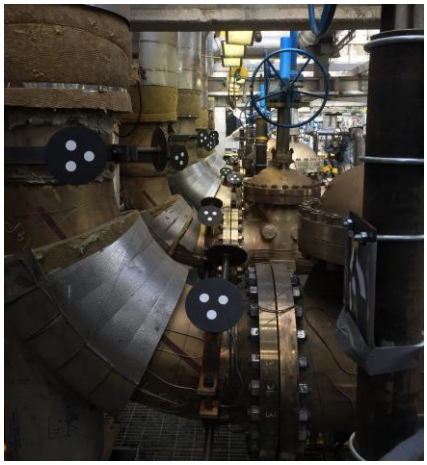
Thermal expansion measurement of large scale systems

Problem overview

Piping displacement due to thermal expansion will affect the hydraulic performance of a centrifugal pump. The loads transferred to the encasing can distort the critical dimensions of the pump creating a multitude of reliability issues. Using TRITOPs ability to measure slight displacements over large scales, a measurement was performed to evaluate the induced load effect on system efficiency.

Test setup



Notes

A refinery was experiencing low mean time between failures on their critical service vacuum bottom pumps. In an effort to determine the root cause, a large scale TRITOP measurement was performed to determine if the cyclic thermal loading of the pump during warmup was responsible for the decreased system performance. Target dots, capable of being tracked in 6 Degrees of Freedom, were placed on 3 pumps, motors, baseplates, all relevant piping as well as the suction and discharge headers. Fixed to the piping shown on the test setup, these target dots allowed for a time lapsed measurement to show the effects of thermal expansion on overall system efficiency.

A series of reference images were collected to create a baseline to compare all future movement / growth to. As the system was brought to operating temperature, several more image sets were collected, creating a displacement trend versus temperature. The results, which can be seen in Figure 1, showed that large deflections of the piping deformed the dimensions of the pumps casing leading to mechanical seal failures and decreased hydraulic performance. The data correlated with the FEA model and even showed displacements greater than predicted.

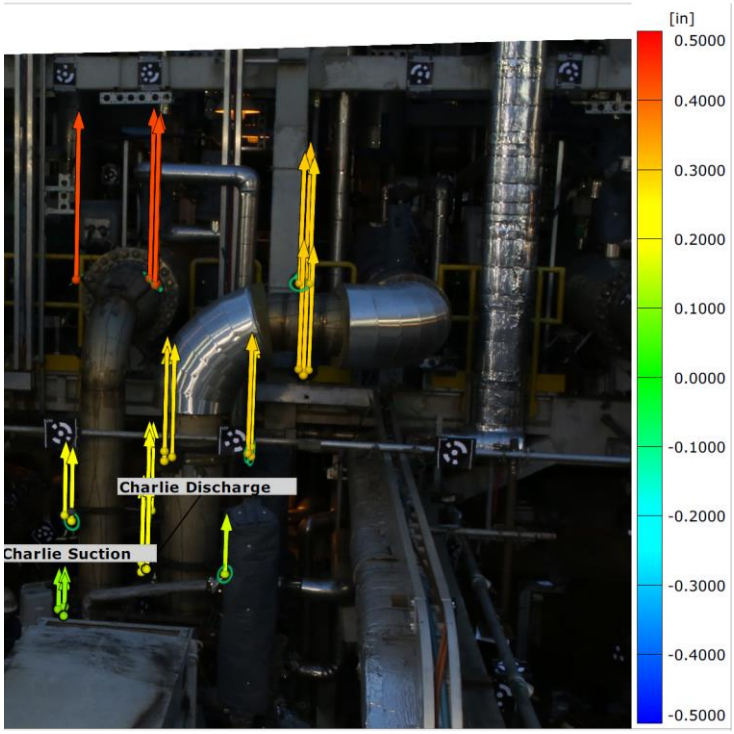
Conclusion

TRITOP Optical metrology solution, was proven to be effective for Large-scale displacement measurements in 3D as well as for validation of FEA models. The results of this test allowed for piping design changes and an overall increase in MTBF.

For more information on this application, please contact Trilion Quality Systems, world leader in custom optical metrology application development.

Keywords: *Mean time Between Failure, TRITOP, 6 DOF, FEA Validation, Root Cause Analysis, System Efficiency*

Figure 1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