Ductile fracture simulation of Japanese through-wall cracked pipe test under load-controlled cyclic loading in very low cycle fatigue.

Jin Ha Hwang¹, Gyo Geun Yoon¹, Naoki Miura², Yun Jae Kim¹

¹ Korea University, Department of Mechanical Engineering
² Central Research Institute of the Electric Power Industry, Materials Science Department

Jinhahwang@korea.ac.kr

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ABSTRACT
The seismic load caused material hardening and change of fracture toughness, unlike monotonic load. Therefore, it is necessary to study seismic load for structural safety of the nuclear power plants. The seismic load is divided into the dynamic load depending on strain rate and cyclic load whose load direction changes. It is essential to understand cyclic load in order to consider the effect of seismic load on nuclear power plant equipment. Because, the fracture toughness of pipe material is affected by cyclic load rather than dynamic load. The Japanese Central Research Institute of the Electric Power Industry conducted pipe test to confirm the effect of the cyclic loading condition on ductile fracture. The pipe was made of STS410 carbon steel (Japanese nuclear power plant pipe material), had through-wall crack of 60 degree. The pipe test was performed by load-controlled under variation of load ratio and amplitude. In this paper, finite element damage analysis simulated pipe behaviour under cyclic loading condition using the Japanese pipe test. The damage model was the multi-axial fracture strain energy model based on the Johns-Cook-type model, determined by the standard tensile test and monotonic through-wall cracked pipe test.

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