Contribution ID: **27** Type: **Oral**

Characterization Program of EUROFER97 RAFM Steel and Implementation Plan in the RCC-MRX Code for the Design and Manufacturing of ITER TBM

Wednesday 3 September 2025 14:50 (30 minutes)

A set of different Test Blanket Module (TBM) concepts will be installed on ITER to validate the design and operation in nuclear fusion environment of Breeding Blanket technologies for fusion facilities. AFCEN code RCC-MRx [1] has been selected for the design and the manufacturing of the European TBMs. Reference Procurement Specification and some material properties are already included in the "probationary rules"tome of the RCC-MRx code for the reduced activation ferritic martensitic (RAFM) steel EUROFER97 [2] chosen for the structural material of European TBMs. In order to fill the remaining gaps needed to complete the implementation of EUROFER97 in the RCC-MRx code [3], an extensive experimental programme is being conducted by the EUROfusion Consortium. On this basis, the codification work in RCC-MRx has recently restarted in a collaboration with Fusion for Energy (F4E), Framatome and CEA.

Qualification programme for EUROFER97
Seven laboratories collaborating within EUROfusion are involved in the qualification programme [4]. Progress of the 2020-2025 programme for the qualification of base metal, including the validation of design rules and evaluation of the effect of irradiation will be presented with a focus on ratcheting, creep-fatigue interaction and immediate plastic flow localization. The 2025-2027 programme for the qualification of tungsten inert gas (TIG) welded joints is starting with tests planned before and after neutron irradiation.

Implementation in the RCC-MRx code
Codification activities driven by F4E are restarting through a five-year framework contract by a consortium FRAMATOME/CEA. The objectives of the contract starting from 2025 are to:
—Analyse the data from the EUROfusion experimental programme in view of preparing the next Modification Request for integration of EUROFER97 in the Tome 1 (Design) of the RCC-MRx.
—Update and complete Reference Procurement Specification in the Tome 2 with experience gained from the manufacturing of the 4th batch of EUROFER delivered by Saarschmiede with certificates EN 10204 3.1.
—Consolidate the codification for the manufacturing and control of TBMs, including welding (Tomes 3 to 5) using the feedback from the development activities for the fabrication and assembly processes.

The EUROfusion experimental programme, as well as the progress on procurement and fabrication development by F4E, will allow completing the supporting Material File requested to justify the design and manufacturing of the TBMs according to the requirements of the RCC-MRx code.
REFERENCES
[1] AFCEN, RCC-MRx, 2022.
[2] A.A TAVASSOLI et al., Journal of Nuclear Materials 455 (2014) p. 269-276.
[3] Guide for introducing a new material in the RCC-MRx. Technical Publication form AFCEN, 2017.
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Session Classification: Topic II

Track Classification: Track II: Manufacturing, assembly, and licensing