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



SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 4 NOVEMBER 1955

To: Jay W. Forrester

From: Division 6 Staff

Date: 14 November 1955

Approved: John C. Proctor

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## SAGE SYSTEM TEST AND PLANNING

(Group 61, J. F. Jacobs)

### MASTER PROGRAM PREPARATION (H. D. Benington)

#### Operational Programs (D. L. Bailey)

#### Program Design and Central Programs (A. R. Shoolman)

A series of meetings between design personnel of these subsections has begun. The responsibilities of each program in the Master Direction Center Program will be defined in detail as a result of decisions reached at these meetings. Methods for documenting and disseminating all design decisions and for requesting operational information from the Operational Specifications section will be set up. "Coding Specifications for the SAGE Master Direction Center Program (Operational Active)," 6M-3976, by A. R. Shoolman, dated 4 November 1955 has been completed and will be issued next week.

#### Utility Programs (C. H. Gaudette)

During the week ending 4 November, the Compiler was assembled and operated on the computer. However, a considerable amount of lost time during the first part of the week delayed the checkout.

The operational specifications for the Checker and the Utility Control programs will be issued during the week of 7 November.

#### Checkout (P. R. Vance)

The first draft of the table simulation proposal has been completed, and work on the coding specifications will be started next week. "Group 61 Duplex-Standby Activities," 6M-3937, by P. R. Vance and M. D. Feldstein, has been published.

#### Manuals for Programmers (P. R. Bagley)

Work continues on several manuals for programmers. Current status report:

| Subject | Status |
|---|---|
| Program Compiling Process | first draft completed |
| FSQ-7 Programming Data Sheets | first draft 1/3 done |
| Program Checker | preliminary outline done |

Lincoln has requested IBM to start a section of the AN/FSQ-7 Programming Course every four weeks. IBM is currently seeking a way to do this.

MASTER PROGRAM PREPARATION (continued)

A memorandum has been drafted which suggests certain additions and changes of emphasis in the course.

Card Preparation Room (H. Newhall, Jr.)

The proposed colocation of the punched card facilities with the card-magnetic tape-printer equipment has launched a series of revisions involving all aspects of Card Room operation. Plans are nearing completion which include the physical layout, operational procedures, and personnel requirements of the new installation. Currently, it is proposed that the new installation be placed in the basement of "A" Building (Bays 8-11).

The first of the Utility Programs (the Compiler) to come into the Card Room did not cause as much disruption in the normal routine as might have been expected. The urgency of this job made it necessary to work 16 hours overtime during a weekend, but by the following Monday, operations had returned to the normal routine with no delay in servicing the programmers.

OPERATIONAL SPECIFICATIONS FOR SAGE SYSTEM (C. A. Zraket)

Air Surveillance (E. W. Wolf)

The WWI effort which will include the essential characteristics of two subsectors for the initial purpose of providing operational data on the XD-1 crosstell procedures has been named the WISE (Whirlwind I SAGE Evaluation) System. Frona Brooks and Dave Latimer are preparing the operational specifications under the motto "Wiser Than Sage."

Harry Gochman has completed a rough draft of the memo on air surveillance stations. Randy Ornstein's OPS specification on crosstelling is also through the rough draft stage.

The first draft of 6M-3960, "Mathematical Specifications for Radar Data Inputs in a SAGE Direction Center," has been issued.

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

The following progress has been made on operational specifications for Weapons Direction since the last Biweekly report:

| | |
|---|---|
| Subsector Command Post (6M-3795, P. Bragar) | Rev. 1 issued |
| Weapons Assignment (6M-3744, A. Heineck, A. Chandler) | Supp. 1 issued |
| Intercept Direction (6M-3786, A. Heineck, A. Chandler) | Supp. 1 issued<br>Rev. 1 issued |

Weapons Direction (continued) CONFIDENTIAL

In addition, Correction 1 to the revised Antiaircraft Direction specification has been drafted.

Francis Garth will join the subsection in about two weeks when his commitments in the Identification-Manual Inputs-Weather area are fulfilled. He will be responsible for Intercept Direction and Weapons Assignment and will work with Ed Brande of IBM. Bruno Strauss of Boeing's advanced research group has joined the subsection and is currently undergoing programming training. He will assist Dan Ladd in consultation on the Subsector Command Post and Raid Forming specifications and in the study of integration of missile systems with SAGE.

ESS Planning (C. Grandy) CONFIDENTIAL

A subsection has been organized to deal with various aspects of Group 61's planning for shakedown operation of the Experimental SAGE Subsector. The members are C. Grandy, T. Callahan, R. Luscher (BTL), A. Thomas (WE). The activities of this subsection are threefold:

1. To define requirements for SOP's for Direction Center operators and personnel at external locations.
2. To coordinate equipment needs and schedules.
3. To plan tests suitable for system shakedown and to coordinate this planning with other Lincoln and non-Lincoln organizations.

Identification, Manual Inputs, and Weather CONFIDENTIAL
(F. M. Garth, S. J. Hauser)

We have completed a rough draft of the mathematical specifications of the Identification function which will be read by C. A. Zraket in preparation for concurrence with ADC at Lincoln.

A list of corrections to the OPS specifications and material for memoranda on their functions in XD-1 are being prepared on Identification, Manual Inputs, and Weather.

Jean Bryan has joined the Identification-Simulation subsection and has begun study of the operational specifications.

Combat Center (W. Lone) CONFIDENTIAL

One section of a rough draft of the "Guide to Combat Center Operations" will be ready for typing November 7. The scheduled completion date, 15 November, is expected to be met.

ADES is redesigning the DC and CC buildings for possible adaptation in SAGE installations not yet under construction. On the basis of a meeting at Lincoln held 3 November, ADES will come up with a proposal for a new Combat Center building design.

Standby Computer (A. Heineck)

Harry Bridges (Lincoln) has been assigned to work with J. Groce (IBM) and A. Heineck in this subsection. This subsection will write the operational, program, and coding specifications for the standby computer. During the next four to six weeks, we hope to generate an operational plan which will give a broad-brush treatment to the use, modes of operation, recovery times, etc., of the standby computer.

Training and Battle Simulation (J. Levenson) CONFIDENTIAL

"Interim Operational Specification for Training and Battle Simulation in the SAGE System," 6M-3899, has been issued. My responsibility for TBS operational specifications has ended.

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

Five new RAND people in the section are attending a special MTC programming course. The efforts of Alex Vanderburgh (Group 62) in running this course are much appreciated. It is expected that these five people will be available for our work about the fifth of December.

Simulation (J. Levenson, R. Russo) CONFIDENTIAL

Judy Levenson has finished the TBS OPS Specifications and is now working full time on the problems associated with data simulation.

R. Russo has completed a rough draft of mathematical specifications for interceptor simulation (part of TBS Mathematical Specifications).

Recording (E. Lafferty) CONFIDENTIAL

A proposal of data to be recorded has been forwarded to parties concerned. A first rough draft of the Recording OPS Specification is completed.

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

First drafts of Experimental Subsector Operator Task Descriptions have been completed with the exception of ASO, AST, ASC, BSO, OT, PT and INS positions, the operational explanation of which is not contained in specifications literature and requires further research. Completion of these remaining descriptions is expected one week after release of the pertinent specifications.

The Lincoln Project Office and Air Training Command have, with current plans, set a deadline date of 18 June 1956 for preparation of simulated operator training tape problems. This would provide an evaluation period of thirteen weeks by Air Training Command instructors in which to adapt these problems for use by the first class of Air Defense Command subsector operators. This planning, however, excludes the need for simulation tapes during computer time assigned for Experimental Subsector operator training in April and May 1956. Means for justifying the expense of this time in terms of training received remains a problem requiring immediate attention.

Lincoln Project Office has stated in meeting the intent to discharge its responsibility for the Experimental Subsector operator training via a Personnel Training Committee to be formed without delay and chaired by Lincoln Project Office.

STAFF TRAINING (A. P. Hill)

The SAGE Familiarization Course was held at Murphy Army Hospital during the period 17-28 October. Approximately 150 people attended this course representing such organizations as the: Air Defense Command, Navy Bureau of Ships, CAA, RAND, IBM, ADES, Boeing, Lockheed, and NRL.

A series of lectures will be given chiefly for the benefit of new Lincoln and RAND personnel who have just completed the IBM programming course. The lectures will serve as an "Air Defense Indoctrination," with the Operational Specifications being used as the main reference material. It is planned that the lectures will be given every Monday, Wednesday, and Friday mornings at Murphy Army Hospital, Room 133A, starting on November 14.

Anyone who wishes to attend these lectures should contact A. P. Hill, ext. 5470, for details.

COMPUTER OPERATION (P. L. Guinard)

| | | |
|---|---|---|
| Program Checkout (Utility Assembly) | | 10:15 |
| Down Time | | |
| (In/out Equipment) | 4:00 | |
| (Computer Malfunction) | 0:45 | 4:45 |
| Total Assigned Time | | 15:00 |
| Extra Time Allotted | | 2:15 |
| | | 17:15 |

## FSQ-7 PROTOTYPE DESIGN AND INSTALLATION

(Group 62, N. H. Taylor)

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

#### Building Modifications (H. F. Mercer)

Lighting - The contractor finished his work by 27 October. Louver sections will not be installed in the S and W Rooms until modifications to the consoles are completed.
Command Post - Floor tile remains to be installed. Division 1 has started installation of utilities for the projection booth.

#### Acceptance Test (J. D. Crane)

The results of three demonstration runs on the digital and situation display generation frames showed that the equipment could perform the functions specified by the test. GFI (exclusive of DDR's) equipment was also demonstrated during three test runs. All GFI programs ran, but the noise generated by relay switching at "North" time caused intermittent failures. This noise problem and the excessive "Y" type diode failures in the GFI area are being investigated.

### MEMORY TEST COMPUTER (W. A. Hosier)

The good ship MTC is steaming ahead at about three-quarters speed on what we believe is a course toward the ill-charted island of Magnetic Tape Installation; the fog is still pretty thick, however, and the navigation is all dead reckoning. A formidable barrier lies ahead in the shape of Tape Adapter Frame Procurement, which has either to be got around or through. The former course, by which we build our own, is apt to delay us too long and exhaust our budgetary fuel; the latter involves going through channels controlled by IBM and the Air Force to get a frame off the Kingston production line. IBM is making a strenuous effort to see us through, and there is good reason to hope that another two weeks will see the fog lifting. On the assumption that the ship will make port by 1 March, we are publishing a preliminary programmers' manual for use of the magnetic tape and drum (6M-3974, by B. G. Farley).

Farley's memo describes the mechanics of such block transfers, which are in brief as follows:

1. ca RC drum starting address (used only with the drum, not necessary with tape).

MEMORY TEST COMPUTER (continued)

2. sof 1000 octal plus n, where n determines the medium (tape or drum), the tape drive unit (1 to 3) or drum field (3 to 14) and the mode (read or write).

3. ca RC positive word count (zero to skip a tape record, maximum block length of 2048 MTC words).

4. cb ("copy block") Core Memory starting address: This instruction does the actual reading or writing of a block of registers.

5. pf ("perform") n: A composite instruction which does various things depending on n (backspace, rewind, write end-of-file, set "prepared," sense IO interlock, sense for rewind status).

Control

The frames for the new MTC control have arrived from the shop and are being wired for power and such panels as are now on hand. Gates and Ziegler have worked out command pulse sequences for all existing instructions (those remaining are the new instructions applying to block transfers) and the technique of mixing from gated clock pulses to CPO's. Hardware seems to be coming through about as fast as we can assemble it for the time being.

Display

The new scope mount for the DuMont 12-1/2" tube, deflection amplifiers, etc., has arrived from the shop and will be wired up next week. All the pieces for the new display system (which was once optimistically forecast for last April!) are thus on hand, and we hope to be able to demonstrate its improved quality by December.

Ferranti Reader

Tom Stockebrand has put together a test control rack for the Ferranti Reader, to see what improvements we might make in our technique of using it. One interesting item, hitherto suspected but untried, is that a decided improvement in margins results from lowering the voltage applied to the light source; the gain of amplifiers in the photocell circuits is much higher than needed when the light is run at full intensity.

MEMORY TEST COMPUTER (continued)

Computer operation has continued much as before, with operating time apportioned as follows:

| | Hours | Per Cent |
|---|---|---|
| Analysis and Data Processing | 96.2 | 38.6 |
| Development and Testing | 72.2 | 29.0 |
| Installation | 1.0 | 3.7 |
| Reliability Check Programs | 15.9 | 15.7 |
| Interrupting Failures | 7.1 | 3.0 |
| Maintenance and Marginal Checking | 31.8 | 10.0 |
| Total | 224.2 | 100.0 |

Summary of defects found in tubes and components, 24 October to 4 November:

| Tube or Component | Defect | Qty. | Hours Lost |
|---|---|---|---|
| 2D21 | Gone to air | 1 | 0 |
| 6145 | Tap short | 2 | 0 |
| 7AK7 | Low plate current | 1 | .35 |
| 7AK7 | Tap short | 1 | 0 |
| | Total | 5 | 0.35 |

BASIC CIRCUITS (R. L. Best)

Flip-Flop Mod II (MTC) (N. J. Ockene)

A new high-speed flip-flop, employing no transformers in the set and clear circuits, has been developed. One of the features of this new circuit is a minimum upper level delay of approximately 33 milli-microseconds which is independent of input pulse amplitude. The circuit is presently being tested in a standard MTC plug-in unit.

Plane Driver (Semiautomatic Plane Tester) (D. Shansky)

A circuit capable of furnishing positive and negative 420 ma current pulses (0.5 μsec rise and fall times - 10% duty factor) into the selection plane winding of a modulator memory plane has been designed and is being breadboarded.

High Speed Power Cathode Follower (MTC Control)
(M. Flanagan, D. Shansky)

This current has been packaged in an MTC type pluggable unit and is

BASIC CIRCUITS (continued)

presently being drawn up by our drafting department. Data on the absolute margins of operation are presently being taken.

Gap-Filter Sweep Circuit (B. Barrett)

More marginal checking data is now being taken on the simplified blocking oscillator circuit.

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

The design for the single-tube hot probe has been completed and a working model is being constructed. Experiments were conducted to minimize the ringing on the cold probe by the use of resistance wire as the center conductor of the 8-foot coaxial cable with reasonable success. The cathanode follower circuit has been tested successfully at the end of the 8-foot cold probe.

Digital Data Receiver (E. Glover)

Minor modifications to the circuit feeding the high-Q filter have improved its output amplitude considerably. It has been tested with the phone line loop and all of the so called "worst case" patterns of data with no failures. Margins have not yet been taken. The solution of the timing difficulties, however, has left us with the problem of the synchronization and data slices; we are having difficulty setting them to function correctly for all patterns when a phone line is used.

Vector Intensity Decoder (R. B. Paddock)

The larger output swing required has changed many aspects of this circuit. A new approach, therefore, has led to a new breadboard which is being debugged.

Sense Amplifier (P. J. Murphy)

The possibility of strobing directly at the output of the sense winding is being investigated in order to eliminate all unwanted signals at the amplifier input. The present approach employs a balanced-bridge diode gate circuit. The coupling circuits in Zopatti's amplifier are being further investigated with the aim of improving the overall response.

SAGE SYSTEMS OFFICE (H. E. Anderson)

The Systems Office brief indexing system is currently undergoing a

change. The proposed scheme, a coded decimal numbering system, will be set up to handle all pertinent and defense material. It is hoped that this will make the large amount of information more useful to everyone concerned.

Teletype Inputs

Several possible improvements to the SAGE teletype system will be evaluated in XD-1. One of these is an IBM 047 tape-controlled card punch. The incoming teletype message is punched on paper tape. The tape is then inserted into the 047 which translates the punched tape to a punched card which is then put into the computer. In order to evaluate this input method, an 047 and a Model #19 teletype machine (which will punch tape directly from a keyboard) are being moved to Room Y in Bldg. F.

Another possible improvement to the teletype system is a message composer being built by Western Electric. A BTL breadboard of this is now located in Room Y of Bldg. F. The unit consists of a panel of rotary switches, teletype transmitter, and control equipment which sequences the information to the transmitter in proper order. All fixed information is wired into the control equipment while the variable part is set up on the rotary switches. The time at which a message is transmitted is automatically inserted from an internal clock in the control equipment. This machine would be most useful for transmitting highly repetitive information such as flight plans from remote sites to direction centers.

Talos Reply-Back Study

It now appears that no new information about location of missile sites will be available very soon from either the Air Force or the Talos group at Johns Hopkins. The reply back study will be tentatively completed, using the site locations presently available. When better data is available, this will be included in the report.

Review of Operational Specifications

The following revised OPS specifications have been reviewed:

1. Radar Data Inputs
2. Manual Data Inputs
3. Presentation of Weather Data

In addition, Ben Ginsburg has started a series of brief talks about the OPS specifications to better acquaint Systems Office personnel with the overall operation of the system.

Tape Conversion Equipment

Memorandum 6M-3978, "Auxiliary Data Processing Equipment Operating Specification," explaining how to program XD-1 for use with the tape conversion equipment and how to operate this equipment, is nearing completion. The following delivery information was supplied by Project High at the last coordination meeting:

| | |
|---|---|
| Tape to Printer | 15 January |
| Card to Tape | 30 January |
| Tape to Punch | 20 February |

Film Processing Facilities

The automatic and input cameras in each direction center will produce film which must be developed, printed, and projected for viewing. Group 61 has given an estimate of the quantity of exposures in a 24-hour period and the desired period of time from exposure to use of the data photographed. Group 60 has made an estimate of the equipment and personnel required. All of this information has been given to Group 66 to determine if local facilities outside the DC could handle the processing or if facilities internal to the DC are necessary.

## ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

### CHEMISTRY OF MAGNETIC MATERIALS (F. E. Vinal)

#### Memory Core Production

Core production for the TX-0 memory is well along toward completion:

| | |
|---|---|
| Double-tested | 1,844,335 |
| Single-tested | 197,000 |
| On hand for testing | 230,000 |
| On hand for firing | 425,000 |
| Total | 2,696,335 |

Pressing cores from batches now in process will provide material to carry over the 3,000,000 mark, so no further batch preparation will be required. (R. C. Zopatti, J. J. Sacco)

#### Inorganic Chemistry

Square-loop ferrites of a lithium-nickel ferrite composition have shown promise as a source of memory cores. However, a better understanding of their chemistry and stoichiometry will be required before the promise can be realized. Chemical experiments indicate that the presence of $Ni^{+3}$ is a definite possibility in these materials. (D. Wickham, D. L. Brown)

Blends of lithium ferrite of a spinel structure with another non-magnetic form of lithium ferrite of a rock-salt structure have been found to be strongly magnetic and spinel in character. Other properties remain to be determined. (D. Wickham, W. J. Croft)

Investigation of magnetic domain patterns in polycrystalline ferrites is continuing, primarily in cooperation with the Photo Lab of Division 7 in an effort to record on movie film the activity of these domain patterns with a changing magnetic field. (F. S. Maddocks)

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

#### Instrumentation

The vibrating coil for the vibrating-coil magnetometer has been wound (115,000 turns, No. 45 wire). Parts for the vibrator have been received and delivery of the magnet is expected the week of November 14. Initial testing of the magnetometer should begin in the next biweekly period.

It has been decided to replace the present pulse-evaluation tests

with the one developed by Childress. A memorandum is being written which discusses the basis of testing, describes the new equipment, outlines the new test procedure, and gives all the formulas required for reducing the data.

The parts for the current drive for the dc fluxmeter have been received from the shop and are being assembled. The drift in the galvanometer is currently about 1 per cent in 2 minutes; it is hoped that this can be considerably improved. The Mosley recorder is still giving trouble.

Measurements

The reduction of data from the evaluation tests made on the present memory core materials continues. It is evident that the accuracy of the data is limited by the accuracy of the time interval measurements. There is, therefore, a need for equipment and techniques that permit measuring time intervals of less than $10^{-6}$ seconds with an error of less than one per cent.

A series of experiments of domain wall velocity in single crystals of ferrite will be made as soon as the vibrating-coil magnetometer is assembled and can make preliminary measurements of anisotropy, magnetostriction, and saturation moment on these materials. The wall velocity measurements will be made in window frames of ferrites which have been cut from discs. Two cutting tools have been designed to support wall configurations, one in the (110) plane, and one in the (112) plane. The influence of the crystalline anisotropy on wall velocity varies with the crystalline plane to which the wall is parallel. The influence of anisotropy on wall velocity for a wall in the (110) plane is in the literature; that for a wall in the (112) plane is being calculated. The window frame measurements should permit a direct correlation of the effect of anisotropy upon the domain wall velocity.

NEW COMPONENTS AND CIRCUITS (T. Meisling)

Philco Quarterly Progress Report

On November 1 Philco gave a formal presentation of the work performed during the first quarter of the extended subcontract. The work is divided into four tasks. Tasks 1 and 3 represent the major portion of the work.

> Task 1 - Reliability - has been concerned with the study of degradation mechanisms in surface barrier transistors. At least two processes, which are temperature dependent, have been isolated. A study of the surface has been made to determine the effects of potting compounds on parameter changes.
> Task 2 - Establishment of Specifications for a Computer SBT - has produced a tentative specification sheet for

the L-5122 SBT which is designed to operate in the TM-1 flip-flop. Transistors made to this specification are on order. A considerable amount of work on hole storage measurement has gone on in this area.
Task 3 - New Devices - has resulted in the delivery of initial laboratory samples of a core driver transistor.
Task 4 - Circuits - has led to the development of some flip-flop and logic circuits using emitter followers which show promise.

SBT Life Tests

Both direct-coupled SBT shift registers are doing well. The 8-digit shielded unit has held a pattern for 17 weeks (since June 8). The unshielded unit has held a pattern for 8 weeks (since September 8). A third 8-digit shift register has been constructed from TM-1 plug-in units and will be put on test very soon.

MEMORY (J. L. Mitchell)

Experimental Switch and Plane

Our main effort has been concentrated on understanding the characteristics of the sense winding. Various types of termination and methods of interconnecting the individual modules have been tried. Further experiments will be conducted as soon as the new current regulator for the switch driver is installed.

Cooling and Supplies

The construction of the walls in the basement of Building A is well underway and should be completed next week. The air conditioning contractor will be in next week and will start installation of the air conditioning ducts.

$256^2$ Construction

Fifty-eight 64 x 64 memory plane modules have been accepted to date. Sufficient planes (constructed with preshaken cores) have been tested to indicate that the needles are the main cause of broken cores. Design of the small plane tester is almost complete.

The design of the essential parts of the memory stall is almost complete and construction will start soon. The drawings of the plug-in unit racks are complete and construction will start as soon as the materials arrive. The drawings of the power racks, panels, etc., will be complete within a week.

It has been discovered that all the memory planes made to date have

cracks in the Formex insulation on the wires. It has been determined that these cracks are caused by use of alcohol in the wire stripping and in the fluxing operations. An intensive investigation of this problem is under way. Meanwhile, the method of handling the wires will remain unchanged. It should be noted that the planes are immersed in coil dope when they are completed and this probably seals the cracks in the insulation.

Advanced Development

Bradspies' sense amplifier was tested on the 256 x 256 plane and several weak points in the design were found; however, no major problems have been foun . The ircuit has been reworked and greatly improved results are expected. Further tests will be run during. the next few weeks.

At the quarterly meeting, Philco presented us with three of their core driver transistors. The current gain is adequate, but the avalanche break-down voltage is too low and will have to be increased.

LOGICAL DESIGN (W. A. Clark)

The TX-0 control study has continued and should be completed by 18 November. The new circuit limitation of putting no more than 2 transistors in series will result in a control element which is more complicated than had originally been expected. In particular, the gating of register drivers becomes more difficult and either more equipment or slower operation will result, depending on the design chosen.

At the request of the Memory Section, the EMAR logic is to be modified slightly to permit a choice of rastering through the entire memory plane or through any selected unit plane. This change is described in 6M-3820, "A Raster Control Switch for EMAR" by H. P. Peterson.

The third installment in the series of notes for the course "The Logical Structure of Digital Computers" has been issued as 6M-3938, Supplement 2. Boolean algebra is introduced as an algebra for describing symbol-printing operations in Class A Turing machines.

SYSTEM DESIGN (K. H. Olsen)

EMAR

The plug-in units for EMAR have been rhodium-plated and all components mounted. Transistors are now being inserted.

The display decoders have been built and mounted.

TX-0

The design for the plug-in units is being continued. Work has been started on the block schematics. A vacuum tube clock will be used, and a tentative circuit has been designed.

Power Supply

A regulated transistor power-supply designed by Bob Hughes was presented to the Test Equipment Committee, and several of these will probably be built.

## AN/FSQ-7 AND CAPE COD DIRECTION CENTER

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

### CAPE COD ENGINEERING (L. L. Holmes)

Al Roberts has been transferred from this section to Group 64 at Lexington. Along with the reassignment of Al Roberts, several additional personnel changes have materialized:

1. C. S. Lin, O. C. Wheeler, and A. N. Blumenthal are no longer working in the MITE and magnetic drum equipment area. They will concentrate on problems pertaining to any or all of the WWI areas.

2. L. Healy will continue to be responsible for the MITE and magnetic drum area and will be assisted by E. W. Pughe. The Barta Building crosstelling equipment checkout will be completed by E. W. Pughe. He will represent our section in the formation and completion of the XD-1 and WWI crosstelling tests.

3. C. H. Greim has been transferred from the Cape Cod Direction Center (CCDC) to L. Healy's section. He will be the technician in charge of the Room 156 area.

4. L. C. Norcott is no longer working in the CCDC and is now giving his attention to the Raytheon Magnetic Tape System.

5. W. Karlsen is now in charge of all of the equipment in the CCDC.

6. A. R. Curtiss will spend part of his time assisting D. A. Morrison with equipment test programming.

7. T. Sandy will transfer from this section to Group 64, Lexington, on 14 November, where he will continue to concentrate on semiautomatic height finding subsystem tests.

8. The WE-ADES personnel who have been working with us at the Barta Building will leave here by the 14th of November. They will join the ESS subsystems test teams now forming at Lexington. Their contributions at WWI have been appreciated and it is hoped that they have been provided with a background for their future assignments.

CAPE COD ENGINEERING (continued)

WWI Computer Operation

| | |
|---|---|
| Scheduled Computer Hours: | 314.5 |
| Interrupting Incidents: | 16.0 |
| Hours Lost: | 5.0 |
| Percent Good Time: | 98.4 |
| Mean Time Between Failures in Hours: | 19.3 |

Six of the 16 interrupting incidents occurred when development work in an unused area reflected trouble into employed parts of the system.

WWI Operations Schedule

A preliminary forecast of the WWI computer time requirements for the period of November 1955 to January 1957 has been prepared. The forecast is a result of the gathering of information pertaining to the predicted WWI needs of both Lincoln Lab and MIT groups.

Crosstelling

Tests using both WWI and XD-1 are tentatively scheduled to start on 1 December 1955. The WWI programs required for this subsystem testing will be written by E. W. Pughe. It is hoped that ten two-hour tests during the month of December will be sufficient to make the subsystem operational.

Recently WWI has transmitted messages to the Building F (Lexington) switchboard and back without any obvious errors. Crosstelling information is now being recorded on slot 6 of the buffer drum.

Semiautomatic Height Finding Subsystem Testing

The WWI-S. Truro height tests have continued with fair success. During the next two weeks there will be two tests scheduled, one of which will use a controlled aircraft. The computer program for that test has recently been checked out by T. Sandy.

Preliminary acceptance test specifications for an ESS semiautomatic height finding subsystem have been written and distributed.

Magnetic Tape Delayed Printout System

Delayed printout operations have been interrupted occasionally by two types of failure:

1. Combination of the first two characters that follow

CAPE COD ENGINEERING (continued)

a Flexowriter tab operation. The source of the trouble has not been determined.

2. Magnetic tape reading failures resulting from a buildup of foreign matter on the magnetic tape unit heads. The matter is not removable by the daily cleaning process. Specimens of the matter will be analyzed.

SYSTEM TEST PLANNING AND COORDINATION (K. E. McVicar) CONFIDENTIAL

EPSCOM (R. P. Mayer)

This committee now consists of four permanent members, five members on loan from other groups of Division 6, two BTL programmers, and three WE programmers, bringing the total to 14. Five new WE and two new RAND people are expected during the coming biweekly period which will bring the total to 21.

H. I. Rundquist and S. L. Thompson will assist in the planning and coordination of EPSCOM. Howie Rundquist is a permanent member and will assist in:

1. Formulating a general philosophy for programmers,
2. Planning utility programs and program libraries,
3. Coordinating our work with that of Group 61, etc,

Sam Thompson is on loan from Gus O'Brien's XD-1 Test Specification Section and will:

1. Assist in coordinating the work of EPSCOM programmers who are writing XD-1 programs,
2. Serve as EPSCOM representative on the various system test teams,
3. Assist EPSCOM programmers in making most effective use of our XD-1 time, etc.

MTC DDT/DDR/GFI (A. Werlin, J. Mazza)

A. Werlin has incorporated azimuth jitter into the DDT/DDR and DDT/GFI program. This mode of operation will be tried with the GFI equipment the week of November 7. It is hoped to have the additional feature of checking the GFI equipment with data from an external site (simulated pattern with live jitter) in the near future.

XD-1 Pattern Checking

W. J. Marston has been checking out a program which sets up the pattern display and all necessary control information needed for the Radar Pattern Testing Program, ORPT-0200. A program for testing radar returns for duplicated, extra, or missing returns has been written but not tested. A very simple program was written and tested which, under toggle switch register control, will generate any pattern in such a form that it can later be punched in binary cards with the octal punch program.

B. M. Beatty has written and checked a program to display the detected errors at the proper position on the situation display console, along with coordinates and legends. This program is being expanded to destroy old information on the scope at specified intervals of time, but with the option of retaining the information until the accurate button on the scope is pushed.

Work has not yet started on the method of printing out errors, which this program will eventually have in addition to the display.

XD-1 Raw Data Display

S. L. Thompson's program, ESFS0000, provides a simple PPI display of raw data from any site. It has been run using live data from GFI sites and with a magnetic tape recording of data from South Truro. The program appears to be OK, but the data has been poor.

XD-1 Tracking

Work is continuing on the single-track program ESTK0000 (formerly mentioned as TESS0000) of Shererd, Thompson, and Rundquist. The lack of light guns and manual input keyboards is slowing down part of the work. The data conversion and the tracking routines are completed, and work is being done on the track display routine.

WWI/XD-1/XT

Crosstell messages have been sent from WWI through the phone lines to Lexington and received again (not using XD-1) for a period of 15 minutes without an error.

A WWI program to use XD-1 as a slave computer is being written by E. W. Pughe. The schedule is to start the crosstell loop using XD-1 and WWI on or about 1 December 1955.

The XD-1 counterpart of this program is being written by R. C. Mayberry. It is being expanded to check the received XT messages from

WWI against the corresponding message in a stored table, and print out the bits of the received work that are wrong. The program will also print out the run number, messages received, messages not accepted by the computer, and whether or not it took excessive time for WWI to send the messages. A skeleton program to do everything except the printout is now completed.

MTC/G/A (C. W. Watt, I. Aronson)

Chan Watt and Irving Aronson have started to write a program for MTC to generate test messages for the G/A Data Link. The messages generated by MTC will be recorded on an Ampex recorder at Barta for the future daily use by the Data Link test team.

G/A Output

Starting Monday, 24 October, the test word generator in the output frame of XD-1 has made available to Group 311 a single test word which has been transmitted over the phone line at Prospect Hill. A demonstration was held on Monday, 31 October, by Group 311 in which the test messages on the phone line were properly received and retransmitted by UHF link to Building B. Instruments in a mock-up of the airborne indicator panel were set up by these messages.

The several possibilities for providing the G/A equipment with a message of more complex structure than that possible using the single-word generator have been investigaged more thoroughly. It was decided to concentrate for the moment on the preparation of a magnetic tape using MTC as a message source. This tape will be recorded on an Ampex recorder at the Barta Building and will be played back over the phone line to Prospect Hill. A method for using the XD-1 output buffer drum as a message source was also shown to be feasible and it is thought that this will be better in the long run than the tape for producing test messages.

"Background and Preliminary Discussion of G.E. Ground/Air Data Link Systems Tests," 6M-3957, was issued.

Crosstelling Output

The plans for tying XD-1 and WWI together to test the crosstelling link between them have been made firm during the past two weeks. The work as scheduled several weeks ago has progressed satisfactorily. The crosstelling output of WWI has been fed back into the crosstelling input via a DDT-phone line-DDR loop with satisfactory results and the same type of loop has been closed between the crosstelling output and

crosstelling input sections of XD-1. We do not expect to be able to actually tie the two computers together until the output section of XD-1 is certified by IBM as being in reliable operating condition. It is expected that this will be about the first of December. If all goes as expected, the XD-1-WWI output tests should be concluded by 1 January 1956.

## VACUUM TUBES

(Group 65, P. Youtz)

### TUBE TECHNIQUES (J. S. Palermo)

A revised bariated-nickel cathode program was formulated in order to obtain additional data on the preparation and operation of these cathodes. Toward this end a summary report of the entire process was issued and the preparation of the necessary LTPS was started before any further cathodes were produced. The purpose of these procedures is to standardize the many techniques.

Additional 5-inch Charactron tubes, reprocessed from old Typotron tubes without the flood gun or storage target, were made for Group 62. However, the adequate evaluation of these tubes has been delayed due to a cathode problem. The risks of this problem were considered since we were using salvaged guns from dissected Typotrons. This practice introduced innumerable variables which must be investigated.

### CHARACTRONS (P. C. Tandy)

Four MIT 19-inch tubes and one Convair Charactron tube have completed from 2324 to 6514 hours on life test. One MIT tube, CHT-112, failed after 2600 hours of life because of low beam current and poor cathode uniformity. This tube had operated on life test at -44 volts dc bias. Another MIT tube, CHT-113, still has good beam current and fairly good cathode uniformity after the same period of life at -50 volts dc bias. CHT-113 was the poorer of the two tubes at the previous testing period.

Fourteen cathode-study tubes have completed from 2755 to 4134 hours. The two tubes with 4134 hours were started by A. Zacharias. Transfer characteristic curves of pulse-beam current vs. pulse grid-cathode voltage show that four tubes do not give 50 microamperes at zero bias after about 3000 hours of life. Three of these four tubes have failed in the last 1000 hours of operation. One tube, CT-53, has been rejected after 2993.8 hours for field emission, apparently due to the presence of phosphor particles on the inside surface of the bulb in the vicinity of the $A_1$ and $A_2$ discs. Grid leakage on 15 CT tubes was measured between 0.01 and 0.27 μa with 150 volts bias and 6.3 volts applied to the heaters. Since a direct short gives a 250 μa reading, the above leakages were not considered excessive.

A bariated-nickel cathode tube with triode construction, CT-137, has been discontinued from life test because of continuous breakdown between $G_1$ and $G_2$. This tube will be dissected in an attempt to obtain more information concerning the cause of tube failure.

CHARACTRONS (continued)

The leakage tester for the CT cathode-study life program is under construction. The test station for this program will be wired when the cabinet is received.

Eight Typotrons and nine bariated-nickel cathode tubes, six diode and three triode, are continuing to operate on life test.

RECEIVER TUBES (S. Twicken)

A progress meeting on the DT-438 was held at Tung-Sol, Bloomfield, New Jersey. Progress continues to be slow. The details of the meeting are reported by T. F. Clough.

Analysis of sample data submitted by G.E. relative to the impending use of passive P-50 cathode alloy shows favorable trends in the characteristics of the 0528. G.E. has been able to increase the grid turns per inch slightly, resulting in $\mu$ and Class A plate current being higher than past production and much closer to the original bogies. Since G.E. has successfully completed 2000-hour life tests on P-50 with respect to interface impedance and grid current (as required by the specification) approval has been given to G.E. to put the P-50 into production. Some six million sleeves have been reserved. This should allow G.E. to produce 0528's for several years without another cathode alloy or melt change. In the meantime, G.E. is also investigating another passive alloy to use as a potential second source of supply.

Standard methods of measuring interface were proposed at a meeting of the ASTM Task Force on Cathode Interface Impedance. This group will nowattempt to define standard methods of life testing for interface.

COMMERCIAL TUBES (T. F. Clough)

The Lincoln Tube Process Specifications are being written for the cathode-study tube program. Processing procedures for the bariated-nickel cathode will be included.

Members of the Project High Tube Group, S. Twicken, and I attended a meeting on the DT-438 (improved 5998) at Tung-Sol, Bloomfield, New Jersey, on 3 November. The Tung-Sol program is five weeks behind schedule at this time. Tung-Sol's plate supplier has been unable to produce plates to specification, and there has been a misunderstanding on delivery requirements between Tung-Sol and its supplier. An early solution to the dimensional-specification problem has been promised. The Lincoln SAGE film was shown at Tung-Sol in order to acquaint their personnel with the wide aspects of

COMMERCIAL TUBES (continued)

the tube's application. An interim specification for the DT-438 was agreed upon with the exception of a few important but non-controversial points which will be agreed upon when further background data has been studied. Tube production will have to cease until agreement is reached, since this interim specification will be used by IBM to order tubes during the period of statistical evaluation of the final DT-438 specification and negotiation of a production purchase order.

## PRODUCTION COORDINATION OFFICE

(Group 66, B. E. Morriss)

POWER GENERATION (J. J. Gano)

The document on load, performance, and reliability requirements of power generation for combined centers is awaiting IBM concurrence.

Power Transient Detector (S. T. Coffin)

A combination low level and transient electronic dc voltage monitor has been designed for general use in computer systems. A breadboard form is being tested and a power supply designed for this monitor.

Thermistors for Filament Cycling (G. F. Sandy)

A visit was made to Carboloy Department of G.E. in Detroit to:

1. See if they knew why the lead washers used for uniform distribution of pressure in a thermistor assembly were melting and why the thermistors were breaking.

2. See if they would make a thermistor with a larger current rating.

We hope to solve the problem of melted washers by substituting silver coating for tin coating.

G.E. had no idea why our thermistors were breaking. They will make a 3" O.D. by 1/2" thick thermistor and send it to us for testing. It is hoped this thermistor can be rated for 35 amperes, the load requirements in AN/FSQ-7. Reasons for the thermistors' breaking are being investigated.

XD-1 (G. L. Piantoni)

A power flow diagram, including electronic equipment as well as power and auxiliaries, is near completion.

TX-0 (J. D. Clarke)

The power control system has been designed electrically and mechanically. Mechanical details are in drafting. A marginal checking distribution system is being developed.

WWI Air Conditioning System (R. Jahn)

A new schematic diagram of this system is being prepared.

PRODUCTION COORDINATION OFFICE (continued)

COMMUNICATIONS (W. Glass, C. Carter, F. Irish)

A meeting was held at the Weymouth NAS on 31 October to discuss the termination of SAGE Experimental Subsector circuits at that base. Telephone circuit orders will be issued or revised to reflect the agreements reached there.

A meeting was held at Lincoln with ADC and EADF to discuss the operational orders to be issued by EADF outlining their participation in the ESS. Communication requirements for the ESS were presented to EADF at this meeting.

A meeting was held with the NET&T Co. and representatives of Division 3 to discuss the termination of telephone circuits at No. Truro for retransmission over the scatter link to Texas Tower 2. This meeting uncovered the fact that an incompatibility exists between telephone circuits and the scatter link. This problem has been referred to the LPO for further investigation.

Another attempt was made through R. E. Rader of Division 2 to obtain ADC's permission for Lincoln to use approximately 12 channels on the scatter link. If this permission is not granted, it will be impossible to tie Texas Tower 2 into the ESS.

A meeting of the Wire Communications Test Team was held on 27 October to discuss the progress of that team to date. Ideas on types of tests to be performed and on who could perform them were presented.

## ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

### PERSONNEL

#### New Staff

##### Assigned to Group 61

Haig Hedison received his BS and BA from Suffolk University. He was formerly employed by the American Machine and Foundry Corp.

##### Assigned to Group 63

Harold Petersen received his MA in Math from Wayne University where he was employed as a Research Associate.

#### Terminations

Donald Richards is now with the Air Force in Washington, D. C.

### MATERIAL (H. B. Morley)

The Purchasing Department has notified us that the order for the 200-volt, 40-amp thyratron rectifier for the transistor computer has been placed with Power Equipment Company.

New catalogs of interest: IRE Products Directory '55; Lafayette Radio, 10/55; Radio Master '56; and Radio Shack '56.

### ENGINEERING (A. R. Smith)

#### Ferranti Reader

Redesign of a Ferranti reader by substitution of photosensitive transistors for photoelectric cells, resulting in a net equipment reduction plus the ability to read various colored tape, is now in the fabrication stage.

#### Kelvin & Hughes

Design is progressing satisfactorily on the repackaging of a Kelvin & Hughes camera for XD-1 Command Post. The power supply design is completed and being checked. The Charactron tube driver, the plug-gable unit chassis, and internal air conditioning problems enter design this coming week.

ENGINEERING (continued)

Fabrication Requirements

Since the reduction in our model shop facilities, there have been increasing problems involving the expediting of fabrication, particularly those of breadboard, emergency repairs and quickie-type jobs. In order to solve this problem, we are requesting requirements estimate from each group for the coming year, with emphasis placed on the coming six months. The anticipated machine and sheet metal load should be forwarded to your supervisor in terms of manhours per week or month under the classifications of planned (or scheduled) and breadboard, (or quickie) type jobs. Since all sheet metal work is being handled outside of Division 6, special attention should be given to those estimates.

TEST EQUIPMENT COMMITTEE (D. R. Brown, Chairman; L. L. Sutro)

The Standard Test Equipment (Whirlwind and Burroughs) continues to give satisfactory service and to meet most needs. However, some new requirements have appeared, particularly in connection with transistor circuit development. New test equipment will be designed for these new requirements. The Test Equipment Committee is anxious to achieve, in the design of new test equipment, units which will be as flexible and generally useful as the Standard Test Equipment designed six or seven years ago. New units will be designed for requirements which can be clearly defined, but at the same time these new units are expected to become a part of a gradually developing new line of Standard Test Equipment.

The Test Equipment Committee has approved purchase of the following units. The principal addition to the division's test equipment is the Tektronix characteristic curve tracer, a scope which plots four to twelve characteristic curves of a tube under test for each setting of the controls.

| Unit | Mfr | Model | Specifications | User |
|---|---|---|---|---|
| DC Voltmeter | Weston | 931 | 150/15/3 V, 5000/V | Components |
| " | " | " | 500/100/10 V, 5000/V | Section |
| DC Milliammeter | " | " | 3000/300/30 ma. | " |
| " | " | " | 3/0.3/0.08 ma | " |
| Scope Camera | DuMont | 269 | 35 mm camera on extension barrel | Gr. 65 |
| 35 mm Camera | Exacta | VX | Reflex camera with f/1.9 lens | Gr. 65 |
| Characteristic-curve Tracer | Tektronix | 570 | | Div. 6 |
| 6 Probes | " | P410 | 8 μμf | Div. 6 |
| Scope | DuMont | 324-R | | XD-1 |

STUDIES IN PROCESS

| Study | Responsibility of |
|---|---|
| **GROUP 61** | |
| Digital Data Display Program Specs | H. Briscoe |
| In-Out Program Specs | A. Shoolman, A. Ginsberg |
| Radar Input OPS Specs | F. Brooks |
| Situation Display Program | A. Schwartz |
| Switch Interpretation | R. Olsen |
| Table Storage Requirements | L. B. Collins |
| Track Scan | F. Ogg, P. Strait |
| XD-1 Inactivity Alarm Proposal | M. Feldstein, P. Vance |
| XD-1 Startover Program OPS Specs | P. R. Vance |
| Lectures, AD Programming Course | A. R. Shoolman |
| OPS Specifications | A. R. Shoolman |
| **GROUP 62** | |
| *Memory Test Computer* | |
| Card and Tape Symbolic Address Assy. | B. G. Farley |
| Flight Test Analysis (for Gr. 22) | G. Harris, C. Uskavitch |
| Pattern Recognition (for Gr. 24,34) | G. Dineen, O. Selfridge et al |
| Simulation (Gr. 22) | H. Neumann, B. Stahl et al |
| New Control Design MTC | E. Gates, H. Ziegler |
| High-Speed Punch Installation MTC | A. D. Hughes |
| *Systems Office* | |
| Review of Plans for Use of Bomarc with SAGE | H. E. Anderson, J. P. May |
| Talos Reply Back Message | N. T. Jones |
| Teletype Input System | R. H. Gerhardt |
| **GROUP 63** | |
| *New Components and Circuits* (T. Meisling) | |
| Variation of Current Gain, $\alpha$, with Emitter Current | |
| Development of a Bridge to Measure the Quantity $r_b' C_c$ at 4 mc/sec. | |
| Modification of Some Routine Tests (to give increased stability and accuracy to facilitate the comparison of our parameter measurements with those of Lansdale.) | |
| Surface-Barrier Transistor Hole Storage | |
| Design of a Mercury-Relay Step-Current Generator | |

## GLOSSARY

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

| | |
|---|---|
| G/A | ground to air |
| GFI | gap filler input |
| GSR | group selection register |
| IBM | International Business Machines Corp. |
| INS | interceptor simulator |
| LPO | Lincoln Project Office |
| LRI | long range radar input |
| LTPS | Lincoln Tube Process Specification |
| MAR | memory address register |
| MEL | minimum equipment list |
| MISP | Manned Interceptor Simulation Program |
| MITE | multiple input terminal equipment |
| MTC | Memory Test Computer |
| NAS | Naval Air Station |
| NET&T | New England Telephone and Telegraph Co. |
| NRL | Naval Research Laboratory |
| OPS | Operations |
| OT | Overlap Technician |
| PIUMP | plug-in unit mounting panel |
| PPI | planned position indicator |
| PRF | pulse repetition frequency |
| PT | Plotting Technician |
| RAFD | Rome AF Depot |
| RAND | Research and Development Corp. |
| RC | register containing |
| RD | radar data |
| SAGE | Semiautomatic Ground Environment |
| SBT | surface barrier transistor |
| SAR | storage address register |
| SD | situation display |
| SDG | SD generator |
| SDV | slowed down video |
| SIF | selective identification feature |
| SC | Signal Corps |
| SCEL | SC Engineering Laboratory |
| SOP | standing operating procedure |
| SO | Systems Office |
| STP | System Training Program |
| TBS | training and battle simulation |
| TD | track data |
| TIR | Technical Information Release |
| UHF | ultra high frequency |
| WE | Western Electric Co. |
| WISE | Whirlwind I SAGE Evaluation |
| WWI | Whirlwind I |
| XT | Crosstell |

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DOCUMENTS ISSUED

(Frances Christopher)



CONFIDENTIAL

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| ADMINISTRATION & SERVICES (Group 60) | | | |
| 3956 | Div. 6 Staff | Biweekly Report for 21 October 1955 | C |
| 3968 | H. W. Hodgdon | Reliability Course at Redstone Arsenal 4-6 October 1955 - Trip Report | U |
| SAGE SYSTEM TEST AND PLANNING (Group 61) | | | |
| 3728 S#1 | R. R. Reed | Category and Display Assignment BIT Assignments for Sage Situation Display consoles | C |
| 3739-1 | J. J. Cahill | Operational Specification for Interim Antiaircraft Direction in the Sage System | S |
| 3744 S#1 | C. C. Grandy et al | Operational Specifications for Weapons Assignment in the Sage System | C |
| 3786 S#1 | C. C. Grandy et al | Operational Specifications for Sage Intercept Direction | C |
| 3786-1 | C. C. Grandy et al | Same title | S |
| 3778 S#1 | S. J. Hauser et al | Use and Presentation of Weather Data in the Sage System | C |
| 3778-1 | S. J. Hauser | Same title | C |
| 3780 S#1 | S. J. Hauser | Operational Specifications for Identification Function in Sage | C |
| 3780-1 | S. J. Hauser | Same Title | C |
| 3795 S#1 | P. Brager | Operational Specifications for Subsector Command Post in Sage | C |
| 3795-1 | P. Brager | Same title | C |
| 3810-1 | P. Brager | Operational Specifications for Forward Telling in the Sage System | C |
| 3814 S#1 | F. Garth et al | Operational Specification for the Manual Data-Input Function in the Sage System | C |
| 3814-1 | F. Garth | Same title | C |
| 3836 S#1 | D. L. Bailey | Operational Specification for Automatic Tracking in the Sage System | C |
| 3836-1 | D. L. Bailey | Same title | C |
| 5075 | H. A. Keit et al | Initiation Tests: Series I | C |
| 5076 | H. A. Keit | Initiation Test Specifications, Series II | C |

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| 6A-186 | W. A. Hosier | MTC Non-Staff Administration | U |
| 3773-1 | A. D. Hughes | Specifications for AN/FSQ-8 Equipment | S |
| 3851-1 | J. Giordano | Master Reference List of Equipment Specifications for XD-1 | C |
| 3872 | J. P. May | Status of Mark X and SIF and Their Effect on Sage | S |
| 3952 | J. Giordano | Minutes of the IBM-LL/SO Concurrence Meeting #42 Held at Lincoln Lab. 20 October 1955 | U |
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| 3961 | J. Giordano | Minutes of the Experimental Sage Subsector Planning Approval Committee Meeting 24 October 1955 | C |
| ADVANCE DEVELOPMENT (Group 63) | | | |
| 3938 S#2 | W. A. Clark | The Logical Structure of Digital Computers Boolean Algebra | U |
| PRODUCTION AN/FSQ-7 & CAPE COD DIRECTION CENTER (Group 64) | | | |
| 3943 | S. B. Ginsburg | Proposal for Operating XD-1 With Raydist | C |
| 3957 | C. W. Watt | Background and Preliminary Discussion of G. E. Ground/Air Data Link System Tests | C |
| PRODUCTION COORDINATION OFFICE (Group 66) | | | |
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| 3913-1 | J. J. Carson | Specifications for Utilizing the Kelvin & Hughes Rapid Processing Photographic Projector System in Sage System Command Posts | U |
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| 3954 C#1 | A. Wright | Same title | U |
| 3969 | A. Wright | Cape Cod System Weekly Operations | U |
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| | | IBM DOCUMENTS | |
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| 842 | B. W. Kippenham | Project High Engineering Report-Gap-Filler Input Element Drum Circuit | U |
| 843 | B. W. Kippenham | Project High Engineering Report-Gap-Filler Input Element North Synchronizing Circuit | U |
| 844 | C. D. Jackson | Project High Engineering Report-Drum Manual Erase | U |
| 845 | I. Levine | Project High Engineering Report-Magnetic Tape Core Protection | U |
| 846 | J. Ogg | Project High Engineering Report-Gap-Filler Input Element Alarm Circuit | U |
| 847 | C. J. Krauss | Project High Engineering Report-Gap-Filler Input Element Azimuth Synchronizer (Motor Drive)Circuit | U |
| 848 | R. Palmer | Project High Engineering Report-Operation of Maintenance Console | U |
| 849 | J. W. Gibson | Project High Engineering Report-Ferrite Core Fabrication and Testing | U |
| 850 | W. Rooney | Project High Semi-Monthly Report #63 | C |
| 851 | ---------- | Central Reference Room Bulletin | U |
| 852 | R. J. Paddock | Sequences of Operations for Types 713, 718 and 723 Card Machines | U |
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