DIGITAL PROFILE MAPPING TECHNIQUE (DPMT) DURING TURBINE OVERHAULING

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ABSTRACT: Turbine overhauling involves various critical activities including TG shaft run out measurements, coupling face convexity / concavity measurement and complete measurement of elevation of TG deck , bearing pedestals, ovality of turbine casings, parting plane matching and machine catenary by conventional methods. This paper deals with uses of digital profile mapping technique for fast and accurate measurement of turbine critical dimensions and rectification of the same by real time digital readouts which in turn reduces the turbine overhaul duration as well as saves cost and energy.

INTRODUCTION:

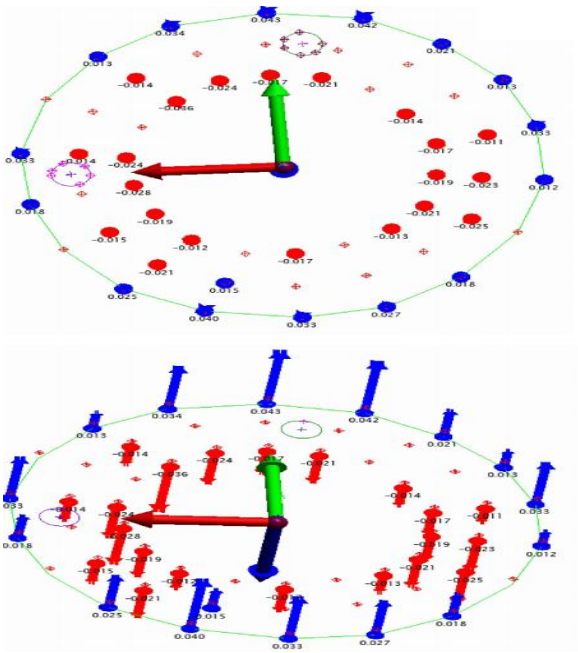
"Digital profile mapping technique (DPMT) blend with customize software solution" enables TG overhauling team to analyze turbine in process activities with real time results to make better and faster decisions with improved accuracy in comparison to current conventional methods. This may results in saving some productive day of total schedule of TG overhauling and eliminating the big hassles of frequent handling of heavy components by TG EOT crane.

DPMT APPLICATIONS:

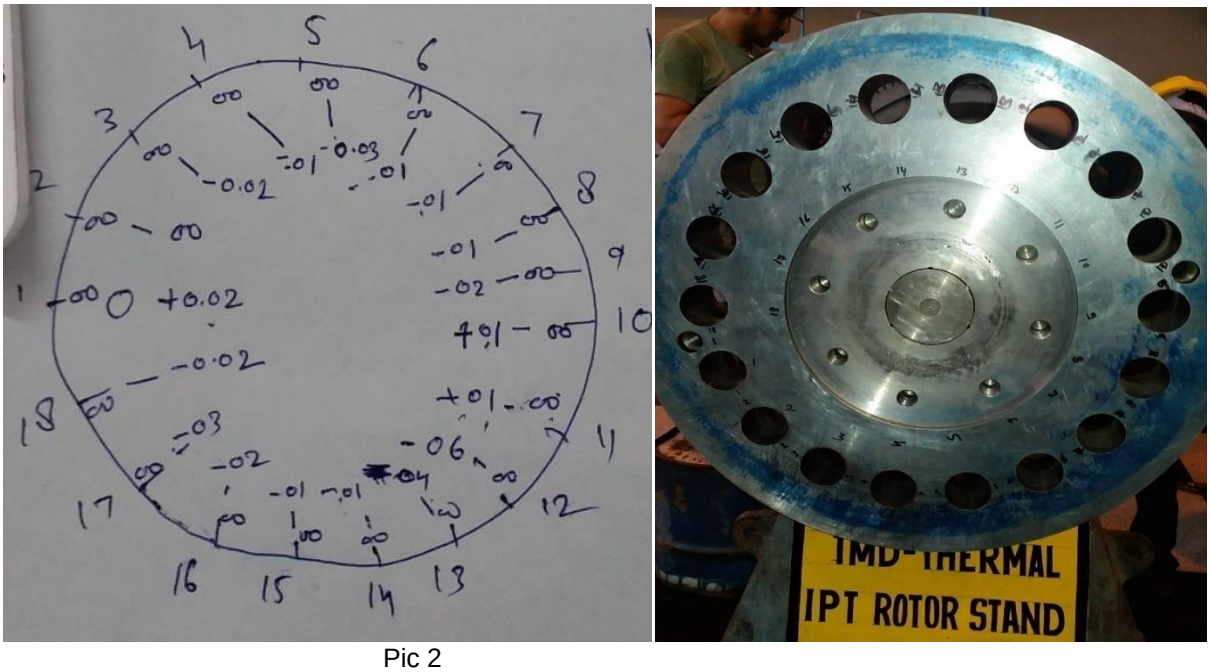
- Turbine coupling face run out mapping (Concavity / Convexity)
- Turbine casing parting Plane Matching
- Turbine Casing Ovality Measurement
- Turbine Pedestal Leveling & Adjustment
- HP Turbine Inner casing centering with outer casing

TURBINE COUPLING FACE RUNOUT MAPPING:

Coupling face concavity / convexity measurement by conventional method and face correction consume lot of time and to find out the best fit position of the couplings we have to shift hole position two to three times and then takes throw at the neck of the coupling to control swing value of turbine. It consumes lot of time and results are uncertain.
In DPMT evenly distributed multiple points are mapped in between two coupling holes face surface. Deviation values are represented in graphical format with plotting hills and valleys. It will give coupling face behavior. Coupling face convexity / concave behavior and real time read outs of coupling faces after each face correction and best fit position for coupling can be identified by superimposing both the coupling faces in 3-D simulation programme. Coupling face run out measured by DPMT shown in Pic: 1 and the measurement with conventional blue check method is shown in Pic: 2



Pic 1: Hills & Valleys graphical Representation



Pic 2

Advantages of DPM over Conventional Method

- Improves measurement accuracy.
- No need of blue ink/check process and it saves time.
- No need of rotor handling for face matching process tightening & loosing of bolts rotations of the rotors on fixed stands or rotator.
- Eliminates the possibilities of deformation by lifting rotors.
- Save energy, process time & crane usage time.
- Minimum scraping position of matching faces can be derived by simulating measured faces in software (at any angle).

- Adjacent coupling faces run-out mapping values can be simulated in software to find the existing results.
- Digital maintained reports of all matching faces will help in plotting and future decision making.
- Real time digital readouts of coupling faces after each correction.

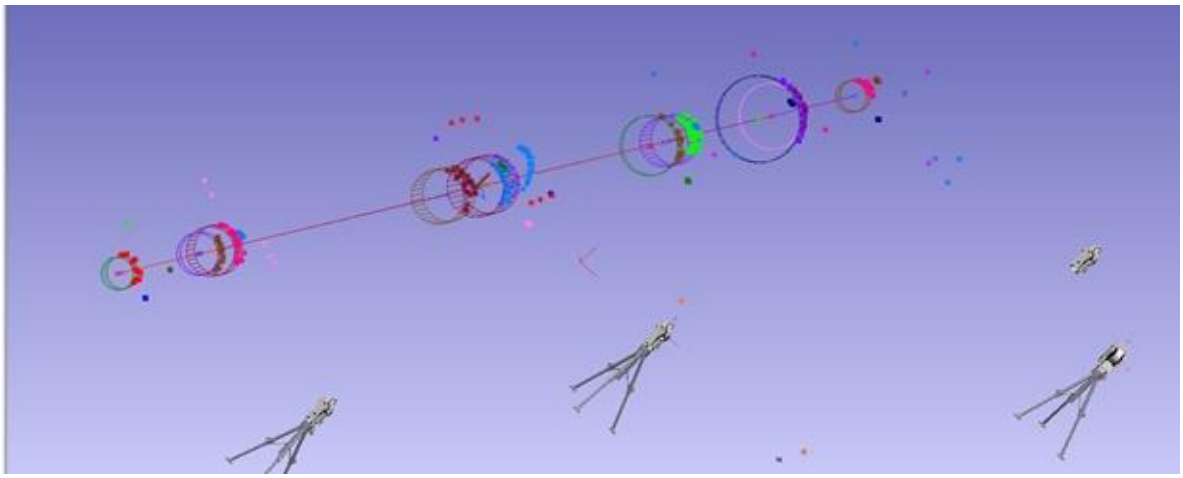
TURBINE PEDESTAL LAVELING/ CATENARY MEASUREMENT

A catenary curve for a turbine-generator gives the actual positions of the bearings as they currently exist and shows the alignment health of unit. The main objective in setting and maintaining rotor alignment is to achieve satisfactory dynamic behavior of the running shaft line. Excessive misalignment can affect the vibration behavior of the multi-bearing shaft line. It imposes an effective bending moment at the couplings which acts like a rotating out-of-balance. During initial erection, bearings are set at appropriate heights relative to one another to form the catenary shape.

The catenary curve is being generated by measuring the shaft centre line at each bearing. Pre leveling and Adjustments will help in achieving precise catenary in final alignment with less time.

Turbine pedestal elevation checking with the help of laser technique will help in creating reference coordinates for future so that catenay can be checked during unit in service. This feature is only possible with laser mapping technique. Laser trackers have been used for these measurements. Pic:3 shows the software representation of the measurement while table:1 shows the catenary reading taken by laser tracker.

In conventional method Pot level measurement is taken to find out the pedestal elevation which is used to calculate catenary which involves several corrections i.e seal bore error, half bore etc. The result of this process also depends on water settlement time, surroundings temperature & air velocity. Table: 2 shows the reading taken by pot level



Pic: 3 Mapping Software Representation

Pedestal 1 Measured at block gauge top	8.229
Pedestal 2 Measured at block gauge top	6.45
Pedestal 3 Measured at block gauge top	4.342
Pedestal 4 Measured at block gauge top	0
Pedestal 5 Measured at block gauge top	0.581
Pedestal 6 Measured at block gauge top	8.759

Table:1

Pedestal No.	Seal bore error	Elevation w.r.t pedestal 4	Pot level	Final catenary after correction
1	0.025	0.72	7.7	8.42
2	-0.755	-0.06	6.88	6.82
3	0.495	1.19	2.2	3.39
4	-0.695	0	0	0

Table:2

Advantages of DPM over Conventional Method (WATER POT LEVEL METHOD)

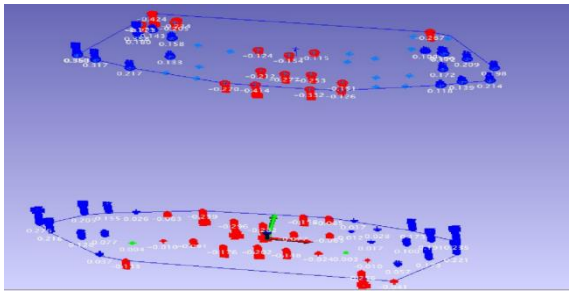
- No waiting for water settlement, temperature control & air velocity.
- No correction required for half bore, seal bore error.
- No block gauge maintenance /manufacturing required.
- Parallel working on turbine pedestals is undisturbed.
- Catenary measurement is possible within 1-2 hours in comparison with 8 hours in conventional method.

TURBINE CASING PARTING PLANE MATCHING & CASING OVALITY MEASURMENT:

Turbine casing parting plane matching carried out to ensure leak proof tightening and to check the ovality of the casing.

Use of a laser for leveling and determining flatness involves by sweeping a laser beam horizontally, making a perfectly horizontal 'plane of sight'. This technique gives speed, accuracy and capability to provide excellent performance.

It measures the flatness of Parting plane and also the convexity / concavity behavior. Real time read outs of the planes correction and best match can be identified by superimposing both the parting planes in simulation programme. Pic. 4 shows the mapping of casing parting plane and their representation. In conventional method the plane matching is carried out by applying blue on the parting plane and hot tightening of top and bottom casing several times to achieve the best match and ovality reading. This process sometimes requires scraping of fins and blade shroud to achieve the best result.

Pic. 4 Real time mapping Report IP inner bottom LH &RH

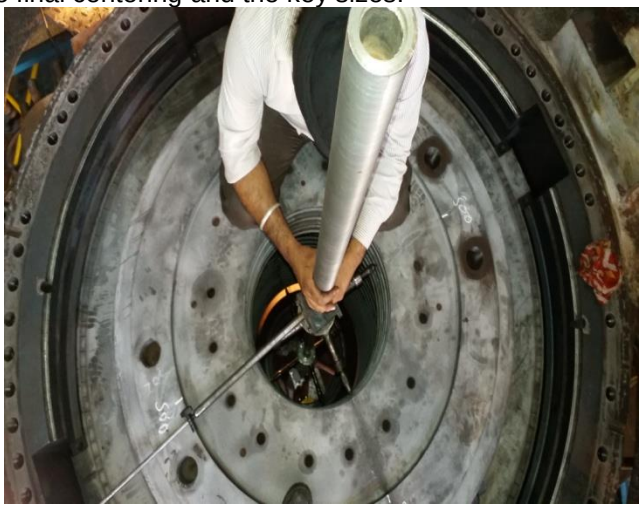
Advantages of DPM over Conventional Method.

- By parting plane matching and circularity check best ovality results can be achieved.
- Result in improved efficiency by optimizing the cutting of fins and blade shrouds.
- Correlation of casing parting plane flatness with ovality will help in accurate decision to achieve box-up in least time.
- No need of repeated casing handling for parting plane matching process by tightening & loosening of bolts.
- **One time box-up save energy, process time & crane usage time.**

FUTURE PROSPECT

HP TURBINE INNER CASING CENTERING WITH OUTER CASING

High pressure turbine inner casing centering with barrel is done to achieve uniform radial clearances and the best efficiency of the turbine.
This process involves the centering device which is first centered with the HP turbine inner casing then the inner casing is put in to the barrel to get the final centering and the key sizes.

Advantages of DPM Over Conventional Method:

- Inner casings & barrel centering can be achieved accurately.
- Precise key sizes can be achieved improve efficiency by accurate centering of inner casing & barrel.
- No conventional tools preparations & indirect measurement preparations.
- No need of repeated center matching process.

- Box-up can be done in least time.
- **HP centering process can be completed in less time in compare to conventional method.**

With the help of laser technique the complete mapping of inner casing & barrel is carried out separately and by simulating in software centering of casing can be done with barrel and proper key size can be calculated**.**