

1.2.16. SIMULATION OF EDDY CURRENT TESTING OF STEAM GENERATOR TUBES IN THE PROXIMITY OF SUPPORT PLATES QUATREFOIL-SHAPED HOLES WITH AN HYBRID FINITE FE-VIM MODEL

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Eddy current inspection of Steam Generator (SG) tubes in the vicinity of tube support plates (TSP) is an important aspect of the safety of the nuclear plants. The appearance of material defects like corrosion or cracking is frequent in this particular region of the SG installations. In addition, the impact of the tube to the TSP due to vibrations during the SG operation might lead to tube wear at the contact points. The detection of defects in the proximity of support plate presents increased difficulties due to the perturbation signals arising from the presence of the plate. Additional effects like gradual deposit of conducting or/and ferromagnetic material in the gap between the plate hole and the tube external wall may create additional perturbations which have to be identified and distinguished from the flaw signature as well.

The aim of this collaborative work between CEA and IRSN is to extend the capabilities of the CIVA software by developing a simulation tool for the evaluation of industrial non-destructive testing method used for the tube inspection in the support plate region.

For the numerical modelling of this problem, a combination of the Finite Elements Method (FEM) with the Volume Integral Method (VIM) is used in order to combine the advantages of the two techniques. According to this approach, the primary field is calculated using the FEM for the tube-plate ensemble whereas the flaw response is calculated via the VIM.

In a previous communication, we presented application and simulations cases concerning support plates with circular-shaped holes. The results show that the proposed method is enabling to handle such configurations. Since, we worked on taking into account quatrefoil-shaped holes support plates and magnetic material in the same issue. Application cases concerning support plates with magnetic quatrefoil-shaped holes will be given in this article to illustrate the good agreement between simulation and experimental data.