Gas compressor failure investigation

Project overview
During the commissioning of a gas plant extension project, a reciprocating compressor failed catastrophically causing a small hydrocarbon release. The unit was rebuilt but failed again on commissioning. At this point, a Root Cause Analysis (RCA) team was assembled and Edif ERA was awarded the role as a third party independent expert to assist in the investigation.

Forensic investigation into catastrophic failure of a natural gas compressor in Nigeria

Client benefits
Edif ERA mobilised to the site very quickly which meant that vital evidence was still available for collection, contributing to a successful RCA. Our previous failure investigation experience equipped us with the expertise to conduct the analysis required to understand the causes of the catastrophic failures of such compressors.

Our multidisciplinary team had the capability to cover all technical aspects of the failure and provide realistic recommendations on how to resolve the causes of failure. The client was able to recommission the plant with confidence and reduced the potential down time of the plant.

The challenge
The repeated failure of the compressor held up the successful commissioning of the plant. The delay of the commissioning of the plant meant that the only safe alternative was to flare the gas. This has disadvantages both to the environment and the profitability of the plant. Re-instatement of the compressor and the successful commissioning and operation of the plant was critical to enable operations to start and minimise fines and other financial losses.
Our approach

Members of the Edif ERA forensics team conducted a site visit to obtain evidence and interview personnel. Relevant components and information was then sent to Edif ERA engineers for investigation and analysis. Areas of investigation were:

- Manufacture of the piston – our metallurgical specialists reviewed the material composition and formation of the high stressed areas of the compressor pistons
- Assembly of the compressor – we analysed the assembly reports for the second build of the compressor to ensure that checks had been carried out to help confirm that the compressor was built adequately
- Design of the package – our rotating equipment specialists reviewed the suitability of the design of the package for the intended service
- Operating conditions and start-up procedure – our rotating equipment engineers analysed the operating data and procedures to investigate the possibility of liquid ingestion into the compressor

This work allowed us to highlight a number of issues that contributed to the repeated failure of the compressor. The RCA team reviewed all of the investigation results and came up with several solutions which the client could select from.

The conclusion

The compressor was designed to boost low-pressure gas, with a flow rate of up to 20 million scf/day. Forensic examination of the components showed that excess pressure had been applied onto the face of the compressor piston. Finite Element Analysis showed that the piston should have been capable of withstanding normal operating pressures. A review of the process drawings showed that, under certain conditions, the compressor could experience high-pressure spikes.

The recommended course of action, agreed by all parties, was to change the operating mode of the compressor and to modify the process resulting in the safe operation of the compressor. A number of other recommendations were made by Edif ERA to ensure that the package would remain reliable in the future.