Contribution ID: **83** Type: **25 min Oral**

Technological developments of the W7-X and JT-60SA metallic actively cooled divertor

Tuesday, 15 October 2024 14:25 (25 minutes)

For a successful operation of ITER and of future fusion reactors, several fusion devices are currently being exploited and upgraded. This paper focuses on the technical developments lead in JT-60SA (Japan) and Wendelstein 7-X (W7-X, Germany) fusion devices to provide support on the long pulse operation in metallic environment using operation conditions complementary to the current existing fusion devices.
The tokamak JT-60SA has been constructed in the framework of the broader approach with strong European support. After the operation of carbon divertor, a transition to a metallic device is foreseen for the "Integrated Research Phase I". Tungsten actively cooled divertor target PFCs (W-ACD) will be installed to provide information on high-beta, inductive and non-inductive operations in metallic environment. The conceptual design of the JT-60SA W-ACD is planned to be achieved in 2026.
In parallel, Europe is also promoting studies on the stellarator concept, considered as the backup solution for the European reactor design. For this purpose, a transition of W7-X to a carbon free environment is planned. As for JT-60SA, the concept of the W7-X W-ACD with the related validated manufacturing process is planned to be qualified in 2026.
Analyzing the boundary conditions and loads related to the future W-ACDs of JT-60SA and W7-X, some similarities exist. First, these W-ACDs are planned to handle steady state thermal heat loads in the range of 10 MW/m². The current boundary conditions (cooling conditions···) and interfaces of the already existing device dictate rather strongly the design options. The armour material is planned to be pure tungsten (W) or W alloys for both fusion devices. Moreover, one of the option for these two devices is to the join the armour material to CuCrZr manufactured by additive manufacturing, ,in which the cooling circuit is inserted. To take benefit from these similarities, projects are run within the same European work package called Divertor (WPDIV). In this paper, the concepts currently investigated for the metallic targets of JT-60SA and W7-X will be detailed and the current results of the manufacturing steps will be presented.
"This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 —EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them."

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Session Classification: PWI session

Track Classification: Plasma Wall Interactions, Exhaust and Control