Title
MINUTES OF MEETING OF MTA ACCELERATOR COMMITTEE HELD MARCH 29, 1951

Author
Ball, R.H.

Publication Date
1951-03-29

UCRL-1212

c.2

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MINUTES OF MEETING OF MTA ACCELERATOR COMMITTEE
HELD MARCH 29, 1951

Present: UCRL: Alvarez, Baker, Farly, Gordon, Lofgren, Longacre, McMillan, Norton, Panofsky, Wallace

CR&D: Chaffe, Davis, Fossati, Hildebrand, Maker

AEC: Ball

There was a discussion regarding the use of gap splitters and the point in the Mark II machine at which they should first be installed. Panofsky said a more detailed design of the gap splitters will have to be developed before this question can be answered.

The question of control of power to drift tube magnets was discussed. Panofsky said the focusing is being designed to maintain the beam at a constant diameter. It may be desirable to contract the beam slightly to allow for some misalignment of drift tubes which would result in an increased requirement for focusing power by an amount which is unknown but which will probably not be greater than 50%. Since there will be come deuterons accepted in the first gap which will not be successfully accelerated for the full length of the machine it is desired to run the first few drift tubes on the verge of beam stability so that what beam loss must occur will take place in the low energy end of the machine. Beyond the first few drift tubes it will be desirable to run with high stability. Panofsky said that radial and phase oscillations have been calculated and the period of oscillation is a distance corresponding to about 20 drift tubes. The particles will feel only the average focusing effect over approximately a quarter wavelength which will correspond to about 5 or 6 drift tubes. This will permit the drift tubes in the high energy end to be grouped in sets of approximately this number for power supply purposes. The first dozen or so drift tubes will require a higher degree of individual adjustment. It was felt that the first half dozen drift tubes must be supplied with individual power controls to permit the magnetic fields to be controlled all the way down to zero field. For about the next half dozen drift tubes they could be grouped in pairs and provided with a moderate range of power control and beyond the first dozen the drift tubes can be grouped together in sets of 5 or 6 per power supply and provided with only nominal power regulation. Panofsky said the predominant defocusing factor in the first few drift tubes will probably be that of space charge. If one over-focuses in this region one will introduce radial oscillations of large amplitude and thereby increase the difficulties of focusing in the high energy end of the machine. One therefore needs to provide sufficient magnetic focusing in the low energy end to counterbalance these defocusing forces so that focusing of the high energy particles will be more easily accomplished. Since we must provide for starting with a very small initial beam it is necessary to provide for individual controls on the first few magnets to permit the magnetic fields to be reduced essentially to zero. Hildebrand said they will undertake to study the advantages of parallel and series wiring of the drift tube magnets at the high energy end and will also study the use of rectifier versus MG set power supplies for these drift tubes for which the range of power regulation necessary will be small.

Hildebrand asked when the load characteristics would be known to within 10% so as to permit CR&D to go to bid for the power supply. Panofsky said this would require about one more month.

Baker reported on his recent visit to the Lancaster, Pennsylvania, plant of RCA. He said construction has begun on the building which will be used for the development program of the 2332 tube. RCA is presently studying means of increasing the power output of the 2332 by such means as lengthening or broadening filaments and possibly increasing the plate voltage. He said he had discussed the problem of cluster oscillators and had uncovered two screen grid tubes suitable for driving the 2332 Eimac. One such tube is the Eimac 4 W 20,000 A and the other is the RCA A-2505.

Hildebrand said that during the discussion of oscillator power requirements for a 125-milliamp beam the question was raised as to whether the Mark II machine should be designed for pulsed operation or for CW operation at the same average beam load. It was agreed that specifications would be completed on the basis of pulsed operation but that CW operation with a 100-milliamp beam would be investigated further. The specifications for the power supply for pulsed operation are now nearly ready to go out for bid. Fossati presented the data tiven in Tables 1, 2, and 3, giving a comparison between operation of Mark II pulsed or CW with a 100-milliamp beam.

Analysis of Power Requirements for PW and CW Operation of Mark II with a 100 ma Average Beam

	PW With MG Sets	CW
Peak RF power (MW)		
Skin losses (peak)	54	54
Beam power (peak)	175	35
Average RF power (MW)		
Skin losses (average)	13.5	54
Beam power (average)	35	35
Total	48.5	89
Average D.C. power (MW)	65	118
Average A.C. input (MW)	76	140

Table 1.

Cost Analysis for PW and CW Operation of Mark II with a 100 ma Average Beam

	PW With MG Sets (megabucks)	CW With MG Sets (megabucks)	CW With Tap Changers (megabucks)
Cost of power supply from rectifier transformers to DC distribution cubicles, inclusive	5.5	5.5	5.5
Oscillators and transmission lines	8.5 (40 clusters)	5.7 (26 clusters)	5.7 (26 clusters)
Motor-generator sets	3.5	4.5	--
Tap changers	--	--	1.5
Total purchase cost of affected electrical equipment	17.5	15.7	12.7
Installation cost of electrical equipment	3.5	3.1	2.5
Extra distribution system and transformers	--	1.0	1.0
Installed cost of extra water cooling facilities	--	0.8	0.8
Total cost of affected equipment	21.0	20.6	17.0
NET CAPITAL SAVING	--	0.4	4.0
Power cost for cavity (per year)	2.2	3.9	3.9
Power cost for water cooling	0.056	0.18	0.18
Total power cost(@ 4 mils/KW hr and 80% load factor)	2.26	4.08	4.08
NET ANNUAL SAVING IN POWER COST	1.82	--	--

Table 2

Relative Advantages of PW-vs-CW Without MG Sets

	PW	CW Without MG Sets
Spark down as seen by power line	76 MW + 10% = 83.6 MW max.	140 MW
Ratio of beam load to skin loss	10 x limits of experience but startup can be at lower beam.	2 x limits of experience. Does not demonstrate ratio required for high beam CW.
Control of power supply	?	?
Future increases in capacity	By conversion to CW	Can be accomplished gradually and more easily.
Capital payout	Extra capital cost pays out in two years of PW operation.	Saves money if beam is increased in less than two years.
Power and communications problems	--	More difficult for power company and communications interference.
Target problem	--	Directionally easier but no tangible saving and is poorer test of high beam CW operation.
Injector beam density	--	Easier but not a tangible advantage.

Table 3

The consensus of the meeting relative to the three alternatives was: (a) If the power company will permit us to operate CW without MG sets it would be desirable for us to do so. (b) If the power company insists on the inclusion of the MG sets the advantages of CW operation are uncertain. (c) Pulsed operation is less attractive. This opinion was based on the assumption that early CW high beam operation is anticipated. This implies, therefore, that the target and accelerator cooling surfaces should be designed to permit an increase to a 500 ma beam without major rebuilding.

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