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OBSERVATIONS ON THE MUNICH MP ARC DISCHARGE CONDITIONING TEST

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Introduction - In July and August 1984, a hydrogen arc discharge was run in the accelerator tube of the Munich MP Van de Graaff accelerator. The Oak Ridge authors were invited to observe the procedure and testing of the result.

Arc Discharge Procedure - The hydrogen arc discharge was run on one half of the MP accelerator tubes at a time. First, the low-energy tube was conditioned by operating a hydrogen arc discharge for about three hours at an average current of about 4 amperes. Hydrogen gas was admitted to the tube at the tank end and extracted from the terminal. The nominal pressure was about 100 mTorr with a factor of two difference between entrance and exit pressures. A nickel mesh filament at the terminal end provided electrons to maintain the discharge. Each tube element (20 cm) sustained a voltage of about 50 volts and the voltage across a dead section (contains insulators) was about 300 volts resulting in a terminal-to-ground voltage of about 2900 volts (40 x 50 + 3 x 300). A stabilizing resistor between terminal and power supply dropped an additional 4,800 volts at 4 amperes resulting in a net voltage requirement of 7,700 volts. The high-energy tube was conditioned in a similar way except gas was

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admitted at the terminal while filament and pump were at the ground end. Some difficulty was encountered in maintaining the arc. In the low-energy tube, a new filament was installed to correct the problem, but in the high-energy end, the filament temperature was increased significantly. The problem was apparently due to poisoning of the filament by gas being evolved during the arc discharge.

Result - Following the arc discharge, the accelerator was pressurized to about 0.7 MPa.(100 psia) and voltage applied to the terminal. The voltage was increased to 9.2 MV before conditioning was noted. Portions of the tube and column were then selectively shorted to condition individual tube sections (ten tubes) or sub-sections (2 or 3 tubes). Pressure in the accelerator tube was nominally on the low 10^{-7} Torr range. The conditioning exercise continued for almost two weeks with one tank opening which lasted about 24 hours. Each tube section was conditioned several times during the two-week interval. A summary of the conditioning results is contained in Table I.

TABLE I

Accel. Tube Sect. No.	Prior Cond. Volt. (MV)	Final Cond. Volt. (MV)	Max. Cond. Volt. (MV)	Decond. Volt. Span (MV)
1	3.5	3.2	3.25	0.25
2	3.6	3.32	3.32	0.25
3	3.7	3.75	3.83	0.25
4	3.7	3.7	3.85	0.85
5	3.6	3.6	3.7	0.2
6	3.6	3.7	3.7	0.44
7	3.0	3.2	3.5	0.44
8	3.6	3.4	3.63	0.5

In Table I, the accelerator tubes are numbered from the low-energy end of the accelerator. "Prior Cond. Volt." is the conditioned level of each tube section prior to the arc discharge as calculated from sub-section measurements. "Final" and "Max. Cond. Volt." are conditions attained during the two-week interval. Sections 3, 4, 5, and 6 conditioned quickly and most of the time was spent on sections 1, 2, 7 and

8. The tube sections exhibited a rather unusual deconditioning behavior with time, and the last column in Table I is an effort to summarize this effect. This de-conditioning also occurs in new tubes.

At the end of the two-week conditioning period, the entire accelerator was operating at a voltage of 11.4 MV.

Conclusion - The general concensus of the Munich accelerator staff was that the arc discharge had slightly improved sections 3, 4, 5 and 6; sections 7 and 8 were unchanged and sections 1 and 2 were slightly poorer. This result was somewhat surprising in light of previous tests[1] which demonstrated a marked improvement in breakdown voltage of "short" tube sections following an arc discharge cleaning. Also, section 4 of the MP accelerator improved from 3.5 to 3.9 MV following a preliminary arc discharge cleaning test in December 1983.

References

1. G. Korschinek, et al., Nucl. Instrum. Methods, 220, 82 (1984).

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