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Increasing life time and reliability of a large boiler feed water pump by means of coupled FEM -CFD (Finite element method - Computational fluid dynamics) simulations

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Summary

Effective simulations for ensuring optimal performance and predicting correct hydraulic and thermo-mechanical behavior of today's huge boiler feed water pumps is a challenge for engineers and constructors. Generally, boiler feed water pumps are subjected to extreme mechanical and thermal stresses because of their huge size, high operating pressure and temperature or rather temperature gradients. Optimal performance of boiler feed water pumps has great significance not only for the pump designers and manufacturers but also for the operators of pumps in power plants. In this research paper, steady and transient operating conditions of one of the two largest pumps ever built in the world of its kind, installed in Niederaussem lignite-fired power station near Cologne, Germany have been simulated by considering the fluid-structure interaction phenomenon (coupled FEM-CFD simulations). Simulation results are validated by means of thermal elements, installed on pump's inner and outer casing. These coupled FEM-CFD simulations are an important input for a condition monitoring tool, which can ensure better performance, reliability, and life time consumption estimation. Methodology of this proposed condition monitoring tool is also explained in this research paper. A commercial coupled FEM-CFD code has been used as a simulation tool. Simulation of these machines can not only predict the hydraulic and thermo-mechanical behavior of feed water pumps, but also can help operators at power plants to monitor the condition of the pump during its operation.

Keywords: Boiler feed water pump, Coupled FEM-CFD Simulations, Condition monitoring tool, Steady and transient operating conditions, Hydraulic and thermo-mechanical behavior, life time consumption rate