

RADIOACTIVE INVENTORY AND CONTACT DOSE RATES IN ITER TBM SYSTEMS

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The testing of Tritium Breeder Blanket concepts is one of the ITER missions and has been recognized as an essential milestone in the development of a future reactor ensuring tritium self-sufficiency, extraction of high grade heat and electricity production.

Europe is currently developing two reference breeder blankets concepts for DEMO reactor specifications that will be tested in ITER under the form of Test Blanket Modules (TBMs):

- the Helium-Cooled Lithium-Lead (**HCLL**) concept which uses the eutectic Pb-15.7Li as both breeder and neutron multiplier,
- the Helium-Cooled Pebble-Bed (**HCPB**) concept which features lithiated ceramic pebbles (Li_4SiO_4 or Li_2TiO_3) as breeder and beryllium pebbles as neutron multiplier.

The determination of the radioactive inventory and of the contact dose rates in the different TBM systems is an essential step in view of the evaluation of the radiological safety of the blanket and of the ITER machine overall, both in case of routine operation and in case of accident.

The following systems and locations have been addressed in this study:

1. For HCLL TBM:

- PbLi system: piping in the port interspace and system/components in the Port Cell (PC), including the cold trap of the PbLi system.
- TRS (Tritium Removal System): system/components in the PC and in the Tritium building.
- HCS (Helium Cooling System): piping in the port interspace, system/components in the PC and in the CVCS (Chemical Volume and Control System) area of the tokamak building.
- CPS (Coolant Purification System): system/components in the CVCS area of the tokamak building.

2. For HCPB TBM:

- HCS and CPS: same as for HCLL.
- TES (Tritium Extraction System): piping in the port interspace, system/components in the PC and in the Tritium building

The evaluations have been carried out by means of the MICROSHIELD code, starting from the data on the neutron-induced radioactivity in the blanket materials, completely available for both the blanket modules.

The possible sources of radioactive material in all the systems have been individuated and their contributes estimated:

- For HCLL, EUROFER corrosion products contamination, and activation of PbLi.
- For HCPB, contamination powder from the ceramic breeder material into the He gas, possible contamination of He purge gas by Be dust from Be pebble beds, and EUROFER corrosion products into the helium coolant or purge gas.

In general, for both HCLL and HCPB systems, radioactivity inventory and contact dose rates turn out to be quite moderate. Some final considerations on the main radioactive safety consequences of the performed estimates are carried out.