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Get the facts on oil mist lubrication

Savings in driver maintenance, lower operating manpower, reduced lubricant consumption and energy savings should also be included in a cost justification

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In early 2008, a Houston-based reliability professional was surprised that the $4,000,000 cost proposal he had just received for a plantwide oil mist system was really not close to the cost projected in the *Oil Mist Lubrication Handbook* in 1987.[1] Well, not only have things changed in the intervening 21 years, but it was clear from of the ensuing conversation that serious misunderstandings tend to creep in when people do spotty and selective reading. The situation is even worse when "project advisors" do little, except perhaps relay their mixed bag of opinions.

Why context is important. In an article published in 1990,[2] we noted "together with an appropriate amount of a suitable state-of-the-art synthetic lubricant, this low-cost retrofit (referring to a modern magnetic seal and a plugged vent instead of the customarily open-to-atmosphere bearing housing vent port) may extend bearing life to the point where oil mist lubrication is no longer economically attractive." This statement is as true in 2008 as it was in 1990. It referred to the small but diligent group of equipment users that insist on correct pump installation, operation and maintenance. For them, oil mist lubrication may indeed not be justifiable. These are the relatively few facilities that expertly apply the right lubricant to a particular bearing and change the oil periodically. Industry in some Western European countries apparently does not experience enough bearing failures to justify additional (incremental) failure avoidance through the use of plantwide oil mist systems.

In stark contrast, virtually all US facilities will likely benefit from oil mist lubrication. Many elements contribute to this remarkable difference. The European mindset appears more oriented toward taking the necessary time to do things right, whereas on this side of the Atlantic the mere speed with which a repair is effected is often given more weight. In Europe, the administrative person in charge will not (usually) interfere with the experience-based judgment of a highly qualified craftsperson. If periodic oil changes are needed, they will be performed. If bearing installation tools are needed, these will be procured and properly used. Piping will be installed with proper fits, and the list just goes on.

Regrettably, the same approach is rarely practiced in the US. All too often the person in charge may insist on quick work, or will not allocate the time it takes to understand and remedy the underlying failure causes. When our typical person in charge manages to quickly restore equipment to running condition, he or she will be elevated to higher status. If the quick-fix attempt fails, blame for having guessed wrong can usually be shifted to others. Deviations from the original quality norm become the new norm and repeat failures are experienced.

Whenever truly pertinent training and accountability are lacking, the cycle repeats itself. As just one example, in many plants no one can explain why and how a constant-level lubricator works and why the widely used nonbalanced versions no longer represent state-of-art accessories. Lube replenishing duties are often overlooked, or carried out wrongly. Inadequate slinger rings are used in many thousands of bearing housings, and defensive bickering is often preferred over listening to solid science and fact-based explanations. Again, in those widely prevailing circumstances upgrading to oil mist would prove highly valuable and will be quite easy to cost-justify.

Oil mist provides more than just lubrication. Oil mist lubrication should always be mentioned together with the term oil mist preservation. Because oil mist inevitably preserves stand-by equipment, the resulting reliability increase deserves to be reflected in the cost justification, as should failure avoidance and the ensuing reduction in pump-related fires. Needless to say, this type of lubrication and preservation is even more easily justified in geographic regions with high humidity or blowing sand. Additional credits are derived from oil mist lubrication for equipment drivers. Indeed, every experienced user plant applies oil mist to electric motor bearings. The mist is routed through bearings in accordance with the guidelines set forth in the 8th and later editions of the API-610 Standard (Fig. 1). These editions clearly depict the optimized through-flow method that has now been in use at some of the world's most profitable facilities for almost four decades.

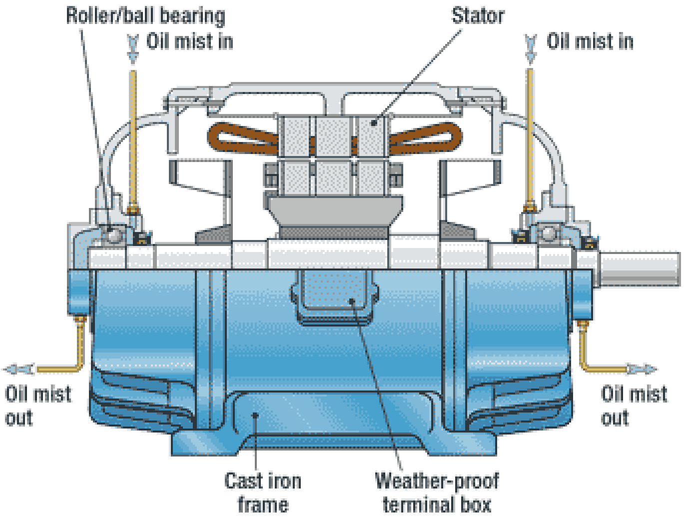


Fig. 1 Oil mist application on an electric motor, per API-610. *Note dual-face magnetic bearing protector seals.*

Numerous papers and articles have documented this fact. Engineers from user companies, among them some of the largest multinational refiners and petrochemical companies, have freely shared their highly favorable experiences. Reliability professionals at these facilities are in the business of keeping plants running. At the same time, they have been tasked with finding cost-effective ways of extending and optimizing equipment uptime. Optimizing uptime does not mean adding maintenance cost and, in fact, implies maintenance cost reductions. The final outcome and ultimate test of a best-of-class facility has been, and will continue to be, lowest possible life cycle cost of all assets. In many places, oil mist lubrication has aided in meeting these test criteria.

Recent statistics are useful. Major oil mist system suppliers have furnished monetary data on the estimated overall economic performance for various plants. These suppliers can provide the data expressed as DCF return and payback period. One supplier divided the information into broad categories of user plants, including refineries, petrochemicals and polymers or, perhaps, metals processing. Knowledgeable vendors can also provide details on the additional benefits of the technology. For instance, significant benefits are derived from using oil mist for both indoor as well as outdoor storage protection (Fig. 2), and even "mothballing" entire plants.

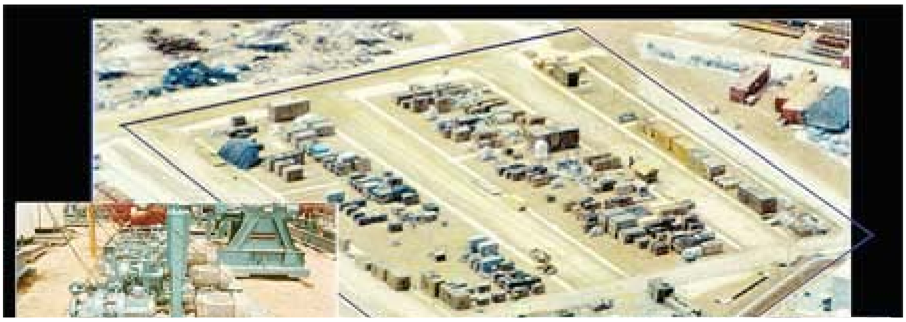


Fig. 2 Outdoor equipment storage before installation at a grassroots facility in Thailand.

While we are not allowed to give the names and locations of plants that supplied relevant data, we can alert you to the benefits calculated by some of these oil mist users. It should be noted that these data include numbers you can use in calculating cost justification and payback. Keep in mind that the oil mist provider may find ways to be more specific. That said, here is what we are at liberty to share:

- Plantwide oil mist lubrication has been applied in over 100 refineries and chemical plants in dozens of different countries.
- Satisfied users include major big and small companies.
- The investment made by these plants generates attractive returns and short payout periods, based on improved reliability and reduced cost.

The demonstrated areas of improvement include, for example:

1. Reduced pump and electric motor bearing failures:

- 80–90% reduction in pump bearing failures is typical.
- Electric motor bearing failures are often lowered by over 90%.
- Competent oil mist suppliers can provide data on:

a. Bearing failures at a major refinery in Thailand
b. A California refinery sharing its electric motor failure history
c. Major olefins plant failure history.

2. Reduced seal failure events:

- Reduced seal failures in the 30–50% range
- One user reported average seal life doubled to eight years.
- Examples include:

a. Bearing and seal experience of an oil mist user in California
b. Seal life comparison from an offshore facility.

3. Reduced failures rates of specialty equipment:

- Oil mist application has shown excellent results in a variety of other equipment applications.
- Rotary lobe blowers, chemical mixers and cooling tower fan gearboxes are examples of more specialized applications with big payouts.
- Examples include:

a. A polymer processing equipment failure history
b. Applicable experience with rotary blowers
c. Highly favorable refinery cooling tower gearbox history.

4. Results expressed as MTBR improvement for pumps, drivers and other equipment:

- One user reports improvement from three years before oil mist, to now nine years after oil mist.
- Another user went from four years (before) to now almost eight years (after oil mist was introduced).
- Detailed examples are available for:

a. A refinery in a Pacific Rim country; it published seal life comparisons

b. Highly favorable pump MTBR experience
c. Similarly favorable steam turbine MTBR experience.

5. Disclosure of pump maintenance costs, showing significant reductions. Percentages are:

- One user reports a 40% reduction in all work orders for pump maintenance.
- Others reported pump repair cost reduced by 60-80%. These included:

a. An asphalt plant
b. Experience at several refineries
c. Dollar cost-reduction numbers provided by one refinery.

6. Operations manpower to carry out lubrication tasks was reduced.

- User reporting 47% reduction in hours needed to complete lubrication-related tasks.
- User feedback from a Pacific Rim country supports the data.

7. Lubricant consumption was reduced.

- 40% typical reduction due to more efficient application
- One user reduced consumption 70% by applying recommended recovery steps.
- Comparison of oil usage in several affiliated Pacific refineries is available.

8. Reduced energy consumption is a fact.

- 1–2% lower energy use demonstrated in several controlled tests
- Energy consumption study in a South American location has been published.

9. Eliminated lost production incidents.

- Specialty polymer producer estimated 7–8% runtime improvement
- Refiner eliminated value of reduction of lost production incidents on crude oil unit.

Overall economic results for five refining applications have been published:

A. Western state refinery:

- Applied oil mist to crude unit, FCCUs and steam boiler area in 1999
- Experienced sharp reduction in pump maintenance cost
- Eliminated lost production incidents on crude unit
- DCF returns exceed 200%
- Payback achieved in less than one year.

B. Southern plains asphalt plant

- One system for entire plant installed in 1997
- Pump repair costs dropped 72%
- DCF return of 150%
- Payback in less than one year.

C. Overseas refinery:

- Installed systems throughout one plant in mid-1990s
- Compared performance with sister plant without oil mist
- Results include doubling MTBR for pumps and seals, cutting operating manpower in half

- and reducing lubricant consumption
- Estimated DCF return for converting other refinery to mist is 54%
- Estimated payback is only 1.9 years.

D. Mid-coast refinery:

- Two systems installed in 1996 on crude processing units
- Pump bearing repairs costs dropped 88%
- DCF return of 70% based only on lower repair costs
- Payback was achieved in 1.5 years.

E. Southern US refinery:

- Three systems installed in 1989
- Pump repair costs reduced by 65–70%
- DCF returns of 75% achieved, based only on pump repair savings
- Payback in 1.5 years.

Similarly, the overall economic results for three petrochemical applications are available:

A. Specialty polymer plant in a western state:

- Failure rate on rotating equipment was about every six months before oil mist
- Failure rate dropped 98% after mist applied
- Plant availability to manufacture polymer increased 5–7%
- DCF return without including increased production exceeded 400%
- Payout in less than six months.

B. Commodity polymer plant in mid-south region:

- High rate of rotary lobe blower failures motivated mist investment
- Blower maintenance cost reduced by 90% within two years
- Resulting DCF return of 45% and payback period of two years.

C. Central Gulf Coast olefins plant:

- Compared pump failures between plant built in early 1980s with mist and one without built 10 years earlier
- Pump bearing failures 90% lower with oil mist-lubricated plant
- DCF return, based only on lower bearing failures, of 75%
- Payback in 1.5 years.

Cost justification with 600 pumps. For the sake of ready overview, see Figs. 3–10 and Table 1.

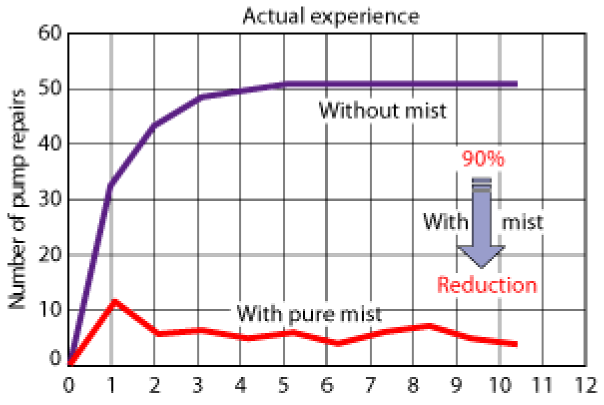


Fig. 3 Pump bearing experience published by Shell Oil Company.

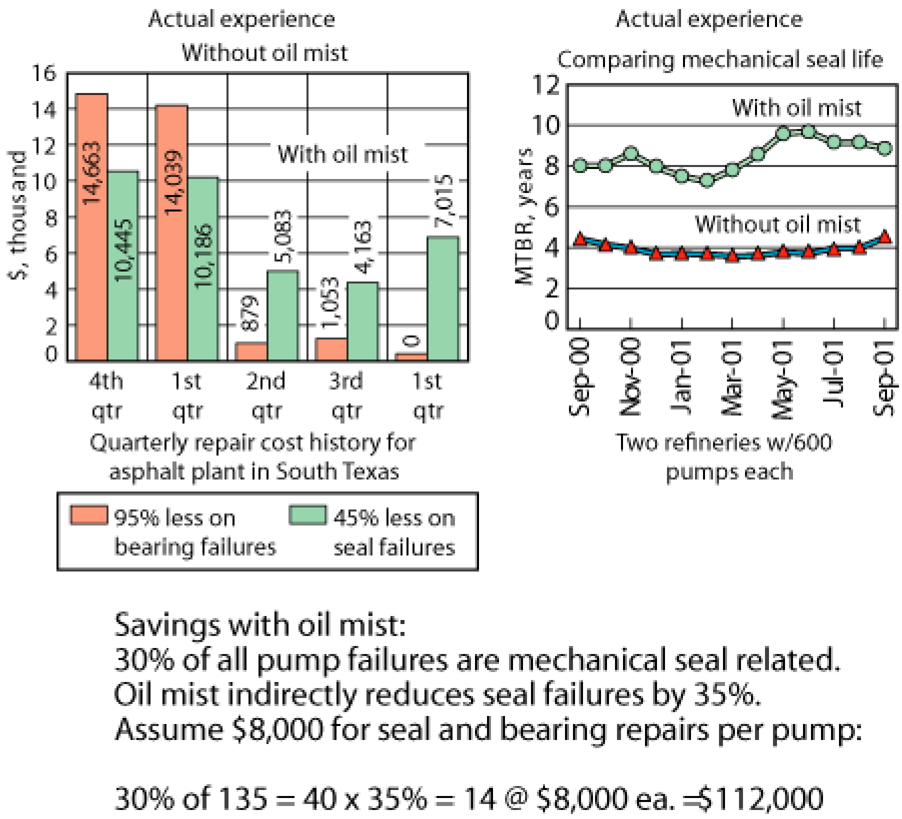


Fig. 4 Pump seal experience.

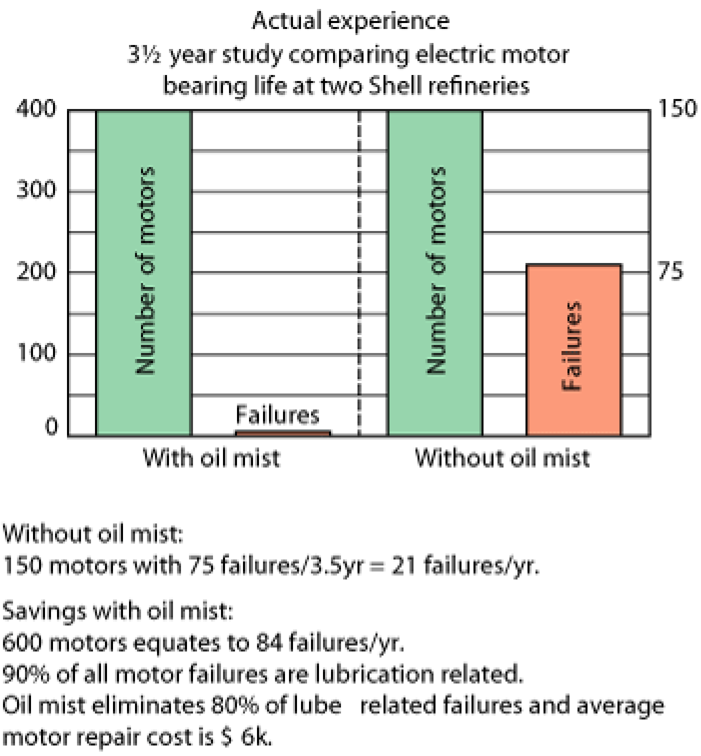


Fig. 5 Motor bearing experience.

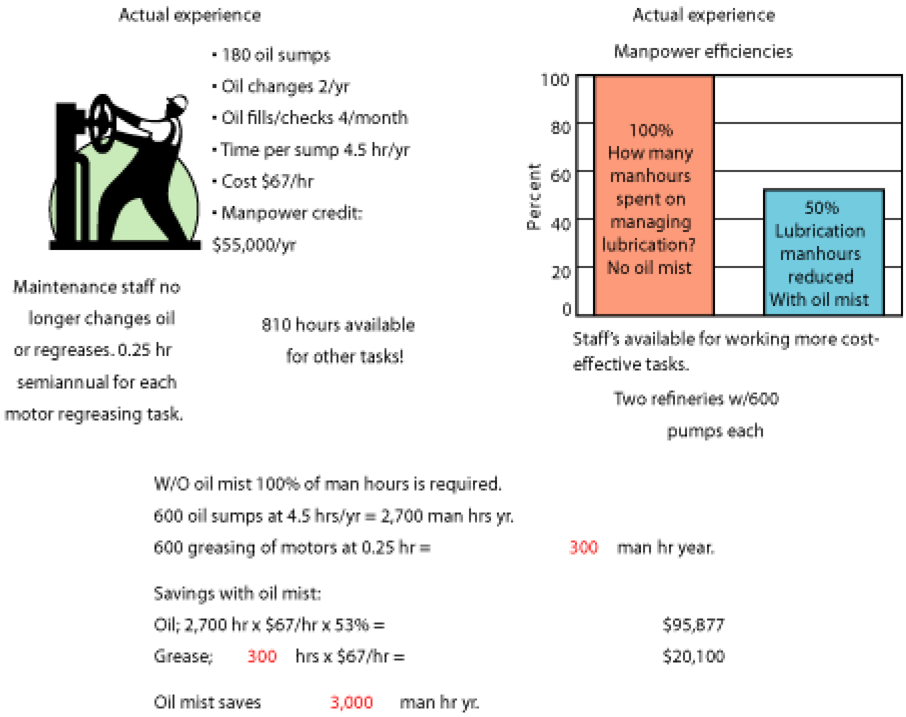


Fig. 6 Manpower efficiencies.

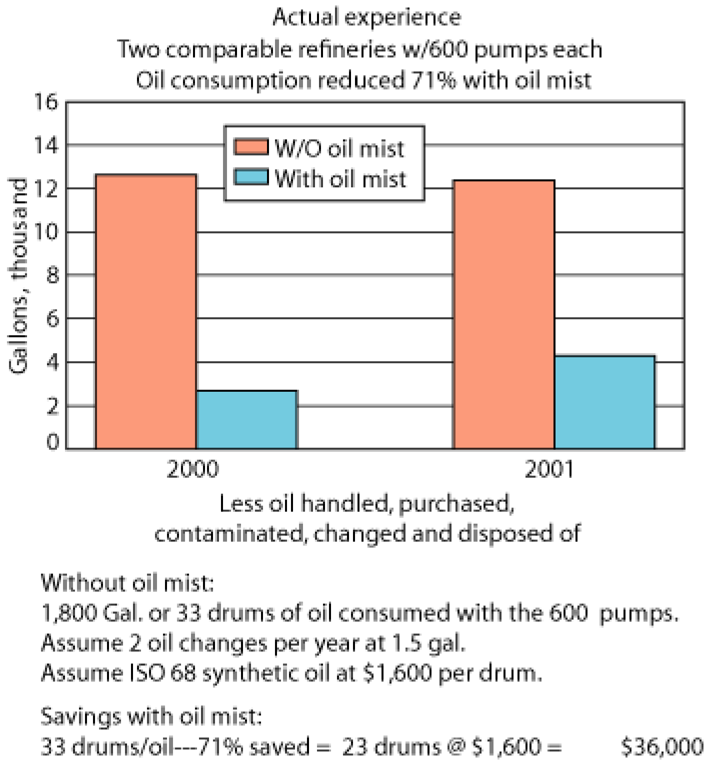


Fig. 7 Oil savings.

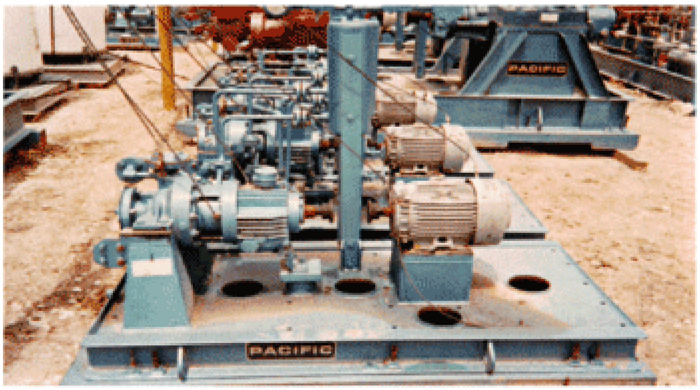
Without oil mist:
Bearing and seal-related failures only. Assume 1,000 pump failures result in one significant fire.
Assume $10 million for fire damage.

Assume $1,000,000/day for lost production and 12 days to return to full-scale operations.

Savings (or cost-avoidance) with oil mist:
25 bearing-related pump failures; Figs. 1 and 2 <> 84 motor-related pump failures; per Fig. 4.
109 avoided potential fire possibilities.
1,000 failures/109 failures/yr = 1 fire possibility in 9.2 yrs.

$10 million/9.2 years =	$1,087,000/yr
$12 million/9.2 years =	$1,304,000/yr

Fig. 8 Fire potential savings.



Without oil mist:
Spared equipment failures of pumps, motors and turbines that result in minor upset of production. Assume $1,000,000/day loss for any given process unit. Assume five days lead time for repair; eliminating 109 failures = 545 additional days/yr for production. 4.5 yr/MTBR leads to a failure every 1,606 days for any given service.

Lost production avoided with oil mist:
545 days / 1606 days = 0.33 additional production days/year.
$1,000,000 x 0.33 days = $330,000

Fig. 9 Nonfire-related potential production savings.

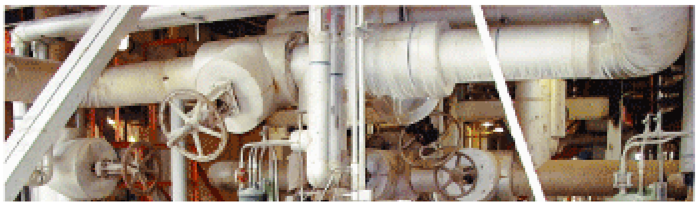


Fig. 10 Nonspared equipment savings.

TABLE 1. Savings summary

Pump bearings	$ 132,000
Pump seals	112,000
Motors	488,000
Manpower	115,977
Oil savings	36,800
Fire potential	2,391,000
Production	330,000
Nonspared	405,000
Total	**$4,010,000**

Many companies have found it cost-justified to invest in oil mist, although their calculations were often based on lower pump maintenance costs alone. While that is noteworthy, savings in driver maintenance, lower operating manpower, reduced lubricant consumption and energy savings merit consideration as well. Once these are included, the results will further make the case for oil mist lubrication. Production credits deserve to be included and even the obvious value of reducing the frequency of fire incidents should be factored into these calculations.

Unless proven otherwise (and there are such rare instances), plantwide oil mist is cost- justified for new plants and retrofits. A sound strategic technology package is aimed at maximizing reliability and minimizing life cycle cost for rotating equipment. We trust this summary gives focus to the lube-related reliability improvement efforts proposed by competent professionals. We have obviously utilized vendor feedback and have attempted to bring factual information to the reliability engineer's attention. In turn, he or she has to reconfigure the data into a formal cost justification and bring it to the attention of management. Formal cost justifications can be facilitated with the help of, and solid input from, knowledgeable vendors. Such an analysis might quickly prove the true value of the $4,000,000 plantwide oil mist project mentioned at the beginning of our article.

When reliability professionals purposefully engage in relevant literature searches and then cost-justify their recommendations, they can more easily convey the merits of best-available technology to their employers. Doing so will not detract from their principal daily role of keeping the plant running safely and reliably. It will, however, make reliability professionals more productive, resourceful, informed and authoritative contributors. They will thus add value to an enterprise. **HP**

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