# Turnaround Strategies For Maintenance Departments

**Rao C. S.**


## ABSTRACT

*The maintenance scenario is very often dominated by breakdowns, backlog of jobs, low priority for quality of repairs, shortage of manpower and low level of planned maintenance.*

*The reason for this is lack of clarity on the role and job of maintenance which is primarily to detect, record and remove the defects in plant/equipment as per a plan and schedule ensuring high quality of repairs, whithout allowing defects to aggravate and accumulate.*

*The maintenance department finds it difficult to allot resources for the above planned maintenance activities because it is busy with Recurring breakdowns & Recurring repairs, Abnormal failures, Poor quality of repairs and Accumulation of defects. By eliminating these, the resources can be liberated and diverted to planned maintenance.*

*This paper describes how the above approach is being implemented to improve the reliability of PM I in the mechanical areas. The recurring breakdowns of felt roll bearings, Vacuum fans and jacuator nut of size press lead roll are brought under control so far. The next lot of recurring breakdowns are now under intensive attack.*

*The actions being taken on abnormal failures eg: corroded tie rod and MG gear box bearings are described. The approach adopted for ensuring quality of repairs is also explained.*

*The experience of last 9 months in developing better systems has given us encouragement in vigorously pursuing the Goals of - Zero breakdowns between planned shuts and Zero defects in plant and equipment.*


## NEED FOR TURNAROUND STRATEGIES

There is a definite need for turnaround strategies for a maintenance department that is under constant day-to-day pressure without any respite, busy mostly coping with failures and a heavy backlog of work.

They need it for the following reasons:

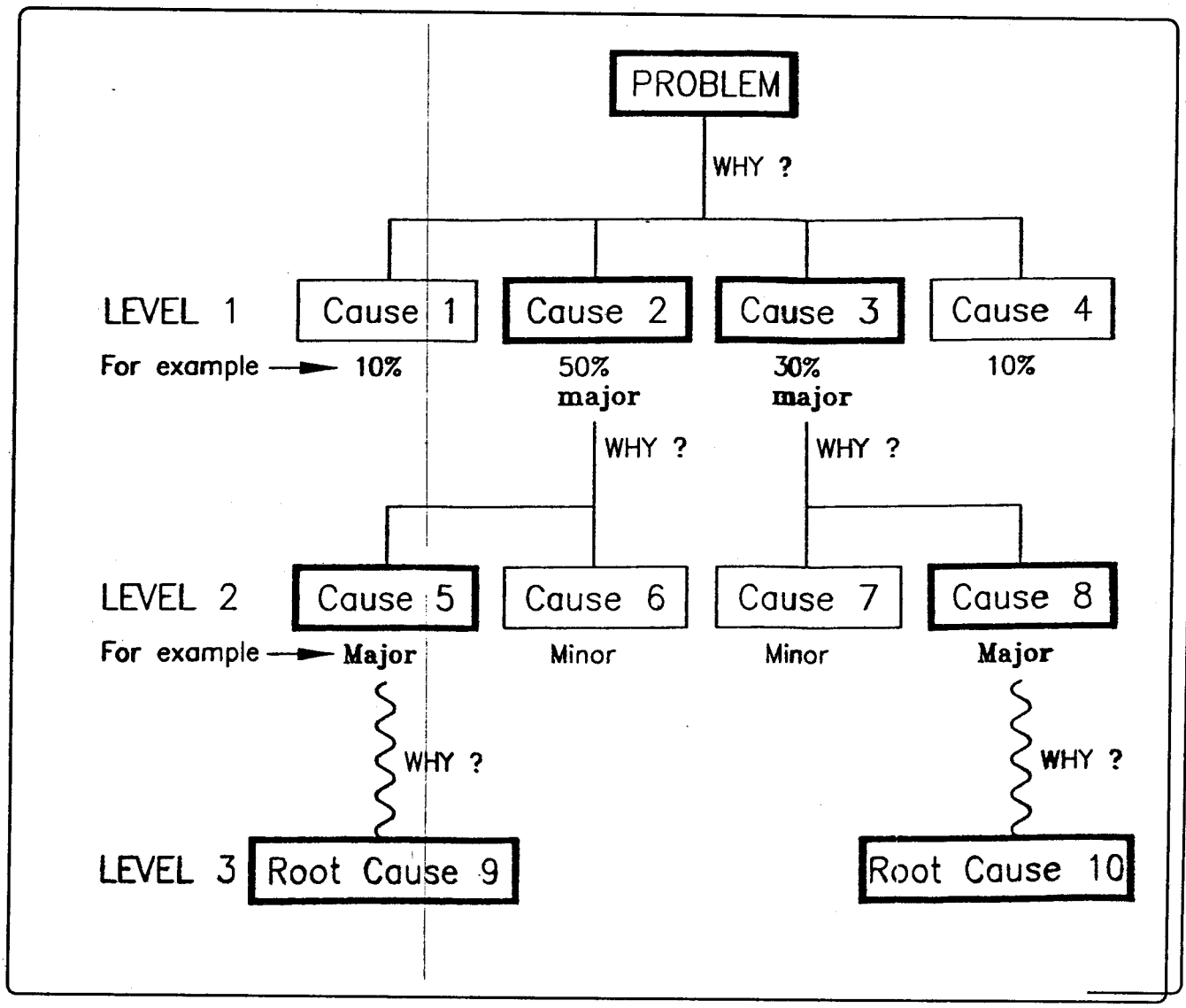
Short term — Help the maintenance to come out of a predominantly harassing situation.

Medium term — Breakdown oriented culture to be converted to planned maintenance culture.

**ITC Bhadrachalam Paperboards Ltd.**
**Village: Sarapaka - 507 128**
**Dist. Khammam (A.P.)**

## THE "WHY?" CHART FOR PROBLEM SOLVING

EXHIBIT 1




A. Define the problem. Clarify and quantify roughly.

B. Ask why the problem has arisen. What are all the likely causes.

C. List out likely causes. Clarify and roughly quantify the % contribution of each cause to the problem.

D. Select the major 2 causes. Ask why the causes 2 and 3 have arisen. What are their likely causes.

E. List out likely causes 5, 6, 7 and 8. Clarify and roughly evaluate their contribution to the major causes 2 and 3.

F. Ask for causes to major causes 5 and 8.

G List out likely root causes 9 and 10.

Elimination of root causes 9 and 10 will lead to significant reduction in the problem.

H. Repeat the process down to level 4 and 5 till convincing root cause (s) come out

Very often the solutions to problem become obvious at this stage.

**EXHIBIT -2**

**DEFECT LIST**

**DEPARTMENT : Paper M/c (Mech)**

**SECTION : PM-I** **As on 30 April 99**

| Sl. Nr. | Equipment Code No. & Descr. | Defect Description | R*/Y | Shut Reqd (Hrs) | Material Required | Manpower Required |
|---|---|---|---|---|---|---|
| 1. | Vacc. Fan Nr 8 | Sound from bearings | R | 3 | Shaft, Bearings | 2F+2K |
| 2. | PV Fan Nr 4 | Pulley worn out | R | 4 | Pulley | 2F+1K |
| 3. | TL TCC pump | Casing worn out | R | 8 | Casing | 2F+3K |
| 4. | TL SCC pump | Dely line collar Leaking | R | 4 | | Contractor-1F+ 1 K |

*** R-requires immediate planning for removal of defect.**
**Y- requires only close monitoring.**

**F - Fitter**
**K - Khalasi**

Long term — Provide a solid base for the maintenance function as reliable as the production function.

## DEFECTS MONITORING & REMOVAL

A machine or any other asset develop defects due to wear, corrosion, heat, contamination etc.

If defects are not promptly eliminated, they get aggravated and accumulated leading to risk of breakdown, product quality loss, safety risk and increased cost of maintenance.

**Defects are of two kinds**

- Affecting product quality (Process related defects)
- Affecting machine reliability (Engineering defects)

The elimination of process related defects gets automatic priority with strong support from top management as delay in their elimination leads to product defects and revenue loss in short term itself.

But the engineering defects which do not affect process in short term tend to be ignored, not even listed out fully. Moreover the feeling of ownership over the machines and other assets in generally diffused without role clarity between Process, Engineering and Top management for maintaining plant with Zero defects.

The hidden curse unique to the maintenance function is that the defects left in the machine at the end of each year (back log) get carried over to the subsequent years unlike backlog of production which gets washed off at the end of each year.

Focussing on defects and the factors leading to their generation will abort breakdowns which cause huge loss of revenue.

## ROLE OF MAINTENANCE

We can now conclude that the basic role of Maintenance function is to :

**" Continuously monitor and religiously remove the defects from plant and equipment, without allowing their aggravation or accumulation.**

**Ensure zero breakdown between planned shuts.**

**Make defects zero by end of month, end of quarter or at least by end of year.**

**Prevent generation of defects eliminating their root causes.**

**Restore the health of plant and equipment to the designed condition and be fully confident of their reliability.**

**Continuously reduce the cost of maintenance downtimes + materials + man hours + product rejections and complaints + all wastage due to equipment defects."**

How can this be done ?

By continuously detecting and recording the defects, planning for their removal with materials and men, scheduling the shutdown and carrying out repairs with high degree of QUALITY - with the ultimate aim of achieving ZERO DEFECTS.

For this purpose the proforma enclosed at Exhibit 2 can be used.

100% up to date defect detection, listing and reporting will put pressure on Maintenance, Process and Top management to evolve integrated and cost effective plans for production and defects removal. It will also build up pressure for selection of reliable equipment, their correct commissioning and good operation and maintenance practices that will generate least defects.

Unfortunately, unlike the process reuirements which get everybody's attention and support the maintenance requirements viz., cleaning and lubrication, physical inspection, condition monitoring, planning and scheduled repairs with high quality and corrective actions based on feedback, are not demanded by process or top management. For these to be fulfilled, maintenance has to generate pressure on itself which is highly improbable. Hence these basic maintenance reuirements tend to get neglected.

What is the lasting solution or system to counter this neglects, that would be insulated from changes in personnel in maintenance, process or top management? It is proposed that an independent group for "Inspection and condition monitoring (CM)" be made responsible for continuous detection of 100% defects, recording them and raising of repair work orders on maintenance just as marketing department locates the customer gets the order and raises the manufacturing advices on the process.

Having established the defects elimination system reliably, the role of the maintenance engineers should shift to defect prevention by - ensuring accountability for repair, design modification, correcting the wrong installation, train people for knowledge and skill, develop and enforce requisite systems and habits.

The next problem is how to organise for the above described system of tackling defects in totality when the existing people in maintenance are over busy fire fighting?

The answer to this is that the people are wasting their limited and precious resources on feeding enemies passively instead of kicking them out.

## ENEMIES OF GOOD MAINTENANCE

Who are these enemies ?

They are Recurring breakdown and

Recurring repairs

Abnormal occurences/failures

Poor quality of repairs

Accumulation of defects

How to kick out these enemies ?

- Target the top 3 Recurring breakdowns and Recurring repairs and eliminate their root causes - never to come again in future or to come with far less frequency. The "WHY" chart is a handy tool for analysing problems.
- Analyse every single abnormal failure and eliminate its root causes.
- Avoid poor quality of repairs by ensuring correct parts, feedback to correct people about failures and accountability for correct quality.
- Report the trend of backlog of defects to Maintenance, Process and Top management by two indices - shut hours backlog and man hours backlog.

As the above strategies get implemented, the breakdown fever will come down substantially thus liberating the resources for planned maintenance.

The following pages describe how we have adopted the above strategies and the results achieved so far:

## CASE STUDY OF MAINTENANCE IMPROVEMENT ITC BHADRACHALAM - THE PM-I EXPERIENCE

The approach and practices advocated in the previous pages of this article are being implemented in our Paper Machine-I and also other section of the Mill. Some of them are well established and some are in the initial stages.

A review of some practices and their effect on the trend of performance of Mechanical Maintenance is presented in this last section. The same principles are being implemented in other departments also.

### PREAMBLE

The PM-I is a combination machine of 180 TPD that produces uncoated board, absorbent kraft, tetrapack et. it has 5 Formers, one Fourdrinier wire, 3 Presses, 7 Dryer, Size press and 2 Cooling cylinders.

The Mechanical Maintenance department has been allotted a budget of 1.3% of the total hours of the month for breakdowns. In a 30 day month, the total hours are 30x24 = 720 and 1.3% of these are 9.3 hrs.

There is no practice of periodic, planned shutdown of the machine for the sake of Engineering Maintenance. Major shutdowns are decided on need basis. for example, the cracked end cover of one cooling cylinder was to be replaced for which the machine was stopped for 3 days in the year 1991 and many other major jobs were also done at that time.

In last 20 years of operation planned and unplanned stoppages were for 12 days excluding the stoppages for process maintenance needs.

The Engineering Maintenance needs of the machine have been met so far during the order changes when the machine is stopped for process maintenance jobs-cleaning machine, clothing, filters, chests etc and wire / felt / roll changes for budgeted hours of 2 hrs to 10 hrs depending on the jobs to be done.

During these shuts, nearly 50% manpower of the Mechanical Department is engaged in doing the process maintenance jobs cited above. Balance 50% of people are used for mechanical maintenance jobs. If more time is needed by Mechanical Department for longer jobs than the available shutdown, it is allowed and the extra hours are booked against their budget of 1.3%.

The yearly mechanical downtime percentages over last 20 years are given below.

| YEAR | DOWNTIME % | |
|---|---|---|
| 98-99 | 2.6 | |
| 97-98 | 1.7 | |
| 96-97 | 1.8 | |
| 95-96 | 1.9 | |
| 94-95 | 1.7 | |
| 93-94 | 1.6 | |
| 92-93 | 1.6 | |
| 91-92 | 1.6 | |
| 90-91 | 1.3 | |
| 89-90 | 2.8 | |
| 88-89 | 1.0 | |
| 87-88 | 1.0 | |
| 86-87 | 1.0 | |
| 85-86 | 2.6 | |
| 84-85 | 1.4 | |
| 83-84 | 1.2 | |
| 82-83 | 1.9 | |
| 81-82 | 0.9 | |
| 80-81 | 1.1 | |
| 79-80 | 3.0 | Machine commissioned. |

We can see a gradual increase from around 1-1.3% to 1.6% and continuing the upward trend.

### RECURRING BREAKDOWNS

As a first step in the improvement campaign started in Aug 98, the top 3 recurring breakdowns which contributed to maximum downtime in hours were selected for detailed analysis and corrective actions. These were - felt roll bearings, vacuum fans and size press lead roll.

| | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 97 | 97 | 97 | 97 | 97 | 98 | 98 | 98 | 98 | 98 | 98 | 98 |
| Hrs. | - | - | - | - | 9.0 | 2.5 | - | - | - | 1.5 | 1.5 | - |
| Freq. | - | - | - | - | 3 | 1 | - | - | - | 2 | 1 | - |

**Table-1 Frequency Failure for felt roll Bearings.**

| | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|---|---|---|---|---|---|---|---|---|---|
| | 98 | 98 | 98 | 98 | 98 | 99 | 99 | 99 | 99 |
| Downtime Hrs. : | 3.0 | 2.2 | - | - | - | - | - | 3.35 | - |
| Frequency : | 1 | 1 | - | - | - | - | - | 1 | - |

**Table-2 Down time Frequency Failure for felt roll Bearings.**

## FELT ROLL BEARING FAILURES (Total installed bearings are 344)

The downtime hours and frequency of failure in last 12 months from July 98 at which time the detailed review of these failures started are given in Table 1.

The bearing concerned is 22314 CCK C3 W33. On detailed investigations it was concluded that the Fitters were assembling the bearing and sleeve on journal without checking and ensuring that the reduction in clearance specified by SKF is achieved - they were only checking the final clearance to make it 0.03 mm. Immediate action was taken to explain to all of them that they should measure the initial clearance and ensure its reduction as per values given by SKF by checking with feeler gauge repeatedly while tightening the lock nut on the journal. A wall chart was also installed specifying the reduction in clearance for each dia. of shaft. Proper journal tolerance and shape was also ensured.

Additionally, frequent inspection was done by hand feeling and SPM readings and about 18 doubtful bearings were replaced during the order change stoppages of the machine avoiding breakdowns.

The breakdown due to withdrawal sleeve getting loose on shaft could not be detected by hand feeling or by SPM. Since last 3 months, they are being covered by vibration analysis which indicates sleeve looseness well in advance.

The results of subsequent 9 months are given on Table 2.

The failure in March 99 was due to human lapse of oilman who did not grease the bearing inspite of clear instructions. Even this could have been avoided had SPM reading been taken soon after start up as per agreed practice.

The department has a high level of confidence in avoiding failures of these bearings hereafter.

## FORMER VACUUM FANS

**(Installed Quantity : 4 of Double Impeller)**

The downtime hrs due to breakdowns of above vacuum fans and frequency were as follows from Aug 97 to July 98 and given in Table 3.

Detailed analysis of failures showed that many were due to failure of fan shafts which are driven by V-belts and failure of belts. It was also seen that many fans were overdesigned for the current product

| | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 97 | 97 | 97 | 97 | 97 | 98 | 98 | 98 | 98 | 98 | 98 | 98 |
| Hrs. | - | 2.0 | - | 2.0 | - | 0.5 | - | 0.5 | 1.0 | - | - | 0.25 |
| Freq. | - | 4 | - | 1 | - | 1 | - | 2 | 3 | - | - | 1 |

**Table-3 Frequency Failure for former fvacuum fans.**

| | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|---|---|---|---|---|---|---|---|---|---|
| | 98 | 98 | 98 | 98 | 98 | 99 | 99 | 99 | 99 |
| Downtime Hrs. : | 1.0 | 4.5 | 4.25 | 2.5 | - | - | - | - | - |
| Frequency : | 1 | 1 | 1 | 1 | - | - | - | 1 | - |

**Table-4 Frequency Failure for former vaccum fans.**

range and running with significant throttling of dampers resulting in wastage of power.

After a study of air flow requirements, it was concluded that the speeds can be significantly reduced-from 4300 RPM to 2900 RPM in which case the fan shaft can be directly coupled to motor shaft avoiding V-belt drive.

The new shafts and new bases for all fans were made and progressively installed by Nov 98. There has been no breakdown in these fans thereafter as can be seen from following.data shown in Table 4.

## SIZE PRESS LEAD ROLL

The supporting arms of the lead roll were jammed at their fulcrum pins due to lack of lubrication provision leading to frequent failure of the jactuator nuts.

From Aug. 97 to July 98 the downtime hours were 5.5 and frequency was 5.

Continuous attempts were made during each order change shut and both the arms were made free by Jan. 99. Thereafter there has been no breakdown as periodic lubrication is being done to these pins from the end faces of pins. A major modification to the pins is to be made so that grease can be injected into the middle of the pin and spread over the full contact area as a permanent solution to the problem.

## OTHER RECURRING BREAKDOWNS

The next lot of such recurring breakdowns now being attacked are:

| | April 98 – Mar 99 | |
|---|---|---|
| | **Downtime** | **Frequency** |
| Vacuum pumps (Total - 13 pumps) | 9 hrs. | 6 |
| Reel secondary arm causing creasing of board during roll change. (Downtime booked equal to product rejections) | 8.5 hrs | 10 |
| Pumps - Stock and backwater (Total - 45) | 9 hrs | 15 |

**Vacuum pumps :** All of them overdue for overhauling requiring complete descaling of inner surfaces and removal of heavy deposits from the water separators which were causing loss of vacuum at the machine.

All pumps and water separators are being cleaned to remove accumulated deposits and overhauling/replacement being takn up one at a time.

**Secondary arm :** The worn out rails have been replaced. The spool rolls are found to be in bad condition with the hubs disturbed in the shells causing difference in center distance in relation to the rails. They are now taken up for reconditioning which will take nearly another 6-8 months (8 spool rolls to be conditioned one at a time).

**Pumps :** The causes for breakdowns were identified mostly as incorrect components/ assembly of the spare rotors. Detailed check list cum inspection record is being maintained leading to better discipline in the technicians. It may take another 6-9 months to show results as old habits change slowly.

## RECURRING OFF-MACHINE REPAIRS

The main cause for the overbusyness of the available manpower is the recurring repairs of some assemblies. When these are analysed and the optimum life for them is realised, the backlog of jobs in the department would come down and men can be diverted to planned maintenance. Centrifugal pumps being a

large population, they were targeted for maintenance reduction.

### Overhauling of pump rotors (stock and backwater - Total 45 pumps)

This is a perennial activity. A rotor is changed during opportunity shuts mostly on indications of-high SPM reading indicating damaged bearing and worn out sleeve leading to chronic gland leak. These two are in fact interrelated-heavy gland leak leads to bearing damages.

It was observed by trials based on the OEM manuals, that the bearing and sleeve life can be significantly improved if the pressure of gland sealing water in the lantern ring zone could be maintained about 1kg/cm$^2$ higher than the casing pressure for stock and backwater pumps which are not sensitive to entry of clear water into the medium. Somehow the practice of leaving the outlet hole of the sealing water open allowing the water to flow out freely was prevalent for a long time causing low pressure of sealing water and heavy wear out of sleeve. A special campaign was launched in all areas to permanently plug the outlet hole so that the lantern ring zone would get pressurised to the process water header pressure of about 3-3.5 kg/cm$^2$ which is enough for most of the stock and backwater pumps.

Another action taken was to change the material specification in the drawing for the sleeve from existing SS 316 to SS 410 hardened to 40-45 RC.

The pressurisation of seal water has led to remarkable improvement of sleeve life and gland packing life as seen below in sleeve consumption in some of the pump as well as saving of manhours spent in gland packing replacement and overhauling of rotors.

| Type of pump | Installed Qty | Consumption of sleeves | | | |
|---|---|---|---|---|---|
| | | 95-96 | 96-97 | 97-98 | 98-99 |
| KIRL KPDI | 21* | 14 | 16 | 20 | 9 |
| UTMAL | 29 | 25 | 35 | 30 | 20 |

* During 98-99, 10 more pumps were added increasing the installed quantity to 31.

Further savings are expected when the hard sleeves are received and installed in all such pumps.

**Next targets for analysis are agitator assemblies, refiners and roll assemblies as they account for the bulk of manhours consumed in off machine repairs.**

## ABNORMAL OCCURANCES

Following cases of one-off major breakdowns have been analyed and remedial actions initiated.

**Tie Rod of 1st Fabric Stretcher :** The thick walled pipe used as tie rod had corroded badly and failed in running (Nov. 98) causing a downtime of 5 hrs. Detailed inspection of all such corroded components has been done and planned replacements are being made.

**MG Gear Box** The NDS bearing of the MG Gear box had failed 3 times in quick succession (Dec 98) causing a downtime of 14.50 hrs on a single day.

Several defects in the gear box assembly recently reconditioned were identified and corrected. Many weak points in the oil circulation system were identified after this breakdown.

Modifications to the piping to reduce pressure loss, oil level control pot modification, installation of sight glass flow indicator, installation of flow switch with interlock to MG drive, and interlock of MG drive to the oil pump have been completed.

One major lesson learnt from this breakdown was that any assembly should be checked thoroughly keeping the assembly and component drawings at the assembly spot. Otherwise serious errors may occur. Very often the lubrication systems thoughtfully provided by the manufacturer are not fully

understood and are disturbed leading to oil starvation of a bearing or some gears. This lesson is being implemented in other assembly operations.

## QUALITY OF REPAIRS

During the intense debates over every recurring breakdown and abnormal occurrence, several instances of premature failure of recently completed repairs come to light and attracted critical attention. Without much debate the team started the practice of using a check list cum assembly record to record the actual clearances etc. and the names of the Technicians and Engineer concerned.

Every premature failure is being traced to the individuals and team concerned and discussed in minute detail injecting a sense of accountability for each repair as well as improving the knowledge of making correct assembly.

All the Engineers and Technicians were advised not to hurry though the repairs without ensuring quality, for fear of incurring downtime against the budget of Mechanical Department. At no time the quality of repair should be sacrificed. This approach is slowly improving the quality of repairs and reduction of premature failures.

## PLANNED MAINTENANCE

Over last 8 months, the following concrete steps have been initiated and continued, to focus more towards planned maintenance on the lines suggested in previous pages.

## DEFECTS LISTING

The systematic practice of observing and listing out the defects in prescribed format has been started. It has been impressed on all Engineers that listing out 100% of the defects in machine is the First Step in Maintenance and the Maintenance Engineer who is not doing this has not even taken the first step in doing his job. He does not have the Foundation for his job.

Three different people are contributing to this process of defect observation, recording and reporting.

- The Engineers responsible for PM-I maintenance who carry out detailed inspections.

- The lubrication and condition monitoring Engineer who identifies

  - high SPM reading bearings
  - high vibration readings
  - Oil leakages
  - deterioration of lubricating oil quality with the help of patch test kit in the department and oil analysis by outside Lab including Wear Debris analysis.

- The 3 shift managers who observe the defects in their rounds

Vibration analysis has been started through an external agency since last 6 months. For the first time, the dryer gear casings have been assessed. Several cases of unsatisfactory vibration levels have been detected and actions being taken. The balancing machine available in the company is being used more as a result of these studies.

One recent major learning for the Engineering Department as a whole is about sludge and metal particles in lubricating and hydraulic oils. Specially in COL Systems and Hydraulic systems, the importance of oil cleanliness through correctly rated (12 micron) filters, centrifuging and regular testing of oils for wear debries and particle analysis has been realised. Actions have been taken to instal a dedicated centrifuge for the PM-I COL system and the existing filter rating of 100 micron is being reduced to 25 micron as a first step. We intend to put 12 micron filter elements finally. Breather plugs are being installed over the existing open vent pipes to reduce dust ingression into oil system along with the air breathed into the system leading to frequent jamming of filters.

The Engineer in-charge of the machine maintenance compiles all the defects and prepares for the removal of RED defects - arranging for materials, estimating the repair time, estimating the manpower required etc. He also receives the process job list and prepares as a whole for the next order change shut whose date is tentatively known 7-10 days in advance. He gets an excellent advantage from the exhaustive Defects List from which he targets the critical ones for elimination in the next shut.

There has been a major gain out of the serveral presentations made about the concepts of defect accumulation and the imperative of planned maintenance shuts delinked from order change shuts

to avoid accumulation and increasing backlog of defects. for the year 1999-2000 for the first time, a provision of 1% planned Engineering Shutdown Budget has been allocated which will be utilised by all the maintenance departments. The Engineering team is now fully enabled to monitor and improve machine health in a cost effective manner.

## TIME BASED REPLACEMENTS

Some of the components that failed suddenly in running, that may fail before next shut and whose condition can not be monitored with confidence, have been identified and time based replacement schedule prepared for them based on their average past life. They are being changed without waiting for any adverse indications as per schedule.

Examples are: Flat belts for vacuum pumps, rollers for dandy and doctor blades. These replacements also enter the planned shutdown job list.

## FEEDBACK ON REPAIRS

All premature failures of repairs are being traced to the Technicians and Engineers concerned and detailed discussions held to identify the causes. The weak spots in respect of knowledge, skill, attitude, systems, habits accountability and motivation are being strengthened (EXHIBIT-3).

## GROUP DISCUSSIONS AND CORRECTIVE ACTIONS

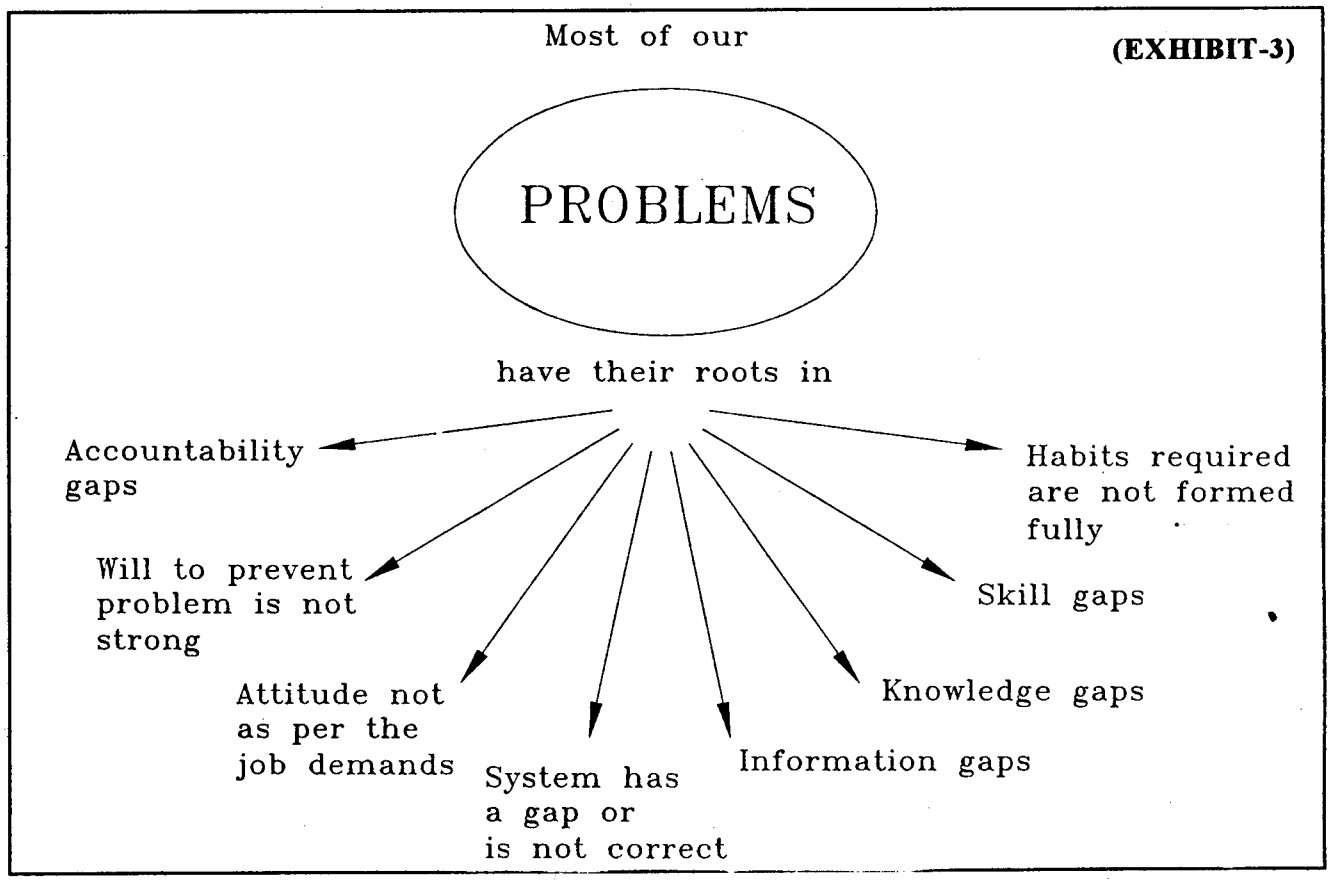
Monthly review of the latest problems are being held to discuss each breakdown upto its minute detail with the complete group of managers - the HOD, Area Engineer, Lubrication and Condition monitoring Engineer and the Planning Engineer. The causes identified and corrective actions decided are being minuted and circulated to all. The action plans are regularly reviewed.

## TRAINING AND CONSULTANCY

We realise that the knowledge and skill level of the needs to be substantially improved.

A begining has been made by engaging a consultancy group to visit and interact periodically focussing on specific bearing failures and working out remedial actions. Results will be known after about 6 months. When we are not able to make progress in solving any problem, we are seeking the advice

**(EXHIBIT-3)**



| | Apr. | May | June | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 99 | 99 | 99 | 99 | 99 |
| Down Time % | 0.4 | 2 | 2.7 | 5.5 | 2.5 | 2.3 | 1.6 | 4.3 | 3.0 | 1.9 | 1.8 | 3.6 | 1.7 |

**Table 5 Overall mechanical downtime.**

of experts to crack the problem in other areas also.

The training of Maintenance managers has been significantly enhanced leading to better knowledge of basics, exposure to new developments and exchange of experiences with their co-professionals from other organisations.

## RESULTS ACHIEVED SO FAR

## DOWNTIMES

Overall mechanical downtime has shown reduction in some months over the last 8 months as a result of above efforts as shown in Table 5.

Though the percentage in Apr 99 is the second lowest in last 12 months, we have to watch for 3-4 months more to gain enough confidence that the improved systems have set in and will continue to help in better control of downtimes.

## DEFECTS LIST

The system of recording defects in equipment has begun but needs lot more thorougness. This process is gaining strength as the Engineers are being advised that there is really no justification for any breakdowns between planned shuts as they are responsible for observing, recording, planning and removal of defects in a planned shut for which budgetary provision has been made. Atleast in mechanical systems, there cannot be a breakdown without a detectable defect in 90% of cases. Some of them are tasting the benefits of being aware and prepared for removal of defects with required materials.

The key to further progress now lies in making this system a part of the daily routine giving confidence and a sense of achievement to the maintenance team.

## RECURRING BREAKDOWNS

We can say with conviction that the Engineering team has developed the taste for analysing and eliminating recurring breakdowns and repairs. This would contribute a great deal towards sustaining the improvements and controlling the demand for more manpower which has a direct correlation to recurring breakdowns and recurring off machine repairs.

Our experience so far has given hope that the above illustrated approach and practices will progressively elevate the performance and cost effectiveness of the maintenance team.