DEVELOPMENT OF LASER WELDING FOR ITER DIVERTOR DOME APPLICATION

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The ITER divertor is modular structure consisting of 54 cassettes. Each cassette consists of cassette body, inner and outer vertical targets and the Dome. Russian Federation is responsible for manufacturing and delivery for ITER 60 Domes. The every Dome consists of steel supporting structure with 34 plasma-facing units. The steel support structure includes three manifolds with 12 plugs. Each plasma-facing unit and manifold plugs are supposed to be welded by laser beam welding.

During laser beam welding of stainless steels for thicknesses more than 3 mm a lot of droplets appeared close to the weld area. These welding structures are part of divertor cooling system. Thus droplets from root weld side can be detached, appeared in cooling system and contaminate cooling pumps. In the common practice of laser and e-beam welding both surfaces are machined. The main problem for using of laser welding for Dome manufacture are ITER requirement of full penetration and inaccessibility of weld root for machining after welding.

The attempts to select different welding regimes, to use the longitudinal beam scanning or removable catchers from different materials were not allow avoiding the droplets appearing at the weld root. One from the more successful attempts was using ESAB OK10.69 flux. The flux placed to root side of the weld. Besides the flux the argon shielding gas was used for both welding sides.

The samples and mock ups of different parts of Dome divertor with thicknesses from 7 mm up to 12 mm were welded for development welding technology. The welded stainless steels parts were from 316L(N)-IG and XM-19 steels.

The fiber laser LS-15 with robot Motoman HP50 in FlexLase laser cell was used for welding with full power of 15 kW.

The welds quality was controlled by visual and radiography examinations. These examinations were demonstrated good weld quality. The industrial videoscope was used for visual examination of weld root side.