The story is true, the narrative real. Names have been changed so as not to touch too many raw nerves.

Played out over a recent several-day period, the following situation seems to be typical of how some industry specialists are attempting to acquire knowledge these days. The point is that phone calls and Internet searches should not be viewed as substitutes for the more traditional structured approaches to learning. These approaches include reading appropriate texts.

"Hi Heinz," read the e-mail from a stranger. "I have read thru (sic) some of your articles I found at Magazine X and have learned quite a bit. How can I get in touch with you to discuss what levels of consultation you offer? If you could call me today or tomorrow, I'd appreciate it very much, as I am working on a short-fuse project. Thanks very much…Tommy"

So, I called Tommy, an engineer employed by a very large, well-known Engineering and Design firm involved in the construction and upkeep of nuclear power plants. I spent about 20 minutes on the phone, trying to steer him in the direction of reference material that would explain why one of the pumps he was concerned with seemed to always have an excessively high bearing housing oil level. Since he was interested in "solving" the problem by using sealed grease-lubricated bearings, I attempted to explain why this solution is certainly not worthy of being the first one to consider. It's difficult, however, to download several decades of applicable pump experience to relative newcomers when virtually every question asked seems out of context, and would require a string of tie-in explanations. Therefore, for written backup, I mailed Tommy a list of applicable books and articles that would shed more light on the issue. He replied in writing:

"Heinz, thanks for your time & info yesterday. It was most helpful. I am looking forward to your

recommendations for reading/reference material. I was hoping to ask—you wrote an article that appeared in Magazine X (in which) you created a subjective rating system for various configurations. I was trying to see how my system of questions would fall within the rankings. Would you be willing & interested in hearing my interpretation of what ranking my system has and offering your feedback & thoughts? Thanks, Heinz, looking forward to your recommended references…Tommy"

OK. I replied, "Try calling between 1 and 2 PM (CST) today." Tommy acknowledged:

"Thanks, Heinz. I will call tomorrow. Thanks for your thoughts, I am going thru all of them. In your subjective ratings chart of lube systems, what is the "balance line" between bearings? I am not sure what it is, to figure out if the APS system has it or not. Thanks very much…Tommy."

A second reply was needed to indicate that I would be available until 3 PM (CST) today, and that tomorrow I could be reached at and from—whatever. Tommy, though, apparently is busy. He e-mails back:

"Subject: RE: Pump bearing upgrades. Heinz—I actually have a meeting today from 1-2 with GOODANDBIG PUMP CORPORATION to discuss their recommended oil level, as well as discuss with them the feasibility of greased, sealed bearings. Can I call you afterwards? And, what is your phone number? I also have asked a pump & motors engineer here if they have your 'Pump User's Handbook' so I can start using it today. By the way, from reading your writings, I would very much like to use a flinger disc, but it would not fit inside their housing. Thanks…Tommy."

Although I promptly e-mailed the following information and questions to Tommy, I also recalled early in our communications that he had mentioned being on a "short fuse" project. In light of this, I assumed he probably would not see my reply prior to his meeting with GOODANDBIG. I wrote:

- Greased, sealed bearings are suitable within a somewhat limited DN-range only. Therefore, what is your bearing DN (bore diameter times rpm)?
- Once the grease is depleted (due to churning or oxidation or separation centrifugation) into oil and soap, the bearing will fail rapidly. Therefore, any non-regreasable "life-time" grease-lubricated bearings at a nuclear power plant will probably have to be replaced on a

precautionary (safe) schedule. Does that imply that regreasable bearings are a wiser choice? Not necessarily, because regreasable bearings should be avoided at plants that disregard the critical nature of using correct regreasing procedures.

- Does this plant use intelligent regreasing procedures? How do you know?
- Also, regardless of bearing lubrication and application method, bearings with certain cage materials should not be used in your pumps.
- Important: I believe it should be mandatory to (a) use a modern bearing protector seal on the bearing housings, and (b) only use pressure-balanced lubricators; i.e. you must disallow "open system" constant level lubricators.
- Questions for GOODANDBIG CORPORATION:
- What type of flinger disc doesn't fit in their bearing housings?
- What size doesn't fit?
- What material is used in flinger discs that DO fit elsewhere in industry?
- What's the constraint with the particular pump type that you seem to be dealing with?
- Are any upgrade measures possible?
- Have upgrade measures been implemented by Bestof- Class companies elsewhere?
- Why don't these other companies have the problem you seem to have?
- What sense does it make to pursue a fundamental design change when others don't seem to have the problem?

- The pressure that exists behind a bearing is not always that existing in front of the (same) bearing, nor at the bearing at the far end of the housing. Sometimes, this unequal pressure is due to windage generation (fan effect) by an angularly arranged cage. At other times, it has to do with lack of a suitable drainage opening at the bottom of the bearing seat. This is shown on Fig. 7-22 of the "Pump User's Handbook." The area of the needed cross-sectional opening is determined from equation 7-6.
- When unequal pressures are suspected, Best-of-Class users will install a "balance line" (tubing or pipe) that ensures that all spaces are at equal pressure.
- I strongly suspect that the workers at the affected facility don't understand that the laws of physics demand an air volume to exist at the top of the constant level lubricator bulb. This air will be at a slight vacuum and, together with the static pressure of the liquid column in the bulb, must equal the pressure in the air space floating above the liquid oil level in the bearing housing.
- Based on what you have related to me so far, attempts to overfill the lubricator bulb are the most likely (although not the only possible) cause of the high oil levels.
- Unfortunately, we are approaching a level of correspondence that goes beyond what I consider normal. Perhaps we might agree that my time, too, is valuable. Please honor my request to confine your call tomorrow to very brief essentials.…HPB

Tommy's reply came the next day:

"Hello, Heinz, thank you for your commentary & explanations. I appreciate them very much! I actually don't have any specific questions to ask, I was just seeking clarifications, which have been very helpful. Perhaps I don't need to call today and would only touch base if I had another clarification to ask? I will pursue finding your book. Thanks very much, Heinz! I wish you had been teaching some of the classes I took…Tommy."

That was the end of the story, or so I thought (see Sidebar). I might add that the classes I took in the 1950s didn't teach the details outlined in my e-mails, either. On the other hand, they did teach the fundamentals of common sense and showed us students how to apply the basics of physics to hydraulics and general troubleshooting.

Collectively, common sense and physics were (and still are) the foundation of mechanical engineering. "Cold phone calls" were unheard of in the 1950s, and the Internet did not exist. But books did, and books were our prized possessions. Furthermore, the desire to read and educate oneself was there. Today, however, as evidenced by this round of communications between Tommy and me, whether that same desire to actually read and educate oneself still exists in some industrial environments is doubtful.

Tommy Wasn't Done Yet...

A day or so after receiving what I thought had been Tommy's last e-mail message to me, I find the following in my Outlook mailbox:

"Heinz, thanks for the info. You had asked me about the DN #—and I too wanted to verify the DN #, to apply it to your 1-100 scale of relative bearing housing scheme ratings. The shaft RPM is 3600. The shaft journal sizes are 2 5/8" and 3 1/8" OD. Therefore the DN values are: 9,450 and 11,250. Or in mm (240,000 and 285,750). If you are using a DN value of 8,000 to "allow or disallow" slinger rings, is that in units of inch-rpm? Thanks very much…Tommy"

I reply. "Yes, it's inches multiplied by rpm. Thus, I would allow slinger rings only if the installation were to positively meet "criteria of perfection" in terms of horizontality of shaft system, immersion depth, oil viscosity, ring concentricity and ring finish (RMS). That said, I would disallow them whenever the facility cannot: (a) ascertain that these criteria are met; but (b) expected me to give them advice on Best Available Technology. Slinger rings simply are not Best Available Technology at DN values exceeding 8000."

Now, Tommy e-mails back:

"Thanks, Heinz. After our discussion last week, I asked Maintenance to verify concentricity of the ring. No results yet. As for horizontality, it'd be hard to make it 'perfect' within a very small tolerance, of course, however I'm looking into what features exist to mitigate this, such as running the slinger ring in an arced groove or groove or slot, etc. All the best, appreciate the food for thought as always. . .Tommy"

Exasperated, I vow to send Tommy one last e-mail. It reads as follows:

"In which case, (and assuming that the laws of gravity DO INDEED pertain at your plant), the slinger ring will make contact with the sides of the groove, and will slow down. Then, we're right back to where we started and the whole exercise has been futile. At which time I anticipate you will suggest making the slinger ring cross-section trapezoidal. Note that the resulting sharper edges easily cut though the oil film and abrasive wear will take place. Wear particles (slivers of brass or bronze) will contaminate the oil, and on, and on and on. . . That, then, explains why Best-of-Class professionals do NOT consider slinger rings appropriate for the truly reliability-focused."

…HPB

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