

High-Pressure Air Injection on a Low-Head Francis Turbine

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Abstract

Birecik is a Turkish hydroelectric power plant located at the Euphrat River in the southeast of Turkey. During commissioning of the units, a vibration phenomenon was discovered, restricted to a small power band. The cone which supports the thrust bearing and which is braced against the turbine head cover started to vibrate at its natural frequency.

Investigations showed the vibrations to be innocuous to the lifetime of the machine. Exhaustive vibration measurements on site pointed to hydraulic source for the vibration. Detailed flow simulations by means of computational fluid dynamics (CFD) were carried out. They permitted the detailed analysis of a variety of transient flow phenomena happening inside the machine.

They revealed the presence of interblade vortices in the power and head range where the vibrations occurred. As a consequence, it was suggested to inject air downstream of the wicket gates through the head cover. In 2012, one unit of the Birecik power plant was equipped with such an air injection system. As soon as the air injection was turned on, the machine operated calmly in the small power band where vibrations had been observed before. The necessary air volume was considerably smaller than expected to be necessary for a calm operation.