Using IoT to Improve Mechanical Seal Reliability

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Image 1. IoT elements of predictive maintenance *(Image courtesy of Flowserve Corp.)*

The Internet of Things (IoT) is a phrase in the limelight. The concept of IoT is extremely appealing, in all forms, to commercial industry. The technology of IoT has been implemented in various industries globally and it is finally approaching the rotating equipment industry.

To fully explain and understand how IoT technology can be implemented to increase mechanical seal reliability, a description of maintenance philosophies is needed. There are three main types of maintenance philosophies in industry today: reactive, preventative and predictive. Currently in the pump industry, and more specifically with mechanical seals, most of the maintenance is either in the reactive or preventative ideologies. This is where the current model of IoT comes into play. IoT is a powerful tool that will enable the industry to progress to a predictive maintenance model. This is accomplished by using advanced technology in several key areas such as device connectivity, data storage and cutting-edge analytics.

Pitfalls of Reactive Maintenance

Reactive maintenance, at first glance, seems like a great idea. The old saying "if it ain't broke don't fix it" comes to mind when thinking about this maintenance strategy. The main practice of this maintenance strategy is that users do not replace equipment until it is damaged or broken. This practice creates an environment where a failure of the mechanical seal can result in secondary damages to the pump 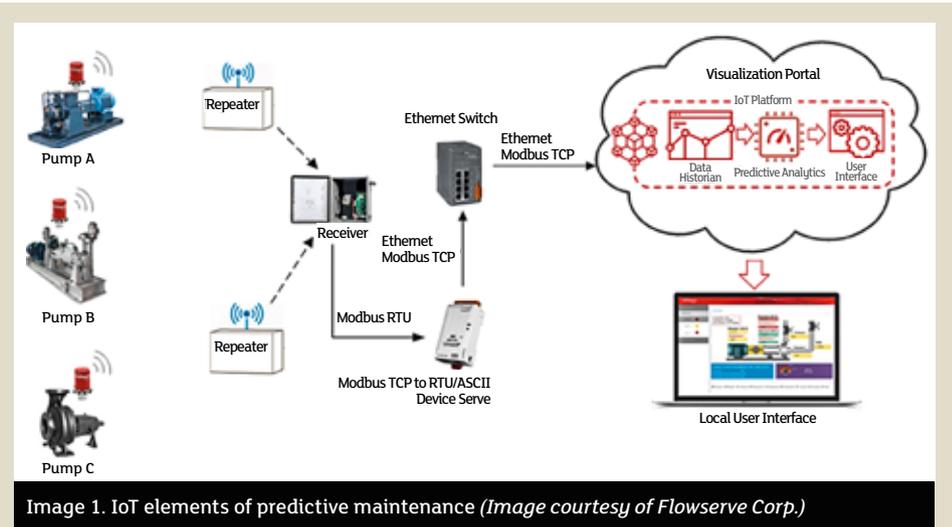and support systems, resulting in an unplanned shutdown of the equipment. This forced shutdown can create less-than-ideal situations for the teams in charge of the equipment. An example is a mechanical seal damaged beyond simple repair that now allows dangerous process fluids to leak to the environment.

After decades of implementing this maintenance strategy and gaining better insight into industrial equipment, most modern facilities shifted to a maintenance philosophy that is preventative rather than reactive.

Preventative Maintenance: A Step in the Right Direction

This is the maintenance model currently deployed by the majority of the industrial world. The idea behind preventative maintenance is that instead of running equipment until a component fails or breaks, it runs until wear parts need replacing.

A great example of a component in rotating equipment that fails first is the mechanical seal. Depending on the type of mechanical seal used on the equipment, a slight misalignment can have harmful effects on seal life. An example is when the end user knows the mechanical seals in a given application typically fail within two years. In an effort to avoid unplanned downtime, the maintenance engineer establishes a schedule to replace the mechanical seals, and potentially other components, within this two-year time frame during a planned shutdown.

A potential downside to this maintenance philosophy is that the mechanical seal that was replaced may have had significantly more life left at the time it was removed. And it may also be that, for whatever reason, it could not reach the expected life and failed prematurely causing an unplanned shutdown.

The assumption that a wear component will have exactly the same usable life every time it is installed presents shortcomings. What if the industry had a method to indicate that the seal can run for four years before it breaks? What if there was a way to know exactly when the seal will fail? Predictive maintenance built on IoT addresses these questions and offers the next step in maintenance strategies for mechanical seals and other pieces of rotating equipment.

Predictive Maintenance Potential

A predictive maintenance model is based around the knowledge of when and why a part is going to fail. A key requirement is the understanding of the condition of a particular asset, known as "condition-based monitoring" (CBM). Unlike preventative maintenance in which equipment is replaced at predetermined times, a predictive strategy allows for a deeper understanding of how the equipment is running, its operating conditions and ways to improve the process to avoid past failure modes.

Predictive maintenance can help with the ordering of spare parts for planned downtimes, creating safer working environments and increasing the overall lifetime of the equipment. Giving insight into when to schedule planned downtimes is a major benefit of predictive maintenance. Planned downtimes, compared to unplanned failures or accidents, are much more efficient and cost effective. Insight gained by predicting what resources will be needed at certain planned downtimes streamlines the ordering of spare parts. The increased safety due to lower rates of failures or accidents is another plus for this maintenance strategy. The numerous advantages of this maintenance strategy are what make this the appealing goal for most of the industrial world today.

How IoT Sparks Predictive Maintenance

With the help of IoT, predictive maintenance can become a reality. IoT is a tool with advancing capabilities in the realms of device connectivity, data collection, data storage, data protection and advanced large data analytics. Adopting IoT will create an industrial world that is more interconnected than ever before. Image 1 illustrates the key elements of a predictive maintenance process using IoT. The first step that needs to be accomplished when implementing an IoT strategy is device connectivity. In the case of

a mechanical seal, the seal must be instrumented and connected to a data analysis system, which could be internet-based or local. This is easier today due to controllers, sensors and other monitoring equipment designed with the capability for connectivity. This equipment will record, transfer and save data for use in some form of advanced analytics. This connectivity is the first step in creating an IoT platform that can give equipment operators deeper insight into how the equipment is performing and when failures will occur.

Once the data points are collected, the data needs to be transferred and stored securely. The advancement of cybersecurity protection is crucial. The massive amount of data required also calls for increased storage capacity of digital systems. Luckily, the advancement of technology has allowed for large quantities of data to be stored, typically in some form of cloud-based system.

The final step of an IoT solution is the analytics. The connectivity of devices and the increase in data storage techniques are great advancements in technology, but they are merely bridges to allow for advanced analytics implementation. The way in which the data is analyzed creates the real benefit for the mechanical industry. The data that is collected needs to be analyzed and then presented in a way that the end user can easily understand and use to implement a solution. The manufacturer of the equipment has the expert knowledge on how the equipment is designed, how it ideally should be operated, and has specific historical insight on the most common failures. A comprehensive history of the assets including all health indicators recorded during the CBM program also need to be accessible. From an analytics standpoint, these are crucial pieces of the puzzle to provide the best advice and service to the end user. The more relevant data that is available, the more accurate the predictions can become. This improved predictability

results in many benefits: increase of equipment reliability, more efficient management of maintenance downtime, insights into how to eliminate failure modes through changes in operation or product design, and ultimately a reduction in maintenance costs.

Benefitting the Future

Mechanical seals are often the device that drives maintenance cycles for rotating equipment. The application of IoT can help increase the reliability of mechanical seals, which will help increase the reliability of the entire system. IoT is the gateway to enabling the practice of predictive maintenance programs. It has the potential to create more efficient processes that can reduce cost through equipment reliability. ∎

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