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P4.054 On multistage development of ITER High Field Side Reflectometry diagnostic module design based on thermal stress numerical assessment

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The High Field Side Reflectometry (HFSR) is one of the ITER diagnostics, which provides information about plasma state by measuring the electron density profile. HFSR diagnostics undergoes a strong action of different physical nature loads.

Five various designs have been developed and studied since 2014 as a result of interaction of Peter the Great St. Petersburg Polytechnic University, NRC "Kurchatov Institute" and Fusion Centre. Multiphysics engineering finite-element analysis has been performed for each of the HFSR design.

This study deals with thermal loads which were discovered to be the most significant from structural integrity point of view. HFSR is subjected to non-uniform nuclear heating during plasma operation, high-intensity antenna radiative heating from plasma and substantial cyclic thermal loads during ITER life that makes satisfying the strength requirements challenging. Several thermal analyses were conducted to determine conditions ensuring the least and the most dangerous state.

Key features of the proposed mathematical model and results of numerical simulations which demonstrate a stress state of the diagnostics are given. The process of multistage diagnostic design development based on the finite element analysis results is presented. In addition, the study of bolt tightening force and friction coefficient values influence on a stress-strain state of the final diagnostic design is fulfilled. The necessity of accounting these factors in numerical simulations is demonstrated.

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