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DESIGN, CONSTRUCTION AND INSTALLATION OF LIMITER & DIVERTOR OF ADITYA-U TOKAMAK

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The ADITYA tokamak (R0 = 75 cm, a = 25 cm)[1] having a limiter configuration has been upgraded to a state-of-art ADITYA-U tokamak[2] with divertor configuration to support the future Indian Fusion program. Limiter and Divertor are the most important subsystems of any tokamak. They are used to form the plasma boundary inside the tokamak and restrict the high-temperature plasma from hitting the vacuum vessel wall and provide protection to in-vessel components. A much better configuration in terms of energy and particle exhaust can be achieved in the divertor configuration, where the outermost magnetic field flux lines are opened up to make them strike on a chosen divertor target.
The positions of the limiter and divertor plate locations inside ADITYA-U have been determined based on numerical simulation of the plasma equilibrium profile. The new machine accommodates three different configuration of limiter and divertor assemblies. ADITYA-U is having a toroidally continuous inner limiter with a poloidal extent of ⅛ of poloidal periphery of vessel. There are two outer limiter assemblies installed at two different toroidal location with poloidal extent of 1/4 of poloidal periphery of vessel. The divertor plates are toroidally continuous structures located at upper and bottom halves of the vessel. In addition, one pair of the safety limiter which is a poloidal ring of graphite tiles placed inside vessel (at toroidal) symmetrical locations. Initially graphite will be used as plasma facing material (PFM) in all the limiter and divertor plates. Shaped graphite tiles have been fixed on specially designed support structures made out of SS-304L inside the torus shaped vacuum vessel. The dimensions of the limiter and divertor tiles are decided based on their installation inside the vacuum vessel as well as on the total plasma heat loads falling on them. Depending upon the heat loads; the thickness of graphite tiles for limiter and divertor plates is decided.
All Limiter assemblies of ADITYA-U have been installed inside vacuum vessel. As the vessel dimensions of ADITYA-U are not suitable for any human to go inside the vessel, installation of limiter tiles along with integration of other in-vessel components on the high field wall side was very challenging. Successful plasma operation with these limiters has been obtained during the first phase of machine operation. The divertor plates will be installed during phase-2 machine operation. In this paper, ADITYA-U limiter and divertor conceptual design, fabrication and installation along with challenges faced will be presented.

Reference:
[1] Bhatt et al., Aditya: the first Indian Tokamak, Indian Journal of Pure and Applied Physicsm 27:710
[2] J Ghosh et al., Upgradation of Aditya Tokamak with Limiter Configuration to Aditya Upgrade Tokamak with Divertor Configuration, 26th IAEA Fusion Energy Conference, Kyoto, Japan

Eligible for student paper award?

No

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