

Case Study 18

Water Contamination in Steam Turbine Lube Oil

Background

A combined-cycle gas turbine (CCGT) power plant uses natural gas as a fuel source to drive the gas turbine which rotates a generator to create electricity. Exhaust heat from the gas turbine combustion boils water into steam and the steam pressure drives the steam turbine which also rotates a generator to create electricity. The bearings that support the shafts of these turbines are under heavy load making bearing lubrication vital to reliable sustained and standby operation. By their very name, “Steam Turbines” operate in a high moisture environment. Water contamination in lube oil is a common but serious problem by altering viscosity, reducing lubricity, stripping additives and causing corrosion. Water contamination exists in different states. Dissolved water is solubilized in the oil and below the oil saturation limit. It generally is not visible nor easily removed but is least destructive. Free water is suspended water droplets above that readily settle out with gravity and appears either hazy with low levels or as defined “phase separated” layers, usually at the bottom of the reservoir, with high levels. Emulsified water is finely dispersed free water droplets in a stable suspension that does not easily settle by gravity, visually appears milky and is considered the most destructive. All three are problematic however emulsified and excessive free water is catastrophic. A local CCGT facility was referred to Northeast Filter to address significant water contamination in their 5,000-gallon steam turbine lube oil reservoir that caused their turbine to trip immediately after an outage. While humid environment with exhaust steam and oil cooler leaks are common water ingress causes, they believe steam leaking through failed shaft seals was the culprit. During turbine shutdown, condensate forms in the reservoir causing issues during start-up.

Solution

When the VAS team arrived, the plant had already drained most of the settled free water out of the reservoir, but the oil was still milky. Fluid analysis showed their Chevron GST-32 lube oil had 5% moisture content. GST-32 is specifically formulated for steam turbine conditions and exhibits excellent water separability with minimal foaming making it an ideal candidate for coalescing. A 2-gallon sample was processed through a benchtop coalescer with exceptional results bringing the water content down to 109 ppm (by ASTM-1744 Karl Fischer) on a single pass through the coalescer. NFC provided a rental coalescing system to use until the actual unit they purchased arrived. The high flow rate of the coalescer quickly removed the water to bring the oil to like new condition preventing any system damage by limiting water exposure to a short period of time. The turbine started up without issue and the coalescing system has run flawlessly ever since!



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