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Editorial

Special Issue on Structural and Thermo-Mechanical Analyses in Nuclear Fusion Reactors

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Nuclear fusion is one of the most promising technologies to be adopted for the production of electricity. Indeed, since this kind of reactor adopts hydrogen isotopes as fuel, nuclear fusion power plants will not emit any green-house gases and will not suffer limitations in terms of fossil fuel provisions. Moreover, their operation will lead to a reduced amount of nuclear waste, mainly due to the absence of long-lived isotopes.

These are some of the reasons that have led the world community to make an effort towards achieving the feasible design for a nuclear fusion reactor. In order to achieve a mature design of a nuclear fusion machine, different aspects and requirements have to be considered and fulfilled. The goal of this Special Issue was to provide an overview of the different activities that are currently on-going in the design of a nuclear fusion reactor from the structural and thermo-mechanical standpoint.

A total of five papers from different fusion-reactor-related areas, such as breeding blankets, magnets, and diagnostics, have been collected and are presented in this Special Issue. The paper published by Reteesh et al. [1] reports on an interesting procedure for the design of a challenging DEMO Helium Cooled Pebble Bed (HCPB) breeding blanket local region, adopting non-linear analyses aimed at assessing the inelastic criteria mentioned in the RCC-MRx design code. Chelihi et al. [2] focussed their attention on Thomson diagnostic structural behaviour during the normal operation of WEST tokamak. The analyses highlighted that the system is able to withstand the expected loads, even though some areas of improvement were noted. Catanzaro et al. [3] carried out a detailed optimisation of the cooling structures (both first wall channels and breeding zone tubes) of the Central Outboard Blanket (COB) segment of the DEMO Water Cooled Lead Lithium (WCLL) breeding blanket. Moreover, they proposed an innovative method aimed at the extrapolation of the thermal field calculated on a local region of the WCLL breeding blanket to the overall COB segment; they aimed to assess its thermo-mechanical behaviour under different loading scenarios. Bongiovì et al. [4] performed a detailed analysis of the top cap of the DEMO WCLL breeding blanket. In the first phase, thermal optimisation of the top cap region was performed. Then, a mechanical analysis was carried out considering the results obtained in the previous thermal step to verify that the design code criteria were fulfilled. This process was iterated until both thermal and mechanical criteria were fulfilled. Finally, Giannini et al. [5] presented a detailed electromagnetic and structural analysis performed on the DEMO toroidal field coil system and its support structures. The structural model was used to obtain the displacement and stress fields at various time points to perform mechanical evaluation as well as the fatigue assessment.

Although submissions for this Special Issue have been closed, the research on nuclear fusion reactors continues with the aim of tackling the open issues in the field, in order to reach more mature reactor designs that could produce "fusion electricity" by the end of the current century.

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