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**Question 13: Is it a common or recommended practice for you to changeout all HF alkylation unit pump seals during turnarounds? What strategies do you employ to improve pump seal life in these services?**

**LAMBIE** (KBC Advanced Technologies, Inc.)

Doing blanket changeouts of all pump seals at turnarounds is not a recommended practice. Pump seals should be replaced on an as-needed basis. Changing a seal at a turnaround, knowing that it will not last until the next turnaround, may be desirable, but only for those services that are deemed too dangerous to work on while in operation. Any pumps seals used for shutdown or decontamination procedures (such as neutralization, acidizing, or chemical cleaning) should be replaced at turnarounds.

As far as the decision-making process, it should be based on the results of the refinery risk matrix which considers the consequences for not changing the seal, both from an economic standpoint and also from a health, safety, and environmental standpoint. The decision should also consider the risk of the probability of failure, which is based on the reliability of the pump and also relies on the experience of the Operations, Maintenance, and Reliability personnel. Detailed maintenance records should be reviewed as part of the decision-making process, as they will give an indication of the frequency and causes of the failure, as well as indicate operator experience with regard to the history of a particular pump, how the pump is found, and the condition in which it was left.

As far as strategies to protect the pump seal life, the use of the proper material for main seal components that are HF-resistant is recommended as is operating around the best efficiency point as much as possible. Having good seal installation practices, making sure the area is free and clear of debris and dust, and ensuring that any open seal flush lines are covered to prevent debris from entering are recommended. Also, minimizing the number of starts and restarts of the pump helps protect the seal life as does having good maintenance practices that include reliability and monitoring KPIs. Having an accurate records' archiving process for each of the pumps is recommended.

**DUNHAM** (UOP LLC, A Honeywell Company)

I just want to add that at turnaround time, it is more important to replace the valves around the pumps so that when you do need to replace the seals on the run, you can safely isolate the pump.

**ERIC LEETON** (UOP LLC, A Honeywell Company)

Some of the problems I have seen in startups or restarts of several alky units concern the quality of the seal flush; i.e., the proper filters in your flush system. For pumps that have been shut down or idle in the meantime, folks will isolate them and may even do some limited flushing to keep the pump case purged.

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So when they restart the unit, they can have some fines that accumulate in the pump case and/or associated piping. Of course, the solids enter in the seal and abrade it. So when you have a pump that is spared or idle, flush through it or purge it out with flush before you block it in. Those are some big contributors.

Regarding proper installation, I had one location where we replaced six pump seals in about 45 days. When they finally got around to doing a root cause failure analysis, they realized that the multiple seal failures were caused by improper shaft alignment. Improper installation resulted in excessive work and rework.

**ALMA SCHURIG** (Big West Oil, LLC)

My question is a follow-up to the question about recommended practices for pump operation and switching between primary and spare pumps during normal operation to help with pump seal life. Your response was to minimize the number of times you start and stop; but at some point, you also have to switch between your primary and spare. How do you balance these requirements?

**DUNHAM** (UOP LLC, A Honeywell Company)

We sometimes get this question during an audit when they are talking about pump reliability. I think most people will plan to switch pumps on maybe a two-week basis. There are some people who say, "We are going to switch them every week." Other people will go three weeks or four weeks, but I think a reasonable range for switching between your main pump and spare is between two and four weeks.

**SHRIKANT MADHAV VAIDYA** (Indian Oil Corporation Limited)

This has nothing to do with the question here. My question is about these turbine-driven pumps, which we have in the lube oil circuit of a major compressor. There is a standby electric-driven pump which comes online in case of failure of the steam turbine-driven pump. Invariably, the turbine-driven pumps are operational all throughout the year, but the Operations people are very skeptical of turning to the motor-driven pump for preventive maintenance of the turbine-driven pump. So, what is a good practice of a pump changeover schedule when your main pump lube oil is turbine-driven?

**UNIDENTIFIED SPEAKER** [DUNHAM (UOP LLC, A Honeywell Company)?]

So if it goes down, the electricity automatically comes on?

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**SHRIKANT MADHAV VAIDYA** (Indian Oil Corporation Limited)

Yes, that is the interlock action provided to allow us to maintain the lube oil pressure in case of a failure of the turbine-driven pump when the electric motor-driven pump comes online. But invariably, we do not change pumps (from turbine-driven to motor-driven) for our regular routine maintenance of the turbine-driven pump. We always allow the turbine driven pump to run, and the motor-driven pump always remains as a standby for several months.

**UNIDENTIFIED SPEAKER** [DUNHAM (UOP LLC, A Honeywell Company)?]

So are you asking if they have confidence in the electric because you never test it?

**SHRIKANT MADHAV VAIDYA** (Indian Oil Corporation Limited)

That is one part. I am also asking about good practice. Should we change the turbine-driven oil after a fixed time frequency to the motor-driven pump for some time or allow it the way it is happening now?

**UNIDENTIFIED SPEAKER** [DUNHAM (UOP LLC, A Honeywell Company)?]

That is a good question. I am not sure I have an answer for that, but that is a good question. [Laughter]

**DAVID GATES** (Motiva Enterprises LLC)

That is definitely one of the opportunities out there. I do not know if we have any mechanical rotating equipment people in the room, but I am convinced that my folks would say that you need to try very hard to stick to your schedule and run that electric pump. We have had at least one opportunity where, when we needed the spare pump, it would not run. So, if anyone else wants to chime in, please do so. But absolutely, I think you do need to be running the spares to make sure you have a reliable spare when you actually need it.

**STEPHEN LONG** (SLL4RPC3 LLC)

In reference to your question about running the electrical spare, checking your spare pump for its mechanical reliability does not mean you need to shut down the turbine pump, especially when it is a critical service. I recommend that you operate both pumps together to give you time to check the standby pump. Then, after you are confident that the electrical standby pump is performing to your expectation, shut down the turbine-driven pump. I agree with Mr. Dunham's comment that two to four

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weeks ought to be enough. I definitely agree with David Gates that you need to be confident that your spare pump is ready to run and maintain your unit's reliability when the turbine driven pump is lost.

**BURTON** (Motiva Enterprises LLC)

Just one more comment. Not only is the motor the spare, but it is also the control system that initiates turning on the pump. So, the whole system must be tested. A typical practice is for Operations to slow down turbine drive pump to the point that it activates the circuit, which then triggers the motor drive pump to come on. This procedure provides assurance that whole system, and not just the motor pump, is available when needed.

**GARY HAWKINS** (Emerson Process Management)

We have seen considerable interest in pressure, temperature, level, and flow instrumentation to monitor auxiliary seal flush systems as specified in API Standard 682, as well as the special flush piping plans for hydrofluoric acid services as specified by the process licensor. Maintaining a continuous supply of seal flush at the right conditions is a good practice. Being able to monitor the flush through the control system can provide assurance that all is well and provide alarms when parameters deviate from what is expected. Since vibration due to any source applies stresses to the mechanical seal, refiners are also deploying wireless vibration transmitters to monitor for changing vibration patterns from the pumps or motors that can provide sufficient warning to switch to the spare pump in a safe manner rather than continue to operate until the seal fails.

**SCOTT LAMBIE** (KBC Advanced Technologies, Inc.)

Doing a blanket changeout of all HF alkylation unit pump seals during turnarounds is not a recommended practice. Pump seal replacement on an as-needed basis is recommended instead. It may make sense to replace a pump seal during a turnaround if the seal is not expected to last until the next turnaround, especially in services that are considered risky to work on while the HF unit is online. It would be prudent to replace the seals of process pumps that have been used in normal shutdown and decontamination procedures such as neutralization, acidizing, and/or chemical cleaning.

The decision of whether or not to change the pump seals should be based on results of the site Risk Analysis Matrix. The risk analysis should include, at a minimum, the consequences for not changing the seal, as well as the risks. The consequences are typically based on, but not limited to, economics and Health, Safety and Environmental (HSE) issues. The risks or probability of failure should take into account the reliability of the equipment, as well as personnel experience of the particular seal. Personnel experience should include input from Operations, Maintenance, and Reliability groups and not rely on a single source of input.

Refineries should have detailed maintenance records for each pump seal indicating failures, as well as

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their frequency and causes. Unit operator experience is valuable to find out the history of incidents, including whether or not there was any seal fluid contamination, previous work order information, the as-found/as-left condition of the pump, failure cause, etc.

There are many strategies that can be used to improve the pump seal life. The main seal components should be made of HF resistant materials, the shaft, impeller, wear rings, throat bushing, and seal components, etc. During normal operation, pumps should operate at or near the best efficiency point (BEP) between 80 and 110%; and if possible, tighter than that.

It is also important to have good seal installation practices. Ensuring that the work area is clean and free of dust and debris will minimize particulates that could potentially end up in pump internals. It is also important to cover any loose or disconnected seal flush tubing or piping. One should take caution to prevent pinching O-rings and make sure the seal flush is turned on and tested before startup. The number of starts and restarts should be minimized, if at all possible.

Seal life can be improved with good maintenance practices. Having a proper equipment inspection strategy is one. It is also important to write and keep living documents of all maintenance information and to convert these to effective maintenance practices. These practices keep track of materials, procedures, operating procedures, and check sheets.

It is essential to track Reliability Monitoring KPIs. This includes monitoring seal flush flow, pressure and level alarms, as well as monitoring failure rates/modes, indicator changes, and costs. Records archiving helps ascertain the root cause failure analyses, which in turn helps to maintain pump reliability.

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