IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN(P): 2347-4599; ISSN(E): 2321-8843
Vol. 4, Issue 6, Jun 2016, 1-8

VIBRATION BASED CONDITION MONITORING FOR GENERATOR

PAVAN KUMAR B K[1], Y.BASAVARAJ[2] & NANDEESH C[3]

[1]Assistant Professor, Department of Mechanical, Ballari Institute of Technology & Management, Ballari, Karnataka, India

[2]Professor and head, BITM, Ballari, Karnataka, India

[3]Department of Mechanical, Ballari Institute of Technology & Management, Ballari, Karnataka, India

ABSTRACT

The new generation of condition monitoring and diagnostics systems plays an important role in efficient functioning of thermal power plants. Most rotating machine defects can be detected by such a system much before dangerous situation occurs. It allows the efficient use of stationary on-line continuous monitoring system for condition monitoring and diagnostics as well. Vibration monitoring for condition monitoring of turbine bearing can reduce expenses of maintenance of turbo generator in power plant as well as prevent unnecessary shut down of plant, which create the power crisis. The last decade has seen a large-scale growth in the requirement of uninterrupted power supply for industries, residential and commercial complexes and educational institutions. At many of these locations, standby power is provided by diesel-generator (DG) sets. Proper control and monitoring of these DG sets is an imperative, since any interruption in the supply caused due to improper functioning of the standby-unit, would lead to a loss of productivity.

KEYWORDS: Condition Monitoring, Diesel-Generator, Diagnostics, Rotating Machine, Vibration

INTRODUCTION

INTRODUCTION TO MONITORING

Monitoring is the systematic collection and analysis and information as a project progresses. It is aimed at improving the efficiency and effectiveness of a project or organization. It is based on targets set and activities planned during the planning faces of work. It helps to keep the work on track and can let management know when things are going wrong. If done properly, it is an invaluable tool for good maintenance, and it provides a useful base for evaluation. It enables you to determine whether the resources you have available are sufficient and are being well used, whether the capacity you have is sufficient and appropriate and whether you are doing what you planned to do.

Maintenance strategies are classified by three developmental stages:

- Break down maintenance
- Preventive maintenance
- Predictive maintenance

Break Down Maintenance

This provides the replacement of defective part or machine after the machine becomes incapable of further operation. Break down maintenance is the easiest method to follow and it avoids the initial costs and training personnel and other related upfront costs**.**

Preventive Maintenance

In preventive maintenance, maintenance is scheduled on calendar or hours to run and is performed irrespective of machine condition. Preventive maintenance alone cannot eliminate break down. The causes of equipment failure change with the passage of time. Figure 1 shows the failure rate curve which is also called as bath tub curve.

Figure 1: Bath Tub Curve

Predictive Maintenance

Trending and analyzing machinery parameters we can detect the developing problems in early stages. Hence repair works can be carried out before failure of a machine.

The vibration predictive maintenance program has four steps:

- Detection
- Analysis
- Correction
- Conformation

Detection

First select all available critical machines in the plant. Prepare a schedule for all these machines for data collection identify bearing locations of the machine train motor non drive end, MND, FNDE, FDE, PNDE, PDE, etc., identify the directions where vibration data is collected like H, V, A etc. define which vibration parameters are to be collected via displacement, velocity, acceleration etc. after doing all these start collecting vibrating data and related data and record them. Collect the data for every fortnight or monthly or so by trending and interpreting the data, identify source of vibration.

Analysis

After identifying the source of vibrations analyze to pinpoint the root cause for vibrations. This can be achieved by eliminating process. Follow confirmative procedures in support of analysis.

Correction

Open and inspect he machine at a convenient time and make necessary corrections

Confirmation

After corrections put the machine in service and again collect vibration data and look for elimination of source.

CONDITION MONITORING

Condition monitoring is the process of monitoring a parameter of condition in machinery, such that a significant change is indicative of a developing failure. The most efficient way of doing predictive maintenance is by condition monitoring technique. Predictive maintenance by condition monitoring technique will boost up the availability of the equipment; will increase the efficiency and industrial safety.

The various steps involved in condition monitoring program are:

- Plant survey feasibility report.
- Machine selection strategic and economic importance.
- Select optimum monitoring techniques there is a large number of parameters that can be collected and analyzed in order to determine machine condition. No single parameter has given consistent results.
- Establish a predictive maintenance programmed inspection schedule, data handling, administration and training.
- Set acceptable condition, data and lists based on machine severity charts, manufacturer's specializations and experience.
- Machine base line measurements are taken after many corrective actions.
- Routine monitoring programmed & Condition analysis and also Fault correction

CONDITION MONITORING TECHNIQUES

The most commonly used techniques of condition monitoring are:

- Lubricant Sampling and Analysis
- Corrosion Monitoring
- Motor Current Analysis
- Acoustic Emissions Detection (e.g., ultrasound)
- Vibration Measurement and Analysis

This paper is mainly focused on vibration monitoring which is the most commonly used method for rotating machines

Vibration Measuring Instruments

The instruments or equipments which are used for measure the displacement, velocity, frequency, phase distortion and acceleration of a vibrating g body are called vibration measuring instruments.

Vibrometer

- A Vibrometer or seismometer is used for measuring displacement of a vibrating body.
- This is used to measure high frequency ω of a vibrating body.
- Its natural frequency has ranged between of 10 Hz to 10000 Hz.
- The sensitivity of this instruments is in the range between the 20 to 350 mV/cm/s.

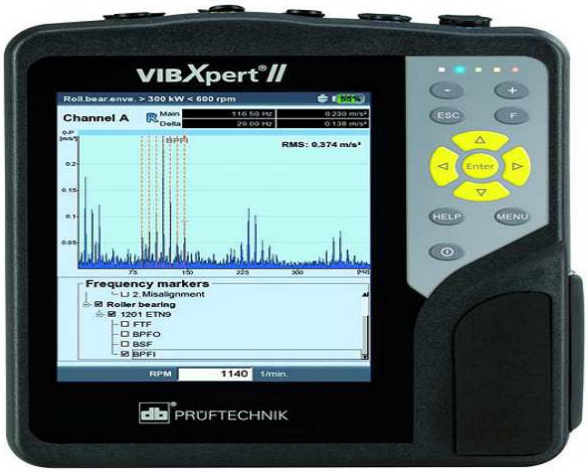

Figure 2: Vibrometer Instrument

Application and Disadvantage of Vibrometer

The instrument is used to record building vibrations and also used for measuring vibration of the huge structure like Railway Bridge. It is large in size because of its relative motion of the seismic mass must be of the same arrangement of the magnitude as that of the vibration to be measured.

The Basic Procedure to Perform Vibration Analysis Involves Six Steps

- **First**: The portable data collector uses a sensor to measure the vibration pattern. This sensor should be mounted on the machine, always close to the vibration source.
- **Second**: When the sensor is in place a sample of the vibration is collected. Normally the data collected is taken back to the office and transferred to a computer for further analysis. In the majority of the cases the vibration measurement is collected in few minutes, if the machine present serious problems the vibration measurements can take all night long. In case, that the machine is located. In a remote area, sensors will be mounted permanently on the ma-chine, and the control room will have the task of monitoring. Al-ways permanent sensors are mounted in critical machines only.
- **Third:** Once the data is downloaded to the computer the task is to detect if there is any problem with the machine. The user should compare the vibrations levels to a set of alarm limits that are al-ready specify by the first

vibration measurement performed to the machine when it was new. At this point is the user responsibility to determine a possible problem with the machine.

- **Fourth:** Analysis of the data is the most important step. The user should study the vibration spectrum and time waveform. By viewing trend and comparisons of previous data it's possible to know what is wrong with the machine and how severe is the problem. At the end a report to the maintenance office should be send with a list of recommend actions if something is wrong with the machine.
- **Fifth**: With the vibration measurements in hand the user can per-form a critical root cause analysis and determined the cause of the problem in first place. This step is very difficult to perform be-cause a lot of experience is needed to have a clear picture of the problem.
- **Sixth:** In this last step the user performs new measurements to certificate that the problem is solve once the machine is repaired.

PROBLEM DEFINITION & METHODOLOGY

- To detect the critical path of a machine and dialysis is to be carried out.
- To determine the frequency with in the specified range of rotating part in a machine.

The Diesel Generator set (diesel engine driven generating set) is a compact and robust machine in which mechanical energy is converted into electrical energy. It uses high speed diesel oil and works on diesel cycle. In this system the air is drawn into the cylinder and compressed to a high ratio (14:1 to 25:1). During this compression, the air is heated to a temperature of 700 – 900 deg. C. A metered quantity of diesel fuel is then injected into the cylinder, which ignites spontaneously because of the high temperature of compressed air. The diesel is injected through injector in the chamber. Hence, the diesel engine is also known as compression ignition (CI) engine.

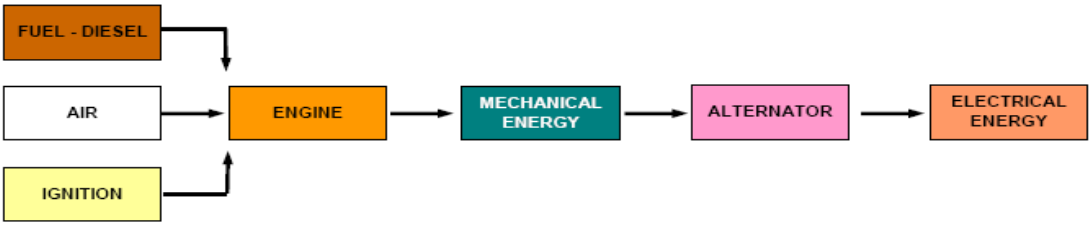

Figure 3: Flow Diagram of Working Principle of DG Set

Figure 4: Diesel Generator (125KVA, Crompton Greaves)

An alternator is coupled with the diesel engine and the kinetic energy of engine is transmitted to alternator and converted into electrical energy. Alternator works on the Faraday's law of electromagnetic induction. This electrical energy is then fed to the load.

VIBRATION MEASUREMENT DATA

Rated RPM of the shaft : 1500 RPM

Measured Rpm of the shaft : 1558 RPM

Vibration Reading Taken on Alternator at Various Positions

Table 1

Position		Direction
Non Drive End		Horizontal
Sl.No.	Parameter	Value
1	RMS	16.05mm/s
2	Amplitude	15.036mm/s
3	Frequency	189.56Hz
4	Max. Amplitude	44.76mm/s
5	Min. Amplitude	-34.49mm/s

Position		Direction
Non Drive End		Vertical
Sl.No.	Parameter	Value
1	RMS	11.61mm/s
2	Amplitude	9.90mm/s
3	Frequency	27Hz
4	Max. Amplitude	27.78mm/s
5	Min. Amplitude	-25.94mm/s

Position		Direction
Non Drive End		Axial
Sl.No.	Parameter	Value
1	RMS	6.974mm/s
2	Amplitude	7.271mm/s
3	Frequency	189.21Hz
4	Max. Amplitude	16mm/s
5	Min. Amplitude	-21mm/s

Position		Direction
Drive End		Horizontal
Sl.No.	Parameter	Value
1	RMS	6.785mm/s
2	Amplitude	7.92mm/s
3	Frequency	27Hz
4	Max. Amplitude	15.80mm/s
5	Min. Amplitude	-16mm/s

Position		Direction
Drive End		Vertical
Sl.No.	Parameter	Value
1	RMS	6.936mm/s
2	Amplitude	7.64mm/s
3	Frequency	27Hz
4	Max. Amplitude	17.81mm/s
5	Min. Amplitude	-16.75mm/s

Position		Direction
Drive End		Axial
Sl.No.	Parameter	Value
1	RMS	6.819mm/s
2	Amplitude	4.37mm/s
3	Frequency	189.21Hz
4	Max. Amplitude	15.67mm/s
5	Min. Amplitude	-17mm/s

FREQUENCY SPECTRUM OF ALTERNATOR

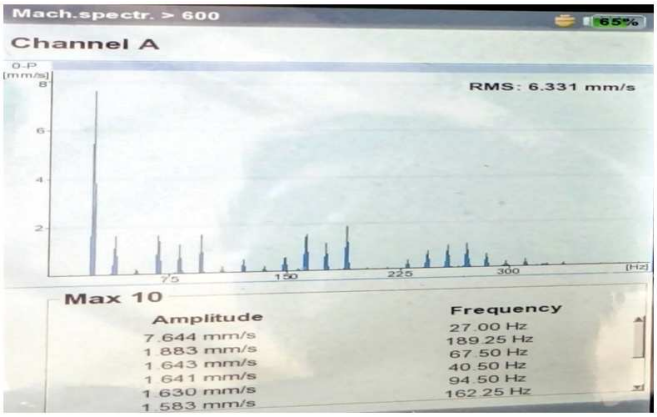

Figure 5: Frequency Spectrum of Alternator

CONCLUSIONS

Vibration when integrated with other condition monitoring tools like oil analysis, wear debris analysis gives perfect monitoring program for rotating equipment in process industries. Technologies will enhance our senses in monitoring.

It is evident from above discussion that vibration-monitoring technique is very powerful tool for assessing the condition of rotary machine and if used with wisdom it can reduce the breakdowns of power plants. Thus we can say that the use of this technique is even more desirable these days with increasing gap in demand and supply of power.

REFERENCES

1. N. Dileep, K. Anusha, C. Satyaprathik, B. Kartheek, K. Ravikumar5 (Asst.Professor), International Journal Of Emerging Technology And Advanced Engineering Website: Www.Ijetae.Com (Issn 2250-2459, Iso 9001:2008 Certified Journal, Volume 3, Issue 1, January 2013) On **"**Condition Monitoring Of Fd-Fan Using Vibration Analysis".
2. Anoop R, Anup J Nambiar, Prathap R, Sridhar Divakar, Dr. T B Isha,"Pc Based Condition Monitoring Of A Diesel – Generator Set"-Centre For Computational Engineering And Networking (Cen), Amrita School Of Engineering, Coimbatore.
3. Qiudong Sun, Zhengxin Zhou, Weiqinguo-"Insulation State On-Line Monitoring And Running Management Of Large Generator" *Energy And Power Engineering*, 2010, 2, 203-207.
4. Alexandre Pellicel1, Gonçalo Cássio1, Marco Aurélio A. Lopes1,Luiz Eduardo Borges Da Silva2, Erik Leandro Bonaldi2, Levy Ely De Lacerda De Oliveira2, Jonas Guedes Borges Da Silva2, Germano Lambert-Torres2, And Pierre Rodrigues3 "Intelligent Data Mining For Turbo-Generatorpredictive Maintenance: An Approach In Real-World" Termonorte Energy Thermal Power Plant Co., Porto Velho, Brazil.
5. Abdulwahed A. Salem, Ahmed Abu-Siada, And Syed Islam "Condition Monitoring Techniques Of The Wind Turbines Gearbox And Rotor", International Journal Of Electrical Energy, Vol. 2, No. 1, March 2014.
6. Greg Stone, Phd "On-Line Condition Monitoring Of Motors And Generators" Www.Unitronics-Electric.Com.
7. Elie Lefeuvre, Adrien Badel, Claude Richard, Lionel Petit, Daniel Guyomar "Optimization Of Piezoelectric Electrical Generators Powered By Random Vibrations", Dtip Of Mems & Moems Stresa, Italy, 26-28 April 2006.
8. Manoj Kumar Chittora "Condition Monitoring Of Turbogenerator By Vibration Monitoring Technique"- Iosr Journal Of Engineering (Iosrjen) E-Issn: 2250-3021, P-Issn: 2278-8719 Vol. 3, Issue 1 (Jan. 2013), ||V1|| Pp 33-37.
9. Khaledabdusamad, David Wenzhonggao And Xiaodong Liang And Jun Zhang "Hazard Model Reliability Analysis Based On A Windgenerator Condition Monitoring System"- Journal Of Energy And Power Engineering 8 (2014) 1309-1322.
10. David Mcmillan & Graham Ault "Towards Quantification Of Condition Monitoring Benefit For Wind Turbine Generators"- This Research Was Conducted Under The Prosen Project, Epsrc Grant Number Ep/C014790/1.