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P3.113 ENEA Ultrasound Test of Plasma Facing Units

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The Plasma Facing Units are the components of the ITER's divertor target exposed to the plasma. PFUs are cooling pipes made of copper covered by tungsten monoblocks as armour.

The non-destructive ultrasonic control is the simplest and most economical test for PFU control. It has also proved to be extremely reliable and accurate in identifying and sizing defects.

ENEA has been working on improving the scanning technique of these components for many years, obtaining increasingly accurate and easy to interpret results. The first tests were performed on small mock-ups and, due to the geometry of the component, tests were performed from inside the tube. The first problem to solve was the reduced pipe thickness and the need to direct the ultrasound beam orthogonally to the tube surface. The choice of the correct probe characteristics and its particular shape solved this problem. Subsequently, the problem of a scan along a curved tube had to be addressed. Then, a flexible tube, at the end of which the probe was placed in a special probe holder able to accompany the curvature, was achieved. The definition of more stringent acceptance criteria for these components has required to increase the scanning resolution. Working on automatic system and data analysis software, we have come to detecting and sizing defects up to 0.5 mm. As sample sizes increase up to full-scale prototype for pre-production, the problem has become to speed up scanning without losing resolution. At this point, the scan along generatrix was discarded to pass to an automatic system that proceeds with a helical path. In this work, the system created and patented in ENEA laboratories for scanning of full-scale Inner Vertical Target PFU prototypes of ITER is illustrated. Test results in terms of resolution and defects sizing are shown.

Presenter: ROCCELLA, selanna (Department of Fusion and Technology for Nuclear Safety and Security ENEA)

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