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Reliability doesn't just happen in facilities, including those in the hydrocarbon processing industry. Here's an expert's view of what's going on in some of today's refinery operations, and how the situation can be improved.

My "post-retirement" experiences in numerous hydrocarbon processing industry (HPI) facilities from 1986 to around 2002—and my exposure to thousands of HPI employees since 1965—has allowed me to make a number of observations and form opinions that are still relevant today. The following brief summary is intended to highlight my observations and permit me to offer a few recommendations. All are aimed at rapidly improving equipment reliability at some refineries I recently have visited. I call these "Reliability Assessment Visits."

Observation: Interest in training varies.
To an extent, all refineries exhibit uneven levels of interest in learning about the operator-machine interface. Some operators take the position that they are not in charge of equipment maintenance or upgrading. They fail to understand that they are the first line of defense, and that all improvements in the refinery must, ultimately, be accepted by them so as to do the operation any good. As an example, there is feedback from operators who claim to have tried to advocate such measures as periodic switchover of pumps but were not allowed to do so. What's wrong with reliability management at those locations?

We frequently come away from sites with the impression that the reasons for switchovers are not known to operations' supervision. What they don't know they can't teach others. Switching pumps is beneficial in preventing the degradation of standby bearings due to vibration

transmitted from the running pump, and rust formation due to constant "breathing" of bearing housings (hence, ingestion of moist and dirt-laden air). The notion that using each pump would make both wear out at exactly the same time is about as correct as the belief that twins have the same life expectancy and likely will die on the same day.

Observation: Upgrading of oil mist systems is possible.
By now, most readers know that I'm a proponent of plant-wide oil mist lubrication and preservation systems—and why. That said, it is interesting to note that some relatively new installations continue to follow a wet sump (purge mist) approach that is of relatively little benefit. Some use cooling where others have found cooling unnecessary for the past 30 years. With expert help, these plants have an opportunity to bring their systems up to industry standards.

Correct slope, top take-offs from the header pipe, spray mist fittings and application fittings located per API-610 8th and later editions are readily achievable and would be cost-effective, as would the use of balanced constant level lubricators in bearing housings with traditional sump lubrication. Old-style non-balanced constant level lubricators will allow pressure differences to exist between the housing interior and atmosphere. This often causes the oil levels inside bearing housings to be unexpectedly low.

In many assessment visits, we were unable to find anyone who was aware of the vendor's stipulated uni-directionality of constant level lubricators. Whenever these are installed on the wrong side of the pump bearing housing, they increase the risk of causing deprivation of oil level.

Many refineries are not organized to understand the seriousness of this issue, nor do they make efforts to remedy the situation. There often seems to be no champion who insists on "picking this ripe, low-hanging fruit" without delay. Although many of these facts were brought to light years ago, word has still not reached all refineries. Consequently, we have seen locations where no efforts are being made to address and remedy the situation.

Observation: Deleting cooling water would reduce bearing failures.
In the late 1960s, smart refineries dismantled cooling water systems on all conventionally-lubricated equipment that incorporated rolling element ("antifriction") bearings. It was clearly established that simply using lubricants with higher ISO viscosity grades allowed for the slight temperature increase to be easily accommodated. Although the oil viscosity was now

being lowered by the increased temperature, it still remained well above the minimum required value.

For the past 30 years, hundreds of refineries have operated their rolling element bearing-equipped pumps without cooling water. Those refineries and chemical plants always noted an unexpected side benefit: Increased bearing life. Cooling water in a jacket surrounding the bearing outer ring affected shrinkage of the outer rings; the reduced bearing internal clearance had promoted early failure of "cooled" bearings. Similarly, using cooling water coils to lower the liquid oil temperature at the bottom of a bearing housing while allowing moist air near its saturation point to occupy the rest of the housing will invite moisture condensation.

There is a real opportunity here to capture credits by selectively deleting cooling water after ascertaining that the correct bearing is used and that this bearing is correctly installed. By allowing 0.25% water in the oil, a pump user typically reduces pump bearing life by a factor of 6!

Observation: There has been excessive mechanical seal consumption.
In mid-2001, a mid-size refinery determined that, in an 18-month period, the cost of mechanical seals for a total of just 10 services exceeded $1,100,000. It was easy to establish that the facility processed the same fluids, operated the same pump types and used the same seal models and flush plans as other refineries. Therefore, it should have been evident—and was indeed easy to ascertain—that issues centering around installation weaknesses (pipe stress, baseplate grouting, etc.) and pump warm-up procedures, such as lack of through-flow in stuffing box while pump was not running or forgetting to use a flush-oil at shutdown and startup, merited closer investigation. This re-enforced our impression that:

• The cooperation between process engineers and mechanical/reliability workforces often does not measure up to expectations.

• Root cause failure analysis is not being practiced to the extent necessary and is not a cooperative effort between operations, maintenance and technical work functions.

• At a minimum, a facility's seal alliance partner needs to provide detailed, written guidelines, perhaps based on observations elsewhere, as to proper warm-up or flush oil startup methods.

EQUIPMENT RELIABILITY

At one refinery being assessed, an operating supervisor stated that the moment hot fluids are introduced into a pump, he calls for a quick startup in the expectation that the pumpage will not become more viscous as it contacts cooler parts of the pump. Another supervisor noted that he trusted his intuition and a scribbled reminder. He volunteered that his idea as to correctness of his reminder "write-up" was not shared by others. These scenarios, again, indicate that some refineries lack relevant, uniformly applied equipment operating instructions. Such instructions, procedures or checklists exist and should be provided at all refinery locations.

Overall Impression: Lots of ripe, low-hanging fruit

On the good side, during these "Plant Reliability Assessment Visits," we always found that every employee has strengths to build on. Everyone has the ability to contribute to a knowledge base—and such a base can always be broadened. In essence, we should assume that all employees are salvageable.

While it is a statistical impossibility for every refinery to be a top performer, there is rarely (in the United States) one single issue that is glaringly wrong and that, if rectified, would save millions. Instead, there are literally hundreds of seemingly minor items that must be rectified at most refineries. Fortunately, this "ripe, low-hanging fruit" is easily picked. It will rarely cost much money to do so and mapping out the path forward should be easy.

Where the money is spent today

Here, then, are a few details and deviations that cost money, if not addressed. These, and many others, were discussed in assessing the reasons for decreased equipment reliability at several mid-sized refineries. They merit being addressed by teams composed of operations, maintenance and technical personnel. The teams must "buy-in" and a champion must intervene if old habits will not die:

1. Operators often are told to run on outboard seal, after the main seal has failed. That's costly and dangerous. Seals are rarely designed for this duty.

2. Beware of newly installed seals throwing sparks upon startup. At one facility, operators were told to always pour water on such a seal; I assume this was the result of a dimensional error made at one time. The solution? Issue dimensional checklists and insist on shop measurements, then discontinue this strange practice.

3. Don't run steam-driven equipment with inoperative trip throttle (T/T) valve(s)—nor without periodically exercising these (T/T) valves. Sticky T/T valves are a huge threat to safety. Realize that these valves are traditionally examined (dismantled) during turnarounds.So,after the next planned shutdown, budget an extra day to leave turbines uncoupled and let your operators exercise the valves to convince them that accidentally tripping a turbine is simply not possible.

4. Don't allow excessive quench steam pressure on some hot service pumps. There should be an orifice and the pressure downstream of that orifice should not exceed 5 psi.

5. Don't use cooling water on oil-mist lubricated pumps— its serves no purpose. Measure the housing temperature. Note that 180 F is acceptable, providing an ISO Grade 68 or 100 turbine oil is used in the system.

6. We established that oil mist was introduced into wet sump bearing housings in the expectation the mist would protect and lubricate the bearings even if liquid oil levels were lost. That is simply not the case. Huge amounts of mist (actually, over-lubrication) would be needed to accomplish this.

7. In wet sump (purge mist) lubricated bearing housings, high oil mist pressure causes oil level to go down in the bearing housing and rising in non-balanced constant level lubricators. The refinery was then asked to convert to pressure-balanced constant level lubricators.

8. Mechanical seal cavities often were not vented upon startup. The result: Trapped air promoted seal leakage and failures. Drilling a hole connecting the stuffing box interior to the casing internals solved the problem. This is a standard shop modification done at some refineries.

9. In efforts to economize by buying refused to turn properly as a result. and stocking fewer types of oil, the refinery made it a (strange) practice

10. Pump suction strainers had been to use excessively thick lubricants. left in place. Many were rather thin-Personnel didn't realize that this was metal startup strainers that were actually a very costly approach since prone to corrode. They were to be the oil rings (slinger rings) often removed at the earliest opportunity.

Multi-phase remedial steps should be considered

As a matter of routine, I often have proposed that a site engage the services of a competent retiree with an extensive reliability background. This individual would track the restoration and upgrading of older oil mist systems, verifying and correcting baseplate and grouting integrity, stress-free piping, correct alignment practices, re-negotiation of certain seal partnerships, constant level lubricator upgrades, issuance and "buy-in" of installation, startup, cleaning, repair instructions, routine upgrade procedures to be implemented every time pumps or motors enter the shop, checklists and the like.

Deriving this material from scratch is unnecessary and costly as it already exists and could easily be adapted to a site's needs. I frequently have estimated that it would require no more than a few weeks to assemble all of the written guidelines (about 600 pages) that a refinery would need. Upon transfer of the material to a refinery, an experienced professional would thoroughly explain its relevance to cross-functional teams and the refinery would manage its full adoption and "buy-in" by operations, maintenance and technical/reliability workforce members.

Some time later, a competent follow-up study could be done to rigorously benchmark and audit the results of the preceding efforts.

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