Virginia Military Institute

Wire Rope Connection Design

Mechanical Engineering (Mechanical Analysis)

Client: Areva Inc.

CEC Design Team: John Crowder
Justin Ausborn
Rory Chisholm

Advisor: Colonel Timothy Hodges

AREVA is a nuclear engineering company that provides refueling services for existing nuclear reactors. During refueling the steam generator must be inspected for cracks in the heat exchanger tube bundles. The non-destructive inspection manipulator apparatus must be inserted into the steam generator by a lifting device that utilizes a wire rope. The purpose of this project was to design an alternative solution that resolved the issue of a failure of the wire rope connection in the lifting device. The teams that oversee these inspections are exposed to radiation particularly when under the access ports in which the manipulators are hoisted. When there is a failure the manipulator has to be manually handled and repaired. Rectifying the situation would increase safety and efficiency, as well as decrease the volume of wire rope which is frequently replaced on these devices. Analytical calculations provided theoretical forces on the wire rope and end connections. Experimentation was utilized to conform the analytical model and to determine the optimal orientation of the wire rope and the end conditions.

After thorough research and testing we concluded that the best possible solution would be to utilize a collet design with JB Weld applied to the crimp. The ideal wire type for the application was wire rope of 7x19 construction because of its flexibility and its ability to bond with the JB Weld. Field team procedural changes were also highly recommended to aid in preventing any failure. We highly recommended that these changes are implemented to avoid failure at the connection point and to avoid spending unnecessary time recovering the manipulator.

Solutions of implementing a fail-safe and a wider base plate were possible additions to add in the future upon further analysis. These two additions worked in theory, however, we did not advise use until they had been tested to ensure that they function as intended. For testing these designs, we recommended that the systems are tested under the same stresses in the initial analysis. If the two designs function as intended, then they would be worthy additions to the system.