Contribution ID: **602** Contribution code: **THU-PO3-205-12** Type: **Poster**

Seismic analysis of magnet systems in helical fusion reactors designed with topology optimization

Thursday 18 November 2021 10:00 (20 minutes)

Superconducting magnets in fusion reactors are subjected to a huge electromagnetic force of >100 MN/m. The magnets have to be sustained with a structure with a strong body to avoid high stress and deformation. Extrapolating existing fusion experimental device constructed ever, the total weight of the magnet system, i.e., the magnet and support structure, of a commercial fusion reactor is estimated to exceed 20,000 tons. Weight reduction is desired from the viewpoint of material procurement, cold mass, and the reduction of radioactive materials after decommissioning. Recently, novel structural shapes with significant weight reduction have been achieved using topology optimization techniques. Here, we employed the topology optimization technique to the magnet-support structure in the helical fusion reactor. Compared with conventional design, we achieved a weight reduction of >25%, which is worth thousands of tons. Furthermore, we confirmed that the maximum von Mises stress in the topology-optimized design was within the allowable stress limit of the structural material. However, the topology-optimized shape seemed sensitive to unusual loads, such as an earthquake, a fast down of the magnet excitation, a loss of coolant, etc. Thus, we performed seismic analysis using the mode superposition method referencing the virtual envelope of acceleration response spectra for recent significant earthquakes. Although robustness against an earthquake depends on the conditions of the ground and floor/building, the calculated results show that the safety of the magnet system could be provided with seismic isolation systems. The results of the seismic analysis under various conditions are presented.

Primary authors: Dr TAMURA, Hitoshi (National Institute for Fusion Science); Dr GOTO, Takuya (National Institute for Fusion Science); Prof. MIYAZAWA, Junichi (National Institute for Fusion Science); Dr TANAKA, Teruya (National Institute for Fusion Science); Prof. YANAGI, Nagato (National Institute for Fusion Science)

Presenter: Dr TAMURA, Hitoshi (National Institute for Fusion Science)

Session Classification: THU-PO3-205 Fusion V: Toward DEMO