

existing units, and ensuring better reliability of uninterrupted power generation at reduced cost of generation by further improving in the working procedures etc.

PRO, Bhusawal TPS

### **BEST PRACTICES**

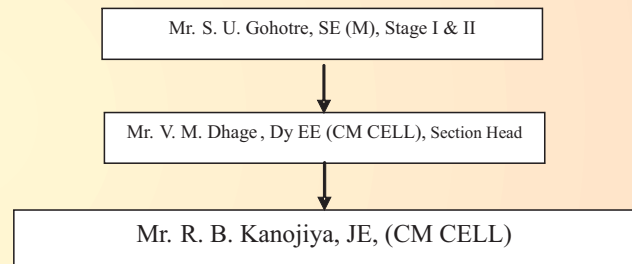
#### **NAME OF SECTION: CONDITION MONITORING CELL, STAGE-I&II**

- **Brief working:** Measure vibration of all critical auxiliary using SKF CMXA 70 FFT vibration analyzer using system analyst software from unit-1 to 7 CSTPS, MSPGCL, Chandrapur. We measure and analyses vibration of auxiliaries in different Power Station of Mahagenco in coordination with TI & C, Nagpur. The Power Station are

- Koradi Thermal Power Station, Koradi,
  - Bhusawal Thermal Power Station, Bhusawal,
  - Nashik Thermal Power Station, Nashik.

We also extend our services to M/s Bharat Heavy Electrical Limited & M/s Maharashtra Electrosmelt Limited.

- **Working Staff Structure:**



- **Scope of work:** To carry out vibration measurement and analysis activities for unit-1 to 7, CSTPS, MSPGCL, Chandrapur as listed below

SN	CMC ACTIVITY	U1	U2	U3	U4	U5	U6	U7	Total Auxiliary	Periodicity
1	Critical Auxiliary									
	Turbine & Generator	1	1	1	1	1	1	1	07	Monthly
	Boiler Feed Pump	3	3	3	3	2	2	1	17	Monthly
	TD BFP	-	-	-	-	2	2	2	6	Monthly
	ID Fan	2	2	2	2	4	4	3	19	Monthly
	FD Fan	2	2	2	2	2	2	2	14	Monthly
	PA Fan	6	6	2	2	2	2	2	22	Monthly
	Tubular Mill							5	05	Monthly
2	Non Critical Auxiliary									
	Seal Air Fan	6	6	2	2	2	2	10	30	As an when required
	CWP	3	2	2	3	4	4	5	23	As an when required
	CEP	3	3	3	3	3	3	3	21	As an when required
	Coal Mill	6	6	6	6	8	8	-	40	As an when required
	CT Fan	14	14	14	14	16	16	12	100	As an when required
3	Other Auxiliary									
	SDP	9		9		12	12	12	53	As an when required
	CCWP	5		5		4	4	4	22	As an when required
	GS/ACWP	7		4		3	3	3	20	As an when required
	HVDC Thirstier Cooling				12				12	As an when required
	Conveyor Belt Motor				75				75	As an when required
	Secondary Crusher				06				06	As an when required
4	Balancing work				24				24	As an when required
5	Motor Current Analysis				156				156	As an when required
6	NFT Measurement (IPT & LPT) Unit-1 to 7				28				28	During Annual and Capital Overhaul
					Total Auxiliary				700	

### Monetary benefits occur to the company due to Condition Monitoring Cell

Some of the cases are described below to calculate the benefit provide by CM Cell:

#### 1. Auxiliary Cooling Water Pump-C of Unit 7 (500 MW)

Electrical Maintenance called us for analysis of Auxiliary Cooling Water Pump of unit 7 which was running with high vibration. We measure and analyzed vibration of complete auxiliary and during spectrum analysis, we found that stator wedges are loose; we reported same to Electrical Maintenance. As per our recommendation maintenance section has taken work on motor. After dismantling of motor it find that three wedges were loosened. If this H.T motor continues to run in this condition, there might be chances that its winding would be damaged. The motor wedges were tightened and motor was assembled. After this we perform balancing work. The auxiliary was put in service and running satisfactorily.

Approximate cost of rewinding and repairing

this H.T. motor is **Rs.8, 50, 000/-**.

Also there may be production loss if this motor breakdown occurs during running.

This much capital cost is saved because of timely and accurate fault analysis done by our section.

#### 2. Induced Draft Fan of Unit 2 (210 MW)

As per operation staff Unit 2 the ID Fan is having high vibration. So we measure and analyses the vibration and comes to conclusion that ID Fan is Unbalance. Balancing of ID Fan needs at least 6 hours outage so it was decided to bias the fans so that ID Fan will run in safe level of vibration so we adjust the scoop such that vibration will be in alert zone rather than in danger zone and provide restriction on scoop operation.

Later on, planned outage was taken looking to the grid position and balancing is performed in coordination with Boiler Maintenance section, stage I & II

Instead of this, if we would have taken immediate outage, then the production loss will be huge during peak time. Also running ID fan is operated at higher scoop it would have caused major breakdown.

### 3. Primary Air Fan of Unit No. 3 (210 MW)

The fan was detected with heavy noise problem in midnight. We were called for measuring vibration and analyzing the problem. After measuring the vibration we found that the motor NDE bearing was running in rough zone and we recommended maintenance section to replace the bearing. After dismantling the bearing, its balls and outer rings were found cracked. As per the recommendation of Condition Monitoring Cell, maintenance department has taken immediate outage and replaced the bearing. Since the problem was in midnight, demand for power is relatively low on the grid; hence outage has not created much generation loss. This problem would have caused severe generation loss, if replacement of bearing would be done in day time when load on grid is high.

The total savings from the production and repair cost of this complete fan is as under.

Production cost of 1 million units @ rate Rs. 1.20/ per unit (6 hours of 210 MW) is **Rs. 12, 00,000/-**

Cost of repair of motor windings & other repair cost of fan is approximately **Rs. 8, 00,000/-**.

### 4. Natural Frequency Test (NFT) of 210 MW LMW Turbines

During overhaul, Natural Frequency Test or Bump test of 23<sup>th</sup> stage blades of IP Turbine and 25<sup>th</sup> and 29<sup>th</sup> stage blades of LP Turbine is to be measured. The approximate cost for bump test is **Rs 2, 50,000** per turbine. We measure the NFT of turbine during each overhaul, hence making huge saving in NFT cost.

### 5. TG Set, Unit 3 high vibration problem

TG Set, Unit 3 is 210 MW LMW Turbine, it was running with high vibration. We measure its bearing pedestal vibration, during analysis it is found that 1/2 X RPM peaks were predominant. We suggested operation section to increase Turbine Lub Oil Temperature by 1 °C. As per our recommendation Lub Oil Temperature was increased by 1 °C, there was substantial reduction in vibration amplitude.

Outage on turbine was avoided, which saved considerable amount for our company.

The total savings / benefits from above cases is approximately **Rs. 33, 50,000/-**. These are only few cases; there are numerous cases during which CM Cell has saved a sizable amount for our company.

## **Non-Monetary benefits occur to the company due to Condition Monitoring Cell**

Apart from our routine work, we also take opportunities to design and develop various softwares which are helpful for our day-to-day condition monitoring work.

### Brief introductions of some software:

#### ***Vib-Tutor***<sup>®</sup>

VIB-TUTOR software works to assist machinery personnel in managing and analyzing collected machinery condition data. In general, VIB-TUTOR software provides vibration analysis training to new users, trends measurement results, analyzed machinery condition according to data inputted by user and generate reports of analysis for presentation purpose. The VIB-TUTOR is developed in Microsoft VB.net with backend database as MS Access.

This software is copyright vide Registration no SW-4045/2009 under Government of India Copyright Office, New Delhi. This software work is appreciated by Mr. S. Bhat and his team of CPRI, Bangalore during their visit to CSTPS, MSPGCL, Chandrapur. CPRI has specially mentioned note of appreciation for this work in their final report of CSTPS, MSPGCL, Chandrapur.

#### ***Schedule Monitoring Software***

Condition Monitoring Cell maintains monthly schedule of various auxiliaries at CSTPS, MSPGCL, Chandrapur. The Schedule Monitoring Software is basically designed and developed to inform user about the schedule which is required to be completed on that date. The Schedule Monitoring software automatically generates the vibration schedule on the first day of any new month. The Schedule Monitoring Software is developed in Microsoft Visual Basic 6.0 with backend database as MS Access.

#### ***Bearing Fault Detection System using FFT Spectrum***

The Bearing Fault Detection System is developed to diagnose bearing fault by using amplitude values of spectrum. Every anti-frictional bearing has four basic frequencies viz. fundamental Trend Frequency (FTF), Ball Spin Frequency (BSF), Ball Pass Frequency Inner Race (BPFI) and Ball Pass Frequency Outer Race (BPFO). As per user selection of bearing type, the Bearing Fault Detection system calculates all the bearing frequencies. The user

provides data of vibration amplitude and accordingly Bearing Fault Detection System identified the fault in the bearing and generates the analysis report. Bearing Fault Detection System is developed in Microsoft Visual Basic 6.0 with backend database as MS Access.

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Design by Vishnuvenkatesh M. Dhage and Ritesh B. Kanojiya.

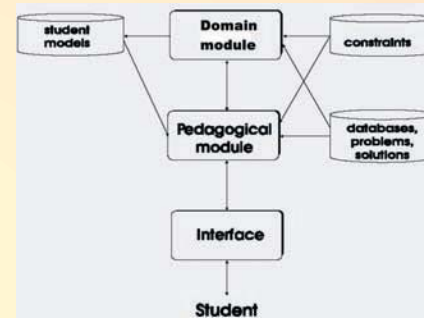
### How to Learn?

*"I hear and I forget.  
I see and I remember.  
I do and I understand."*  
Confucius

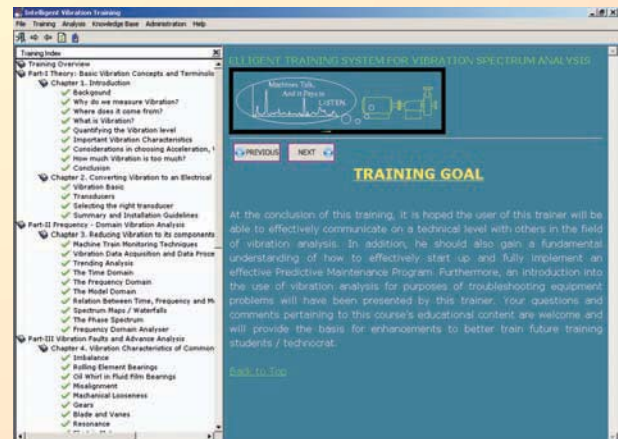
### VIB-TUTOR

- Provide a good "on-hand" practice to student discovering Machinery vibration.
- Teaching with Example
- Vibration analysis with built-in Database relations.  
Useful feedback is given by the system.

### Vib-Tutor Design



### Vib-Tutor Training Screen



### About Vib-Tutor

- Focus on "Machinery Vibration Spectrum Analysis"
- Provide Web based environment for training.
- On hand training examination.
- Multi user interface
- It helps user to achieve complete insight of machinery health.

### Why Learning?

*"Give a man a fish and  
he will eat for a day.  
Teach a man to fish and  
he will eat for the rest of his  
life."*

Chinese

Proverb

### Vib-Tutor Training Model

- Modeling (allows to Use Constraint-Based reduce complexity by focusing on faults only)