

## Impact of DEMO plasma operating phase on tritium inventory in coolant and CPS functionality

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Tritium permeation from Breeding Blanket (BB) towards Primary Heat Transfer System (PHTS) constitutes a relevant issue for operation of DEMO machine. As a matter of fact, once permeated into PHTS, tritium can migrate to working areas and environment via permeation and leaks. In order to control radioactive release, tritium concentration within primary coolant must be kept below fixed limits. To do this, two strategies are under assessment: the use of anti-permeation barriers and/or the adoption of the Coolant Purification System (CPS).

CPS aims at recovering tritium permeated into PHTS, keeping its concentration below design limits. Preliminary sizing has been recently carried out for both helium and water CPS technologies, belonging to ancillary systems of Helium-Cooled Pebble Bed (HCPB) and Water-Cooled Lithium Lead (WCLL) BBs, respectively. CPSs dimensioning was performed to fulfill certain fixed conditions, mainly in terms of thermodynamic and tritium concentration, in primary coolant. However, during DEMO operation, CPS is called to work under an evolving tritium inventory within PHTS. In fact, tritium concentration in primary coolant will have an evolution with time according to the tritium permeation rate, which is linked to the plasma operation, and to the CPS functionality beyond its design point.

The present work deals with the assessment of tritium inventory and CPS operation over the alternation between plasma operation and scheduled maintenance periods, focusing on DEMO first operation phase. Starting from the most recent outcomes of tritium permeation analysis, the evolution of tritium concentration within PHTS is predicted for both helium and water cases, considering CPS efficiency under dynamic conditions. For the analysis, the size of main technologies of both helium and water CPS is kept fixed, according to the preliminary dimensioning. The objective is to predict a reasonable trend of the increase of tritium inventory into coolant over the whole DEMO first operation phase, according to the allowable performances of the CPS under different conditions.

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