Summary slide for FIP/2-1, IAEA-CN-258,

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Progress in Developing ITER and DEMO First Wall Technologies at SWIP

1. The manufacturing technologies for the ITER enhanced heat flux (EHF) first wall (FW) panel have been well developed in SWIP, especially those for the plasma facing unit of fingers. By optimizing design and manufacturing technologies, an EHF FW semi-prototype was successfully manufactured with its two full-size finger pairs passed the 4.7~5.9 MW/m^2 high heat flux thermal fatigue test the first time in the world.

2. The thermal fatigue lifetime of the ITER EHF FW fingers is increased greatly by 1-2 orders by design optimization of the hypervapotron (HVT) cooling channel and the HIP bonding Be/CuCrZr interfacial structure. The former provides a good solution for effect of the HVT side wall laser welding heat effect zone on the CuCrZr/316L(N) bonding interface.

3. The defect at Be/CuCrZr joint interface was found to have great effect on the thermal fatigue performance of the ITER EHF FW, which should be controlled to be less than $12mm^2$ in area. A thick soft pure Copper interlayer could be a final measure towards a stable and defect-free joint forever.

4. The issue of CuCrZr properties has been successfully solved by using explosion bonding instead of HIP bonding CuCrZr/316L(N) joints. A new issue for the Cr and Zr elements segregation along the interface was recently observed, which shall be further addressed.

5. Good progress in developing the W/RAFM steel joints for Chinese CFETR DEMO reactor FW. High shear bonding strength up to 257 MPa has been achieved. Further study is required for optimizing the technologies and for high heat flux test evaluation.