THE CHALLENGES IN PREDICTING THE FATIGUE LIFE OF DISSIMILAR BRAZED

JOINTS AND INITIAL FINITE ELEMENT RESULTS FOR A TUNGSTEN TO EUROFER97

STEEL BRAZED JOINT

N.R Hamilton¹, M.B Olsson Robbie¹, J. Wood¹, A. M. Galloway¹, J. Milnes², I Katramados²

¹ University of Strathclyde, Department of Mechanical Engineeing, Glasgow, G1 1XJ ² EURATOM/CCFE Fusion Association, Culham Science Centre, Oxfordshire, OX14 3DB, UK

Corresponding author: niall.hamilton@strath.ac.uk

The development of a He-cooled divertor for a demonstration reactor (DEMO) is dependent on the reliable joining of refractory metals such as tungsten and reduced activation ferritic-martensitic steels such as EUROFER97. One of the joining technologies currently being developed is high temperature brazing. Due to differences in material properties between tungsten and EUROFER97, high stresses can occur as a result of the joining process in addition to the thermal and mechanical loading. Under cyclic loading the presence of these high stresses can result in fatigue and other forms of failure.

Due to the presence of analytical singularities, complex stress states in the region of the joint and the lack of material property data for brazed layers, no robust technique exists at present to predict the stress states in such joints and consequently allow joint fatigue life estimations. Therefore practical procedures are being developed to assess both the design and the fatigue performance of brazed joints under different types of loading. The procedures aim to be generic and account for residual stresses due to the manufacturing, plasticity, brazing technique and geometry of the joint.

The challenges that must be addressed when modelling dissimilar brazed joints are discussed in this paper along with results from an initial attempt to model a tungsten to EUROFER97 brazed joint. Future work on developing methods to assess the fatigue of brazed joints, the validation strategy for these procedures and proposed design sensitivity studies are also discussed.