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UCRL-1170
Technology - Materials
Testing Accelerator

UNIVERSITY OF CALIFORNIA
RADIATION LABORATORY

Contract No. W-7405-eng-48

CALIFORNIA RESEARCH & DEVELOPMENT COMPANY
Contract No. AT(11-1)-74

MINUTES OF MTA PROGRESS MEETING HELD MARCH 6, 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 MARCH 6, 1951

Present: UCRL: Alvarez, Brobeck, Byerly, Cooksey, Cork, Dimmick, Farly, Gordon, Judd, Kilpatrick, Latimer, Lawrence, Lofgren, Longacre, Martin, Martinelli, McMillan, Norton, Pierson, Reynolds, Robertson, Sewell, Street, Thornton, Twitchell, Van Atta, Wallace

CRDC: Hansen, Hildebrand, Maker, Hammond, Carlton

AEC: Ball, Fidler, Platt

G.E.: Smith, Webster

Westinghouse: Kresser

Lofgren showed to the group a tungsten and a graphite arc aperture plate which had been burned through by back bombardment. The graphite aperture plate was burned through in less than a day. The problem of back bombardment appears to have been brought completely under control in the test set-up by putting 200 volts bias on the collector to hold back secondary electrons and the use of a transverse magnetic field of about 15 gauss in front of the collector. It has also been noticed that prolonged operation reduces the number of secondary electrons by out-gassing surface contaminants which lead to secondary emission. The situation has been improved to the point where a graphite arc aperture can be run all day with the production of a barely perceptible mark from the back bombardment. Before the problem of back bombardment was solved by the above procedures a method was devised to extend the life of the arc aperture plate which involved placing a tungsten rod through a hole in the center of the graphite, upon which the back-bombarded particles would impinge. In answer to a question from Alvarez, he said that the presence of the tungsten rod protruding through the graphite disc did not appear to disturb the boundary of the arc plasma, which was about 2 inches beyond the end of the tungsten rod, and that there was no noticeable difference in the focus of the beam with or without the tungsten rod present. It therefore appears that the problem of back bombardment has been solved for present levels of operation, which are producing 250 to 300 milliamperes of positive ions. Lofgren said they are now at the 20th hour of an endurance run with the injector. This run will terminate at about 30 or 40 hours unless sooner terminated by failure of the equipment. It has been running very steadily with every pulse of a good square form. It is next proposed to measure the abundance of protons and molecular hydrogen in the beam before attempting to obtain higher beam currents.

Alvarez said a 200-megacycle cavity 16 wavelengths long is being built to test procedures for lining up the cavity to resonate at the desired mode. This equipment is being built in the basement of Building 8. The longest tank presently available is 8 wavelengths long and it has been found very simple to align this cavity. The Mark II machine if made 1500 feet long and operated at 12 megacycles will be 16 wavelengths long.

Norton said that the B-1 test cavity in Building 52 will be shut down until about the 19th of March while the heated sphere and other improvements are being installed. Twitchell said they are now about 4 days ahead of schedule.

Alvarez said that in connection with lining up the cavity to resonate on the proper mode it is necessary to tune up the various sections of the accelerator. He has been advocating the use of drift tubes with one flexible end face for the purpose of tuning the individual sections of the cavity. It had been planned to utilize a drift tube of this design for the long drift tube test in the Mark I cavity. He said Maker has recently come up with a suggestion of an alternate method of tuning the cavity--namely, that the diaphragms previously mentioned (UCRL-1134) for dividing the gaps be constructed of thin parallel sheets with provision for a remotely controlled internal mechanism to adjust the thickness of the diaphragm. Alvarez said that, as previously mentioned, there are 2 additional benefits to be derived from the use of such diaphragms. First is that it reduces by a factor of 2 the energy which an electron can pick up in traveling across the gap between adjacent drift tubes. This is particularly important in gaps of high beta, where electrons can pick up enough energy in one crossing of the gap to induce (γ, n) reactions on copper and thereby render the drift tubes intensely radioactive. The second advantage of these diaphragms is that biasing may be applied to them rather than to the drift tubes directly. This will allow the reduction of the bias voltage by a factor of 2. Also, the currents circulating in the smaller supporting stems of the diaphragm will be less than the corresponding currents in the drift tube stems, thereby reducing the requirement for by-pass condensers. It is now planned to test a diaphragm of the suggested design at the time of the long drift tube in Mark I in lieu of providing the drift tube with a flexible end section. In answer to a question from Brobeck, Alvarez said that diaphragms of this design can be utilized throughout the entire length of the machine. He said no diaphragms will be required in the first few gaps because they act pretty much as a unit, but at the position that the first diaphragm will be needed the dimensions of the gap will be large enough to accommodate the diaphragms of this design. He added that no tuning elements are required in Mark I since the gap voltages are not high enough to allow electrons to obtain the threshold energy for the (γ,n) reaction.

Brobeck commented on the change in pre-exciter design for Mark I to eliminate the use of limiter tubes, substituting the RCA A-2332 for the RCA 5831 tube. The new design uses two rotating quarter wave lines, one of which is of small diameter, instead of the previous single rotating half wave line. The pre-exciter is used as a power amplifier with a signal supplied from the cavity through a pre-amplifier having the proper characteristics to provide maximum output from the power amplifier as the cavity voltage builds up. By utilizing the quarter wave rather than

half wave transmission lines there may be a reduction in the expense of this item even though a third transmission line to the pre-amplifier will be required.

Van Atta said they have been studying the availability of materials of which the lattice will be constructed. There are two general possibilities. The first is a multiplying lattice of low k utilizing uranium depleted to 0.3% U^{235}. The other alternate is to utilize a non-multiplying lattice for the production of tritium or U^{233}. The designs of these two types of lattices are becoming more similar as the studies are continued. The reason for this is that more emphasis is being placed upon the utilization of material depleted to 0.3% U^{235}, which may be the only uranium available to the MTA program. The use of material of this depletion results in a smaller multiplication in the lattice than had been previously anticipated. The result is that lattice designs now being considered are beginning to resemble rather closely the simple non-multiplying lattice and they are correspondingly much more compact than designs originally considered. Several weeks ago Untermeyer, of the Argonne National Laboratory, visited Berkeley and discussed with us some of the objectives of the multiplying lattice. He placed particular emphasis upon desirability of sacrificing something in the way of production to achieve a more compact design. As a result of these discussions, design studies have been undertaken of 3 types of lattice, one being a lattice of essentially the Hanford type, which is optimum in terms of production. If one uses depleted uranium slugs of the Hanford diameter the cell dimensions are also essentially that of the Hanford cell. Untermeyer stressed the point that one cannot alter the slug diameter and thereby change the cell dimension without an accompanying sacrifice in the multiplication factor and production. When these changes are made the resonance capture in U^{238} increases relative to thermal capture in U^{235} with the result that the number of megawatts of heat liberated per ton of uranium diminishes. This also means a reduction in the number of megawatts liberated per unit of plutonium produced. The approximate maximum power level achieved at Hanford is 400 megawatts for 250 tons of metal. Platt stated that one advantage of the neutron flux obtained from a comp lattice is that the resultant shift toward an epithermal flux will give a more favorable ratio of Pu^{239} to Pu^{240}. Van Atta said that this advantage would probably allow the production of plutonium at concentrations in excess of 600 GT. Alvarez questioned the economic advisability of sacrificing production to achieve a compact lattice. Van Atta agreed that from the basis of economics it still appears the most advantageous target will be the one with the highest rate of production.

delete

	Compact Uranium Lattice	Hanford Uranium Lattice	Non-multiplying Lattice
inside dimensions (feet)	17' x 17' x 17'	25' x 25' x 25'	11' x 11' x 24'
cell dimension (centimeters)	15 cm	21.3 cm	--
production moles/day	1.6 moles/day	1.8 moles/day	0.8 moles/day
lattice power level (megawatts)	140 MW	200 MW	30 MW for U^{233} prod. or 7 MW for H^3 prod.
weight of metal (tons)	144 tons	148 tons	2.7 tons of Th or 6.2 " of LiAl alloy

Table I.

Table I summarizes data on the size, cell dimensions, production, power level and weight of metal required for the three lattice arrangements being studied.

Hansen said the north wings of the Mark I accelerator building are all poured. They are now working on the framing and forming of the south side. The stairways are being installed throughout the building. The shell and heads of the vessel are essentially complete. All of the drift tube nozzles are in position and are being welded, and work is proceeding on the installation of other nozzles. The installation of mechanical piping is proceeding on schedule. The piping will be ready for vacuum test by the time that the vessel is completed. This is scheduled for the 15th of March. 210 of the 660 shielding blocks have been poured. Some trouble has been experienced with the cooling coils on the big transformer from Oak Ridge and it has been necessary to drain out the cooling oil and re-weld some of the cooling tubes. Some difficulty has also been experienced in obtaining uniform heating with the large furnace which will be used in the soldering of cooling tubes to large liner sections. This difficulty is believed to have been overcome and trial runs on the large-size liner sections will be started tomorrow. A satisfactory technique has been developed for refinishing the interior surface of the liner sheets after soldering of the cooling tubes. During the last week tests have been made of the effectiveness of sprayed coatings of copper, aluminum, and tin in

preventing rusting of steel. Samples of each type of coating were placed out in the weather and allowed to undergo several cycles of alternate wetting and drying. The tin and copper coatings have been found to rust through. A sample of aluminum coated steel has been similarly tested and has not rusted after 25 cycles of wetting and drying. Shot peening of the sprayed surfaces was also tried and in all cases this completely ruptured the bond between the steel and the sprayed coating. The present conclusion is that copper and tin coatings are not satisfactory. Samples of each of these types of sprayed coatings have been sent to DPI for tests of their out-gassing. The cost of application of the sprayed aluminum coating is estimated at $1.00 per square foot and 37,000 square feet will be required for the interior of the Mark I tank. The cost of copper spraying would be twice this value, while that of a tin coating would be approximately 3 times as high. Tests are now proceeding on the spraying of heavier coats of copper.

Alvarez said that on the basis of past experience they would anticipate electrical discharges between the copper liner and the aluminum-coated tank. He added, however, that their reaction to the suggestion of aluminum coatings is conditioned by previous experience with aluminum dees in the cyclotron. It is the present opinion that the severe sparking which accompanied the use of the aluminum dees could have been largely eliminated by biasing the dees since the difficulty was probably due to multipactoring which occurred at lower voltages than with copper because aluminum is a better emitter of secondary electrons than is copper. McMillan pointed out that from the standpoint of corrosion resistance an aluminum coating should be superior to one of copper since aluminum is more electropositive than iron while copper is less so. Aluminum will therefore produce a protective galvanic action and prevent rusting occurring in small cracks or crevices, whereas with copper the galvanic action would be in the reverse direction and would aggravate this problem.

Lofgren said that even if the tank is coated so that it cannot rust one still must prevent the accumulation of moisture within the tank, since otherwise the diffusion pump oil will require changing due to contamination with water, and the resultant out-gassing of the moisture would prolong the pump-down time significantly.

Lawrence said that DPI is now working with U. S. Steel on methods of coating steel by evaporation of various metals. He suggested that DPI be contacted on the problem of a satisfactory coating material and technique of application since they have considerable experience along this line.

Maker said that one problem at Livermore will be to prevent rusting of the tank until all of the sand-blasting is accomplished. Twitchell said that this problem has been faced here recently with a vessel 12 feet in diameter and 17 feet long, which required 4 days to sand-blast. Rusting of the cleaned surface was prevented by simply placing within the tank two 500-watt infra-red heat lamps to keep it a little warmer than its surroundings. There has been no evidence whatever of rusting during this 4-day period. Maker suggested that the drift tube heaters could be turned on when the tank is

down to air and thereby maintain a slightly elevated temperature and Twitchell suggested the circulation of warm water through the cooling tubes on the liner.

Hildebrand said that tentative arrangements have been made for Dr. Simpson to come up from Santa Barbara on Friday to discuss their program of vacuum research. He said they now have 3 uncleared physicists who are engaged in conducting a literature survey in this field. He said they hope to have a program outlined on this program by the end of the week. Thornton said that when he was in Oak Ridge he talked to Dr. Norman about collaborating with us in this work. Norman indicated that he would be glad to make a trip to Berkeley to discuss this program at our convenience. Hildebrand said they would like very much to use the services of Dr. Norman but had intended to postpone requesting his visit until the program is somewhat more firm than at present.