Using FLUENT Software to Optimize a Pelton Installation

Overview

e3k is a leading Australian mechanical engineering consultancy specializing in the research and development of new technologies in the energy, manufacturing, transportation, defense, aerospace and mining sectors.

e3k uses a combination of engineering experience and sophisticated modeling tools such as CFD and FEA to design and optimize advanced technologies.

The company provides a range of engineering services including early-stage conceptual design, detailed engineering modeling and analysis, prototype design, construction and testing, and failure analysis.

Testimonial

“We use FLUENT software across the board to support mechanical design, analysis and optimization. In Pelton and Francis hydropower generation installations for a New Zealand client, for example, FLUENT software has helped us to make significant improvements in system efficiency, which translates directly to the bottom line. In the case of Pelton wheel turbines, the FLUENT product has allowed us to gain valuable insights in an area that is only just becoming accessible to CFD analysis. Without FLUENT software, the unsteady multiphase flow field in a Pelton bucket would be a nightmare.”

Ben McGarry
Principal Engineer
e3k

Challenge

• The project goal was to optimize the efficiency of a multi-nozzle Pelton wheel hydroelectric power station design.
• The branching distributor manifold, the nozzle design and the rotating runner needed to be examined in detail to extract maximum useful energy from the known head and flow conditions.
• The dynamic interaction between water jets and the runner creates a particularly complex unsteady, multiphase flow field.

Solution

FLUENT software was a powerful tool to quantify and visualize the effects of design changes as various aspects of the geometry were refined.

The software was particularly valuable in characterizing the complex flow fields in the rotating runner. It revealed areas in which those crucial few extra percent could be picked up. FLUENT software also enabled the identification of an effect that had not been reported previously in empirical studies.

Benefits

• FLUENT software provided useful and timely feedback on how design modifications would influence the complex multiphase flow fields evident in the Pelton installation.
• Secondary flow losses in one particular component were reduced by more than 80 percent.
• Visualizing unsteady multiphase flow fields using FLUENT software revealed a flow phenomenon that would have been difficult to capture empirically. This could lead to further performance improvements.