Orbit Magazine

System 1 helps customer avoid a critical compressor breakdown and resulting maintenance at a gas booster station.

Date : December 2, 2016

SITUATION

In order to meet production targets, the availability and reliability of critical machines is essential. Kuwait Oil Company (KOC), a major crude oil and natural gas producer in the Middle East leveraged the System1 features from GE's Bently Nevada product line to address a high vibration issue on a compressor at a critical booster station complex.

A critical booster station complex, BS-150, is located in KOC's southeast Kuwait oil fields, consisting of three gas compressor trains. Each train consists of two compressor sections, one low-pressure (LP) casing and one high-pressure (HP) casing, driven independently by GE MS5002 gas turbines. The combined capacity of the three trains exceeds 730 million cubic feet per day.

Unexpectedly, one of the gas compressors tripped on high vibration at the drive end bearing while trying to increase the load to 4300 rotations per minute (rpm) from an idling speed of 3300 rpm.

Upon detailed review of System 1* data and comparing multiple transient events, the possibility of a rub occurring between rotor and stationary elements inside compressor casing during compressor loading was suspected.

The machine train was observed to start successfully after several hours at standstill, whereas loading after hot startups resulted in the machine tripping at high critical speed amplitudes. It was determined that the increase in vibration amplitudes at critical speed during hot startups could be attributed to a change in compressor rotor balance condition. This rotor balance condition change was possibly due to a shaft thermal bow, caused by internal rubbing while the machine was at idle speed and considerable 1X amplitude increase was associated with phase change. Additionally, it was suspected that the decreased internal clearances could be another reason for the rub.

SOLUTION

The KOC engineers assessed the consequences of conducting an internal inspection of the compressor, which would have resulted in several days of machine downtime. KOC decided against performing a machine inspection and instead opted to keep the machine operating under close monitoring. Transient plots were carefully monitored during cold starts to assess and avoid the possibility of an internal compressor rub.

With close monitoring, the train was operated successfully for two years until its next scheduled maintenance. The gas compressor was then overhauled, per the planned schedule. Each internal component of the compressor was removed, cleaned and inspected systematically. A root cause failure analysis revealed the foreign particles entry into the process gas, which created hard scaling inside the compressor inter-stage seal surfaces. The particles deposited within the clearances had resulted in rubbing between the seals and rotor surfaces due to the abrasive motion.

To ensure the provision of clean gas inside the compressor, KOC set an action plan to install a low-pressure station separator and a pumping system upstream of the Gas compressor suction scrubber during the forthcoming preventive maintenance period.

PAYBACK

The gas compressor was successfully re-commissioned after the major overhaul. Upon startup, all machinery vibration levels were observed to be within acceptable limits. The machinery management skills of KOC engineers, aided by the System1 availability, resulted in avoiding costly unplanned downtime of critical machinery, allowing KOC to extend machine operation until the planned maintenance .

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