PRELIMINARY NUCLEAR ANALYSIS OF ITER IN-VESSEL COILS

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In-vessel coils (IVCs) will be used in ITER to provide control of Edge Localized Modes (ELMs) and the vertical stability (VS) of the plasma. The IVC system consists of 27 ELM control coils and 2 toroidal ring VS coils. Accommodating these coils in the ITER design is challenging and several design options are being considered. These coils are imbedded in the back of the shield modules inside the inner shell of the vacuum vessel as shown in Figure 1. As a result, these coils are lightly shielded and are exposed to a nuclear environment that is much severe than for the TF coils. In addition, shielding for the poloidal legs of the ELM coils is reduced by the space occupied by the coolant manifolds. We performed several neutronics calculations using simplified geometrical models to determine the expected nuclear environment and help guide the design evolution. The 20 mm gaps between adjacent shield modules were included. The impact of the IVCs on damage parameters in the vacuum vessel and magnet heating in the TF coils was determined. While the effect is small for total magnet heating, the vacuum vessel parameters have peaking factors up to ~3 primarily due to gap streaming. The peak fast neutron fluence in the IVC is ~3×10^{24} n/m^2 at the end of ITER lifetime. This does not allow using organic insulators and mandates utilization of the more radiation resistant ceramic insulators. A modest copper radiation-induced resistivity increase occurs at that fluence level. We will report on analyses performed for different IVC designs and configurations.

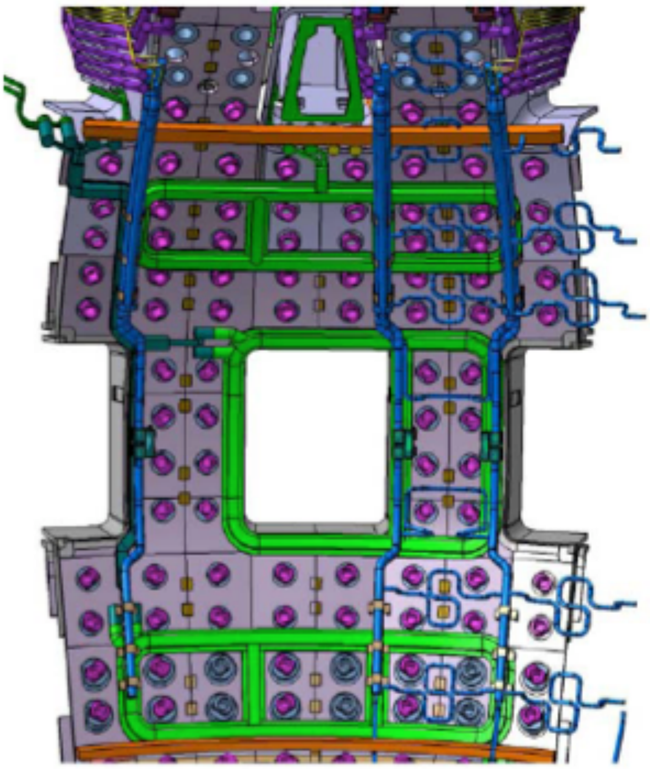

Figure 1: Configuration of IVCs inside ITER vacuum vessel