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P3.234 Evaluation of the effect of impurities in concrete on shutdown dose and activation for fusion reactor facility

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The exposure by shutdown dose and production of radioactive waste predicted from the activation analysis are interesting issues of fusion reactor facility design in the view of radiation safety. Impurities of the irradiated material, such as cobalt in the structural material, are occasionally an important factor in the evaluation of the induced activity.
Concrete is used as the neutron shield and structural material of the neutron production facilities like the nuclear power plant, accelerator facility, etc. The fusion reactor facility will also use the concrete as the shield and structure of the building. ITER uses normal concrete and heavy concrete as a structure material of the building and the bio-shield, respectively. It is also expected to be same in DEMO. Dominant radioactive nuclides produced from the normal composition of concrete such as Fe-55, Fe-59, Mn-54, Na-22, Na-24, etc. are considered not significant in terms of the contribution to the shutdown dose, because they are mainly beta decay nuclides.
In this study, the effect of impurities in concrete on the activation was evaluated based on the calculation of shutdown dose and induced activity. As the impurities in concrete, europium, cobalt, cesium, and nickel are considered. The shutdown dose and induced activities were calculated with the bio-shield composed of heavy concrete, in which highest neutron irradiation is expected among the concrete structures of the fusion reactor facility.
These impurities produced radioactive nuclides with gamma decay such as Co-60, Cs-134, Eu-152 and Eu-154. Especially Eu-152 and E-154 were the most significant radioactive nuclides produced from impurities of concrete because shutdown dose due to them is much higher than the other radioactive nuclides. The increased shutdown dose and induced activity of the concrete were quantified by the content of impurities.

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