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Memorandum 6M-4286

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

SUBJECT: BIWEEKLY REPORT FOR PERIOD ENDING 6 APRIL 1956

To: Jay W. Forrester

From: Division 6 Staff

Date: 13 April 1956

Approved: JCP/hi
J. C. Proctor

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SAGE OPERATIONAL PLANNING

(Group 61, D. R. Israel)

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

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Weapons Direction

The following specifications are in various stages of completion:

Mathematical specifications for:

Antiaircraft	6M-3982 issued
Intercept Direction	6M-3927 final draft expected week of 16 April
Weapons Assignment	6M-3926 issued
Raid Forming	6M-3973-1 issued

Operational specifications for:

Antiaircraft	6M-3739-2 1st draft expected wk of 9 Apr
Intercept Direction	6M-3786-2 1st draft expected wk of 16 Apr
Weapons Assignment	6M-3744-2 1st draft expected wk of 9 Apr
Raid Forming	6M-3720-2 1st draft issued

AIR SURVEILLANCE (E. Wolf)

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Corrections to all operational and mathematical specifications are being processed to bring them up to date as of 15 April. Changes previously agreed upon through OMR's are being incorporated with these corrections.

COMBAT CENTER (W. Lone)

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The following documents have been prepared and will be issued during the next biweekly period:

6M-4031, "A Guide to Joint Combat Center Operations,"
J. Burrows, H. Frachtman, W. Lone, E. Morrione

6M-4237, "Digital Display Slot Assignment for AN/FSQ-8,"
R. R. Reed

6M-4257, "Category and Display Assignment Bit Assignments
for AN/FSQ-8 Situation Display Consoles," R. R. Reed.

R. Miller has been assigned to the section and is currently preparing 6M-4247, "Operational Specifications for Sector Staff Personnel," and 6M-4248, "Operational Specifications for Liaison Personnel."

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Other specifications being prepared for the Combat Center are:

- 6M-4246, "Crosstelling, Forwardtelling, and Backtelling,"
by E. Morrione
- 6M-4249, "Air Surveillance," by J. Burrows
- 6M-4250, "Weapons Allocation," by H. Frachtman
- 6M-4251, "Manual Inputs," by J. Plante
- 6M-4252, "Training and Battle Simulation," by J. Christie

Additional specifications to be written include:

- 6M-4253, "Recording and Data Reduction"
- 6M-4254, "Duplex and Standby Computer Operation"
- 6M-4255, "Situation Displays"
- 6M-4256, "Digital Displays"

DUPLEX AND STANDBY (H. Bridge, J. Groce)

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Operational details for duplex operation have been studied. Some portions of the operational specification for duplex and standby operation have been written in rough form.

Mr. C. E. Diss of IEM has joined the group for the next few weeks and will be responsible for the production of the standby program at Kingston.

WHIRLWIND I - ESS CROSSTELL SYSTEM (S. J. Hauser)

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The components of Package I, as it is described in the first draft of 6M-4026, "Operational and Mathematical Specifications for the Whirlwind I SAGE Evaluation System," are near completion. The assembled package, together with a description of the component programs and storage design, will be prepared and a second draft of 6M-4026 will be issued by 1 May.

Active programming of the WISE System will be suspended on 16 April. From then until 1 May, the programming and coding specifications for the programs of Package I will be documented and ready for use when activity resumes on 1 July.

DATA SIMULATION AND REDUCTION (W. S. Attridge)

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Simulated Data Generation (J. Levenson)

An interoffice memo with directions for preparing inputs to the Simulated Data Generation Program has been distributed to users of the program. A memo describing illegal conditions of input data and program action in detection of errors will be issued shortly, along with the modification to the operational specification memo.

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DATA SIMULATION AND REDUCTION (continued)

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The following assignments of responsibility for parts of the SDG program have been made:

Inputs - V. Fuller, C. R. Schoch
 Flight Generation - J. Bockhorst
 Radar Coverage Determination - B. Persell, J. Slagle
 Beam Flight Intersection Computation - R. Russo
 Simulated Data Tape - E. Lafferty

Data Reduction (R. Olsen)

We are proceeding with the station history mode flow diagrams. The second draft of the data reduction operational specification has been distributed within Group 61 for comment.

MTC Operation (D. Bancroft)

The symbolic assembler is working in a limited fashion. A backlog of programs remains to be assembled and code-checked when the machine becomes available in its entirety.

Operations for the period 26 March to 6 April:

	<u>Hours</u>	<u>Per Cent of Scheduled Time</u>
Scheduled	14:00	100
Available and Used	9:00	64
Satisfactory Operation	4:24	30

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ESS DC IMPLEMENTATION AND COORDINATION

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

TECHNICAL CONTROL (C. W. Watt)

Space for the maintenance coordinator in Bldg. F is being requested in memo 6M-4284. A second proposal 6M-4284, S 1, to cover the location of extra equipment that will be needed for technical control in Bldg. F is being prepared. A location for such equipment as the ground-to-air data link monitor will be proposed. It has been determined that the radio supervisor's panel in Room Y of Bldg. F will be the most probable location for ground-to-air voice monitoring. It will be proposed that trouble location in external radio equipment be directed from this point. The assembling of the equipment checkout program for direction center equipment such as manual inputs and keyboards, light guns, warning lights, and display consoles has started. This program will be prepared by EPSCOM and will incorporate existing IBM programs.

Paul Harris of Group 21 is preparing a memo outlining the participation of Division 2 in the technical control function for ESS.

We are fortunate in having obtained the services of Capt. Dan Carroll of 6520th AC&W Squadron who is now spending almost full time on the implementation of plans for the ESS technical control function. It is expected that he will eventually become the C & E Duty Officer in the experimental subsector.

EXTERNAL EQUIPMENT AND COMMUNICATIONS (C. Carter, W. Glass, F. Irish)

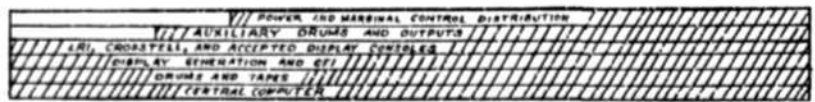
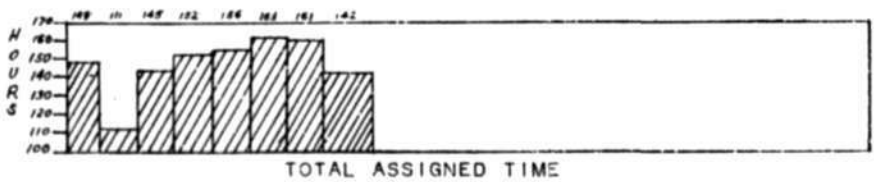
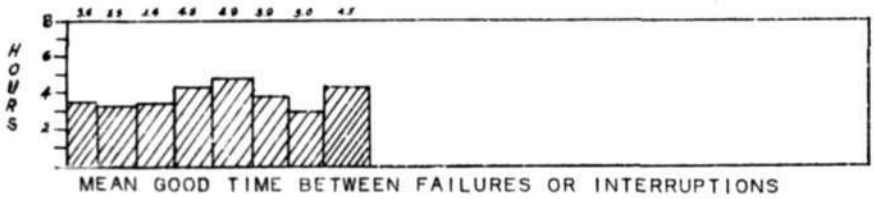
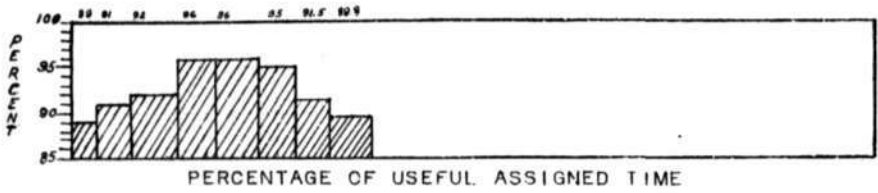
Comments were submitted on a preliminary copy of the WE-ADES documents, "Combat Center - Internal Communications" and "Combat Center - External Communications." This document will be published by and available from WE-ADES on or about 10 April.

On 27 March a meeting was held at Lincoln with representatives of NET&T and BTL to discuss installation and operation of G/A radio switching and monitoring equipment for the ESS Direction Center.

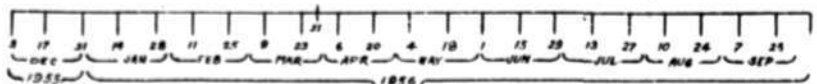
The "-4" revision of 6M-3275 "Leased Telephone Circuits for the SAGE Experimental Subsector" has been published and is available in the Division 6 Document Room.

A meeting was held at North Truro on 5 April with representatives of the Air Force and the telephone company to discuss space requirements for communications equipment at the Shore Station and on the Texas Tower.

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



EQUIPMENT INCLUDED IN RELIABILITY STUDIES



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EPSCOM (R. P. Mayer)

Two new WE programmers, Bill Hansell and John Tadler, have joined EPSCOM. The EPSCOM manpower now stands at 23 permanent members (BTL, Lincoln, and RAND) and 12 members subject to rotation (WE), for a total of 35 people.

Specifications for programs requested by the Assembly Test Committee are being prepared by Sam Thompson, Howard Rundquist, and members of the Assembly Test Committee. Several programmers are studying the coding problems presented.

The Group 67 card room and computer procedures have not been completely worked out yet. We are attempting to train our programmers to make use of these procedures as soon as they become available.

Further details on all of the EPSCOM programs can be found in the EPSCOM Biweekly Report 6M-4289.

CIRCUIT SUPPORT (R. J. Callahan)

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

Memorandum 6M-4283 describing the above circuit is in preparation.

Charactron Vector Intensity Modulator (R. B. Paddock)

This circuit now appears to meet all the present requirements and marginal check data are being collected. The packaging by IBM should begin very soon.

LRI Monitor (B. W. Barrett)

J. McCusker and I are figuring out the cabling and logical changes necessary to connect the Bendix consoles to the breadboard system. In a conference with I.B.M., Bendix, and M.I.T., the temporary use of certain improvised equipment in the auxiliary, maintenance, mapper supervisor, and camera consoles in order to meet the July 1 delivery date was approved.

DESIGN CONTROL (W. A. Hosier)

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

The general time problem in the SAGE System and some proposed partial solutions to it are outlined in 6M-4266 which was published on 27 March. It now looks as if Shur and Puorro of IBM will continue to investigate the possible applications of specialized instructions, while I devote attention to the pro's and con's of adding another memory buffer register.

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DESIGN CONTROL (continued)

New CER's (A. A. Rich)

<u>CER's</u>		<u>Originator</u>
141	Change of SD labels and labels and switch modules. Necessary for operational requirements of experimental and production subsector	Group 67
142	Rewrite of duplex input marginal checking and distribution unit specifications, FSQ-7 and FSQ-8.	IBM
143	Change to the GFI monitor specifications, D-78-6. Specifications further clarify the function of the 30 lines from the auxiliary console RO2 to the GFI camera console.	IBM
144	Change to the program element specifications, S-14-1 to provide for start in test memory address (20,010 octal) on automatic branch on alarms.	IBM
145	Automatic drum erasing for XD-1, P-257. This change proposes a means of controlling magnetic drum-erase feature by programming.	IBM
146	A reproposal to use a H-manila .0065 card for XD-1 and FSQ-7's.	IBM

Change Requests for XD-1 and Production Machines (J.D. Crane)

Any requests for changes to be made in XD-1, AN/FSQ-7, or AN/FSQ-8 should be sent to the DCO; however, requests originating in Group 61 and 67 must reach the DCO via H. K. Rising.

Investigation of CER's (S. B. Ginsburg)

Operational and mathematical specifications, 6M-4032, 6M-3778-1, 6M-3982, 6M-4028, and 6M-3960 were reviewed for TIR release.

CER 149, S-52, "Duplex Switching Console Specifications", is presently being reviewed for IBM-DCO concurrence. CER 139, "Change to the Specifications for the GFI Mapper Consoles for FSQ-7", was rejected. It called attention to the possible loss of data for a full scan following an excess target alarm. It is an operational necessity that this alarm be self-clearing.

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POWER AND CONTROLS (J. J. Gano)

XD-1 (J. J. Gano)

At a meeting with IBM it was decided to install the electronic voltage detectors, which Coffin designed, to monitor the d-c supplies. Several are presently under construction. Their application will give us information on the occurrence of short duration transients which may cause computer errors. SAGE at present provides for only steady-state detectors.

Magnetics (R. C. Jahn)

Square wave inputs obtained from a 60-cycle chopper are now being used to study the waveforms of the magnetic reset amplifier. These waveforms are easier to analyze than the sinusoidal waveforms used previously.

D-C Supplies (S. T. Coffin)

A breadboard transistor-magnetic power supply has been built, and is being tested for the best dynamic regulation. Performance is roughly the same as that of the thyatron supplies used in WWI and TX-0. It will be used as a -15 volt 10 amp. supply in the Div. 6 d-c distribution system. Thermocouple measurements indicate that with a simple heat dissipator design, a 2N57 may dissipate 7 watts in a typical application.

Laboratory Power

In order that our engineers may have more time for development, all problems on laboratory d-c power and industrial controls should be referred to Bill Carroll.

SD RECORDING CAMERA (L. Sutro)

A photograph that has been displayed for several months as the best work of the situation display recording camera showed a square array of numbers which are readable but not as clear as we believe possible. Loren Prentice and I have been trying to improve the resolving power of the system and thus increase the clarity of prints.

Tests performed last week showed that (1) the camera is properly focused within the nearest 0.002" and (2) because of the convex curvature of the Charactron, the lens has to be stopped down so far that the film is not adequately exposed. A film reputed to be more sensitive to blue light than Tri-X will now be tried. But it is evident that the greatest improvement can come with replacement of the 19" Charactron by a 5" or 7" tube. The smaller tubes yield approximately 4 times as much light per character, have far less distortion and, because their surfaces are flat, should permit the diaphragm to be opened two more stops. This wider opening, together with the brighter display, can bring 16 times as much light to the film. I think that IBM and Hazeltine should consider the use of the 5" or 7" tube for the SD recording cameras of production computers.

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

MAGNETIC MATERIALS (J. B. Goodenough)

Memory Core Testing (R. C. Zopatti)

The total number of memory cores double-tested by this section to date for the 256 x 256 x 37 memory is 2,775,100. There are also about 15,000 untested and 100,000 single tested cores on hand, making a grand total of approximately 2,890,100 cores.

Chemistry

Thin-Films Project (F. S. Maddocks)

Chemical analyses of several evaporated Permaloy films have been completed. In all cases, the iron content of the film has been higher than that of the charge, by about three percent. Not enough data is available yet to be able to predict film composition from charge composition. (See also report on symposium, Page 10)

Memory Core Production (D. L. Brown)

Approximately 225,000 F397 memory cores have been processed and delivered to the testing section.

Experimental Chemistry (D. Wickham)

It is desired to investigate some of the physical properties of compositions in the system NiO-VO. The synthesis of several compositions in this series has been started.

Crystallography (W. J. Croft)

A boule of Mn_3O_4 is being studied in order to prepare oriented sections for resistivity and magnetic measurements.

Physics

D-C Fluxmeter (R. A. Pacl)

All power supplies used in conjunction with the d-c fluxmeter are being regulated and filtered to reduce drift and distortion.

VCM (N. Menyuk)

A feedback loop has been installed successfully in the vibrator mechanism of the vibrating-coil magnetometer. At the present time the loop gain is 5, which is adequate for measurements on powdered

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MAGNETIC MATERIALS (continued)

ferrite samples. Considerable improvement in the gain is expected upon the arrival of units which have been ordered.

Experiment (D. O. Smith)

The switching properties of a thin film of nickel-iron alloy supplied by E.R.A. is being studied. It is found that under the conditions of operation obtaining in a coincident-current memory, this film switches in less than 20 msec.

Thin-Film Research (N. Menyuk, D. O. Smith)

We attended the Armour Symposium on Relaxation Phenomena in Ferromagnetic Materials held April 4-6. Among other papers, S.M. Rubens and his associates at E.R.A. reported on the results of their thin film research. Their results indicate that the switching time is reducible by about an order of magnitude below that in the ferrites presently employed. Power levels are also reduced by more than an order of magnitude. The switching mechanism is strongly dependent upon the anisotropy constant K , being due to domain wall motion below a critical value proportional to K . Domain rotation occurs above this value. The higher speeds are obtained by reducing K to values low enough for the rotation mechanism to occur at field strengths which can be used in coincident current devices. The theory has been worked out independently in this laboratory and by E.R.A. The close agreement with their experimental results leaves little room for doubt. These results also appear to settle the disagreement concerning the magnetization reversal mechanism in thin metal tapes 1/8-mil thick and greater. Since these tapes have a higher value of K , the mechanism appears to be domain-wall motion, as has been maintained in this laboratory.

TRANSISTORS (D. J. Eckl)

Developmental Transistors

The transistor field has been moving rapidly towards the higher frequency spectrum in the past year. At present, the only reliable transistor available in production quantities for the 50 mc/sec region is the surface-barrier transistor. Two experimental transistors examined in the past week give an indication of what may be expected in the future. These units are at least a year away from production. However, they will oscillate in the 200-300 mc/s range. To compare them with the SET, a multivibrator circuit was constructed. SET's could be made to operate at about 8 mc/s in this circuit. The two experimental units, although they had considerably different characteristics, could be made to operate at 25 mc/s. In a flip-flop circuit these units could be triggered with 10-25 msec pulses and set and cleared at an interval of 50 msec or less -- an effective frequency of 20 megapulses/sec.

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TRANSISTORS (continued)

The lack of test equipment for these frequency ranges makes the problem of obtaining significant information a difficult one. All rise times are measured as 7 μ secs which is the rise time of the Tektronix 517 scope. Signal levels are low which means an amplifier must be used. The generation of 10-25 μ sec pulses is also a problem. Mercury relays have been used but are not satisfactory.

Transistor Testing (P. A. Fergus)

Distribution curves have been plotted for 2200 SBT's which will be used in a report summarizing SBT parameters. Similar curves have been plotted for the GE 2N136 which will appear in a memorandum. This latter unit is a 5 mc p-n-p alloy.

Silicon Diode Noise Generator (E. U. Cohler)

The silicon diode noise generator is being developed to provide random bits at a 200 kilopulse/second rate for certain computer applications. While the diode noise is not truly random, and is not exhibited uniformly for all diodes, it is felt that the method is practical for such special instrument application. The method of operation is to develop randomly spaced (in time) pulses from the diode, and allow them to trigger a flip-flop which is sensed for a zero or one output every 5.0 μ secs. The pulses from the generator are "pseudo-random" in both spacing and amplitude and occur at rates which may be in excess of 1.0 mc. The problem is one of obtaining diodes with sufficiently high frequency, high-amplitude output. To date there is no complete theory relating frequency and amplitude to other diode parameters which are better known. Experimental models of the generator will soon be tested with TX-0.

SBT Switching Speeds (J. R. Freeman)

Comparison of the double propagation times τ for four types of surface-barrier transistors have yielded the following information to date. All times are given in μ secs per inverter stage.

Direct Coupled

(Supply voltages and Collector resistances optimized)

SB100 τ = 65SB100T τ = 90L5131 τ = 34L5117 τ = 27

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TRANSISTORS (continued)

τ is the double propagation time (the sum of the turn on and turn off times of an inverter stage driven by an identical stage and driving an identical stage).

Coupled with $R_c = 690$, $R_b = 2.2K$

(interstage capacitor optimized)

SB100 ($E_{cc} = 6.0v$) $R_b C = 85$
 $\tau = 75$

SB 100T ($E_{cc} = 3.0v$) $R_b C = 100$
 $\tau = 75$

Coupled with $R_c = 470$, $R_b = 1.2K$, $E_{cc} = 3.0v$

(interstage capacitor optimized)

SB100 $R_b C = 85$
 $\tau = 85$

SB100T $R_b C = 100$
 $\tau = 140$

L5131 $R_b C = 65$
 $\tau = 65$

L5117 $R_b C = 65$
 $\tau = 45$

MEMORY (J. L. Mitchell)

Cooling and Supplies

We have started to put the compressors into operation and the preliminary "debugging" of the air conditioning system is under way. The installation of the power supplies is progressing satisfactorily.

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MEMORY (continued)

256² Memory

To date, 362 64 x 64 memory plane modules have been accepted, and 14 256 x 256 memory planes have been shimmed together. The wiring of the memory stack is progressing satisfactorily. This job continues to take more time than we estimated due to the tremendous number of connections that have to be made. It now looks as though the first plane will be ready for operation sometime during the week of April 9th. The remainder of the system is ready and awaiting the completion of the wiring of the first plane.

Advance Development

The preparation for greater experimental activity on the plated planes is underway. Results to date look very good. Work on the heating of memory cores when switched at high prf's is still in the preliminary stage.

DISPLAY (C. L. Corderman)

Character Legibility Studies (R. H. Gould)

In cooperation with members of Group 38 we have started on an investigation of the frequency of intensification needed for a "flicker-free" display with different types of phosphors. A number of "cathode study tubes" are being built with different phosphors for testing. A larger tube with a number of different phosphors on its face is being considered.

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

A first supplement to 6M-3284, describing and analyzing the individual stages of the line driver amplifier giving operating equations, actual voltage readings, loading of components, power supply requirements, and marginal check data is nearly ready for publication. It is intended to serve as a reference source for maintaining the line drivers and also presents some of the data required for an MRD report.

A second supplement to 6M-3284, describing the overall behavior of the line driver has been started. It is planned to show a theoretical analysis of the complete amplifier using the individual stage operating equation presented in supplement #1 as well as the available experimental data.

Development

An M-note, 6M-4282, has been written describing recent attempts to

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DISPLAY (continued)

find an improved high-speed precision magnetic deflection yoke. Stromberg-Carlson is now in the midst of developing such a yoke. Three other companies have offered to undertake such a development. (H. E. Ziemann)

Technical proposals for the development of a larger-screen, character-writing display tube having controlled persistence have been received from IBM. A summary of comments will be prepared after all interested people at Lincoln have examined them.

Several discussions have taken place concerning a remote display console for FSQ-7. Schedules and block diagrams for such a unit will be prepared during the next three weeks. The system to be proposed will employ a small memory (approximately 64 tracks) which is fed from a phone line and is rapidly cycled through to give a flicker-free display on an XD-1 type console. Transistor circuitry will be used whenever it is feasible. (C. L. Corderman)

SYSTEM DESIGN (K. H. Olsen)

The TX-0 control and arithmetic elements have been assembled and as far as we can tell all orders are working correctly. The Flexowriter and the transistorized photoelectric tape reader have been installed and checked out and the display system is being assembled.

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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

Comments on the draft of 6M-4223 have been received and the test schedule is now being revised in conjunction with Group 22. It is expected the revised memorandum will be issued by the week of 16 April. W. Johnson has started preparing a sample shakedown test specification dealing with automatic tracking. It is expected the specification will help clarify the problems involved in writing such specifications.

The flight path library for simulated problems has been completed and the path specifications have been released to the card room to be punched. A second simulated problem has been designed. This problem is intended to be a test of the simulated data generation program and the simulation facility of the master program. R. Lawrence and D. Coyne are preparing a memorandum describing this problem.

The Assembly Testing Committee rejected the automatic tracking test proposed by T. Callahan. Assembly testing concept has been reviewed with J. Ishihara of Group 67 and T. Callahan and M. DiCarlo-Cottone are preparing a new proposal.

System Verification

The verification criteria are being reviewed again and the issuance of the draft of 6M-4281, "ESS Shakedown Test Requirements," has been postponed until the week of 9 April. Detailed shakedown testing requirements are being developed from the verification criteria. Some concrete proposals have been made by R. Watters for interception direction and by T. Callahan for automatic tracking. Two additional studies have been undertaken in this area. One is that of air defense function logic which should result in clear criteria for assembly testing; the second is a study of operator shakedown to consider the problems involved in utilizing operators.

The initial data reduction requirement given in 6M-4203 will be revised as a result of comments submitted through the PCC. We expect to issue a revised memorandum during the new two weeks.

Facilities

A rough draft of our operator requirements which supplements the test schedule given in 6M-4223 has been prepared in conjunction with Group 22. This will be issued as a memorandum when the revision of 6M-4223 is completed.

The anticipated requirement for simulated problems has been stated in schedule form in 6M-4280, "Weekly Simulated Problems Requirements

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ESS SHAKEDOWN PLANNING (continued)

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for ESS Shakedown Exercises" by M. J. DiCarlo-Cottone. This memorandum is intended to be a guide for those responsible for actual manufacture of the problems.

Personnel Changes

Al Roberts has joined the system verification activity to work on testing requirements. He is on temporary loan from Group 66.

WWI COMPUTER OPERATION (L. L. Holmes)

Scheduled Computer Hours	323.5
Interrupting Incidents	16
Hours Lost	5.3
Percent Good Time	98.4
Mean Time Between Failures in Hours	19.8

In general, the system reliability was good. Three incidents totaling approximately two hours were caused by accidental loss of power.

Another phenolic breakdown (silver migration) in an accumulator panel contributed an additional two hours of lost time.

There were nine computer alarms that indicated trouble in two areas. The investigation of the failures will be continued during the next regularly scheduled maintenance period.

There were no interruptions that are known to have been caused by tubes. During this period, 30 tubes were replaced through the use of the marginal checking facility.

Delayed Printout Equipment

Using the CCS, Group 22 conducts one SOT mission each week. The strike and interceptor aircraft track information necessary for evaluating the CCS is stored on Raytheon magnetic tape units. The recorded data is later "reduced" from 4 reels to approximately 60 reels. The resultant recordings are in a format for delayed printout operation. The required delayed printout time can amount to 165 hours, and with the two existing printout systems working simultaneously there are 82.5 hours used. Because of other WWI commitments, Group 22 must now wait almost a week for all of their results.

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WWI COMPUTER OPERATION (continued)

It has been decided that we will increase our delayed printout facility to three systems and provide a flexible control system capable of having any three of four magnetic tape units (1, 2, 3A and 3B) printout simultaneously on any of the three systems. The equipment additions and revisions, plus careful scheduling of the magnetic tape units, should enable Group 22 to reduce the wait period to about four days.

L. H. Norcott and O. C. Wheeler have designed the new control system and will supervise both the testing and installation of the equipment. During this installation and testing, we will not deprive users of WWI of any delayed printout time. The hardware should be operational by 12 May 1956.

G/A Data Link Equipment

With the concurrence of Group 22, Group 311 has discontinued the service of the Collins ground-to-air data link system. Consequently there is no need to maintain the WWI - Collins data link output system. The output coder for the Collins system and associated monitoring equipment have been removed from service. The only ground-to-air data link system now available at WWI is the GE G/A system.

Room 156 Equipment

E. W. Pughe, Jr. is now acquainting himself with the magnetic drum equipment. L. D. Healy will continue to supervise the Room 156 equipment, but is now actively working in the central computer area.

D. A. Morrison has prepared a new version of the Room 156 marginal checking program. The book containing the check routines has been corrected and will soon include flow diagrams for each program.

MEMORY TEST COMPUTER (H. L. Ziegler)

Testing of all series regulator tubes in the MTC power supplies should be completed in about a week. Tube faults are about equally divided between shorted electrodes and low I_p , with the total from both causes running to about 40 % of all tubes tested. Rejected tubes are being replaced as rapidly as the Tube Lab supply permits.

The components testing lab has been requested to make a series of tests on the 150 ma. slow-blow fuses used in the series-tube circuits of the power supplies. From these tubes we hope to determine the feasibility of measuring I_R drops across these fuses as indication

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MEMORY TEST COMPUTER (continued)

of circuit currents; a high degree of accuracy is not required for our purposes.

In the interests of increased reliability and of meeting anticipated future needs power-supply current capacities are being increased to provide some factor of safety. Along this same line (increasing reliability) a relatively simple scheme of marginal-checking individual series tubes has been worked out and is to be tried soon.

Logical checkout of the adapter frame for magnetic tapes has been completed and tie-in to computer control began at noon Friday, 6 April. Work will continue throughout the weekend with the hope of having one tape drive unit in operation by the middle of the following week.

There is as yet no fixed policy which governs modifications to the magnetic tape equipment or the requisition of spare parts or special tools required for maintenance. Group 66 has been asked to help establish a workable agreement with IBM.

With the exception of areas affected by the tie-in of magnetic tape, logical checkout of the computer and equipment is now complete. Still remaining however, are faults more subtle in nature -- intermittent failures originating from marginal pulse amplitudes and timing, and from prf sensitivity. A program of systematic circuit cleanup to eliminate these trouble spots will get under way as soon as logical checkout of magnetic tapes is completed.

As indicated in the previous BIWEEKLY, a study of card machine reliability has been initiated. Improved timing through new gears and cams seems to be the best answer for the existing MFC installation. For long-term planning, the local (Cambridge) IBM representative has agreed to supply detailed data on equipment that appears promising.

Training of MFC technicians will resume 16 April under a new and somewhat novel arrangement devised by Alex Vanderburgh. Lessons and teaching methods are designed to permit each individual technician to set his own pace. Actual troubleshooting of computer will be included in this training whenever practicable.

A "first-run midnight operation" service for programmers will be available soon. From a request form filled out by the programmer, an operator will load the program and permit it to run for a prescribed period or until it fails in some manner. The operator then records all pertinent data and produces a post mortem of storage on IBM cards. For further details see A.Vanderburgh, Room B-149, Ext. 116

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VACUUM TUBES

(Group 65, P. Youtz)

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

Cathode Study Program

A production-type Philips pressed cathode (0.070-inch diameter emitter) was processed during this period for evaluation under the CT program test conditions.

The B-N program was resumed this week upon receipt of a supply of chemically analyzed nickel powder from Bell Laboratories. An analysis of the activator currently used is expected shortly.

An additional display study program for Groups 62 and 38 has been started to evaluate phosphor characteristics. The objective of this program is to prepare a 19-inch yoke study tube containing equally sized segments of six different types of phosphors. A comparable experiment with a 5-inch flat CRT was quite successful although a 19-inch curved panel is expected to present new problems. In the meantime a series of fourteen 2-inch CT's have been started for preliminary studies.

Solid-State Display Studies

The preparation of various components for solid-state studies for Group 24 continues although somewhat curtailed due to the present schedule in the chemical laboratory.

RECEIVER TUBES (S. Twicken)

The IBM people operating the display consoles have been experiencing some difficulties with the 6161, deflection driver for the Charactron. Tests here indicate considerable gas current, mangled grids and grid-cathode shorts. The grid difficulties in all probability stem from previous gas arcs. Arrangements were made to get some quantitative data on operating temperature and dissipation and the IBM Tube Group at Kingston has been alerted to the existence of the problem. Discussion of the problem with RCA is being held up pending further information on operating conditions, incidence of failure, etc.

Several additional test lots of SR-1782A's from Sylvania have been examined. These look quite promising from the point of view that the pulse plate current is some 15 ma. higher, increasing the margins of the gate circuit and the pulse amplifier circuit, while the d-c current may not have been increased enough to necessitate an

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TUBE TECHNIQUES (continued)

increase in the specification maximum. All data on dimensional changes are being collected for a meeting at Sylvania on April 18.

A meeting of the JTC Subcommittee on Computer Tubes was held at the Barta Building and included a tour of Whirlwind. I have been asked to write a defense of the "absolute maximum" rating system for computer tubes in the face of agitation to adopt the "design maximum" system which expresses ratings in terms of an average tube. Those members of the JTC Group representing companies building the basic tube types for AN/FSQ-7 were taken on a tour of XD-1.

COMMERCIAL TUBES (T. F. Clough)

On 29 March 1956 N. Nitschke of IBM and I attended a meeting held at Raytheon to review their program as second source of the 0528 (low-power twin triode). Their progress is satisfactory. All parts are in and operators are being trained. The tube will be made in a special department. The mounts will be constructed on hooded benches in an air-conditioned area. The exhaust and sealing operations will be done on improved machines of new design. These machines are in and are being set up. Life-test equipment is also installed and being tested. Actual production is due to start in the new department within a few weeks.

We are cooperating with N. J. Ockene of Group 62 in a program to improve the reliability of the MTC power supply. All of the series regulator tubes, some of which have been in service several years, will be given a preliminary test in MTC. Any tubes that the test indicates to be of questionable quality will be more rigorously checked in the Lexington tube-test area and defective tubes replaced.

A New London #901A transconductor analyzer has been installed in Room D-237. One of its features is its ability to test high-transconductance tubes without oscillation difficulties.

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

Six MIT 19-inch tubes have completed between 965 and 9935 hours of life test, and seven Charactrons have completed between 2579 and 3334 hours. Transfer-characteristic, screen capacitance and dissipation factor, and helical-accelerator resistance tests have indicated no significant changes.

Thirty-seven oxide-coated cathode-study tubes have completed between 163 and 7564 hours. Thirty-five of these tubes on the

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TUBE TECHNIQUES (continued)

present program have accumulated up to 1720 hours. Since the last report, four tubes on this program were given the preinstallation test. One of these was rejected for grid emission and poor cathode uniformity.

Five cathode study tubes with between 6000 and 7500 hours of operation were retested to the present specification. Two tubes were rejected for low pulse beam current and one for poor cathode uniformity.

Thirty-three bariated-nickel cathode tubes in 2-inch bulbs have operated between 164 and 1720 hours. The last series of tubes with variation of activator in the emission layer does not appear to have improved appreciably with life.

Thirteen triode and five diode early bariated-nickel cathode tubes have accumulated between 1914 and 4179 hours. Most of the cathode currents continue to drop with life.

Eighteen Typotrons have completed up to 8479 hours of life. A report will be issued after the monthly tests, now in progress, have been completed.

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SAGE DC AND CC SITES

(Group 66, B. E. Morriss)

SITE PLANNING (K. E. McVicar)

A draft of the organization for a proposed SAGE subsector activation group for the air defense program checkout has been issued for comment and the document will be issued during the next biweekly period.

In order to gain experience for the SAGE site activity, the members of the Site Planning Section are being assigned to various activities in ESS. A. J. Roberts will work with the ESS Shakedown Planning Section of Group 64 and F. B. Johnson will work with Group 61. Assignments for the remainder of the section are being worked out.

EQUIPMENT (W. H. Ayer)

Conference on Seaward Expansion for SAGE

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A conference, called by ADC Headquarters, was held at WE-ADES in New York City on 3 and 4 April. The purpose was to determine communication requirements and problems involved in communicating with Airborne Early Warning and control planes and picket ships.

The primary problems involved centered in two areas: (1) Communications required to implement the presently planned program with the SAGE System and, (2) the communications required to cover future facilities and operational concepts.

ADC Headquarters outlined the present and future plans for the seaward expansion of radar coverage. The immediate problem is to establish communications facilities for the SAGE System for the inner AEW aircraft and the Navy picket vessels, and to plan for eventual communication facilities for the outer AEW aircraft.

ADC desires alternate facilities at each direction center site for communication with a portion of the vessels and aircraft of adjacent subsectors, should the latter be destroyed. This secondary mode of communication will be voice only as compared to voice and radio teletype that are now being used as a primary communication at each subsector.

The main problems from this conference which may be brought to Lincoln's immediate attention are:

- (1) The location of the terminating facilities at the consoles for this G/A radio phone
- (2) There is a new ADC requirement that the teletype

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EQUIPMENT (continued)

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termination from these elements which are now located in the manual inputs room should be "send" and "receive," rather than "receive" only. This will require a slight revision of the teletype layout in the manual inputs room.

Western Electric will examine the present telephone and radio telephone termination required at each console, and inform Lincoln Laboratory if these terminations exceed the maximum capacity of the presently planned telephone switching modules. In addition, they will examine the availability and the physical requirements of a "send and receive" teletype with a tape punch-printer. If Western Electric discovers space problems as a result of their investigations, we will assist them in trying to find an acceptable solution.

Building Redesign

At a series of meetings held in Washington on 21-23 March attended by representatives of Hq. USAF, ADES, and Lincoln, there was a discussion concerning the proposed direction center building redesign.

The new design changes the building from four stories to three and increases in the over-all dimensions to 150 x 270 feet. This represents a 2% expansion in the area of the building. The purpose of the new design was more efficient operational layouts and greater flexibility.

The 2% increase in space was justified because of new Air Force requirements, as yet not detailed, for missiles to be integrated with SAGE. The net result of the meetings was that the installations representatives, Hq. USAF, indicated they would recommend approval of the redesigned building.

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PROGRAM PRODUCTION

(Group 67, Jack A. Arnow)

DIRECTION CENTER ACTIVE (DCA) PROGRAMS (D. L. Bailey, J. P. Haverty)

Program Design (L. Collins)

Temporary assignment of personnel to other subsections has reduced our manpower. However, this subsection will be at approximately 80% full strength by 9 April and at full strength by the end of the next biweekly period.

Arnie Erickson and Bob Steinert (both RAND) have joined the subsection and are working with Hank Howell on environment control.

Since the initiation of formalized modification procedure, table design (Judy Stone) has processed some 70 item and table mods, during two biweekly periods.

Several tables have been republished to incorporate mods and unify Design Notes. To date, DCA data storage consists of 91 tables and 37,560 registers, of which 28,660 registers require AM drum storage.

A new DCA glossary, including table and program tags as well as items, will be published within the coming week. In the coming month the glossary will be expanded to include selected tagless data-storage items and will eventually include all useful abbreviations.

Environment requirements and com pool correlation has been completed for 13 programs and some 16 more programs are in process.

System use (set/use) data has been assembled for 25 programs, including all 17 programs of the first package for assembly checkout. This data is being card-punched (Job 0095) and will be available for processing by card machinery or computer program.

The first com pool has been punched and stored on the master tape using the new combined deck (Job 0085).

The bulk of the subsection's effort has gone into detail design, data reduction and development and improvement of routine operations.

Coding is continuing on both WWA and WIN. WWA is estimated to be 60% coded and WIN to be 15% coded.

Miscellaneous Operational Program (F. Ogg)

All miscellaneous operational programs are in the parameter checkout phase. The raid forming program is 14% checked out, and the complete

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DIRECTION CENTER ACTIVE (DCA) PROGRAMS (continued)

group of programs is 20% checked out. The programs in the initial package, track sort, simulated tape input, and simulation I have a higher priority than the rest of the programs in the group, and most of the manpower of this section is concentrated in checking out these programs.

Tracking (J. P. Haverty)

All of the tracking programs are in the process of being parameter-checked. The complete group of programs is approximately 20% checked out. The smooth and predict program is practically parameter-checked.

Displays (H. Briscoe)

The SD track program has been released to the card room and the sectional draft of the coding specification has been completed. The first draft of the SED display program has been completed.

A preliminary environment has been prepared for the DD control program.

Studies of the requirements for the fixed-geography loading program and the intercept director attention device program have been completed. As a result of these studies, (1) the fixed geography requirements have been turned over to EPSCOM for programming, and (2) the coding specifications for the intercept situation displays should be completed in the next biweekly period.

A. Schwartz of Hazeltine Electronics is scheduled to leave the display subsection to return to Hazeltine on April 6. C. Meadow will take over the work Schwartz has been doing in the miscellaneous situation display area.

Switch Interpretation (A. Marshall)

All basic package switch programs have been released to the card room, and documentation has been sent to typing. Parameter checkout on these programs is proceeding at a satisfactory rate.

Chuck Mosmann and Frances Kelley have done an excellent job on the KTB program (simulation switches). Progress on this program is now comparable with that of other programs in the basic package.

Central and In-Out (W. Harris)

Five programs and one subroutine have been released to the card room:

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DIRECTION CENTER ACTIVE (DCA) PROGRAMS (continued)

TNC (track number conversion system subroutine)

CTH (track history makeup)

CTA (central track processing A)

CTB (central track processing B)

CCI (card input)

CHO (height output)

Planning has begun for parameter checkout of these programs. J. Bernard has joined the subsection and will work on checkout of CTA.

Coding of the two crosstell programs concerned with crosstelling between automatic subsectors has been temporarily suspended. G. Dimock has joined the subsection and will work on the crosstell program (CXB) concerned with telling to AA and manual direction centers.

Design and specification of the sequence control programs (PEC and PTM) is nearly complete, and it is anticipated that preliminary coding specifications will go to the typist in the next biweekly period.

Tape format for the recording programs appears to be nearing completion, and it is anticipated that the specification of the format will be issued in a form suitable for use by recording tape data reducers some time in the next biweekly period.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

PERSONNEL

Staff

Assigned to Group 61

William B. Woodward received his BS in Physics from Denver University and his MS in Mathematics from Brown University. He was formerly employed by Brown University as a research assistant.

Terminations

Pauline Reimers resigned to get married.

Joseph J. Sacco and Lloyd B. Smith are now employed by RCA in Needham.

Transfers

Jiro Ishihara has transferred from Group 61 to Group 67.

Nonstaff (W. A. Kates)

New

Laura Bodemar	Office	Group 67
Eleanor Maddox	Office	Group 67
Nancy Phillips	Office	Group 67
Frances Lampham	Office	Group 61
Kenneth Shampine	Draftsman	Group 60
Geraldine McConnell	Office	Group 60
Stephen Snyder	Office	Group 60

Transfers

Albert DiGiacomo	Technician	Group 62 to 21
Joan Pasquina	Office	Group 60 to 22

Terminations

Sydney Witzer	Office	Group 60
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DOCUMENT AND DUPLICATING ROOMS (A. M. Falcione)

6M-Numbered Drafts

In order to maintain adequate security control and to ease the workload

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DOCUMENT AND DUPLICATING ROOMS (continued)

of secretaries, all drafts of 6M-numbered memoranda should be submitted to the Division 6 Document Room for reproduction and distribution.

Master Slide File

The Division 6 Document Room maintains a master slide file of all the slides used by the various staff members for talks, lectures, discussions, conferences, etc. In order to maintain this file as complete as possible, it is suggested that all requests for new slides be made to Miss Mary Matas in Room C130 who will make the necessary arrangements for having the slides made for the Division 6 Document Room. This will save staff time in chasing down information and drawings for new slides.

Division 6 Duplicating Services

Indications are that future requirements to be placed on our Division 6 Duplicating Room will increase beyond our present capacity. It may be necessary to have some of the surplus duplicating work done by outside concerns.

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

Reorganization of staff assignments to accommodate responsibility for Test Equipment HQ operation has been made as follows:

R. Biagiotti will be primarily responsible for supervision of Components Section operations.

C. Morrione will actively participate in supervision of TE HQ operations and study means of reducing clerical load and increasing maintenance schedules.

H. Hodgdon will exercise over-all supervision, coordinate personnel requirements, maintain liaison with other groups, and participate in Test Equipment Committee and Standards Committee activities.

Work load in the Components Section has increased--average backlog is now approximately two weeks, not including life tests.

We have finally received the long-awaited high-potential test unit. As soon as it is set up and checked out, we will be able to apply high-potential breakdown tests to components or equipment up to 40 KV a-c or d-c. Current protection as low as 5 μ A is provided, and capacity up to 2ma is available.

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TEST EQUIPMENT HEADQUARTERS (H. W. Hodgdon)

A considerable amount of time has been spent in familiarizing ourselves with problems in this section, preparatory to relieving Lou Sutro of the administration of it. It is expected that this will be accomplished by next week.

Inventory of test equipment at Barta and Bldg. 10 has been made, and when checked against records, will complete our list of missing equipment.

It is hoped that some simplification of the records system can be accomplished soon in order to reduce the clerical load on Christopher, and thereby speed up the maintenance program to meet schedules.

The Property Office requires that commercial test equipment be charged out on signatures. It will be necessary in the future for users to sign personally for all commercial test equipment, and a program is being planned for the coming weeks to obtain signatures on all such equipment presently on loan but not signed for.

GENERAL ENGINEERING (A. R. Smith)

Experimental Light Box

The experimental light box, using twelve blue filter covered 40-watt instant start daylight lamps and designed to improve the light conditions around consoles in Building F, is approaching completion and will be ready for test next week. It is important to note that this model intends only to validate the principle by which the light problem can be resolved and in no way implies extensive application throughout XD-1 or future production models without further design consideration. Due to the bulk and weight involved, each application should be considered individually.

Vacuum Deposition

Our first major problem involving film evaporation under vacuum conditions has been submitted by Group 63, Building 10 personnel, and involves three phases. The first phase is to produce finite linear single plane motion for a mask or stencil and a glass slide; each to work independently of each other. An additional requirement is to produce comparable motion for the viewing lens which is used to inspect the results of the deposition in two perpendicular planes. The second phase of this problem is to provide resisting, cooling and heating, and thermocouple switches. The final phase is a high current switch and shield. The interesting aspects of this problem is to provide above-mentioned motions within a vacuum area from an operated external source and, wherever possible, void of any sliding surfaces which might entrap gases and, therefore, contaminate the vacuum.

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GENERAL ENGINEERING (continued)

Core Test Handler

We are well pleased with the development of the core test handler to date. All of the motions, excepting the introduction of a probe, are now being experimentally demonstrated by a breadboard model, producing cores at the rate of two per second. All of the basic elements of the final model are currently in construction.

The future program is to continue experimentation with the breadboard model by introducing an accept-reject selection system which is void of moving parts. The final assembly, including the probe system, will probably commence in two weeks. The possibility of meeting previously scheduled delivery date of the 1st of May looks very promising at this time.

Fire Annunciator - Building F

The design premise for the annunciator system, including the smoke sampler, has been agreed upon and the physical design layout of the elements and the display board is in process.

TX-O Readout Equipment

Group 63 personnel and Loren Prentice visited the Fairchild and Maurier Corporations last week to evaluate the application of each equipment to this problem. The Fairchild 16 millimeter model apparently is only in the artistry stage and does not seem practical for our 35 millimeter application. The Maurier equipment might conceivably satisfy the basic requirements with some mechanical revisions, such as introducing a film chopper.

Experimental Memory Plane

An investigation is underway to determine the feasibility of substituting a mechanical reduction method for the present photographic technique of reproducing a 4 x 4 plane negative or positive within the specified tolerances of .001 of an inch and subsequently used in the printed circuit program.

DIVISION 6 SOCIAL ACTIVITIES COMMITTEE (T. Finocchio)

The newly elected members of the Division 6 Social Activities Committee held their first meeting on Monday, 2 April 1956. This Committee will serve as a nucleus around which social activities of the Division will be planned. The results of the first meeting have been posted on bulletin boards. Notices will appear periodically on bulletin boards reporting the progress of the Committee.

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DIVISION 6 GLOSSARY

AA	antiaircraft
AAOC	AA Operation Center
a-c	alternating current
AD	Air Defense
ADC	AD Command
ADES	AD Engineering Service
ADSOD	ADES Project Office
AEW	Airborne Early Warning
AF	Air Force
AFB	AF Base
AFCRC	AF Cambridge Research Center
AFIRO	AF Installation Requirements Office
AGC	automatic gain control
AGET	Advisory Group on Electron Tubes
AMC	Air Materiel Command
AMIS	Air Movements Identification Service
APL	Applied Physics Laboratory
AQL	average quality level
ARAACOM	Army Antiaircraft Command
ARDC	Air Research and Development Command
ARTCC	Air Route Traffic Control Center
ASC	Air Situation Coordinator
ASESA	Armed Services Electro-Standards Agency
ASO	Air Surveillance Officer
ASR	automatic send-receive
AST	Air Surveillance Technician
ASTM	American Society for Testing Materials
ATC	Air Training Command
ATCF	ATC Facility
ATO	Air Tactics Officer
ATT	Air Tactics Technician
B-N	bariated-nickel
BTL	Bell Telephone Laboratories
BSO	Battle Simulation Officer
CAA	Civil Aeronautics Administration
CAT	category
CBS	Columbia Broadcasting System
CC	combat center
CCDC	Cape Cod Direction Center
CDC	call direction code
CCS	Cape Cod System
CER	change evaluation request
C&E	communications and electronics
CHT	Charactron tube
CM	core memory
CP	Command Post

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GLOSSARY (continued)

CPO	command pulse output
CRT	cathode ray tube
CS	coding specification(s)
DAB	display assignment bit
DACL	Dynamic Analysis and Control Laboratory
d-c	direct-current
DC	direction center
DCA	DC active
DCO	Design Control Office
DD	digital display
DDG	DD generator
DDR	digital data receiver
DDT	digital data transmitter
DGP	Data Generation Program
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
FF	flip-flop
FGD	fine-grain data
FM	frequency modulation
FORX	FGD orientation with Raydist and calibrated Mark X
G/A	ground-to-air
GFI	gap-filler input
GSR	group selection register
HEC	Hazeltine Electronics Corp.
IBM	International Business Machines Corp.
ID	identification
IFF	identification - friend or foe
INS	interceptor simulator
IPS	initial program specification
IRE	Institute of Radio Engineers
JETEC	Joint Electron Tube Engineering Council
KSR	keyboard send-receive
LPO	Lincoln Project Office
LRI	long-range radar input
LTPS	Lincoln tube process specification
MAR	memory address register
MCD	marginal checking and distribution
MEL	minimum equipment list
M-G	motor-generator
MIL	Military

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GLOSSARY (continued)

MISP	Manned Interceptor Simulation Program
MITE	multiple input terminal equipment
MPPS	Master Program Preparation Section
MTC	Memory Test Computer
NAS	Naval Air Station
NET&T	New England Telephone and Telegraph Co.
n-p-n	negative-positive-negative
NRL	Naval Research Laboratory
OB	output buffer
OMR	operational modification(s) request
OPS	operations
OT	Overlap Technician
PCC	Planning Coordination Center
PCD	power control distribution
PCO	Production Coordination Office
PIUMP	plug-in unit mounting panel
p-n-p	positive-negative-positive
PPI	planned position indicator
PRF	pulse repetition frequency
pps	pulses per second
PT	Plotting Technician
RADC	Rome Air Development Center
RAFD	Rome Air Force Depot
RAND	Research and Development Corp.
RC	register containing
R-C	resistance-capacitance
RD	radar data
RECI	Request for Engineering Change and/or Information
RETMA	Radio, Electronics, Television Manufacturers Association
ROTR	receive-only typing reperforator
S&EC	Scientific and Engineering Computation
SAC	Strategic Air Command
SAGE	Semiautomatic Ground Environment
SAHL	semiautomatic height-finder live
SAR	storage address register
SBT	surface-barrier transistor
SD	situation display
SDG	SD generator
SDV	slowed down video
SIF	selective identification feature
SIZ	security identification zone
SC	Signal Corps
SCEL	SC Engineering Laboratory
SOP	standing operating procedure
SO	Systems Office

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GLOSSARY (continued)

SOT	Systems Operations Test
STP	System Training Program
SPIS	SAGE Program Identification Service
TAPE	Technical Advisory Panel for Electronics
TBS	training and battle simulation
TCAP	Tactical Channel Assignment Panel
TD	track data
TIR	Technical Information Release
TT	Texas Tower
UHF	ultra high frequency
VCM	vibrating coil magnetometer
VHF	very high frequency
WADC	Wright Air Development Center
WE	Western Electric Co.
WISE	Whirlwind I SAGE Evaluation
wpm	words per minute
WSPO	Weapons Systems Project Office
WWI	Whirlwind I
XT	crostell

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