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P4.009 Technological challenges for the design of the RFX-mod2 experiment

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An upgrade of the RFX-mod experiment is presently in the final design phase, with the main objectives of improving the control of magnetic confinement, plasma density and plasma wall interaction in both RFP and Tokamak configuration.
The achievement of these aims implies a major change and reconfiguration of the internal components of the machine assembly: the present toroidal support structure (Rmajor=2m, Rminor=0.5 m, made of stainless steel) will be adapted to provide the function of vacuum vessel and to encompass the conductive stabilizing shell, deeply modified in order to sustain the new first wall and a wide system of in-vessel diagnostics.
The machine modification is subject to stringent constraints in terms of geometrical interface with existing components (in particular external coils and diagnostic systems) and to the compliance with specified electrical insulation both along toroidal and poloidal direction, to allow suitable penetration of electromagnetic fields within the plasma chamber ant to minimize the risk of arcing among in-vessel components which could occur during over-voltages induced in standard or abnormal operating conditions.
The technical solutions conceived to fulfil geometrical, vacuum and electrical requirements have been developed in collaboration with some local industries, involved in the framework of an industrial innovation project supported by public regional funding. Critical aspects of the design are in particular: development of vacuum-tight electrical-insulated crossed joints of the new vessel, by using high-performance polymers; implementation of specific welding procedures to control the deformation of major machine components with tight tolerances; implementation of surface coatings of in-vacuum components; realization of in-vessel diagnostics and machine components by means of metal additive manufacturing processes.
The paper will present an overview of the design choices and the proposed implementations, assessed on the base of engineering analyses and results of experimental tests performed on mock-ups of the new components.

Presenter: PERUZZO, Simone (Consorzio RFX)

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