

# EFFECTIVE MAINTENANCE PRACTICES FOR MINING EQUIPMENTS

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**Abstract:** Maintenance represents a significant proportion of the overall operating costs in the mining industry. Despite the large cost of maintenance, management has only given passing attention to the optimization of the maintenance process. As the engineering/mining equipment becomes sophisticated and expensive to produce and maintain, maintenance management has to face even more challenging situations to maintain effectively such equipments in industrial environment. This paper highlights the different types of maintenance practices: predictive, preventive, proactive, reactive being followed for mining machineries, maintenance models, TPM, Modular Mining Systems' INTELLIMINE1 for maintenance and focuses on proper maintenance planning for improving availability and utilization of machineries in surface and sub-surface mining operations.

## 1. Introduction

Maintenance of mining equipment can make up between 20 and 35 percent of the total mining operation. Utilizing a proper mining maintenance with a tight focus on optimizing scheduled maintenance operations can reduce these costs substantially by deferring non essential maintenance, reducing maintenance manpower and controlling spare part inventory as well as only using contract maintenance when it makes most sense.

Maintaining equipment in the field has been a challenging task since the beginning of industrial revolution. Since then, a significant of progress has been made to maintain equipment effectively in the field. As the engineering/mining equipment becomes sophisticated and expensive to produce and maintain, maintenance management has to face even more challenging situations to maintain effectively such equipments in industrial environment.

## 2. OBJECTIVES OF MAINTENANCE PROGRAM

- Maximising production or increasing facilities availability at the lowest cost and at the highest quality and safety standards.
- Reducing breakdowns and emergency shutdowns.
- Optimizing resources utilization.

## 3. TYPES OF MAINTENANCE PROGRAMS

Different types of maintenance (Fig.1) are being practiced in various parts of world. Adoption of particular Maintenance type greatly depends upon the resources of organization or company. One maintenance approach may cost less than other so each professional has to see the resources and then decide for "which maintenance type is best for his plant". It can be broadly classified as:

- ✚ **Reactive maintenance**
- ✚ **Preventive maintenance**
- ✚ **Predictive maintenance and**
- ✚ **Proactive maintenance.**

## 4. Total Productive Maintenance (TPM)

TPM consists of a range of methods known to improve reliability, quality and production. TPM seeks to develop a "maintenance-free" design, asking all employees to help improve maintenance productivity by stimulating their daily awareness (Nakajima 1988). In any industry, the performance of a company's main priorities needs to be measured by means of key performance indicators. Common parameters include total system/plant effectiveness, system/plant productivity, availability, cost efficiency and quality (Moubray 1997). TPM is in the upper part of the hierarchical asset

management pyramid shown below (Figure 4) since it involves both technical and human aspects. TPM is a good concept to use in mining because human factors play a significant role in the operation of a mine.

Yeoman and Millington (1997) list the five pillars (Figure 5) of TPM as:

- Increased equipment effectiveness
- Training
- Autonomous maintenance
- Early equipment management
- Planned preventive maintenance.

## **5. MAINTENANCE MODELS**

The various possible maintenance models:

### **5.1. CORRECTIVE MODEL**

### **5.2. CONDITIONAL MODEL**

### **5.3. SYSTEMATIC MODEL**

### **5.4. HIGH AVAILABILITY MAINTENANCE MODEL**

## **6. FOUR POINTS NEEDING ATTENTION IN MINING EQUIPMENT DAILY MAINTENANCE**

Mining machinery maintenance is the premise and basis of application. In the long-term use, mechanical parts may wear, clearance may increase, and matching configuration may change, so the due static balance and dynamic balance may be destroyed, resulting into decreasing stability, reliability and efficiency, which can even bring permanent damage to the assembly and parts. Therefore, we must establish an effective mining machinery management mechanism, especially intensifying mechanical equipment maintenance management, and strictly implement the rules and regulations. Combining the actual situation, we can work out the maintenance plan scientifically, efficiently and reasonably. A specially-assigned person should be responsible for the inspection, and carry out maintenance work on time according to the wearing conditions. Regular maintenance and a maintenance record should be kept.

## **7. MAINTENANCE PLANNING IN UNDERGROUND MINING OPERATIONS**

Underground mining operations, similar to many industrial enterprises, have long recognized the potential benefits of maintenance planning. However, underground mining operations' efforts to implement maintenance planning have generally met with little success. Most companies, upon the collapse of their maintenance planning, convince themselves that underground mining is so "unique" that to accurately plan, schedule and measure maintenance work is impractical.

## **8. CONCLUSIONS**

Maintenance can be measured and controlled just as other functions can, and its effectiveness can be improved in a systematic way with the proper planning. Initiating a maintenance planning system requires planning and effort. The maintenance organization must be properly staffed. Energetic and realistic management teams, willing to overcome the misconceptions about the impossibility of improving maintenance in underground mining operations, can achieve dramatic results when the effort is applied. Specific formalized monitoring systems must be embraced or the system of planned maintenance will deteriorate.

TPM is used in mining to eliminate waste by reducing or eliminating production time lost to machine failures. The goal of a TPM program is to ensure that fleets of mobile equipment and process lines are always available. By minimizing slow running equipment and downtime, maximum value is added at minimum cost. Management procedures must be aligned with TPM, based on autonomous maintenance, work groups and increased worker competence.

## REFERENCES

- Gandhi, O.P. Maintenance Management, ITMMEC, IIT Delhi,  
([www.iitr.ac.in/outreach/web/CIRCIS/sps2007/Maintenance%20Management.doc](http://www.iitr.ac.in/outreach/web/CIRCIS/sps2007/Maintenance%20Management.doc))  
<http://hvac-system-basics.blogspot.in/2012/08/basic-types-of-maintenance-programs.html>  
<http://www.jaw-breakers.com/W239.html>
- Michael W. Lewis, Luiz Steinberg, (2001) "Maintenance of mobile mine equipment in the information age",  
*Journal of Quality in Maintenance Engineering*, Vol. 7 Iss: 4, pp.264 - 274  
<http://confirm.pbbiblogs.com/2009/11/28/8-types-of-maintenance-a-comparison/>
- Kelly, Anthony, "Managing maintenance resources", Butterworth-Heinemann, 2006.
- Collacott, R.A., "Mechanical fault diagnosis", Chapman and Hall, 1977.
- Levitt Joel, "Handbook of maintenance management", Industrial Press, 1997.
- Wilson Alan, "Asset maintenance management", Industrial Press, 2002.
- Tery Wireman, "Developing performance indicators for maintenance", Industrial Press, 2005.
- Alguindigue, I (1998), "Fulfilling the promise of predictive maintenance", *Machine, Plant & Systems Monitor*,  
pp.24-6.
- Hamilton, C.O., Maintenance Planning in Underground Mining Operations, Performance Associates International,  
Inc. Tucson, Arizona. [www.maintenanceworld.com/.../Maintenance-Planning-Underground](http://www.maintenanceworld.com/.../Maintenance-Planning-Underground)
- A. Gustafson, H. Schunnesson, D. Galar, R. Mkemai, (2011), TPM Framework For Underground Mobile Mining  
Equipment; A Case Study, *Mpes, Almati*, October, 12-14, 865-879.

