DOSE RATES IN CXRS MAINTENANCE AREAS: SPEEDING UP THE ENGINEERING DESIGN OF COMPONENTS

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The function of the ITER core CXRS diagnostic system is to provide information about important plasma physics parameters by analyzing visible light emitted by the plasma. The device is located in Upper Port Plug #3. The Diagnostic Neutral Beam induces low-intensity light which impinges on the front surface of the port plug. This light should be transmitted with high efficiency to the back end of the plug and collected in a fibre bundle, which transmits the light towards a set of spectrometers for spectral analysis. Part of the equipment is located in the Upper Port #3 Interspace. This cell with stainless steel walls is also the area where maintenance is foreseen on the sensitive optical components of the CXRS. This implies that personnel access should be possible around 12 days after shut-down. One of the limiting parameters for this access is the radiation dose produced by neutron activation of the ITER structure.

In this paper we concentrate on the calculation of the dose rate. The calculational model was divided in three spatial areas in order to estimate the contribution from the upper port region, equatorial port region and lower port region separately. Additionally, separate calculations were made for the contribution of the activation of the steel walls of the upper port interspace and the activation of the rest of the ITER structure. The former calculation was done in an exact, the latter one in an approximate manner.

In previous analyses of the ECRH upper port plug a low value of the dose rate was obtained (around 15 μSv/h). However, the current analyses result in values which are substantially higher, close to the limiting value of 100 μSv/h. We observe that a large fraction of the dose rate is due to radiation streaming through the gaps around the port plugs. Furthermore, the contribution of the lower port region is substantial. Especially the lower ports which lead to the vacuum pumps provide large open volumes which promote the transport of radiation to the outside of the machine. Although in some of the lower ports more shielding material is present we opted for conservatism in our analyses and adopted the standard model for ITER neutronics analyses (the A-lite model).

We propose that in design analyses of ITER components the accompanying neutronics analyses yield separate contributions for the relevant component and for the remainder of the structure. If the former contribution is only small compared to the latter this procedure could prevent unnecessary conservatism in the radiation shielding of the component. This could result in simplified design of components and in shorter turn-around times in the design phase.