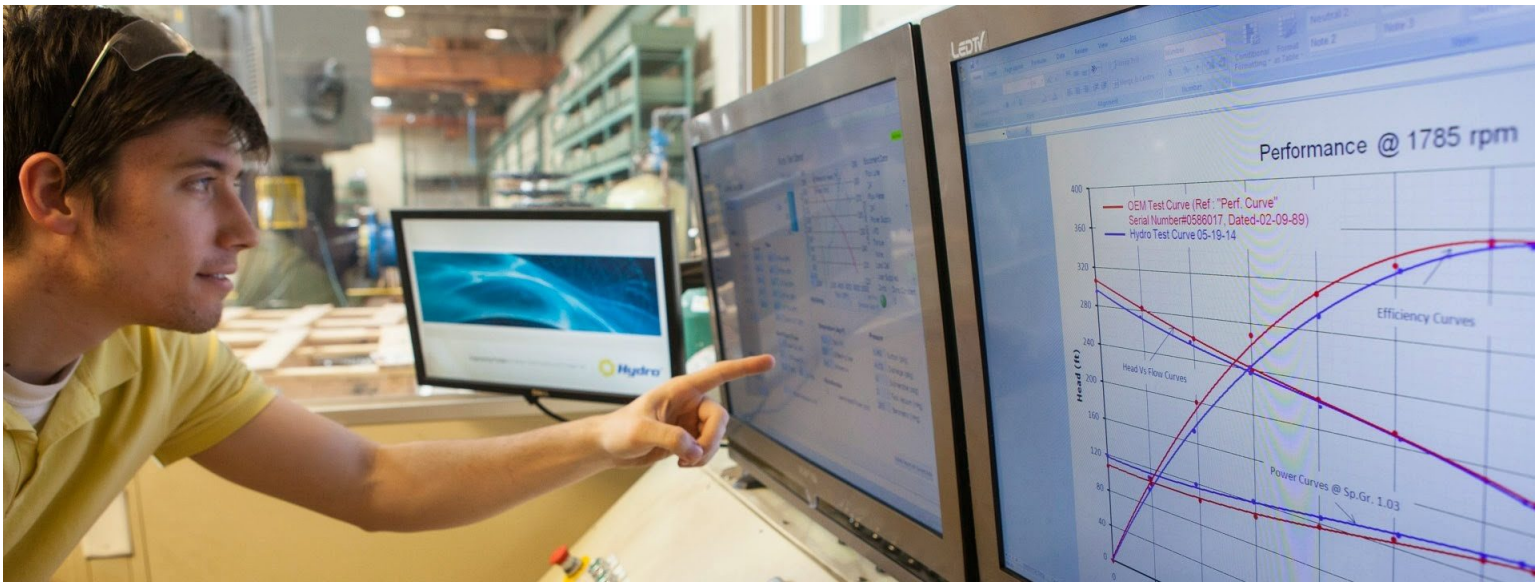
Testing Brings a Long-Term Solution



When an oil and gas vertical firewater pump suffered heavy abrasion and wear due to significant sand and particulate matter from a nearby river, HydroTex Golden Triangle, based in Beaumont, Texas, solved the problem, meeting the hydraulic requirements of the firewater system.

In this case, the impellers were severely worn, which meant that replacements and upgrades were needed if it was to meet the National Firewater Protection Agency (NFPA) hydraulic requirements. The critical pump was removed from service and classified as an emergency. The removal naturally resulted in downtime at the local site, so a quick turnaround was vital.

Hydro, Inc. has a network of service centers that provide total pump support in Texas. It has 96,000 ft^2 of dedicated pump repair space and has the resources, capabilities, and Original Equipment Manufacturer (OEM) experience needed to offer total solutions for critical pumps from root cause failure analysis to startup. In this case, Hydro, Inc.'s Beaumont-based service center, HydroTex Golden Triangle, worked to provide an expedient resolution that would meet the hydraulic requirements of the -firewater system.

Background

Most oil and gas pump applications require high-standard fire protection. Firewater pumps are traditionally conventional, vertical line-shaft pumps driven by diesel engines and often require a high level of maintenance.

In addition, most firewater pumps demand extensive rating requirements. Refineries and plants have specialized fire safety needs. API partners with the NFPA to develop fire codes that support the principles of fire prevention for the petroleum industry. Refineries install extensive fire protection equipment to include firewater systems, foam fire suppression systems, fire extinguishers, and fire alarms. NFPA 20, for example, is the standard for the installation of stationary pumps for fire protection. This standard protects life and property by providing requirements for the installation of fire pumps to ensure that systems will work as intended to deliver adequate and reliable water supplies in a fire emergency.

Challenges

In 2017, this particular vertical oil and gas firewater pump was originally pulled from service due to continued failure and underperformance. A previous vendor had provided the bowl assemblies with impellers that would meet the customer's hydraulic performance requirements and the timeline for replacement. Despite this effort, the problem remained unresolved and the pump continued to underperform.

Three years later, in 2020, the pump was pulled out of operation again due to continued underperformance and critical failure. It was sent to Hydro, Inc.'s Houston service center for further evaluation and analysis. A complete examination determined that the packing was too tight, wearing out the shaft prematurely.

The NFPA requires that firewater pumps be performance tested to ensure compliance with firewater system hydraulic requirements. Testing for firewater pumps is typically performed in situ in the field, which can limit the evaluation of pump performance to a smaller range.

Verifying performance

Post-repair, the pump was shipped to Hydro, Inc.'s world-class performance test lab, which is certified by the Hydraulic Institute and located in Chicago.

At this point, the pump retained the same bowl assembly and impellers that were purchased in 2017 from a previous vendor. The as-found performance test revealed that despite the repair, the pump still underperformed in terms of the NFPA requirements. The pump significantly underperformed with discharge pressure more than 40 psi below the required pressure at the rated flow of the pump.

After an investigation by Hydro, Inc., it was revealed that the pump's OEM offered three impeller designs to meet different performance requirements. All three impeller designs would fit into the same bowl assembly. Each design produces the flow rate, but at different discharge pressures. The initial test results confirmed that the impeller design provided in 2017 was problematic for the particular configuration of that pump.

Upon testing, new impellers were provided by the OEM and sent to Hydro, Inc.'s Chicago service center. The new set of impellers were installed in the bowl assembly and tested in its test lab. While the second test was an improvement, the pump still underperformed by 15 psi at the rated flow of the

pump.

Following the second test, the third set of impellers was also provided and tested. The third set tested correctly and met the NFPA hydraulic performance requirements. During each iteration of impellers tested, the pumps had to be disassembled, reassembled, and tested.

Engineering analysis

The engineering analysis had uncovered that the packing was too tight, resulting in the formation of an hourglass shape on the shaft due to severe wear. The pump had not been in service for an extended time but pumping the abrasive sand had caused the overall damage. Further repairs by Hydro, Inc. included replacing the shafts, wear rings, bushings, and reclaiming registers in a complete pump rebuild.

Furthermore, the testing revealed the performance issues which were a result of the wrong impeller design being provided for the particular application and configuration. The initial test results, while lower than NFPA requirements, were confounding given that the pump and parts were provided by the OEM. In this case, the end-user required a partner to help provide verified results and to investigate the performance issue to determine a long-term resolution.

Conclusion

It is important to note that when testing for performance and validation, the end-user is not only investing in the service, but also the guarantee of success upon installation. The cost of downtime due to failure is more expensive than extensive high-quality testing and analysis.

In this case, by using its in-house testing facility and engineering network, Hydro, Inc. was able to solve a range of complex problems (Figure 3). Moving forward, the oil and gas company decided that regardless of the time frame, they want Hydro, Inc. to supply all replacement parts and perform all testing services for its pumps. The company also wants to rerate its pumps to meet 110% of specific duty points for the pump's performance. The NFPA requires no less than 95% of performance. If it falls below this standard, it must be pulled from service.

Hydro, Inc. further concluded that the sand damage would not be eliminated. However, the longevity of the equipment was provided by rerating the impellers to meet 110% of capacity.

Read the article here.