

Waste implications from minor impurities in European DEMO materials

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Waste-production predictions for the future demonstration fusion power plant (DEMO) are necessary to produce an accurate picture of the likely environmental and economic costs of radioactive waste disposal at end-of-life (EOL). Even during the conceptual stage of DEMO design it is important to perform waste assessment so as to avoid potential surprises caused by design flaws that could lead to unacceptable levels of long-term high-level waste.

An integrated simulation process combining Monte-Carlo neutron transport simulations, high-fidelity inventory calculations, and extensive and reproducible post-processing algorithms has been used for the evolving European DEMO designs to quantify the time-varying mass inventories in different waste classes for individual regions and components of the reactor vessel, as well as for the reactor as a whole.

Waste categories based on UK regulations reveal that minor impurities contained in certain materials, such as Eurofer, tungsten, and beryllium, can have a significant impact on the waste classification prospects of materials, potentially leading to the production of waste that will remain as intermediate level-waste (or worse) for hundreds of years beyond DEMO EOL.

The computational framework developed for these assessments can be rapidly and continuously applied to the maturing DEMO design, helping to guide design choices to mitigate long-lived waste production and ensure that most waste becomes low-level waste (or better) within a few decades.

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