

RFX – mod2: status of machine upgrade

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A substantial modification of the toroidal complex of the RFX experiment, named RFX-mod2, is currently under completion, aimed at improving the control of magnetic confinement, plasma density and plasma wall interaction in both RFP and Tokamak configurations [1, 2].

The modifications involve the whole core system of the machine and in particular the vacuum vessel, the entire plasma facing components and a wide set of in-vessel diagnostic systems.

Improvement of the control of MHD instabilities is intended to be achieved by embedding the existing 3 mm thick copper stabilizing shell within the new vacuum vessel, so enhancing the ‘shell/plasma proximity’. This implied a significant modification of the previous stainless steel mechanical support structure, suitably adapted in order to become the new vacuum boundary.

Novel technological solutions have been implemented to comply with the combination of challenging requirements, in terms of electrical insulation and vacuum compatibility of in-vessel components, and stringent geometrical constraints to maintain compatibility with the interfaces of the existing machine components, in particular external coils and diagnostic systems. Examples worth mentioning are the use of high-performance polymers and acrylic based syntactic foam materials for peculiar vessel parts, of ceramic coatings to guarantee electrical insulation of plasma facing components and the realization of rather complex in-vessel components by means of metal additive manufacturing. This project was developed in collaboration with local industries in the framework of an industrial innovation project co-funded by Italian public bodies.

This contribution will present an overview of the RFX-mod2 device and its scientific goals for the forthcoming experimental phase, together with a detailed description of the design solutions implemented and tested for the realization of the new components integrated in the machine complex. In particular, evidence of the results of prototype testing, performed to qualify the above mentioned technological solutions, and the manufacturing status of the most critical components, will be given.

[1] Marrelli L., et al., “Upgrades of the RFX-mod reversed field pinch and expected scenario improvements”, Nuclear Fusion 59 (2019) 076027 (14pp), <https://doi.org/10.1088/1741-4326/ab1c6a>

[2] Peruzzo S., et al. "Technological challenges for the design of the RFX-mod2 experiment", Fusion Engineering and Design 146 (2019) 692-696, <https://doi.org/10.1016/j.fusengdes.2019.01.057>