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Numerical simulation and experimental study of gap supported tube subjected to fluid-elastic coupling forces for hybrid characterization tests

W.Benmalek[1&2], M.Collet[1], E.Foltete[1], M.Ouisse[1] and M.Corus[2]

Email: wissam.benmalek@femto-st.fr, manuel.collet@univ-fcomte.fr emmanuel.foltete@femto-st.fr , morvan.ouisse@univ-fcomte.fr and mathieu.corus@edf.fr

[1] FEMTO-ST Institute, Applied Mechanics Department, 24 rue de l'épitaphe, 25000 Besançon, France

[2] Electricité de France R&D, 1 Avenue du Général de Gaulle, 92141 Clamart Cedex, France

ABSTRACT

In steam generators, the primary loop tubes are subjected to fluid coupling forces and impacts. Understanding the behavior of these tubes is crucial when designing steam generators. In fact, mastering aforementioned could allow engineers to improve the design of these components optimizing the safety factors and ameliorating the overall performances and the average life of the structure.

The aim of our research is to provide a better understanding of the conjugate stabilizing effects of impacts and coupling with fluid-elastic forces. Since fluid-elastic forces are difficult to simulate and expensive to reproduce experimentally, the fluid coupling forces of our numerical model are represented using velocity dependent damping and stiffness matrices, both for the fluid and the tube.

In this paper, first we present a hybrid approach consisting on determining experimentally both the modal contribution of fluid-elastic forces and impact forces to feed our semi-analytical model. Then an active vibration control approach is setup to reproduce the modal contribution of fluid-elastic forces on the tube taking in consideration the non-linearities due to the impacts.