USER EXPERIENCE WITH PORTABLE DATA TERMINALS IN A MACHINERY MONITORING PROGRAM

by

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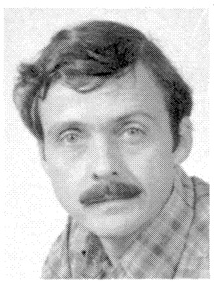

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INTRODUCTION

A description is presented from a user's viewpoint, of a vibration monitoring program using a portable data terminal (PDT) system. A brief description of these systems is given, followed by an explanation of what they can and cannot do, and then certain key details of the program are discussed. Finally, shortcomings and possible future advancements are reviewed.

DESCRIPTION

Vibration monitoring of rotating equipment is not the topic of this discussion. There are many articles and books in the literature that describe the theoretical and practical aspects of vibration monitoring, and there are even some recent papers about the technical aspects of vibration monitoring using the PDT devices [1, 2, 3]. There are many instruments on the market today to measure vibration. Some are for permanently installed installations, and these can be purchased to measure displacement, velocity, or acceleration. Permanently installed systems, especially when combined with computerized data collection systems, are the most efficient and effective methods of monitoring vibration (and thus the general health) of rotating equipment. However, the cost of installing such systems has restricted their use to larger machinery trains where the outage costs are significant and easily measurable, and where the cost for such permanent systems can be readily justified. However, cost justification for permanent systems is not available for the many items of "general purpose" equipment—the pumps, motors, turbines, gears, fans, etc., that make up the majority of rotating equipment in any petrochemical plant. For this equipment there are many "portable" instruments on the market that can be used for vibration monitoring. Until about three years ago, these monitoring devices were usually velocity probes with a portable monitor, some of which could also do spectrum analysis. Any of these devices can, and have, been used in predictive maintenance vibration monitoring programs. Unfortunately, as many users have found out, these types of programs sometimes miss identifying deteriorating bearings due to either lack of tending, infrequent monitoring, or possibly not monitoring the correct parameters. In addition, these "manual" programs are usually very manpower intensive. Still, many users have been able to justify such programs based on real savings. Others have found it hard to justify these programs, especially during difficult economic times when there is a push to reduce manpower at all levels.

The portable data terminal is a device that can solve many of the problems associated with the older systems. A PDT system basically consists of three pieces: the PDT box with its associated probe, a personal computer (PC), and software to operate the system. The PDT is, essentially, a portable computer that is first connected, via a wire, to the PC and "downloaded" with a program that defines what data are to be collected. The PDT is then carried to the equipment to be monitored where a vibration probe (usually an accelerometer) that is connected to the PDT is briefly attached to the equipment. The PDT then acts as a vibration monitor, and at the appropriate command from the operator, will digitize the signal and store it in memory. After all data are collected the PDT is carried back to the PC where it is reconnected and the data stored in the PDT memory are "uploaded" to the PC. A program is then run on the PC that stores the data in appropriate computer files for future reference. Since the data are now in the computer, other programs can be run to manipulate these data. For example, overall vibration levels can be compared against preset "alarm" levels and flagged, the data can be trended *vs* time or crosstrended against other parameters, spectrum plots (if collected) can be recalled and reviewed, etc. The extent or amount of analyses is usually not limited by the instrument (although no doubt some PDTs and software packages are more powerful and user friendly than others), but instead are limited only by the amount of time and the expertise of the user.

WHAT A PDT SYSTEM CAN DO

Any of the PDT systems available on the market today, if properly applied, can be expected to do certain things:

• *Again, the details of vibration analysis as a predictive maintenance tool are not the subject of this paper, since it is so well documented in the open literature.* The only thing different in the approach with a PDT system is that the PDT can be more effective in measuring and collecting the data, and that the PC can be more effective in manipulating the data than any manual method.

• *Save money.* If the information available from any vibration monitoring program is accurate and used in a timely manner then real money savings can be obtained.

Justification. The potential savings in maintenance costs alone, not considering operations affects, can be used to justify a PDT system. For example:

System Cost:	PC with peripherals	=	$10,000
	PDT	=	$10,000
	Software Package	=	$10,000
	Technician	=	$45,000*
	Total	=	$75,000

*Assumes $30,000 salary plus 50% for benefits. Note this is the only recurring cost per year.

Maintenance Savings: Assume $3,000 per pump repair (a typical number today that does not include all company overhead and burden), and assume that the PDT program will reduce the cost of two failures per month by one third by catching deteriorating bearings before a major wreck occurs. Also assume that two complete failures per month will be avoided by detecting operating conditions that could cause a failure. These savings can be considered minimum for a program monitoring about 500 pump-driver sets, and can certainly be adjusted upward based on local plant experience.

Savings:	Reduce Repair Costs	=	$24,000*
	Reduce Failures	=	$72,000*
	Total	=	$96,000*

*Yearly numbers

The user can assume a five year project life, and apply whatever financial analysis his company employs to check the return on investment. Unless there are other restraints (such as company opposition to increasing manpower), a vibration monitoring program can thus usually be justified.

• *Minimize manpower and hardware systems*. As mentioned, many user companies have instituted vibration monitoring programs using older, rather basic, equipment. Some of these systems rely on manual logging of data with either no tending or manual paper plotting of values. Some also do spectrum analysis, plotting the data on either paper or cards. Some users even tape record the vibration signals in the field and then analyze and plot the data back in the office. Obviously, however time consuming these programs may be, these users have been able to justify the programs due to either measurable savings (e. g., reduced maintenance costs) and/or intangible savings (e. g., reduced operational outages).

Justification. A user with an existing "manual" vibration monitoring program could possibly justify switching over to a PDT based system on the strength of potential time savings alone. This time savings could be used to either reduce manpower or expand the monitoring program (e. g., increased frequency of monitoring, increased numbers of items monitored, expanded types of vibration analysis, etc.), For example, the following data from two actual plants that use two different makes of PDT systems can be compared with an existing manual system:

	Plant A	Plant B
Total No. of Points Monitored	5700*	4300*
Total No. of Pump-Driver Sets	470*	410*
Number of Full Time Personnel in Program	1	1
Frequency of Monitoring Each Pump Set	1×/ Week	1×/ Week

*Includes operating and spare equipment

The user who attempts to justify a PDT system based solely on additional monitoring may find that he cannot justify the hardware expense. However, the user should also be able to legitimately take credit for additional saves on equipment presently being monitored. This can be expected because other parameters besides the typical low frequency overall value can be easily measured. For example, some PDT systems can also monitor high frequency "spike energy" signals (5k-50k HZ range), some can alarm on amplitude at discrete frequencies (or frequency ranges), some can measure surface temperature data, some can be used to log other parameters (pressures, levels, flow readings from other instruments), etc. As mentioned, the amount of monitoring and the possibilities are endless.

WHAT A PDT SYSTEM CANNOT DO

There are certain things that a PDT monitoring program, even one using the "best" equipment and the "best" personnel, cannot be expected to perform. Some of these even apply to any other vibration monitoring program.

• *Detect every bearing distress condition before catastrophic failure*. Many papers have been written about what vibration monitoring can do. What people tend to forget is that to detect a bearing problem, first measure the vibration. This sounds pretty basic, but the frequency of monitoring is a very crucial aspect. If we were all working in "perfect" plants where the only bearing failures were wearouts, life would be very easy and we could probably only monitor once per month or quarter. Likewise, people also tend to forget that too many bearing failures happen during the first eight hours of installation, due to either incorrect bearing fits, bad bearings, or misoperation (e. g., inadequate oil supply, severe misalignment, etc.) Again, if vibration monitoring is not done at the right time, it may not be possible to detect these problems in time to prevent a failure.

• *Detect mechanical seal distress*. This, too, may sound basic to anyone who is familiar with rotating equipment. However, too often in our rush to buy into the latest technology we miss seeing the forest for the trees. Any plant that desires to lower their maintenance costs should first identify just where their money is being spent. This implies that accurate failure records should be kept, hopefully in a computerized data base that will allow sorting by any parameter. The point here is that if one were allowed to make only one change and had the $75,000 available that could buy a PDT system for one year, he might be better off by identifying one "bad actor" pump that is causing considerable maintenance expenditures and devote this money to solving that one problem. This may sound sacrilegious to those who firmly believe in vibration analysis, but by looking at actual maintenance costs and return on investment the reviewer will find this is true all too often. This is not to say that a PDT (or any) vibration monitoring program is not beneficial or cost effective, but simply that it must be made a *part* of the total effort to reduce costs and increase reliability. Management should not be told that a PDT system will solve all of the problems—if they are then the program will surely be unable to fulfill its promise and may die a slow death when people lose confidence in the capability of the system to solve all of the plant problems.

• *Replace common sense and experience as the best method of monitoring equipment*. The absolute best "tool" for determining the condition of a piece of equipment is a trained, experienced, knowledgeable person. A PDT system *cannot* and *should not* be expected to replace someone who has operated or maintained a piece of equipment for 10 to 20 years and who knows all of its special quirks and operating conditions. Unfortunately, especially in recent years when companies thought they could save money by offering early retirements, we have lost many of these experienced people.

There are certainly instances when vibration analysis will be able to detect problems that a human's senses cannot detect, but in terms of overall effectiveness in keeping equipment operating safely a well trained and devoted operator or mechanic cannot be surpassed.

SPECIFIC DETAILS OF A PDT MONITORING PROGRAM

Many people who are interested in setting up a PDT monitoring program are immediately concerned about what brand or model of system they should purchase. Unfortunately, this discussion cannot give details that make this choice easier. Each user should first become familiar with the dozen or so models on the market today by gathering all available specification sheets, comparing details, and then narrowing the selection down to three or four vendors. Those salesmen should then be allowed to demonstrate, in person and with actual hardware and software, their systems in your plant by actually setting up a data base and collecting data and then reviewing the results. This will usually result in the user being able to further narrow the choice to two brands, and can then obtain specific names and phone numbers of other users from the salesmen. Ideally, about five users per model should be contacted to ensure that a balanced cross-section of opinion is obtained. The only advice this author can give is that any potential purchaser should look for the most versatile system he can purchase and not be worried about the price—the few thousand dollars extra needed to purchase an important feature can end up saving many times that amount during the life of the system, and can usually be accommodated in the justification. It is also extremely important for the potential buyer to carefully evaluate both the hardware *and the software*—the software is just as important to the system as the box, and can make the difference between being extremely pleased with the system or being frustrated every time he uses it.

After a purchase decision has been made, the real work begins. The user should now decide how he is going to handle the six major areas listed below. If any of these are ignored then either the monitoring program will not be as successful as it could be, or considerable time will be wasted going back to resolve these areas after the program is initially set up for the user.

Personnel

There are at least three different jobs involved with a PDT program—a PC and database manager, a data taker, and a vibration analyst. Ideally, these three tasks will be performed by one person, but that is not necessary if one person cannot be found who can do all three jobs.

The PC and database manager is the one who sets up the PC hardware, and who is familiar with the operating system (usually DOS). This person can also handle loading the program and doing updates as they come along. A very important task is handling the database backup system. This user believes that if one were to depend on only a hard disc to save data, without any backup, one will be shocked one day when all of his history is lost due to a computer problem that ruins all of the files. Backups should be made consistently, say every Friday, and can be done with floppy discs, tapes, or removable cartridges. The PC manager can decide how this is to be done, and this decision should be made when the PDT system scope is being developed, since it affects the cost of the computer hardware.

The data taker is the person who would actually collect the vibration/process data in the field. He should understand the importance of consistently taking data at the same location, and in the same manner. He should also be familiar enough with the equipment being monitored to recognize unusual conditions that may affect the data being taken, e. g., pump cavitation, a squealing bearing, a leaking seal, a cracked or loose bearing housing or foot, etc.

The vibration analyst is one who reviews the data after it is loaded into the PC files, and who decides what is of interest and might require followup work. He usually also decides what the alarm levels are and exactly what data are collected. He usually makes the call on which pieces of equipment need more work, e. g., more analysis or monitoring, a bearing replacement, a change in operating conditions, etc.

It is more time and manpower effective if these tasks can be performed by the same person. Many times, companies separate these tasks, believing that it is not effective to have a highly trained vibration analyst taking data in the field. However, the experience of having seen, heard, and touched the equipment while taking the data can greatly help in detecting problems. Also, some PDT boxes allow the data taker to see the overall and spectrum data just as they are being taken. This leads to vibration analysis actually being performed at the same time, greatly enhancing the effectiveness of the system.

It should also be noted here that some users have found that a PDT monitoring program is effective just because it makes people spend time in the field doing nothing but looking at the equipment. Some people even claim that the PDT just becomes a good excuse to get someone out into the field looking for problems. Quite often, visual checks can indeed lead to big savings, e. g., finding a bearing sump out of oil or a leaking seal.

If the user decides that the data taker and analyst jobs are to be separated, he usually assigns less trained and less experienced personnel to the data taker function. If this happens, special caution must be taken to ensure that good data are actually being collected. For example, the specific points on the machinery can be marked with a punch and/or paint, or permanent clip-on type adapters can be installed (a fairly expensive and time-consuming job in itself.) The idea here is to simply eliminate any possibility or question of bad data being collected. Just as with any computer system, the old phrase of "garbage in, garbage out" applies.

Data Points

In advance of setting up the database, the vibration analyst needs to decide on exactly what data are going to be collected. This decision could be based on the type of data presently being collected, or can be based on other users' experience. Some decisions that need to be made are: How many vibration points per bearing should be taken, e. g., do you want one point or X and Y and axial? Should you collect only low frequency data (say to 10× operating speed) or should you also collect high frequency data (say 5k to 50k HZ) if the PDT is capable of capturing this data? Should you collect frequency spectra every time, only at set time intervals, or only when overall levels are exceeded? As a guideline only, and certainly not intended to be proposed as the optimum method, the author can advise how his plant's system is presently arranged. We collect X and Y on every accessible bearing and one axial per machine. The PDT we happen to use requires a separate point for the high frequency data, so we also collect this on one location for each bearing. We have found that quite often the overall high frequency signal indicates bearing distress far in advance of the low frequency overall signal, or change in the low frequency spectrum. Sometimes, however, we have seen a change in the overall high frequency signal that did not signify actual bearing distress, but was apparently from another source, e. g., cavitation or fluid noise. For a typical two-bearing machine, we collect seven data points—two horizontal, two vertical, two high frequency, and one axial. We have overall alarms set in the software, and our PDT lets the data taker view the previous value taken plus the current value and alarm value. The PDT data taker can thus decide for himself when he wants to collect spectrum data—he can base this on exceeding the preset overall level, on a change since the last reading (even though an alarm was not exceeded), or just on a feeling that something is amiss (an audible noise, or just knowing that he is dealing with a problem piece of equipment). This may sound like a lot of data to some people, and we certainly do not propose that what we do is the optimum. Frankly, we do not know what the optimum amount of data is, but would rather have too much data than be caught at a decision making point and find out that a crucial piece of data is missing. Maybe someday enough history will be collected to tell all of us just exactly what we should do. The user must make up his mind before setting up the database, or much time will be wasted going back to correct his first guess.

There is one other interesting aspect of monitoring that should also be considered. Some of the more advanced PDT systems on the market allow the user to enter and save data other than vibration. This can be extremely useful in analyzing the effect of operating parameters on vibration, and thus, ultimately, on bearing and seal life. For example, one could build points in the data base for speed, flow, suction vessel level, temperature, etc., in addition to vibration points, and the software could then allow the user to plot any of these parameters against time. Although this author has yet to see it done, it is easy to visualize that any two parameters could be cross plotted by the software to determine cause and effect. Usually, this kind of detailed analysis is reserved for problem pieces of equipment, and is used to determine the *cause* of vibration. Many times a recurring vibration problem is caused by fluctuating operating conditions and unless applicable data are collected the vibration will continue to be a mystery. Much time can be wasted chasing possible mechanical effects (lubrication, alignment) that are not the root cause of the problem.

Paper Route

After the initial decision has been made on the type of data to be collected, it is time to develop a paper route. It would be beneficial if the vibration analyst and the data taker developed this together. They first decide how the plant is going to be split up into sections, or routes. Each section should consist of a manageable number of data points that can be collected in one continuous sweep, say three hours maximum time in the field. Sometimes the size of the section is limited by physical boundaries or by operating sections; e. g., the data taker may have to obtain a work permit to enter a unit so the route may be limited to the size of that unit. In fact, in our plant, most of our routes are set by operating units. Sometimes the maximum size of the sections is set by the PDT itself, i. e., the maximum memory that the PDT can store.

After the individual sections are selected, it is time to determine how the data taker is going to walk through each section to collect data. The data taker should decide the order in which each piece of equipment is going to have its data taken. It is usually of help if a standard procedure is followed, e. g., pump outboard, pump inboard, driver inboard, driver outboard, process data. *Note* that this sequence cannot be made out by sitting in an office—the actual physical constraints in the field must be seen. Quite often, any set standard procedure will have to be modified for some equipment due to inaccessible locations. As the route is being determined by actually walking through the section, the data taker should write down the sequence on paper. This can be abbreviated, e. g., we use POV, POH, POA, PIV, PIH, MIV, MIH, MOV, MOH, MOA to designate the points, where P is pump, M is motor, I is inboard, O is outboard, V is vertical, H is horizontal, and A is axial, and these designations are preceded by the tag number of the equipment, e. g., PIOOA-POV.

As the point sequence is being determined, it is also important to determine the exact location of the vibration sensor. Sometimes it may be helpful to paint or center punch the locations, or to use special decals (assuming they cannot come off easily). As mentioned before, it is of utmost importance that the points are positively identified, if there are to be multiple data takers for the same piece of equipment, or the data will be suspect.

Frequency of Monitoring

Some vibration data is better than none. As discussed earlier, continuous data collection is the extreme and probably cannot be justified based on today's costs. The PDT approach is an attempt to find a middle ground, but the monitoring frequency decision must still be made by the user, or it may be made for him by other constraints. This user does not believe that monthly monitoring is adequate for the majority of pumps in a petrochemical plant environment, where process and people changes tend to impose fluctuating conditions on the equipment. In fact, *weekly monitoring* (which we are attempting to do now) may not be enough. Our limitation, as can be expected, is set by how much equipment we intend to monitor and by the number of people we have to take data. We can take three routes of data daily, which allows us to cover our 940 pieces of equipment (470 pump driver sets, of which about half are operating) every week. In addition, we have some equipment that we are concerned about which requires extra monitoring and might get daily checks. This is one point in which multiple data takers would be of help. One analyst can check data obtained by multiple data takers. In our opinion, as many as four to six fulltime data takers can work with one fulltime analyst if the data base is set up to optimize the capabilities of the available software.

Data Review

The last sentence leads into another important area—how the data that has been collected is going to be reviewed. We have many pump sets on which we have been collecting data weekly for more than one year and have yet to look at any of the data! We also have some pumps for which we collect multiple vibration spectra daily or weekly and look at those immediately after the data is loaded into the computer. The amount of analysis is directly related to the number of problems we have with that piece of equipment.

When initially setting up a database, the user will usually set overall vibration level alarms at some nominal values, say 0.3 and 0.5 ips for "alert" and "danger" alarms. These values will probably be good for 90 percent of the equipment, and the rest will be set by experience. These alarms will be checked by the software after each set of data is uploaded into the computer. An exception report will usually be run to see which points exceeded these levels. Although this author has yet to see it implemented in any software, it could be helpful if percent change alarms could also be set. Many times a bearing can be severely distressed but because of the rotor loads, and may not vibrate excessively until just before it totally wrecks, e. g., journal bearings on a gear box.

In addition to reviewing the points that exceeded preset alarm levels, one may also want to review those points for which vibration spectra were also taken. Some PDT systems can be set up to collect spectra automatically when overall levels have exceeded the alarm levels. As mentioned earlier, some PDTs also let the data taker collect spectra at will, and if the data taker made the decision to collect the data, it might also be worth reviewing. He may have heard something unusual or have known of a special operating condition and so opted to collect the extra data. This is not to imply that we review every spectrum taken. We have some equipment that we are sensitive about, and which prompted us to issue standing instructions to take all spectra every time, even though overall levels have not changed.

Another reason to review the data is simply the curiosity of an individual, usually the data taker. Sometimes an operator, mechanic, technician, or engineer may also notice something that might make review of the vibration data useful.

"Review of the data" means simply to recall from the computer files everything about that equipment. All overall trends (amplitude vs. time) for all points on the train, recent vibration spectra (if available), and any other data (process info, phase data) should be included. Any change with time should be carefully investigated, as well as cross-effects between data. This is when powerful software is useful, and when a basic software package that only loads and unloads data becomes a burden rather than a help. The software should allow the user considerable freedom in *quickly* recalling and plotting data, should allow for overlay plots (multiple spectra on the same screen), and the spectra should be easily manipulated. The author believes that these are the weakest points in any of the software packages on the market today, but at the same time it is impressive how some vendors have improved their packages in the recent past. There must be many ways to improve the data review (e. g., windows), but one caution must be noted: Any smart software developer should learn what is important to the people using his package, or options may be developed that are useless and more important ones might be missed. The author has seen software packages on the market that were so slow that any user would find the product entirely useless. There will be definite differences in opinion between a computer programmer who knows nothing about vibration analysis and an experienced analyst, and unfortunately there have been some PDT systems marketed that only reflect a programmer's viewpoint.

The entire point about data review is that the vibration analyst should only spend time looking at those pieces of equipment that *need* to be looked at. The software should be smart enough to do the initial scan that immediately says that 90 percent of the equipment monitored is in acceptable condition. Time can then be spent appropriately. This alone is the biggest single selling point for PDT systems. Any manual system requires too much manual labor to do this checking.

After the data are reviewed the vibration analyst needs to make the decision about the next step—should he let the equipment operate as is and just continue the normal monitoring frequency; should he call for more frequent monitoring; should he go out and do more analysis; should he call for shutting down the equipment either now, or at the earliest convenience for quick alignment checks or for bearing replacements? This is when a PDT system cannot replace a knowledgeable individual (at least at the present state of so called "expert" systems). Some PDT vendors believe that the PDT system should only be used as an initial screening device to detect the equipment for which the analyst can then take out his spectrum analyzer, phase meter, etc., to truly analyze the problem. However, even at the present state of the art of sophisticated PDT systems, this is simply not a good use of the vibration analyst's time. The data taker could have collected almost all of the data the analyst needs; this should equip the analyst with enough information to make an intelligent decision without resorting to more field data collection.

Dissemination of the Results

Knowing that a bearing is in severe distress and may fail immediately, or that one is gradually wearing out and may fail in two weeks is only of academic interest, unless this information is put to proper use. The maintenance system in the plant must be able to effectively disseminate the information obtained by the monitoring program to appropriate operation and maintenance personnel who can then intelligently plan for equipment shutdown, operating condition changes, or other monitoring or analysis to be performed. Dissemination and acceptance-related problems can be the weak link in any monitoring program. The best system and personnel cannot be justified, if the maintenance and operating people do not believe the data, and refuse to use the information.

There are numerous ways (tricks) to get people to use the PDT system data, and we use many of them. One way is to have the maintenance department own the system. Thus it is not "Technical" or "Operations" telling them something, it is coming from their own people. Another is to have agreement with operations and/or maintenance that the PDT analyst can write work request/orders directly. Obviously, this implies that both analyst and system have gained credibility and trust.

Any monitoring system becomes cost-effective when people believe it is telling them the truth. And people start believing in the system when they see results. Too many "missed calls" can ruin confidence. This can be either by not catching a problem, or by calling for an outage and nothing being found wrong. This is bound to happen, and if it is not happening at all, the system is probably not used often enough.

One other item needs to be mentioned—publicity. Even a system that has become truly effective by overcoming all technical and people hurdles can die a slow death, if appropriate management personnel are not properly informed. Management information can become a very touchy issue. One thing that you do not want is a technical bulletin every time the system finds something. This over-publicity that only stresses the good side soon becomes tiring, and ends up looking too suspicious to be true. One method we use is a monthly summary memo (typically one page long), that briefly highlights how much data was collected, the work requests written, and the things found as a result of the work request. This memo becomes almost a standard form that the analyst issues. Figure 1 is an example from our plant. In addition, we may also write special memos about key, major results. These are typically written by the machinery engineer since they usually document much more than just the PDT system findings. To be believable, these memos should also document the cases when the PDT system did not properly predict a failure. For these cases, every effort should be made to determine just what went wrong so the mistake won't be repeated, or at least so people realize the limitations of the system.

This publicity can be useful in both maintaining continuing utilization of an existing system, and in developing credits for future expansion or change to a system. One interesting aspect of PDT monitoring is that it is a rapidly changing technology. Any system purchased today will surely be improved on in as little as one year. Most PDT vendors allow for some sort of free or nominal charge software update contract, but there are always hardware changes that they cannot give away. If you want to be sure that you can take advantage of these future developments, you should document the credits as they accrue for the system you now have. This can be a very easy task if you set up certain key functions, and let the people involved develop credits almost on a monthly basis.

SHORTCOMINGS/FUTURE ADVANCEMENTS

The author believes that the PDT approach is only an interim answer to the monitoring problem. A critical element that is not solved with the PDT approach is the frequency of monitoring. We have seen too many "quick" failures that could not be caught

Exxon Chemical Americas
Baytown Chemical Plant
Maintenance and Engineering Department
"Quality Service, Our Only Product"

N O T E G R A M

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JULY MICROLOG REPORT

Distribution:

This is the eighth Microlog Status Report.

Data Collected

- NRU - 4 each route (eight total).
- Col. 8/9, CT17 - 3 each route (three total).
- PFU - 3 each route (three total).
- LPU - 4 of 1 route, 3 of the other (seven total).
- PAU - 3 each route (six total).
- AXU - 2 each route (two total).
- IBU, WCU - 1 each route (one total).
- IAU - no route (downtime).
- HPU, CT70 - 1 each route (one total).
- PCU - 2 each route (six total).
- Total 37 routes taken.

Work Request Generated As A Result of Microlog

- NRU - MP2A - realignment and set magnetic center.
- LPU - P406B - bad pump bearings.
- LPU - MP216A - bad thrust bearings.
- PGU - P413 - bad bearings and leaking seal.
- PS121 - P17 - bad gearbox bearings.
- NRU - P2 - pump cavitation.

R. Bradford

RB/sho

Figure 1. Example of Monthly Summary Memo.

by monthly or even weekly monitoring. The most sensitive bearing issue is that of thrust bearing failures in hydrocarbon pumps with mechanical seals. Once the thrust bearing even starts to fail the rotor axial position is lost and the seals fail immediately. This too often leads to fires, explosions, and personnel injuries. The only effective method of dealing with these problems is continuous monitoring with automatic shutdown. Even with an excellent PDT program, we have gone to the extreme of installing a permanent acceleration monitor on one set of pumps that have a bad history of fires. This was a very expensive installation ($20,000), and thus, cannot be justified for all pumps. The author, however, believes that this problem is one that PDT technology will eventually solve, bringing down the cost of continuous monitoring to an acceptable level (say $500 per channel) with such reliable hardware and software systems that they can be put on automatic shutdown without too many risks of false trips. We are now at the state of the art with general purpose equipment where major machinery trains were 20 years ago. Some of us also expect that the advances in mini/micro computers, and the software for machinery monitoring, will actually result in much more powerful systems being put on GP equipment in the near future than we have on the big trains today.

As mentioned previously, the weak points of today's systems are mostly in the software. Many improvements could be made, e. g., cross-plotting of parameters, percentage change alarms. Of utmost importance is speed response and "user-friendliness" of the software. Without these even the most advanced analysis techniques will be useless.

CONCLUSION

Portable data terminal monitoring systems (PDTs) can be extremely useful in predicting equipment life, and thus can be used to reduce maintenance costs. However, for this to happen not only does the hardware and software have to function properly, but the user must know how to fit the system into a maintenance program, so it is allowed to do what it can do. The six areas listed above should be addressed before the PDT system is put into use to save time, money, and possibly even the entire PDT program in a plant.

REFERENCES

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