



The Gas Turbine Industry's Best Kept Secret: First-Stage Nozzle Replacement Coupons

By Kevin Davis, president of Frarendi, Inc.

The gas turbine electrical generation industry is projected to produce \$118.4 billion in revenue from 2005-2014, according to a 2005 Forecast International study. Consequently, operating gas turbines at optimum efficiency levels has a significant impact on the economics of this multi-billion dollar industry. The constant erosion of first-stage nozzle trailing edges is one of the greatest challenges in maintaining power generation efficiency because it significantly shortens the turbine's operating time and the nozzle's lifespan. Erosion is caused by a variety of factors including structural fatigue due to extended operating periods; using fuels with high levels of impurities; thermal forces and inadequate cooling, mechanical failures; hot corrosion; and damage caused by foreign objects.

Gas turbine owners and operators have traditionally chosen two popular options for extending the life of their first-stage nozzles: repair the vane cracks or missing material using a weld approach or replace the entire nozzle. As an alternative to these expensive, temporary and time-consuming options, Frarendi has researched and developed a replacement coupon that repairs first-stage nozzle trailing edges to their original structural integrity and high performance levels.

While welding can be a simple and effective short-term solution in some routine maintenance situations, the nozzle will continue to degrade with each weld. Repetitive welding of the trailing edge will result in a

weaker total nozzle, increasing the probability of more frequent repairs and more downtime for the turbine. The lack of predictable sustainability of a welded repair typically puts land-based gas turbines on a rapid count-down to total nozzle replacement.

Another traditional solution for repairing a worn or damaged nozzle is to purchase a completely new first-stage nozzle. While total replacement will decrease the immediate frequency of repairs, and in essence reset the clock on the nozzle's lifespan, it is a very expensive and often unnecessary investment. The expense of purchasing a new nozzle can be magnified by a potential prolonged service outage due to the lengthy delivery process of replacing an entire nozzle.

The Replacement Coupon

Decades of experience in the power generation industry and significant research and technological advancements have led to a repair solution for eroded and damaged first-stage nozzles. The Frarendi replacement coupon is a quick, inexpensive and metallurgically-sound alternative to traditional forms of first-stage nozzle repair. Frarendi supplies replacement trailing edge coupons to service and repair shops that make it possible to remove and replace the eroded sections of first-stage nozzles, while maintaining the structural and metallurgical integrity of the original parts. The replacement coupons also rival the lifespan of the original parts and extend the life of the entire nozzle, saving significant time and money.



The sound metallurgical properties and dimensional control of the replacement coupons result in a refurbished turbine's optimal performance.

Each coupon is made of the same high-quality, castable and weldable cobalt based FSX-414 Alloy used in the original base metal of the nozzle. Coupons are matched with the exact geometric and dimensional specifications of the original vane. Intricate cooling holes are machined into each coupon using an electro-discharge machining (EDM) process at the piece part level. These holes are precisely drilled into the coupons to match the holes in the original vane to ensure that performance is not compromised. Overall, repairing first-stage nozzle trailing edges with replacement coupons, instead of welding, results in a stronger and more reliable nozzle.

Providing this cost-saving and sustainable repair option to a wide-range of land-based gas turbines, Frarendi offers a comprehensive selection of ready-to-install replacement coupons that range from \$300 U.S. to \$1,100 U.S. each. Sets are kept in stock at all times to provide a rapid repair process for replacing a variety of trailing edge nozzle parts including: Frame 3; Frame 5; Frame 6B; Frame 7B; Frame 7E; Frame 7F/7FA; and Frame 9E.



The Coupon Repair Process

After the repair professional determines the suitability of the replacement coupon for the turbine restoration, then the appropriate coupon can be ordered and shipped in as little as two weeks. The damaged trailing edge is cut out of the nozzle and the new coupon can then be welded into place. In most cases, a precise fit and reliable repair can be completed without any

special equipment or machinery. A broad spectrum of replacement coupons has been developed to address most first-stage trailing edge nozzle repair challenges. In order to offer even more robust products for the land-based turbine industry, Frarendi is continuing its research and development process.

Frarendi's coupons are a solution that benefits gas turbine owners and operators as well as the repair shops that serve them. Maintenance schedules and turbine assessment plans should be discussed with repair shop experts to determine the best solution for specific turbine restoration. In most cases, Frarendi's coupons are a simple and cost-effective solution that can easily become a part of a regularly scheduled repair and maintenance regimen.

About the Author

Kevin Davis is the president of Frarendi, Inc. and plays a key role in establishing and overseeing the business and financial strategy for the company. He is a business innovator with more than 32 years of experience managing and growing successful manufacturing and technology companies across the United States. In addition to running Frarendi, Mr. Davis also owns or is a strategic advisor to a variety of metal processing, manufacturing and technology businesses.

Mr. Davis served as president of AcraLine Products, Inc., a custom manufacturer of fabricated metal products for the aerospace industry for more than 20 years until he sold the company in 2005. He has hands-on experience in process engineering, sheet metal fabrication, welding and industrial procurement. In addition to his vast industry experience, Mr. Davis received a Bachelor of Science degree in mechanical engineering from Purdue University. Ω