THE INFLUENCE OF THE TOLERANCES OF THE COLLIMATOR CHANNEL SYSTEM ON THE WORK OF THE ITER VNС DIAGNOSTICS [[1]](#footnote-1)\*)

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The ITER Vertical Neutron Camera (VNС) is a system designed to measure the profile of a plasma neutron source. The VNC consists of two fan-shaped collimating structures: the Upper and the Lower, located in two different ports of the ITER Vacuum Vessel. The Upper VNC is installed in the Port Plug of the Upper diagnostic Port 18 and has six measuring channels with collimators for VNC lines of sight. The Lower VNC is installed in the Diagnostic Rack located inside the Lower Port 14. It also has six measuring channels but only five of them have collimators. One measuring channel of Lower VNC is "blind" and is needed to count background neutrons.

CAD model consisted of Lower VNC, parts of Divertor cassette and Blanket Shielding Module has been developed to assess the passage of the neutron flux to VNC detectors by optical method. The collimators of the Lower VNC pass through Blanket Shielding Module, Divertor cassette and a VNC Detector Module itself installed in the Diagnostic Rack. All mentioned above components have independent attachment to the ITER Vacuum Vessel. Line of sight has been built for each VNC measuring channel as well.

In general, the sources of errors in neutron source emissivity profile reconstruction are manufacturing tolerances of collimating channels within components, errors in the relative positioning of components during installation and deformations of collimator channels under mechanical loads arising from tokamak operation. It’s expected that all mentioned sources of errors will have an impact on the resulting accuracy of neutron source emissivity profile reconstruction.

In order to estimate the influence of relative position of the collimating channels within different components on the resulting neutron flux reaching detectors of Lower VNC, an optical method and calculation of detectors response to the incident neutrons by radiation transport analysis were used.

Later after analysis of mechanical displacements and thermal movements, the diameter of the collimating channels in the Divertor cassette body has been increased and axes of the collimating channels have been adjusted in order to compensate the misalignments between Divertor cassette and other components.

In the optical method, the percentage ratio of normal cross-sections of each line of sight for neutrons passage has been calculated with respect to different positions of the Lower VNC. Additionally, neutron transport calculation has been performed to evaluate detectors’ response under different cases of collimator channels displacements. The calculation was carried out by the Monte Carlo method, considering the real geometry of the VNC collimators and surrounding structures.

The analysis showed that the worst losses of signal (upto 30% of initial intensity) occur in the 7th measuring channel, which is the closest to the Divertor cassette. At the same times, consideration of the actual (as-installed) position of the collimating channels in the Blanket Shielding Module and in Divertor cassette, as well as analyzing the data obtained by the "blind" VNC measuring channel, allows to make the necessary corrections to the algorithm of neutron source emissivity profile reconstruction.

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