

# Preventive Maintenance Procedures for Improving Plant Efficiency : A Review

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## ABSTRACT

The systematic approach of preventive maintenance is a plan which provides a positive course of action to remove the unwanted breakdown and unnecessary cost of repair or replacement by analyzing the previous five year components failure data of any plant. M.P. Wind farms limited's wind electric generators (WEGs). This paper proposed three types of scheduled maintenance programs namely quarterly, half yearly and yearly for In this report I have proposed three types of scheduled maintenance programme namely quarterly, half yearly and yearly. Activities involved in these schedules are based on previous break down history of M.P. Wind farms limited's wind electric generators. Activities involved in these schedules are based on previous break down history of M.P. Wind farms limited's wind electric generators.

**Keywords :** Preventive maintenance, M.P. Wind farms limited's wind electric generators

## I. INTRODUCTION

The main concern of any generating plant is to generate power with maximum machine availability and minimum down time. There are many electrical and mechanical components in the wind electric turbine, it is intended to concentrate on the different component and equipment of the turbine through new technologies, suitable maintenance procedures and refine processes. Preventive maintenance has been recognized throughout the world as an essential tool of reducing down time and improving availability of machine. It is a conventional method whose focus is to reduce the breakdown and cost of replacement. The Madhya Pradesh (M.P.) Wind Farms Limited is a leading power generating industry in wind power and it is having 58 conventional wind electric generators along with 58- unit sub stations and three main sub stations. At present this machine which is an integral

part of case company is not running smoothly, it is observed that there are too many breakdowns and due to this it is causing too many difficulties to the maintenance department. Initially as such no scheduled maintenance programme was given by the supplier, which leads to a number of problems like production loss, lack of quality power and too much time consuming, so it is intended to reform this expensive conventional system and bring about a lot of improvement in the way of handling this machine Need of the Maintenance

The significance of these procedures is to enumerate the impact of effective maintenance procedures as an efficient tool which enables the power plant operators to,

- Improve system reliability
- Decrease cost of replacement
- Decreases system downtime electrical as well as mechanical breakdown

- Providing the data to develop preventive maintenance procedure for different components of wind electric turbine
- Reduce injury
- Protect assets and prolong the useful life of production equipment
- To rise the profit of the company
- Increase generation level.

In the literature it has been observed that researchers are still working hard to find out the major factors which affect the performance of the wind electric generator (WEG). One of the most important is regular maintenance of the most critical components of the wind electric generator. Various maintenance procedures are in practice which ensure the efficient generation of power by a wind electric generator. Most commonly executed maintenance procedure on wind electric generator includes: periodic gearbox oil changes, rotor blade cleaning, bolt tensioning etc. Through all these minor maintenance procedures a wind electric generator can operate at its peak performance level as well as help to prevent major breakdowns like gearbox bearing failure, which could potentially lead to replace the entire gearbox, one of the most expensive components of the entire wind tower. Imad Alsyouf and Idriss El-Thalji [1], discusses and analyses the recent practices in the area of maintenance of wing electric generators and gives brief review of operation and maintenance of wind electric generator. Inacio Fonseca et al [2], present a predictive model to manage wind electric generator maintenance. Julia Nilsson [3], explained the benefits of condition based system with two case studies of wind electric generator by breaking down the entire maintenance cost into several components. Francois et al [4], proposed an approach to optimize the maintenance of components in which degradation is classified on the basis of severity of the damage. Frascois Besmard et al [5], discussed the benefits of the preventive maintenance and showed that there is a large potential in cost savings by maintenance optimization to make the project more cost effective. This part of the paper focuses on the overall review of

most commonly used and efficient maintenance procedures prevailing in the field. The assortment of relevant information may help the plant operators to analysis and execute the necessary actions which lead the plant in improving its performance.

## II. DEFINITION OF MAINTENANCE

“Maintenance is the routine and recurring process of keeping a particular machine or quality in its normal operating condition so that it can deliver its expected performance or service without causing any loss of time on account of accidental damage or breakdown”[6].

Or

“The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, [detection](#), and correction of incipient failures either before they occur or before they develop into major defects” [7].

## III. NEED OF MAINTENANCE

The purpose of maintenance is to attempt the improvement in the performance of equipment by ensuring that the all its parts will perform reliably and efficiently, by preventing the rate of breakdowns or failures, and by minimizing the adverse effects resulting from breakdowns or failures. In fact it is the objective of the maintenance procedures to maintain or increase the reliability of the operating system as a whole.

## IV. SIGNIFICANCE OF MAINTENANCE

Maintenance is necessary for the smooth and efficient working of an industry and helps in improving the productivity. It also helps to keep the machine in their optimum operation conditions [7]. The significance of plant maintenance varies with the type of plant and its production. Plant maintenance plays a prominent role in production management because plant breakdown creates major problem such as:

- Loss of productive time.
- Re-scheduling of production.
- Need for overtimes.
- Need for subcontracting work.
- Temporary work shortage, worker may require alternative work to have maximum work to have maximum utilization of labor.

## V. FUNCTION OF MAINTENANCE

The significant functions of maintenance can be listed as follows:

- To develop maintenance policies, procedures and standards for the organization
- To schedule planned maintenance work in consultation with the concerned production departments
- To carry repairs and rectify or repair planned equipment and other facilities to ensure good availability and optimum operational efficiency
- To ensure scheduled inspection of plant, machinery and equipment
- To keep record of all maintenance work (repairs, replacements, modification, lubrication, overhauls etc.)
- To carry out periodic inspections of equipment and facilities to know conditions, this may lead to their stoppage and breakdown
- To prevent inventory of spare parts and other materials needs for maintenance work.
- To carry out alteration, modifications or improvement in existing equipments and buildings to minimize breakdown
- To prepare maintenance budget and to ensure that maintenance expenditure does not exceed the planned budget.
- To enforce and train personal to carry out maintenance work effectively and efficiently.

## VI. TYPES OF MAINTENANCE

Basically maintenance can be divided into two groups:

- a) Breakdown maintenance.

- b) Planned maintenance.

The planned maintenance can further be subdivided into:

- Scheduled maintenance.
- Preventive maintenance.
- Corrective maintenance

### 6.1 Breakdown maintenance

Breakdown maintenance implies that repairing can be done after the failure of equipment to perform its normal function. For example an electric motor fails to start, a belt is broken etc. this practice allows a maintenance of any other facilities to run without much routine attention, till it actually breakdown or fails to carry out its function. In this type of maintenance no attempt is made to prevent the occurrence of breakdown.

#### Disadvantages of breakdown maintenance:

- a) The type, gravity, place and time of breakdown are of random nature. This practice leads to disruption of production plants.
- b) It also makes it impossible to plant workload and distribution of maintenance work force for balanced attention of all equipments.

### 6.2 Planned maintenance

The planned maintenance is an organized type of maintenance which takes care of other aspects such as control and records required for this type of work. Under this type of maintenance, the work is planned before hand to avoid random failures. To meet the requirements of the planned maintenance, first of all thorough study has to be carried out to decide the periodicity of maintenance work. Time study can also suggest ways and means of devising optimal maintenance schedule for the given system.

#### 6.2.1 Scheduled maintenance

In this type of maintenance work, the actual maintenance program is scheduled in consultation with the production department, so that the relevant equipment is made available for maintenance work. The frequency of such maintenance work is pre-determined from experience so as to utilize the ideal time of the equipment effectively. Though schedules

maintenance is costly compare to breakdown maintenance, the availability of equipment is enhanced.

### 6.2.2 Preventive maintenance

Preventive maintenance consists of routine action taken in a planned manner to prevent breakdown and to ensure operational efficiency to the extent it is economically and practicably possible. In preventive maintenance periodic inspection is carried out to anticipate breakdowns and to prevent them before they occur, instead of allowing the breakdown to happen and then take action. The underlying principle is prevention is better than cure. Therefore, for adopting preventive maintenance policy, one must have the data showing the frequency with which machine have maintenance free performance for a given number of operating hours.

#### Functions of Preventive Maintenance

- To minimize the possibility of unanticipated production interruptions by locating or uncovering any condition this may lead to it.
- To make plant equipment and machines always available and ready for use.
- To maintain the value of the equipment, machinery and other services facilities by periodic inspection, repairs, over halting etc.
- To reduce the work content of maintenance jobs.
- To ensure safety of life of employees.

#### Elements of Preventive Maintenance

- a) Routine attention: This involves maintenance activities that take regular care of the machine. Routine servicing includes cleaning, oiling and adjusting.
- b) Routine examination: it is carried out to identify dormant faults or items prone to failure. This type of preventive maintenance work helps to detect faults before they can actually occur.
- c) Preventive replacement: The preventive maintenance work comprises preventive

replacement of parts and components that have a definite life. Such type of replacement help to avoid emergency situations and prolonged downtime and risk of hazards associated with sudden breakdowns.

- d) Inspection measurements: Inspection measurements comprise jobs of preventive maintenance that aim at identifying the degradation rate and such items which are at unacceptable service conditions. This type of maintenance work requires many costly instruments.

Planning and implementation of a preventive maintenance system is a costly affair because during inspection all deteriorated parts are replaced. This type of maintenance is effectively applied in situation where risk in operations caused by failures of equipment must be avoided. However the higher cost of maintenance usually gets compensated by prolonged operational life of the equipment. To avoid serious breakdowns the preventive mode of maintenance is usually implemented.

### 6.2.3 Corrective maintenance

The use of planned preventive maintenance brings out the nature of repetitive failure of certain parts of the equipment. When such repetitive failures are observed, corrective maintenance can be applied so that re-occurrence of such failure can be avoided. These types of failure can be reported to the manufacturer to suggest modification to the equipment. Corrective maintenance can be defined as the maintenance carried out to restore equipment that has stopped working to acceptable standards.

## 6.3 Conclusion

This part of the paper presents the overall analysis of all the promising methods of maintenance which may help any plant to improve its operating status and so do the efficiency. The overall analytical analysis exhibited in this paper leads to the conclusion that the preventive maintenance can be recommended as the

most fruit full and effective method which can be applied successfully for improving the working status of any plant. In the Part II of this companion set the case study of Madhya Pradesh (M.P.) Wind Farms Limited Dewas, India has been presented which will demonstrate the utility the proper maintenance procedures.

## VII. REFERENCES

- 1) Imad Alsyouf and Idriss El-Thalji, "Maintenance practice in wind power", Conference proceeding, European Wind Conference and Exhibition, 2008.
- 2) Inacio Fonseca, Torres Farinha and F. Maciel Barbosa, "On condition maintenance for wind turbines", Conference proceeding, IEEE Bucharest Power Tech Conference, Bucharest, Romania, 2009.
- 3) Julia Nilsson, "Maintenance Management of Wind Power Systems Using Condition Monitoring Systems—Life Cycle Cost Analysis for Two Case Studies", IEEE transactions on Energy Conversion, Vol. 22, No. 1, 2007
- 4) Francois Besnard, Michael Patriksson, Ann-Brith Stromberg, Adam Wojciechowski and Lina Bertling, "An Optimization Framework for Opportunistic Maintenance of Offshore Wind Power System", IEEE Bucharest Power Tech Conference, Bucharest, Romania, 2009.
- 5) Francois Besnard and Lina Bertling, "An Approach for Condition-Based Maintenance Optimization Applied to Wind Turbine Blades", IEEE transactions on sustainable energy, vol. 1, No. 2, 2010.
- 6) R. C. Mishra and K. Padthak, "Maintenance Engineering and Management", Book, Published by Prentice Hall of India Private limited, New delhi, 2005
- 7) Sushil Kumar Srivastava, "Maintenance Engineering and Management", Book, Published by S. Chand and company limited, New Delhi, revised edition 2006