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On Structural Analyses of the ITER Vacuum Vessel Bolometer Camera Housing Conceptual Design

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The ITER bolometer provides an absolutely calibrated measurement of the radiation emitted by the plasma which is a part of the total energy balance. The development is especially challenging because of the extreme environmental conditions within the vacuum vessel (VV) during plasma operation. The bolometer has to guarantee reliable measurements within an environment characterized by high neutron flux as well as temperatures exceeding 200 °C. In addition to the thermal loads the bolometer body is exposed to the mechanical loads caused by electromagnetic forces during transient events called disruption.

This paper describes a possible procedure for a structural analysis of the bolometer camera body. To examine all important structural properties of the bolometer body, a multiple nonlinear finite element model based on a CAD conceptual design, has been generated. Subsequently, a transient mechanical analysis has been performed using the finite element code ANSYS. The input for the analyses was generated by a general electromagnetic model, taking into account the contribution of all structural parts and electromagnetic loading starting with the DINA code. From the wide range of DINA results the worst case load scenario has been chosen.

This analysis enables the study of the response of the bolometer camera structure to the dynamic excitation caused by electromagnetic forces during the plasma disruption. Moreover, the influence of the different design solutions and different material properties has been investigated. Due to dynamic oscillating excitation by electromagnetic forces the whole bolometer structure is thoroughly shaken, as demonstrated by the results of deformation analyses. The analyses results will be used to validate the design against the required structural integrity during worst-case scenarios and verify the reliability of the bolometer camera design during operation. Finally, this analysis provides the results needed to perform the fatigue analysis of the VV bosses supporting the bolometer camera.

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