Process Flow Diagrams modelling tools for tritium transfers on EU HCPB TBMs and DEMO auxiliary systems

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The tritium availability is a critical issue in the pathway to future fusion reactors. Fuel self-sufficiency and inventory control will determine fusion technology in the coming decades.

The ultimate predictive capabilities of tritium transport modelling tools will be one of the major technological pillars contributing to a robust demonstration of fuel autonomy, tritium control and global safe management in future fusion plants.

Predictive modelling tools are one of the most valuable ways to confirm the fuel cycle performance before direct testing in ITER TBM experiments. Because of the modular nature of the tritium cycle in a fusion reactor, Process Flow Diagrams represent the unavoidable first step towards the development of a validated release-rate model. Furthermore such as predictive PFD is useful to establish DEMO relevant design specifications and testing conditions for TBM system components in ITER.

PFDs balancing dynamically transferred T atoms below 0.001% at both, TBM and DEMO scale levels have been developed in CIEMAT based on TMAP7 [1]. Such 1-dimensional tool is the unique tritium transport modelling tool having ITER QA pedigree.

PFDs models include refined coupling of primary coolant chemistry control and EUROFER permeation properties through the surface state of oxidation based on Elllingam´s diagrams.

This work presents the PFD modelling tool bases at both, ITER-TBM and DEMO scale for HCPB design and reference runs. The PFD tool modularity, including simplified system design specifications permits system scale sizing analyses and reference operational ranges.

The scope and projection of the model and capabilities for the systems design are discussed.

[1] G. Longhurst. Tritium migration analysis TMAP7 code. INEL, USA.

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