

A Machinery Maintenance Strategy

Back in the early seventies of last century we listened to the maintenance consultant who came up with the ideas in Figure 1. This was a good while before we heard about Reliability Centered Maintenance (RCM) and all the other “M’s”. After the seminar we considered this concept of “Total Preventive Maintenance“ not exactly revolutionary but as something we could take back to our plants and use as a strategy which has served us well ever since.

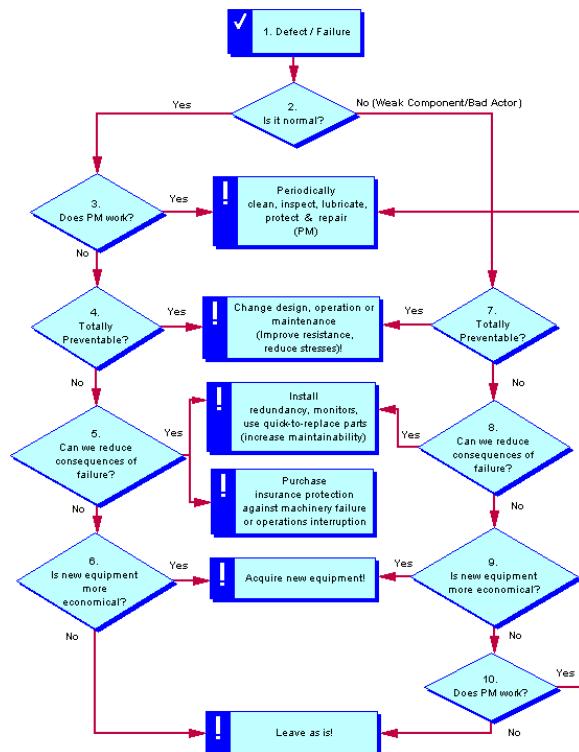


Figure 1. Total preventive maintenance¹.

In reviewing the decision flow sheet shown in Figure 1 we start with step number one which reminds us to register all defects and failures around our equipment in order to come up with the best counter measures.

The second step is to test each failure as to its normalcy. Here we would consider *normal* attaining a Mean-Time-Between-Failure (MTBF) benchmark set by ourselves or others. A good example would be a

mechanical seal for a pipe line pump application. For instance, we hear today about MTBF values of some six years for mechanical seals in HC service.

If the seal failure is considered normal with respect to a benchmark MTBF, we check in step three if we could possibly extend seal life by Preventive Maintenance (PM) measures. Now, there is a large body of evidence that suggests that a well selected and designed seal tends to exhibit random rather than time- or cycle-dependent failure behavior. Therefore, they do not respond well to PM measures. The old maintenance adage “leave well enough alone” applies. This is contrary to what some other experts seem to convey. They prefer to use an index such as mean-time-between-planned-maintenance which suggests that mechanical seals should receive periodic inspections, overhauls or other invasive maintenance attention. We would like to state that this is not being borne out by our experience in the HC industries. If we have been visiting our mechanical seals periodically it has been in five-year or so turn-around intervals applied to major turbomachinery.

We would now come to step four in which we ask ourselves if the failure could be totally eliminated by altering the design, operation or maintenance mode.

If we are convinced that we have already optimized these parameters we proceed to step five that forces us to investigate the possibility of reducing the consequences of this failure that will occur regardless of what we have done. Here we consider protecting ourselves by such measures as introducing redundancy features, i.e. dual seals or spare pumps, monitoring devices such as incipient failure indicators, quick-change-out assemblies, i.e. cartridge designs; we could even think about taking out machinery failure and business interruption insurance.

¹ Modified from H.Grothus, “Die Total Vorbeugende Instandhaltung”, Grothus Verlag, Dorsten, Germany, 1974.

After being unable to come up with any ideas in the previous step, we are faced in step six with the question as to whether different components or new equipment are more economical. If we do not see any way of justifying new and more reliable equipment we have come to the “bitter end” and must leave things as they are and live with the situation.

In case our example mechanical seal does not meet the normalcy test in step two, we go to step seven. This means that we are faced with a weak link or a “bad actor”. We must test, as in step four, if we can eliminate it by the measures already described. To stay with our example, a hands-on failure analysis should lead to a thorough investigation of the suitability of the seal for the service it is in. Start-up and operating procedures as well as maintenance and repair standards should be reviewed.

If step seven yields a no, we go to step eight to find out if the actions indicated in step five would work.

Step nine: If we have not been able to find any possibilities to apply the measures mentioned in step eight, we investigate if a new investment is economical.

Arriving at step ten means that our only possibility for tackling these type of failures would be preventive maintenance measures as described in step three. Most likely preventive maintenance and increased vigilance would be of some help. However, they should be considered a last resort in the case of a frequently failing seal. If PM yields no results we must resign and again, live with the problem.

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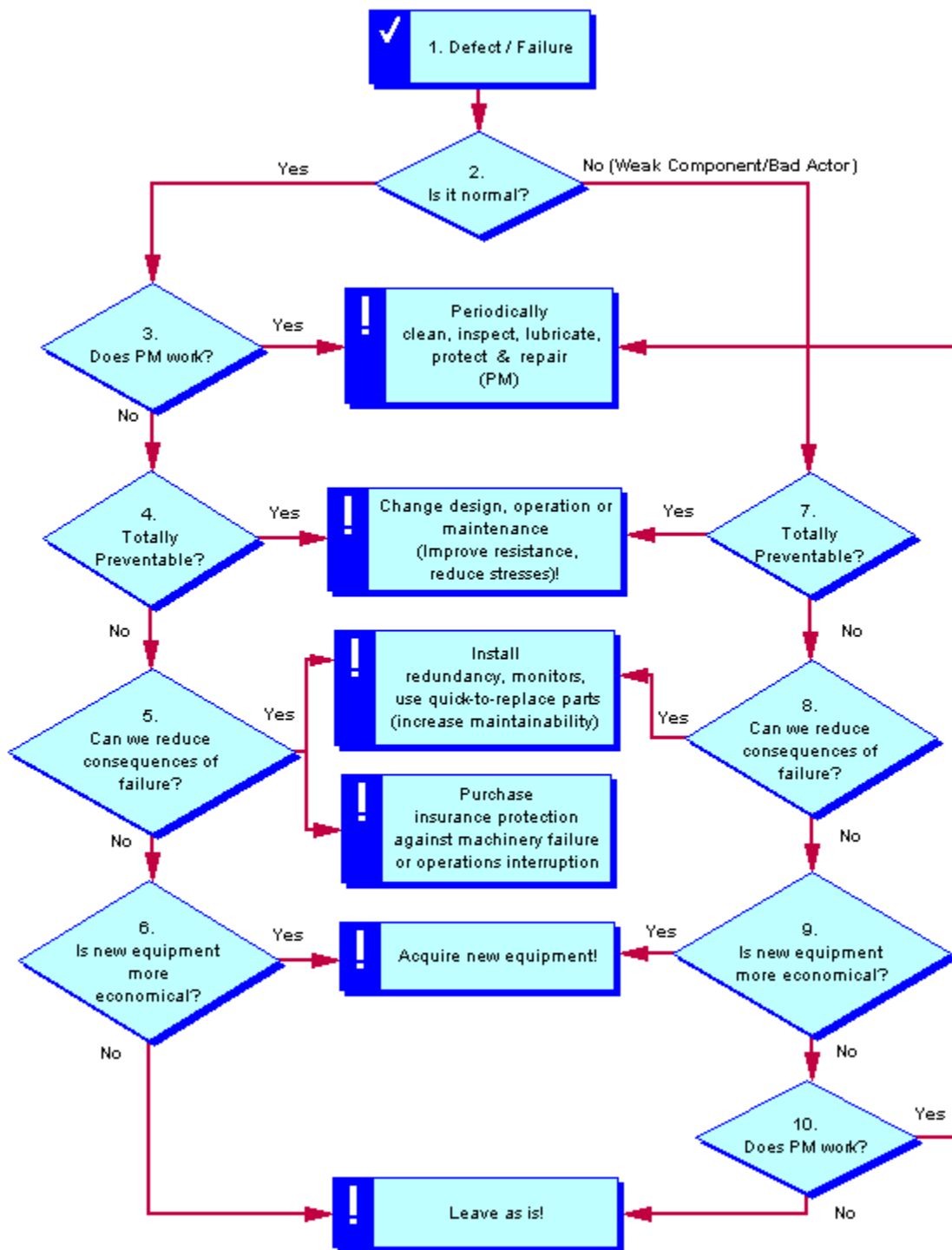


Figure 1. Total preventive maintenance ¹.