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Tokamak design and maintenance scheme trade off Application on CFETR

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The new tokamak generation will be characterized by the necessity of full remote maintenance for most of the critical components. Because no human intervention can be envisaged, the remote systems will have to prove high reliability and rescue capabilities. The availability of the fusion facility will have to be maximized, as a consequence, the efficiency of the maintenance equipment will become a key factor. To fulfill these constraints, the remote maintenance principles will need to be simplified as much as possible and be taken into account at the early stages of the tokamak design. This is an iterative process between Tokamak design and Maintenance system design in order to reach the best possible trade off.
Such an exercise of this iterative work was done on the CFETR preliminary design.
Main targets were established in the view of optimization of the remote maintenance, then an assessment of the first maintenance scenario, envisaged for the in-vessel components, was done and alternative solutions were proposed. This process was repeated during meetings with the tokamak sub-system owners.
The paper will present the results of a first phase of optimization. This work has provided guidelines for the main tokamak sub-systems like the magnet configuration, the blanket and divertor modularity, the neutron shielding and cryostat arrangement, the transfer of components and the hot cell configuration.
It also produced some innovative solutions for the overall maintenance scheme like the implementation of a hot cell at the top of the tokamak hall avoiding cask transfers. On this basis a CFETR maintenance scenario is proposed.
The paper will address the following topics:
• Preliminary design and optimization drivers
• Blanket and divertor design proposal
• Blanket and divertor maintenance system
• Equatorial plug maintenance system
• Cask, transfer and double door system proposal
• In-cryostat maintenance principle
• Pending issues to be analysed

Eligible for student paper award?

No

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