Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, September 26, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (D. Morrison)

The following is an estimate by the Computer Operators of the usable percentage of assigned operation time and the number of computer errors for the period 12 September - 25 September 1952:

Number of assigned hours	58.9
Usable percentage of assigned time	80
Usable percentage of assigned time since March, 1951	84.6
Number of transient errors	2
Number of steady-state errors	4
Number of intermittent errors	24

(H. L. Ziegler, A. J. Roberts)

Operation of ES Storage has continued to improve during this past bi-weekly period, mainly because of control circuit work rather than storage tube work. The one tube that was replaced failed because of power difficulties not the fault of the tube.

Because of excessive drift on the ES Deflection lines the sixteen 715 ESD output amplifier tubes were submitted for retest. Twelve of these had to be rejected because of various defects. As a safety measure, it was decided to replace all sixteen tubes.

Oscillation of the gate-generator and the cathode follower in the RF Pulser was responsible for much of our storage difficulties at the beginning of this period. Satisfactory operation was obtained by replacing these circuits with the gate-generator section of a Type I Register Driver.

The ESD Decoders have been recabled to permit reading of their contents directly as they appear on the flip-flop Indicator lights.

The new ES erase system has been put into operation. This system which uses the ES Erase Control panel and the In-Out Delay Counter replaces the temporary test-equipment one in Test Control.

1.11 Operation (continued)

(S. H. Dodd)

During the past bi-weekly period trouble with poor complement margins on the d-c coupled flip-flops has been encountered. Normal procedures of balanced tubes and checking cross-over resistors have failed to correct the poor margins and a detailed analysis of the circuits is being made in an effort to locate the source of the trouble.

(N. L. Daggett)

Spurious operation of the R-F Pulser has been traced to oscillation of the gate-generator in the pulser. The oscillations were caused by poor video layout which resulted in feedback from the high-power video stages of the pulser. The trouble has been eliminated by removing the gate-generator circuit from the pulser and using a standard WWI gate-generator circuit in a separate rack to initiate the r-f pulse.

(S. E. Desjardins)

Eight modified D-C, I-O register panels for use as Test Control Synchronizers have been delivered from the shop and are currently being video tested. Cables for these panels have been requested. Block Schematics have been drawn by the drafting department for the new test control system.

Planning for the new Teletalk Intercommunication system has been completed. Some of the cable required, and also the junction boxes have been delivered. Bill Carroll is presently running-in the available cable.

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

The following failures of electrical components have been reported since September 12, 1952:

Component	No. of Failures	Hours of Operation	Reasons for Failure
Crystal			
D-357	4	1 - - 11667	Drift to Low R_b
		2 - - 12937	Low R_b
		1 - - 13309	Low R_b
1N38a	1	903	Low R_b
Transformers			
5:1 Pulse	3	1 - - 12508	Open Secondary
		2 - - 13184	Open Primary

1.12 Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	7	1 - - 0	Low I_b
		2 - - 4033	1 - Low I_b
			1 - High Cut-off
		4 - - 13000-14000	3 - Short
			1 - Low I_b
7AK7	3	1 - - 0	short
		1 - - 474	short
		1 - - 13521	flicker short
829 B	1	1 - - 0	Broken envelope
C16J	1	35606	improper firing
6AS7	1	12869	Leakage
715	14	2 - - 0	1 - Open heater
			1 - loose base
		2 - - 2000-3000	Low I_b
		3 - - 3000-4000	1 - grid emission
			1 - leakage
			1 - Low I_b
		7 - - 8000-9000	1 - Leakage
			1 - Excessive droop
			2 - varies with tapping
			2 - excessive droop
			1 - Low I_b
6L6	5	5 - - 13000-14000	4 - Low I_b
			1 - Flicker short
3E29	2	1 - 10925	1 - Low I_b
		1 - 13169	1 - Flicker short
6AH6	1	13527	Tap Short
6AK5	4	1394	1 - gassy
			2 - Flicker short
			1 - tap short
6AG7	1	1394	1 - Control grid to screen grid short
6AL5	1	1378	1 - Flicker short
5687	1	571	1 - Flicker short
6Y6G	1	824	1 - open heater
6SN7	1	8081	1 - high leakage

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

The following Storage Tube Failures were reported during this bi-weekly period:

ST-607-1 was rejected after 1104 hours of operation because of HVG failure.

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

Following is the storage tube complement as of 2400 September 25:

Digit	Tube	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	26
1 B	ST-606-1	9599	496
2 B	ST-612	9575	520
3 B	ST-601	8524	1576
4 B	ST-516	6641	3459
5 B	ST-548-1	8299	1800
6 B	ST-534-2	7469	2631
7 B	ST-540	7937	2163
8 B	ST-549	8259	1841
9 B	ST-519	6624	3476
10 B	ST-544-1	8683	1417
11 B	ST-542	8148	1953
12 B	ST-608-1	8918	1183
13 B	RT-258	5207	4893
14 B	ST-541-1	7961	2139
15 B	ST-603	8322	1777
16 B	ST-533	7801	2299
16 A	ST-613	9046	1054

ES Clock hours as of 2400 September 25, 1952 10095

Average life hours of tubes in service 1926

Average life hours of last 5 rejected tubes 2917

1.2 Five-Digit Multiplier (C. N. Paskauskas)

The multiplier has been running with its daily two or three after hours errors.

On 25 September the Esterline-Angus recorder was placed in operation on one of the error counters to check the time the errors occurred. On 26 September two errors were recorded at 0745 so it appears they may be caused by some piece of equipment in the building being turned off or on.

During the period of this report no components were replaced.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

M.I.T.E. (R. Paddock, A. Werlin)

Testing of the M.I.T.E. 3-panel prototype has been continuing. A plug-in reference voltage regulator has been constructed to supply the proper voltages to the switch units. The decoding action of the switch units has been checked and appears to operate as expected. Pulse amplitudes throughout the system seem to be ample and pulses distorted due to the use of delay lines are reshaped satisfactorily by the use of a B.A. It was found that the pulse amplitude is reduced to a marginal value if a Gate B.A. drives the positive complement input to two flip-flops and is terminated with 100 ohms. Removing the termination gives sufficient pulse amplitude without prohibitive ringing.

A wiring layout of a complete ten-panel rack of M.I.T.E. equipment to feed the buffer drum has been drawn up and a video wiring schedule will probably be made from this.

The local F.F. indicator light brackets have been redesigned to accommodate neon light sockets and allow their use with the terminal board which will be mounted on the panel.

New Drawings (J. Dintenfass)

The assembly and schematic drawings of Alarm Control were modified to conform with the latest block diagram of In-Out Control.

The assembly drawings for Block Control and Synchronizer #2 were sketched.

(T. Sandy)

The circuit for the In-Out Register Input Mixer, WWI, was designed and sent to drafting to be drawn up. The layout of this circuit is also being drawn up.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

New Test for Shorts (S. Twicken)

Design has begun on a new method for testing tubes for shorts, opens and leakage. The tube under test, its longitudinal axis

2.21 Vacuum Tubes (continued)

horizontal, will be rotated 360° first in one direction and then back by a reversible motor while a tapper, in a stationary housing, will strike the tube every 90°. A bank of neons will indicate shorts and heater-cathode leakage on one cycle and, by switching to another circuit, opens on a second cycle, two cycles being required for a complete test. This new setup should be faster and easier to operate than the present method, should pick up more shorts and place less of a strain on the tube.

Design of the indicating circuits is complete. Work is continuing on the packaging of the unit. Design of the mechanical means (a cam, perhaps) for reversing the motor has begun with the aid of Bob Hunt.

Arithmetic Elements (A. Heineck)

The past two weeks have been spent setting up a vacuum tube section within the arithmetic element group, and gathering literature on arithmetic elements developed at other digital computer laboratories. The plan of this section is to study the circuitry and logic in present use at other laboratories, along with any new developments in our own laboratory, and compare these with the circuits and logic of WWI. Our ultimate objective is to select, on the basis of this study and comparison, the one or two best arithmetic elements and have 16-digit prototypes constructed for test in M.T.C. Work has already been started on a study of the SEAC system's dynamic flip-flop and also on a new static flip-flop which uses low performance tubes. Work will soon begin on a study of the ORDVAC system which has a static flip-flop and gate unlike that used at WWI.

N.B.S. Circuits (S.L. Thompson)

A circulating pulse flip-flop, of the type that is used by the National Bureau of Standards, has been built. However, the delay lines that are required have not yet been prepared by the shop, therefore, only preliminary adjustments can be made on the circuit.

2.22 Transistors (I. Aronson)

Half of the past bi-weekly period was spent in writing an E-Note on the Alpha and V_{c34} test panels.

Twelve more RCA TA-165's were received and processed. Three failed to meet the minimum alpha specification.

2.22 Transistors (continued)

Leo Riley and Dorothy Smith are compiling data on the transistor life tests. The work they have done so far has consisted mainly of using the previously determined temperature coefficients of α, r_{co}, and V_{c34} to correct the weekly readings for temperature and then plot the corrected curves.

An experiment has been set up to investigate the triggering requirements of a one-transistor flip-flop. Noble Pribble, a recently returned part-time student, has been carrying out this program and will probably continue to do so.

An investigation has also been started to determine "hole storage time". The test is similar to our standard rise and fall time test except that the input pulse has been increased enough to saturate the collector. No definite results have been obtained yet.

Mr. E.J. Quirk of Scientific Specialties Inc., (Brighton), visited us on September 16 to show us some of his pilot production line transistors. We ran about 10 of them through our standard tests with encouraging results. Only one transistor compared to our best Bell 1698's, but Quirk thinks he can duplicate the characteristics of this one in future production models.

Transistor Accumulator (D.J. Eckl, R.J. Callahan)

Since the last report, the basic cycle of operation has been increased further to 156 problems per second to cut down idle time. During the past weekend, the accumulator was in continuous operation from 1700 Friday to 0800 Monday. In this interval the number of complete cycles was 35 million (420 million additions). The number of errors indicated was 15. The greater number of these occurred Saturday afternoon and Sunday morning. Operation is still considerably worse during the daytime hours than in the evening. The major part of the trouble is due to spurious pulses produced by the gate and delayed pulse generators in the control equipment.

During the past three evenings, the number of errors recorded were 45, 3, and 2. The number of errors during the day runs about 3-5 per hour. The installation of Sola transformers on the line seems to have helped matters somewhat.

Weekly measurements are still being made on transistor parameters. There are some units which have changed considerably and continually. However, replacements have not shown the same behavior so that the difficulty seems to be individual poor transistors rather than

2.22 Transistors (continued)

circuit problems. It has been observed that after a shut down for measurements, there has been some difficulty in resuming proper operation. Whether this is a thermal equilibrium effect cannot be stated at this time.

Additional test equipment has made it possible to set up the control unit to stop the accumulator when an error is made. A flip-flop register shows the digits in which the errors occurred. Restarting after an error can also be made automatic and this is done on unattended test runs.

Measurements of various sorts are continuing in preparation for a preliminary report on the accumulator. Of particular interest is the total power requirement of 12.4 watts for the accumulator, exclusive of pulse sources.

The total operating time at this writing is 550 hours.

Felker System of Bit Storage (R.H. Gerhardt)

The breadboard model of the circulating pulse circuit is being tested. At present the circuit may be set with a single pulse. It may be cleared by closing a diode with a clip lead to a negative voltage thus shorting out the pulse. Although the circuit was to be complemented, I have been unable to do this. The main reason seems to be that the input pulse does not have enough amplitude and width due to the transformer in the input circuit.

Some material on commercial transformers has been received and is being studied. We may obtain a few samples to try them in the circuit.

A study of other similar systems of bit storage will be made to determine if we can build a circuit that is less stringent on transistor requirements.

2.3 Ferromagnetic and Ferroelectric Cores

2.31 Magnetic-Core Materials

Chemistry and Ceramics (F. E. Vinal, J. Sacco)

Facilities — estimates have been submitted on the physical plant changes and a design and estimate for the chemical laboratory has also been submitted. Detailed equipment lists are in preparation.

Ferrites — A preparation intended to duplicate LIR-62-13-II-A of last April, did not approach loop squareness although the technique and appearance appeared greatly improved over the earlier preparation. A study of techniques for the preparation of polished specimens and thin sections for microscopic and petrographic examination has been initiated.

Square-Loop Ferromagnetic-Ceramic Toroids (G. Economos)

A number of toroids made by the Laboratory for Insulation Research's ceramic section have shown very promising results. The body used is of the general composition as that which is used by the General Ceramics and Steatite Corp., but certain variations have been made to facilitate our investigations. The materials used ($MgCO_3$, $MnCO_3$ and Fe_2O_3) are of 99+ % purity to minimize the effects of impurities. Body 3A10 contains these raw components broken down into the oxides at 500° C then ground wet for 20 hours. R_{sm} values for F-108 toroids from this body vary from +0.48 to +0.58. Duplicate firing of this body (R-3A10) gave a comarable value (+0.61) showing the reproducibility of the procedure. F-304-1 toroids (3A11) gave R_{sm} values of about +0.50. The density of this fired material is about 4.4 gm/cc.

A modification of this body (3A3) was made by reacting the mixed unground oxides at 1050° C for about 6 hours then grinding wet for 10 hours. F-108 toroids of this body gave a R_{sm} value of +0.50. This seems to indicate that regardless of the procedure used in the preparation of a particular composition, the R_{sm} value can be changed by varying the final firing process; final density and grain size appear to be important. This same composition made from General Ceramics and Steatite Corp. materials has not given R_{sm} values of over +0.35. Body 3A10 and its modifications (3A9, 3A3 and 3A4) will be further investigated to obtain a clearer picture of what the effects of each fabricating process will be. Investigations on the elementary components ($MgO \cdot Fe_2O_3$ and $MnO \cdot Fe_2O_3$) processed under identical conditions will aid in finding more conclusive answers.

Analysis and Preparation of Ferromagnetic Materials (J. H. Baldrige)

A report of procedures for analysis as they have been modified for use in this laboratory is being prepared.

A number of replies have been received from companies which market compounds of the rare earths. There is still some doubt as to whether the materials which they can furnish will be sufficiently pure for our use.

2.31 Magnetic-Core Materials (Continued)

An experiment has been carried out to determine the amount of steel picked up from the steel bearings used for milling of ferritic materials. The weight of steel picked up in 20 hours of milling was found to be less than 0.1% of the weight of the ferrite being milled.

Phase Investigation of Ferrites (J. H. Epstein)

The sample tested was intended to be $MgO \cdot Mn_2O_3$, not $MnO \cdot Mn_2O_3$ as previously stated. It is definitely not a spinel. Only two powder pattern lines were obtained, from which no identification with known material could be made. The particles seem to be flat hexagonal plates, and a larger crystal (.5 mm) would be required for further studies.

The Mn Mg ferrite preparation by precipitation gave a spinel lattice when Mg predominated. With increase in Mn content the material was too readily oxidized in air, giving Mn_2O_3 and Fe_2O_3.

Pulse Tester Calibration (R. Pacl)

A vibrating reed interrupter is being investigated as a square-wave source. By operating from a d-c source whose voltage is accurately known, we hope to be able to accurately calibrate the scopes. The possibility of comparing the current pulse from the tester with the interrupter is also being investigated.

6CD6 Core Driver (J. D. Childress)

To prevent oscillations when two 6CD6's are connected in parallel, a transient suppressor network, 100Ω across 3.3uh, is necessary in the plate circuit. This is in addition to the original suppressor circuit in the cathode.

Oscillations were also found in the buffer amplifier and have been suppressed similarly.

Magnetics, Inc. Cores (R. F. Jenney)

A trip to Magnetics, Inc. resulted in measurements of the size of the wraps and bobbins of their cores. The results are summarized in Memorandum M-1650 and indicate that cores wound on small bobbins are best for our purposes.

The automatic core tester is undergoing some minor adjustments before being put into operation.

2.31 Magnetic-Core Materials (Continued)

Hysteresis Test (C. D. Morrison)

A test of the effects of temperature on the hysteresis loop of MF-1118 (F-259) has been completed. The temperature ranged from -196° centigrade to +300° centigrade, and for each different temperature a picture of the loop was taken. The coordinates have been calibrated and it will be possible to read the flux and the coercive force directly from the picture. However, since the test has just been completed the results have not been analyzed.

Seminar Meetings on Magnetism (A. L. Loeb)

The past two weeks saw the first four seminar meetings; by common agreement the time has now been set at 12 - 1 p.m. Tuesdays and Thursdays. The position of magnetism in the broader fields, applied as well as theoretical, was indicated. The tensor quality of permittivity and permeability were pointed out. By request, Maxwell's equations were discussed, and the influence of the time dependance of permeability in pulse characteristic tests was stressed. Diamagnetism and some paramagnetism have been treated. Norman Menyuk is committing these sessions to paper in a set of lecture notes, to be released periodically.

On Tuesday, September 16, Dr. Rathenau of Philips, Eindhoven, visited the laboratory and was shown around by Dudley Buck and Arthur Loeb. Square-loop characteristics of ceramic materials were discussed and more interest aroused at Philips.

Louis Gold and Arthur Loeb conferred with Prof. Harris of the Chemistry Dept. about thin films research. This contact will be maintained.

Uniformity Test on Cores (E. L. Dobbyn, J. H. McCusker)

One-quarter mil, 5 wrap, metallic cores from Magnetics, Inc. and Magnetic Metals (Magnetics, Inc.'s bobbins) were checked for uniformity. The cores from Magnetic Metals were more uniform than those from Magnetics, Inc. Further tests are being run on the cores from Magnetic Metals.

2.32 Magnetic-Core Memory

Delta Noise Problem (A. Katz, E. Guditz)

The delta output from 256 half-selected MF-1118 ceramic memory cores is approximately 1/8 volt. This would be the worst possible delta for a 128 x 128 array under normal operating conditions. The ONE output voltage of a memory core (as seen on a single-turn sick-up loop) is approximately 3/8 volt, while a ZERO is approximately 1/8 volt. These data indicate that delta noise is not a problem in a 16 x 16 array, and probably will not become significant until the array size is increased to 64 x 64 and beyond.

2.32 Magnetic-Core Memory (Continued)

Switch-Core Study (A. Katz, E. Guditz)

Analysis of experimental data recently gathered by Guditz indicates that the simplification in construction resulting from utilizing few turns on the switch core windings can be obtained only at the expense of inordinately large driver currents. For cores in which the primary turns ($4 \leq N_1 \leq 10$) and the secondary turns ($1 \leq N_2 \leq 10$) we have found that the "coefficient of coupling" can vary from 0.05 to 0.80 with increasing N_2. This shows that, unless there are several secondary turns, the leakage will be so great that relatively little energy is coupled from primary to secondary.

16 x 16 Metallic Array (B. Widrowitz, S. Fine)

Measurements of an average delta were made by pulsing the XY winding after the cores were set in a checkerboard pattern. During these tests, rise time of current drivers and driving current magnitudes were varied. The data will be used to estimate the limitations that are placed on current margins by this form of noise.

B. Widrowitz has spent some time on an investigation of the effects of HF current pulses upon small metallic cores.

Sensing Panel Development (C. A. Laspina)

The sensing panel was tried on the 16 x 16 metallic array and the operation was marginal. The panel was designed to operate with an input of 20 mv but the output of the sensing winding on the 16 x 16 array provides only 8 mv.

The panel is being changed to provide the gain necessary to operate a gate.

2.33 Magnetic-Core Circuits

Magnetic Flip-Flop (C. Schultz)

An investigation is being made of a three-input flip-flop unit which consists of a gate tube and a magnetic core. The state of the flip-flop will be revealed, upon application of a pulse, by the presence or absence of a pulse in the output.

Gate-Core Circuits (G. R. Briggs)

Effort is being made to develop the capacitor-coupled gate core to operate satisfactorily in a stepping register at a megacycle clock pulse frequency. The device can be made to operate at this speed, but both the mmf drive to the cores and the stepping rate become critical. Further effort will be required to eliminate this trouble. Further testing of the resistance-coupled gate core is being postponed until a change in the testing logic to

2.33 Magnetic-Core Circuits (Continued)

enable slower clock pulse frequencies to be used can be completed. The rest of the time has been spent writing an E-Note describing the magnetic-core gate work to date.

2.34 Ferroelectric Materials

Ferroelectric Pulse Tester (J. Woolf)

The ferroelectric pulse tester has been assembled in the shop and is now being debugged.

2.4 Test Equipment

Test Equipment Committee (L. Sutro)

The number of Burroughs units received this summer now totals 294. Of these, 94 have been delivered to engineers and the remainder are awaiting inspection. Nickerson's men had to turn all their attention to WWI panels for over a week. Now they are returning to inspection of Burroughs units.

Another order for Burroughs units was placed on September 24. It will start coming in during December and will be completed in February. Before this order starts to arrive, the 96 Burroughs units delivered to engineers in September 1951 will be called back and tested. From now on, standard test equipment will be tested once a year.

The committee has received the following which have been placed in the stockroom for anyone who needs them:

25 d-c power strips, 8-plug
15 d-c power strips, 4-plug
150 d-c power cables, 4' long, 12 strand
50 d-c power cables, 8' long, 10 strand
100 1' video cables
100 2' video cables
100 3' video cables
100 4' video cables
100 5' video cables
700 91-ohm terminators

To the list of standard test equipment, the committee has added the Tektronix Coupling Unit which plugs into the four banana jacks on the side of a Tektronix 514D and permits connection to the vertical plates without amplification. Herb Platt designed the unit. Ten are being made now and more will be made later.

Gas-Tube Pulse Distributor (J. Woolf)

The gas-tube pulse distributor is undergoing modifications to correct the instability in the circuit.

2.5 Basic Circuits (R.L. Best, J.F. Jacobs)

We have just returned from a visit to I.B.M. to investigate their circuits and logic. We shall shortly issue an M-Note describing what we found.

2.5 Basic Circuits (continued)

(H. Boyd)

2-mc low-performance d-c coupled cathode follower 12AU7 Flip-Flop: Tests have been satisfactorily completed and an E-Note is now being prepared.

2.6 Component Reliability

Ferrite Pulse Transformers (R.E. Hunt)

Earl Gates and I are in the process of writing an E-Note giving complete mechanical and electrical specifications for these transformers. We spent several hours on September 24th with N. Daggett and J. O'Brien comparing these transformers with the hypersil cored transformers. The two transformers were found to be essentially the same. Some suggestions were made for improving the ferrite cored transformers; i.e., making them better than the hypersil. Essentially, it was felt that it would be a good thing if these transformers widened the pulse slightly to offset the narrowing caused by gating circuits.

B. Paine will test these transformers, this coming week, at elevated temperature and humidity. He will try to find any tendency towards electrolitic corrosion, etc. These transformers have been in use in the 5-digit multiplier now for 4 months. No failures have been reported.

Our production procedures have been improved so that currently we could manufacture in excess of 250 per week. We hope to complete our final design and specifications within 2-3 weeks.

2.7 Memory Test Computer

Magnetic Core Storage Breadboard (Olsen, Pfaff)

A breadboard of a magnetic core substitute for flip-flop storage has been successfully tested. Each digit of storage requires one metallic core and two 7AK7 tubes with some simple circuitry. One tube is used for "reading" into the core; the other for writing. "Read" and "write" require about 0.3 microsecond. Reading a "zero" produces a negative 20-volt pulse; reading a "one" produces a positive 80-volt pulse.

Although the scheme is expensive compared to the coincident-current memory, it is less expensive than the WWI flip-flop storage and requires almost no engineering.

2.7 Memory Test Computer (continued)

Terminal Equipment (R. Pfaff)

An investigation of possible terminal equipment systems for M.T.C. is now under way.

D-C Power Supplies (R.G. Farmer)

The ordering of all hard-to-get parts for the M.T.C. power supplies has been completed with the ordering of meters and power transformers. As soon as the dimensions of the power transformers are received, the rectifier sections will be laid out.

A tentative arrangement of the placement of the rectifiers and regulators in their racks has been drawn up. The supplies will occupy seven 26" x 6' racks. One more rack will be necessary for the central power supply panel.

Circuits (J. Crane, R. von Buelow)

Designs were frozen on the basic circuits to be used in M.T.C. Mechanical layouts are near completion and prototypes of two digits of each type of circuit are being constructed. These circuits are the (1) gate-buffer amplifier,(2) dual gate, (3) cathode follower, (4) decoder, and (5) parity check. (The only plug-in unit will be the flip-flop.) These circuits will be mounted with all 16 digits on a vertical strip 6" x 45 1/2".

Test (R. Hughes)

The M.T.C. Flip-flop-Gate combination was pulse tested and proved satisfactory.

The breadboard marginal checking panel has been debugged and works satisfactorily.

A 400-ma marginal checking supply has been drawn up and will be analyzed.

Production (H. Smead)

Two more plug-in racks have been delivered, making a total of three available. The power distribution panels, of which there are two models, have been put into production. These are to be completed December 1st. It is expected that the plug-in flip-flops will be sent out to the vendor within a few days.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

The 600-series storage tubes constructed as replacements for Bank B contained a small Faraday cage on the target assembly and had the holding gun one inch closer to the target surface. The cage is used to investigate the beam distortion and deflection shift caused by positive ions.

Two research tubes which were 600-series storage tubes, containing both a Faraday cage and ion collector ring, were constructed and checked for ion deflection shift this past period. Three research tubes were constructed and processed to study the conversion and activation processing of Philips "L" cathodes.

Efforts were continued toward developing techniques to produce a stable stannic-oxide coating which will be used instead of dag.

3.2 Test (C. T. Kirk)

During this bi-weekly period, construction began on a unit to measure the velocity distribution of the electrons in the holding-gun beam and present this distribution directly on a scope. Various pieces of Storage Tube Laboratory test equipment were evaluated for suitability for use in the unit.

Pretest (D. M. Fisher)

Five tubes were pretested during this bi-weekly period. ST629-C-1 was satisfactory; ST626-C-1 was marginal because of a low maximum V_{HG}; and, ST627-C-1 was classified marginal because of a high lower switching potential. ST628-C-1 was rejected because of a measle and numerous air inclusions on the surface. RT330-C, a stannic-oxide tube, did not appear to have any contaminated areas on the surface, but was marginal because of a high lower switching potential.

Storage Tube Reliability Tester (R. E. Hegler)

During this bi-weekly period, efforts were continued towards understanding the operation of the STRT.

About two minutes after a normal array had been written on ST623-C-1, positive spots began to go negative at the holding gun center. Within five minutes, approximately fifty spots were lost. If the holding gun were turned off for the same period of time, no spots were lost. This would indicate that the loss of spots is caused by the holding gun.

3.2 Test (Continued)

The criterion for stability is that any small disturbing force sets up opposing forces, such that these forces tend to return the system to normal. Under normal operation, the holding beam is the opposing force which maintains stability. In this particular tube, it appears that after a time the disturbing force and the opposing force are in the same direction. One possible mechanism for this condition of instability could be the liberation of low-velocity electrons from the main collector by the holding beam, and the fact that these low-velocity electrons cause positive spots to go below first crossover. It was thought that by increasing the auxiliary-collector voltage, some of these low-velocity electrons would be attracted by the auxiliary collector thus reducing this effect. However, this was not the case. Lowering V_{AC} reduced this effect. There are too many second-order effects to evaluate what was taking place.

A video cable rack which is to be mounted next to the STRT has been designed. The necessary material for this rack is on order.

3.3 Research and Development (C. L. Corderman)

The first tube, RT333-C, with both a Faraday Cage and an ion-collector ring, has been checked for ion-deflection shift. The effect of the ion ring potential in reducing the shift took place predominately in the range from 0 - 25 volts below the third anode potential. Using an A_3 voltage of 150 volts, little further reduction in shift was obtained when the ion ring was taken below 125 volts. The holding-beam coverage was decidedly poorer with the ion ring below 125 volts, so that 125 volts seemed to be the optimum potential for the ring. Since the position of the ring had very little effect upon the ion shift, it was placed near the target where its effect upon holding-beam coverage was least noticeable.

Initially, with both the ring and A_3 at 150 volts, and 1.4 ma of holding-gun cathode current, the ion shift was somewhat less than for the same current in other tubes which had been examined. However, with the ring at 125 volts, the shift was reduced and the results were approximately those obtained with 0.4 ma cathode current (-20 volts holding-gun bias) and with the ring at 150 volts.

After a weekend of operation during which the current was held at 1.4 ma and the ring at 125 volts, the shift which occurred with 1.4 ma current and the ring at 150 volts was considerably smaller than had been previously observed. Furthermore, the shift was slightly worse when the ring was again lowered to 125 volts.

These conflicting results, plus the fact that the amount of shift observed depended upon the high-velocity-beam distribution, led to the development of a better method of measuring the deflection shift. This method is independent of the high-velocity-beam shape as long as it has a single peak, and measures the shift both horizontally and

3.3 Research and Development (Continued)

vertically by applying, at appropriate times, short gates to the deflection plates the amplitudes of which are just sufficient to maximize the cage current. The difference in amplitude between these gates for two different sensing times during the holding-gun cutoff gives a direct measure of the shift of the high-velocity beam.

On the basis of test results on RT333-C, a prototype ion-ring tube, RT334-C, has been constructed. This tube uses a regular screen frame ring, supported by four metal posts and placed two inches away from the auxiliary-collector frame. This tube will be tested during the next period, and further life testing of both tubes will be carried out using the new shift measuring equipment.

Pulse Readout (A. J. Cann)

During this bi-weekly period, a video amplifier was made out of an old r-f amplifier, and though the bandwidth is not what was expected, it amplifies the readout pulse very nicely. It is much more convenient to use than the two 514-D scopes in cascade.

Some attention has been given to a readout scheme using no filters, but using instead a sufficient bias on the first stage to offset the gate. The top of the gate will have to be clipped much cleaner than it is now to make this scheme work.

Type "L" Cathode (T. S. Greenwood)

Three tubes were processed during this bi-weekly period, RT326, RT327 and RT328. The processing schedule for each tube was the same as the basic schedule used on RT323; however, slight modifications were made. For RT328, the early part of the conversion was accelerated, and the entire conversion was accelerated for RT326 and RT327. The latter tubes behaved normally, but in RT328, the pressure drop, which marked the end of conversion, was considerably slower. However, all three tubes activated normally.

Tests on these tubes showed that the beam currents were not stable, but the instability disappeared after approximately fifty hours of operation. In one case, RT327, the initial instability was in the form of a decay with a time constant of about three minutes. Since in none of these cases did the cathode current show a corresponding instability, the trouble may have arisen from absorbed gases in the gun components.

A new method of mounting the cathodes was used on RT327 and RT328. Although it is not capable of giving the very small spacings between grid and cathode that are eventually desired, this mount appears to be satisfactory from the standpoint of reproducibility. Pending further work in this direction, this mount should permit more meaningful results in activation studies.

3.3 Research and Development (Continued)

Deflection Shift Test Setup (J. Jacobowitz)

The mode of operation for the deflection shift test setup has been revised. As it now stands, the unit has the following principal features: a.) provision for Faraday-cage measurements of deflection shift, b.) provisions for investigating pulse readout techniques, and c.) TV readout.

My attention is concentrated on attempting to explain and understand some of the waveforms obtained from the Faraday-cage measurements. Several oscillations have been observed in these waveforms. One of these oscillations takes place during the time the holding gun is cut OFF, and another occurs after the holding gun is gated ON. It is felt that both oscillations are related to the time rate of change in ion concentration at various points in the tube.

4.0 TERMINAL EQUIPMENT

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

Three of our five new "FL" Flexowriters have been modified and work on the fourth is now in progress.

One of the modified typewriters has been installed in room 222 for use as output "Printer #3".

A second modified "FL" has been delivered to test control for use in preparing tapes. This machine is available for use with the paper tape output system as "Printer #2" if occasion requires.

4.2 Magnetic-Tape System (K.E. McVicar)

Work on the magnetic-tape system is nearing completion. One electronic change, scheduled for this coming week-end, will leave only minor adjustments to be made on the circuitry. Reliability checking and some video signal tracing, for record purposes, remain to be finished.

The Raytheon units still require some work before we will have more than one unit available. Negotiations with Raytheon on this matter are in progress.

4.5 Magnetic Drums (K.E. McVicar, P.W. Stephan)

A tentative schedule for testing of the auxiliary drum system has been written. In addition, proposals have been made for video checks and a simple cycling test on the drum. The test equipment necessary for these operations is being assembled and checked.

Several circuits were designed which cycle a pattern around a drum track and check the transfers. Ways of recording various patterns of ones and zeros were found. Several circuits for changing a 0.1 μsec pulse to a 0.5 μsec pulse are being checked. The auxiliary drum circuits use a 0.5 μsec pulse as the standard pulse.

5.0 INSTALLATION AND POWER

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

The installation of racks in room 156 seems to be slightly behind schedule. However, it is still hoped that they will be completely installed by October 10.

Most of the wires that run between test control and room 156, test control and room 041, and room 156 and 041 have been cut and marked. The 4 x 4 wireways between room 156 and room 041 have been installed, except for the connections at the ends.

5.1 Power Cabling and Distribution (Continued)

Last Tuesday morning, some modifications were made to the Power Supply Control Panel #1 in preparation for the tie-in with the Power Supply Control System #2. It is planned to complete these modifications next Tuesday morning.

Due to Alpha wire not meeting their expected delivery of #10 twisted pair cable, this cable has been ordered from Packard Electric. (Delivery in three to five weeks.) This is a critical item, since this wire must be sent to Gavitt Mfg. to be fabricated into cables for the rack power distribution.

5.2 Power Supplies and Control

Whittemore D-C Supplies (J.J. Gano, R. Jahn)

The -15, -30, and +150 supplies as delivered by Power Equipment Company do not contain all the revisions that had been recommended as a result of our studies. The supplies will be set in operation immediately and as manpower permits, each in turn will be withdrawn from service and another supply substituted. After thorough testing, they will be revised to obtain improved performance.

Upon the installation of these three supplies, the -15, -30, -150, +120, and +150 will be regulated. The +90, +250, and -300 will continue unregulated for another month.

New Filament Alternator (G.A. Kerby)

The new MG set has been installed and the motor is ready to start. Static measurements of the parameters of the alternator and its exciter have been taken. The layout of assembly of the regulator has been started.

6.0 BLOCK DIAGRAMS (J.H. Hughes)

The new order, dm, Difference of Magnitudes, was installed 23 September. It replaces qf in order position 23. All the other "q" orders except qp were also taken out. This leaves order positions 6, 7, and 12 unassigned.

Some members of Group 61 have inquired about the possibility of putting in a "Subtract One" order. M-1649 is a memorandum which tells how it might be done.

(B.E. Morriss)

The printer for room 222 has now been installed. It responds to the si 216 (octal) order.

6.0 BLOCK DIAGRAMS (Continued)

It was pointed out that the in-out delay counter requires considerably longer to propagate a carry through all 14 digits than was assumed. This indicates the possibility of marginal operation at present and the necessity of changes in the block transfer orders. Timing is being measured to determine the extent of changes necessary.

The question of decimal indicators as a part of the in-out system has continually come up. A cursory look at available equipment some time ago did not reveal anything which would not involve considerable equipment and without considerable high-speed storage be very slow from the computer's point of view. The use of the buffer drum for the storage has been suggested and G. Young and myself will continue to search for decimal display devices. It would be appreciated if anyone having knowledge of such devices would pass the information on to us. It is impossible to intelligently investigate such systems without much better estimates as to the number which might be desired, and the approximate rate of change of data displayed in this manner.

7.0 CHECKING METHODS

7.4 Marginal Checking (T. Leary)

Two more test tapes are now available and are being worked into our daily marginal checking. T-2057 is a Photoelectric Tape Reader test. There is a short program block on the tape and the rest of the tape consists of test blocks. Once the program has been read in, the computer selects PETR and searches for a line identifying a test block. When it finds a test block it checks the 40 words of alternating ones and zeroes in the test block. The identifying line prevents the computer from trying to check the program block.

T-2060 makes use of all the intensification orders available as of the moment to display a diagonal line. The deflection positions are increased after each intensification by the smallest decoder increment, and after every 64 intensifications a new intensification order is selected. The program can easily be adjusted to test more intensification orders as they become available.

Each of these programs contains a pair of successive si orders whose only purpose is to complement the in-out switch. The PETR test does this just before each word is checked and the diagonal-line display each time the line is completed.

Programmed Marginal Checking System (D. Morrison)

The hinged rack to contain Model II Marginal Checking equipment is on order. Delivery is expected on or about 1 November 1952.

7.4 Marginal Checking (Continued)

Investigation of the Counter-Selector circuit is nearing completion and a panel layout sketch will soon be available.

John Hughes is designing the Relay Panel and expects to have circuit schematic and layout sketches ready for the Drafting Department early next week.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this bi-weekly period on each general applications problem is given below in terms of programming hours spent by laboratory personnel (exclusive of time spent by outsiders working on some of the problems), minutes of computer time used, and progress reports as submitted by the programmers in question.

11. Point-by-Point Scope Plotting of Alpha-Numerical Characters (Output Camera, O.C.): Kopley, 3 hours; WWI, 7 minutes

40. Input Conversion Using Magnetic Tape Storage: Helwig, 59 hours; Combelic, 40 hours; Kopley, 50 hours; Demurjian, 59 hours; Porter, 52 hours; Gilmore, 80 hours; Frankovich, 37 hours; Briscoe, 59.5 hours

The specifications for the PA routines which will be selected and read in automatically by the comprehensive conversion program have been decided upon and the programs have been written.

The PA routines to be included are the following: 30,0; 15,15; and 30-n,n; $0<n<15$. Each of these routines will provide an optional cycle control facility (B-box). Seven instructions are being provided to operate on the cycle control registers. Some of these will effectively perform many of the ordinary WW red tape orders. For floating point routines the dv order will be optional. For the 30-n,n PA routine a buffer register (b) can be added and operations can be added and operations can be performed in the 30,15 system in this register.

If optional features are not called for, they are not read in by the conversion program.

The adaptation program to set up for the read in of the combined PA and output routines is being considered.

The direct and five-fifty-six conversion programs have been written and tested successfully. A memorandum is being written which will describe their vocabulary, rules for type preparation and storage limitations. It will also include the general vocabulary for the comprehensive conversion program, which will use the paper punch output instead of magnetic tape. This is being done to decrease the trouble shooting problem which will be complicated enough without having difficulties, which might arise from incorrect magnetic tape programming.

The Comprehensive Conversion Program is still being written but is expected to be tested in the next bi-weekly period. The vocabulary and rules for its use have been tentatively frozen pending the discovery of a need for further additions or revisions, and will be described in a forthcoming memo.

The program will make extensive use of two magnetic tape units during the conversion process, enabling a decrease in the gross conversion time over what was previously required when only one tape unit was to be used as well as a

8.1 Programs and Computer Operation (continued)

simplified post mortem procedure.

Since the last bi-weekly many changes have been made in the output portion of the Comprehensive Conversion Program and other changes are under consideration. The programmer will now select output by a three letter combination. The first letter will be either S (scope), T (Typewriter), P (punch), D (drum) or M (magnetic tape). The second letter will be either O (output) or I (input). The third letter will be either A (alphameric), B (binary) or C (curve). If an "i" precedes the three letter output symbol, the output routine will be interpretive.

On the line following the three letter combination, the programmer writes a "model number" such as + p678.45 s $2^{\alpha} 10^{\beta}$. If the sign is a "+" then all numbers will be preceded by a "+" or "-". If the sign of the model number is "-", then only negative numbers will be preceded by a sign. If no sign is indicated, none will be printed. The "p" means that initial zeros will be printed. An "i" means ignore initial zeros and an "n" means normalize. If a letter is missing in this position, spaces will be inserted in place of initial zeros. The number of digits to the left and the number of digits to the right of the decimal point indicate the desired form of output. If no decimal point is indicated, none will be printed, such as in decimal integers or perhaps decimal fractions.

The next letter or letters indicate the terminal character after each word. An "s" designates one space, "ss" designates two spaces, etc., "t" indicates tab, "c" indicates carriage return and "f" indicates format (lay-out). $2^{\alpha}10^{\beta}$ indicates the scale factor used. When $\beta=0$, $\alpha=0$ and when $\beta=0$, $\alpha=15$ we have special cases of the scale factor. The former denotes decimal fraction output and the latter decimal integer. For any other α, β combinaion, the adaptation program will place a scale factor program parameter after the program parameter which follows the sp to the entry point of the output routine. Reference to previous bi-weeklies will be helpful in attempting to follow the above discussion.

73. Demonstration Program: Kostaras, 2 hours; Mackey, 12 hours; McQuillan, 8 hours

The demonstration programs are being rewritten using the new WWI orders and Flexowriter code. Four of the tapes have been successfully operated; two remain to be tested.

Computer time, hours	
Programs	9 hours, 45 minutes
Conversion	6 hours, 51 minutes
Demonstration	53 minutes
Total	17 hours, 29 minutes
Total time assigned	185 hours, 57 minutes
Usable time, percentage	92%
Number of programs operated	14

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 REPORTS

No.	Title	No. of Pages	Date	Author
E-480	Experience with General Electric G11A Transistors	4	9-17-52	J. F. Jacobs
E-481	Toggle Switch Inputs and Indicator Light Outputs as External Units	8	9-17-52	G. A. Young
E-482	Operation of Magnetic Tape Units	7	9-11-52	B. E. Morriss
M-1639	Bi-Weekly Report, September 12, 1952	28	9-12-52	
M-1643	Control Matrix Modifications to be Made 13 September 1952	1	9-18-52	J. H. Hughes
M-1644	Stock Control	1	9-23-52	G. A. Lexander
M-1646	Minutes of Test Equipment Committee Meeting of September 15, 1952	3	9-23-52	L. Sutro
M-1648	Calendar Refills for 1953	1	9-25-52	G. Lexander
M-1649	Proposed New Order sc, Subtract One	2	9-24-52	J. H. Hughes
M-1650	The Effect of Size of Metal Cores on Pulse Measurements	1	9-25-52	R. Jenney
A-140	Salvage	1	9-15-52	H. B. Morley
A-141	Mail Delivery	2	9-15-52	H. B. Morley

LIBRARY FILES

No.	Identifying Information	Source
2053	First Quarterly Progress Report-Square Hysteresis Loop Ferrite Development	General Ceramics & Steatite Corp.
2054	Automatic Control: Scientific American, September, 1952	
1974	A Numerically Controlled Milling Machine, Part I	M. I. T.
2056	Dual-Triode Trigger Circuits, Reprint	Electronics, July, '45
2057	Design of a Flip-Flop Circuit by Linear Circuit Analysis	A.I.E.E., 51-85
2058	A Symposium on Commercially Available General-Purpose Electronic Digital Computers of Moderate Price	Naval Math. Computing Advisory Panel

JOURNALS

Electrical Communication, September, 1952
Proceedings of the I. R. E., September, 1952
Machine Design, September, 1952
Research Reviews, September, 1952

9.2 Standards, Purchasing, and Stock

Procurement and Stock (H.B. Morley)

Arrangements are being made to use the new Lincoln Purchase Order forms beginning October 1. Some changes in departmental procedure will be necessary. Cost and account symbols will not be changed. Any requisitions after this date will be written: 6850-6, followed by account number, rather than as previously, 6889-6, followed by account number.

Orders for Burroughs test equipment have been placed with Control Instrument Co.

Delivery of the motor-generator set for Whirlwind power supply has been made. The contactor should be completed and delivered very soon.

Deliveries of steel items are not expected to be as good as during early Summer.

New personnel have been added to the Purchasing Office and are being trained.

A Memo outlining the intended stock control system has been issued, under Memorandum M-1644, to all personnel.

Mail deliveries will be helped if the addressee's initials are shown with the surname, as well as the room number; e.g., J.F. Doe, Rm. W-109, instead of merely "Doe", Whittemore.

Personnel requisitioning material are again reminded to allow maximum lead time on "date needed".

Standards (H.W. Hodgdon)

New or revised standards issued this period:

021-1 Capacitors, Fixed, Ceramic Tubular
022-1 Capacitors, Fixed Mica
026-3 Capacitors, Variable, Air Dielectric

Proposed standards have been drafted for coaxial connectors and for panel meters.

Standards for electron tubes and for selenium rectifiers are being prepared for printing.

It has been suggested that all non-standard components be removed from open stock as a means of insuring that only standard items are used in equipment design. This proposal will be discussed further with Stock Control to see if it will fit in with their plans.

9.2 Standards, Purchasing, and Stock (continued)

Preparation of standards sheets has been hampered recently by lack of personnel since our two part-time students terminated. It may be necessary to consider additional full-time personnel if sufficient part-time student help is not available.

9.3 Construction

Production Control (F.F. Manning)

The following units have been completed since September 12, 1952.

CR#	Qty	Unit title	Originator
1492-18	3	Plug-in Mounting Panel 19"	Watt
1492-32	1	Modify Plug-in Mounting Panel. Serial #9	Watt
1492-34	1	Modify Plug-in Mounting Panel. Serial	Manning
1633-3	3	A-C Circuit Breaker Box	Mercer
1647	1	Driver for Mag. Core Tester Serial #3	Brown
1767	500	Video Cables (Lab Equip)	Sutro
1767	60	D-C Power Cables (Lab Equip)	Sutro
1788	10	D-C Power Strips - 8 Plug (Lab Equip)	Sutro
1900-3	40	Filament Power Switch Panels	Sandy
1906-2	5	Microphone Cables	McVicar
1929	69	1:1 Pulse Transformer	Manning
1941	1	Ferroelectric Core Tester	Woolf
1953	2	Circulating Pulse Indicator	Gerhardt
1770	1	Generator for 4 Independent Pulses (Breadboard)	Briggs
1780	2	Generator for 4 Independent Pulses (Breadboard)	Briggs
1900-3D	29	External Power Cables	Sandy

The following units are under construction:

CR#	Qty	Unit title	Originator
1283	1	10 amp 600 V Rectifier	Hunt
1958	12	Core Drivers Mod. 5	Sutro
1965	8	Delay Line	S. Thompson
1492-27	1	Gate-Buffer Plug-in Unit	Watt
-28	1	Flip-Flop Plug-in Unit	Watt
-29	1	Dual Buffer Amplifier Plug-in Unit	Watt
-30	1	Switch Plug-in Unit	Watt
1684	10	Low Speed 26 Counters	Sutro
1793	5	Multivibrator Frequency Dividers	Sutro
1977		Tektronix Coupling Box	Sutro
2000-1	107	Video Cables	Norman
1905	1	Indicator Panel	Holmes
1617	1	-300 V, 5 amp Regulator	Kerby
1969	100ea	1:1 & 3:1 Pulse Transformers	Hunt
1805	1	Magnetic Tape Print-out Reading Amplifier	Farnsworth

9.3 Construction (continued)

CR#	Qty	Unit title	Originator
1633-4	50	Assemble Lab Bench Channels	Manning
1415	5	ST Mounts	Dodd
1767	500	Video Cables	Sutro
1778	3	Rack Power Control	Corderman

9.4 Drafting (A.M. Falcione)

1. New Drawings

	Cir. Sch.	Assy & P.L.	Al Panel
Power Supply for Fil. Alt. Reg. Mod II	C-52539		
Core Tester Model V	C-52170		C-52172
In-Out Register Input Mixer	SA-52595	SB-52596	
In-Out Switch, Mag. Drum Matrix	SB-52609	SC-52610	
Tektronix Coupling Unit	SA-52350	SB-52351	
Indicator Panel Mod II	B-52576		
Aux. Supply for Power Supply Test Load	C-52383	D-52408	D-52536
MTC Power Supply Test Load	C-52384	E-52496	D-52572 C-52573 C-52571
Two Way Switch Unit	C-52618	C-52618	

2. Toroid Coil Winder

Beacuse of additional changes found necessary in our checking process, complete drawings will be processed on or before our next bi-weekly day.

10.0 GENERAL

New Staff (J.C. Proctor)

Edward J. Craig is a Research Assistant working in Professor Linvill's section. He has a BS in EE from Union College and is working toward his doctorate in the EE Department at MIT.

Michael Geraghty, a new staff member in Wieser's group has a BS in Mathematics from the University of Notre Dame.

John Goodenough, an AB in Mathematics from Yale has also a Master's degree and a Doctor's degree from the University of Chicago. He has had experience as a Weather forecaster, a research assistant at the University of Chicago, and as a Research Engineer in the Westinghouse Laboratories. He has been assigned to work in Dave Brown's group.

10.0 GENERAL (continued)

Hubert Henegar, a new member of Norm Taylor's group has a BS in EE from the University of Toledo. He has experience as a radio relay team chief in the Army.

Arthur Hughes, a Research Assistant assigned to Norm Taylor's group has a BS in EE from the University of Virginia and had experience as a customer's engineer at IBM.

Stanley Oken, a Research Assistant working with Norm Taylor, has a BS in EE from the College of the City of New York and has worked as a student at the U.S. Naval Air Development Center.

Charles Simmonds has a BS in EE from the University of Utah and experience at the Bell Telephone Laboratories in the training school. He is a Research Assistant assigned to Norm Taylor's group.

Hilda Uchiyamada, a new member of C. Adams' group has an MA from Hunter College in Math and Physics and has also completed some of the work toward her doctarate. Her experience covers an Assistant Professorship in Physics at Champlain College, a power plant unit leader for Republic Aviation Corp. and a Jr. Physicist at the University of Chicago Metallurgical Laboratories.

Keeva Vozoff has a BS in Physics from the University of Minnesota and a MS in Geophysics from Penn. State College. He is a Research Assistant working toward his doctorate in Geophysics and has been assigned to work on the oil reservoir project in Adams' group. He has worked previously as a Geophysics Engineer for Phelps Dodge Corp. and a Graduate Assistant at Penn State College.

Staff Terminations (J.C. Proctor)

Donald Aronson
Donn Combelic
Walter Drogue
John Nolan
Manuel Rotenberg

New Non-Staff (R.A. Osborne)

Joyce Bowers is a new secretary in the Personnel office.

Eleanore Crockett has joined the Purchasing Department as a secretary.

Francisco DaCosta is a new Lab Assistant in the Construction Shop.

Roger Eastman has also joined the Construction Shop as a Lab Assistant.

John Knight is a new member of the Whittemore janitor crew.

10.0 GENERAL (continued)

Richard Markham is an MIT student working part time in the Storage Tube Group.

Delight Nease is a new Clerk Typist in the Purchasing Department.

Joseph Rodriguez is an MIT student working on a part-time basis for Paine.

John Shea is a Harvard student working part time in the Applications Group.

Holly Ward has returned to work in the Applications Group. He is a student at Boston University.

Kathleen Wertz is a Laboratory Assistant working in D. Brown's group.

Frank Yates is an MIT student working part time for Watt.

Non-Staff Terminations (R.A. Osborne)

William Antoine
Salvatore Caso
Roland Favreau
Marion Jones
Gerald Lampke
Joane Nichols
Leo Piecha
Milton Toorans
Alvan Tritter