

ITER IN VESSEL VIEWING SYSTEM DESIGN AND ASSESSMENT ACTIVITIES

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The In Vessel Viewing System (IVVS) is fundamental remote handling equipment, which will be used to make a survey of the status of the blanket first wall and divertor plasma facing components.

A prototype of a laser In Vessel Viewing and ranging System [1] was developed and tested at ENEA laboratories in Frascati under EFDA task agreements, it uses the amplitude modulated laser radar concept and it is based on an intrinsically radiation resistant concept and architecture to withstand the severe ITER conditions. It is able to perform sub-millimetric bi-dimensional and three-dimensional images inside ITER during maintenance procedure allowing the evaluation of the state and damages of the in-vessel surface.

The present prototype has been designed to operate under room conditions and starting from springtime 2009 a Grant with F4E is in progress for the design and the assessment of the IVVS system for ITER, keeping in account all the environmental conditions and constraints.

The paper describes the work in progress that covers three main areas:

- The execution of laboratory tests with the present IVVS mock-up, and further upgrades of the mock-up in order to verify that the performances of the mock-up are matching (or at which level are approaching) those required for the final application in ITER. The tests and upgrades cover the behavior of the system in ITER relevant materials, the expected depth of field and characterization with distance and incidence angle, the evaluation of the effects of deployer vibrations and possible recovery methods.
- The assessment of the expected viewing/metrology capability of the IVVS in the ITER conditions including a complete characterization of the system that has been summarized in quality functions and it has been used for the development of a mapping tool, which is able to produce colors map of ITER in-vessel surface in order to represent the viewing and metrology characteristics of the system. This activity gives important information and feedbacks for the effective design and optimization of the IVVS system and for the deployer optimal geometry and positions.
- The conceptual designs of an IVVS probe prototype and related test bed, in preparation of the future procurement and testing activities. The performances will be enhanced as possible for depth of field and for other parameters basing on experience acquired with the current prototype. The conceptual design is keeping in account all the ITER environmental conditions (UHV conditions - 10⁻³ Pa; Operating temperature ≤120°C; baking temperature 240°C; dose rate up to 5 KGy/hour of gamma rays; total dose: up to 10 MGy, total neutron fluence 5×10¹³ n/cm²; Magnetic field of up to 8 Tesla). The conjunction of these hard constraints has a big impact in the choice of materials and components and in particular for the motors. It will be also described a possible layout and the principal characteristics of a test facility for the test of the IVVS systems produced in the future procurements.

[1] C. Neri et al., The upgraded laser in vessel viewing system (IVVS) for ITER, Fusion Engineering and Design, volume 84, year 2009, pp 224–228