Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, April 10, 1953

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM OPERATION

1.1 Whirlwind I System

1.11 Operation (F. J. Eramo)

The following is an estimate by the computer operators of usable percentage of assigned operation time and the number of computer errors for the period 27 March - 9 April 1953:

Number of assigned hours	113
Usable percentage of assigned time	83
Usable percentage of assigned time since March, 1951	85
Number of transient errors	36
Number of steady-state errors	2
Number of intermittent errors	10

(S. H. Dodd)

In an effort to obtain more information about the cause of positive switching encountered in storage row, we are obtaining a multiple-channel recorder which will be used to monitor various power and signal leads driving the electrostatic storage digit column.

The second bank of electrostatic storage (Bank A) is now in operation but is not as yet quite as reliable as Bank B. Programmers can arrange with Roberts or Corderman to use Bank A if they so desire. Bank A is not, however, to be considered as permanently available at high reliability, and errors encountered in Bank A operation are not to be charged against WWI reliability. Full reliability of Bank A is expected by the promised date of May 15.

The engineering and testing of the new marginal-checking system is progressing well. This new system will be in operation by the end of the next biweekly period.

1.11 Operation (continued)

The installation of the equipment and the video and signal wires associated with the new terminal equipment will involve a large amount of work, and to make sure that the installation is completed on schedule, it is requested that those engineers involved push this work as fast as possible.

(C. L. Corderman and D. M. Fisher)

The full complement of 17 tubes is now operating in Bank A of ES Row. Digit 16A has been removed from service as an immediate spare for Bank B and is now the parity digit for Bank A. The over-all margins for Bank A are not yet as good as Bank B since A contains several old-model tubes and some tubes which were removed from Bank B because of low margins. These tubes are being replaced as 800-series tubes, not required immediately for Bank B, become available.

Until May 15th, only Bank B will be in service during normal applications time. In the event of a complete failure of a Bank B tube, the technician in charge of the computer will select Bank A only. Anyone wishing to use both storage banks concurrently may contact Al Roberts or C. Corderman to arrange a time.

A six-channel recorder has been requested for the purpose of monitoring several elements of a storage tube when positive switching occurs. The most frequent type of switching appears to be caused by some action taking place within the storage tubes.

(L. L. Holmes)

Video and panel changes necessary for the new WWI order ab have been made. Pulse checking of the circuits involved in the changes will be done tomorrow. The ab operation will probably be usable as of April 13th.

Plans have been completed to install an additional digit of electrostatic storage in Rack EX5 of the computer room. The digit will probably be used for temporary replacement of troublesome digits in either or both banks.

(S. E. Desjardins)

The scope-switch panel was installed in test control and is functioning far more satisfactorily than the previous setup which required four unsightly pushbutton-selector panels and a coaxial-jack panel.

1.12 Component Failures in WWI (L. O. Leighton)

The following failures of electrical components have been reported since March 27, 1953:

Components	No. of Failures	Hours of Operation	Reasons for Failure
Capacitors			
10-mfd, 600-volt oil-filled	1	14000 - 15000	Arcover on capacitor
Condensers			
7-45-mmfd, trimmer	1	6000 - 7000	High resistance
Crystals			
D-357	3	16000 - 17000	1-low R_b; 2-drifting to low R_b
D-358	1	15000 - 16000	Low R_b
Potentiometers			
10000-ohm, 2-watt	1	8000 - 9000	Noisy
	2	9000 - 10000	Noisy
2500-ohm, 2-watt	1	8000 - 9000	Noisy
Resistors			
220-ohm, 1-watt ±5% carbon	1	6000 - 7000	Below tolerance
	2	9000 - 10000	1-above tolerance; 1-burn-out
220-ohm, 1-watt ±5%	1	9000 - 10000	Above tolerance
5000-ohm, 1-watt ±5% deposited-carbon	1	6000 - 7000	Above tolerance
10-ohm, 1-watt ±5%	1	14000 - 15000	Overheated
1000-ohm, 1-watt ±5%	1	8000 - 9000	Above tolerance
Tubes			
6X5GT	1	9000 - 10000	Short
6L6G	1	9000 - 10000	Short
6SN7	1	3000 - 4000	Low I_b
	1	16000 - 17000	Short
	1	17000 - 18000	Short
715B	1	0	Leakage
ELC6J	1	5000 - 6000	High voltage drop

1.12 Component Failures in WWI (continued)

Components	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	1	3000 - 4000	Short
	1	5000 - 6000	Low I_b
	2	11000 - 12000	1-low I_b; 1-short
	2	12000 - 13000	1-low I_b; 1-short
	1	14000 - 15000	Low I_b
	1	15000 - 16000	Short
	20	16000 - 17000	15-short; 5-low I_b
6AS7	1	0 - 1000	Low I_b
	1	7000 - 8000	Low I_b
	1	13000 - 14000	Gas
	2	14000 - 15000	1-leakage; 1-short
SR-1407	1	1000 - 2000	Short
	1	3000 - 4000	Leakage
6145	1	0	Short
6Y6	1	16000 - 17000	Low I_b
	1	17000 - 18000	Interface
7AK7	1	3000 - 4000	Leakage
5U4G	1	0 - 1000	Short
6J5	2	8000 - 9000	Short

1.13 Storage-Tube Failures in WWI (L. O. Leighton)

The following storage-tube replacements were reported during this bi-weekly period:

ST-539 was rejected after 22 hours of operation because of low gun current.
ST-523 was rejected after 22 hours of operation because of low gun current.
ST-609-1 was rejected after 430 hours of operation because of low margins.
ST-702-C was rejected after 1705 hours of operation because of low margins and positive switching.
ST-603 was removed after 5176 hours of operation because of space needed for ion-collector tube.
ST-533 was removed after 5715 hours of operation because of space needed for ion-collector tube.
ST-516 was removed after 6875 hours of operation because of space needed for ion-collector tube.

1.14 Storage-Tube Complement in WWI (L. O. Leighton)

Following is the storage-tube complement as of 2400 April 9, 1953:

Digit	STM No.	Tubes	Hours of Installation	Hours of Operation
0 B	38	ST-619-C-1	10069	3451
1 B	12	ST-711-C	11989	1431
2 B	31	ST-807	13501	19
3 B	10	ST-601	8524	4996
4 B	33	RT-380	13516	4
5 B	41	ST-745	12982	538
6 B	3	ST-751	13170	850
7 B	26	ST-540	7937	6583
8 B	21	ST-739	12729	791
9 B	42	ST-720-C	12937	538
10 B	18	ST-700-C	10917	2603
11 B	25	ST-753-1	13129	391
12 B	28	ST-747	13261	258
13 B	9	ST-803	13411	109
14 B	24	ST-624-C-1	10507	3013
15 B	45	ST-729-1	12600	920
16 B	11	ST-716-C-1	11702	1818
0 A	43	ST-722-C	13130	390
1 A	20	ST-752-1	13170	350
2 A	4	ST-754-1	13170	350
3 A	23	ST-802	13411	109
4 A	32	ST-808	13516	4
5 A	40	ST-525	13389	467
6 A	34	ST-701-C-1	12889	631
7 A	35	ST-800	13340	180
8 A	19	ST-806	13501	19
9 A	44	ST-742	12640	880
10 A	30	ST-801	13363	157
11 A	36	ST-744-1	12822	698
12 A	8	ST-746	12982	538
13 A	29	ST-543-3	13389	467
14 A	5	ST-614	13235	284
15 A	22	ST-805	13457	492
16 A	27	ST-613	9046	4474

ES Clock hours as of 2400 April 9, 1953. 13520
Average life of tubes in service in Bank B 1639
Average life hours of tubes in service in Bank A 617
Average life hours of last five rejected tubes 3980

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.13 Arithmetic Element

Logical Diagrams (Heineck, Callahan, Aronson, Thompson)

Logical diagrams for division, indexing, checking, shifting, and full-length operation of the two arithmetic elements were studied during the past two weeks.

2.14 In-Out Control (R.H. Gould)

The block diagrams of the changes in WWI in-out control necessary for the WWI system expansion have been received and block-schematic changes to agree have been started.

(R.H. Gerhardt)

The study of the in-out system for WWII is continuing. Some block diagrams have been made and others were studied.

(J. Dintenfass, T. Sandy)

The two intervention matrices, WWI, were statically tested and found to be satisfactory.

The display matrix #2, WWI, was modified and statically tested and found to be satisfactory.

The new PIUMP's for the new display system have been completed and have been mounted in the computer room (WWI).

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes (H.B. Frost)

The 6145 situation is slowly becoming more manageable. Most of the backlog of orders should be cleared within a month, and any serious shortages should be remedied in the very near future. However, notice is still requested from anyone who anticipates using 10 or more tubes of a given type, particularly in rush jobs not going through regular production channels.

Additional conferences have been held with RCA and GE on tubes for WWII. Our specifications and needs have been established

2.21 Vacuum Tubes (continued)

fairly well, and channels have been defined for contractual arrangements. Kromer, Fallows, Youtz, and Frost have all been involved in these discussions.

One SR1407 was reported in the last biweekly report as failing in WWI because of interface impedance. An investigation showed that this tube should have been classed as a low-plate-current or flip-flop-unbalance failure. The interface impedance reported was quite low, not in the accurate region of the test set in the shop. More critical tests failed to show any interface impedance at rated heater voltage.

Samples of three different tubes which might be useful as magnetic-matrix drivers have been received via John Geisler of IBM. These are the 5998, the A4717, and the SA-1, all of which are variants of the 6AS7G. The 5998 and A4717 have higher mu and lower perveance than the 6AS7; the XA-1 has higher average current and dissipation ratings. All have some possibilities and some weaknesses.

My thesis proposal has been submitted to the Electrical Engineering Department. During the next period, I expect to design some special tubes for the thesis investigation.

2.22 Transistors

Hole Storage (N.T. Jones)

An integrator circuit has been built to observe hole storage as compared to the more generally used term "hole-storage time". The relationship of the integral of hole-storage current to back voltage, forward current, temperature, and other parameters is now being determined. Dr. Kingston of Lincoln Group 35 has developed a theory for hole storage in junction and bonded diodes. Considerable work will be done using this theory as a basis.

Measurements (N.T. Jones)

Sixteen new GE G-11A, 10 National Union T-18B, and 9 CBS-Hytron PT-2S transistors were received and measured in this biweekly period. The National Union items are the first units with the new standard socketry to be received in this group.

Life Tests (N.T. Jones)

The individual circuits for the expanded life tests have been designed. Design and debugging of accessory equipment is now under way. The present life tests will be terminated in the very near future.

2.22 Transistors (continued)

Flip-Flop Development (E.U. Cohler)

In the past biweekly period, the flip-flop which has been developed was built up with three pulse-standardizer circuits for triggering. It was found to operate reliably at 500 kc with any type of triggering (set-clear, set-complement, or complement-complement). Despite the lack of shaping diodes, the waveform at this frequency was excellent, and the swing was greater than has previously been obtained with the same supply voltage.

A rather complete note on the work done on flip-flops is now being prepared.

Transistor Core Driver (S. Oken)

The circuit for the transistor core driver has been altered slightly and is now working well. It was run continuously for several days without any harmful effect on the transistors.

A 4 x 4 coincident-current memory array will be built and tested if tests now being run on a single core give the good results expected. So far, I have been able to obtain a current which will switch the core while half of this current will not.

Transistor Accumulator (D.J. Eckl)

The accumulator has been in operation 3974 hours.

The margins on the A-register flip-flop have been increased to the following:

High negative collector voltage	-140v to -65v
Low negative collector voltage	- 30v to -10v
Base voltage	+ 90v to 0v

The marginal-checking wiring for the vacuum-tube gates has been partially completed.

Test Equipment (D.J. Eckl)

The collector-characteristic plotter has been revised to make it possible to obtain base characteristics as well.

2.22 Transistors (continued)

Transistor Counter (D.J. Eckl)

A counter using single-transistor flip-flops has been developed by Dan Esakov. The circuit requires 0.5-μsec negative pulses for triggering and has operated up to 200 kc/sec. Satisfactory operation may be expected from 90% of any group of transistors with $1.9 < \alpha < 2.7$ and $r_{co} < 20k$.

2.3 Ferromagnetic and Ferroelectric Materials

2.31 Magnetic-Core Materials (D.R. Brown)

To date, 60,842 cores for MTC have been received from General Ceramics. From these, we have selected 18,838 good cores. The last lot received, Lot 41, did not have as high a yield as we had expected. From the 1428 cores in the lot, we were able to select 522 good cores. No cores have been received during the last week, but additional cores have been requested from General Ceramics, and testing will resume sometime during the next biweekly period.

We are making arrangements to keep the 40,000 rejected cores from General Ceramics' shipments. These will be available for experimental fabrication, impedance measurements, mockups, etc.

An order for additional good MTC cores has been proposed; the quantity being considered at the moment is 10,000. This would permit the construction of two 64 x 64 experimental planes.

A new General Ceramics material, MF-1374, has a coercive force and switching time very similar to Molybdenum Permalloy.

Several tiny cores have been received from RCA Laboratories. The material has high coercive force and a switching time of approximately 0.3 microseconds.

Several automatic core-testing setups will be required by early summer. IBM has one mechanical design nearly ready for assembly. We are working on the circuitry for the automatic tester at MIT.

(R.F. Jenney, R. Pacl)

An addition to the hysteresigraph intended to speed up the measurement of squareness ratio worked, but several changes will be necessary before it is satisfactory for use in the tests. These changes will be made when the hysteresigraph is not in use.

IBM is working on several models of core-handling devices for use in an automatic or semiautomatic core tester. All models are quite different from the ones developed here, and one which will be finished shortly appears to be quite satisfactory.

Our third core handler has been breadboarded, and the solid probe is being tested. There is some noise which can be eliminated.

Seminar on Magnetism (A. Loeb)

Spinel structures were discussed in detail. Norman Menyuk reported on the North Carolina meeting of the American Physical Society. Neel's fundamental paper on ferrimagnetion is being studied in detail, particularly the many omitted steps. The notes are being typed very rapidly now, with only about a week's lag.

2.31 Magnetic-Core Materials (Continued)

Magnetism Seminar Reports (N. Menyuk)

Since last reported, eleven additional memoranda based on A. Loeb's seminar on magnetism have been printed. These reports cover meetings 35 to 45 inclusive.

Investigations of Ferromagnetic Materials (F. Vinal, B. Maglio, J. Sacco)

Firings of the $MnO-MgO-Fe_2O_3$ bodies at 1350°C, 1400°C, and 1450°C have been completed. Samples from each of these firing procedures have been sent to testing to obtain squareness data and coercive-force data. Also, for each of the time-temperature firing points, a sample core will be prepared for crystal study.

Samples are now being prepared for the investigation of a system of $MgO-Al_2O_3-Fe_2O_3$. Firing date for the first cores of this series is expected to be April 14, 1953.

During the past week, a visit was made to the U.S. Bureau of Mines Experiment Station located at the University of Maryland. They have a small group engaged in ferrite work under the sponsorship of the Johns Hopkins Applied Physics Laboratory and the Naval Research Laboratory. The concept, activity, and general purpose of this group is the analogue of our own ferrite group with the exception that instead of cores for memory and information storage their goal is ferrites for microwave gyrators. It appears more than a coincidence that the compositions they have found most promising thus far for microwave gyrators resemble very closely those compositions thus far found most promising for memory cores.

Domains of Reverse Magnetization (J. Goodenough, P. Baltzer)

Several experiments have been run on Ferroxcube 4B to investigate the change in nucleation and domain-wall motion for different conditions of driving force and applied circumferential stress. The results of these experiments appear compatible with the model proposed by J. Goodenough and N. Menyuk in E-532.

Switching Coefficient (N. Menyuk, B. Gurley)

Two 4-79 Mo-permalloy cores rolled to 1/4-mil thickness and cut at 45° from the grain-orientation direction were obtained from Magnetics, Inc. The value of the switching coefficient, S_w, of these cores was compared with a regular 1/4-mil mo-perm core cut in the direction of grain orientation. The cores cut at 45° were found to switch faster than the regular cores for the same applied field, and the first peak of the output signal was sharply reduced by the 45° orientation. Both these characteristics have been explained qualitatively in terms of the domain patterns set up within the core to avoid having magnetic poles at the core surface.

2.31 Magnetic-Core Materials (Continued)

Measurements are being undertaken of the switching coefficients of a series of cores obtained from G. Economos. All these cores are of the same material, being distinguished by varying firing temperatures, pressures, and time at firing temperature. The high coercive force of these materials is making an accurate measurement of S_w difficult.

Switch-Time Comparator

Two units have been constructed from schematic SB-54559. Further tests are being conducted on these units to determine the effect of PRF, zero set voltage, etc. The Tektronix type 180 time-mark generator makes possible rapid tests of linearity etc.

Free-Energy Model of the Hysteresis Loop (A. Loeb)

A rather universal equation has been derived for the normalized or reduced hysteresis loop from the model described in M-1744. This result will be described in memorandum M-1968.

Production Tester (J.W. Schallerer)

Investigation of the voltage characteristics of cores with higher outputs than MTC cores has begun. It is hoped that these cores will be acceptable for memory applications, thereby relaxing our requirements and increasing the yield of cores tested in the future. The tests will consist of delta measurements and location of these cores on the voltage-out vs. driving-force curves.

Tests have also started on MF 1326F F-340 to determine the proper operating point. These cores have a 60-mil OD, 33-mil ID, and are 20-mils thick.

New Materials (B. Smulowicz)

Pulse tests have been performed on MF-1374, a new General Ceramics body, indicating a very high selection ratio with a switching time of 6.5 microseconds.

A preliminary experimental investigation of the effects of independent variation of pulse duration on the core output shows satisfactory results. It seems that the duration of the "read" pulse can be decreased below the permissible minimum for the "write" pulse without affecting the amplitude of the disturbed one or the waveform of the response to the first non-selective pulse.

Work has begun on the construction of a new current generator to be used in conjunction with the 60-cycle hysteresigraph. This unit will deliver up to 60 amperes to a single-turn primary winding on the tested core.

2.31 Magnetic-Core Materials (Continued)

Temperature Tests (J.D. Childress)

Data is being taken on the variation of ∂_1, ∂_2, and l vs temperature and driving-pulse width.

Little change has been noted in core operation in the range 20°C to 50°C.

2.32 Magnetic-Core Memory

Memory Test Setup V (W. Ogden, E.A. Guditz)

All panels in the memory rack have been video tested and are working satisfactorily. MTC Memory Plane #1 has been wired in and is being driven by read and write currents. Sensing-winding outputs have been observed; they look good in respect to the amplitude, shape, and uniformity of the ONE outputs. The array output has not yet been fed into a sensing amplifier and used to control the rewrite operation so ZERO outputs have not been observed. Measurement of the disturbed ONE outputs shows a maximum output of 155 millivolts and a minimum output of 116 millivolts with driving currents of 0.5 ampere per coordinate line. Switching time is 1.0 μsec with the peaks occurring at 0.5 μsec. The driving-pulse duration is 1.7 μsec. The rise time of the driving pulse is 0.5 μsec, the fall time is 0.4 μsec. The read-write cycle repetition rate was advanced to 200 kc before a noticeable decrease in output amplitude occurred.

Memory-plane construction is progressing satisfactorily. Eleven planes have been completed by this Laboratory, three more are under construction, and four are being made at IBM.

Magnetic-Matrix Switch (A. Katz, J.L. Mitchell)

Tests were made on a single switch core made up of MF 1312 F262 cores stacked seven cores high. This is the switch core that A. Katz is using in the 32-position magnetic-matrix switch now under construction. The results obtained were very encouraging, and we were able to get good wave shapes when the switch core was loaded with a load simulating the MTC memory. Some heating of the core was observed; this effect will be investigated further.

Tuesday, A. Katz and I visited M.K. Haynes of IBM and talked with him about the work his group was doing on magnetic-matrix switches and other magnetic-core circuitry.

(J. Raffel)

Tests on switches recently constructed show good signal-to-noise ratios, uniformity from line to line, and current output-pulse waveform.

An investigation of the problem of heating in the core material at high pulse-repetition rates is to be undertaken.

2.32 Magnetic-Core Memory (Continued)

X-Y Plane Driver (D. Shansky)

The magnetic-core switch driver described in the last biweekly has been assembled and partially de-bugged. The necessity for shaping the current pulse however, will involve a redesign of the comparator circuit in the current regulator. With the present circuit, it has been possible to obtain current pulses of 500-ma maximum amplitude variable to zero with rise times of 0.05 μsec and fall times of the same order of magnitude.

Z-Plane Driver

A circuit similar to that of the X-Y plane driver is presently being designed. Tentative specs call for a current amplitude of approximately 500 ma, rise time 0.25 μsec, and circuit recovery time the same order of magnitude as the current pulse length -- 1.5 μsec. This current pulse is to be regulated to within 5%.

Memory Test Setup I

This setup is now using inhibition while writing. Somewhat poorer ONE-ZERO discrimination has been observed using inhibition than without it. Logic to enable the writing of an approximate "worst" pattern automatically has been wired. It is approximate in that no undisturbed signal or undisturbed half selected output is on the sensing winding; i.e., $ONE = 1_D-(N-2)\delta_2-2HSI_1$

$$ZERO = 0_D+(N-2)\delta_2-2HSO_1$$

Some methods of sensing whereby any noise on the sensing winding and all half selected outputs are cancelled are being considered. One method that looks promising will soon be evaluated.

Memory Arrays for MTC (W. Canty, A. Hughes)

Eleven arrays have been completed and tested. Three more are in construction.

2.34 Ferroelectric Materials (C.D. Morrison)

A test to determine the effect of frequency on the maximum squareness ratio of a ferroelectric ceramic has been partially completed, and the results for one material (Glenco P-46) are complete. These results show that the maximum squareness ratio decreases with increasing frequency. The low-frequency results (25 - 200 cps) are accurate, but at high frequencies the results are not too accurate though the trend is the same. The inaccuracy appears because of a heating of the ceramics to a higher temperature by the high-frequency signal.

2.4 Test Equipment

Test Equipment Committee (L. Sutro)

Twelve "Series A" type 514D oscilloscopes ordered by the committee in December have arrived and are being tested. The "Series A" scopes have a cathode-ray tube with twice the vertical deflection sensitivity; it is the new RCA 5ABP1. Signals applied directly to the plates of the new scope will appear twice as high as on present scopes, but signals brought through the amplifier will appear the same on both new and old scopes. The "Series A" scopes use an amplifier with 1/2 the gain of present scopes. The result is a more linear display. For example, the graticule has lines 1 cm higher and 1 cm lower than the present scopes.

Test Equipment Headquarters (L. Sutro)

In the 12 new Tektronix "Series A" 514D scopes, display of 1-mc square wave has been satisfactory in every unit. In previous 514D scopes, the vertical amplifier frequently needed alignment before the display was satisfactory. In addition, the principal source of tube failure seems to have been removed. Drivers in the vertical-deflection circuit are now 6AU6's instead of 6AH6's. The preamplifier uses a 12AU6 and a 6U8 instead of two 12AW6's.

Work completed:

	Standard Test Equipment	Oscilloscopes
Repaired	4	
Inspected and repaired	58	4

Two more men are being trained to service oscilloscopes. Experimental work continues on two types of Burroughs units that do not meet our specifications.

Differential Video Probe for Scope Use (H. Zieman)

The video probe mentioned in the previous biweekly report has been tested, the drawings modified, and eight production units have been ordered.

The gain of the unit is constant at 0.4 for all input voltages from 0v to 4v. The frequency response of the unit together with a Tektronix scope is flat from 20 cps (lower frequencies were not tested) to 2 megacycles and is down 3 db at 8.5 megacycles. The ratio of common mode to differential mode gain is better than 0.04%.

2.4 Test Equipment (continued)

The power requirements for the unit are 40 ma at -450 volts, and 1.8 amp at 6.3v AC at a d-c level of -150 volts. A separate isolation transformer is supplied with the unit when this d-c level cannot be conveniently supplied.

2.5 Basic Circuits

Diode-Driving Cathode Followers (B. Remis)

A second set of design curves for cathode followers driving diode switching circuits has been drawn. This data allows the selection of the cathode resistor by use of a single graph.

Phase Measurements (B. Remis)

The conversion of the phase-measuring device mentioned in the last biweekly from breadboard form to that of a piece of specialized Lab test equipment has been completed.

Decoder-Output Amplifier (H. Zieman)

The decoder-output amplifier presently being used has shown considerable instability due to power-supply fluctuations and induced voltages on input leads and within the amplifier itself. A new design is being developed which will incorporate a push-pull signal throughout the amplifier. The use of differential amplifiers should decrease the susceptibility of the circuit to power-supply fluctuations and induced voltages. It is also hoped to eliminate the VR coupling tubes to remove their effect on instability.

Gate-Tube Circuit (H. Platt)

Further investigation shows that the 3:1 transformer in the output of the gate tube will be able to drive heavy loads satisfactorily. A 5:1 transformer was unsatisfactory in that the output was always below unity gain. In driving a chain of gate tubes, the pulse would quickly disappear.

A run of output vs input with load capacitance as parameter was made with the 3:1 transformer in the output in order to measure the equivalent load of a Boyd flip-flop. It was found that if the output pulse width were kept to 0.1 μsec, the transformer circuit seemed to resonate with about 340 pf (a compensating choke was used to shape the pulse). Also, an output-input plot of the Boyd flip-flop showed that the load presented to the gate tube varied widely with input amplitude.

2.5 Basic Circuits (continued)

In setting, the load looked like from 30 to 300 pf, the largest load appearing when the input to the FF was from 30 to 36 volts high. Complementing was more severe with a load that looked like 120-400 pf. For inputs to the FF between 28 and 35 volts, the loading was at a maximum.

A preliminary design has been arrived at for one particular load. Its margins are still to be investigated. PRF sensitivity measurements indicate that the gate-tube circuit is at most as sensitive as the pulse gater driving it. The pulse is being cleaned up so that good measurements may be made.

Level Amplifier (C. A. Laspina)

Resistance and voltage margins on the low-impedance-divider triode level amplifier have been taken and will be compared with margins to be taken in the high-impedance-divider and flip-flop level amplifiers. Voltage and tube parameter margins are fairly wide, but the resistances tolerances are narrow (less than 15%).

The delay was measured for different PRF's and is under 0.05 μsec for input rise times of about 0.15 μsec. Because of the faster rise time of the amplifier, the input and output reach their extremes at the same time. Rise time could be shortened even further by over-designing the amplifier and clamping at the desired voltage levels.

Pulse Delays (J. Woolf)

The investigation of pulse delays has continued with emphasis on distributed constant lines.

Based on measurements of Brew & Co.'s glass-rod delay line, a new design of a 2-μsec delay line will be supplied by Brew. These lines will be provided with taps at 0.25-μsec intervals. Also, these lines are about one quarter the length of 1350-ohm line and present greater packaging possibility.

Pulse Standardizer (J. Woolf)

In order to develop a standard 0.1-μsec pulse with an off tube, several methods of triggering were attempted. The results indicate that the circuitry used was inadequate. More thought will have to be given to the basic idea of pulse formation by regeneration.

2.5 Basic Circuits (continued)

Diode-Driving Flip-Flop II (H. Boyd)

The +10- to -30-volt output flip-flop is now undergoing extensive tests to determine its ability to meet its functional specifications, and to determine its reliability.

As the weakest links in previous flip-flops of this type have been the divider-arm tolerances, a "Normalized Divider-Tolerance Chart" was designed to be used in conjunction with the "Normalized Flip-Flop Chart" in designing flip-flops to obtain the maximum reliability for the maximum performance.

The two charts predicted a divider resistor tolerance of about ± 23% for this particular flip-flop, while experiments yield ± 23.2%.

Another chart, yet unnamed, shows that for a 5965 duo-triode, diminishing returns would be reached for stability factors above 5, for here the performance-tolerance product is a maximum. The stability factor for this flip-flop is 5.

In order to get 1% more divider tolerance the stability factor would have to be increased by 26%, with a like drastic decrease in performance.

Buffer Amplifier (S. Bradspies)

Work on the buffer amplifier has been progressing smoothly thus far. The stage is being tested with a line terminated in 91 ohms shunted by 470 μμf. Eventually, it will be tested by putting several of the tube types to be driven by the amplifier in the actual circuit and noting the effect of grid current on the pulse output form, as well as the effect of stray capacity

D-C Level Inverter (J.S. Gillette)

The 7AD7 tube circuit was modified to give better delay characteristics and smaller crystal surge currents. The delay is 0.05 μsec, and the rise and fall times are 0.1 μsec.

The possibility of using a 5965 tube with cathode clamping is being investigated.

2.6 Component Analysis and Standards

2.61 New Components (B. Paine)

Trips have been made during the last biweekly period to IBM at Poughkeepsie (to attend the first meeting of the joint MIT - IBM Standards Committee and, later, to work out with IBM acceptable soldering procedures on the MTC memory planes) and to the Chase Resistor Company.

As a result of the MIT - IBM Standards Committee meeting, two Component Application Memos were issued on composition resistors and deposited-carbon resistors. Copies of these have been distributed to some design engineers here and at Poughkeepsie for their comments. Additional copies may be obtained from me.

Five M-series memorandums have been issued to date on reliable-components meetings held with manufacturers and independent laboratories. Trips are now planned to Sickles to discuss pulse-transformer construction and to the Corning Glass Works to discuss glass resistors and capacitors.

2.62 Component Failure Analysis (B. Paine)

A summary of component-failure-analysis activities will shortly be issued as an M-series memorandum.

2.63 Standards (H. Hodgdon)

On April 3, C.W. Watt and I visited the Sperry Gyroscope Company for discussions on component reliability with their Standards Engineering group. A detailed report is being prepared in Memorandum M-1973.

Formal Standards Committee meetings are being discontinued for the time being, since it is difficult to get enough attendance at any one time to accomplish anything worthwhile. Proposals and notes on standards will be circulated from time to time for comment. A good part of my time will probably be devoted to the joint MIT - IBM standards work for WWII in the next few months. It is hoped that much of this will coincide with or be parallel to our own Laboratory standards.

2.7 Memory Test Computer

Computer Operation (P.R. Bagley, H.E. Anderson, R. Hughes)

During the past biweekly period, the MTC has been operating satisfactorily. Several interesting display programs have been run. Preliminary marginal checking has been started. Results indicate satisfactory margins. Component failures have consisted of 4 subminiature toggle switches.

Control (P.R. Bagley, H.E. Anderson)

Plans for installation of new equipment for control are nearly complete; this work should be completed by April 17. The computer will be shut down during most of this time.

Memory-Switch Inter-Wiring (J. Crane)

Inter-wiring of the memory-switch flip-flops, which receive the address for magnetic memory from the A-register, and the memory-address panel is now complete. The memory-address panel contains 20 cathode followers that drive the two 32-position crystal matrices used to select a register in memory. Also, 10 decoder tubes located on the memory-address panel are connected to display the address on a scope located on the console.

In-Out (R. Pfaff)

In-Out has operated with the computer for several hours and has appeared to be reliable over that period of time.

Automatic Marginal Checking (R. Pfaff)

A preliminary investigation of various ways of performing automatic marginal checking has been initiated. A cheap and reliable method has come to light, which will be proposed when testing of the memory is well under way.

Marginal Checking (H.K. Smead)

The marginal-checking wiring and the marginal-checking amplidynes have been installed and are operating.

MTC Memory (W. Canty, A. Hughes)

Digit Plane Drivers

A test setup has been devised for video checking. Actual testing of digit-plane drivers is awaiting delivery of 10-watt noninductive resistors necessary for the completion of these units.

2.7 Memory Test Computer (Continued)

Sense Amplifiers (W. Canty, A. Hughes)

At present, these units are undergoing modification in the shop.

MTC Memory Rack

This unit is nearly complete. All units with the exception of the current-control panel are mounted and wired up. At present d-c and a-c wiring is being brought over to the rack.

Power-Supply Control (R.C. Hopkins)

Drafting is completed on all units of power-supply control for MTC. The meter panel and bus panel have been delivered. Construction has been completed on the control panel and has begun on the interlock panels.

MTC Power Supplies

The design of a -200-volt auxiliary supply has been completed. This supply is to be used with the -15-volt and -30-volt regulators to provide the proper d-c levels. This completes all design work of the supplies.

Construction has been started on the rectifier section of the supplies in our shops. The series-tube sections and -300-volt auxiliary sections are being sent out to be assembled by outside vendors.

Timing Diagrams (R.C. Hopkins)

Timing diagrams for each instruction of MTC have been completed. These diagrams show the flow of pulses through control and the resultant contents of the registers of the computer for each step. The diagrams were designed to assist in trouble shooting and to permit an easily understandable explanation of control operation. They will also assist programmers by serving as a simple traffic diagram.

Plugboard Storage (H. Henegar)

The method of incorporating the IBM plugboard as additional panel storage in MTC has been decided upon. It will parallel the present toggle-switch storage, thereby giving 64 registers of panel storage as compared to the present 32. The "live" FF register may be inserted in place of any one of the 64 registers.

Selection of the 64 registers will be done by a modified 32-position crystal-matrix switch. The modification consists of adding two crystal "AND" gates to each of the 32 outputs and driving them with a sixth panel-switch FF.

Design and layout of the necessary panels is now in progress.

3.0 STORAGE TUBES (P. Youtz)

The work on the problems of lower stability failure and positive switching which was reported in recent biweeklies has continued this period. The pressure surges which occur during the bakeout of storage tubes have been reduced several orders of magnitude by changing both the conductive coating on the body seal and the bakeout schedules of the storage tubes. Work will continue in this direction.

Experimental work on an improved and more fully oxidized beryllium mosaic was started this period to eliminate some of the recent lower stability failures.

Work continued on the various research and development projects reported in previous biweeklies.

3.1 Construction (P. Youtz)

In Section 1.11, it is recorded that the full complement of seventeen tubes is now operating in Bank A of ES row. 800-series storage tubes were constructed as replacements for any marginal tubes in Bank B and as replacements for the old-model tubes and marginal tubes of Bank A.

Several storage tubes with stannic-oxide coatings instead of dag coatings were constructed this period to take advantage of the improved operating vacuum of tubes with this coating. However, the cathodes of the electron guns in these tubes appear to be slightly poisoned. This problem will be studied further.

3.2 Test

Television Demonstrator (D. M. Fisher)

During this period, seven 800-series storage tubes and two stannic-oxide tubes were pretested. One tube, ST804, was rejected because of a small area on the surface possessing poor secondary-emission characteristics.

Storage Tube Reliability Tester (R. E. Hegler)

ST801 through ST808, excluding ST804 which was rejected at the TVD, were tested at the STRT. All were satisfactory except ST802 which was considered marginal because of a smaller than normal spot-interaction area.

RT380 which has a stannic-oxide coating was satisfactory and was sent to WWI.

3.3 Research and Development

Envelope Bakeout (T. S. Greenwood)

The investigation of pressure surging which occurs during the preliminary bakeout of storage-tube envelopes has revealed that the surges are largely due to the dag used on the body seal of the tube. When a water suspension of dag with added sodium silicate is used, considerable surging takes place throughout the entire temperature range. The use of the dag without added silicate reduces the pressure peaks to a large extent; but to bring the maximum pressures down to a satisfactory level, oven control is also required. By restricting the rate of temperature rise of the ovens to 4°C/minute the pressure can be held below 5×10^{-3} mm of Hg. on all dag tubes. The use of the same control on stannic-oxide tubes, which have the same dag on the body seal, produces pressures which are a decade lower.

Following the preliminary bakeout the guns are inserted in the tube and the tube rebaked. Since the pressures during this bakeout are now higher (maximum 10 μ) than during preliminary bakeout, oven control will soon be applied to this bakeout also. This will insure that pressures in the tube will not exceed 1×10^{-3} mm Hg. after the initial bakeout.

Positive Switching and Lower Stability Failure (C. L. Corderman)

Beginning with ST802, the processing schedule for storage tubes was changed; following the first bakeout, we are now admitting helium at room temperature instead of oxygen at about 200°C. None of the tubes processed with this new schedule has failed due to internal breakdown. Possibly more significant is the fact that they have not as yet exhibited positive switching in WWI. To compensate for the desirable surface oxidation which has been eliminated, experiments are in progress to more fully oxidize the beryllium while the surface is still in the evaporation tube.

"L" Cathodes (R. J. Biagiotti and T. S. Greenwood)

A conversation was held with R. C. Hughes of Philips Laboratories during this biweekly period. Among the items discussed were the chemical composition of the impregnated-type cathode and methods of reducing grid emission. Confirmation was obtained on several aspects of the cathode chemistry involved in "L" cathode processing.

R. J. Biagiotti joined the group in the middle of the period and will work with "L" cathodes. He will take over the work alone in May.

3.3 Research and Development (Continued)

One tube was made this period. This was again a cavity-type cathode utilizing a ceramic mount. This tube processed satisfactorily, and, although it developed a partial grid-cathode short, was suitable for testing. Unfortunately, several failures in the test equipment have prevented adequate testing.

In preparation for use of impregnated cathodes, drawings for assembly jigs and mounting parts are nearing completion and an M-note on proper processing is being issued. A few storage tubes using these cathodes should be available early in May.

Pulse Readout (A. J. Cann)

The large signal plate gate referred to in the last report has been found to permit correct readout of positive spots which have been partly discharged by stray electrons.

The transient response of the amplifier as a function of its tuning is being investigated.

A pulse amplifier (1 tube) has been developed, which puts out a .05 μs pulse, 15 volts high into 100 ohms. When used for sensing the readout gate tube this pulse permits greater timing tolerances than the old pulse which was about .07 - .08 μs. The tolerance increased to ± .015 μs, which is equivalent to ± 54 degrees phase shift in the amplifier. The tolerance on suppressor bias is now ± 25 volts.

Velocity Distribution Measurements (C. T. Kirk)

The first week of this biweekly period was spent on vacation.

Construction on the 10Kc system is continuing. Some modifications were made in the design of the 10Kc amplifier now under construction. A more stable 10Kc oscillator driver is being designed.

4.0 TERMINAL EQUIPMENT

Signal Wiring (G. F. Sandy)

The Remote Station Distribution Box has been installed back of AX row in the computer room. The first shipment of the 20 conductor cables for connecting to the Remote Station Distribution Box has been received and is now being fabricated for installation of the cable between the Box and the proper computer panels in AX row. It is planned to run these 122 cables between AX row and the Box during installation next Monday morning. The actual connections will be made during next week, insofar as possible. These 122 cables used up approximately 3,000 feet of the amount on hand. We still have enough cable to make about 30 runs towards the New Control Room. It is planned to cut these cables next week and install them next Friday based on the final layout of the room as given to me by Dave Israel. The vendor has promised to deliver the balance of the 16,000 feet of the 20 conductor cables by April 20, at which time it is planned to cut this cable for installation from the Remote Station Distribution Box to the remaining remote stations.

4.1 Typewriter and Tape Punch (L. H. Norcott)

A breadboard of a tape verifier, designed for use with our present FL Flexowriters, is now being assembled in the Flexo shop.

This verifier checks the typing of one operator against a tape previously prepared by another typist. When both typists agree on a particular code, that code will be perforated in a second tape. In case of disagreement, however, an alarm will be given, and the second tape will not be perforated until the cause of the alarm is determined and corrected.

When the verifier is not in use, the FL may be used like any of our other Flexowriters.

4.2 Magnetic Tape

Magnetic-Tape Print-Out (E. P. Farnsworth)

Pushbutton rewind control with automatic limit stop has been provided for the delayed print-out tape mechanisms. A "forward print/reverse print" switch has also been added to facilitate the study of magnetic-tape blemishes and other discrepancies in singly recorded characters. This switch will also be a convenience for programmers since output may be laid down on tape in reverse order and then printed out without rewinding.

The new long-carriage FL Flexowriter with automatic "punch or print" from magnetic tape is ready for installation next week. Shortly after installation, the digits for recording Flexo code on magnetic tape will be shifted to 0 through 5 to coincide with the direct-output printer

4.2 Magnetic Tape (Continued)

code. In addition, a "one" in digit 6 will operate the seventh-hole-punch solenoid, and a "one" in digit 7 will operate the punch only. A memo will be issued to explain these changes.

Magnetic-Tape System (E. P. Farnsworth, J. W. Forgie)

The re-record mode of operation has been modified so as to switch to record after detecting a block mark instead of re-recording the block mark. This change has improved the reliability of the re-record order for skip-back and permitted reversing the reading-head polarity.

The latter change permits a lower slicing level since overshoots are now negative. Further changes are planned to improve the system performance. The outboard 250-v supply for the reading amplifiers has been removed and replaced by an RC filter from the +500-v bus.

Magnetic-Tape Mechanisms (E. P. Farnsworth, J. W. Forgie)

Tape mechanism #2 was overhauled and connected into WWI when the fifth drive-control panel was delivered from the shop last week.

Dust covers have been installed on all units. Individual external power switch and control panels for each tape unit are being designed to provide a "rewind" position on the selection switch, protective-power interlocking with AX3 and TC, and to make the controls more accessible. Limit-stop contacts will be added to all tape units for "rewind".

4.3 Display (R. H. Gould)

Dumont has reported difficulty in making the K1084P7M cathode-ray tubes for our 16-inch display scopes. They have sent us two tubes whose screens are said to be "poisoned" and four tubes that are all right. A test setup has been built to quickly determine the condition of the CRT's before they are installed in a scope.

(F. E. Irish)

The components required for both the number generator and the vector generator have been assembled. The installation of this equipment into WWI will start during the coming biweekly period.

4.4 Magnetic Drums (K. E. McVicar)

The auxiliary-drum system has been switched to WWI power and a system of power-supply interlocks and blown-fuse indication installed. These changes permit twenty-four-hour-a-day operation.

At any time the computer is operating, the drum system will be available unless notice to the contrary is posted on the blackboard in the test control room.

(H. L. Ziegler)

Existing breadboard panels have been installed to provide a rather incomplete but fairly representative auxiliary-drum monitor. It is felt that this system, meager though it is, will be beneficial by providing at test control some indication of auxiliary-drum operation and will help to acquaint Systems people with magnetic-drum waveforms. Construction of permanent units for this monitoring system has been delayed by our inability to obtain the ERA type chassis and terminal boards.

Power distribution to drum bay #1 and the former power-supply bay is being investigated. Present plans are to put all accessory circuits, e.g. cathode followers for monitor, etc., in the #1 drum bay.

(C. W. Simmonds)

A panel for testing all the plug-in units associated with the magnetic-drum assembly is now being constructed. Provision has been made for converting Whirlwind I 0.1-microsecond pulses to the 0.5-microsecond pulses required for the drum system. The power supplies formerly used for the magnetic-drum assembly will be used to supply the necessary voltages. Signals and voltages will be brought out to Jones strips, where they can be easily measured.

5.0 INSTALLATION AND POWER

5.1 Power Distribution and Control (G. F. Sandy)

The wireways for the new Control Room have been completely fabricated, and construction has proceeded for about a week. These wireways should be completed in another two weeks. Power wiring of racks in the computer for the new In-Out is practically complete. Rack J1 in Room 156 has not been wired for power yet, but it is contemplated that the wiring for this rack will proceed next week. This is the rack which supplies all power for a new control room. All of the panels that go in this rack have been received.

5.2 Power Supplies and Controls

D-C Power Supplies (S. Coffin)

The -150-volt, 10-amp Whittemore d-c supply is now operating satisfactorily, after having increased the size of its fuses. The +150-volt, 50-amp supply that was removed from Whittemore for redesigning has had several changes made in its power section. This should improve reliability of operation; it will serve as a model for improving the other 50-amp thyratron supplies.

WWI Power (J. J. Lynch)

An investigation of the primary power facilities has been made in preparation for additional loads expected in the late summer.

-150 Power Supply WWI (J. J. Lynch)

Thyratron-tube sockets have caused several interrupting failures due to poor filament contact.

A new-type socket will be installed next shutdown period.

Air Conditioning (R. E. Garrett)

The Freon piping and wiring are practically complete. The final tests of new equipment with Room 156 as load will be made next week, entirely separate from existing systems. When the "de-bugging" is complete, the system in Room 222 will be tied into the new Freon lines during an installation period. The WWI air-handling units will be tied into the system during the following installation period.

Building Power (R. E. Garrett)

Arrangements have been made with the Cambridge Electric Light Co. to increase transformer capacity of Barta Building within the next two weeks through the use of a temporary arrangement which is scheduled to be replaced by a large three-phase power transformer next December. The final arrangement will use the entire courtyard space and approval of the installation by Buildings and Power is anticipated shortly.

MTC Alternator (R. Jahn)

The alternator has been run at no load. Vibration and noise are unusually low. I am preparing regulator tests and parameter measurements for next week.

5.2 Power Supplies and Controls (Continued)

MITE Filament-Alternator Control (R. Jahn)

A 50,000-ohm pot was damaged when it was driven into the stop because of a faulty adjustment of the cycle stop switch. Tolerances on the stops were increased to prevent recurrence of this trouble.

6.0 BLOCK DIAGRAMS (J. H. Hughes)

The new instruction ab, add B-register, has been installed and will soon be pulse tested (for details see M-1793).

Logical changes in the divide-control and divide-error sign-control panels have been made temporarily. The change in the divide control (divide pulse distributor) saves 17 μsec per divide order by cutting out an unnecessary counted delay in the "carry, divide-shift-left" cycle. The change in the divide-error panel allows the divide-error FF to be checked. These changes will probably be made permanent.

7.0 CHECKING METHODS

7.1 Test Programs (T. Leary)

Thought is being given to revising our test programs to operate with the programmed marginal-checking equipment which is soon to be installed. An entirely new display check program will have to be written for the new display system.

7.4 Marginal Checking

Marginal Checking, Mod II (J. H. Hughes)

Cabling between the crossbar and skip-switch panel has been completed. The relay panel was completed today. On April 13, we will start testing the system as far as possible without actually installing it.

On April 17, we hope and expect to install the new system in WWI replacing the old marginal-checking system except for power panels and the auto drive which will be modified to fit the new system.

Programmed Marginal-Checking System (D. A. Morrison)

Testing of the MC counter-selector-decoder panel continues. The unit is ready for installation on the panel-selection frame.

Drawings of the panel are in work. It is planned to install the panel-selection frame in the WWI system on April 17.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this biweekly period on each general applications problem is given below in terms of programming hours, minutes of computer time, and progress reports as submitted by the programmers in question. The most recent developments in the comprehensive system of service routines (CS) are described under problem #100. There were no new general-applications problems initiated during this biweekly period. Routines for the calculation of Fourier transforms and autocorrelation functions have been completed and will soon be described in a separate report. Progress on this work is described under problem #107.

A skit has been prepared describing the experiences of an outside user of Whirlwind I from the time he decides to use Whirlwind I to the time that he receives a satisfactory solution to his problem. It is expected that a black and white and/or a color movie will be made of the skit.

100. Comprehensive System of Service Routines: Briscoe, 61 hours; Demurjian, 36 hours; Denman, 34 hours; Frankovich, 11 hours; Hazel, 25.5 hours; Helwig, 60 hours; Kopley, 21.5 hours; Porter, 15.5 hours; Vanderburgh, 8 hours; WWI, 542 minutes

A punched-paper-tape input program using the drum is now available. A magnetic-tape input program using the drum is being tested.

The conversion section of the CS has been modified to use the new magnetic-tape input program and is now being tested.

The first pass of the CS and the PA subroutine section are being modified to make use of two banks of ES. The additional ES registers are being used to increase the length of the storage block in the first pass. This will cut down the number of "fences" read in a standard CS program.

A new 6-way post-mortem program using the magnetic drum is being formulated. This program will print out specified ranges in specified forms (integers, instructions, etc) and will have the further option of printing out only those registers which have changed during the program. This information will be read into the computer from paper tape.

The floating-address and tape title-display programs have been tested and will be incorporated into future CS.

The output adaptation program has been modified to handle so-called "special cases", i.e., routines like FORMAT, DRUM INPUT BINARY, etc.

The DIB (drum input binary) and DOB (drum output binary) output subroutines have been tested and are being written in CS form.

Tests are being conducted on the display of letters on a 3 x 5 grid for use in post-mortem routines.

Helwig

8.1 Programs and Computer Operation (continued)

101. Optical Properties of Thin Metal Films: Denman, 8.5 hours; Loeb, 15 hours; WWI, 7 minutes

The parameters for checking the multivaluedness of the reflection and transmission functions were run successfully, and the apparent repetition of results when the optical constants are multiplied by two has been disproved. (The repetition previously obtained was probably due to the incorrect read-in of the parameters.)

The program for automatic evaluation of optical constants has now been checked, and a tape is being prepared.

Loeb

104. Hydro Thermal Power System; Calculus of Variations: Demurjian, .5 hours; Cypser, 15 hours; WWI, 122 minutes

Four iterations were successfully obtained before a parity alarm forced a stop. The convergence behavior when reaching operating limitations has been partially observed. A transient type of overshoot occurs which progresses as a damped travelling wave to adjacent sampling points in successive iterations.

Later attempts to use the same program but starting with the results of the four iterations have been unsuccessful, with cause unknown.

Further iterations will be sought when the cause of the present difficulty has been determined.

Cypser

106. MIT Seismic Project: Briscoe, 1.5 hours; Simpson, 50 hours; Smith, 20 hours; Walsh, 15 hours; WWI, 47 minutes

We have completed and tested a generalized prediction program allowing us to vary and thus optimize operator parameters. An expanded version of this program using 8 operators instead of 1, magnetic-drum storage, scope displays and delayed printouts has been written and is being tested. A frequency distribution program has also been written and used.

We plan to use the working prediction program extensively until the expanded version is working. When it is working another program will be written to be used with it, allowing a different sort of information to be obtained from seismograms, heretofore impossible because of the computation involved.

Robinson

107. (a) Autocorrelation and (b) Fourier Transform, Evaluate Integrals: Frankovich, .5 hours; Ross, 50 hours; WWI, 155 minutes

The final correction of the Autocorrelation-Simpson program was made through the use of a specially written mistake-diagnosis routine. One register was found to be in error.

With the final correction of the Autocorrelation-Simpson program (2346m10), all programs are now operative. Three good autocorrelation runs and one trans-

8.1 Programs and Computer Operation (continued)

form run have been made. Five more transform runs will complete the problem.
Ross

111. Fourier Analysis--Autocorrelation Problem: Hazel, 2 hours; Zierler, 10 hours; WWI, 23 minutes

No further results were obtained in this period because of difficulties encountered in running the program. Different results were obtained in operating the same program at different times and a number of parity alarms occurred. It is felt that some of these difficulties may be due to the way in which we have used the mechanical tape reader (MTR). The present program calls in 1080 words from the MTR during computation. The MTR was used since there were about 1000 operations and print out between each pair of words read in. Now that the auxiliary magnetic drum is available, the program is being modified so that all 1080 words are called in from PETR and stored on the drum at the beginning of operation. The change will also include the use of the delayed printer rather than the typewriter for output.

Zierler

112. Lawley's Method of Factor Analysis; Characteristic Vectors (modified): Denman, 15 hours; WWI, 93 minutes

Recent improvements in the magnetic tape enabled us to obtain 80 iterations in the solution of the matrix equation. Results were printed out after every 10 iterations. Examination of these results indicates that convergence to within the range of round-off error was obtained. These results are being checked by desk calculation at the Educational Testing Service, and further use of the computer will be decided on the basis of these results.

Denman

113. Shear-Wall Analogy, Simultaneous Linear Equations: Sydney, 30 hours; Kopley, 1 hour; WWI, 30 minutes

The number of significant figures obtained in our solution of this problem on WWI is not satisfactory. However, we feel that the operation time of a program using double-length numbers would be excessive. A revised program that may reduce accumulated round-off errors is being tested.

Sydney

114. Design of Optical Instruments: Combelic, 15 hours; Mahoney, 30 hours; WWI, 34 minutes

The generalized program for ray-tracing is now written and will be tested during the next bi-weekly period.

Combelic

116. Torpedo Impulse Response; Convolution: Hamilton, 10 hours; Kramer, 10 hours; WWI, 35 minutes

Three runs were made during this bi-weekly period. Of the three, one gave useful results; the other two failed because of the presence of illegal symbols

8.1 Programs and Computer Operation (continued)

on the data tape. The results obtained carry the problem half-way through the fourth of the steps described in the biweekly of March 13, 1953 for one system.

The Fourier Transform program developed by D. Ross (Problem #107) will be used for handling the input, output, and error data.

Kramer

118. Quantized Group Communication and Learning; Non-Markovian Stochastic Process: K. Ralston, 18 hours; Denman, 3.5 hours; WWI, 15 minutes

The program used for simulation of a communication network has been corrected and run for a simple network. Results, checked against previous calculations, indicate that the program is operating correctly and that the source of random numbers is quite adequate.

Calculations will proceed for several networks.

K. Ralston

119. Spherical Wave Propagation: Fox, 1 hour; A. Ralston, 15 hours; WWI, 30 minutes

The last biweekly period was spent in trouble shooting the complete program. The main difficulties are caused by the size and complexity of the program.

Plans for the future are to continue trouble-shooting until the program is in working order.

A. Ralston

120. Thermodynamic and Dynamic Effects of Water Injection into Gas Streams of High Temperature and High Velocity simultaneous algebraic equations: Porter, 2 hours; Gavril, 80 hours; WWI, 0 minutes

A first draft of a (15,0) program for a step-by-step solution of the differential equations describing the one-dimensional aerothermopressor, has been completed. This program occupies some 400 registers in excess of ES storage and provision is being made to make use of the auxiliary magnetic drum. The final draft of this program is expected to be available for test performance within ten days.

Gavril

121. Determination of Weak Signal plus Noise Probability Functions: Porter, 3 hours; WWI, 14 minutes; Sponsler, 5 hours

In the past two weeks a program was successfully run which computed the fifth-root of an arbitrary real number; computed the Modified Bessel Function of the first kind and zero order of real argument; computed the negative exponential function; and finally combined the three functions to give a probability density function resulting from a noise-theory study.

8.1 Programs and Computer Operation (continued)

A new program was written to incorporate these results into an integration program which will give the solution of a simplified radar noise theory problem.

Sponsler

123. Earth Resistivity Interpretation: Integration of Empirical Functions: Briscoe, 1 hour; Vozoff, 4 hours; WWI, 2 minutes

Our program (2293m4) for calculating $J_0(x)$ has run and has given results to better than 1% over the range $0 < x < 2$.

We are now preparing a program that makes use of a difference-equation solution to Bessel's equation to evaluate $J_0(x)$ for arguments up to the range where asymptotic expressions can be used.

Vozoff

124. Deuteron Binding Energy and Wave Functions: Combelic 100 hours; WWI, 73 minutes

The basic program for finding the eigen-values has been almost completely tested and will then be ready for production runs.

It is estimated that 4 to 6 hours of computer time in the next 3 weeks will complete the required calculations.

Combelic

125. Analytical Differentiation: Porter, 1.5 hours; Nolan, 15 hours; WWI, 126 minutes

The errors in the print-out program have been corrected. The enlarged program was tested with different transcendental functions. On almost all of these functions the differentiation was correctly performed but the reordering and the drum-control program malfunctioned. Post mortems have been obtained to facilitate the location of these errors.

Nolan

128. MIT Subject 6.537 Digital Computer Applications Practice--Spring 1953: WWI, 67 minutes

Three of the eight students registered in 6.537 used WWI to work on term problems. More details of the individual term problems will be given in later reports.

Adams

130. Six-component Distillation, Variable Enthalpy and Equilibrium Data Simultaneous Non-linear Equations: Briscoe, 1.5 hours; O'Donnell, 40 hours; WWI, 172 minutes

Trouble-shooting is continuing. The general subroutines for enthalpy and equilibrium data have been tested and have worked satisfactorily. More rigorous testing will be done on them and the main program. Tests are now starting on the main program. It is hoped to complete the problem in the next three weeks.

O'Donnell

8.1 Programs and Computer Operation (continued)

131. Special Problems (Staff training, demonstrations, etc.): WWI, 16 minutes

Demonstrations were held for a visiting class from Northeastern University, and for visitors from ERA.

Adams

132. Revision, Extension and Testing of Subroutine Library Used in Programs for obtaining Data for the Numerically Controlled Milling Machine; routine numerical and logical operations: Frankovich, 2 hours; Runyon, 35 hours; WWI, 31 minutes

This problem consists of the writing and testing of a set of library-type subroutines to be used in obtaining data for the numerically controlled milling machine (NCMM). The immediate objective is to develop enough routines to allow NCMM tapes for most plane curves to be prepared automatically.

The NCMM tape-preparation routine was tested successfully. Two other routines are being tested. This represents about 20% of the job.

Runyon

133. Non-linear Meson Equation: Arden 10 hours; Finkelstein, 25 hours; WWI, 16 minutes

The test described in the previous biweekly report was made. One typing and two programming errors have been found and corrected.

Finkelstein

Computer Time	
Programs	27 hours, 30 minutes
Conversion	13 hours, 47 minutes
Scope Calibration	40 minutes
Magnetic-Tape Test	14 minutes
Magnetic-Drum Test	05 minutes
Total Time Used	42 hours, 16 minutes
Total Time Assigned	49 hours, 16 minutes
Usable Time, Percentage	85.7%
Number of Programs Operated	165

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Diana Belanger)

The following material has been received in the Library, Room W2-301, and is available to laboratory personnel.

LABORATORY FILES

No.	Title	No. of Pages	Date	Author
E-531	Driving Current Margins on Memory Test Setup I	13	3-6-53	S. Fine
M-1922	Diode Driving Cathode Follower Design	1	3-20-53	B. R. Remis
M-1923	Laboratory Personnel	15	4-6-53	
M-1929	Ad Hoc Conference on $FeNi_3$	3	3-25-53	D. Buck et al
M-1930	S & EC Performance Request	4	3-24-53	M. Demurjian
M-1936	Z-Plane Driver (WW II Memory Digit Plane)	1	3-27-53	D. Shansky
M-1939	Reliable Comp. Meeting No. 4-Erie Resistor Corp.	3	3-30-53	B. B. Paine C. W. Watt
M-1940	Same, No. 5-Bell Tel. Labs	6	3-30-53	B. B. Paine
M-1941	High Input Impedance Diode-Driving Flip-Flop	2	3-26-53	B. R. Remis
M-1942	Gate Tube Circuits in WWII	2	3-27-53	H. J. Platt
M-1945	General Description of Decoder Output Amplifier	1	3-27-53	H. Zeiman
M-1948	Reliable Comp. Meeting No. 3-Aerovox Corp.	3	4-1-53	H. W. Hodgdon B. B. Paine
M-1949	Auxiliary Drum Testing, Summary No. 2	3	4-1-53	K. McVicar
M-1954	March 1953 Storage and Research Tube Summary	4	4-3-53	D. Fisher
M-1958	Meeting on March 31, 1953 to Discuss Proposed New Orders for WWI	3	4-6-53	J. H. Hughes
A-100-1	Radio Use	1	4-3-53	J. C. Proctor
A-143	Barta Building Guard Instruction	7	4-1-53	J. C. Procotr

LIBRARY FILES

No.	Identifying Information	Source
2319	Memory Studies at the National Bureau of Standards	N. B. S.
2320	Transient Response	Proceedings of the IRE, 3/45
2321	D-C Amplifier Stabilized for Zero and Gain	AIEE
2322	Bibliography of Information Theory	Raytheon
2324	Buffering Between Input-Output and the Computer	N. B. S.
2328	Transonic Flow Over a Wedge with a Detached Shock Wave	Ballistic Rsch. Labs.
2329	Tables for the Analysis of Allowed and Forbidden Beta Transitions	Oak Ridge Nat. Lab.
2330	Base Triggered Transistor Switching Circuits	Lincoln Lab.
2331	On Spectra of Second-Order Differential Operators	N. B. S.

9.1 Publications (Continued) (J. B. Bennett)

R-221, Whirlwind Design Logic (First Draft), has been issued. Those persons to whom copies were distributed are requested to observe the deadline (April 22) for comments and criticism.

9.2 Purchasing and Stock (H.B. Morley)

April 1 had been set as deadline date for procurement of material for the 16" scope requirement. This deadline has been met, except for 128 selenium rectifiers. The manufacturer of the rectifiers told us on two separate occasions that the units had been shipped. Because of this unreliability, an order was placed for a substitute equivalent. Shipments from both suppliers are now due April 13.

Dumont's K1084-7M 16" CRT metallized tube became a critical manufacturing problem but has begun to ease off. Two "poisoned" tubes were received on a replacement basis on April 8; four factory-inspected tubes were received April 9. A continuing check will be carried on with Dumont until the order is completed.

Kardex stock control now covers all material listed in the Standards Book on April 1.

Nearly all materials for construction requisitions are being supplied from stock, with the exception of some critical items and non-standard parts.

Critical items, requiring long advance orders, continue as follows:

Resistors - Precision; wire-wound and carbon; power and non-inductive types
Meters - All types; and electronic measuring equipment
Capacitors - Paper tubular and cans; plug-in electrolytics
Connectors - BNC; all others and plugs
Sockets - All types
Wire - All types
Transformers - All types
Barrier strips
Selenium rectifiers

9.3 Construction

Production Control (F.F. Manning)

There have been 32 Construction Requisitions totaling 202 items satisfied by Group 60 electronic shops since March 27, 1953.

There are 22 Construction Requisitions totaling 539 items under construction by Group 60 electronic shops.

For further information on the status of any particular job, please call Production Control Office (Ext 3492).

9.3 Construction (continued)

Outside Vendor (R.F. Bradley)

There are 15 open orders outstanding with vendors totaling 5059 items. Deliveries in the past biweekly period have totaled 2404 items. Information on specific orders may be secured from the writer (Ext. 3476).

9.4 Drafting (A.M. Falcione)

1. New Unit Drawings

Title	Cir. Sch.	Assy. & PL.	Al. Panel
Buffer Drum Plug-in Chassis (WWI)		D-53752	D-53753
Negative Voltage Interlock Panel (MTC)	D-53955	E-54113	D-54221
Positive Voltage Interlock Panel (MTC)	D-54132	E-54112	D-54182
Alt. Control Panel (MTC)	C-53815	E-54169	D-54133
Light Gun (Cape Cod)	SB-54102	D-54009	C-54010
Alarm Relay Panel (MTC)	SB-53862	D-53786	C-54271
420 In-Out Sw. 16 Pos. Matrix (WWI)	D-54170	D-54178	D-54304
Bus Control Panel (MTC)	SD-53860	E-54255	E-54256
Activate Register (Cape Cod)	SD-54266	D-54397	E-54398
Vector Generator Integrator(Cape Cod)	SB-54349	SC-54350	
Wireways for Test Control (Cape Cod)		E-54225	
Light Gun Ampl. Mod. III (Cape Cod)	SC-54477	D-54478	
-15/-30V Regulator for -200V Aux. Supply	SB-54577		

2. Changing of Graded Drawings

Engineers who desire to change graded drawings should mark the affected drawing in red pencil with the desired changes. These changes should be made on the latest revision of that drawing and not on any version which they may have on hand (possibly outdated and changed considerably). Failure to follow this procedure results in confusion and much lost time in Drafting in coordinating the information with the existing drawing. This condition would not occur if engineers returned old graded drawings to the Print Room as requested when later versions of graded drawings are issued to them.

10.0 GENERAL

New Staff (J.C. Proctor)

Eric W. Wolf is a new staff member assigned to Wieser's group. He received his BS in EE in 1949 from CCNY and his MS in EE in 1951 from Ohio State. For the past three years, he has been an engineer in the Aircraft Radiation Laboratory at Wright Patterson AF Base, working on microwave design and development.

10.0 GENERAL (CONTINUED)

New Non-Staff (R. A. Osborne)

Mildred Clark is a new member of the Drafting Department.

James Gunning is a part-time laboratory assistant in the 6345 Group.

Martin McMahon is a new laboratory assistant in the Construction Shop.

Alan Sanville is a new laboratory assistant in the 6345 Group.

Georgette Thebage is a new clerk in the Stock Control Section of the Purchasing Department.

George Tunning is a new technician in Group 65.

Joel Zegelbaum is a Northeastern University cooperative student working in Group 65.

Terminated Non-Staff

Frances Balkonis
Dennis Creedon
Edward Gear
Richard Mayer
Joaquin Perry
Richard Rainey
Peter Sorrentino

IBM Activity (A.P. Kromer)

The exchange of information between MIT and IBM groups has continued through a series of meetings and visits to each of the laboratory locations. Work during the past biweekly period has concerned detailed circuits, a general study of in-out terminal equipment, component standardization (resistors, capacitors, vacuum tubes, etc.), magnetic cores, logical design, and mechanical design.