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RADIATION LABORATORY

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MINUTES OF MTA PROGRESS MEETING
TUESDAY, SEPTEMBER 12, 1950

Present: UCRL: Baker, Brobeck, Cooksey, Dexter, Farly, Gordon, Latimer, Lawrence, Lofgren, Longacre, Martin, McKissen, McMillan, Norton, Panofsky, Powell, Reynolds, Street, Twitchell, Van Atta

CRDC: Cope, Crandall, Hansen, Hildebrand, Kent, Maker, Powell, Fossati

AEC: Ball, Fidler, Ramey

Lawrence said that the electron accelerating model of the Mark I linear accelerator has produced what appears to be a real beam. Shimming of the magnet pole faces of the cyclotron electron model to correct the field contour is proceeding.

Lofgren reported that he has obtained a total ion current of 1.2 amperes at 70 KV at a distance of 16 inches from the source. At a distance of 24 inches the ion current collected was 800 ma. The focusing system for the beam has been changed by the addition of a fourth electrode so that the ions are decelerated and accelerated once more. This holds the beam in focus for several additional inches. He plans to proceed with the construction of the full-scale ion source and stated that December 1 is its scheduled completion date.

Gordon reported on the problem of heating the drift tube surfaces for the purpose of improving their field emission characteristics. He said the basic structure of the drift tube from this standpoint is a $\frac{1}{4}$-inch thickness of copper backed up by cooling tubes alternating with calrod heating units hard soldered to the copper. Drift tube No. 8 was taken as a typical case; this will contain 3600 pounds of copper in the shell plus an additional 1200 lbs. of copper for cooling tubes. He said an investment of $16,000 would be required in heating equipment in order to supply heat at twice the rate required to maintain the equilibrium temperature of 250° C. At this rate of heating, 128 minutes is estimated to be required to attain the equilibrium temperature. An investment in heating equipment of $32,000 would be required to supply heat at a rate equal to four times that required to maintain equilibrium. At this increased heating rate 55 minutes would be required to reach a surface temperature of 250° C. It was the consensus that the smaller investment would be adequate in spite of the longer time required in view of the fact that heating of the drift tubes may be required only during the latter stages of the tank pump-down or at intervals of at least several days. Gordon added that estimates give approximately 60 minutes required for cooling by radiation from 250° to 150°, which latter temperature is low enough to allow

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water to be introduced into the cooling tubes so that accelerator operation can be undertaken. He pointed out that the introduction of the water at temperatures above 150° would probably result in damage to gaskets by the high temperature steam that would be generated. He added that with the heating power decided upon a thermal cycle would require about 3 hours exclusive of the time during which the drift tubes are maintained at the maximum temperature.

Baker said the oscillator using the RCA 5831 tube was connected to the resonant load in Building 52 about one week ago, using large coupling loops, and plate voltage was raised to 25 KV. The power in-put under these conditions, limited by the oscillator plate voltage, was 200 KW and the oscillator efficiency was 95%. The oscillator efficiency and power consumption were measured under CW operation; however, normal operation during the test was pulsed. He said that a parasitic frequency was encountered during the initial operation and that steps have been taken to eliminate it; however, it cannot be completely eliminated until a new "hat" structure is designed for the tube which will have a smaller capacity. They have now replaced the coupling loop with one of half the original area, which increases the load by a factor of 4 at the same oscillator plate voltage. He said with the new coupling loops he has restricted the plate voltage to 10 KV due to concern for damage to the power tube which might result if the stored energy in the resonant load were to feed back to the tube in the event of sparking within the tube. In order to test the severity of damage which might be expected within the tube should such sparking occur, he built an rf shorting strap and found that considerable copper was melted even though the electronic "crowbar" which removes the plate voltage was built into the circuit. In order to more rapidly dissipate the stored energy in the tank without its reaching the oscillator he has installed a spark gap near the top of the tank. He said about 15 microseconds is required to remove the tank voltage by the use of this spark gap, whereas the time constant for the resonant load is about 1 ms. Farly asked if it would not be satisfactory to absorb part of the energy in a resistance load rather than absorb all of it in the resonant load. Baker said that since one of the big problems remaining is to devise a means for satisfactorily protecting the tube from this large stored energy he wants to run with a pure resonant load until he has this problem solved.

Van Atta said that target designs considered to date have been along rather conservative lines in an attempt to design a suitable target with as high a probability of success as possible. He said in their calculations they have assumed that the intensity distribution of the beam is proportional to 1/r with a flat maximum approximately 30 times the average intensity of the beam. It is further assumed that this beam will be distributed by a sweeping mechanism to provide a ratio of maximum to average intensity of 3.5 - 4 on the walls of the target. Target designs using solid half-inch uranium rods are satisfactory provided the ratio of peak to average intensity does not exceed 2. When this ratio exceeds 2 the temperature at the center of the uranium rod becomes excessive. In order to overcome this limitation a design has been considered in which the target element to be fitted into the target channels would consist of 3 concentric tubes of copper clad uranium plus a central plug of aluminum. These tubes of clad uranium would be fabricated by first

preparing sandwiches of approximately 1/8" uranium clad on both sides with about 10 mil copper. These sandwiches would then be rolled into tubes and hard-soldered along the seam. A primary target of this latter design would have neutron losses about 20% greater than would be the case in the use of solid uranium rods. In addition there would be a loss of approximately 15% of the neutrons due to diffusion of moderated neutrons back into the primary target structure in which neutrons, particularly in the resonance region, will be strongly absorbed. A consideration of these and other minor losses in this type of target arrangement seemed to indicate that neutron losses approaching 50% might result. In order to improve the neutron economy within the target some thought is being given to a target comprising bare uranium disposed within a closed helium-filled vessel to which the beam would gain access through a window of approximately 1/32" thickness. Such a target design eliminates the large quantities of aluminum or copper otherwise required for cladding. Van Atta said that with respect to this latter target design a choice of final beam energy is important since the heat produced per unit volume of the window will be less by a factor of 2 or 3 for the 350 Mev beam than for the 250 Mev beam. He said that Howard Browne is studying various lattice arrangements for the secondary target in order to maximize tritium production. Panofsky inquired as to the possibility of the window to such a target being made thick enough to produce appreciable scattering of the beam so as to reduce still further the ratio of maximum to average intensity. Van Atta said he thought it would not be possible to take advantage of this fact since the thicknesses required for appreciable scattering would result in excessive heating of the window. Panofsky said that it might be possible to achieve scattering without excessive heating if a tungsten window were used.

Hildebrand said that the general construction program is still on schedule but that they were having some trouble in getting a satisfactory delivery schedule from DPI for the booster pumps. Cope said this difficulty arises from the fact that the booster pumps which are on order are larger than any that DPI has made previously and they are holding out for an additional 6 weeks during which they can test the units to insure compliance with specifications. He said they hoped to reach an agreement whereby DPI would deliver the first of the 4 booster pumps immediately upon its completion in order that we may expedite our testing program with the understanding that required modification of the pump can be completed at a later date. He added that they have assurances from General Electric that they are on schedule in fabrication of the main oscillator power supply being procured from them but that they are sending a representative to the General Electric plant to gain first-hand information on their progress.

Hildebrand said that at a meeting last Friday it was agreed that the deflection of the Mark I beam would not exceed 8° so as to allow the Mark I target to be included within the present building and to eliminate the requirement for additional cranes. He added that the same precessor and vacuum cone will be used for both the test and production targets on Mark I.

Twitchell said that one half of the copper for the drift tube magnets is now in the mill at Los Angeles.

Brobeck said he had two problems in mind on which data had not yet been given

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to CRDC. One of these is the mechanical arrangement to determine and, if necessary, correct the positions of the drift tubes when the focusing magnets are turned on and the other is the development of a satisfactory means for sparking down the stored energy in the cavity. In neither case is the data required immediately.

Russell H. Ball

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