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Design optimization of RF lines in vacuum environment for the MITICA experiment

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Operation of the thermonuclear fusion experiment ITER requires additional heating via injection of neutral beams from accelerated negative ions; two injectors will deliver a total power of 33 MW. The MITICA experiment (Megavolt ITER Injector & Concept Advancement) is the prototype and the test bed of the ITER Heating and Current Drive Neutral Beam Injectors (HNB). MITICA injector experiments shall demonstrate the reliable and accurate emission of a 17 MW beam of neutral particles of deuterium or hydrogen for duration up to 1 hour, fulfilling ITER specific requirements. MITICA test bed is in the final design phase and will be procured and installed in PRIMA facility (Padova Research on Injector Megavolt Accelerated) in Padova, Italy.

This contribution regards the transmission line of MITICA experiment. The design of MITICA RF coaxial lines considered lines of 1" 5/8, but thermal simulations carried out on MITICA RF lines model showed that the temperature of the lines was too high with respect to the maximum operational limit indicated by the supplier. This operation condition can deteriorate the correct functionality of the coaxial lines, due to the risk of losing the good electrical contact on the sliding connections between the parts of the line at higher temperature. The effects of emissivity enhancement and of the increasing in the diameter of the conductors, aimed to lowering the maximum temperature of the lines after 1 hour pulse, are presented: the calculations show the thermal results of MITICA RF lines and of other components involved in the interface between HV Bushing and the MITICA Beam Source, as a function of the emissivity value and of other geometrical parameters. Moreover, five coating products were tested: the outgassing behavior of the selected products and their emissivity assessment are also presented, together with the definition of the application procedures.

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