

Summary

- Based on today's knowledge on material behaviour under fusion reactor conditions, this work provides strategies for advanced breeding blanket design, materials selection, and fabrication routes.
- One of the strategies (first-wall plating by ODS steel) has been selected to demonstrate a superior thermo-hydraulic performance by high-heat-flux testing of a helium cooled mock-up in HELOKA (Helium Loop Karlsruhe).
- The surface operation temperature could be extended from 550 °C (this is the maximum for EUROFER) to 650 °C (for 100 heat flux pulses of 2 minutes and for additional 7 cycles of 2 hours each, heat flux of 0.9 MW/m², simple helium cooling without flow promoters).
- Extremely robust and crack-resistant HIP joining process for the EUROFER/ODS-steel plating demonstrated and industrial-scale fabrication processes with very high tolerances against manufacturing imperfections for advanced blanket first wall proven
- Production route of 100 kg ODS steel powder and plate fabrication verified. Up-scaling to the several 10-ton ranges is feasible.