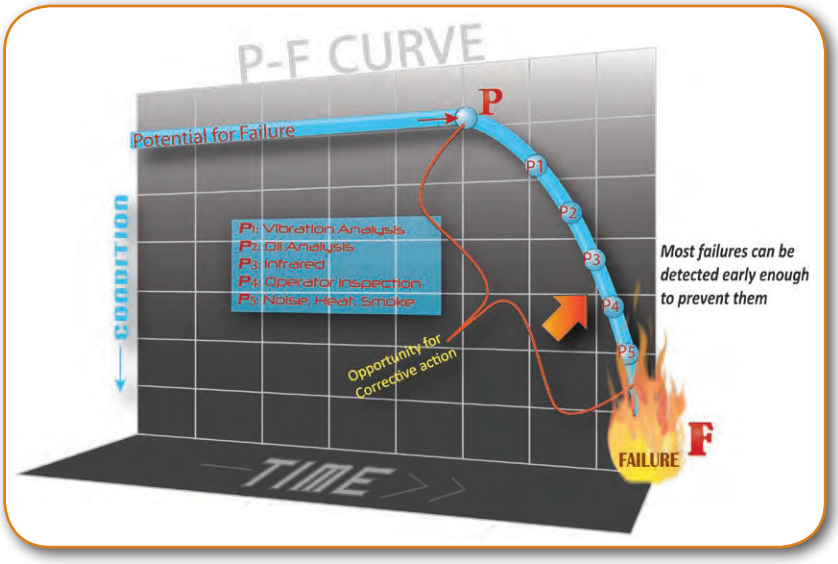
The P-F Curve

FIGHTING THE URGE TO DEFER MAINTENANCE DURING CHALLENGING ECONOMIC TIMES.

By Preston Ingalls

With the downturn in the economy and companies searching to cut costs as much as possible, the temptation is to start scaling back on servicing fleet and plants. But, without a careful analysis, this will most likely lead to short-term and long-term issues. Don't assume the company's existing Preventive Maintenance (PM) program is sacred—there could be too little or too much PM taking place.

In addition to PM, Corrective Maintenance (CM) should be examined. CM is maintenance which is required when an item has failed or worn out, or shows evidence of being excessively worn, and bringing the unit or piece of equipment back to a working or functional state. Corrective maintenance is carried out on items where the consequences of failure or wearing out are not significant and the cost of corrective maintenance is not greater than preventive maintenance. Corrective maintenance may or may not be scheduled. A form of corrective maintenance that needs to be done as soon as possible is called Emergency Maintenance (EM).



Unlike EM and some CM, PM is generally scheduled. Scheduling work consistently in a downturned market can be challenging as Jeff Buckmaster, equipment manager for Skanska USA Civil West California, states, "Our utilization is low due to the economy and we have found that our scheduled maintenance work orders are coming at a much lower rate. This makes it hard to schedule and plan enough work to keep a back log so that our crew is not sent to the jobs for one or two work orders. In the past, it was unacceptable to not have the work order process closed in a 2-week time span; we have had to relax that measure so that we can plan cost effective work."

SCHEDULING TO EXTEND LIFE

The purpose of a solid PM program is to minimize breakdowns and excessive depreciation. In its simplest form, preventive maintenance can be compared to the service schedule for an automobile. It includes activities such as lubrication, painting, testing, cleaning, adjusting, and minor component replacement, aimed at extending the life of the equipment.

The following illustrates some of the specific outcomes expected from an effective PM process:

- Reduced equipment downtime;
- Improved conservation and increased life expectancy of equipment assets, virtually eliminating premature replacement of the equipment;
- Lower overtime costs and more efficient utilization of maintenance staff, a result of working in a more planned and scheduled manner;
- Minimized need for large-scale, disruptive repairs;
- To reduce the production losses from equipment failures;
- To acquire meaningful data from the equipment history so more intelligent decisions on repair, overhaul, and replacement to maximize the return on capital employed can be made;
- To provide tasks for planning and scheduling for minimal production disruption;
- Timely identification of high maintenance cost equipment allowing for proactive operator training and/or planned replacement of obsolete equipment;
- Reduced incidents of secondary failures; improved safety and quality of equipment;
- Reduced cost of repairs by reducing secondary failures; when parts fail in service, they sometimes damage other parts—collateral damage.

The problem is that studies have shown that 30 to 40 percent of preventive maintenance costs are spent on equipment with negligible failure impact. In other words, about a third of the PMs done do not prevent failures from occurring.

Some of the characteristics of under-servicing equipment are:

- Preventive activities not performed at all or performed at too long intervals (too much time in between);

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- Unproductive or non-existent preventive activities.

Under-servicing equipment results in frequent and extended breakdowns, excessive unplanned work, and lost productivity and output.

On the other hand, characteristics of over-servicing are:

- Performing non-valued added PM activities (these contribute nothing to prevent failures or reduce wear);
- Performing PM activities more often than required;
- PM Activities are redundant (i.e. duplicate other effort).

Over-servicing equipment results in excessive cost, wasted labor, unneeded downtime, and reduced output.

Owners should be looking at servicing equipment based on failure risks. This means examining those things that could fail, the impact of them failing, deciding on the most significant risks, how those could be detected early enough and prevented (mitigated).

A good source for this information is equipment history and the knowledge of the mechanics and technicians. Determining which components would cause the most damage or loss and putting into place a means to detect changes in the condition of those components is smart and efficient.

KNOWING THE CURVE

As the *P-F Curve* chart illustrates, failures can be detected in advance if inspection is conducted. The curve shows that as a failure starts occurring, the equipment deteriorates to the point at which it can possibly be detected as the Potential for Failure (P point). If the failure goes undetected and not corrected, it continues on until the Failure occurs (F point). The period of time between P and F, commonly called the *P-F interval*, is the window of opportunity during which an inspection can possibly detect the pending failure and resolve it through corrective action.

P1, P2, and P3, shown on the curve, are Condition-Based Maintenance and Preventive Maintenance inspection activities applied by maintenance personnel to detect early changes in condition. P4 and P5, which are closer to the failure event, and, therefore more easily detectable, are activities operations personnel can apply to detect changes in condition before failure occurs. This is the main advantage of having an Operator Care program as part of the PM process.

The key here is to apply predictive or condition monitoring tactics (P1, P2, and P3) early enough to detect changes in conditions so we can act upon them to prevent failure. These technologies (ultrasonics, oil analysis, coolant analysis, infrared thermography, vibration analysis, etc.) are more accurate than human senses and therefore, can detect changes sooner than traditional PM inspection. These technologies make the inspection more objective and less subjective.

Although the temptation is to forego or defer Corrective Maintenance and Preventive Maintenance activities until later to save money, the costs will be, on average, 4 to 5 times higher if failures are allowed to occur.

Mason Ford, equipment manager for Skanska USA Civil Northeast, states, "Companies need to complete maintenance activities at the right time for maximum efficiency." ■