Electro-Mechanically Actuated Trip and Throttle Valve

Overview
Dresser-Rand currently uses a hydraulic system to operate a special type of fail-safe valve for steam turbines. This valve closes rapidly to stop steam flow into a turbine, during emergency situations, to prevent injury and damage to the turbine. Some steam turbine applications, specifically on nuclear powered submarines, cannot support the current required oil operated system. For these applications, it is required that the oil system be replaced with an Electro Mechanical Actuation (EMA) that is as reliable and safe as the hydraulic system.

Objectives
- Complete a performance analysis between electro-mechanical and hydraulic actuation
- Research and select and electro-mechanical actuator capable of operating the valve
- Design a system to couple the selected electro-mechanical actuator to the existing valve components
- Provide a recommendation for the application of this system

Approach
- Researched and evaluated the needs to be met by electro-mechanical system. Through working closely with Dresser-Rand, the most important qualities of the hydraulic system were determined and applied to the search for an electro-mechanical actuator.
- An external search was conducted to determine the appropriate actuator/actuators for this application.
- A comprehensive performance comparison of the hydraulic and electro-mechanical system, along with a patent search of existing technology, was conducted
- Several concept design were generated and evaluated based on their ability to meet the customer needs, manufacturability, and cost
- After selecting the final concept, a coupling bracket was modelled using SolidWorks to connect the electro-mechanical actuator to the existing valve components. The 3-D model was evaluated using finite element analysis to confirm maximum stresses and the factor of safety.
- The team worked closely with sales and applications engineers from both Exlar and Dresser-Rand to complete component and material selection for the final design.
- Finally, an economic analysis was conducted to determine the cost of implementation for the final design.

Outcomes
- The Exlar FT60-1212 provides the required force, speed, and stroke to actuate the valve
- The selected HPK motor is compatible with both the Exlar FT60 and Dresser-Rand’s Introl® positioner for control
- The coupling bracket is an investment cast part made from corrosion resistant ASTM A217 Grade CA-15 Stainless Steel and will meet Dresser-Rand’s requirements for surface finish
- The coupling bracket has a minimum factor of safety of 8, confirmed using SolidWorks Simulation
- The cost of the new system is $24,500
- It is suggested that this system be implemented on 8-600 class, or smaller, valves that do not support the hydraulic system