STUDY OF LARGE GAP BREAKDOWNS IN VACUUM BETWEEN 200KV AND 1MV WITH 500J OF STORED ENERGY FOR ITER NEUTRAL BEAM ACCELERATOR

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The transmission line between the neutral beam injector and the power supply at ITER will be about 100 meters long. The acceleration voltage is going to be 1 MV. During a HV breakdown in the accelerator, the stored energy in the last section of the transmission line and in the HV bushing will be dissipated on to the accelerator surfaces. The estimated energy in such a breakdown is 500 Joule for the ITER neutral beam system. This is approximately 100 times higher than is considered acceptable in present systems.

Previous experimental results obtained at various laboratories were obtained at much lower voltages and stored energies. It was therefore considered important to perform real experiments with conditions as close as possible to the ITER situation to validate the design.

Electrical breakdowns between two electrodes in vacuum represent a critical issue. Any evaporation of electrode materials might cause de-conditionning or real damage to the surfaces and hamper maximum performance. These are the reasons why the experiments need to be performed.

ITER is planning to use the MAMuG accelerator. In this case, the voltage will be 200 kV between each accelerating grid and 1MV between the negative ion source and ground. It is therefore planned to perform two campaigns of experiments to simulate the two cases, one at 200kV, the other at 1MV.

In order to perform these experiments the Cadarache 1 MV testbed had to be modified.
An extension of the transmission line have been manufactured to integrate the additional capacitors needed to create the stored energy. This new tank is used for both 1MV and 200kV capacitors.

A “movable cathode”, installed at the place of the present accelerator allows us to study the breakdown. With this new component, it’s possible to alter the gap between the electrodes without breaking the vacuum and to measure the breakdown current and voltage and the shape of the arc. Thermal measurement systems and fast image recording cameras help to analyse the experiments.

We will in this paper describe the proposed set-up of the test bed, the choice of components and the electrical simulation that has been done of the system together with the choice of diagnostic equipments.
All the results obtained at 200kV will also be presented and hopefully some results obtained with 1MV applied on the anode.