

Neutron transport and material activation in a power plant based on the HCLL blanket concept

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The European Power Plant Conceptual Study (PPCS) analysed the engineering, operational, economic, safety and environmental performance of four power plants based on magnetically confined fusion plasmas to obtain high grade heat to be used for power production, prioritising design detail and integration of the different analyses. The plants spanned a range of physics assumptions and technology concepts ranging from near-term to very advanced, and were designed to obtain the same electrical output, subject to economic optimisation. Conclusions of the PPCS identified a fifth blanket concept in the near-term category whose promising potential performance, and development as a test module for ITER, triggered the evaluation of this technology as a candidate for power production. This is the helium-cooled, lithium-lead blanket concept (HCLL).

Following the PPCS methodology, a power plant based on this blanket has been conceptually designed, analysed and optimised. Neutron transport and material activation analyses performed for the safety and environmental assessment of the plant, made using the purpose-built HERCULES code, are described here together with a comprehensive estimation and categorisation of the active waste generated and comparison with the previous models. Results show features similar to the rest of the models, reported earlier, and in particular show that no permanent disposal waste (PDW) is generated during the operation and decommissioning of such a power plant, provided that the low-activation steel Eurofer is used.