Oceaneering Enables Safe, Continued Production by Mitigating the Risk of Fatigue on a Thermowell

Project overview
In 2016, an oil and gas operator based in Azerbaijan planned to increase production rates on an offshore platform beyond original specified capacity for the facility. As part of the change management process and during debottlenecking, the operator’s in-house team highlighted the need for due diligence checks on all associated infrastructure. This was to provide assurance on the capability and integrity of equipment used to handle increased production rates.
**Issues**

Typically, initial screening information on these types of due diligence projects can give very conservative information and they are not always representative of the final, installed equipment. The operator needed assurance that they were making the safest and most financially-viable solution within the most appropriate timescales.

The thermowell, used to measure the temperature and the process stream on the gas export line, was identified as having a high risk of failure, and the operator required information on the integrity quickly. Providing an accurate measurement of the level of vibration from the thermowell tip was challenging because of the design of the component. There is no off-the-shelf solution for this type of work.

**The Oceaneering Solution**

Oceaneering was tasked with assessing and quantifying the risk for the proposed new operating regime of process piping systems. During these checks a thermowell was assessed against specific design codes (ASME Performance Test Code 19.3) and was found to be non-compliant. This meant that there was an increased risk of fatigue from potential flow-induced vibration. The consequences of fatigue of the thermowell were potentially catastrophic and costly.

We conducted measurements using a specialized thermowell tip probe which provided evidence that the thermowell was being subjected to unacceptable vibration levels at increased production rates. We provided the operator with recommendations to manage the risk of fatigue, through the provision of acceptable operating limits. The longer-term solution was the design of a new thermowell to meet the increased operating capacity of the plant.

We delivered a highly detailed technical assessment which provided accurate information and confidence on the condition of the thermowell, justifying the approach to manage production flow, which, in turn, afforded the operator time to complete the modification of the thermowell during a planned shutdown.
A pre-planned flow trial, running the plant at the proposed conditions, provided us with the opportunity to extract and analyze real data on how the infrastructure was performing at the new production throughput levels. We used a thermowell tip vibration probe to measure tip vibration directly, which enabled us to verify the initial screening results.

Our engineers used a portable analyzer to acquire the vibration time histories from both the tip probe and the thermowell flange itself, providing cross correlation and confirming the results.

We agreed a test plan with the operator to measure, quantify and feedback the results from increased production flow, at all times ensuring the safe operations by predefining the test parameters and working in close collaboration with the operations team throughout the process.

We then proceeded to analyse the data from the test in real time to give an indirect measurement of the dynamic stress at the thermowell root, which then demonstrated the significant potential for a fatigue failure if operated in an increased flow regime.

**Benefits**
By initiating a comprehensive flow-trial, we provided the operator with assurance that the risk of thermowell fatigue could be managed if the appropriate steps were followed. This provided the operator with a safe operating envelope beyond the original design specification.

We also accurately assessed the response of the thermowell, overcoming the limitations of the original screening calculation, and provided more detailed information about the operating limits and the risk profile of the equipment.

By quantifying the risk, we were able to provide an immediate solution that enabled continued operations. Longer-term, we specified a replacement thermowell, enabling the plant to safely operate at increased production rates. We recommended the removal of the original component and specified the new replacement thermowell. This assured the safe, long-term operation of the asset at increased production rates.