Contribution ID: **1198** Type: **not specified**

P3.151 Thermal behavior of conceptual blankets in K-DEMO under decay heat induced by neutron irradiation

Wednesday, 19 September 2018 11:00 (2 hours)

It is foreseen from the decay heat analysis that the total decay heat from the blankets reaches up to 55.6 MW immediately after two years of the full power operation of K-DEMO with the fusion power of 2.2 GW. Especially, the estimation shows that the decay heat from an outboard blanket made of Reduced Activation Ferritic Martensitic (RAFM) steel and tungsten first wall would be tens of kilowatts per module. The issue is very important for the K-DEMO operation and maintenance, particularly for the safety of the reactor. Also, the issue is very closely related to the design parameters of hot cell and component cooling strategy.
We have investigated the thermal behavior of conceptual blanket modules in K-DEMO under the decay heat by 3-D heat transfer analysis using ANSYS Fluent software. The significant decay heat just after plasma shutdown can cause thermal failure in the case of a module without any active cooling. In an outboard module, it leads to the maximum local temperature over 1300 ℃ and the temperature difference up to 840 ℃. Natural convection provides integrity to remain within the allowable temperature range of the materials used, when provided that the cool-down time is secured at least a couple of days; the overall temperature of the module is reduced to about 200 ℃ in 10 days after the shutdown. The results suggest that cool-down time of such in-vessel components should be carefully considered for the maintenance scenario and schedule. Moreover, it shows that the active cooling of the components through a primary heat transfer system is essential until the components would be sufficiently cooled down. The results would be used as a reference point for safety assessment and maintenance of K-DEMO.

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Session Classification: P3