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

Development of C&S for fusion in-vessel components: from ITER to DEMO

In the fission industry, nuclear installations are designed and constructed following established Codes and Standards (C&S), developed over decades based on operational feedback and regulatory requirements. In contrast, fusion facilities lack a harmonized regulatory framework and their safety hazards are different from those of fission plants. Additionally, while mission-critical components - such as In-Vessel Components (IVCs) - may not be classified as safety-related and might be exempt from regulation, they must still adhere to the highest quality standards for investment protection and operational reliability.

To address these challenges, ITER adopted a multi-code approach, combining industrial codes –such as ASME and RCC-MRx - with ITER-specific design criteria and guidelines. Despite the comprehensive documentation generated by ITER, key challenges still remain due to regulatory uncertainties and extended operational domain of IVCs in future fusion power plants.

To bridge these gaps, EUROfusion, in collaboration with Fusion for Energy (F4E), is actively working on the development of C&S for DEMO IVCs. A major focus is the development of the RCC-MRx code for the EU Test Blanket Modules, which will provide critical information for the design of the Breeding Blanket. In parallel, EUROfusion is developing specific DEMO Design Criteria for In-Vessel Components (DDC-IC), introducing new design rules and alternative damage assessment methodologies to enhance performance while reducing excessive conservatism.

The DDC-IC aims to serve as a structured guide for DEMO IVC design, establishing a robust foundation for future fusion reactors. This work provides an overview of EUROfusion's efforts and the current status of DDC-IC development.

Technical Categories Addressed

Other Systems

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Session Classification: Development of Codes and Standards