

Report M-170

March 15, 1960

File Electric Power Utilities Committee

PCE

TWO-MILE LINEAR ELECTRON ACCELERATOR

INTERIM SPECIFICATIONS CHANGE

MODULATOR DC POWER SUPPLIES REQUIREMENTS

MEETING

Monday, March 14, 1960

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SUMMARY

The following changes in the Project M Specifications, Issue No. 1, dated September 11, 1959 are hereby recommended. Reference is made to section E which should be revised to read as follows:

E. <u>MODULATOR POWER SUPPLIES</u>	<u>Stage I</u>	<u>Stage II</u>	<u>Note</u>
* Total number required	32	122	13
* Number of modulators per power supply	8	8	14
* Average power output per power supply (max)	648 Kw	648 Kw	15
* Output voltage range (before charging choke)	50-100 %	50-100%	16
* Input voltage	12 Kv, 3ph	12Kv, 3 ph	
Total connected input power to modulator power supplies	20.9 Mw	83.6 Mw	17
* Total power system connected load	22 Mva	8.8 Mva	18
* 13. Including two spares	<u>NOTES</u>		
* 14. This number (8) appears to be the optimum number of modulators per power supply on the basis of economy, Stage I operation of (1) power supply per sector, conservative system diversity, and moderate equipment ratings. Refer to the <u>Discussion</u> section below.			

- \* 15. Power supply average power output is based on obtaining 64 Mw peak klystron beam power (max.), 73 Kw average power output from each klystron modulator, and 90% modulator efficiency and  $1.15 \times 10^{-3}$  duty cycle.
- 16. Output voltage range is determined by klystron tube peak power operating levels. (64 Mw max. and 19 mw min.) and 8% rectifier circuit regulation.
- \* 17. Total average input power to modulator power supplies is based upon 73 kw output power per modulator and 83.5% combined modulator-power supply efficiency.
- \* 18. System demand based on an estimated ratio of kva/kw = 1.05 for the particular full wave rectifier circuit used.

\* Denotes change from original or addition to Issue No. 1, dated September 11, 1959.

#### DISCUSSION OF POWER SUPPLY SIZE COST

The cost of changing from 10 power supplies to 30 power supplies is \$650,000 for AC switchgear, DC cable, etc and \$250,000 in power supply components cost. Thus for a total of \$900,000 the following applies:

#### DISCUSSION OF POWER SITUATION

Failure of any part of the machine should be of less than 2 seconds duration or should not result in a spectrum shift of more than 0.5 % in beam energy. This applies to the whole machine or to the use of any fraction down to 1/5 of the length.

Failure of a modulator power supply would require an off period of 60 seconds while one of the spare power supplies is adjusted to correct voltage and switched in. Such failure is expected at very rare intervals.

The choice of 30 power supplies provided for the selection of more closely matched groups of klystrons. This choice of one power supply per sector implements the phasing adjustment of a sector and maintains the phase adjustments within the sector when power level is to be changed. The choice of these smaller power supplies keeps the fault current (as well as the crowbar) moderate in size.

System reliability demands that we have 2 spare power supplies as well as a double bus system.

Although 3000 Kw DC power supplies have been built, the smaller 650 Kw units seem less dangerous in the event of a filter capacitor failure.

Accurate information is needed on the number of klystrons to be used in the test (formerly "prototype") accelerator. Numbers from 4 to 32 have been heard.

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