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Turbine Compressor Vibration Analysis and Rotor Movement Evaluation by Shaft Center Line Method (The Case History Related to Main Turbine Compressor of an Olefin Plant in Iran Oil Industries)

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Abstract: Vibration monitoring methods of most critical equipment like main turbine and compressors always play important role in preventive maintenance and management consideration in big industrial plants. There are a number of traditional methods like monitoring the overall vibration data from Bently Nevada paneland the time waveform (TWF) or fast Fourier transform (FFT)monitoring.Besides, Shaft centerline monitoring method developed too much in recent years. There are a number of arguments both in favor of and against this method between people who work in preventive maintenance and condition monitoring systems (vibration analysts). In this paper basic principal of Turbine compressor vibration analysis and rotor movement evaluation by shaft centerline method discussed in details through a case history. This case history is related to main turbine compressor of an olefin plant in Iran oil industry. In addition, some common mistakes that may occur by vibration analyst during the process discussed in details. It is worthy to know that,these mistakes may one of the reasons that sometimes this method seems to be not effective. Furthermore, recent patent and innovation in shaft position and movement evaluation are discussed in this paper.

Key words: Shaft centerline position · Attitude angle · Journal bearing · Sleeve bearing, tilting pad · Steam turbine · Main compressor · Multistage compressor · Condition monitoring · Non-contact probe

INTRODUCTION

The Importance of Shaft Centerline Position: Theturbine or compressor shaftsusuallylocated in journal bearings. the center of the bearing always is in same position because bearing consider as a stationary part after installation but shaft centerline moving in a vertical position. Before starting the process of start up for compressor and warming up the steam turbine, the shaft centerline is below the bearing centerline that calls sleep condition of the main shaft (Figure 1).

After starting the oil pump of the compressor, this centrifugal pump start to injecting oil to the bearing and the huge shaft of compressor start to moving upward gradually. The new shaft centerline moving over bearing center line in a vertical line (shown in figure 2).

The shaft centerline is always over the bearing center line during the turbo compressor operation and of course the shaft centerline will change its position during operation.First, the process ofchanging inshaft center line monitoring is discussed.

The case bearing or housing bearing for most critical equipment is usually thick and the piezoelectric or velocity contact type vibration probe cannot representing the real shaft vibration because of damping phenomena.The traditional condition monitoring system for most critical equipment like steam turbine, gas turbine and multi stage compressors based on journal bearing temperature monitoring [1]. Nowadaysthe condition monitoring system of these types of machines are usuallynon-contact type.A typical none contact probe shown in figure 3. Two non-contactprobes install with 45

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Fig. 1: Bearing center line and shaft center line position in shaft sleep condition.

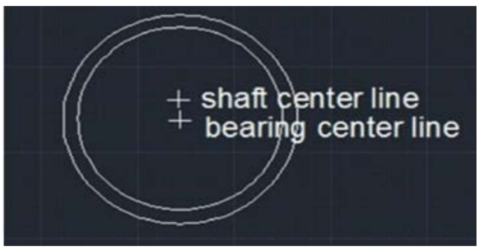

Fig. 2: Bearing center line and shaft center line position before operation.

Fig. 3: Non-contact type probe with 200 mv/mils sensitivity [2]

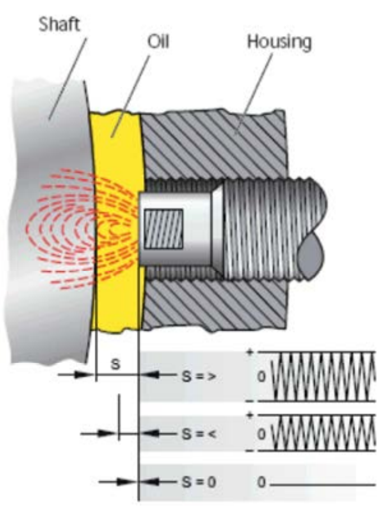

Fig. 4: Measuring principle of an eddy current sensor and definition of direction of movement.

Fig. 5: Bently Nevada non-contact probe location45° degree over the main shaft shown in Figure 5. The installation group calibrates the distance of the probe with shaft due to the material of shaft and probe sensitivity and length of the cables. The probe sensitivity for our non-contact probe is 200 mV/mils called scale factor. It means the probe translate each mils with 200 mV. One mils is unite of distance equal to 25.4 micron usually use in maintenance and mV is equal of 0.001 Volt [2].

The working principle behind eddy current sensors has shown Figure 4. Itis based on the fact that the coil in the sensor head generates an alternating magnetic field whose field lines emerge from the sensor plane, pass through the object and then close again. The measurement field (alternating magnetic field) generates eddy currents in the electrically conductive object, leading to a loss in joules. These eddy current losses in the object increase as the distance to the object decreases.On the input side of the sensor coil, the eddy current losses are reflected in a change in the complexinput impedance, which is measured and evaluated. An output signal proportionalto the distance is formed, such as 0... 10 V or 4... 20 mA.that all will translate to micrometer peak to peak [3].

Beside this monitoring system,A Multi-Probe Setup for the Measurement of Angular Vibrations in a Rotating Shaft recently introduced to measuring the angular vibrationsof a rotating shaft that is effective for monitoring the torsional vibrations in huge turbo machines and compressors. The cogwheel shape can be very irregular, for example the “geared wheel” is represented by some bolts mounted on a joint in the shaft.

By using related formulations, modeling and calibration, we have proposed a theoretical description of the probe output signal, as a function of the angular vibrations and the cogwheel shape [5].

Also beside this method,Shaft Power and Performance Meter recently developed and consider as new patent in mechanical engineering thisSystem is self-supervision by using redundant vibrating string transducers that detached from shaft and fixed to clamp

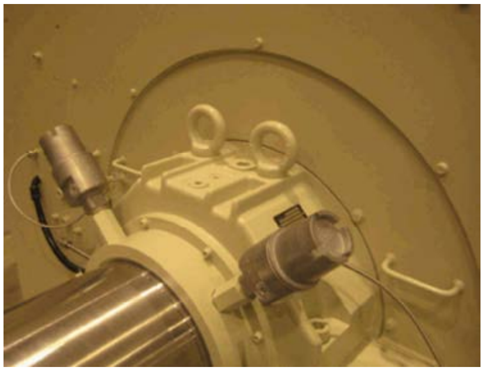

Fig. 6: Typical bently Nevada connections location 45° [4].

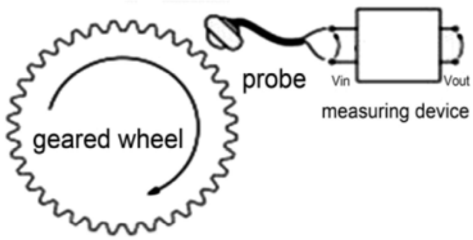

Fig. 7: Measurement of Angular Vibrations in a Rotating Shaft

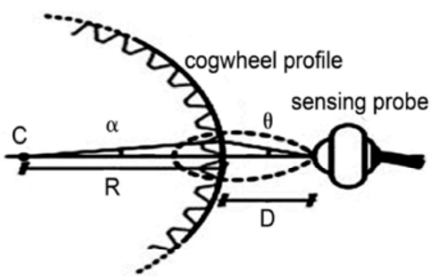

Fig. 8: Experimental set up parameter.

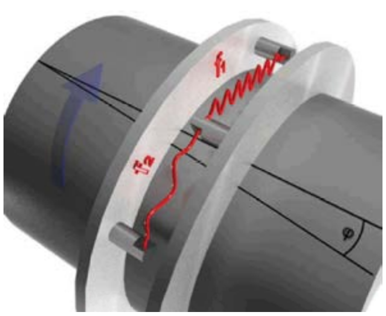

Fig. 9: Principle sensor arrangement

rings, which allow easy dismounting.The principal of this method base on Wireless data and power transmission between shaft and transmission unit [6].

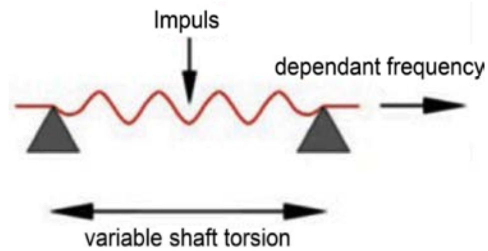

Fig. 10: Vibrating string measuring principle

Fig. 11: Vibrating string transducer MDS 31

If we introduce X and Y axis in the direction of the noncontact probes then we draw the final circle with the center of shaft center line just before operation(due to the machinery installation) and the radial of distance between shaft center and bearing center. This circle called allowable circle. The shaft center linealways should be inside the allowable circle otherwise the touch will accrue between shaft and bearing because of geometry considerations. The shaft center line position have a direction with the center of this circle this line have a degree with axis Y called attitude angle that should be between 20 to 50 in optimal condition [7].

The shaft center line position calculated with following formula:

Center line position =Gap (from Bently Nevada monitoring system) - Gap initial (installation time)/scale factor [8] (1)

Gaps usually are in volt and scale factor is in mv/mils then we should change the unit to volt/mils.

The common mistake occurs when we got the numbers of voltage from probe installation group or machinery group.The numbers must be accurate enough with 0.01 volt otherwise it will make the geometry method useless and cause unreliable conclusion [9].The method have some appendix.One of them is Er number that introduced as the following formula:

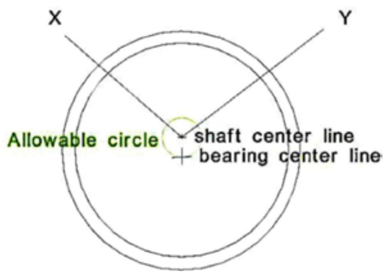

Fig. 12: Allowable circle position

Er=the center line displacement to shaft center/radial bearing clearance (2)

The center line displacement to shaft center calculate by geometric method from the mentioned circles and also radial bearing clearance is the clearance that machinery group installing the bearing in installation time. Eris always between 0 and 1 if Er is more than 0.7 the mechanical system of bearing is stable otherwise the bearing system probably unstableand closer monitoring should be perform for turbine and compressor [10]. The stability of the system is always a function of Er, RPM of the main shaft and clearance of the bearing [11]. One of the new patent and innovation in shaft vibration analysis is Short time amplitude frequency spectrum array for section shaft vibration analysis for mechanical rotor. A short-term spectrum array for mechanic rotor single section shaft vibration analysis called short-term amplitude frequency spectrum array, manufacturing comprising steps of: (1) reading an x signal sequence and y signal sequence in two vertical directions from a section of a rotary shaft collected synchronously; (2) dividing the x signal sequence and y signal sequence according to a certain time delay D and short-term window length L, dividing a group of short-term signal sequence;(3) processing Fourier transformation individually for each pair of two directional short-term signals; (4) solving Fourier levels individually; (5) synthesizing an ellipse by twodirectional Fourier components of each frequency for each pair of Fourier level; (6) calculating size of major semiaxis of the synthesized ellipse, that is shaft vibration component amplitude of each frequency; (7) obtaining short-term amplitude frequency spectrum in the cross section for each pair of two short-term signals, using frequency or order as a transverse axis and shaft vibration amplitude as a vertical axis; (8) arranging short-term amplitude frequency spectrum of each time cross along time axis to obtain short-term amplitude frequency spectrum array[12]. Another aspect of none contact probe is in machinery installation technics and some innovation recently developed in this field. Bearing assemblies including proximity probes for monitoring relative position and vibration of rotating shaft - has bearing housing adapted to rotatable support shaft, cylindrical shell within bearing housing defining shaft bore for receiving rotatable shaft and permitting lubrication during operation Bearing assemblies including proximity probes Bearing assembly including at least one proximity probe for monitoring the relative vibration of a rotating shaft contained therein. The bearing assembly includes a bearing housing surrounding and supporting a cylindrical shell. The cylindrical shell defines a shaft bore for receiving a rotating shaft. At least one proximity probe is embedded in the cylindrical shell for monitoring the shaft vibration. A second proximity probe may be added to enable monitoring radial shaft position. The proximity probes are connected to an instrument or instruments for displaying a signal received from the probes for allowing a user to determine shaft vibration or position [13]. Non-contact probes applications have recentlydeveloped. Methods of measuring copper impurities on a silicon surface are disclosed. In certain embodiments, copper is electrically activated by ultra-violet illumination of the surface at room temperature. Activation can enhance the copper contribution to surface recombination and to surface voltage, which are measured in a noncontact manner using a ac-surface photovoltage and a vibrating Kelvin-probe, respectively. Differential measurements before andafter activation enable the separations of the copper impurities from other surface contaminants [14]. Also An ultra-precision non-contact three-dimensional probing system based on a spherical capacitive plate has a probe which comprises a spherical probing head, a stylus pipe, an active shielding pipe, a signal conducting rod, an insulating element, a stylus holder and a probe body. The stylus pipe, the active shielding pipe and the signal conducting rod are coaxially assembled and they are insulated against each other with the insulating element. The spherical probing head is mounted at one end of the insulating element and it has a spherical capacitive plate over its surface. The capacitive signal coming from the spherical capacitive plate is outputted through the signal-conductingrod. The active shielding pipe is driven by the signal converting and processing circuit of the probing system to maintain equipotential with the signal-conductingrod and so the influence of parasitic capacitance and spatial electromagnetic interference can be eliminated [15]. In operation new techniques,developments a system for warming up a steam turbine includes a gas turbine and a controller operably connected to the gas turbine. The controller is programmed to receive a plurality of measured input signals and control the gas turbine to produce an exhaust having a desired energy. A first measured input signal is reflective of a measured operating parameter of the gas turbine and a second measured input signal is reflective of an operating parameter of the steam turbine. A method for warming up a steam turbine includes sending a plurality of measured input signals to a controller, wherein a first measured input signal reflects a measured operating parameter of a gas turbine and a second measured input signal reflects an operating parameter of the steam turbine. The method further includes controlling the gas turbine based on the plurality of measured input signals and producing an exhaust from the gas turbine, wherein the exhaust has a desired energy [16]. Active non-contact probe card also developed recently Provided is an active non-contact probe card including a carrier, a support base, a piezoelectric material layer, an active sensor array chip and a control circuit. The support base is disposed on the carrier. The piezoelectric material layer is connected with the support base. The position of the active sensor array chip with respect to the carrier is determined according to the thicknesses of the support base and the thicknesses of the piezoelectric material layer. A control circuit provides a control voltage to the piezoelectric material layer to control the thickness of the piezoelectric material layer, so as to adjust the position of the active sensor array chip with respect to the carrier [17].Another new patent and innovation in this field is Short time two-dimension holographic spectrum or vibration analysis for mechanical rotating shaft. A short-term spectrum array for mechanic rotor single section shaft vibration analysis called short-term two-dimensional holograph array, manufacturing comprising steps of: (1) reading an x signal sequence and y signal sequence in two vertical directions from a section of a rotary shaft collected synchronously; (2) dividing the x signal sequence and y signal sequence according to a certain time delay D and short-term window length L, dividing a group of short term signal sequence; (3) synthesizing a short-term two dimensional holograph in a frequency domain with a pair of two directional short-term signal sequences with same time cross; (4) arranging synthesized short-term two-dimensional holograph along time shaft, arranging according to time sequence intercepted according to short-term signal sequence. The short-term two-dimensional holograph array not only reacts dynamic change of amplitude of shaft vibration component along time, but also reacts features that vibration directions change dynamically, being a tool for depth analysis of stable operation of mechanic rotary shaft [18]. Start up and shut down time is one of the most challenging periods in vibration monitoring. Amplitude spectrum array waterfall plot for shaft vibration analysis of starting-stopping process is one of the innovations in this area. The invention relates to an amplitude spectrum array waterfall plot for shaft vibration analysis of starting-stopping process of equipment. A making method of the waterfall plot comprises three steps: (1) reading a pair of vibration displacement signal arrays, i.e. an x signal array and a y signal array of a rotating shaft in the process of starting or stopping; (2) evaluating a synthesized amplitude spectrum of the x signal array and the y signal array at each rotation speed; and (3) arranging the synthesized amplitude spectrum in rising speed or reducing speed sequence into an array plot which is the made amplitude spectrum array waterfall plot. Any amplitude on the waterfall plot made by the method can represent the true amplitude of the corresponding shaft vibration component in a bearing cross section; the shape of the waterfall plot is only involved with the starting and stopping process and has no relationwith the installation position of a sensor; and the invention is convenient for understanding the characteristics of machine states [19]. Multi-range non-contact probe is also considering as a new patent in this area. A multi-range non-contact probe is provided which performs approximate range-finding measurement functions in addition to more precise structured light measurement functions. The probe iscompatible with a probe control interface, which allows advanced measuring capabilities and functions to be used with a probe head system that provides a limited number of wired connections. A laser beam of the probe is directed along a first optical path during a first period for providing structured light measurement functions and is directed along a second optical path for a second time period for providing range finding functions. A single beam modification element having at least first and second portions with different types of optical characteristics is moved to output the laser beam from the first portion along the first optical path and then to output the laser beam from the second portion along the second optical path[20]. Non-contact focused, ultrasonic probe vibration measuring,gauging, condition monitoring is one of the innovation that can have some application in industrial robotics as well as preventive maintenance. Method and apparatus for vibration measurement, gauging, condition monitoring and 5 feedback control of robots, using one or more ultrasonic probes that are non-contact and form a focused beam. The ultrasonic is driven by a pulse-receiver controlled by a computer. The probe has a substantially spherical transducer surface that forms the focused beam within a gas or a liquid. Diameter of the probe determines the size of the beam, which can be chosen to satisfy a particular application. The focused beam has acoustic depth of field, which is the furthest distance from the probe to a surface that can return a measurable echo to a pulse emitted by the probe [21].

The vibration decomposition of wave also is one of the most challenging concepts in preventive maintenance the resolution of graphs increasing day to day the higher amount of resolution cause better and more effective vibration analysis. The filtering ability of data collector also developed too much in recent years.these condition will help us to better understanding of machine condition [22].Wireless sensor networking also developed in recent years the wireless condition monitoring systems have a great advantages comparative to previous portable systems.firstly different maintenance groups have high speed access to vibration information simultaneously and more effectively.secondly these kind of system reduce the amount of errors especially in installation times beside this the monitoring system is closer than conventional type [23]. Optimization decision making of the complex system maintenance strategy like most critical equipment also developed in recent years and have a great economic advantages. The reliability centered maintenance base on stochastically activities in maintenance action help the maintenance management to make optimal decisions [24]. Unbalance and misalignment of most critical equipment coupling is also one of the most challenging concepts in preventive maintenance. the alignment of these kind of equipment have some kind of complexity and have special procedure in technical documents.the unbalance of coupling also hard to diagnosis in conventional vibration analysis methods. the optimum way to diagnosis both faults in turbine compressor vibration analysis is measuring phase in both side of coupling.in this project this activities measured accurately in both side of coupling that represented normal condition of both unbalance and misalignment.Nowadays several methods developed to simulate the coupling of most critical equipment motions all base on vibration modal analysis [25]. the shaft crack represented by monitoring of coast down and run up characteristics when passing through resonance (critical speeds of turbine compressor) both graphs base on phase type d iagrams. different modeling systems recently developed mostly base on vibration modal analysis[26]. An environmental friendly palm-grease has already been formulated from modified RBDPO (Refined Bleach Deodorized Palm Oil) as base oil and lithium soap as thickener. Such palm-grease is dedicated for general application and or equipment working in areas like most critical equipment.there are several conventional methods for diagnosis wear in most critical equipment like turbine compressors some base on diagnosis impacts in TWF but because of the nature of turbine multistage compressors process condition the impact may because of process condition and it could be confusing to distinguish the real cause.rotor rub have usually truncated wave form, symptoms same as mechanical looseness, sub harmonics 1/2,1/3 and so on and also strong harmonic pattern caused by truncation.

The new techniques like shaft centerline method also develop that will explain in next part in this paper [27].

Some methods recently developed for detecting micro vibrations an adaptive inverse dynamics control is applied to control and suppress the micro vibrationsof equipment the piezoelectric layers are used as sensors and actuators. Micro-vibrations, generally defined as low amplitude vibrations at frequencies up to 1 kHz, are now of critical importance in a number of areas like preventive maintenance [28]. the axial motion of rotor can be evaluate by gap voltage analysis two axial none contact probe end of the turbine and compressor rotor should be equal to each other by 0.01 volt accuracy otherwise the rotor is not in parallel condition also the motion of rotor of turbine and compressor should be reasonable by this method otherwise it could be misalignment of coupling or any abnormality in turbine and compressor [29]. the quality of steam in steam turbines is also one of the important factor in vibration behavior of most critical equipment.new generation governor is mostly electronically than previous mechanical systems and have excellent control and close monitoring periods. Thesekinds of new facilities will help us to improve the vibration analysis in preventive maintenance [30]. the main process parameter in most critical equipment like inlet and out let pressure and temperature for both turbine and compressor help us to evaluate the condition of energy balance by thermodynamic laws like second law of thermodynamic.by these kind of consideration we can help our evaluations by modeling the turbine compressor as well as possible and close to performance condition of machine [31].

Abbreviations and Acronyms:

Fast Fourier Transform	=	FFT
Time wave form	=	TWF
Bently Nevada connection	=	BNC
Condition monitoring	=	CM
Preventive maintenance	=	PM
Non drive end	=	NDE
Drive end	=	DE
Peak to peak	=	P-P

Experimental Details: Main turbine compressor MPC-C-8001 thatworking in 11000 RPM equipped with Bently Nevada 3500 series monitoring system. MPC-C-8001 is the heartof an olefin plant in Iran oil industry.The overall vibration measured in micrometer peak-to-peak (p-p).The alert limit is 20 micron and the danger is 40. Then, less than 20 is good and between 20 and 40 is fair.Alarmlamp will appeared in BNC board in substation (alert condition) in fair conditions.More than 40 is rough condition and compressor will automatically tripped to protect the rotary and stationary part of turbo compressor.

The overall vibration trends did not show any considerable increase. The last data was almost constant with previous vibration measured during last 6 month. But the PM group reporting some abnormal noise from drive end bearing of compressor (point number3).the last vibration data reported as following

All the traditional vibration analysis systemswere constant. The phase almost was same in different position and directions.In addition, the axial movement analysis showed nothing abnormal. The TWF and FFT analysis only reliable in radial direction (horizontal or vertical).AllTWF, FFT measured by easy viber data collector (VMI) and analyzed with spectra pro software that we used in our CM group.The turbine side TWF was still in constant shape as following.

The symmetry still exist also the carrier and high frequency ride wave (modulation) is like previous signals. These data all related to POINT 2-turbine DE in vertical position. The FFT also same as previous signals.

The compressor side TWF showed some stronger impact in bearing system but the amplitude of impact not too much to allow us any recommendation for checking bearing systems in point 3. Point 4 was remaining steady in shape of both TWF and FFT. In addition, the FFT form remained constant in all position and direction. The first two diagrams related to point 3 horizontal direction was as following.

Fig. 13: Bently Nevada 3500 series machinery monitoring system.

Fig. 14: MPC-C-8001

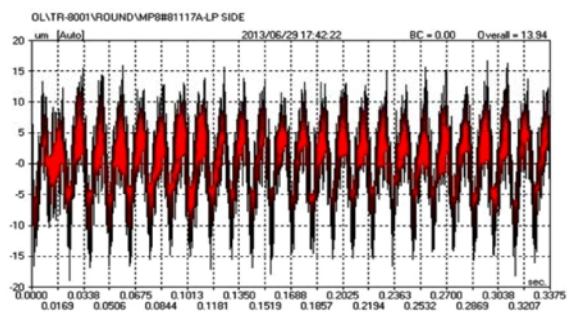

Fig. 15: TWF steam turbine low pressure side.

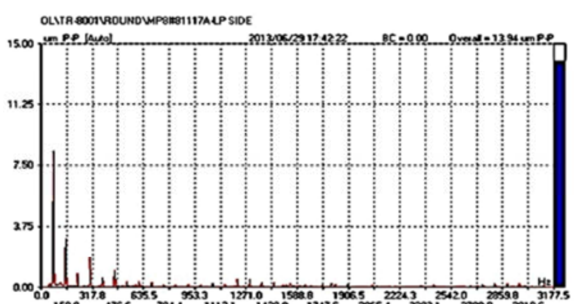

Fig. 16: FFT steam turbine low-pressure side

Furthermore, the following two diagrams related to point 3 vertical direction. The cursor can help usto have better understanding and evaluation for scales between time and amplitude.

Due to performing all analysis and PM report and maintenance history of this main compressor. CM group decided to perform shaftcenterline analysis in point 3 for further vibration analysis.

Table 1: Vibration displacement micrometer peak to peak MPC-C-8001

MPC-C-8001	POINT 1-turbine NDE	POINT 2-turbine DE	POINT 3-compressor DE	POINT 4-compressor NDE
Horizontal	5.39	7.053	13.18	12.22
Vertical	9.29	13.94	11.58	7.48
Axial	7.03	6.07	7.09	6.08

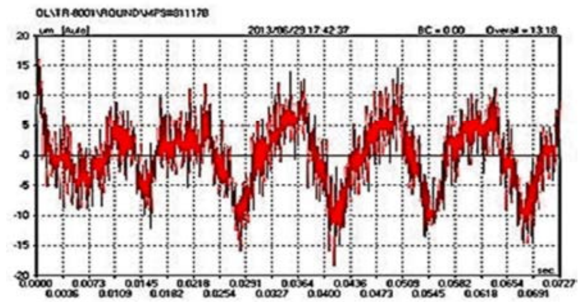

Fig. 17: TWF point 3 horizontal direction

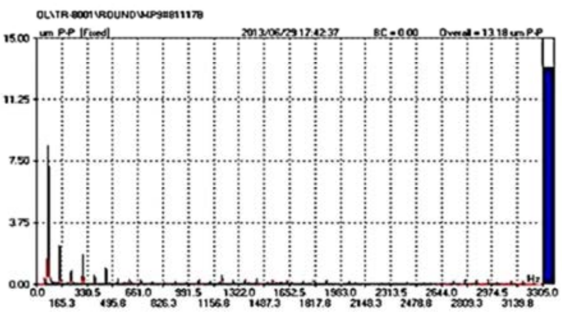

Fig. 18: FFT point 3 horizontal direction

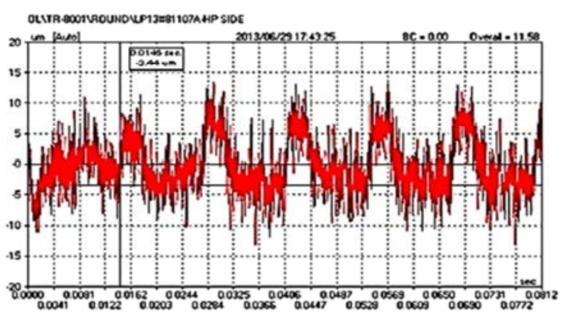

Fig. 19: TWF point 3 vertical direction

Fig. 20: FFT point 3 vertical direction

RESULT AND DISCUSSION

The process condition of both turbine and compressor such as suction and discharge pressure and inlet and outlet temperature was constant and in the range of turbine and compressor technicaldocuments due to the trend data of operation system in main board of olefin plant. In addition, the quality of steam was acceptable and in range of turbine documentation. Therefore, the problem of abnormal noise in point 3 should be mechanical rather than something related to the process problems. I drew the allowable circle and calculated the centerline shaft position,with assist of the gap voltage data monitored, trend from bently Nevada board in substation and the methodology that explained beforeinlatest 34 days.The shaft position data calculated and replaced in following table:

In addition, the shaft centerline position with allowable circle drew as following:

As we can see in this circle the shaft touched the bearing in the down half of the bearing and the bearing may damage in this location. Now we have enough evidence to predict this phenomena and it is mandatory to recommend the operation process department and management to turn of the machine and change the process role of this compressor to the spare compressor simultaneously to continuing the olefin production during maintenance of this compressor. The bearing housing in point three consist of a journal and a thrust bearing. The journal is sleeve type and the thrust is tilting pad. After checking the bearingssystem in point three, the upper half was ok but the down half was touched and damaged seriously.Also the main shaft touch and should be sent to metal spray. The bearing should changeandreinstalled. Thetouched down half of bearingshown in these figures.

The up Half of the Bearing Is as Following.

The Rotor and Man Shaft Condition Were as Following:
As it is clear from the above photos the bearing condition was terrible meanwhile all traditional signals like overall vibrations, BNC data, TWF, FFT, phase trends and gap voltage trends showed nothing abnormal or any dramatic increase.Nevertheless, the shaft centerline monitoring provided enough evidence for suitable and on

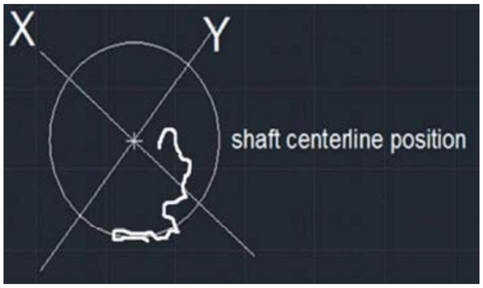

Fig. 21: Shaftcenterline positionMPC-C-8001

Fig. 22: Touched down half of the bearing point 3

Fig. 23: Up half of the bearing point 3

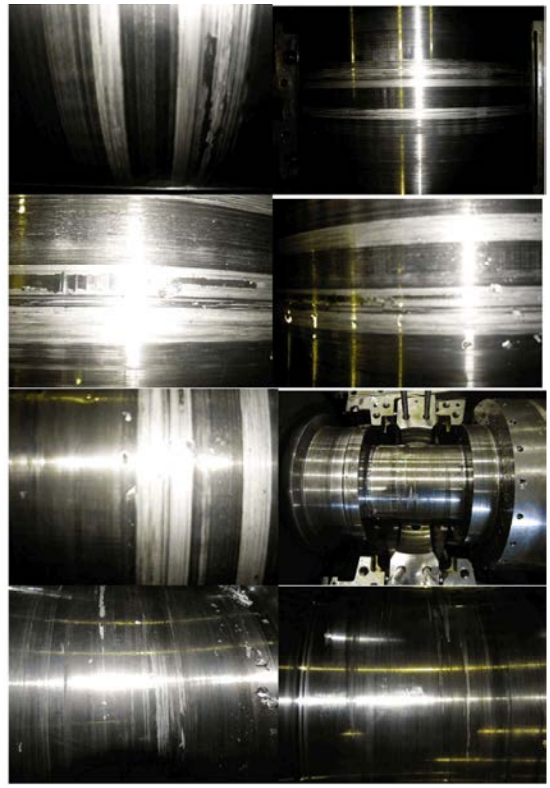

Fig. 24: Rotor and main shaft condition MPC-C-8001

Table 2: Shaftcenterline position data in final allowable circle

Date	27/05/2013	28/05/2013	29/05/2013	30/05/2013	31/05/2013
Y	O.9	1.2	1.2	1.4	1.8
X	-1.2	-1.2	-0.8	-0.6	-0.6
Date	01/06/2013	02/06/2013	03/06/2013	04/06/2013	05/06/2013
Y	2.2	2	1.8	1.5	1.8
X	-0.4	-1	-2.2	-1.5	-1.6
Date	06/06/2013	07/06/2013	08/06/2013	09/06/2013	10/06/2013
Y	1.9	1.9	1.7	2.4	1.6
X	-1.8	-2	-2.2	-2.4	-2.8
Date	11/06/2013	12/06/2013	13/06/2013	14/06/2013	15/06/2013
Y	0.9	0.6	0.4	0.2	0.1
X	-3	-3.2	-3.6	-3.6	-3.5
Date	16/06/2013	17/06/2013	18/06/2013	19/06/2013	20/06/2013
Y	-0.1	-0.6	-1	-1.2	-1.2
X	-3.6	-3	-2.9	-3.5	-3.6
Date	21/06/2013	22/06/2013	23/06/2013	24/06/2013	25/06/2013
Y	-1.4	-1.7	-1.9	-2	-2.2
X	-3.8	-3.9	-4.2	-4.2	-3.5
Date	26/06/2013	27/06/2013	28/06/2013	29/06/2013	
Y	-2.5	-3.2	-4	-4.2	
X	-2.5	-2.3	-2.5	-3	

timerecommendations and cause successful fault prediction.If CM group did not perform this method, the alignment will facedserious problems in next step. The valuable turbine blades might have some touches or damages.Furthermore; some damagesmightoccur in multi stage compressor parts. This would cause high economical maintenance and production costs for the factory. In addition, the plantmightface an unexpected shut down for several hours.The process may have 4 to 5 hourshigh-pressurework to start up the spare compressor.Furthermore, thousands of dollars wasted in these kinds of shutdowns.Because of quit of olefin production.In addition, olefin is the base material for tens of other petrochemical companies in the pet zone and they faced serious problems in production. Besides, petrochemical companies should pay fine to the export ships that coming from far countries every hour. All in all this 4 to 5 hours may cost thousands of dollars wasted in production.Besidethis, we had considerable mechanical part damage like turbine parts and all these evidences showed us the effectiveness of shaft centerline method for future applications in any most critical equipment in any factories comparative to traditional methods.

Current and Future Development: the shaft centerline analysis perform successfully for main steam turbinemultistage compressor MPC-C-8001 related to an olefin plant in Iran oil industry for point 3-compressor drive end bearing. The traditional methods like overall trends of vibration displacement micrometer peak to peak (p-p) by Bently Nevada board in substation, phase trends,TWF and FFTmonitoring did not indicate any dramatic increaseand enough evidence to any machinery maintenance recommendation for checking the bearings but by shaft center line analysis we predict the strong touch in down half of bearing that was completely true.Besides the shaft center line method could predicted the exact location of touches successfully. After maintenance actions, the bearing changed,reinstalled andreplaced. The main shaft sent to metal spray work shop.this successful analysis cause protect potential unexpected shutdown that might posehuge mechanical and production cost on the factory. Therefore shaft centerline analysis could be effective if perform accurately and correctly on most critical equipment. In conclusion, rotor movement evaluation by shaft centerline method is one of the most effective tools in predictive maintenance and condition monitoring systems and low vibration do not always indicate a healthy machine.

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