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SUBJECT: Project M Instrumentation

Contents:

The construction of a control and monitoring console is proposed. It will be used both as a test bench for Project M instrumentation problems and as the permanent and improved control console for Mark IV.

A drawing of the console and schematic diagrams of a telemetering equipment and of a video system are attached. These have been used as a basis for a cost estimate. The estimated cost is \$7,700.

Sixty to ninety days of an electronic technician's time, forty-five to sixty days of an electrician's time and sixty to eighty days of a machinist's time are required as an average.

Stepwise construction of a new control and monitoring console for Mark IV is proposed. Its purpose is twofold: to have the opportunity to test new means of monitoring and control, and to improve the operation of Mark IV. The accent, of course, is on the first statement.

The test program comprises the following points:

- 1) Use of digital monitoring of the overall performance of the accelerator.
- 2) Use of telemetering and associate display.
- 3) Use of new means of display.
- 4) Use and evaluation of selector-operated video system.
- 5) Distinction between essential and secondary monitoring and control items.
- 6) Human engineering evaluation of the operation.

And now a few details:

1) The digital monitoring means and the associated printer will furnish a tape-printed logbook of the operation. It is composed of a sampler, (motor-driven commutator) or else, a digital voltmeter and visual readout and a printer. A measurement can be read and printed every 2 seconds. Such quantities will be recorded as: klystron power

and voltage, gun parameters, pressures, etc. Such a round of measurements can be repeated every 5 or 10 minutes.

2) Telemetering is not a duplication of what is obtained by digital means. It allows a continuous monitoring of parameters of interest. If a very low-speed scanning is employed telemetering and digital monitoring can be united in one system. This combination may be interesting to evaluate. Anyway, it seems worthwhile to find out how reliable is the telemetering system indicated in the enclosed schematic diagram; to determine its response, its temperature stability, how it behaves in the presence of noise and which are the best displays to be used in connection with it.

3) New types of displays, such as small rectangular cathode-ray tubes, neon lamp proportional indicators and neon-tube indicators are the means which will be tested both in connection with the telemetering equipment and as separate units.

4) The testing of a video system is planned. It will require one sectionalized cable and a relay system operated by a telephone-type selector circuit.

5) The console will be constructed with plug-in panels in such a way that after an evaluation of essential and secondary components it will be possible to give to it the best possible structure. Non-essential elements will be gradually eliminated. The purpose is to obtain a control console with the minimum number of control or monitoring means. At the same time, human engineering aspects of a rational control console will be examined. It is mentioned in this connection that a glass board will be built with an outlay of the accelerator and the principal indicators on it, similar to the board used in railway centers and power stations. It is reasonable to suppose that the surveillance of the accelerator will be greatly facilitated by a display of this type.

Cost Estimate

A. Telemetry Equipment, 4-channel

1	Phasing circuit	\$50		
4	Multisars	40		
4	Monostables	20		
4	Gates	40		
3	Delay lines	30		
8	Compensated amplifiers	40		
4	Totem poles	40		
4	Receiving gates	40		
4	D.C. restorers	10		
4	Filters	80		
4	Displays	120	to	\$400.
		570	to	850
	Unforeseen expenses 20%	114		170
		\$684		1,020

B. Digital Equipment

1	Scanner	\$200		
1	Digital voltm.	1,000		
1	Printer	1,000		
		2,200		
	Unforeseen expenses 10%	220		
		2,420		

C. Video System

1	5-point selector unit	\$1,500		
10	Coaxial switches	500		
		2,000		
	Unforeseen expenses 10%	200		
		2,200		

D. Mechanical Structures, etc.

1 C-unit console	\$900
1 Indicator board	250
Cables and wires	200
Various hardware	500
	<u>1,850</u>
Unforeseen 20%	370
	<u>2,120</u>

Total Cost:

Telemetering equipment	\$1,020
Digital "	2,420
Video System	2,200
Mechanical	2,120
GRAND TOTAL	<u>\$7,760</u>

This estimate is based on the assumption that all the equipment existing on the present Mark IV control-console can be utilized.