

IN-VESSEL REMOTE HANDLING MACHINE FOR BLANKET REPLACEMENT IN THE DEMO FUSION REACTOR

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Studies for the integration of blanket in a fusion reactor have been undertaken in the last year at FZK. In the course of these investigations maintenance concepts based on large module replacement of ITER derivation have mainly been addressed.

Context of the in-vessel machine: The concept proposed here assumes that there are several hundred elements to replace and a weight limit of 10 t applies to the individual elements. Major radius is 8.6 m. In the course of blanket replacement mechanical and hydraulic connections must be severed/established. The present in-vessel remote handling machine is responsible only for mechanical connections thus it is coupled with an in-bore tool dealing with the hydraulic connections. The in-bore tool is reaching the blankets from the “back” through cooling and other pipes and is operating parallel and largely independently from the in-vessel remote handling machine.

Installation and operation of in-vessel remote handling machine: A rail is built up in the middle of the vessel along the major radius of the tokamak, and is supported from four ports with long radial arms attached perpendicularly to the rails. These arms occupy the upper sections of the ports. On the rail four manipulators are operating, each being responsible for 90 degree section. These manipulators can travel along the rail reaching every element within their section with a telescopic arm and are capable of highly complex movements at great precision manipulating the elements at max 4 m distance. The manipulators take the old elements to the ports where the element exchange takes place through the lower sections of them (the upper sections being used for the support of the rails) with a dedicated device, an in-vessel transporter, which will be used to transport the old elements away and bring new elements into a position where the in-vessel manipulator can grab them.

The main characteristic feature and advantage of this system is that for all the operations involving the in-vessel blanket replacement (installation of the rail, support and element exchange) only the opening of the four equatorial ports are required, and no in-vessel components are “touched” for support.

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