NEUTRON IRRADIATION EFFECTS ON PLASMA-FACING MATERIALS – V. Barabash, G. Federici (ITER Joint Central Team), M. Roedig (Forschungszentrum Juelich), L. L. Snead (Oak Ridge National Laboratory), and C. H. Wu (EFDA – Close Support Unit)

Extended Abstract (the full paper will be published in the Journal of Nuclear Materials as Proceedings of the Ninth International Conference on Fusion Reactor Materials, October 10-15, 1999, Colorado Springs, Colorado).

Beryllium, tungsten, and carbon fibre composites are leading candidate armour materials for plasma facing components of the Next Step fusion device. In recent years, the data base on the influence of neutron irradiation on the properties of Be, W, and CFC has been significantly improved.

- Mainly in the frame of ITER R&D program the qualitative data on physical and mechanical properties for the modern Be grades and CFCs have been generated;

- The study of the combined effects of the neutron irradiation and high heat fluxes on the behavior of the armour materials has started; for future activities it is important to define the expected operational conditions.

This paper reviews the effects of neutron irradiation on thermal and mechanical properties and bulk tritium retention of armour materials (beryllium, tungsten, and carbon). For each material, the main properties affected by neutron irradiation are determined and described. For beryllium and tungsten the key issues are the loss of ductility and embrittlement at low irradiation temperature, for carbon based materials neutron irradiation affects mainly the thermal conductivity. The results of a study of the damage of neutron irradiated armour materials under thermal shock and disruption conditions are also summarized. Based on current knowledge and recent experimental observations, the expected thermal and structural performance of neutron irradiated armour materials in the ITER plasma facing components are analyzed.

For ITER application all three armour materials such as Be, W, and CFCs are selected. The expected performance of the armour materials in ITER seems adequate and at least indicative supported by the available experimental results. For each material, the key problem is the mechanical integrity and keeping their function of the wall structure protecting. The issue for Be and W is integrity of brittle material after neutron irradiation and at transient and steady state high heat fluxes. Still more activity is needed to validate the performance of neutron irradiated armour materials.