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Synergies in the technological developments of the W7-X and JT-60SA metallic divertor plasma facing components

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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 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 actively cooled divertor, a transition to a metallic device is foreseen after 2033 for the "Integrated Research Phase II". 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. In both cases, the operation of actively cooled components based on carbon armour material (C-ACD) is planned before the transition to the W-ACD. Consequently, the boundary conditions (cooling conditions…) and interfaces of the already existing device dictate rather strongly the design options. The size of current C-ACDs for the two devices are also equivalent (~400 mm * 30-50 mm). To take benefit from these similarities, projects have been launched within the European work package called Divertor (WPDIV). The subprojects W7-X/JT-60SA will develop and demonstrate the feasibility of W-ACDs for W7-X and JT-60SA, within the boundary conditions and interfaces of the corresponding device, by full scale prototype manufacturing and high-heat-flux testing. In this paper, the concepts currently investigated for the metallic targets of JT-60SA and W7-X will be detailed and the rationale for the material and manufacturing processes choices will be presented.

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Speaker's Affiliation

CEA, Cadarache

Member State or IGO

France

Primary authors: RICHOU, Marianne; BOSCARY, Jean (IPP Garching); FELLINGER, Joris (IPP Greifswald); FIRDAOUSS, Mehdi (CEA/IRFM); NEU, Rudolf (Technische Universität München & MPI für Plasmaphysik)

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