An Operational Non Destructive Examination for ITER Divertor Plasma Facing Components

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To meet the power exhaust - heat flux of 20MW/m² - requirements of Plasma Facing Components (PFCs) during plasma operation requires control of their thermal and mechanical integrity. As heat exhaust capability and lifetime of PFCs during in-situ operation are linked to the manufacturing quality, it is an absolute requirement to develop reliable nondestructive examination methods, in particular of the CFC-CuCrZr joint, throughout the manufacturing process. Within the framework of Tokamak Tore Supra upgrade, a pioneering activity has been developed to evaluate the capability of the PFC to be efficiently cooled. In 1998 a test bed - so called SATIR - based on the heat transient method was developed by the CEA and is used today as an inspection tool in order to guarantee the PFCs performances. The technical procurement plan of ITER Divertor targets stated that all Cu cast layers on CFC armour should be subjected to 100% thermographic examination. Each ITER Party should demonstrate its technical capability to carry out the PFC with the required cooling efficiently. The ITER Divertor PFCs pose new challenges especially for the monoblock CFC thickness, and the number of full scale units to be tested which is higher than on any existing or under construction fusion machine. The SATIR method as functional inspection has been identified as the basis test to decide upon the final acceptance of the Divertor PFCs.

In order to increase the detection sensitivity of SATIR test bed, several possibilities have been assessed i) the increase of the convective heat transfer coefficient, which improved in a significant way the sensitivity of SATIR diagnostic on ITER components. ii) the installation of a digital infrared camera and the improvement of the thermal signal processing, has led to a considerable increase of performances iii) an innovative process based on spatial image autocorrelation will allow to localize the interlayer defect without the use of reference.

This paper deals with all the improvements performed on SATIR test bed to meet a reliable examination of the ITER Divertor, and show that SATIR is an operational test bed for testing of the full scale ITER Divertor components.

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