Building a PM Program
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Which came first, the PM program or the emergencies? I once casually asked an eighty-five year old woman how she kept her large old farmhouse so clean. Expecting a simple "Thanks" for the compliment, I was surprised when she began to explain her method. "First you take a broom and sweep the kitchen . . . . ", she said, and then continued to describe the steps in keeping a house clean. The simple but effective view she took to housekeeping made me think about a common obstacle of preventive maintenance cited by maintenance managers. Too many managers I meet today state that there is no time to perform preventive maintenance because a large part of their workforce is dedicated to emergency repairs. Paradoxically, these managers usually realize that if they had an effective PM program they wouldn't have the emergencies.

The start of a PM program doesn't have to be a "chicken or the egg" philosophical dilemma. Companies can, slowly but surely, reap the gains of a PM program by focusing their effort on the work rather than on the idea of *a program*.

Old approaches to implementing a preventive maintenance program have a spotty track record. It was often said that a PM program must be designed and sold from the top down, before it could be formally implemented. Some people imposed the requirement of a rigorous cost vs. benefit analysis on the total program before it could be approved. The demand for justification is often dictated in the face of firsthand and clear evidence that one dollar spent on a routine PM procedure could easily have saved two to three dollars lost on the last emergency repair performed.

Other efforts to implement a PM program are tied to the purchase of a computer software to run it all. Once the purchase of the software is approved, the implementation of the PM program is quickly overshadowed by the initial data collection task required by many computer systems.

PM *should* determine a major portion of the work performed on a day-to-day or week-to-week basis. The work is pre-planned. Labor estimates, material, and tool requirements are known. However, suggesting that PM is the most important work performed during a normal workday sometimes receives chuckles from people who work in maintenance. They know that, more often than not, PM work is the first to be displaced from the schedule by emergency work or other so called "more important work". The low regard PM has in some plants may be derived from a lack of quality and focus on the effort. Lots of time goes into the initial sale of a PM effort, but little time into the actual work performed.

So, how do you eat an elephant? One bite at a time. Top management doesn't have to know that you are embarking on an effort to overhaul or start a PM program. They probably don't care, or think you're already doing it. Small steps toward a complete program can be even more effective than first establishing a "master plan". However, prioritizing your effort should be an initial step.

Identify the equipment with high downtime, high maintenance, or repetitive repairs. This is usually a small percentage of the total equipment in the plant. ABC analysis (80-20 rule) or old fashioned "fat files" may help in this identification. In the absence of a formal cost justification, this list will certainly get you closer to the best result for each dollar spent.

Take only the top one or two pieces of equipment on the list and attempt to identify the root cause of the problems most commonly encountered. A detailed review of work order history may yield the source. A brainstorming session with operations and maintenance personnel can be just as productive. PM programs which are developed with the involvement of operations have proven to be the most successful.

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Next, develop a solid PM procedure to combat the root cause of the problem. All too often, a PM work order is handed to a maintenance worker without any more detail than a statement such as, "PM the plant air compressor", or "Inspect the gearbox". The mechanic is expected to draw on personal knowledge of equipment and do all the preventive work required. What is actually accomplished can vary widely from one employee to the next, and the work performed may not even be the work intended by the manager. The time taken out of the normal workday to perform PM should be productive. To improve the productivity, the work needs to be well defined. A written procedure with a data sheet should be developed for most PM work.

The following types of PM procedures should be considered:

Inspections

An inspection is usually performed on operating machinery using the basic senses of sight, sound, and touch. Unless specific parameters have been identified, the quality of the inspection is totally dependent on the sensitivity of the inspector to potential equipment problems. Associated checklists used on inspections are often just a list of equipment, the symptomatic conditions to be looked for, and a location on the checklist where a "check mark" is to be entered. Such checklists often become abused, with inspectors hurriedly filling in the check marks or even completing the forms back in the shop.

Inspections can be enhanced by adding gauges or instrument inspections to the route. Rotating components or drive belts can be inspected under the "freezing" action of a battery powered strobe light. Belt drive inspection can be expanded to include the use of sheave gauges and belt tension gauges. Critical temperature limits on bearings or compressor valves can be determined by using an inexpensive temperature infrared pyrometer. Vibration checks using low cost, pen sized meters can be used to detect beginning problems in equipment due to imbalance, misalignment, or looseness. Adding such innovations to an inspection often raises the interest level of the inspector as well as heightens the quality of information returned.

Adjustments

Adjustments involve the optimization of operating equipment. It could be a simple fine tuning of cam on a limit switch, or could involve the tuning of a boiler combustion control system to maximize fuel efficiency. A record of adjustments made can become the basis for optimizing the PM frequency, or can point to the need for component replacement if too frequent adjustments must be made.

Testing

Tests are used to verify that equipment is performing according to specifications and are often associated with safety controls or environmental equipment. A typical PM of this type might be used to verify the automatic shutdown controls on a boiler steam drum. Documentation is often required when performing these types of tests. They should include a form which shows the date and results of the test, and should be signed by the tester.

Calibrations

A calibration verifies or corrects the accuracy of critical indicators, control instrumentation, or final elements. A data sheet should be included which indicates "as found", "correct", and "as left" condition. These sheets should be signed and dated.

Rebuilds

A rebuild invariably requires equipment downtime. During a rebuild, critical dimensions are checked and worn parts replaced. The goal of a rebuild is to restore equipment to "like new" condition. Rebuilds are sometimes turned over to an outside vendor. The vendor may be the original equipment manufacturer (OEM) or a service vendor familiar with the machinery's maintenance requirements. In either case, the conclusion of the rebuild should include a detailed report covering what was done, what was found, what was replaced, and what should be checked on the next rebuild.

Replacements

Replacement PMs can involve the periodic replacement of disposable components, such as air, oil, or fuel filters. Replacement PMs can also include replace-in-kind for inexpensive but critical equipment. Often, such replacements are economically justified over more frequent inspections. A typical replacement PM would be replacement of inexpensive positive displacement fuel oil pumps at the beginning of the winter season.

Good PM procedures should incorporate the following elements:

1. A list of tools, parts, or instruments required to perform the PM should be provided at the beginning of every procedure

2. A form must be provided if the PM procedure includes taking measurements or readings, so this information can be recorded.

3. If measurements or readings are taken, the data form must include a limit or range of values, which will indicate whether or not the measurement or reading is normal.

4. Safety considerations should be listed, such as "lock-out" or "hot-work" procedures.

The following sources will help in the development of PM procedures:

1. Vendor recommended PM:

   The maintenance manuals provided by equipment manufacturers are invaluable when trying to build a PM pro-cedure. However, the procedure in the manual should not be used in its original form. Additional tests, repairs or inspections should be added which reflect the special use of the machine in your facility. As an example, if a compressor normally operates at an overload, routine inspections should be more frequent than suggested by the manufacturer. Also, it may be advisable to perform tests on the oil to determine serviceability, rather than automatically replacing the oil.

2. Plant Experience:

   Mechanics who work on equipment and the operators who run it can help define PM that might be specific to the equipment's environment. Working together, they often discover PM procedures that would not otherwise be obvious. The operator might be aware of a specific symptom that precludes a problem. The mechanic may be able to relate the symptom to a failing component.

3. Generic PM:

   Generic PM procedures developed for general classes of equipment can be modified to fit a specific facility requirement. Some typical procedures of this type are developed by professional organizations such as the Institute of Electrical and Electronic Engineers (I.E.E.E.), Instrument Society of America, (I.S.A), American Society of Mechanical Engineers (A.S.M.E), or the National Fire Protection Association, (N.F.P.A.).

The development of a PM procedure is not complete until it has been performed and corrected. Solicit the remarks of persons required to perform the procedure. If the procedure doesn't work for them, it won't be a successful effort. Additionally, reacting to their comments and giving their efforts visibility will improve involvement in the program.

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After the procedure is corrected, the frequency of the PM may have to be adjusted. Obviously, if a failure has occurred between PM inspections, the PM procedure and frequency should be reviewed. Less obvious, but equally important, is the identification of PM work which is performed *too often*. As a rule, an effective PM program will generate three corrective action work orders, or on-the-spot repairs, for every ten inspections performed. If a procedure doesn't seem to be paying off in this way, the time between inspections should be extended. Frequencies left uncorrected undermine the credibility in the program for the persons performing the work and those benefiting from the effort.

Once your first procedure is off and running, return to your list of equipment candidates for PM work and add new equipment and procedures to the program. When is the program complete? Many right minded industrial organizations have adopted the seemingly unattainable goal of "All accidents are preventable." They know that the goal helps people focus on the ways to prevent accidents, i.e. reducing unsafe conditions and unsafe acts. A similar approach should be taken with respect to equipment failures in a plant. Focusing on a goal such as "all failures are preventable", or "all downtime is preventable", leads plant personnel to identify the causes of failures and discover ways to reduce them. Chances are you will never identify and solve *all* your equipment problems, but with your eye on the goal you'll be headed in the right direction. But first . . . go get a broom.

This article was written by a consultant from **New Standard Institute, Inc.** For other articles on Maintenance-related subjects, view our website at http://www.newstandardinstitute.com or contact us via email at nsi@newstandardinstitute.com or call **(203) 783-1582** to discuss the subject with one of our consultants.

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