipment maintenance for this period:

Equipment	Checked and O. K.	Checked and Repaired
Standard Test Equipment	11	30
Oscilloscopes	2	4
Commercial Test Equipment	2	8

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COMPONENTS (continued)

The need for improved scopes such as the Tektronix 540 series is becoming more and more apparent, and two additional Type 545's are being ordered, together with a selection of plug-in preamplifiers for use with them.

DOCUMENT ROOM (A. M. Falcione)

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(P. E. Falcione)

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The following documents were published by Division 6 or received from IBM during the period ending May 4, 1956.

NO. 6M-	AUTHOR	TITLE	CLS.
ADMINISTRATION & SERVICES (Group 60)			
4302	Div. 6 Staff	Biweekly Report for Period Ending 20 April 1956	C
4304	M. Bright	Division 6 Power Distribution Equipment	U
4305	J. W. Forrester	Time Demands on the AN/FSQ-7 (XD-1) Computer During 1957-1958	C
4310	H. W. Hodgdon	Test Equipment Committee Meeting 13 April 1956	U
SAGE SYSTEM TEST & PLANNING (Group 61)			
3732-1	J. Burrows	AN/FSQ-8 Console Equipment and Label Layouts	C
3778-1 C#2	J. Bryan S. Hauser	Use, Presentation of Weather Data in the SAGE System	C
3828-1 C#1	E. Wolf	Operational Specifications for the Height Finding Function in the Sage Direction Center	C
3836-1 C#2	H. Gochman	Operational Specifications for Automatic Tracking in the Sage System	C
3930-1 C#3	H. P. Bridge	Operational Specifications for the XD-1 Startover Function	U
3997 C#1	E. Wolf	Mathematical Specifications for Height Finding	C

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4028 C#1	J. Bryan S. Hauser	Changes to Mathematical Specification for Identification Function in Sage	C
4032 C#1	J. Bryan S. Hauser	Mathematical Specifications for Data-Input Function in Sage	C
4077 C#1	W. Attridge	Mathematical Specifications for Training & Battle Simulation in the SAGE System	C
4257	R. R. Reed	Category & Display Assignment Bit Assignments for AN/FSQ-8 Situation Display Consoles	C
FSQ-7 PROTOTYPE DESIGN & INSTALLATION (Group 62)			
4274	T. J. Sandy	Addendum to all Test Concept Memorandums	U
4284 S#1	C. W. Watt	Establishing Technical Control in ESS: Summary of Equipment Needed in the Direction Center and Proposed Location	U
4284 S#2	C. W. Watt	Establishing Technical Control in ESS: Proposed for Special Alarm Panel at Maintinance Coordinator's Position	U
4094	I. Aronson J. A. O'Brien	Test Concepts for Sage Ground to Air Data Link Subsystem	C
4306	R. P. Mayer	Equipment Program Services Committee Reorganization	U
4307	R. P. Mayer	EPSCOM Biweekly Report for 20 April 1956	U
4312	J. Giordano	Minutes of the IBM-DCO Concurrence Meeting No. 60 Held at Lincoln Laboratory, 26 April 1956	U

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ADVANCE DEVELOPMENT (Group 63)			
4298	A. L. Loeb	Proposed Research Program on Thin Film	U
VACUUM TUBES (Group 65)			
3895 S#2	D. C. Lynch J. S. Palermo	Surface Processing of Vacuum Tube Components	U
PRODUCTION COORDINATION OFFICE (Group 66)			
4292	K. Brock	Word Formats	C
4301	P. Bragar J. Carson	Manning and Resources Needed at McGuire for Operational Program Checkout	C
4311	E. D. Lundberg	Procedure for Processing Equipment Change Requests in Groups 61 & 67	U
COMPUTER PROGRAM PRODUCTION (Group 67)			
3399-1 S#1	J. Berman	Nomenclature for Consoles and Operating Positions in XD-1	U
4041 C#3	P. R. Bagley	Editor Subroutine System Corrections	U
4082-4	J. F. Jean	Initial Program Specifications List	U
4214-1	P. Isaac P. Bagley	Data Organization for Lincoln Utility System II: Central Tables, Tapes & Card Forms, Storage Allocations	U

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		IBM DOCUMENTS ISSUED	
970	G. R. Rosenberger	KMPD Engineering Report Distribution Element, Power Supply and Marginal Checking System	U
971	R. J. Paddock	KMPD Engineering Report Sequence of Operations for Types 713, 718, & 723 Card Machines	U
972	----------	Progress Report AN/FSQ-7 & AN/FSQ-8 IBM Corp. CD# 6-408-773	C
973	W. McCoy	KMPD Engineering Report Prototype Card Assembly Testing Methods	U
974	----------	AN/FSQ-7 Engineering Progress Report CD#904-1867	S
975	G. J. Halgas	KMPD Engineering Report — Control of Simplex Distribution Equipment in the Power Supply & Marginal Checking	U
976	J. S. Crosby	KMPD Engineering Report — Unit Test of the Long-Range Radar Input Element of the AN/FSQ-7 (XD-1) CDC TR-91	U
977	R.P. Crago	Progress Report AN/FSQ-7 & AN/FSQ-8	C
978	J. W. Heermans	KMPD Engineering Report Crystal Oscillator, Models C, D, & E TR-162	U
979	J. W. Smith	KMPD Engineering Report Sense Amplifier, Model B TR-161	U

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NO.	AUTHOR	TITLE	CLS.
643 (P-181) (D-12-1)	R. W. Bottomley	Proposed Changes in the Card Machine	U
644 (P-189-2)	F. A. Behnke	Change to P-189-1 entitled IRI Monitor for XD-1	U