Dresser-Rand 3 – Adjustable Impeller Eye Labyrinth Seal

Overview
Dresser-Rand is one of the leading manufacturers of centrifugal compressors for the oil and gas industry. One of the main components Dresser-Rand implements to improve compressor efficiency is the impeller eye labyrinth seal, which reduces recirculation of flow. During the testing phase, Dresser-Rand varies labyrinth seal clearance to evaluate the impact of doing so on overall efficiency. The current test process to undergo this clearance analysis requires the disassembly of the compressor test case, insertion of a new seal with an alternate clearance, and reassembly of the case – a process that takes up to two weeks.

Objectives
The objective of the project is to develop an impeller eye labyrinth seal such that the seal clearance can be adjusted without disassembling the test case. The main deliverable of the project is a detailed design with analysis, and the construction of a visual prototype as time and resources allow.

Approach
• An initial site visit to the Dresser-Rand facility led to the realization of the problem and understanding of the objective.
• Customer needs analysis through expert consultation showed precision and efficiency to be most important for the final design.
• Background research showed no directly related products currently on the market.
• The concept generation and selection process led to a focus on the two main components – the labyrinth seal geometry and alterations, and the actuating mechanism.
• Final design selection meshed ideas from multiple design concepts – a segmented labyrinth seal with attached actuating rods, an actuating ring for variable geometry, and a gear drive mechanism.
• CAD models were created during the design process and finite element analysis was performed to analyse the deformation and stress of the design under test operating conditions.
• A visual prototype was constructed with 3D print models of the segmented seal and actuating ring.

Outcomes
• The sponsor will save $43,000 per initial test required as a result of this project.
• The reduction in testing time with the implementation of this design is approximately 2 weeks per initial test required.
• Competency of the precision shown by this design is verified through hand calculations and finite element analysis for deformation and stress under test operation conditions.