Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: PROJECT GRIND MEETING OF JUNE 25, 1953 (Second Day)

To: AN/FSQ-7 Planning Group

From: A. P. Kromer, R. P. Mayer

Date: June 29, 1953

Abstract: At this meeting marginal checking, power supplies and magnetic memory were discussed. It was generally agreed that more work remains to be done on marginal checking andpower supplies before decisions can be made, and that the memory section was more firmly established.

Members Present:

I.	Aronson*	MIT	J.F.	Jacobs	MIT
M.M.	Astrahan	IBM	A.P.	Kromer	MIT
P.A.	Beeby*	IBM	R.P.	Mayer	MIT
R.L.	Best	MIT	J.L.	Mitchell**	MIT
D.R.	Brown**	MIT		Moyer*	IBM
W.J.	Canty**	MIT	W.	Ogden**	MIT
J.M.	Coombs	IBM	K.H.	Olsen	MIT
R.P.	Crago	IBM	W.N.	Papian**	MIT
D.J.	Crawford	IBM	R.J.	Pfaff	MIT
N.L.	Daggett	MIT	M.J.	Raffensperger	IBM
N.P.	Edwards	IBM	E.S.	Rich	MIT
R.R.	Everett	MIT	H.D.	Ross	IBM
R.S.	Fallows*	MIT	G.F.	Sandy*	MIT
R.G.	Farmer *	MIT	N.H.	Taylor	MIT
W.	Fitzgerald*	IBM	L.	Walters*	IBM
J.J.	Gano*	MIT	W.	Whittenberg**	IBM

I. Marginal Checking

Memorandum M-2202 states the existence and function of the marginal checking group. Although further study need be made by this group, it is desirable at the moment to obtain some idea of how to break down marginal checking lines so that electronic design of the logical progress can proceed and so the power supplies can be worked out.

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* Present at Marginal Checking and Power Supply discussion only.

** Present at Memory discussion only.

It was agreed that no mechanical marginal checking will be built in.

The capacity of the marginal checking generator must be such that it can carry any circuit to failure although this capacity may not be used in most cases.

It was generally agreed that no more than two hours a day will be available for process of marginal checking itself. The basic philosophy should be that "if a part starts to deteriorate or is different from other circuits, it should be replaced."

Whole circuits must be marginal checked. (This may be done by varying the voltage on adjacent circuits in some cases.)

It is not necessary to locate an error more precisely than to the pluggable unit containing it.

All procedures and variable voltage lines must be manually controllable through simple circuits and any automatic equipment decided on later can make use of the same lines. Someone must study the methods of setting excursion limits for use in automatic (or manual) operation. It must be possible to service and repair all marginal checking equipment without interrupting computer operation.

Marginal checking lines will be arranged and grouped roughly as follows: (an illustrative example will be presented next week).

(1) A single line will connect to all circuits, in a unique logical section, which have the same supply voltage and approximately the same percentage margin. A "unique" logical section is to be defined in such a way that each pluggable unit being checked should be fed by and fed into ones which are not being checked (it is suspected that no more than 170 lines will be needed in the central computer including magnetic memory).

(2) All lines, having the same supply voltage and the same percentage margin, in a physical frame (gross logical division) can be varied together.

(3) All lines having the same supply voltage and same percentage margin, in the whole computer can be varied together (perhaps by varying power supply). It should be mentioned that Norm Daggett thinks this type of control would be excellent.

A marginal checking procedure using the above arrangement of lines was suggested as follows:

(a) With a check program running, marginal check all group lines (see (3) above) to see if any of this is wrong. Log any trouble and proceed to (b).

(b) If a failure occurs in one such group, split that group into subgroups (see (2) above) and vary each subgroup. Log the trouble and proceed to (c).

(c) Depending on the particular frame discovered to be in trouble, insert a diagnostic program and/or split the faulty subgroup into individual lines (see (1) above) and vary each one.

(d) Replace the faulty pluggable unit or log trouble to be fixed later.

Automatic equipment for any and all of the above procedure should not be provided unless it is sufficiently simple.

Automatic or manual procedures must not cause unreliable nor electronic damage nor serious logical damage (writing between pockets on the drum, etc.).

It was agreed that further investigations should be carried on in connection with diagnostic programs and techniques for automatically logging troubles and margins. Study of the application of marginal checking to power supplies and air conditioning equipment should be made.

II. Memory

The memory section was discussed next. It is fairly well established that magnetic memory will contain 4,096 registers, 33 bits each (including one parity bit) in a 64 x 64 x 33 core array using a 2:1 current ratio selection scheme.

It was definitely decided that everything should have sufficient capacity so that a complete second memory can be added later without redesigning of logic, air conditioning, power supply, room space, etc., although a second memory may not actually be built for sometime.

A memory cycle was proposed which required 7 3/4 microseconds for a complete read-write time from one strobe to the next. It was agreed that every attempt should be made to obtain a faster memory cycle. It may be possible to make memory cycle faster due to the following details which could be possible eliminated: a post write disturb pulse requires 1/4 to 3/4 microsecond longer than the memory address register setup time depending on how the M. Adr. Reg. is read into. It is possible that a post write disturb is not necessary or that it can be made no longer than the M. Adr. Reg. setup time. 1/2 microsecond is used for staggering the read pulses in order to reduce noise. An additional 1/2 microsecond is used for staggering write pulses if at somewhere drivers are used in the system which uses stagger read. Stagger read might be ommitted if 4 sensing lines per plane are used instead of the 2 which were proposed at the meeting; but this would probably require extra sensing amplifiers adding 528 cathodes to the system unless low level gates could be used. Such techniques will be investigated.

MIT will check to see if cores must be tested specially to make use of the stagger read system.

The sensing amplifier will use a balanced input and amplifier, full wave rectification taking place immediately preceding strobing gate.

It was agreed that people should concentrate on developing transformer driving systems. A crystal translator (matrix switch) will control cathode drivers which drive the driving transformers. IBM will study the 6146 and 7AK7 tubes as transformer drivers and MIT will study the 5998 tube (a direct vacuum tube driver without transformers). It was generally decided that a few spare planes should be wired into the memory array for emergency use. Perhaps the complete memory cube will be pluggable but independent planes will definitely not be pluggable. Perhaps 2 planes will be sewn together as one assembly but probably not more than 2 (although investigation is being made on the possibility of sewing the whole cube). The cube will probably be about 1' x 1' x 2 1/2'. It took 2 man weeks to wire an MTC plane, so careful production schedules must be made immediately.

The memory cube must be air conditioned to ± a few degrees Centigrade. This will probably require a separate low velocity recirculating system with thermostatic control of injection of cool air from the main system.

III. Power Supplies

This was the first major discussion of power supplies and few decisions were reached although some major decisions and ordering action are required soon, since power supply equipment is required very early in the installation period. It was decided that there will be a diesel generator unit provided for XD1 for practice with such a device. Details will be decided later. The water cooling portion of the air conditioning system will be broken into several sections or units (perhaps 4) for reliability.

Rotating machines will be used between the line and all power supply regulator units in order to isolate the system from transients at the power source and within the AN/FSQ-7 Central. At least 1 spare machine will be provided. The motor and generator sections of each machine must be separate in order to prevent capacatative coupling of large transients. A 208 volt system was suggested (120 volts, 3 phase, 4 wire).

In general, any standby power unit should be able to take over within one minute of power failure.

Filaments will cycle up (when starting) from some voltage (not necessarily Zero) to a final voltage which will be regulated. They will be cycled off except in an emergency when another supply is going to be flipped on.

Estimated requirements for AC power needed for computer and associated equipment is 200-250 KVA with approximately 100-150 KVA for air conditioning, lights, etc.

The DC should be regulated to roughly 0.3% for any type of load variation or to within about 2% if all types of variations were cumulative in the worst way. (The following types of variations were mentioned: 95% steady change of load, 80% transient change, 98% change at any frequency, ripple and immediate drift). Estimated voltage requirements are -450, -300, +250, ± 150, +90, -30, +15. High voltage for scopes might be by way of low voltage high frequency system. The estimated DC power requirements totals about 56 KVA.

The logic and planning group should help define power supply number of units to use, number of standby units, etc. All this depends on methods of operating during breakdown, methods of marginal checking, etc.

The method of sequence power on and off must be designed to prevent writing undesirable information on the drum or between slots on the drum even when emergency cut-off drops everything considerably (emergency cut-off probably should not drop air conditioning system).

It must be possible to apply power to any large logical block without disturbing power supply to the rest of the system.

Signed A. P. Kromer

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