Condition Monitoring of Smaller, Less Critical Equipment Provides Major Improvements in Reliability and Lower Maintenance Costs

"The current predictive maintenance program is really an extension and improvement of a vibration analysis program that we have had at the refinery for some time", advised Tony Soby, a vibration specialist at the Shell Oil Company refinery located in Martinez, CA. "As we learned more from the vibration analysis of large and critical machines, it became obvious that there was a lot of money to be saved in monitoring less critical equipment as well. As a result, our mechanical inspectors started taking hand logged vibration data on smaller process pumps and motors on a regular basis".

"Part of the problem with smaller pumps and process equipment is that by the time someone notices that something is wrong with it, the damage is considerable. At that point, we often have to make a new shaft, machine the fit of the bearing, and do all of this with an accelerated work ticket and sometimes overtime. For a 50 HP pump, that could mean a repair cost of as much as $4 000 to $6 000, not including process slow downs or disruptions".

"Our early handheld measurements indicated that we could identify process pump problems much earlier in the failure cycle, when all we had to do was replace a damaged bearing. This 'early warning' allowed us to plan and schedule the repairs when it was convenient for operations, and we have estimated the repair costs per pump to be $2 500 or less in most cases".

Fig. 1. SKF Microlog portable data collector.

"We also use the vibration trend data to decide when **NOT** to replace bearings. In the past, it was standard practice to replace bearings when seals were replaced, even if there was no evidence of a bearing problem. Now, with good vibration and trend data, we can make an informed decision not to replace the bearings, thus reducing the overall time for a seal replacement by 60% or more".

The operating people, process managers and administrative people were convinced that it was cost-effective to expand the hand logging program throughout the plant. Fortunately, at that time management was extremely interested in programs that would improve equipment reliability, maintenance operations and on-stream factors.

"At the time that we were looking for the hardware to expand the program, the SKF Microlog system was the only automated data collector on the market that met our requirements", he continued. "We wanted a collector that would take average, not just single, spectrums, trend overall values, and collect overall values of velocity and ball bearing spike energy".

"Average spectrums were important because they allow us to reduce the level of noise in the signal and reduce or eliminate interfering random peaks. This is particularly important when we are taking a baseline spectrum on a normally operating machine. If a machine is obviously in bad shape, the signal peaks will really stand out, and the interference is not a problem; however, the vibration signals of a normally operating machine are much lower, and signal noise can make a major difference".

"We also feel that it is an advantage to have this averaged spectrum available when we take a reading on a machine. In that way, if there is a serious problem, the operator usually does not have to restart the machine to provide the additional measurements needed to diagnose the problem. In that sense, the unit provides a valuable source of troubleshooting information".

When they first started the hand-logging program, they monitored process pumps from 5 HP up to 200 HP. As they developed a larger database, they expanded the monitoring to include lube pumps, rotary gear pumps, reciprocating pumps and gear boxes.

"We wanted to get the entire plant onto the system, but we realized that it was important to start small and build the credibility and cost justification carefully", he added. "During the first year we collected the data to show our management that it was definitely worthwhile to expand the program. After that, our plan was to select a plant area, train the people, get the program running well, then go on to the next area. It took about a year for us to cover most of the areas in refinery".

"We also decided to have our operators take the measurements, which is a little different than other plants. Our operators are not normally skilled in vibration analysis, but they are directly responsible for their immediate production area and the vibration information helps them become more aware of the performance of their equipment and in control of the process. If they find a machine problem, they have the authority to immediately switch the process to a spare, so we eliminate the need for a maintenance person to go out into the plant and convince the operator that there is a problem".

"Our operators were, for the most part, not experienced in taking technical measurements with instruments, so one of our initial concerns was to make sure that we got good measurements and valid data, and that the process of data collection was simple and easy to understand. We developed a one-day training program that shows the operator how to use the data logger, interface the system with a computer, load and unload data, and take readings. None of the operators has had any difficulty with the data logger, so our experience indicates that learning how to use the system has turned out to be a non-problem".

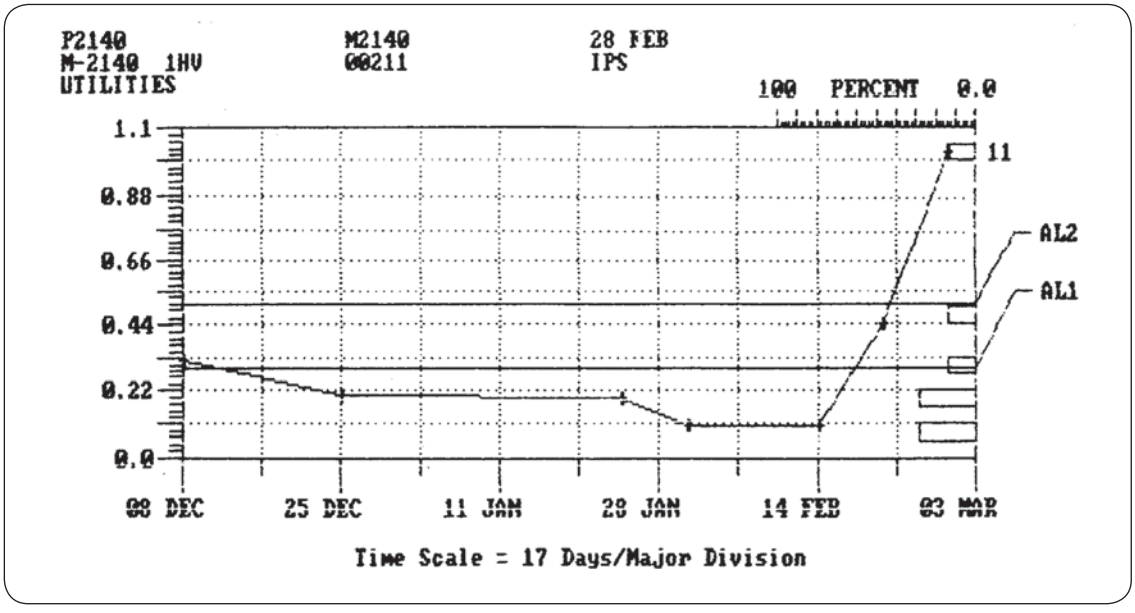

Fig. 2. This pump started to develop a bearing problem that was identified; however, the spare was being serviced, so they had to continue operating it, even though the readings exceeded the first alarm limit.

"A more important concern has been getting repeatable data, particularly since we have so many different people taking measurements, and sometimes we have a wider variation and standard deviation on day-to-day measurements than we would have if there was only one person taking the readings. One way that we have tried to overcome this is to prominently mark the measurement points, drill a hole at that location to insert the stinger into, and show them the amount of pressure to put on the probe".

"This additional preparation, plus the increasing experience of each operator, seems to have eliminated a lot of the early problems we had with data repeatability and reliability".

"Actually, the entire process has been steadily improving over the past two years", he continued. "We have installed oil-mist systems on many of the machines to improve reliability, and we are now using reverse indicator alignment on our pumps and machine trains. We have improved our training programs, and we are more careful not to install problems when we repair or replace a machine".

"Improvements in the SKF Condition Monitoring system have increased its speed for taking and analyzing data, the operating instructions are simpler and faster, and our need for product support from them has greatly diminished".

"We have two more plants within the refinery to get on the program, and we are going to take a little different approach with them. Instead of handling all of the installation and training from our group, we are going to identify the key people in those operating units and have them do a lot of the program development and training themselves. Each of these steps is part of a continuing development that is allowing the program to run more efficiently".

"The best advise for someone considering predictive maintenance is to invest in a system and start using it", he concluded. "For less than $25 000, you can purchase the data logger, software and a small PC. Start with a minimum of 25 machines in areas where you know there are problems, develop one or two routes and schedule measurements twice a month at first. That level of commitment will require one or two man-days per week, and it will allow you to build a database relatively quickly. If your plant is not doing any periodic machine condition monitoring, it is almost guaranteed that you will quickly identify enough potential cost savings to convince management to expand the program".

"From my experience, however, it is important to start small and increase the size of the program slowly. You will save the plant some money, but you will also make some mistakes, so give your program the time to develop properly. There is one advantage to working with balance-of-plant equipment, and that is if you make a mistake, you are not going to affect a critical machine. There will be situations where the instruments tell you to shut down a machine, and there really is not a problem, and you may identify problems so early in the process that they will not need immediate attention".

"We have also found it very important to follow up on a problem after the machine has been repaired and we will cut up the bearing or part and show them where the damage was. We will also show them the few cases where there was not any damage and, more often than not, that has improved our credibility with the operating people".

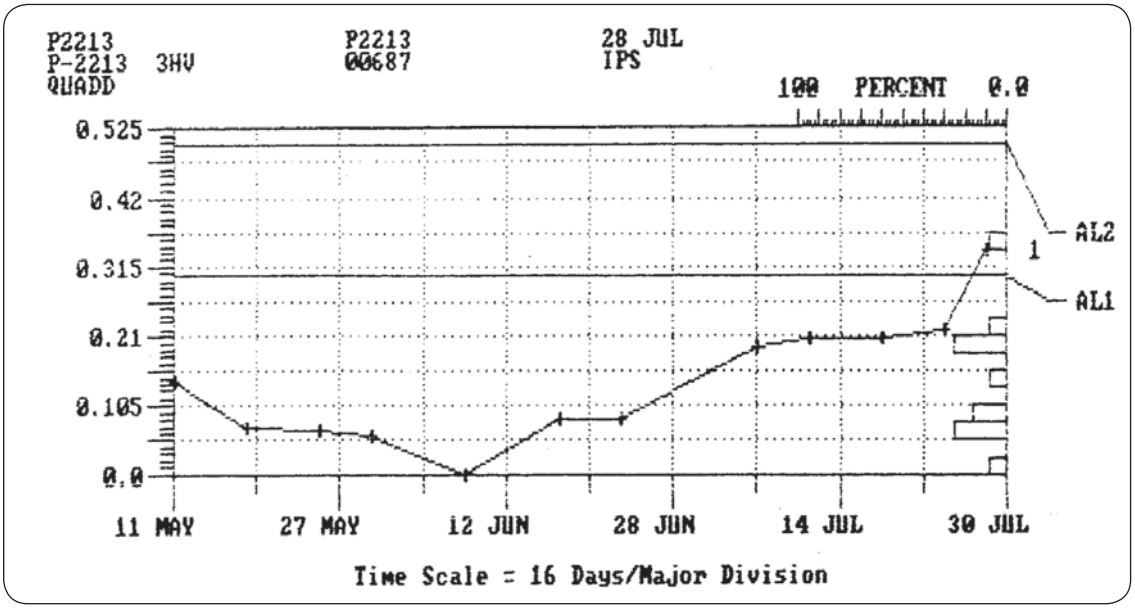

Fig. 3. A typical vibration spectra of a process pump, showing the gradual increase in signal level until it exceeds the first alarm limit and it is scheduled for maintenance.

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