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UCRL-1111
Technology - Materials
Testing Accelerator

UNIVERSITY OF CALIFORNIA
RADIATION LABORATORY

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MINUTES OF MTA PROGRESS MEETING HELD JANUARY 30, 1951

Russell H. Ball

Berkeley, California

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RESEARCH SERVICE BRANCH
Atomic Energy Commission
Berkeley Area
Berkeley, California

MINUTES OF MTA PROGRESS MEETING
HELD JANUARY 30, 1951

Present: UCRL: Alvarez, Baker, Brobeck, Cork, Dimmick, Farly, Gordon, Judd, Kilpatrick, Leavitt, Lofgren, Longacre, Norton, Panofsky, Reynolds, Thornton, Twitchell, Wallace

CRDC: Cope, Hildebrand, Maker, Powell

AEC: Ball, Fidler

Westinghouse: Hulse

Brobeck announced that a group of 11 people are now visiting the Laboratory from NAA to discuss target problems connected with Mark II and Mark III.

Brobeck said that the study has continued on the problem first discussed at the meeting of January 16 (UCRL-1093) of providing a means for determining the positions of the drift tubes in Mark I. Analysis indicates the use of telescopes to view the drift tubes directly will be the least expensive method by approximately $30,000. Maker said one of the main limitations on using the photo-electric method was in overcoming the severe limitations which the tank design imposes upon the location of the required number of nozzles for mounting photo cells andlight sources. The optical system required the use of 24 nozzles and would cost an estimated $30,000 to $40,000. An alternative method considered is to observe the drift tubes directly with telescopes mounted outside the shielding wall. This would require, foreach, a single nozzle, together with an associated opening through the shielding. Sighting of the drift tubes would be accomplished with a surveyor's transit, placed to one side of the shielding opening, which would view the drift tube through a 90° prism. Lighting of the drift tube under observation would be accomplished by placing outside of the nozzle on the tank a mirror having a hole in its center. The mirror would be at an angle of 45° with the axis of the tank so that light from an appropriate source on the tank wall would be reflected through the nozzle and onto the drift tubetube while observations of the drift tube were made by viewing through the hole in the mirror. Alvarez suggested that it might prove convenient to bring leads up from the control room to the platform on the shielding from which observations of the drift tube position will be made so that the observer can himself directly adjust the drift tube positions rather than relaying information through the control room. Panofsky pointed out that the positioning of the drift tubes must be determined by the rf current through the by-pass condensers on the supporting stems so that this information would also have to be supplied to the viewer were to make corrections directly in drift tube positions. Alvarez suggested an alternative method of viewing which would require the use of only a single telescope by viewing parallel to the axis of the accelerator along a line between the liner and the tank. Viewing of the drift tubes could be accomplished by sighting successfully upon a series of range finder prisms, one of which would be adjacent to each drift tube. These prisms

always give a 90° angle regardless of their orientation. These could be made of mirrors rather than of solid glass to avoid the problem of radiation darkening. Maker said that it has now been decided that the position of the No. 0 drift tube must also be determined. Since this drift tube is thin it will probably be necessary to sight across its face rather than sighting upon scribe marks as is planned for the remaining drift tubes.

Brobeck said that the present design will have by-pass condensers on drift tubes 1, 2, 4, 6, and 8. By-passing the rf currents requires an array of 73 condensers for each supporting stem at a cost of about $1500. The unbiased stems are insulated and have provision for condensers or solid ground connections as desired. Panofsky said that with the telescope method of viewing the drift tubes RF voltage should be indicated for all drift tubes rather than for the unbiased tubes only. This could be accomplished by utilizing low resistances rather than condensers at the unbiased tubes and observing the RF voltage across the resistors. By-pass condensers might also be needed on the magnet current leads at a quarter wavelength from the stems.

Alvarez asked if it were known whether there is any commercial broadcasting at or near the Mark I frequency of 12.2 megacycles. If there is, special pains will have to be taken to minimize radiation losses from Mark I since at this frequency an output of 20 watts can be heard around the world.

Maker said that the present design being considered for the current-measuring target for Mark I will utilize an arrangement in which the current-measuring target and its accompanying conical tank will be removable as a single unit. This unit will be provided with wheels so that it can be rolled out of position and then hoisted through an opening in the roof of the shielding into an adjacent storage chamber where it can be allowed sufficient time for cooling to permit work to be done on it under reduced radiation hazard. The entire target and cone are insulated, including the distilled water cooling system. The design of the target itself remains the same as that presented in the minutes of the meeting held December 12, 1950 (UCRL-1046). It may be necessary to install vanes near the apex of the cone to eliminate a stagnation point in the cooling water in that region. Panofsky said that the insulation of the target should be between 10^5 and 10^6 ohms so as to permit the measurement of currents of between 1/10 and 1 milliampere. Lofgren suggested that if the beam current to be measured is very small the target will require only nominal cooling so that improved insulation and current measuring sensitivity could be achieved by branching the cooling-water line and providing a long narrow high-resistance insulating section to be used when measuring low currents and a short large-diameter medium resistance insulating section to be used when measuring high beam currents. Brobeck suggested using two short insulating sections in series with an electronic device to maintain the potential between the sections equal to the target potential and thus effectively eliminate large currents through the water.

Brobeck said that the requirement for the thickness of the lead gate between

the beam precessor and the neck of the cone of the target to shield the accelerator region from target activity after shutdown has been reduced from 5 inches to 2 inches.

Baker said that a decision has been reached to provide heating for the sphere in the B-1 cavity to permit more detailed investigation of the X-ray production. The installation of the heating elements may delay the oscillator test program approximately one month. Lofgren suggested that if the delay is of this magnitude the opportunity should be taken to replace the present hydraulically operated gate valve of the diffusion pump with a mechanism which will not discharge large quantities of oil into the vacuum system. The provision of lead shielding for the B-1 cavity has not yet been completed, so that it is still necessary to restrict operation to the night shift. Baker said he has recently been studying the design of pre-exciters. It has been found that increasing the size of the oscillator does not necessarily improve its operation as a pre-exciter because of the increased impedance of thelarger tubes. About the only advantage of using larger tubes is the improved insulation and the availability of greater power. The solution of the pre-exciter problem, however, seems to require the use of a low impedance tube. The pre-exciter recently designed uses two type 5771 tubes. One of these tubes is used as a coupling resistor. Doing this provides the lossy element of the circuit with a grid so that it can be turned off if desired. This has worked very well in principle. It has been found that pre-excitation is made more difficult if the sub-exciter is run continuously. The sub-exciter is a low-level supply which maintains a floor on the plate voltage of the main oscillator and is an electronic supply so that it can be turned off when the crowbar fires. If the sub-exciter is left on all the time there is a low-level of ionization in the tank. In the B-1 cavity this corresponds to 1500 volts on the sphere. If this level of ionization is maintained it is difficult for the pre-exciter to come up to full power. This means that the sub-exciter should come on simultaneously with the pulsed pre-exciter. The sub-exciter will then serve to maintain the tank voltage after it has been brought up by the pulsed pre-exciter. Each time the tank sparks down it will be necessary to start up again with the pulsed pre-exciter. This will require that the coupling loop of the pre-exciter be swung out of the way after the tank reaches full voltage in order to avoid induced voltages of the order of 100 KV on the transmission line. The present mechanism for accomplishing this is to rotate the entire 20-foot end section of the transmission line through 90° so as to turn the coupling loop parallel to the axis of the tank. Since the cavity may spark down as frequently as once or twice a minute it is necessary that this mechanism for rotating the coupling loop operate through a full cycle in approximately one second. Brobeck said that with the present design it would require about 2 seconds. Baker said that a coupling loop of large area is utilized to reduce the amount of pre-exciter power required. The pre-exciter power necessary to excite the cavity is inversely proportional to the square of the coupling loop area. Panofsky suggested that consideration be given to a design which would allow the coupling loop to collapse like a pantograph so as to reduce its area by a factor of 5 or 10 and thereby reduce the induced voltage to a workable value.

Norton asked why the X-ray studies are to be made with the B-1 cavity rather

than on XC since to do this work with B-1 will introduce a one-month delay in the oscillator test program. Panofsky said the B-1 cavity was chosen in preference to XC because the geometry of the former will allow a better extrapolation of the test results to Mark I operating conditions. Baker said that it appears that power consumption by electron loading may become intolerable at voltage gradients more than about 150% of those now being used in the B-1 cavity. This would correspond to 75% of the design gradient of Mark I. It is essential that we determine the practical operating field gradient for use with attainable surface conditions in Mark I and Mark II. The B-1 cavity now has a 5 milliampere current involved in X-ray production. The B-1 cavity now sparks about once per minute; if the voltage gradient were double it would probably spark it continuously.

Baker said that they have now constructed an amplifier-type pre-exciter. This is a technique in which one amplifies the signal from a sub-exciter while maintaining the phase constant. They are using an Eimac tube of 1 KW plate power dissipation, which proved to have just barely enough power to work.

Lofgren said that testing of the full-scale injector will begin next week.

Panofsky said that calculations have been completed on the beam dynamics of Mark I utilizing an entrance aperture of 9.8 inches. The results show a reduction in the phase acceptance angle to about 20 to 30 degrees, which is unsatisfactory. Calculations of apertures of intermediate size are still in progress. These results favor the use of 12 megacycle frequency for Mark II rather than 20.