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TELE CONDITION MONITORING OF GENSETS AT MAITRI STATION

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Abstract

Lifeline to Indian research station Maitri in Antarctica, are the 10 diesel generating (DG) sets, that provide not only basic amenities such as heating, lighting, water; but also communication and power for the scientific instrumentation at the station. Spare parts for the DG sets can only be brought in once during the summer, when the new expedition team arrives with supplies from India. Expert advice may not be available all the time at the station.

Due to this fact and the critical nature of the power supply, condition-based telemonitoring programme for the station has been envisaged. Planned beginning has been made with off-line data collection and computer based analysis with remote monitoring capabilities. The type 2526 Data Collector of B&K is used to regularly log measurements at predefined points on the DG sets. The data is then transmitted via SATCOM/e-mail to R&DEE office in India, where it is stored and analysed in the Compass database. Consultative advice on any incipient faults detected, recommended maintenance action, spare parts optimisation etc. is then directed back to the Data Collector operator in Antarctica, again via SATCOM/e-mail **(Fig.9).**

Introduction

Due to severe cold, strong blizzards, prolonged darkness and most of all its inaccessibility even from the nearest landmass for the major part of the year because of the frozen sea, it is of utmost importance to have highly reliable energy system supplying power to the station.

Principle

Vibration signatures of any machine can be analysed to find out the health of the running machine, thereby early recognition of developing fault and effecting protection of the machine. When fault begins to develop, the dynamic process in the machine changes and some of the forces acting on machine parts also change; thereby influencing the vibration level and shape of the vibration spectrum. Regular vibration measurements and analysis indicate machine

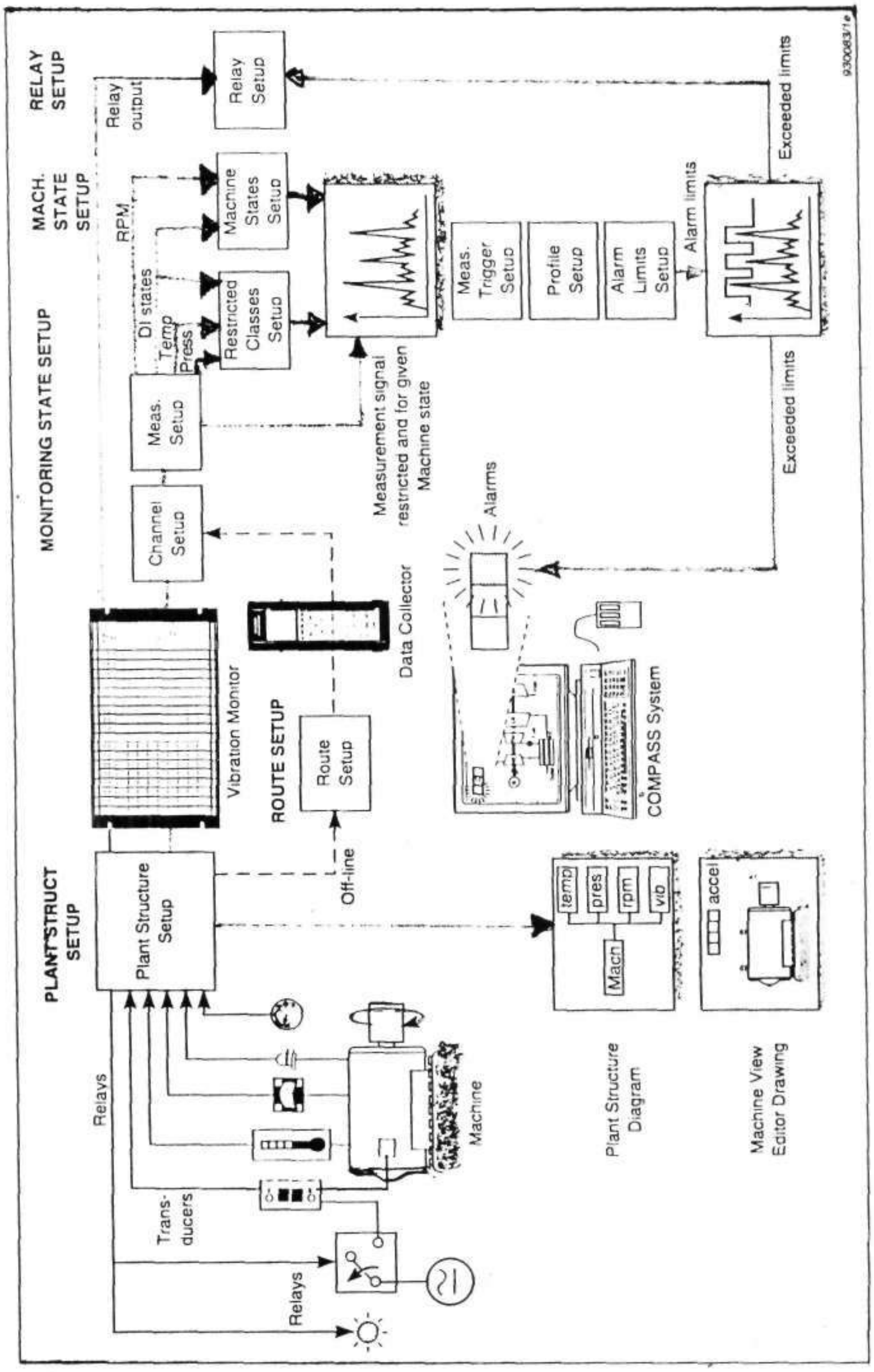
PLANT STRUCT SETUP
Plant Structure Setup
Relays
Trans-ducers
Relays
Machine
Plant Structure Diagram
temp
pres
rpm
vib
Mach
accel
Machine View Editor Drawing
Vibration Monitor
ROUTE SETUP
Route Setup
Off-line
Data Collector
COMPASS System
MONITORING STATE SETUP
Channel Setup
Meas. Setup
Measurement signal restricted and for given Machine state
Alarms
Exceeded limits
DI states
Temp
Press
Restricted Classes Setup
MACH. STATE SETUP
RPM
Machine States Setup
Meas. Trigger Setup
Profile Setup
Alarm Limits Setup
Alarm limits
RELAY SETUP
Relay output
Relay Setup
Exceeded limits
930083/1e

Fig. 1

health trends and the need for maintenance. On condition maintenance necessitates servicing of the machine, only when vibration analysis shows it to be necessary. This is also in agreement with most engineers' instinct that it is unwise to interfere with a smoothly running machine.

By means of regular vibration measurements, the onset of fault condition can be detected and their development followed. Measurements can be extrapolated in order to predict when an unacceptable vibration level will be reached and when the machine will be serviced. This is called Trend-Monitoring **(Figs.7,8)** and it allows the engineer to plan for repairs well in advance.

To provide optimum cost effective monitoring and assure total machine protection and early recognition of the faults, off-line machine monitoring system consisting of software COMPASS & K (Denmark), Pentium work station and intelligent data collector 2526 had been chosen. **Fig.l** shows complete set-up.

Maitri power plant set-up has been shown in **Fig.2.** Measurement set-up for each point, auto-spectrum, envelop-spectrum and 6% CPB (Constant Per-

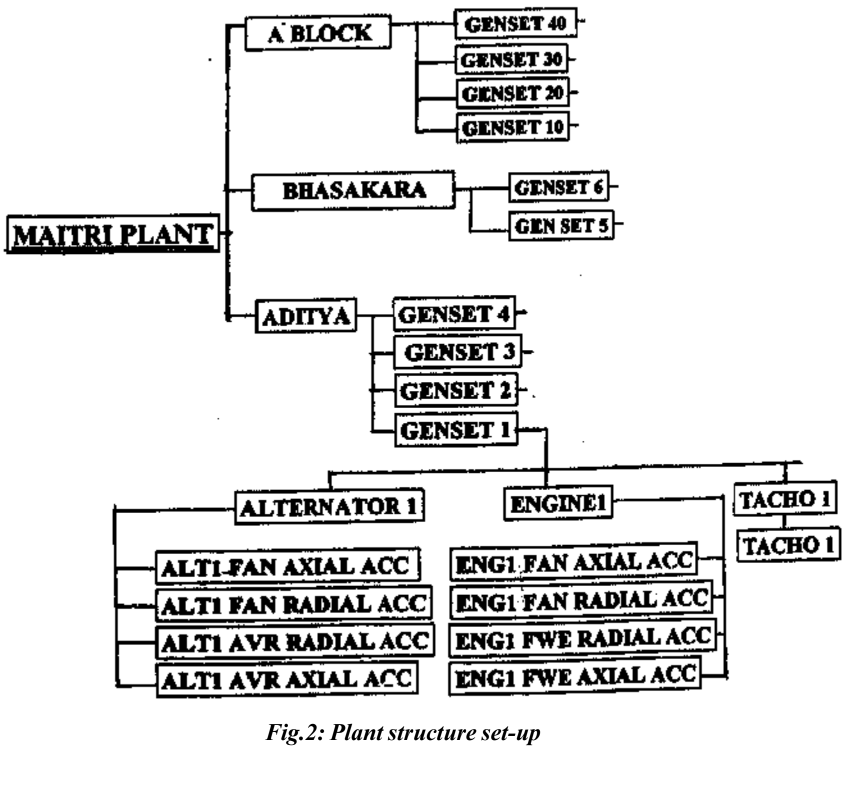

Fig.2: Plant structure set-up

centagc Bandwidth) has been created. Sample spectrums are shown in Figs.3,4,5 respectively. These spectrums have been acquired through data collector, by first loading Route **(Fig.6)** to data collector from CVM (Central Vibration Monitor), then by taking the measurements from the defined measuring points on the machine and then unloading data from the data collector to CVM.

Observation and Analysis

It was observed that whenever vibration levels have crossed alert level, greasing of rolling element bearing was carried out. Measurements taken soon after often indicated vibration levels falling back below alert levels.

In June 96, vibration measurements in Bhaskara block of genset 5 on fan end of alternator showed vibration levels crossing danger level in 5 frequency components, while flywheel end of engine measurements showed increase in vibration levels crossing alarm level limits in 6 frequency components. It was diagnosed as shift in alignment of coupling. It was decided to take preventive action next morning, but by morning the coupling had already given way and the standby genset was given over the load.

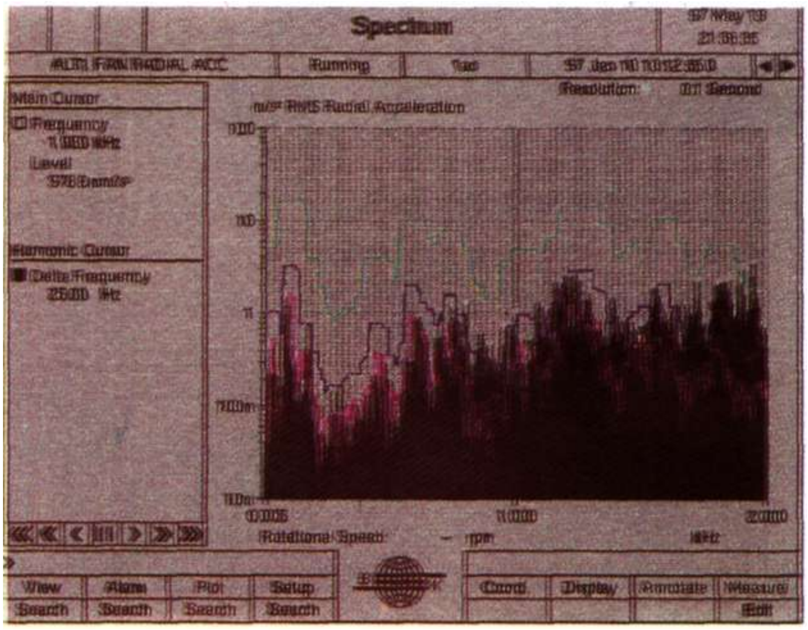

Fig. 3

Table 1: Potential Failure Modes (PFM) with possible remedies

Potential Failure Modes (PFMs)	Description	Remedy
Cracked shaft	Crack develops in shaft due to fatigue or corrosion damage.	Major repair required to shaft.
White metal bearing failure	Rubbing between rotating and stationary components due to thermal distortion and misalignment (High Vibrations)	Correct fault and restore clearance.
Generator rotor earth fault	Rotor winding insulation wears and fails causing earth fault under end rings. End rings damaged due to arcing and overheating.	Replace end rings. Long delivery period for this.
Shaft bend	Temporary bend in shaft due to thermal distortion. Prevents run ups and loading of machine.	Stripdown to check gland clearance, key wear.
Loss of rotating part	Blade of cover band fails causing minor unbalance. Major repairs are expected if not attended in time.	Long repair damage.
Alignment shift	Changes in shaft alignment and shaft to casing alignment. Due to guide key wear, foundation movement etc.	Major maintenance.
Foundation or pedestal crack	Cracking in the support structure changes the flexibility of the support and vibration results.	Outage to locate and repair the cracking.
Generator end ring replacement	Generator end rings can move after maintenance causing balance problem.	Require Re-balancing.

Table 2 : Frequencies of Vibrations to be Monitored

Nature of Fault	Frequency of Dominant Vibration @ 1500 ppm		Direction
Rotating Members out of Balance	25 Hz		Radial
Misalignment & Bent Shaft	Usually 25 often 50 sometimes 75/100		Radial & Axial
	SKF 6319	SKF6316	
Inner race Defect	122.6	122.80	Radial
Outer race Defect	77.4	77	&
Ball Defect	105	103.5	Axial
Cage Defect	9.7	9.6	Radial
Journal Bearings	12.5 Hz &		Primarily
Loose in Housing	12.6 8 Hz		Radial
Oil Firm Whirl or	12 Hz		Primarily
Whip in Journal Bearings	12 Hz		Radial

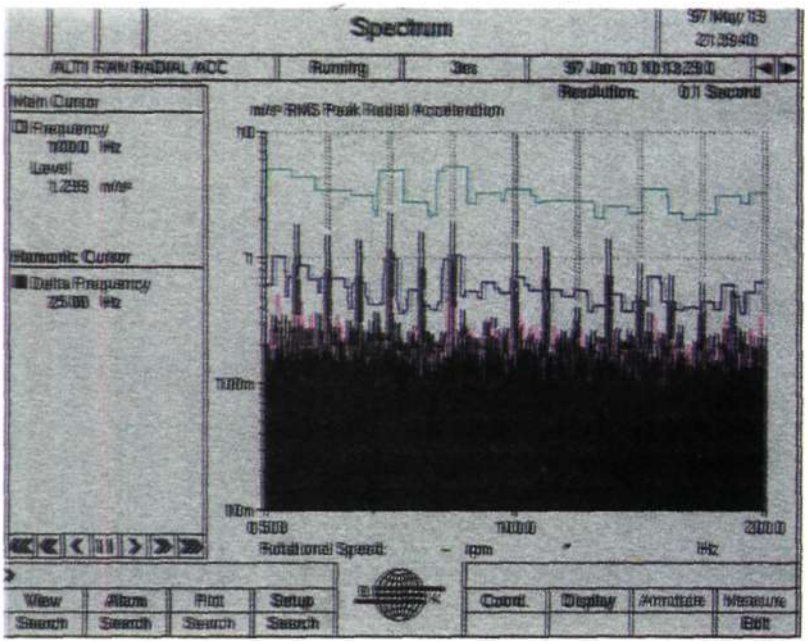

Fig. *4*

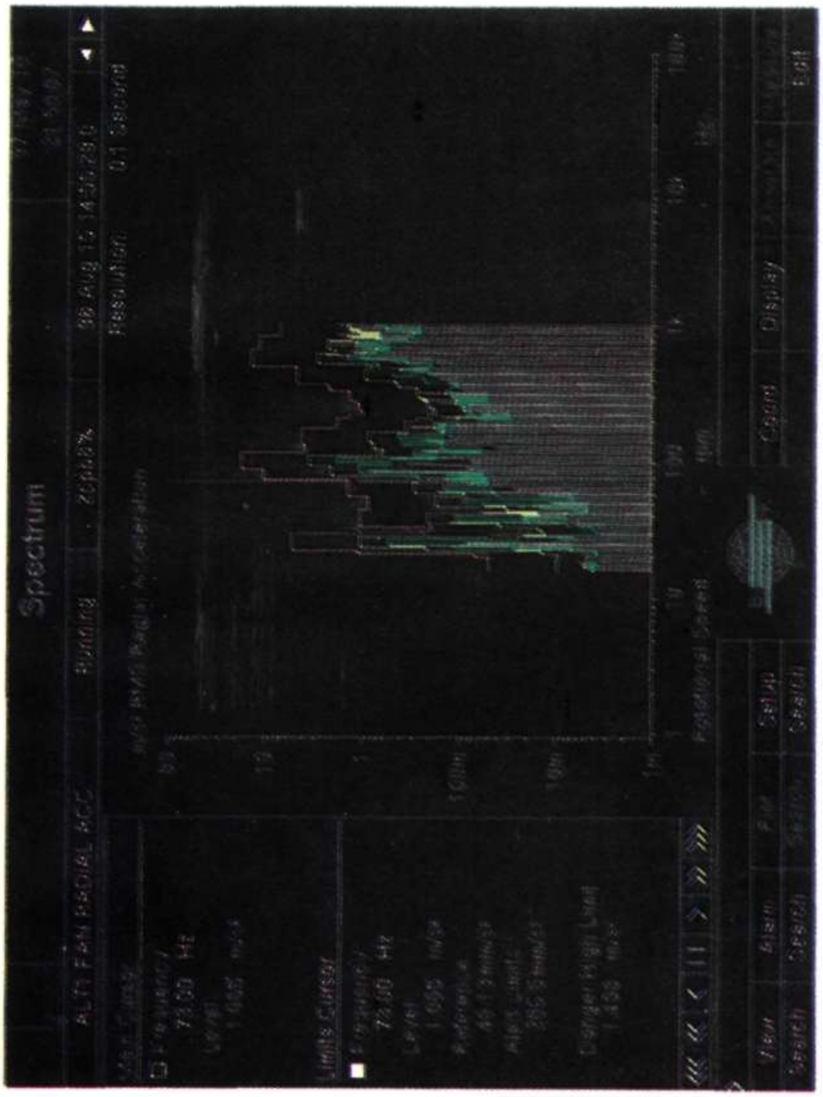

Fig. 5 : The procedure is shown in Fig. 6. Spectrum history of each spectrum can be seen as so called waterfall diagrams shown in Fig. 7.

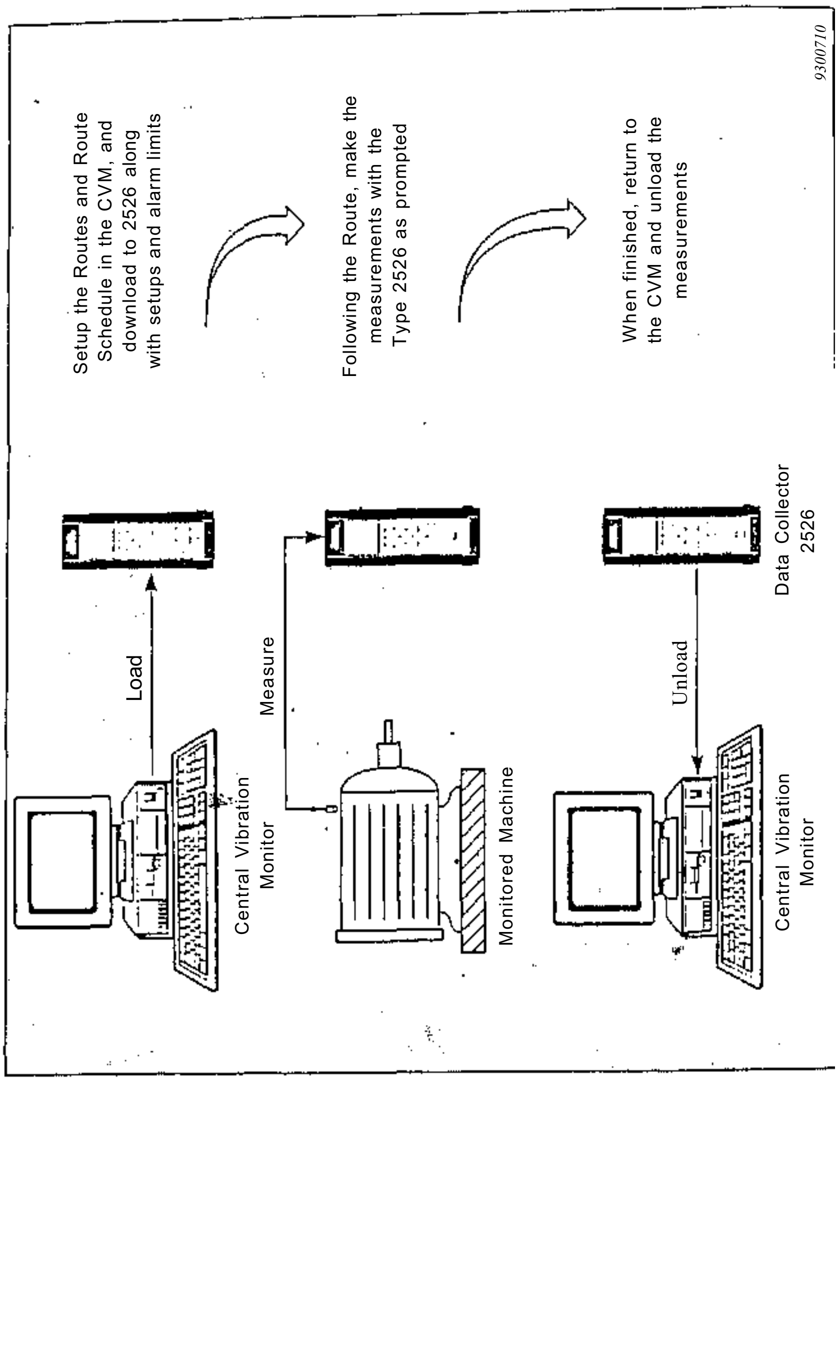
Setup the Routes and Route Schedule in the CVM, and download to 2526 along with setups and alarm limits
Following the Route, make the measurements with the Type 2526 as prompted
When finished, return to the CVM and unload the measurements
Central Vibration Monitor
Load
Measure
Monitored Machine
Unload
Central Vibration Monitor
Data Collector 2526
9300710

Fig. 6

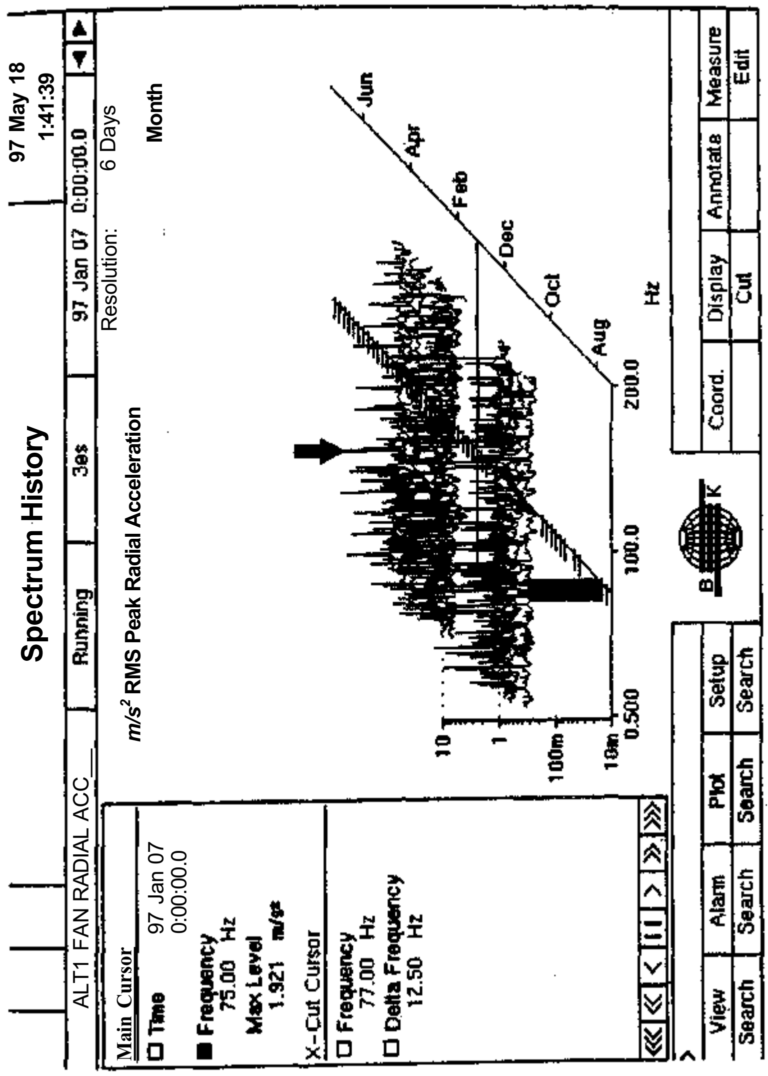

Fig. 7 : Trend Analysis for a particular frequency can be carried out and time to reach vibration levels upto danger limit can be predicted. With correlation as shown in Fig. 8.

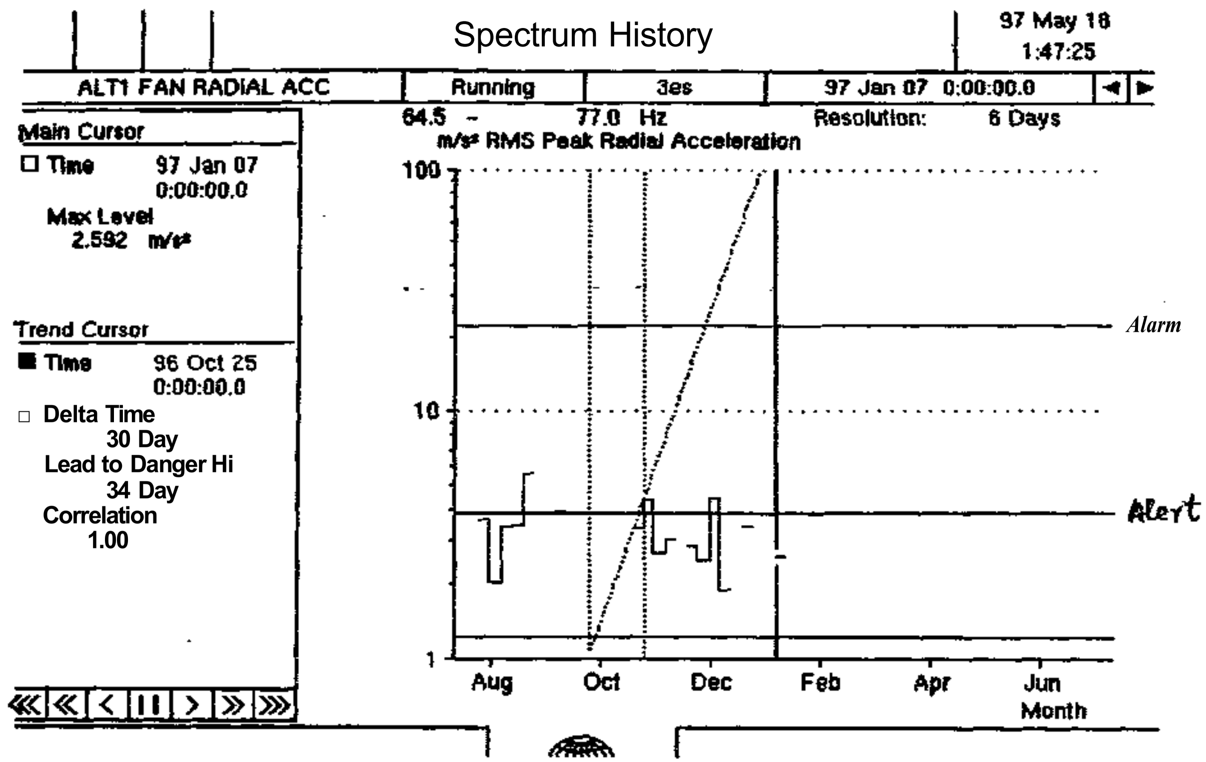

Fig. 8: If time to danger level is less with good correlation factor depending upon the nature of the fault, preventive action e.g. greasing of the bearings, or tightening of loosened foundation bolt. etc. can be taken without stopping the machine

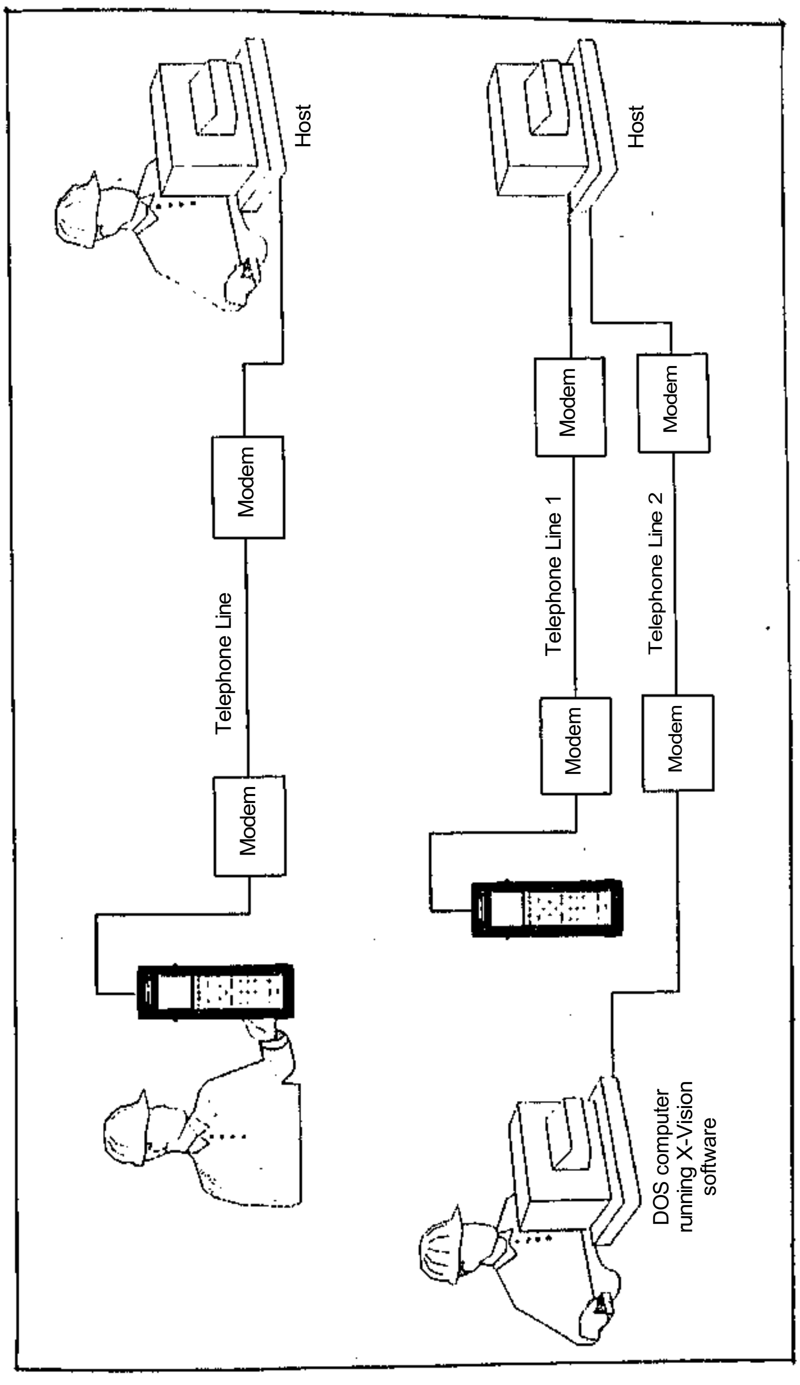
Host
Modem
Telephone Line
Modem
Host
Modem
Modem
Telephone Line 1
Telephone Line 2
Modem
Modem
DOS computer
running X-Vision
software

Fig:9