

REVISION AND ADAPTATION OF THE REFERENCE DESIGN HV BUSHING TO SINGAP CONFIGURATION

A. Masiello, M. Dalla Palma, P. Zaccaria

Consorzio RFX – Associazione EURATOM ENEA sulla fusione, Corso Stati Uniti 4
I-35127 Padova Italy

The present design of the ITER Neutral Beam injector is based on the acceleration to 1 MV of a 40A negative ions current in five 200kV steps [1]. An alternative concept is instead based one single acceleration gap, SINGAP [2], which is expected to yield a considerable simplification of the high voltage components. Also an advantage of the SINGAP solution is a simpler electrical insulation which can be achieved suspending the source and pre-accelerator assembly from the high voltage bushing and attach the post-acceleration electrode inside the beam source vessel [2].

The integration of the SINGAP concept consists in a new design, which keeps unchanged the leading dimensions of the ITER reference design bushing, based on the multigrid MAMuG approach [1], but without the five 200kV voltage steps, so that intermediate screens can be removed.

The double barrier solution has been kept unchanged with the guard gas in the interspace, but the geometry of the insulating rings have been slightly changed. In particular instead of alumina, porcelain has been chosen for the inner ring and its two back up rings; an R&D activity on the brazing of these components on a metallic seal is also ongoing.

Electrostatic design criteria have been reviewed with respect to the reference design, as a result of a large survey also focused on the modification of the electrical properties induced by radiations on both insulating materials and gases. Several electrostatic analyses have been carried out to optimize the design and to try to verify the fulfilment of the above mentioned criteria. Results of analyses acted as a guideline for the design solutions of the components.

Since the bushing shall sustain the beam source, the upper part of the support have been designed together with, inside the support itself, the layout of cooling pipes and bus bars, which has been verified with particular care about electric and mechanical issues.

Structural analyses of insulating rings have been carried out considering different load cases, such as normal operation, transmission line test, interspace test and loss of coolant accident. It was found that all stresses are allowable, but safety factors are reduced with respect to the reference design.

[1] ITER Neutral Beam Heating & Current Drive System, Design Description Document N 53 DDD 29 01-07-03 R 0.1

[2] P.Massmann et. al, The Cadarache 1 MV porcelain SINGAP bushing, Fusion Engineering and Design 56–57 (2001) 539–544

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