CASE STUDY: Nuclear Emergency Diesel Generator (EDG) Inadequate Parts & Part Testing

Summary
During regular engine analysis testing going back to 1999, the 1B EDG had multiple cylinders with very loud, early and abnormal intake valve closure events. Because of the engine analysis data, the lash adjusters for 4 cylinders (4L, 5L, 6L, and 3R) that were suspect were sent back to the supplier for re-testing. The supplier indicated the adjusters passed the manufacturers testing. After the valve failure that occurred in August 2014, the remaining lash adjusters were removed from service and stock and tested on-site with a new test rig that had been developed.

Because of the enhanced on-site testing, the 15 lash adjusters ordered in 1999 failed a more applicable load test. It was determined that the initial testing was insufficient, parts were not manufactured nor assembled correctly, and the failed intake valve stem did not meet the specified tensile strength.

In January 2017, engine analysis identified a suspect lifter on a different engine (2A) that after removal, inspection, and testing, indicated that the lash adjuster was in a degraded but not yet failed condition.

Background
Emergency Diesel Generators at nuclear power plants worldwide provide critical emergency power to equipment and systems in the event of a loss of off-site power. As such these engines are tested periodically and after any maintenance activity to ensure correct operation. In this instance, the 1B EDG which is a Nordberg FS-1316-HSC, 16-cylinder diesel engine rated at approximately 5600 had an intake valve failure during one of these regular tests in August 2014. The failure of cylinder #5 intake valve stem (dropping into the cylinder) during regular engine testing the valve was impacting the top of the piston although not completely into the cylinder as the valve overhang the cylinder liner.

Technology
The client utilized a Windrock four channel portable analyzer to assess the condition and performance of the diesel engine. The analyzer measures dynamic data relative to crankshaft position and then applies combustion principles and science to precisely assess machinery condition and performance. The portable analyzer utilizes multiple sensor technologies to collect data degree-by-degree with respect to crank-angle. Measurement points include in-cylinder pressure, vibration and ultrasonic data on the cylinders. The system also measures vibration in the spectrum realm on the turbocharges and frame as well as angular velocity of the crankshaft. Using this information and built-in diagnostics, Windrock analyzers and software are able to assess the mechanical condition, performance and economic return of diesel engines.

Findings
This nuclear power station has been performing engine analysis on their 4 EDG’s since the early to mid-90’s. The above event occurred in 2014 and with engine analysis allowed for plant personnel to immediately identify a fault, the reason for the fault and correct the fault in a short period. Engine analysis has proven itself to this site to be a valuable tool in monitoring the condition of these critical engines.
About Windrock

Windrock offers industry-leading expertise in condition-based and performance-based monitoring solutions for compressors and engines across multiple applications. We design and manufacture portable analyzers and online systems at our headquarters in Knoxville, TN. In addition to our products, Windrock Technical Services analysts travel the world to help companies with their reliability and maintenance programs. We are proud to be a part of Dover Energy Automation (a Dover Corporation company).