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Short_Tutorial: Introduction to DIAGNOSTICS AND CONTROL OF FUSION-FISSION HYBRID TOKAMAK BASED REACTORS

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A fusion-fission hybrid (FFH) reactor is a complex machine, which includes a tokamak fusion neutron source and two blankets: the tritium regeneration and the actinide burner zones. These three systems need their own diagnostics and controls. Problems associated with the implementation and integration of control systems call for a simplified technology. In this paper, a short overview of the tokamak model devices used as neutron sources for the FFH reactors is presented taking into account the physics and engineering constraints typical of a FFH: fusion gain factor Qfus=2-3 , fusion power 80-100MW , long pulses of few hours, figures compatible with a low power DEMO-like reactor. The criteria determining the diagnostics needs of FFH reactors are then reviewed bearing in mind the requirement that the measurements systems should be simple and robust, and their number be limited, considering the space occupied by the blankets. The diagnostics for the tokamak neutron source, including the machine protection and burn control are among the basic equipment. As the fusion and fission blankets can be integrated in a single subsystem their diagnostics must be conceived as an integrated package that includes the means for measuring isotope content, neutron multiplication and effective reactivity of the fission blanket, as well as tritium regeneration in the breeding blanket. In the context of fission blankets it's important to take into account the possibility of uranium and thorium fuel cycles, with appropriate diagnostic needs. A pilot model FFH experiment presently under study for the conceptual study if the FFH reactor will be presented where the diagnostics systems will be analyzed and characterized and the most recent technological developments in the field of neutron spectroscopy for fusion and fission blankets are presented.

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