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P2.163 Conceptual design of the Enhanced Coolant Purification Systems for the European HCLL and HCPB Test Blanket Modules

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The Coolant Purification Systems, together with the Tritium Extraction System (TES), the Tritium Removal System (TRS) and the two Helium Cooling Systems (HCSs) belong to the ancillary systems of Helium Cooled Lead Lithium (HCLL) and Helium Cooled Pebble Bed (HCPB) Test Blanket Modules (TBMs) which are currently in the preliminary design phase in view of their installation and operation in ITER.
For both European concepts of TBMs, the CPS implements two functions: the first one is the extraction and concentration of the tritium permeated from the TBM modules into the primary cooling circuit; the second one is to control the chemistry of helium primary coolant by removing the impurities from the gas and keeping slight oxidizing conditions in order to promote the formation of natural oxide tritium permeation barriers on the cooling plates of the TBM. The previous conceptual design of this ancillary system has been deeply analyzed during the HCLL and HCPB-TBS (Test Blanket System) Conceptual Design Review (CDR) in 2015.
During CDR it was recognized the need of reduce the tritium permeation into the PC#16 of ITER. Since a significant contribution comes from the HCLL-HCS piping, it was highlighted the need to strongly reduce the tritium permeation rate from the HCS piping.
To achieve this and, then, to lower the tritium partial pressure in the HCS in normal operation, the helium flow-rate treated by CPS has been increased of almost one order of magnitude
In 2017, to fully satisfy the CDR outcomes and the new design requirements/specifications requested by Fusion for Energy (F4E, the European Domestic Agency for ITER), ENEA performed the conceptual design of the Enhanced Coolant Purification Systems.
This paper presents in detail the current design baseline of the “Enhanced” Coolant Purification Systems, focusing on design requirements, assumptions, selection of technologies and preliminary component sizing.

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