Conservatism of Present Plugging Criteria on Steam Generator Tubes and Coalescence Model of Collinear Through-Wall Axial Cracks

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Abstract

The steam generator tubing covers a major portion of the primary pressure-retaining boundary, so that very conservative approaches were taken in the light of steam generator tube integrity. According to the present criteria, tubes wall-thinned in excess of 40% should be plugged whatever the cause was. However, it is reported that there is no safety problem even with thickness reductions greater than 40%. Recently, the plant specific plugging criteria are introduced in many countries by demonstrating that the cracked tube has a sufficient safety margin. One of the drawbacks of such criteria, even though not yet codified, is that it is developed based on tubes with single cracks regardless of the fact that the appearance of multiple cracks is general. Their failure analyses have been, therefore, carried out using an idealized single crack to reduce complexity till now. The objective of this paper is to review the conservatism of the present plugging criteria of steam generator tubes and to propose a new coalescence criterion for twin through-wall cracks existing in steam generator tubes. Using the existing failure models and experimental results, we review the conservatism of the present plugging criteria. In order to verify the usefulness of the proposed new coalescence criterion, we perform finite element analysis.

국산시제 Alloy 600 및 690 재료의 Pb 농도에 따른 Pb-SCC 평가
Pb-SCC Evaluation of Korean-made Alloys 600 and 690 with Pb Concentrations

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요약

원자력 발전소 증기발생기 전열관의 국산시제 2차측 응력부식균열 저항성에 대한 Pb성분의 효과를 평가하기 위하여 상용시제 C600MA, C600TT, C690TT와 국산시제 K600MA, K690TT 재료들에 대해서 Pb를 1000, 3000, 5000ppm 첨가한 4% NaOH 수용액 속에서 C-ring 시험을 하였다. 재료들에 대한 미세구조는 광학현미경과 주사전자현미경으로 관찰하였다. Pb가 첨가되지 않은 순수한 4% NaOH 수용액에서는 어떠한 균열도 발생되지 않았고 Pb의 증가에 따라 응력부식균열 저항성이 감소하였다. 600MA 재료의 5000ppm Pb 시험에서는 압축응력을 받은 부위에서도 IGA가 발견되었다. Pb-SCC 저항성은 Cr 함량에 따라 증가하는 것으로 나타났다.