



19th International Conference on Advanced
Computational Engineering and Experimenting
29 JUNE – 3 JULY 2026 | RHODES, GREECE

ABSTRACT:

Analysis of Flow-Induced Vibration in the Main Steam Line of a BWR-5 Nuclear Power Plant

F. Escalona-Cambray¹, L. H. Hernández-Gómez¹, G. Soto-Mendoza², A. Armenta-Molina¹,
M. A. Guzman-Escalona¹, J. I. E. Palacios-Hernández¹

¹Instituto Politécnico Nacional, Unidad Profesional Zacatenco, Sección de Estudios de Posgrado e Investigación, ESIME, Edificio 5, 3er Piso, Lindavista, Gustavo A. Madero, Ciudad de México 07738, México

²Tecnológico Nacional de México. Departamento de Ingeniería Mecatrónica Tecnológico de Estudios Superiores de Jocotitlán. Toluca-Atlacomulco KM 44.8, Ejido de San Juan y San Agustín, Jocotitlán, 50700 México

Pressure fluctuations and velocity gradients in the relief-valve branches induce vortex shedding in the main steam pipe of a BWR-5 steam generator. This causes flow-induced vibration (FIV), which is a source of sound. This sound is transmitted as sound waves throughout the steam system. The vortex-shedding frequency and the structure's natural frequencies (vibration modes) can resonate, compromising the structural integrity of the system and the equipment connected to it. This is especially true during repowering (to increase electricity generation) when the steam flow velocity increases. The vortex shedding excitation frequency and the natural frequencies were calculated using ANSYS 2022/R1. An initial CFD calculation was performed using the RANS (Reynolds Averaged Navier-Stokes) approach. The acceptable mesh cell size was determined using the equation $L_t = k^3/2/\xi$ (integral length scale) with a two-equation model of $K-\xi$: the turbulence kinetic energy and the turbulence energy dissipation rate. The average eddy size was calculated using this equation. Subsequently, the largest eddies, containing the highest turbulence kinetic energy, were evaluated using the Large Eddy Simulation (LES) approach. Finally, the data was converted from the time domain to the frequency domain using Fast Fourier Transforms (FFTs). The results indicated that the necessary conditions for resonance were not present. The final evaluation was performed in accordance with ASME Code Section III, Division 1, Appendix N.