Solution Brief

Redesign of Multi-Stage Vertical Pump for the Oil Industry

Challenge: Reduce the number of stages required to perform duty for a multi-stage vertical turbine pump.

Results: Impeller modification and de-swirl vane change.

Impact: Increased efficiency and develop head per stage thus reducing the total stages required resulting in significant savings in production and operation.

Vertical turbine pump stages are used in the oil industry to pump fluid for large head applications. The individual pump stage consists of a centrifugal pump impeller, diffuser, and downstream de-swirl vanes that remove the swirl from the flow for a smooth transition to the next stage. Since the number of stages that can be sequentially stacked is enormous (> 100 in downhole bore applications), a significant gain in head per stage can result in savings to the customer by reducing the total number of stages required to perform the required operation.

An OEM that was required to use more stages compared to their competitor to perform the same pump duty submitted their standard configuration for detailed analysis and hydraulic optimization. The geometry was modeled and a Computational Fluid Dynamics (CFD) analysis performed. The results indicated a small gain in impeller efficiency was possible, but more importantly, significant gains could be made in developed head and efficiency with a more optimum de-swirl vane assembly design. The existing design did not adequately de-swirl the flow distorted the flow into the subsequent stages.

A redesign (Figure 1) was made that employed an improved de-swirling vane. The resulting analysis indicated a greater than 10% gain in head compared to the existing design. The net result was that the number of stages required to perform the operation could be decreased by over ten percent, resulting in lower manufacturing costs for the OEM

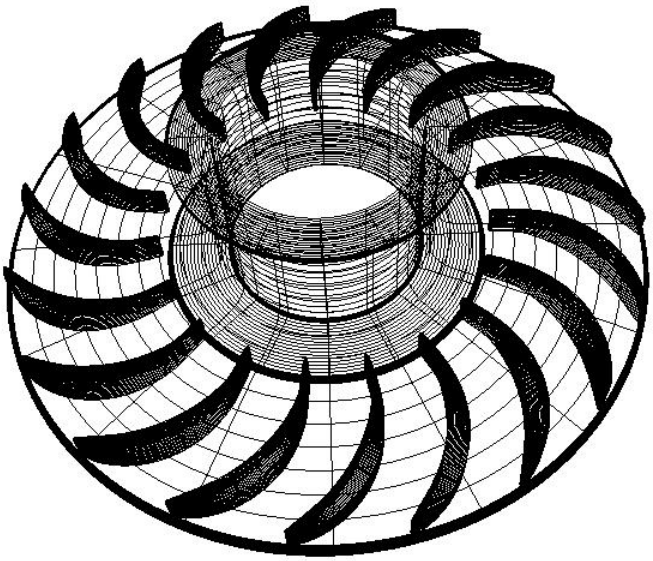

Figure 1: 3D design of the redesigned de-swirl vane that resulted in a 10% gain in head per stage.

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SB08-0131R*p*