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From President's Desk...

Seasons Greetings !!



Dear Friends! Seasons Greetings to all of you as we welcome New Year 2012! I am glad to announce that CMSI was invited by COMADEM to be a technical co sponsor for **COMADEM 2012** International conference being held during July 2012 at Huddersfield, UK. I am also glad to inform you that first ever **CMSI-GITAM endowment lecture** would be delivered by **Prof. Dr Raj BKN Rao**, a well acclaimed expert of condition monitoring. The lecture is scheduled for **31 January 2012** at GITAM University, Visakhapatnam.

I appeal to all our members to attend the lecture and reap benefit from the speech of the expert. R&D Engineers Establishment, a DRDO laboratory from Pune came forward to organize National Conference on Condition Monitoring under the aegis of CMSI. The details will be forwarded soon to all the members. World is moving fast and we need to keep pace with it for successful implementation of technologies. Condition monitoring is no exception and hence we need to keep abreast of the latest developments for effective exploitation of this technology in our industries. I urge all the members to nurture the condition monitoring practice with more vigor and to share their experiences through our newsletter for mutual benefit. Hope 2012 will take us to further heights. Once again, wish you and your family members a happy and prosperous new year.

Dr V Bhujanga Rao

Announcement – NCCM 2012 !!

CMSI is glad to announce that **Research & Development Engineers Establishment (R & DEE), Pune** has been finalized as venue for **Third National Conference on Condition Monitoring (NCCM-2012)** during 18-19 May 2012 (Tentatively). Further details will be intimated shortly through our website: www.comsoi.org

CMSI-GITAM Endowment Lecture !!

Main Features of this Issue...

- Announcement of NCCM 2012
- CMSI-GITAM Endowment Lecture
- Rotor Crack: Diagnosis using Vibration Analysis
- Five Senses of Equipment and the Surrounding Area
- Product News: Resolator
- CMSI Members in News
- CMSI – Jamshedpur Chapter
- New Members
- Reference Books

CMSI is glad to inform all the members that first ever CMSI-GITAM Endowment Lecture will be delivered by eminent **Professor Dr. B.K. Nagaraja Rao** from **UK**, at **GITAM UNIVERSITY (GU)** on **31 January 2012 at 15:00hrs**. This lecture was conceptualized By **CMSI & GITAM UNIVERSITY(GU)** during ICCM 2011 held at GITAM. The lecture is named after the eminent Scientist **Dr. V.Bhujaga Rao**, Distinguished Scientist and Chief Controller, R&D, DRDO, as a mark of honor towards his outstanding contributions and pioneering efforts in condition monitoring.

Dr. BKN Rao was awarded the Higher **Doctorate in Technology (D.Tech)** from the Sunderland University for "his significant, sustained and distinguished contribution in the field of Condition Monitoring". He pioneered the concept of Condition Monitoring and Diagnostic Engineering Management (**COMADEM**) in 1988 and organized successful annual international congress and exhibitions in UK, France, India, and many other countries. He has co-edited 25 international COMADEM congress proceedings which have been published by major publishing organizations. He is an invited Editorial Member of the Journal of Diagnostika, Poland. He is the Editor-in-Chief of the International Journal of COMADEM.

All members are requested to attend and reap the benefit from the lecture by the great exponent of Condition Monitoring!!

Enroll as a member of our society & Advertise your products in News Letter 'MONITOR' and Website www.comsoi.org Check Website for details..

Rotor crack: Diagnosis using Vibration Analysis

The basic principle during crack development is that the rotor loses stiffness in the direction perpendicular to the crack direction. If a crack develops on the circumference of a rotor, transverse to the shaft axis, the stiffness in the plane perpendicular to the crack decreases and remains the same in the other orthogonal plane (Figure 1).

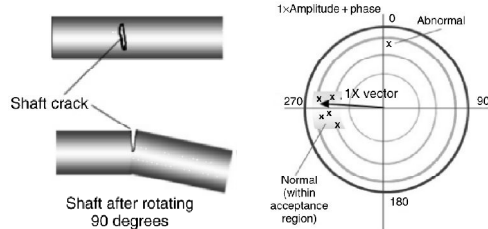


Fig.1

Fig. 2

There are two fundamental symptoms of a shaft crack:

1. Unexplained changes in the $1 \times$ shaft relative amplitude and phase.
2. Occurrence of a $2 \times$ rpm vibration frequency.

The first vital symptom is the **changes in the $1 \times$ synchronous amplitude and phase**. On a turbo machine installed with proximity probes measuring shaft vibration, it may also be possible to notice the defect on a slow roll bow vector (at a low rotational speed).

Shaft bending due to a transverse crack causes the changes in the synchronous $1 \times$ amplitude and phase. It is important to note that the amplitude and phase could be higher or even lower. Thus, any change in the $1 \times$ amplitude and phase should cause an alarm for the possibility of this defect.

The next classical symptom is the **occurrence of the $2 \times$ rpm component**. The cause for this component (as explained earlier) is due to asymmetry in the horizontal shaft stiffness on which radial forces like gravity may be acting.

When viewed on a cascade plot, during a startup or coast down, the $2 \times$ frequency is especially dominant when the rotational speed is in the region of half the critical speed. When the speed is increased, this $2 \times$ peak diminishes. When the rotor crosses the critical speed, the $2 \times$ amplitude also rises along with $3 \times$ and $4 \times$ components that may also be present. When the rotor reaches full speed, the high $1 \times$ may be accompanied by this $2 \times$ frequency too.

Although this is a transient observation, the $1 \times$ amplitude and phase can be monitored under normal operating conditions as well to provide alarms and early warnings of a possible shaft crack. A polar plot (Figure 2) provides a good format for highlighting the change in the $1 \times$ amplitude and phase.

A region in the form of a sector can be plotted to indicate the normal operating vector position that describes the $1 \times$ amplitude and phase. These are also called **acceptance regions**. Acceptance regions can also be plotted for the $2 \times$ component during the transient analysis to provide evidence of a shaft crack.

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Machinery fault diagnosis using vibration analysis

Any change in the position of this vector will cause it to move away from the sector. Alarm windows can be created around this sector to draw attention to a deviation. It should be kept in mind that many other factors such as load, field current, steam conditions or other operating parameters could have changed and might be causing the changes in the $1 \times$ and $2 \times$ amplitude and phase readings. A thermal blow in a large steam turbine can cause a similar high $1 \times$ component. Misalignment can cause large $1 \times$ and $2 \times$ components. In some cases, the high $1 \times$ amplitude was associated with unbalance.

However, if a shaft cannot be balanced properly, a crack could be the culprit.

Web resource: Extract from Text Book "Machinery fault diagnosis using vibration analysis", ISBN 0 7506 6275 1.

Five Senses Inspection of Equipment and the Surrounding Area From Imrtwiki

Condition monitoring is an excellent approach for finding equipment defects but it can be complemented by other inspection methods to get maximum benefit. There is a large range of equipment defects that are most easily found by simple '**Look, Listen & Feel**' inspections. They're also called '**5 Senses**' inspections. Examples of 5 Senses observed defects:

- i) Seeing a fluid leak from a pipe and Hearing an air leak from a valve.
 - ii) Seeing a damaged electrical control box.
 - iii) Seeing a bolt that has lost a nut.
 - iv) Hearing a clicking noise from a machine.
 - v) Feeling that a gearbox has a high temperature.
- These 5 Senses inspections should take very little additional time during a data collection or inspection routine but greatly increase the value of the activity.

Never let 5 Senses inspections become a time waster. At least 90% of the activity should be done in parallel with the routine monitoring activity. Use of the term monitoring will include inspections. *Why is 5 senses inspection so important?* - It is not unusual, especially where equipment being monitored is reliable, that the greatest value from monitoring comes from other observations. Finding machine defects that are unrelated to the monitoring • Observing defects or potential defects in surrounding processes and equipment • Performing simple defects fixes such as tightening loose bolts, greasing bearings and fixing minor safety issues. One of the common problems in maintenance is that rigorous equipment inspections are not done or the personnel used are inexperienced or unmotivated. It is imperative that effective equipment inspections are a part of the Predictive and Proactive strategy.

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Five Senses Inspection of Equipment and the Surrounding Area From Imrtwiki

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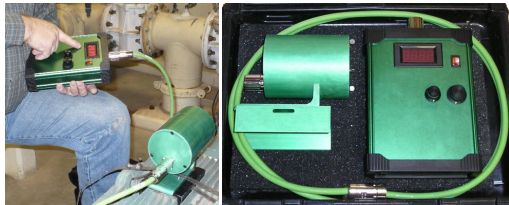
Information learnt from equipment inspections can lead to improvement opportunities both for the equipment and the monitoring process. Understand what you are inspecting? - The key to effective equipment inspection is understanding what you are looking at and recognizing what is out of the ordinary or changed. Many people would have had the experience of looking at something and not recognizing any defects. Then after learning more about the issue or item, upon further observation instantly see a defect.

Web Resource:

<http://www.sirfrt.com.au/imrtwiki/index.php/>

Product News-Resolator: The first practical tool for determining and confirming resonance in machinery and surrounding structures

Resonance problems related to the plant's machinery can be easily and conveniently determined with **Resolator**. Portable, battery operated Resolator can be simply mounted on the various structures and swept through various frequencies to stimulate and then resonances can be detected in the surrounding area. It is used as a powerful tool in addition to the existing vibration instruments to clearly analyze destructive resonant conditions and also to prevent these problems from occurring in the first place.



Capabilities and Benefits of Resolator:

- Use as a valuable precision installation tool
- Pays for itself in just a single troubleshooting job
- Pays for itself over and over again in increased machinery life identify and get rid of resonance in the first place!
- Simplify. Save time. Be clear, sure and confident about your analysis
- Completely enclosed for safety
- Designed to adapt to multiple mounting/clamping bases
- Battery operated for flexible field use without the need for additional power cables
- Adjust weights for vibration source simply and easily
- Use a strobe light on the Resolator's CAM to easily determine resonance telling phase changes
- Stimulate resonances to over 8,000 CPM, allowing for stimulating the first few resonant frequencies of most parts

Web resource: <http://www.update-intl.com/index.htm>

CMSI - JAMSHEDPUR CHAPTER : One day Seminar on 'Maintenance excellence through machinery diagnostics'

One day Seminar on "**MAINTENANCE EXCELENCE THROUGH MACHINERY DIAGNOSTICS**" was organized by CONDITION MONITORING SOCIETY OF INDIA- JAMSHEDPUR CHAPTER along with Institution of Engineers-Jamshedpur Chapter on **14th September 2011** in Institution of Engineers Building at Jamshedpur.

Workshop was inaugurated by *Mr. Subrata Mitra, Director, M.N Dastur & Co Pvt Limited*. Around 75 engineers participated from various steel & allied industries.

Some of the topics covered were,

- *TPM Concept on Condition Monitoring - By Prof Malay Niraj, NIT Jamshedpur.*
- *Role of latest instrumentation in machinery and plant diagnostic- By Mr. P.K Srivastava, Forbes Marshall.*
- *Overview on Condition Monitoring, and its Relevance in Process Industries - By Mr. Ashitava Ghosh, Earth Techniks Pvt Ltd.*
- *Maintenance strategy through oil analysis – By Mr. C.S. Kartik, Kittiwake Proactive Technologies Pvt. Ltd.*
- *Integrated monitoring solutions – By Mr. Kaushal Srivastava, Emerson process management*
- *New Developments in Machinery Diagnostic -Remote and Typical Applications, Motor driven asset – By Mr. Sudip Das, GE India.*



TERMINOLOGY: Starvation - Pump starvation occurs when enough liquid is not present to fill each vane on the impeller every revolution. When this occurs, the amplitude of unit speed can be quite high. Pump starvation is often confused with imbalance. However, starvation has the following characteristics:

- i). Since each vane on the impeller is filled to varying degrees each revolution, the amplitude can vary each revolution.
- ii). The time signal could have some distortion.
- iii). If the pump is driven by an electric motor, the amp load on the motor may be less than normal.

Starvation can also occur when foam is mixed with some slurries. Low amplitudes of vane pass frequency can also be present with starvation.

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Condition Monitoring Society of India(C M S I)

CMSI Members in News



Dr. V. Bhujanga Rao, Chief Controller (HR), DRDO, New Delhi, and Founder President, CMSI received the prestigious **Vasvik Award** for his pioneering work towards the successful **Design and development of various stealth technologies for warships, submersibles and submarine systems, and the indigenous cochlear implant device.**

He received the award from Gujarat Chief Minister Narendra Modi at a function organised at the Charusat, Charotar Institute of Technology, Anand, Gujarat.

CMSI congratulates him on this great achievement and wishes him all the best in future endeavors!!



Dr. K. TRINATH, Additional Director of Naval Science and Technological Laboratory, Visakhapatnam and Life Member of CMSI was awarded **Vivekananda's Excellence Award-2011** by Varaha Lakshmi Narasimha Swamy Educational Trust, Visakhapatnam. The award carries a citation and a cash prize. The award was given on the occasion of birthday celebrations of famous **Scientists Konstantin Enduardovich Tsoilkovsky and Oswald Garrison Villard, Jr.** on 17 Sep 2011. CMSI Congratulates Dr. Trinath for getting the award and wishes him more laurels in his future endeavours.

CMSI Welcomes New Members!!

Institutional Member:

M/s. MACHINERY TRIALS UNIT (MTU-V), INDIAN NAVY, VISAKHAPATNAM

Life Members:

Dr. ASHISH KAMALAKAR DARPE

Shri. D. MUGUNDAN

Editorial Board :

Dr. V. Bhujanga Rao

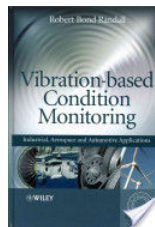
Dr. M. Ananda Rao

Sri. P.V.S.Ganesh Kumar

Sri. T. Venkata Ratnam

Reference Books

Vibration-based Condition Monitoring: Industrial, Automotive and Aerospace Applications by **Robert Bond Randall**



This text explaining complex ideas in an easy to understand way, Vibration-based Condition Monitoring provides a comprehensive survey of the application of vibration analysis to the condition monitoring of machines. Reflecting the natural progression of these systems by presenting the fundamental material and then moving onto detection, diagnosis and prognosis, Randall presents classic and state-of-the-art research results that cover vibration signals from rotating and reciprocating machines; basic signal processing techniques; fault detection; diagnostic techniques, and prognostics.

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BOOK POST

If undelivered please return to:

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Visakhapatnam - 530 027, INDIA, Phone: 0891-2586390

All feedback, comments and contributions to the news letter are most Welcome.

- Editor