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Investigation of the effect of residual stress on the crack driving force

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Nowadays, oil and gas exploration is moving into Arctic region, where the design temperature down to -60˚C are being used. This temperature may be below the ductile-to-brittle transition of the weld, HAZ and/or base material. Residual stress may have a significant contribution to the required fracture toughness. The current ways of treating the effect of residual stresses in structural integrity assessment are believed to be conservative. Therefore, there is a need to understand the degree of conservatism and eventually propose a new approach for this issue, which is considered as very important for arriving at relevant acceptance criteria for steels. The effect of residual stresses on the crack driving force as well as possible initiation of brittle fracture must be investigated. This paper presents a numerical investigation of the influence of residual stresses on the crack driving force. The eigenstrain method has been utilized to introduce residual stress into the finite element model.

Keywords: Residual stresses; eigenstrain method; structural integrity; arctic materials