IONIZING RADIATION COMPATIBILITY IN THE MITICA NEUTRAL BEAM PROTOTYPE

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In the last decades the ionizing radiation tolerance of the electronic components has become a critical issue for system reliability and availability in the aerospace and high energy physics fields, basically due to the extraordinary development of electronic component integration - highly sensitive to ionizing radiation- and to the consequent widespread diffusion of such components in a great variety of devices. For this reason, worldwide R&D activities are in progress, aimed at mitigating the effects of ionizing radiation by designing rad-hard components, qualifying standard components for particular radiation environment, identifying operational limits, installation criteria and maintenance procedures.

Inside the ITER Tokamak building and in particular close to its powerful Neutral Beam Injectors, the radiation tolerance issue shall be very carefully considered. So far, studies regarding radiation tolerance in the framework of fusion project have been carried out only upon passive components, such as glass windows, fibre-optics, cables, thermocouples and electrical insulators; on the contrary, to our knowledge no work has been carried out so far concerning the compatibility of electronic components to the radiation field produced inside the ITER building, and at present only limited guidelines are available for the ITER community to attain radiation tolerant technical solutions.

As a contribution to fill the gap of knowledge, in the framework of the program for the construction of the 1 MeV / 40 A ITER NBI prototype (MITICA) in Padova (Italy), an activity has been launched aimed at identifying the most appropriate design solutions and installation guidelines to keep under control and minimize the effects of ionizing radiation on the electronic components related to control, diagnostics, and electrical insulation located inside the MITICA vessel and its concrete biological shield, being the level of the ionizing radiation produced by MITICA possibly high enough to produce malfunctioning of electronics, often embedded in motors, pumps, valves, gauges etc. In order to make the approach more comprehensive, the study is extended also to passive components, taking advantage of the work previously mentioned.

The paper deals mainly with the method followed to approach the problem, based on three steps: the accurate determination of expected radiation levels maps in the different MITICA NBI components, the identification of electronic and passive component database for MITICA (diagnostics, control, electrical insulation) and finally the assessment of the ionizing radiation compatibility for the identified components. On the basis of this assessment, the list of the preventive or mitigating actions (relocation, shielding, preventive maintenance, etc.) is highlighted.