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M-135

TO: E. L. Ginzton, R. B. Neal and J. V. Lebacqz

FROM: T. F. Turner

SUBJECT: "M" Modulator Switch Investigation

1. Since so many aspects of the modulator design depend on the choice of switch it is very important to determine at an early date which switch or types of switches may be applicable.

Specifically, the following things depend on switch characteristics:

a) Network impedance and transformer ratio are dependent on hold-off voltage and current handling capacity.

b) Pulse rise and decay times and total network capacity are in turn somewhat dependent on transformer turns ratio.

c) Cost of network and transformer to meet droop and ripple requirements are a function of network impedance.

d) Type of charging circuit is dependent on switch deionization time.

e) Complexity, cost, and reliability of trigger circuit are dependent on the nature of the switch chosen.

f) Total tunnel air and water supply requirements, as well as total machine reliability and annual maintenance costs are effected.

2. Considerable investigation (See Memo of 6-24) narrows the possible choices to these so far as we know today:

a) Spark Gaps:

1) Air cooled or pressurized types
2) Vacuum types

b) Thyratrons

c) Ignitrons

For the time being magnetic modulators and hard tube modulators are ruled out as being too inefficient and costly.

3. The following measurements are proposed for each of the types of switches listed above:

a) Hold-off voltage

b) Deionization time

c) Jitter

d) Voltage drop during pulse (Power dissipated)

e) Life expectancy.

Fig. I, shows the kind of circuitry required to test the most complicated switch under consideration - the ignitron.

Fig. II, illustrates two approaches for measuring voltage drop during the pulse. This circuitry is given to illustrate the nature of the solution to the problem and because it influences the cost estimates given below.

Fig. III, illustrates the idea of delayed charging and shows how, within limits, deionization time can be increased at the cost of increased peak charging current.

4. Recommended procedure: If financing for this program is available I suggest the following:

a) Place orders for at least one high power supply.

b) Draw up specifications for and order as soon as bidding procedure allows, all auxillary equipment required.

c) Convert room #42 to a temporary laboratory for this purpose.

d) Hire or transfer adequate manpower for the project. The manpower required will require more thought to determine, but approximately one engineer and one good technician in addition to shop and tube shop support.

Cost Estimate:

So far only capital equipment has been estimated. Labor, cost of wiring lab. for 480 v. power, raw materials for new switch development, cost of power, etc. are still to be determined.

Equipment Costs

Power Supply	$22,000
Charging Choke	500
Hold-off Diodes (or Triodes) Experimental	300
" " " Filament Transformers	375
Adjustable network capacitors (250 Joules)	3,000
High Power Load	1,000
Ignitor Modulator	900
Control Grid Modulator	700
Trigger Amplifier	1,200
Trigger Generator	500
Delay circuits	525
Gate Amplifier	800
Oscilloscope	1,500
Vacuum Pump	500
Misc. Circuitry, Instruments, etc.	2,500
	46,300