Water Flow Tests of EHF FW FSP with ultrasonic method to confirm no blockage [[1]](#footnote-1)\*)

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The First Wall Panels (FWP) of ITER comprise a large number of parallel cooling channels, blocking of the channels during manufacturing of the panels might result in overheating and further failure of relevant element. The method for testing of FWPs by hot water with simultaneous monitoring of the thermal response on the surface by a sensitive IR imager was proposed in the Technical Specification of the Procurement Arrangement signed by the ITER International Organization (IO) and ITER RF Domestic Agency. A thermostabilized room is required to realize this method. A less laborious and cheaper method was offered by the JSC “NIIEFA” that consists in defining the nonuniformity of water flow distribution over separate branches of channels for FWP cooling, that is, for each pair of fingers. This method is characterized by that the water flow is monitored by an ultrasonic flow meter, so there is no need to change coolant flows in the cooling channels on a confined pipeline section.

Monitoring is carried out by a Fluxus F601 ultrasonic flowmeter which provides measurements on smooth pipes 6 mm and more in inner diameter on the testing section 26 mm in length (straight section without turns and welds). The existing FWPs have no pipe sections suitable for measurements. In this connection we propose to use a straight section of the finger. The cross-section of a finger hydraulic channel is complex shaped with a nonuniform distribution of the flow rate, which cannot be taken into account in the software standard settings for the flow meter. Besides, the cross-section and longitudinal section of the cooling channel will always differ with some scatter in the rated values as a result of deformations arising after welding of the finger base. Thus, to correct the readings of the ultrasonic flowmeter, a complex correction factor will be introduced. The testing program and procedure includes testing of finger pairs before and after their installation on the FWP base. Before installation of the pairs on the panel the readings of the flow rate obtained by the flow meter are calibrated for each pair by the readings of a Coriolis flowmeter. After their installation, the previously obtained complex correction factor is used.

Mock-ups replicating the channel geometry in the FWP fingers with a channel different in height have been developed for the preliminary tests. The tests of these mock-ups have confirmed the possibility to use the ultrasonic flow meter for a non-cylindrical cross-section while using the correction factor.

The tests have verified the validity of the method proposed by the JSC “NIIEFA” for monitoring of the water flow rate by the ultrasonic flow meter. The appropriate procedure has been developed by the NIIEFA and approved by the ITER IO for further application in “commercial” FWPs.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/E/ru/JW-Mambetkerimov.docx) [↑](#footnote-ref-1)