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PD/P8-20: Cyclic Stress-Strain Curve for Low Cycle Fatigue Design and Development of Small Specimen Technology

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On a design of a blanket for a fusion reactor, an elasto-plastic analysis of the structure will be performed since huge amount of heat must be removed by a pressurized coolant. In addition, the pressure varies and the cyclic deformation occurs. The design fatigue life of the blanket will be around 1 x 10^4 cycles and it assumes the plastic strain component. Therefore, the design will be carried out under low cycle fatigue condition. The stress and strain condition at the structural discontinuous part will be analyzed by Finite Element Method (FEM) and the stress- strain relation must be applied when the constitutive equation is formed. Usually, the static stress-strain relation is used for FEM, but it is known that the strain hardening property would change gradually during the fatigue process. So, it is important to consider the application of the cyclic stress-strain curve (CSSC) to express the fatigue effect on the fatigue analysis. For this purpose, the CSSC of JLF-1, which is a ferritic/martensitic steel with 9Cr-2W and a major candidate for the fusion blanket, was newly obtained as shown in Fig. 1. As a comparison, the static stress-strain curve (SSSC) is also shown [1]. It is clear that the CSSC becomes softer (lower strength) and presents the different hardening property from the SSSC. It may give an impact on the design of the fusion blanket when the safety design based on the low cycle fatigue will be performed.

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