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(March 19, 1947)

UNITED STATES
ATOMIC ENERGY COMMISSION

SECRET

COVER SHEET AND ROUTE SLIP FOR CLASSIFIED MATERIAL

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MINUTES OF MTA PROGRESS MEETING
TUESDAY, JUNE 27, 1950

Present: UCRL: Alvarez, Baker, Brobeck, Dexter, Farly, Gordon, Latimer, Lofgren, Longacre, Martin, Norton, Powell, Reynolds, Sewell, Street, Twitchell, Van Atta*

CRDC: Cope, Hildebrand, Kent, Powell

AEC: Ball, Dean, English, Fidler, Thomas

*Consultant

Brobeck said that recent calculations on the differential analyzer at UCLA indicate that the effect of using an injection voltage of 80 kilovolts in place of the formerly planned value of 300 kilovolts will require the insertion of an additional drift tube in Mark I. In the new design there will be $8\frac{1}{2}$ gaps as well as $8\frac{1}{2}$ drift tubes. The calculations on the differential analyzer have allowed determination of the dimensions and spacing of the drift tubes, which are as given in the table below:

(The data below are from UCRL-771 (Rev.) and give more detail than was presented at the meeting)

DIMENSIONS IN FEET

Drift Tube	Diameter	Length	Gap Diameter	Distance from front wall of tank to center of Gap	Distance from front wall of tank to center of Drift Tube
0	10.0	0.24			
			0.358	0.4165	
1	9.58	1.63			1.407
			1.07	2.5855	
2	9.17	2.72			4.307
			1.786	6.210	
3	8.75	3.81			8.657
			2.40	11.285	
4	8.33	4.89			14.457
			3.0	17.8155	
5	8.33	6.04			21.749
			3.0	25.8795	
6	8.33	7.26			30.617
			3.0	35.562	
7	8.33	8.53			41.145
			3.0	46.945	
8	8.33	9.87			53.415
end wall				60.110	

The magnetic field requirements for these new drift tubes have changed only slightly from their former values. The magnets for the last four drift tubes will remain as before but new magnets will have to be designed for the first 4 drift tubes. The magnetic field requirements for drift tubes 5, 6, 7, and 8 will be, respectively, 4700, 4300, 4000, and 4000 over a distance of L/2 and the existing designs for these drift tube magnets will allow the attainment of these fields and will also allow them to fit within the redesigned drift tubes. The power requirement for drift tube No. 1 has now gone up again to about 200 kilowatss. Alvarez inquired as to how thoroughly the orbits for the ions had been worked out. Gordon said a detailed analysis has not yet been made. The field strengths are now well known by relaxation methods; however the phase acceptance and field requirements are still not well known. Gordon said that one problem that has appeared due to the reduced length of the first two drift tubes is that they are now so thin as to be difficult to mount by a supporting stem.

Sewell reported that the last two weeks has been spent in determining the positions of drift tube stems on the 1/10th scale model. The drift tube stem has been tried experimentally in three positions. The first position is that where the drift tube stem is perpendicular to the drift tube axis and meets the drift tube at its midpoint. The second position is that in which the drift tube stem is attached to the drift tube at its midpoint but is at some angle slightly less than 90 degrees with the drift tube axis. The third position is that in which the drift tube stem is perpendicular to the drift tube axis but joins the drift tube slightly off center. Position 1 does not give a minimum value for the induced voltage on the stem. Position 2, depending upon the angle between the drift tube axis and the stem, will minimize either the power loss or the voltage between the stem and liner. Position 3 can be made to minimize the voltage on the stem. However, the differences among the three positions with respect to energy loss are rather small, so that actual positioning of the drift tube stem is not critical. Therefore, the primary criteria for positioning the drift tube supports will be that of mechanical suitability. A typical situation to be found on a drift tube stem in the full scale Mark I accelerator will be an induced voltage of 1000 volts, giving an rf current of between 150 and 300 amperes and requiring 500 $\mu\mu$f. Capacitors suitable for this purpose come in sizes of 250 $\mu\mu$f so that a ring of about 20 of these would suffice for each drift tube stem. A drift tube position as described in case 3 above, in which the stem is maintained perpendicular to the beam axis but displaced three or four inches (full-scale), gives a 0 induced voltage on the stem. Alvarez asked what was the effect on the Q of the machine when the by-pass condensers are inserted into the tank. Sewell does not know this yet, but the shunt impedence of the 1/10th scale model is roughly 42 megohms. For the full-scale machine this would be multiplied by $\sqrt{10}$ to give about 130 megohms shunt impedence for the full-scale machine. Baker said that the current on the drift tube stem could also be by-passed through the use of a transmission line, but this would require more space than the use of condensers. Sewell said that measurements of magnetic forces between adjacent drift tubes have been made and the maximum force found was about $1\frac{1}{2}$ tons between magnets 1 and 2 (this being the force between these drift tubes when they are the only 2 magnets carrying current). Sewell said he had been making measurements of the shunt impedence for the full-scale machine, giving these data to Longacre so that calculations can be made of the required length of

Mark II. Sewell reported on the experiments to measure the field penetration into the drift tubes on the 1/10 scale model by the BB test and said they found difficulty in this method since the quantity being measured was the shift in frequency of the cavity which, being proportional to E^2, limited the accuracy to 25% for determining small values of E. [Ed. note: These measurements are being continued on a more rigidly constructed 1/20 scale model using more refined instrumentation.]

Lofgren reported there has been but little change to report in his work on the ion source development during the past week. His best results now are the obtaining of a 500-milliamp d.c. beam focused to a spot of about 3/4 inch diameter and with an energy of 65 Kev. He said that increasing the diameter of the perforated concave anode structure at the end of the arc block does not materially increase the beam current which can be withdrawn from the arc. The reason for this is apparently that the ions which are drawn out from the outer annulus of this concave depression serve as an electrostatic shield to prevent penetration of the extracting field to its central portion. He said he was planning experiments in which the concave portion of the anode structure would be perforated only in an annular region in order to determine the dependence of obtainable beam current as a function of the size of such an annulus. Baker suggested using a grid placed across the perforated area but Lofgren said he preferred to avoid such a technique because of the difficulty of obtaining any reasonable life for such a grid and also due to the difficulty of holding the 80 kilovolts which will be required on the full-scale ion source. Lofgren said that their best value thus far on obtaining rf modulated currents was 100 milliamps.

Alvarez said that recent studies on field emissions on various surfaces have turned up the fact that washing the drift tubes in the linear accelerator with c.p. acetone has reduced the x-ray background by a factor of 20. He said that field emission phenomena are very sensitive to surface condition and the use of c.p. acetone in preference to commercial grade has limited the deposition of sludge left by the latter. He said that copper now appears more satisfactory from the standpoint of field emission than does chromium, and that aluminum is very poor. Brobeck said that they are planning to install a drift tube in the tank in Building 10 and put rf on it and see how it behaves for field emission.

Twitchell reported that all the orders had been placed for the copper conducter for the drift tube magnets. It now looks as though the majority of this copper will be delivered in August. They are now trying to find a winding fabricator to wind the coils for the magnets. He reported they are having difficulty in finding anyone to bid on spinning of the copper heads for the drift tubes. The heads required have a diameter of 120 inches and the largest spinnings being made commercially have a diameter of 104 inches. He said they are also obtaining quotations for the fabrication of the drift tube end pieces by assembling "orange peel slices".

Baker said that the vacuum tank in Building 52 has been vacuum tested and pressures as low as 1/4 microamp have been obtained on overnight pumping with only 1/3 of the planned pumping. The tests on the RCA 5831 1-megawatt power tube should begin in this tank about mid-July. Baker said that it may be necessary to pre-excite at a rather heavy power level in order to prevent multipactor locking in the tank.

Brobeck said it has been determined that the liner cooling system can be an open system. The requirement for cooling of the drift tube magnet is still in doubt by about 20% but this is not of sufficient magnitude to create a very serious problem.

Hildebrand reviewed the status of the work on Mark I. He said that $1,200,000 worth of business has been either contracted or awarded. Most of the contracts involved in this have not yet been signed due to the delay in obtaining the necessary formal approvals and legal reviews, but the work is proceeding without delay. He said there is about $1,300,000 worth of additional business that is either out for bids or bids have been received and are in the process of being analyzed. Regarding construction at the site, the only item of consequence is that the excavation for the pit in which the accelerator will sit has been completed and the contract for the accelerator foundation is expected to be signed this week. Included in the contracts awarded is the fabrication of the vacuum tank itself and fabrication of this item is scheduled for completion on December 1. The welding of the tank during assembly will be tested by the halide method and upon completion of the assembly the entire tank will be tested with helium leak detectors. Orders for motor generator sets for drift tube magnet power supply might have to be held up until recent changes in these power requirements are more firm. A line diagram has been made and analyzed, covering the problems of bringing in and distributing the main power feed to the site, including circuit breakers and transformers. There have been reserved for transfer from Oak Ridge about $500,000 worth of equipment for this purpose. The only major item not reserved from Oak Ridge or on order at the present time is the transformer to provide the 2300-volt power for the magnet power supply and possible drydock power supply. Bids were received from D.P.I for the replacement of the jets in the oil diffusion pumps and for oil booster pumps. They have been analyzed but the actual award of this contract to D.P.I has not yet been made. Requests for bids are out for the refrigerated baffles and on the liquid nitrogen system and its components, and also for compressors for the freon refrigeration. Engineering studies and layout on the vacuum piping is well along. A power rate analysis has been made and negotiations are under way with P. G. and E. for a contract. Requests for bids are now out for the main building; these are due to be opened on July 5. The design of the concrete shielding is about 50 percent complete and should be ready in a few weeks. He said approval of the Commission has been obtained for dismantling several of the buildings at the site. This work is ready for bid. A program for reconditioning of existing buildings should be in order for the Commission's approval by the first of July. Preliminary surveys of existing water and power systems is in progress. Fence alterations for isolating the school district will be ready in August. The contract for fencing the site proper will be ready in July. He said they are having some trouble on steel deliveries and that he hoped that the Commission could assist them in this regard by the assignment of priorities. (Fidler and Thomas pointed out that there is not now a priority system in effect, so that the only possible thing the Commission could do would be to make available to Berkeley steel already ordered by the Commission for some other purpose). Delays in steel delivery might mean that the roof on the accelerator building would not be complete at the time that the vacuum tank is ready for testing. Cope said he had been talking with Dinwiddie Construction Company, who has the contract for the building foundation. He said they have stated that they could have the building roofed by the first of December. This estimate is made on the basis of allocating 45 days for

the erection of the steel frame, which is being very liberal. Reynolds pointed out and Fidler agreed that the availability of necessary steel by a bidder to allow completion of the roof on schedule would be an important and allowable criteria in selecting the successful bidder.

Russell H. Ball

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