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Environmental Fatigue Analysis for Control Rod Drive Mechanisms Seal House

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Abstract : In this paper, the elastoplastic strain correction factor computed by software of ANSYS was modified, and the fatigue usage factor in air was also corrected considering in water under reactor operating condition. The fatigue of key parts on control rod drive mechanisms was analyzed considering the influence of environmental fatigue caused by the coolant in the react pressure vessel. The elastoplastic strain correction factor was modified by analyzing thermal and mechanical loads separately referring the rules of RCC-M 2002. The new elastoplastic strain correction factor Ke(mix) is computed to replace the original Ke computed by the software of ANSYS when evaluating the fatigue produced by thermal and mechanical loads together. Based on the Ke(mix) and the usage cycle and fatigue design curves, the new range of primary plus secondary stresses was evaluated to obtain the final fatigue usage factor. The results show that the precision of fatigue usage factor can be elevated by using modified Ke when the amplify of the primary and secondary stress is large to some extent. One approach has been proposed for incorporating the environmental effects considering the effects of reactor coolant environments on fatigue life in terms of an environmental correction factor Fen, which is the ratio of fatigue life in air at room. To incorporate environmental effects into the RCCM Code fatigue evaluations, the fatigue usage factor based on the current Code design curves is multiplied by the correction factor. The contribution of environmental effects to results is discussed. Fatigue life decreases logarithmically with decreasing strain rate below 10%/s, which is insensitive to strain rate when temperatures below 100°C.

Keywords : environmental fatigue, usage factor, elastoplastic strain correction factor, environmental correction
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