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Memorandum 6M-4347

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

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 18 MAY 1956

To: Jay W. Forrester

From: Division 6 Staff

Date: 24 May 1956

Approved: *[Signature]*

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SAGE OPERATIONAL PLANNING

(Group 61, D. R. Israel)

WEAPONS INTEGRATION

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Weapons

As the result of an ADC-ARDC meeting on 3 May 1956 at Hqs. ADC, a series of meetings have been called to formulate the operational documents which will state the proposed use of the various new weapons with SAGE. These meetings will include personnel from the weapons contractor, the 4620th ADW, Lincoln Project Office, the respective Weapons System Project Office (WSPO), Lincoln Laboratory, and ADC. The chairman will be from Air Defense Command.

Bomarc (IM-99) (H. E. Anderson)

The ADC meeting for the BOMARC-SAGE operational planning is being held in Seattle, Washington from 15 May 1956 to about 24 May 1956. The final draft of the AN/GPA-35 Study Group will be completed following the ADC meeting.

F102A (L. Jeffery, F. Garth, D. Ladd)

The final draft of the Study Group Integration Report will be completed next week when discussions are held with Convair and Hughes at Culver City. The operational planning meeting for the F102A will be held in Colorado Springs at Hqs. ADC from 18 to 22 June 1956.

TALOS (J. May, E. Wolf)

The ADC operational planning meeting on TALOS will be held in Moorestown, New Jersey at RCA on 4-8 June 1956. The study and delineation of the technical problems involved when TALOS will have integrated use with SAGE was started on 15 May 1956 with RCA, Applied Physics Laboratory of the John Hopkins University, IBM and WE-ADES. Due to the short interval before the ADC meeting, extra discussion meetings are contemplated in order to be better prepared to advise ADC of the nature of some of the technical problems involved before adequate integration of TALOS and SAGE can be assured. The study group will meet at Lincoln on 28 and 29 May 1956 for further discussion and investigation. The report of the study group will be completed after the ADC meeting.

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

Members of this section have compiled requirements for data reduction in ESS and in SAGE operations. This work was done as a "Saturday task" in support of the Data Simulation and Reduction Section.

R. A. Mosier (RAND) has joined this section. His first task will be preparation of a "-2" of the Radar Data Inputs Ops Spec, under the direction of P. Stylos.

A memo (6M-3980-2; Zraket, Attridge and Cahill) has been issued giving a final listing of operational and mathematical specifications for the SAGE Direction Center. All specifications on this list have been or will be issued by Group 61 by 4 June 1956.

IDENTIFICATION AND MANUAL INPUTS (S. J. Hauser)

In response to a letter from 4620th ADW to Lincoln PCO recommending changes in IBM equipment for Manual Data Inputs, a committee to study the recommendations has summarized its conclusions in a letter to the 4620th. Discussions of this matter will be included in the next BIWEEKLY when responses to the letter have been received.

DUPLEX STANDBY (J. Groce)

Rough drafts of all sections of the operational specifications for Duplex and Standby computer operation have been completed.

The "Guide to Duplex and Standby Computer Operation at a SAGE Direction Center" (6M-4141) is being revised and the second draft is in rough form.

A meeting was held with the maintenance programming group of IBM in Kingston and it was agreed that all estimates of time requirements for the standby computer would be revised to reflect a maximum use of "duplex mode" operation.

On Saturday, May 12, a meeting was held with Group 61 personnel to discuss the transfer of startover data from one computer to the other.

COMBAT CENTER (W. Lone)

First drafts of 6M-4247, "Operational Specification for Sector Staff and Liaison Personnel", R. Miller; and 6M-4251, "Operational Specifications for the Manual Data-Input Function for the SAGE Combat Center", J. Plante, have been prepared and distributed to the 4620th ADW for discussion purposes.

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COMBAT CENTER (continued)

Conferences were held with Air Force personnel from Continental Air Defense Command to determine the kinds and amounts of data that should be transmitted from SAGE Combat Centers to ADF and ADC by automatic teletype.

DATA SIMULATION AND REDUCTION (W. A. Attridge)

Caroline Lumbar has joined the section and is working on the Data Generation Program.

MFC Operation (D. Bancroft)

Operation for the period 7 to 19 May:

	Hours	% of scheduled time	% of used time
Scheduled	15.00	100.0%	
Available (and used)	15.66	104.4%	100.0%
Satisfactory operation	15.06	100.4%	96.2%

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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)

Operating instructions for the ESS A/G voice radio system have been published by and are available through the New England Telephone and Telegraph Company.

A meeting was held on 10 May 1956 with members of Group 23 to discuss implementation of the missions operations center in Building F. It was concluded that nothing further can be done by this office until the location and operations of this group are specified in detail.

Schedules have been worked out on writing operating instructions for external circuits at remote sites. These instructions will be given to Group 23 for inclusion in their Site Operations Handbook.

DESIGN CONTROL (W. A. Hosier)

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

Two meetings were held this period regarding the possibility of adding two more 64 x 64 memories to each machine (four per duplex), with emphasis on the McGuire installation. The first, at ADES on 10 May in New York, was to explore the building problem; the second, at Poughkeepsie, was to look into aspects of equipment engineering, such as repackaging, driving greater loads and longer lines, etc.

Since IBM has already done most of the design and considerable testing of the proposed digit-plane driver circuit which would be incorporated into the same plug-in unit with a sense amplifier to effect a smaller memory frame, and because of the apparent minimum upheaval in space, air ducts, cabling, etc., compared with other possible locations, the consensus tends toward repackaging memories and fitting four of them into the present space allocated to two. It is felt that the first such installation would probably take a year to produce and install; more specific figures should be forthcoming on this.

Decisions on certain other more remote matters, such as the relative merits of a 256 x 256 memory compared with four 64 x 64 memories split in an overlapped PT-OT cycle, have yet to be made and are still waiting on program analysis and experience.

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DESIGN CONTROL (continued)

Use of 0.009" and 0.0065" Cards (J. D. Crane)

Even though only 0.009" cards will be used within a site, it is necessary to send 0.0065" cards with Hollerith code to Kingston and other IBM process stations. IBM proposes that the cards be converted (.009" to .0065") at each site by means of a 552 interpreter and a 519 summary punch with a conversion switch which allows both machines to use either size card. It appears that this situation will be a satisfactory solution as far as Lincoln is concerned.

GFI Inputs (W. A. Hosier)

The specifications for the GFI input element were relaxed to operate with radar speeds of 4 to 10 rpm instead of 2 to 10. IBM was unable to meet the 2-to-10 specification using standard circuitry. This appeared plausible since there is no trend toward the design of lower-speed radars. The radars (FPS-14, 18) presently designed for SAGE (SDV) fall within these relaxed specifications.

LRI Monitor (ASO Position) (S. B. Ginsburg)

Many operational personnel are unaware of the location of the selection controls for the LRI monitor at the ASO position. It should be noted that these controls are located on the monitor console and not on the ASO auxiliary console.

Situation Display Camera (L. L. Sutro)

Memorandum 6M-4163 has been completed, and describes in one section what the programmer needs to know about the situation display camera, in other sections the logic and operation of the system.

New CER's (A. A. Rich)

<u>CER #</u>		<u>Originator</u>
168	Addition of two more 64 x 64 memories to each duplex machine. An investigation of what would be involved to incorporate the feature to FSQ-7.	MIT
171	Building Redesign for DC, CC, and combined DC and CC	IBM
172	Change to Simplex Power Control and Distribution Unit Specifications for FSQ-7 and FSQ-8, S-41-1. Change to meet the power requirements to photograph recorder-reproducer.	IBM

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DESIGN CONTROL (continued)

- |     |   |     |
|-----|---|-----|
| 173 | Change to General Display System Specifications for FSQ-7 and FSQ-8, S-29-2. Change specifies that the intensification of vectors displayed on the SD console CRT shall be uniform, regardless of length. | IBM |
| 174 | Design, fabricate and install a special alarm panel for C & E Duty Officer in ESS, and design the wiring changes necessary.   | MIT |
| 175 | Photographic recorder-reproducer system FSQ-7 and FSQ-8, S-31. A rewrite of existing specifications.  | IBM |
| 176 | Drum System Specifications for FSQ-7 and FSQ-8, S-19. A rewrite of existing specifications.   | IBM |
| 177 | Output Control and Storage Element Specifications for FSQ-7 and FSQ-8, S-27. A rewrite of existing specifications.  | IBM |

POWER (J. J. Gano)

XD-1 (J. J. Gano)

To assist IBM in solving the problem of overriding utility transients, we are asking Boston Edison to give us their breaker operating times.

Since General Electric's circuit readjustment program has proven unsuccessful in overcoming drift and regulation (6M-4029, S1, "Drift Studies, XD-1 D-C Power Supplies"), Coffin has written 6M-4338, "Summary of D-C Power Supply Evaluation Studies, AN/FSQ-7" in which it is recommended that: (1) IBM test their supplies for performance and workmanship at the Kingston Cells before it becomes a reliability problem at production sites, (2) General Electric apply more and better engineering effort in circuit redesign, and (3) IBM and General Electric make an analysis of component failures to prevent recurrence.

Magnetic Amplifiers (G. F. Sandy)

An analysis of the Ramey flux-reset magnetic amplifier circuit is being made to determine the relationships of the design variables to the input and output currents and voltages. It is hoped that such an analysis will lead to a straight-forward means of designing such circuits and determining the core material and size required for specific inputs and outputs.

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POWER (continued)

TX-0 (S. T. Coffin)

I am working on a transistorized regulator for the TX-0 marginal-checking amplidyne which MTC may also use.

CIRCUIT SUPPORT (R. J. Callahan)

Remote Equipment Maintenance Survey (R. B. Paddock)

Plans have been drawn up for a routine maintenance checkout of the Crosstell Subsystem; the first try will be made next week.  
(M. J. Flannagan)

The components section temperature-tested two dozen silicon Zener diodes. These units were elevated 50° C in steps of 10° C to study the effect of temperature rise on the Zener voltage. Tentative results indicate that the Zener voltage rises about 0.1% per degree centigrade, but that it does return to its original voltage when the temperature is reduced to ambient.

Some small, precision, high-voltage, wire-wound resistors have been received from the Sage Electronics Corp., Rochester, N. Y. The components section will evaluate them for possible use.

Materials are being assembled for measuring Hall voltages for possible use in present circuitry.

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

Federal has delivered its first sample of a crimped resistance wire coax cable patterned after its K-109A and called type CE-330 for testing by us. This cable will be used for the production probe system.

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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 approximately 3,050,000. This completes the cores required by Koch for this job.

ChemistryMemory Core Production (D. L. Brown)

The memory cores required have been supplied. Some batches of cores not yet fired will be fired and stock-piled.

Grain-Growth Study (D. L. Brown)

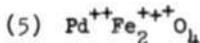
A series of firings have been made on a magnesium-manganese ferrite material in an attempt to obtain measurable differences in grain size. Preliminary magnetic measurements have been made and the measurement of the average grain size in each sample is underway.

Chemistry (D. Wickham, N. Menyuk)

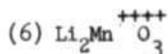
The saturation magnetic moments have been measured for a number of new compounds prepared during the last several months. These samples include the following spinels:

- (1)  $\text{Li}_{0.5}^{+}$ ,  $\text{Zn}_{0.5}^{++}$ ,  $\text{Mn}_{1.5}^{+++}$ ,  $\text{Mn}_{0.5}^{++++}\text{O}_4$ ,
- (2)  $\text{Zn}_{0.5}^{++}$ ,  $\text{Ge}_{0.5}^{++++}$ ,  $\text{Co}^{++}$ ,  $\text{Mn}^{+++}\text{O}_4$
- (3)  $\text{Co}^{++}$   $\text{Mn}_2^{+++}\text{O}_4$
- (4)  $\text{Li}^{+}\text{Mn}^{+++}\text{Mn}^{++++}\text{O}_4$

The following substances have unknown crystal structures:



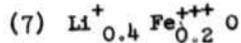
and



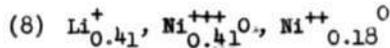
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MAGNETIC MATERIALS (continued)

The following substances have a rock-salt crystal structure:



and



Samples (2) and (8) possess significant magnetic moments, approximately 0.5 and 0.23  $\mu$  /molecule, respectively.

Several samples of nickel chromite  $\text{Ni}^{++}\text{Cr}^{+++}\text{O}_4$  have been prepared for crystallographic studies.

Crystallography (W. J. Croft)

A transition from tetragonal to cubic has been reported for the spinel  $\text{NiCr}_2\text{O}_4$ . This observation will be checked on the best samples we prepare.

It has been found possible to prepare solid solutions of  $\text{Li}^{+}\text{Mn}_2\text{O}_4$  and  $\text{ZnMn}_2\text{O}_4$ . A 50-50 solution is a tetragonal spinel, analogous to hausmannite, with  $A_0 = 8.25\text{\AA}$ ,  $C_0 = 9.28\text{\AA}$  and  $C/A = 1.13$ .

Evaporated Permalloy films produced on cover slide with the Barta Bldg. equipment are apparently noncrystalline. Similarly prepared films from E. R. A. are crystalline.

Chemical Analysis

Each of the above mentioned compositions (except  $\text{NiCr}_2\text{O}_4$ ) has been chemically analyzed; the best possible estimate of the oxidation states present has been made. (E. Keith, L. Doctor, D. Wickham)

Some improvements are sought in methods to be used for the analysis of thin films. In the spectrophotometric determination of iron, rapid fading of the color has caused trouble. Modification of the method so far used are described in the literature and will be tried. (F. S. Maddocks)

PhysicsInstrumentation

The d-c fluxmeter has been operating continuously for several weeks with constantly improving stability. It will probably continue to stabilize for awhile, after which no further improvement is expected. (R. A. Pacl, Jr.)

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MAGNETIC MATERIALS (continued)

A transistorized integrating amplifier has been developed for the 60-cycle fluxmeter. This amplifier appears to provide high gain with exceptional stability. Linearity and frequency response require further checking, but initial tests indicate that the results will be acceptable. (R. A. Pacl, Jr.)

It was found that the present 2-coil geometry of the vibrating-coil magnetometer is unsuitable for magnetically tracking the instrument. This is due to adverse eddy-current effects. In order to overcome this problem, it will be necessary to return to a single vibrating-coil configuration. Work has already been begun in this direction. However, in view of the better sensitivity and stability of the 2-coil geometry, it will not be abandoned. The single-coil unit will be used only for those experiments in which the magnetic field is a continuously varying function. (D. O. Smith and N. Menyuk)

Experimentation (N. Menyuk)

The saturation magnetization of a number of powder samples of new ferrite materials was determined at liquid helium temperature (4 K). The results of this experiment were turned over to D. Wickham.

Magnetic-Film Tests

Preliminary tests on sample thin magnetic films obtained from ERA indicate a switching time of less than 0.3  $\mu$ sec at coincident current. The test setup is being redesigned in order to determine accurately the switching time, since the above figure is an upper limit, and very likely a measure of the bandwidth of the measuring apparatus rather than the magnetic material.

Field Emitter

A trip is planned with K. Shoulders and J. Goodenough to visit Professor Dyke of Linfield College to discuss field emission experiments. Background literature on field emission is being studied in order to examine the possibility of developing switching devices based on this phenomenon which would be suitable for use in the development of computer components.

MEMORY (J. L. Mitchell)

256<sup>2</sup> Memory

To date, 476 64 x 64 modules have been accepted, and 28 256 x 256 planes are complete except for the sense-winding interconnections. The testing of the first plane is going along very well, and it looks as though we will reach a decision on how to make the sense winding interconnections some time during next week. The power

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MEMORY (continued)

supply installation is about complete, and as a result we will probably connect onto our own supply in a week or so.

Construction of the sensing amplifiers is under way, and a report on the amplifier is being written.

Advance Development

A transistor matrix for the transistor core drivers is being designed and breadboarded. A practice 64 x 64 plane using the 50-30 mil cores is being constructed. Several negatives have been made by Waltham Engravers, Inc., for use in experiments on the plated-wiring technique. The use of the engraving process enables us to obtain the necessary precision.

BASIC CIRCUITS (R. L. Best)

Index Register and Program Counter Memory  
for use in the Expansion of TX-O

Transistor driving circuits for the register selection portion of the memory are essentially complete. A sense amplifier is now under development.

DISPLAY (C. L. Corderman)

Development (C. L. Corderman)

The proposal for the remote display console is still in progress.

Charactron Legibility Tests

When the display patterns for the XD-1 Charactron legibility tests were checked on a TBS room display console, some errors were found in one of the three sets of patterns. The other two were error-free. The punched cards were checked and no errors were found. What equipment fault could cause two sets of cards to read in and display perfectly and cause errors on the third set has yet to be determined.

MTC Prototype SD Console (R. Gould)

A work order was placed on 26 March for the necessary air conditioning modifications in B-034 to supply the XD-1 prototype SD console connected to MTC. Until cold air can be blown into the console it is impossible to put power on to drive the magnetic yoke. All other analog circuits may be checked out, however.

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DISPLAY (continued)

Line Drivers (H. Zieman, J. Kriensky)

An Esterline Angus recording voltmeter has been borrowed and a John Fluke precision potentiometric d-c voltmeter has been purchased and received to complete some necessary experimental data for supplement 2 of 6M-3284. This supplement will present the theoretical and experimental analysis of the complete line driver amplifier. The individual stage analysis of this amplifier had been presented in supplement 1 which is being typed.

LOGICAL DESIGN (W. A. Clark)

Speech Pattern Recognition (J. W. Forgie)

Speech recognition studies are currently in a program and equipment debugging phase. Results to date indicate that the input equipment is functioning as desired. A calibration program (the only one yet completely debugged) indicates that the input system has a dynamic range of 58 db and a frequency response which is flat within 1 db from 10 cps to 10 Kc. The dynamic range could be improved about 3 db and the frequency response extended to 20 KC by the use of a better transformer in the audio portion of the input system. However, this improvement will not be made in the immediate future, since the requirements for recognition purposes should be adequately met by the present performance.

Instruction Code for Expanded TX-0 (J. Frankovich)

The instruction code under consideration for the expanded TX-0 is being designed to permit the programmer to address explicitly most of the storage elements in the main computer and to use them in the most advantageous manner for general use. The address and arithmetic elements of the computer will presumably also operate in a sufficiently independent manner that their use can be overlapped when successive instructions alternately refer to them. This is in addition to the independent operation of the in-out element and the two main memories.

SYSTEM DESIGN (K. H. Olsen)

Several modifications have been made on TX-0 which have increased margins. New pulse transformers with improved regulation have been installed in the CPO lines. Samples of the new improved transistor units have been installed in certain of the register drivers where high-current  $\beta$  is needed. Proper termination of pulse lines has decreased the amplitude of noise pulses.

The live register is being installed, and several minor modifications have been completed on TX-0 logic. The new TX-0 display system is under construction.

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SYSTEM DESIGN (continued)

Packaging has been tentatively agreed upon for both the flip-flop and logic circuits of the proposed computer to be expanded from TX-0.

TRANSISTORS

High-Gain SBT

Recent tests of the L-5131 have shown the unit to be superior to the conventional SBT in all respects. However, the gains are not as great as anticipated. Comparison studies of SBT, L5131, and other transistor types are being made at collector currents up to 50 ma.

Inverter Ring Test (J. R. Freeman)

The comparison of the various types of Philco surface-barrier transistors in the best 3-stage R-C coupled oscillators has included all types thus far received. The final summarization of results is as follows:

Type	Coupling Capacitance (in pf)	Frequency of Oscillation (in mc)	Double Propagation Time (in μsecs)
L5122	57	13.3	25
SB100T	33	11.8	28
L5117-1	118	26.0	12.8
L5117-2	82	19.3	17.2
L5131-1	47	20.4	16.7
L5131-2	69	14.8	22.5
L5131-3	57	17.1	19.4
SB1T	39	28.6	11.7

The comparative speeds indicated above have been achieved in circuits chosen as sufficiently similar to afford direct comparison. Higher speeds with the same type circuits are possible. For example the L5122 will run at 14.3 mc with a supply voltage of 2.5 volts, and the circuit parameters properly chosen. Also the SB100T will run at 12.9 mc if the base coupling resistor and the collector resistor are simultaneously increased in value.

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TRANSISTORS (continued)

Texas Instruments Tetrodes (E. U. Cohler)

The Texas Instruments tetrodes Type 501 have been tested and seem to have two difficulties. The saturation resistance is uncontrolled and varies from a few hundred ohms to over four thousand ohms. This, coupled with a low breakdown voltage (in several cases lower than specs), seriously limits the collector-current voltage region in which the devices may operate. Tests are now being performed to determine the suitability of some of the better samples in high-speed flip-flops.

Thermal Tests (E. U. Cohler)

We are performing some experiments to determine the burnout characteristics of SBT's. So far it has been found that the burnout occurs almost instantaneously. The transistor seems to operate normally until a sudden shift in current (less than 0.2  $\mu$ secs in duration) indicates that the collector-to-emitter short has been completed. About 2.5 watts will short the transistor in 5 to 10  $\mu$ secs.

Silicon Diode Noise Generator (E. U. Cohler)

Work on the model of the noise generator is essentially finished and we are awaiting the completion of TX-0 to test it. The theory of the avalanche which seemed to solve all the problems (slowly arriving electrons) has broken down on statistical analysis.

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ESS TEST PLANNING - WWI MTC OPERATION

(Group 64, E. S. Rich)

ESS SHAKEDOWN PLANNING (C. C. Grandy)

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Exercise Design

The format for shakedown test specifications has been completed and checked with Group 23. Though actual use of the format may disclose deficiencies it appears to be comprehensive.

Memorandum 6M-4332, giving the system test schedule for Groups 64 and 22 has been issued and formal ESS-PCC approval has been requested. A corresponding document, 6M-4327, giving personnel requirements for Air Force and Army operators, will be issued soon.

"ESS Shakedown Testing Sequence," 6M-4325, is being revised as a result of comments and further consideration of our testing requirements. It is expected that this memo will be issued during the next biweekly period.

Test Requirements

"General Shakedown Testing Requirements," 6M-4281 is again being revised to incorporate Group 61's recommendations. It is expected that this memo will be issued the week of 21 May.

Manual Test Teams

Status of operational handbooks for external sites is as follows:

Nearly complete

Weather  
Ground Observer Corps  
AACC

In process

Interceptors  
Adjacent Manual DC's

Not started (low priority)

AEW  
Picket Vessels  
Manual CC's  
Air Sea Rescue  
Bombardment Aircraft

Equipment needed at the AMIS installations has been defined in cooperation with Groups 23 and 61. An extrapolation ruler has been designed and a large-scale map is being prepared for data conversion at AMIS.

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WHIRLWIND I (L. L. Holmes)

WWI Computer Operations

Scheduled Computer Hours	327.6
Interrupting Incidents	7
Hours Lost	1
Percent Good Time	99.7
Mean Time Between Failures in Hours	46.7

Good computer reliability continued through this period. A fourth phenolic breakdown on the toggle switch storage output panel suspended operations for 20 minutes. There were no known interruptions due to tubes and 24 tubes were retired from service through our marginal checking facility.

WWI - XD-1 Crosstelling

Two additional subsystem tests, each lasting two hours, were conducted. The imperfect operations were due mostly to a large number of equipment failures in Building F. It appears that the majority of the failures at XD-1 originated in their output system. The recent series of three tests revealed only one incident of interruption introduced at WWI. At that time, noise appeared for a brief period on the Barta Building's entire power system.

Maintenance Programming

A new scope post mortem program was recently adopted at WWI. The new routine doesn't require the use of the program recorded on magnetic tape and therefore avoids what can be a lengthy search time. Don Morrison has issued a memo describing the new routine.

Computer Control Room

The room has recently been renovated. The soundproof enclosure housing the three delayed printers has been erected. The operator's console has been reduced in size and rewired. The magnetic drum monitoring equipment has been relocated. The marginal checking control equipment will shortly be moved to a new location.

Display System

A. N. Blumenthal and C. S. Lin have improved the performance of the display system to a point where its quality surpasses that of the earlier CCS days. Marginal checking procedures will soon be adopted that should enable us to keep the system paramount.

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WHIRLWIND I (continued)

Computer Classes

A. N. Blumenthal, C. S. Lin, and O. C. Wheeler have completed the first phase of the computer classes, i.e., lectures and on-the-computer training covering the central computer area. Talks on the power system have started.

MEMORY TEST COMPUTER (H. L. Ziegler)

Magnetic Tape System

Though still not completely checked out, the magnetic tape system is beginning to show signs of life. Towards the end of this biweekly period, information stored on tape by MTC was correctly reproduced (printed) at the Bldg. A conversion facility. Reading of tape by MTC should be accomplished during the coming week. Plans are already under way for a "round-robin" test of information transfer among the three magnetic tape facilities: MTC, XD-1, and the auxiliary data processing equipment (ADPE) Bldg. A. At the request of Gus O'Brien, redundant reading and information mapping tests are being planned as an aid to improved reliability of XD-1 magnetic tape.

Panel Memory

A completely new approach seems to have solved the panel memory problem mentioned in the previous biweekly. Continued selection of a register caused large wiring capacities to be charged up by reverse current through isolating diodes. Circuitry requirements made it impossible to discharge this large capacity in time to deselect the register before strobe time of the memory cycle. An additional "address" flip-flop, set and cleared within the memory cycle, now deselects all registers immediately after strobe time of the memory cycle, thus preventing any appreciable charging of capacity through the back-resistance of the isolating diodes.

Core Memory

A rash of core memory parities was traced to oscillation of the digit-plane drivers with the filter circuit of the power distribution panel. It was subsequently discovered that this trouble had been corrected once before but had been reintroduced by a shuffle of power distribution panels as they were being modified by the Wiring Shop.

Intercom

The new intercom system is complete except for the mounting brackets for several speakers on the computer frames. Master stations at the

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MEMORY TEST COMPUTER (Continued)

computer console and in B-155 are now wired for 2-way communication with all MTC areas as well as Bldg. F, B-129 (Corderman's office) and B-034, the "Blue Room".

Light Gun Input

Interest in a light-gun input to MTC has revived work along this line. A transistor light-gun, used successfully for this purpose last summer, seems to have vanished without a trace. For this and other reasons circuits are being revised to operate with the XD-1 photo-multiplier light-gun.

Display

Expansion of the display system to include the former AMD (Automatic Memory Display) has been worked out in preliminary fashion. Variations and additions suggested by various people are under consideration. Meanwhile, experimental work continues on improving the quality of display photographs.

High-Speed Punch

Once again we've failed to gain any ground on delivery of the Soroban high-speed punch. A phone call during the past week to Charlie West of Soroban disclosed that delivery will be in July or August rather than about June 1st as previously announced. Interchangeability of parts, plus recently imposed Government priorities, are the latest reasons given for the delay.

Power

The general cleanup of MTC power continues with the marginal checking amplidyne getting most of the attention. Rewinding of the field coils plus the addition of a regulator-amplifier will be necessary to provide the desired regulation and response. A push-button voltage-excursion selector switch is being planned to speed up taking of margins on MTC.

Test

Test programs are being prepared for the IBM card machine, magnetic tapes, and the magnetic drum. Marginal checking activity for both maintenance and for circuit improvement is expected to increase considerably after checkout of magnetic tapes is complete.

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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

The data from the bariated-nickel cathode tubes produced during the past two weeks continue to be very encouraging, and, as a result, it was decided to process a 19-inch Charactron-type display tube and start the B-N portion of the CT program. This tube is presently being tested to Charactron specifications and will then be placed on life test.

Display Program

The 19-inch panel for the phosphor study tube (Groups 63 and 38) has been completed and is scheduled for tube processing during the next period. The purpose of this tube is to compare characteristics of the phosphors presently under consideration for AN/FSQ-7 applications. This tube has been designed so that the various phosphors may be observed simultaneously on one panel.

The 5-inch Charactron projection tube was constructed and received preliminary testing. It was sent to Group 63 for evaluation.

Solid-State Display

A redesign and alteration of the processing techniques for vacuum studies of CdS is necessary due to problems encountered by Group 24 during the past week. Therefore, an additional vacuum tube and a redesigned demountable system to investigate electron beam bombardment of CdS has been scheduled.

Ferromagnetic Evaporated Films

One evaporation on our demountable system was performed by Group 63 during the past period. Both the operation of the system and the resulting film were very satisfactory. (We assume Fred Maddocks has been successfully removed from the demountable vacuum system. Ed)

An ion gauge for evaporation of condensable materials was designed for K. Shoulders. It is now in the assembly stage.

RECEIVER TUBES (S. Twicken)

Raytheon Twin Triodes

The Raytheon FSQ-7 twin-triode program is proceeding quite well.

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A separate grid-making and mount-assembly area is in the last stages of completion. There have been no difficulties with Raytheon's philosophy regarding the means necessary to produce a tube of the desired reliability. Judging from the sample lots observed to date, the characteristics of the tube are now in the desired range. Steady production in the final area should reduce considerably the variation between tubes due to asymmetries, distortion, etc. Raytheon plans to make its first production shipment to IBM in mid-summer.

6888 (SR-1782A)

There has been some agitation at Kingston regarding the adequacy of the 6888 (SR-1782A gate tube) supposedly in one of the timing circuits. At this point it is by no means certain that a problem actually exists. Bob Callahan is chasing this down.

Construction of a simple electrometer circuit has been started in order to measure cathode temperatures by the retarding-potential method and very low currents in general. A relatively simple, but direct method, is being sought to find a handle on the stage of the cathode for an investigation of the rate of deterioration of oxide cathodes in WWI. Prof. Nottingham has suggested that the donor density might provide this handle and a breadboard experiment will be set up to check it out.

I attended a meeting of the JTC 5.5 Subcommittee on Computer Tubes. After a long hassle on the absolute-maximum versus the design-maximum rating systems, a mail ballot is to be taken. The computer equipment people are almost unanimously in favor of the absolute-maximum system while the tube industry is divided. The Manual of Practice for computer tubes will probably be completed in the winter of 1957.

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

Six MIT 19-inch tubes have completed between 1829 and 10,799 hours of life test and twelve Charactrons have completed between 430 and 4198 hours. Charactron Fab. #551 has been rejected for low pulse-matrix current after 3257 hours on life test. One new MIT tube, CHT-141, with a B-N cathode is in the process of being put on life test. The cathode of this tube was fairly uniform, but the pulse zero-bias matrix current from the transfer characteristic is only about 40  $\mu$ a pulse-matrix current. It should be pointed out that B-N cathodes usually improve during the first hours of life.

Twenty-nine oxide-coated cathode study tubes have completed between 874 and 8565 hours. The 27 tubes on the present program have accumulated up to 2722 hours. One tube has been rejected for low pulse A<sub>3</sub> current after 1127 hours.

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CHARACTRONS AND TYPOTRONS (continued)

Forty-eight B-N cathode tubes have operated up to 2722 hours. Data on these tubes are available.

Thirteen triode and five diode early B-N tubes have operated between 2919 and 5184 hours. The tube currents continue to drop with life.

Eighteen Typotrons have completed between 2830 and 9442 hours. Monthly data has been taken and a report will be issued.

RECEIVER TUBES (T. F. Clough)

The survey of the Tung-Sol DT-438 (improved 5998) manufacturing procedures referred to in the last BIWEEKLY continued at their plant on 7 May 1956. Committee members had a series of discussions to review their observations and analyses. N. Mitschke of the IBM tube group edited a report summarizing our recommendations. IBM decided to present this survey to the Tung-Sol management. They did so on 14 May 1956 at Bloomfield, with a full discussion of our proposal. Tung-Sol accepted most suggestions and deferred a decision on some others. It was mutually agreed that the committee will actively follow Tung-Sol's progress toward adoption of the proposal.

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SAGE DC AND CC SITES

(Group 66, B. E. Morriss)

EPSCOM (R. P. Mayer)

One new WE programmer, D. F. O'Neill, has joined EPSCOM and manpower now stands at 30 people.

Paul Coakley (BTL) will be available essentially full time in the EPSCOM area at Murphy. He will assist programmers in the use of the utility system, including the checker.

The planning subsection has started an inquiry into the present plans for master operational recording tape format and analysis. EPSCOM may need to make use of some of these programs for system integration and test. The planning subsection is assisting Group 62 in setting up a preliminary, small-scale, maintenance procedure for ESS.

Further details on all of the EPSCOM programs can be found in the EPSCOM Biweekly Report, 6M-4345.

EQUIPMENT (W. H. Ayer)

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Shortage of Computer Time

A study of the possible solutions to the shortage of computer time, (6M-4302), has been undertaken. Primary effort has been directed toward making additional computing facilities available for SAGE.

A solution to this problem would seem to be a combination of the following:

1. An AN/FSQ-7 for use by the RAND Corporation is necessary, in view of their requirements for computer time which build up to 108 hours per week by the latter half of 1958. Present indications are that IBM could deliver an AN/FSQ-7 about System #10 without delaying other schedules, but in order to have the machine available by 1 July 1957, consideration is being given to sidetracking an earlier one for RAND use. The next few installations would thus be delayed by about two months.
2. Use of the XD-2 machine in Kingston, which is basically similar to XD-1, seems necessary, at least for immediate requirements. Its remote location brings about logistical problems, but steps should be taken so that Lincoln will be in a position to use XD-2 by this fall.
3. The IBM 704 electronic data-processing machines, commercially available, have many similarities to XD-1, and might be used

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EQUIPMENT (continued)

successfully for many of the data-processing tasks which must be performed.

There are IBM 704 computers at the Poughkeepsie Laboratory, at IBM World Headquarters in New York, and at General Electric in Lynn. Presumably time can be obtained on these machines, thereby alleviating some immediate problems.

Consideration is being given to having an IBM 704 computer facility with compatible tape units available at Lincoln on a full-time basis, not only for SAGE, but also for other laboratory requirements.

Additional Memories in the AN/FSQ-7 Computer Area

A conference, between WE-ADES, IBM, and Lincoln was called by Lincoln Laboratory, and held at WE-ADES in New York on 10 May to ascertain possible locations for additional memories if they are needed in the future.

A committee was formed, composed of H. Barton, IBM; D. Patterson, WE-ADES; and W. A. Hosier, Lincoln Laboratory; to examine these possibilities and come up by the end of May with a satisfactory proposal describing how four memory units could be added to the AN/FSQ-7 computer. (See DCO, page 5 )

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PROGRAM PRODUCTION

(Group 67, J. A. Arnow)

PROGRAM ASSEMBLY (A. R. Shoolman)

Program and Table Design (L. B. Collins)

Personnel

Mrs. Ann Lyon has joined the subsection and is working on the processing of environment control.

Miss Mary E. Ferguson has tendered her resignation and will be leaving us 15 June; her fiance has conducted a personnel review and is implementing a contractual agreement with said personnel which is detrimental to our organization, albeit pleasing to the contracting parties, and local personnel individually.

Table Design

Some forty item and table modifications were processed during the last biweekly period.

Table Documentation

A new glossary is in publication which includes reference to DCA index numbers for programs and tables. A "Table Handbook" will be published in the next biweekly period, covering each table: Core length, drum length and drum type, type of table, indexing method, and DCA index number.

Sequence Control

Sequence parameters are being prepared for the basic package. Procedures and documentation methods are being developed concurrently using experience gained in developing the basic package. Documents in preparation or publication include a revised sequence of A-class programs and a list of all programs, a sequence of basic package programs, a design sequence for all programs which will be considered frozen during initial assembly test, and a discussion of radar data transfers and sequence.

Environment Control and Storage Allocation

Compool Mod 04 has been taped, including 848 item tags, 142 table tags, 59 program and subroutine or program entrance tags. This compool provides complete environments for 39 DCA programs. Present storage requirements include a total of 89,337 registers (57,722 for programs and 31,315 for tables).

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PROGRAM ASSEMBLY (continued)

A major effort during the next biweekly period will be the production and publication of complete set-use information for all item tags and tables containing tagless items. This information is required for program analysis, program performance description, and assembly test development.

Special Programs (H. Rundquist)

Simulation

The immediate goal is to provide a simulation magnetic tape which contains an initial block of table simulation data, followed by radar and switch insertion data stored in tape records of a form that may be read by the simulation tape input program (CMT). A tape merge and control program will accomplish this by properly combining the outputs of three programs: Table simulation, keyboard input simulation, and tape data simulation. Coding of these programs is currently under way; completion is phased with DCA program production schedules. Evan Samuel of IBM has joined the subsection and is working on tape data simulation.

Assemble Sequence Parameters

Program Design has specified a program which will generate the transfer and program-unit sequence parameter tables from alphanumeric cards. The output will be the tables located at the correct drum addresses and a binary deck which may be used to read in the table information at the correct drum addresses. Frona Brooks has joined the subsection, and will work on this program.

Adaptation (M. D. Field)

The specification of adaptation parameters for the basic package has been completed. Liaison with Group 61 has been carried on to obtain the required values for implementing the adaptation of the ESS basic package. Many of the required values have been received and conversion to the form required for program use is under way. The aid of the Division 3 Computation Group has been obtained for the conversion effort.

The detailed method of converting the adaptation parameters for the TRI program into program terms and the format of the registers and tables containing these parameters are being specified in a design note which will be completed within the next biweekly period. All equations required will be specified in terms of available inputs.

The specification of adaptation parameters for packages other than

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PROGRAM ASSEMBLY (continued)

the basic package has begun. The information for the air surveillance and height finding packages is now being gathered.

A proposal for the method of organizing, documenting, and implementing the adaptation tasks is in rough form.

The coding specification for the loading program of the geography situation display has been rewritten. A program to translate latitude and longitude to system and/or display coordinates is in the planning stage.

UTILITY AND CHECKOUT (P. R. Vance)

Utility (P. R. Bagley)

Utility System II is now a working system for cards, and includes the following utility programs:

Utility Control	Compiler (without recompiler)
Read-In	Assemble Com Pool
Octal Load	Print/Punch Editor
Checker (old version)	Card-Input Editor
Interim Table Simulation	

Most of the utility programs still contain deficiencies which are harmless as far as DCA program operations are concerned. The precise deficiencies are detailed in an interoffice memo dated 21 May by P. Bagley.

The following programs are being prepared and debugged:

Storage Print	Master Tape Load
Checker (new version)	Library Output
Compiler (with recompiler)	Tape Duplicate & Compare
Library Merge	DCA Tape Read

DOCUMENTATION (H. K. Rising)

The backlog of coding specifications in typing, approval, and distribution is 52, with an average processing time of five days. To date, 572 specifications have been distributed. New post binders have been distributed for coding specification files to replace the 3-ring binders, which were difficult to maintain and file.

Specifications for AN/FSQ-8 light-gun codes, light-gun core, activate core, and manual intervention bit assignments have been completed and should be available during the next biweekly period. A

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DOCUMENTATION (continued)

series of memos (6M-4294 through 6M-4297) has been issued which relates, for each console in XD-1, the action of each switch with the binary coding of that switch in the manual intervention bit registers for use by programmers.

A measurement is being made of the deviation between initial program specifications and the latest operational specifications. Results of this study will be reported in the next biweekly period.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

Staff

Glen R. Heidler, assigned to Group 60, received his BS in Mechanical Engineering from the University of Louisville. He was formerly employed by the Hayes Aircraft Corporation in Birmingham, Alabama.

L. Gerald Marnie, assigned to Group 67, received his BA in Mathematics from Carleton College. He was formerly employed by Carleton College as an accounting lab instructor.

Non-Staff (W. A. Kates)

New

Alden Levine	Office	Group 67
George Smith	Office	Group 67
Ann Lyon	Office	Group 67
Jeannette Robey	Office	Group 61
Mary Hession	Office	Group 67
Arlene Rackliff	Office	Group 67
John Ackley	Technician	Group 63
Louis Johnson	Office	Group 67

Terminations

Jane Sawyer	Office	Group 60
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GENERAL ENGINEERING (A. R. Smith)

Design Engineering Convention

Personnel from the design group covered the first design engineering convention and conference held in Philadelphia last week and, generally speaking, were unimpressed. The most stimulating instructive discussions were on value analysis and incentive plans and patent rights for inventions. Papers on material selection, training of design engineers, and miniaturization were specialized and not too informative or applicable to problems within our organization.

General

All programs reported in the last BIWEEKLY are either still in design or advanced to the fabrication stage.

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COMPONENT EVALUATION (H. W. Hodgdon)

A defective blower unit in the environmental chamber has delayed our work considerably in the past two weeks. The unit has been repaired and is now back in operation.

The most recent shipment of prototype power transformers for Lincoln Standards, received from Sylvania, look very good. Most of the bugs have been worked out, and progress should be much faster from now until completion of prototype testing.

Test Equipment Headquarters (C. Morrione, Jr.)

Test equipment maintenance for this period:

<u>Equipment</u>	<u>Checked &amp; OK</u>	<u>Checked &amp; Repaired</u>
Standard Test Equipment	29	46
Oscilloscopes	3	9
Commercial Test Equipment	2	9

By speeding up maintenance activity, we are building up a healthy reserve of tested units for issue and stock.

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DOCUMENTS ISSUED

ERRATUM

Memorandum 6M-4218 was incorrectly listed as  
CONFIDENTIAL in BIWEEKLY for period ending  
6 April 1956. Should have been UNCLASSIFIED.

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## DOCUMENTS ISSUED

(P. E. Falcione)

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The following documents were published by Division 6 or received from IBM during the period ending 18 May 1956.

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<b>ADMINISTRATION &amp; SERVICES (Group 60)</b>			
4308	R. R. Everett	Time Cycle for the Initial Sage Operational Computer Program	C
4322	Div. 6 Staff	Biweekly Report for Period Ending 4 May 1956	C
<b>SAGE SYSTEM TEST &amp; PLANNING (Group 61)</b>			
3766-1 C#2	H. Gochman	Operational Specifications for Track Detection and Initiation in the Sage System	C
3774-1 C#3	R. C. Miller	Operational Specifications for Sage System Radar Data Inputs	C
3814-1 S#2	J. Bryan S. Hauser	Operational Specifications for the Manual Data Inputs Function in the Sage System	C
3816	S. Ornstein	Operational Specifications for Crosstelling in the Sage System	C
3826-1 C#2	H. Gochman	Operational Specifications for Track Monitoring in the Sage System	C
3989-1 S#1	E. L. Lafferty	Addition to Operational Specification for Recording in ESS	C
3997 C#1	H. E. Frachtman	Mathematical Specifications for Height Finding	C
4006 S#1	R. R. Reed- Hazeltine	Proposal for Change to 6M-3728, "Category and Display Assignment for Sage Situation Display Consoles	C
4028 C#1	S. J. Hauser F. M. Garth	Mathematical Specifications for the Identification Function in Sage	C
4031	J. Burrows et al	A Guide to Joint Combat Center Operations	C
4067-1	J. Levenson	Operational Specifications for Simulated Data Generation	C

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<b>FSQ-7 PROTOTYPE DESIGN &amp; INSTALLATION (Group 62)</b>			
3851-2 S#1	J. Giordano	Master Reference List of Equip- ment Specifications for XD-1	C
3851-2 C#2	J. Giordano	Master Reference List of Equip- ment Specifications for XD-1	C
4244 C#1	A. M. Werlin	Vector Message Geographic Dis- play Program 8402	U
4284 S#1	C. W. Watt	Establishing Technical Control in ESS: Summary of Equipment Needed in the Direction Center and Proposed Locations.	U
4284 S#2	C. W. Watt	Establishing Technical Control in ESS: Proposal for Special Alarm Panel at Maintenance Coordinator's Position	U
4309	S. T. Coffin	Thyratron D-C Power Supplies for TX-O Computer and Display Dev- elopment Lab.	U
<b>ADVANCE DEVELOPMENT (Group 63)</b>			
4303	G. A. Davidson	Parameters of the GE 2N136 PNP Alloyed Junction Transistor	U
<b>ESS TEST PLANNING - WWI &amp; MTC OPERATION (Group 64)</b>			
4088 S#1	M. H. Cannell	Specifications for Air Force and Army Operator Proficiency Re- quired During ESS Shakedown, Revision, and Verification Exercises	C
4203 S#1	J. Wagoner- Rand	Initial Data Reduction Require- ments for ESS Shakedown Exer- cises	C
4278	J. D. Coyne R. F. Lawrence	ESS Shakedown Simulated Problem Design	C

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4300	B. G. Farley	A Project for the Study of Self-Organizing data processing Systems	U
4315	A. Vanderburgh	MTC Distribution List	U
4318	A. Vanderburgh	MTC Estimated Time Allocation: May '56 - December '56	U
5326	H. F. Mercer	ESS-PCC Status Report for Week Ending 27 April 1956	U
5327	H. F. Mercer	ESS Summary Schedule	C
5328	H. F. Mercer	ESS-PCC Status Report for Week Ending 4 May 1956	U
5329	H. F. Mercer	ESS-PCC Status Report for Week Ending 11 May 1956	U
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2996-1 S#1	F. Manning	Lighting Requirements for Sage System Combat Centers	U
3198-3	F. Manning	Master Reference List, Lincoln Laboratory Requirements for Combined Direction Center-Combat Center Buildings	U
3225 S#1	F. Manning	Sector Command Post Requirements	C
3288-1	E. Smiley	Synchronized Clock System for Sage System Combat Center	U
3884-1 S#4	E. Smiley	Master Reference List AN/FSQ-7 Specifications	U
4316	P. J. Gray	Sage System Meeting 23 April 56	C
4317	P. J. Gray	Sage System Meeting 30 April 56	C
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4013-1	D. L. Bailey	Mathematical Specifications for Track Detection and Initiation in the Sage System	C
4069-1	H. Newhall	Procedure for Use of Card Processing Facility	U
4214-1	P. McIsaac-Rand	Data Organization for Lincoln Utility System: Central Tables, Tape & Card Forms, Storage Allocations	U

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4229	P. R. Bagley	Description of the Lincoln Utility System I	U
4229-1	P. R. Bagley	Description of the Lincoln Utility System II	U
4294	A. Rupp et al	Console Keyboard-Keyboard-Input Matrix Relationship for XD-1 Memo II --- Air Surveillance Room	C
4295	A. Rupp et al	Console Keyboard - Keyboard-Input Matrix Relationship for XD-1 Memo III ---Weapons Direction Room	C
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4297	A. Rupp et al	Console Keyboard - Keyboard-Input Matrix Relationship for XD-1. Rms. T,I,D,M, and Computer	C
4321	G. Tolpin- Rand	AN/FSQ-8 Warning Light and Audible Alarm Bit Assignments	U
4323	R. P. Mayer	EPSCOM Biweekly Report for 4 May 1956	C

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980	C. E. Langmack	Probe System Specifications for AN/FSQ-7 Combat Direction Central and AN/FSQ-8 Combat Control Central	U
981	E. G. Bauer	Project High Semi-Monthly Report #75	C
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986	E. G. Bauer	KMPD Engineering Report -- Project High Semi-Monthly Report #72	C
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DR-645 (P-265-1)	R. C. Irwin	Testing of the Clock Register XD-1	U
DR-646 (D-32-8)	H. J. Barton	Change to Specifications for the Duplex Maintenance Console	U
DR-647 (P-290)	J. J. Coughlin	Concurrence on IRI Word Changes for XD-1	U
DR-648 (P-291)	J. J. Coughlin	Concurrence on XT Word Changes for XD-1	U
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DR-654 (D-32-8)	J. D. Crane	Concurrence on Changes to Spec- ifications for the Duplex Maintenance Console	U
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DR-656 (P-192-2)	R. C. Irwin	Automatic Branch on Alarms of XD-1	U