ADVANCED CONCEPTUAL DESIGN OF A MAGNET SUPPORT STRUCTURE FOR PLASMA FUSION DEVICES OF STELLARATOR TYPE

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The plasma fusion research is worldwide focused on two different types of experimental devices - tokamak and stellarator – and their different principles of plasma confinement. In a tokamak, magnetic fields are generated by external coils and by the internal current, which circulates through the plasma and heats it at the same time. In a stellarator, the confining magnetic fields are generated by using exclusively external coils without any circulating current inside the plasma. The system is thus heated by external sources only.
Stellarator devices operate in a steady-state mode in contrast to the tokamak family working in a pulsed mode. The operating modes are probably the most important differences between both principles, in particular with regard to fusion reactors which naturally need a real steady-state operating mode.
Notwithstanding the advantages in operation mode, the fact, that stellarators rely entirely on magnetic fields produced by external coils, requires a more complex shape for the coils than in tokamaks. These very complex coil shapes and the necessary support structures are at present the most challenging tasks in R&D of stellarator devices in comparison with tokamaks.
Based on long time experience [1] in design and structural analyses of stellarator magnet systems and their related support structure, the authors are proposing in this paper an advanced conceptual design for the magnet support structure. This conceptual design is developed particularly with regard to a modular quasi-helical symmetric stellarator reactor, based on the physics optimisation of stellarators published in [2] and [3]. Moreover, the conceptual design is universal regarding the device modularity and size. The featured concept provides high flexibility of the magnet coils during the assembly phase and potentially during the operation.
This paper describes the basic assumptions that a conceptual design of a magnet support structure has to fulfil, regarding the feasibility, reliability and affordability.
Furthermore, the here proposed conceptual design for a plasma fusion device of stellarator type is aimed at to guarantee a high availability of such a facility, in consideration of plasma physical demands.

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