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Health Indicator (HI) status page:

Wind farm		Turbine type	
Location		Turbine serial	12345
Gearbox type	Winergy PEAB	Gearbox serial	48329
Generator type	ABB AMA	Generator serial	4592628
Report Date	14/07/2015	Author	zha

Component	Damage	HI	Time for reaction
Main Bearing Front (MnFr)	Outer race fault	90	< 1month
1 st Planetary Stage (1Ps)	No Damage	5	n.a.
Carrier Shaft Bearing Front of 1Ps (1PsCrFr)	No Damage	5	n.a.
Carrier Shaft Bearing Front of 1Ps (1PsCrRr)	No Damage	5	n.a.
Planet Wheel Bearing of 1Ps (1PsPlaBrg)	No Damage	5	n.a.
Intermediate Speed Stage (Iss)	No Damage	5	n.a.
Sun Shaft Bearing Front (SuFr)	No Damage	5	n.a.
Sun Shaft Bearing Rear (SuRr)	No Damage	5	n.a.
Sun Shaft Second Bearing Rear (Su2Rr)	No Damage	5	n.a.
Intermediate Speed Shaft Bearing Front (IssFr)	No Damage	5	n.a.
Intermediate Speed Shaft Bearing Rear (IssRr)	Initial inner race fault	30	> 3month
High Speed Stage (Hss)	No Damage	5	n.a.
High Speed Shaft Bearing Front (HssFr)	No Damage	5	n.a.
High Speed Shaft Bearing Rear (HssRr)	No Damage	5	n.a.
Generator (Gn)	No Damage	5	n.a.
Generator Bearing Front (GnFr)	Outer race fault	30	> 3month
Generator Bearing Rear (GnRr)	Outer race fault	30	> 3month

HI	Description	Action
0-10	(010) Component OK.	No action needed.
11-30	(020) Component suspicious / initial fault.	No inspection needed.
31-50	(021) Component suspicious / initial fault.	Inspection at site within next service.
51-66	(030) Component conspicuous / advanced fault.	Inspection at site within one month.
67-100	(040) Component severely affected.	Inspection at site swiftly; exchange expected.

Report details:

Main Bearing Front (MnFr): Outer race damage

Health Indicator	Description	Report Date	Author
90	Component severely affected.	29/02/2016	

Recommended Action

Description	Action	Time for reaction
Main bearing shows clearly pattern of an advanced outer race fault. Trend has reached severe level.	(040) Inspection at site swiftly; exchange expected.	< 1 month

FTT_62_Tr - Main bearing

Wind farm	Turbine type
Location	Turbine serial

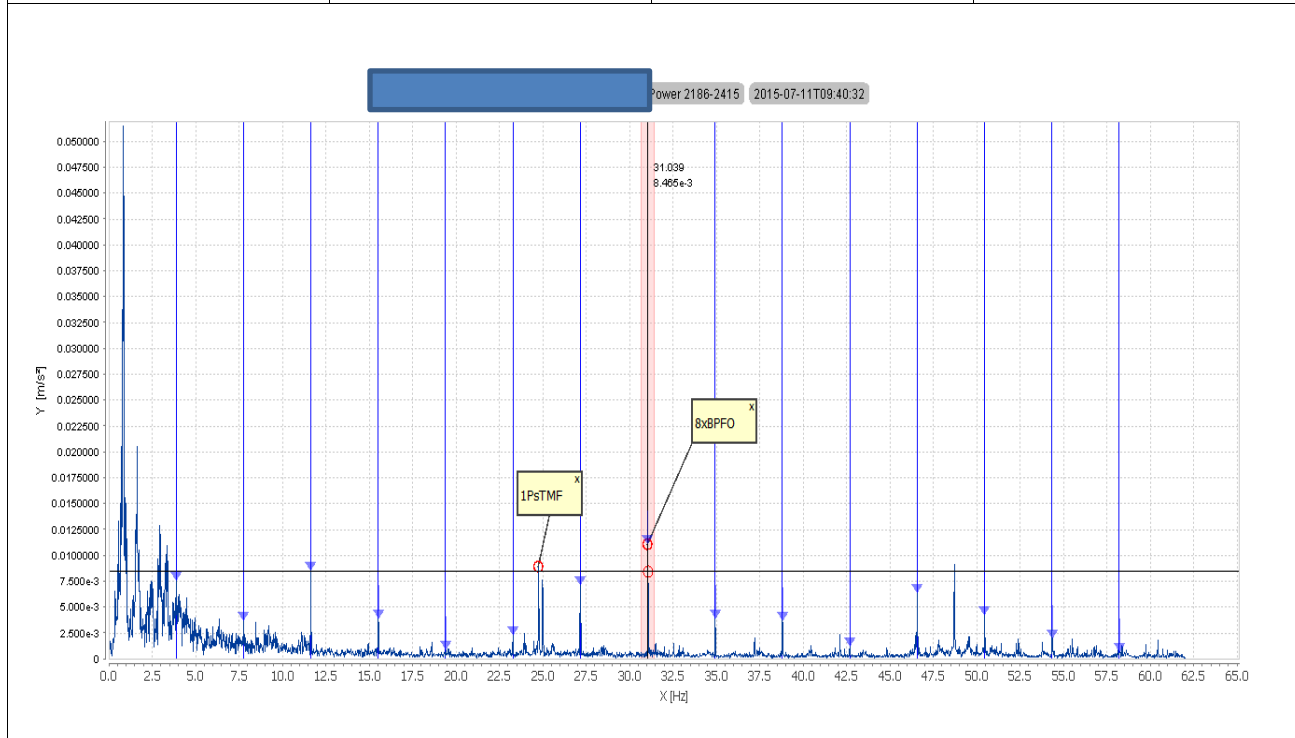


Figure 1

Clear MnFrBPFO fault with a series of harmonics which correspond to a very advanced fault.

Property List of Measurement

Alarm Status	Condition	Power2186-2415
ConfigurationName	Delta	0.7362
Delta Value	Fundamental	3.8812
Measured RPM	Sideband Gap	3.8871
WPS-GeneratorRPM	WPS-ActivePower	2296
Y	X	31.039

FTT_62_Tr - Main bearing

Wind farm		Turbine type	
Location		Turbine serial	

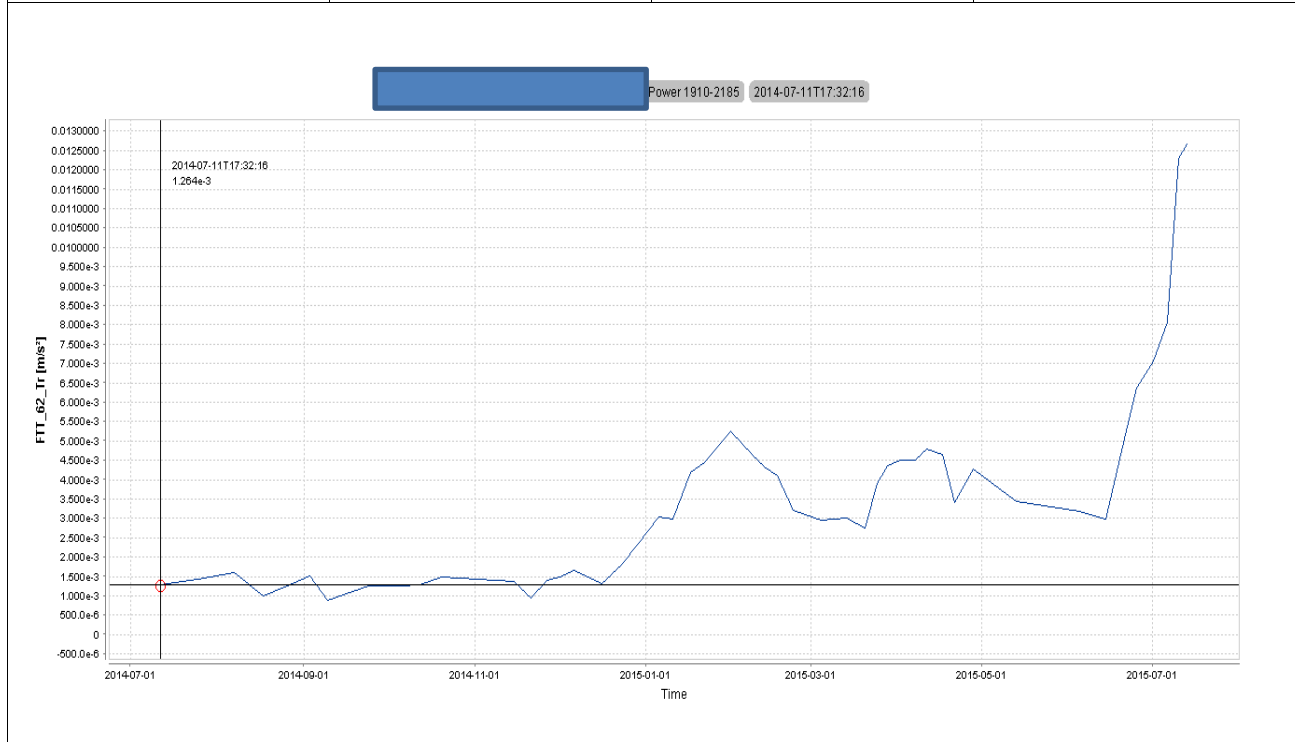


Figure 2

Trend of MnFrBPFO and its harmonics increased significantly.

Property List of Measurement			
Alarm Status		Condition	Power 1910-2185
ConfigurationName		Data Points	50
Duration	107	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1441.849365
Trend Bound Lower	30.670626	Trend Bound Upper	31.406876
WPS-ActivePower	1986	WPS-GeneratorRPM	1439
WPS-WpsStatus	0	X	2014-07-11T17:32:16
Y	1.264e-3		

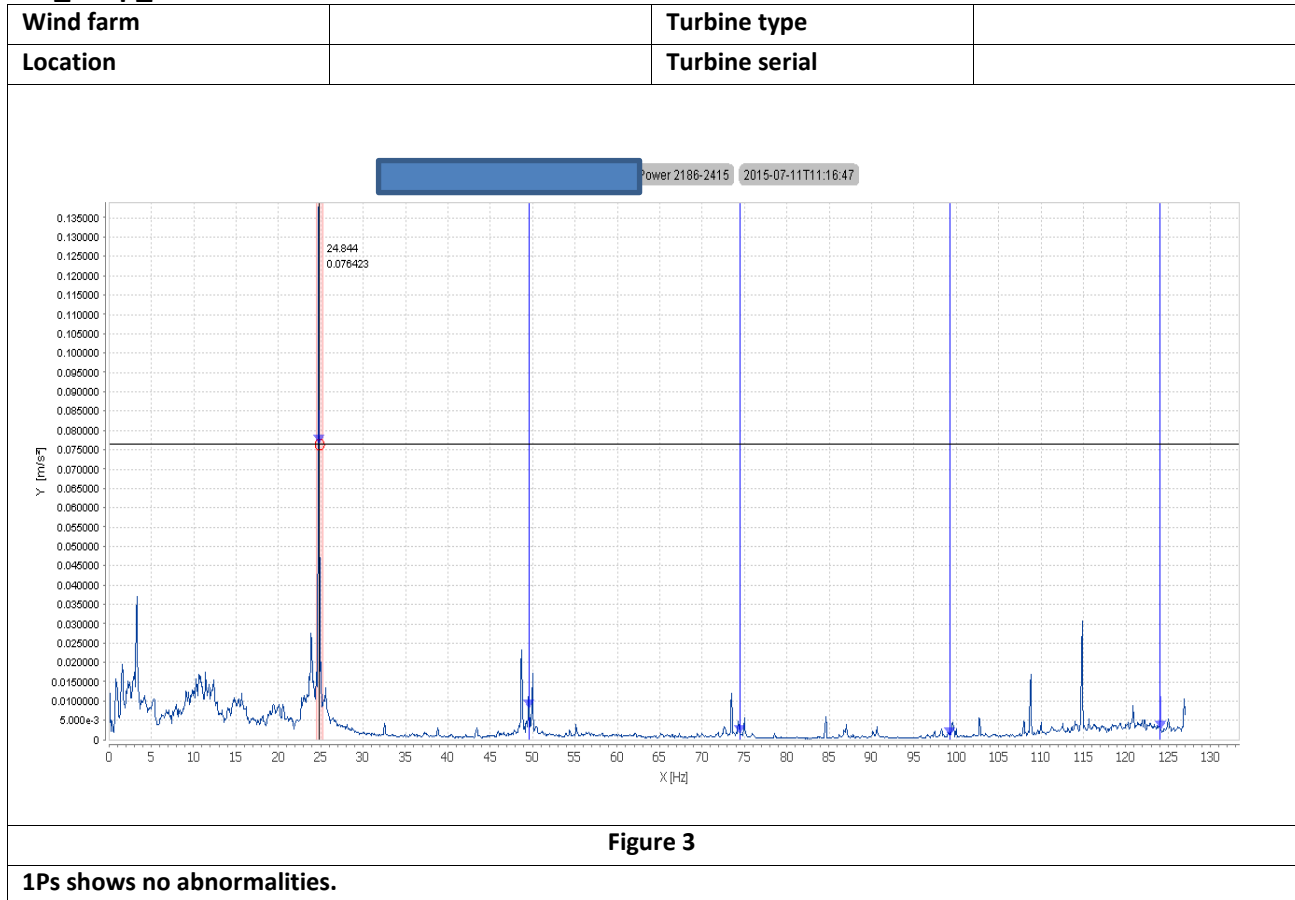
1st Planetary Stage (1Ps): No damage

Health Indicator	Description	Report Date	Author
5	Component OK.	29/02/2016	

Recommended Action

Description	Action	Time for reaction
No abnormalities were found on the planetary stage.	(010) No action needed	Not available.

FFT_127p_Tr - Planet



Property List of Measurement			
Alarm Status		Condition	Power 2186-2415
ConfigurationName		Delta	0.7937
Delta Value	0.145762	Duration	104
Fault Frequency	0	Fault Interval Width	0
Fundamental	24.815	Harmonics	19
Measured RPM	1437.953003	Sideband Gap	6.0297
Sidebands	0	WPS-ActivePower	2234
WPS-GeneratorRPM	1414	X	24.844
Y	0.076423		

FFT_127p_Tr - Planet

Wind farm		Turbine type	
Location		Turbine serial	

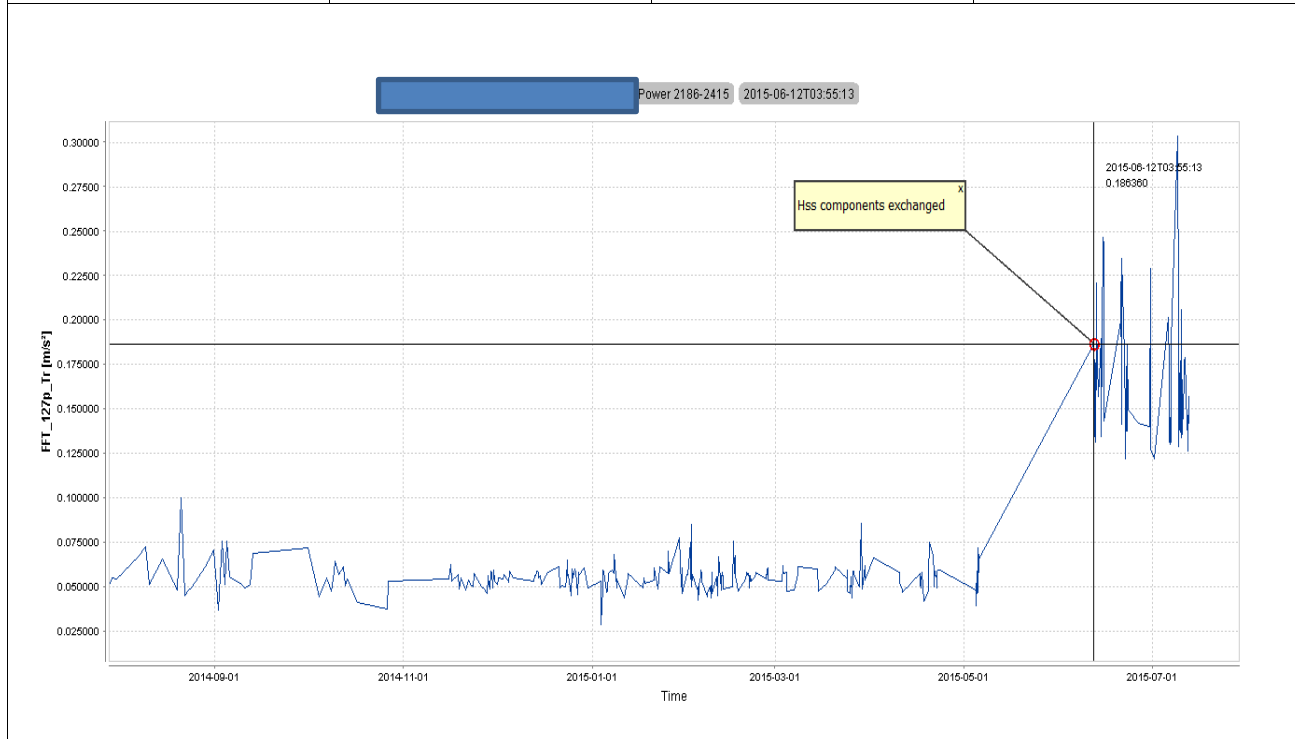


Figure 4

1PsTMF level changed after exchange of Hss components.

Property List of Measurement			
Alarm Status		Condition	Power 2186-2415
ConfigurationName		Data Points	361
Duration	104	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1439.842529
Trend Bound Lower	24.368126	Trend Bound Upper	25.161875
WPS-ActivePower	2305	WPS-GeneratorRPM	1464
WPS-WpsStatus	0	X	2015-06-12T03:55:13
Y	0.186360		

Intermediate Speed Shaft Bearing Rear (IssRr): Inner race damage

Health Indicator	Description	Report Date	Author
30	(021) Component suspicious / initial fault.	29/02/2016	

Recommended Action

Description	Action	Time for reaction
Fault pattern of initial inner race fault of the rear bearing on the intermediate speed shaft (Figure 7) is found. Trends does not show severe increase yet. No abnormalities were found for the tooth engagement of the intermediate speed stage.	Inspection at site within next service.	3month

FFT_300p_Tr - IMS

Wind farm		Turbine type	
Location		Turbine serial	

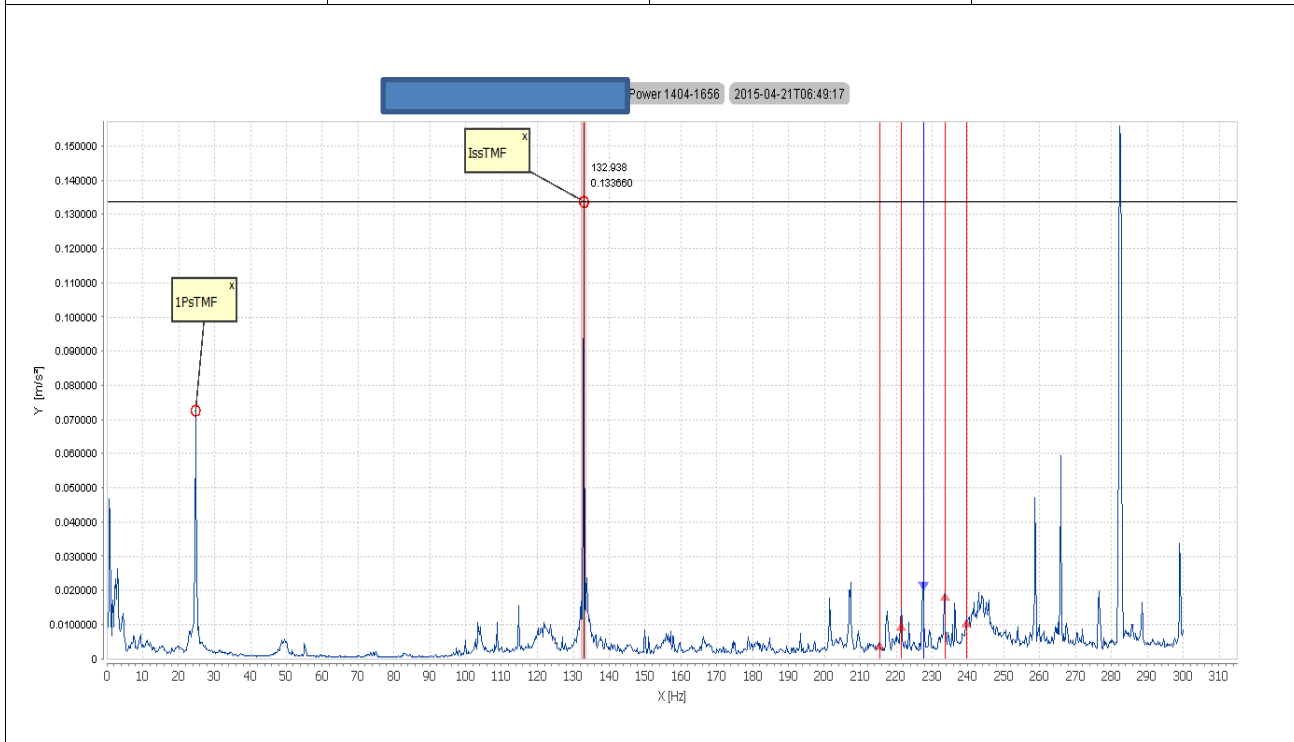


Figure 5

IssTMF without abnormalities.
Spectrum shows series of 6Hz without clear fault indication.

Property List of Measurement			
Measured RPM	1437.666992	Condition	Power 1404-1656
WPS-ActivePower	1583	Delta	1.125
Fundamental	227.57	Sideband Gap	6.0578
Y	0.133660	X	132.938

FFT_300p_Tr - IMS

Wind farm		Turbine type	
Location		Turbine serial	

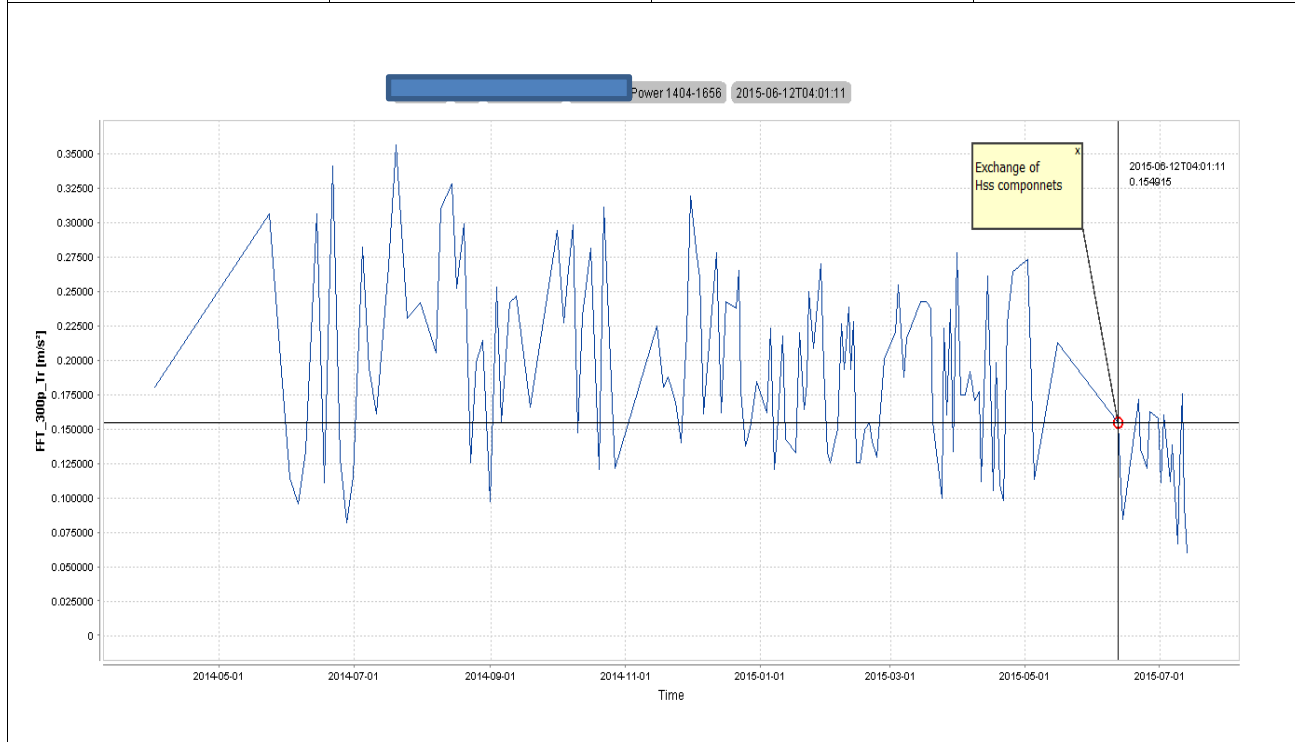


Figure 6

1IsSTMF ceased after exchange of Hss components.

Property List of Measurement			
Alarm Status		Condition	Power 1910-2185
ConfigurationName		Data Points	143
Duration	44	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1450.338379
Trend Bound Lower	132.5625	Trend Bound Upper	133.3125
WPS-ActivePower	1957	WPS-GeneratorRPM	1447
WPS-WpsStatus	0	X	2015-06-12T04:01:11
Y	0.154915		

FFT_1000p_2_Tr - IMS

Wind farm		Turbine type	
Location		Turbine serial	

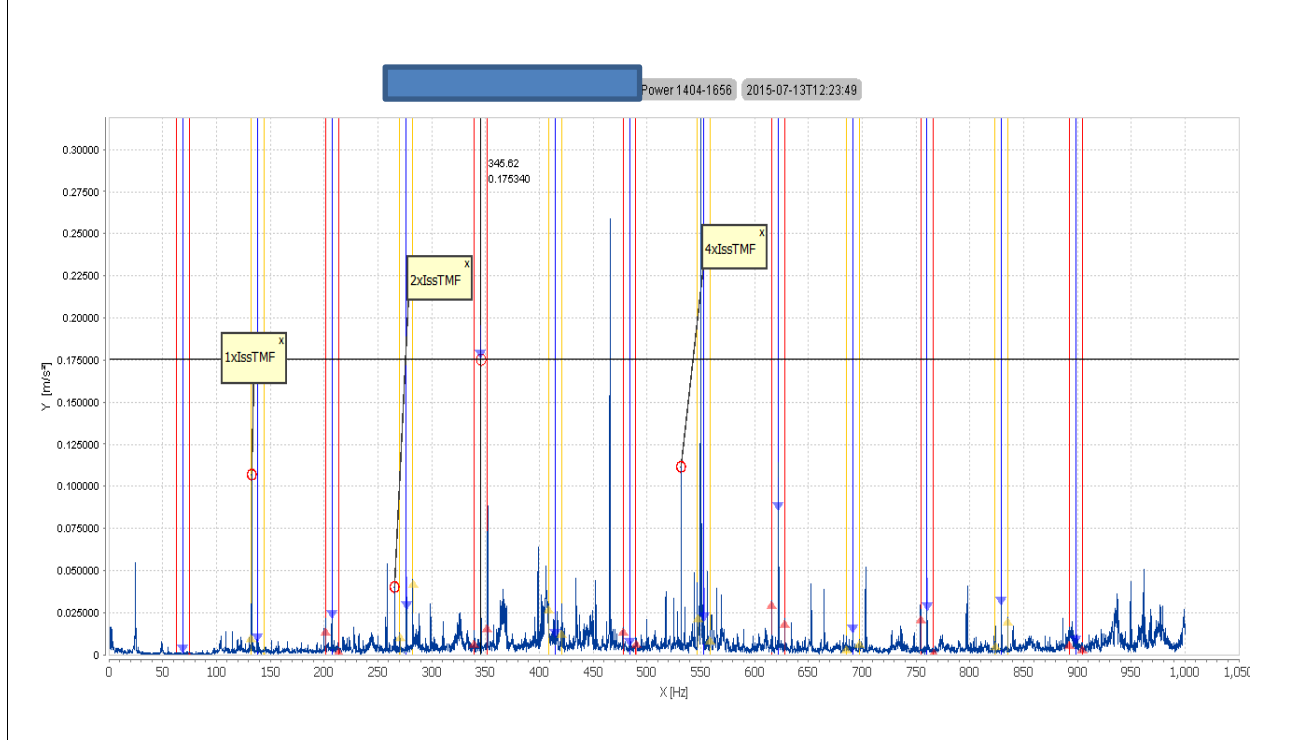


Figure 7

Besides distinctive TMFs there is also a modulation of 69Hz (BPFI IssRr 32244) with 1xIssShf. Other turbines do not show this pattern. Trend constant.

Property List of Measurement			
Alarm Status		Condition	Power 1404-1656
ConfigurationName		Duration	14
Fault Frequency	0	Fault Interval Width	0
Fundamental	69.125	Harmonics	13
Measured RPM	1441.127441	Sideband Gap	6.0000
Sidebands	1	WPS-ActivePower	1437
WPS-GeneratorRPM	1456	X	345.62
Y	0.175340		

High Speed Stage (Hss): No damage

Health Indicator	Description	Report Date	Author
5	Component OK.	29/02/2016	zha

Recommended Action

Description	Action	Time for reaction
No abnormalities were found on the high speed stage.	(010) No action needed	Not available.

Env_4000 - Highspeed

Wind farm		Turbine type	
Location		Turbine serial	

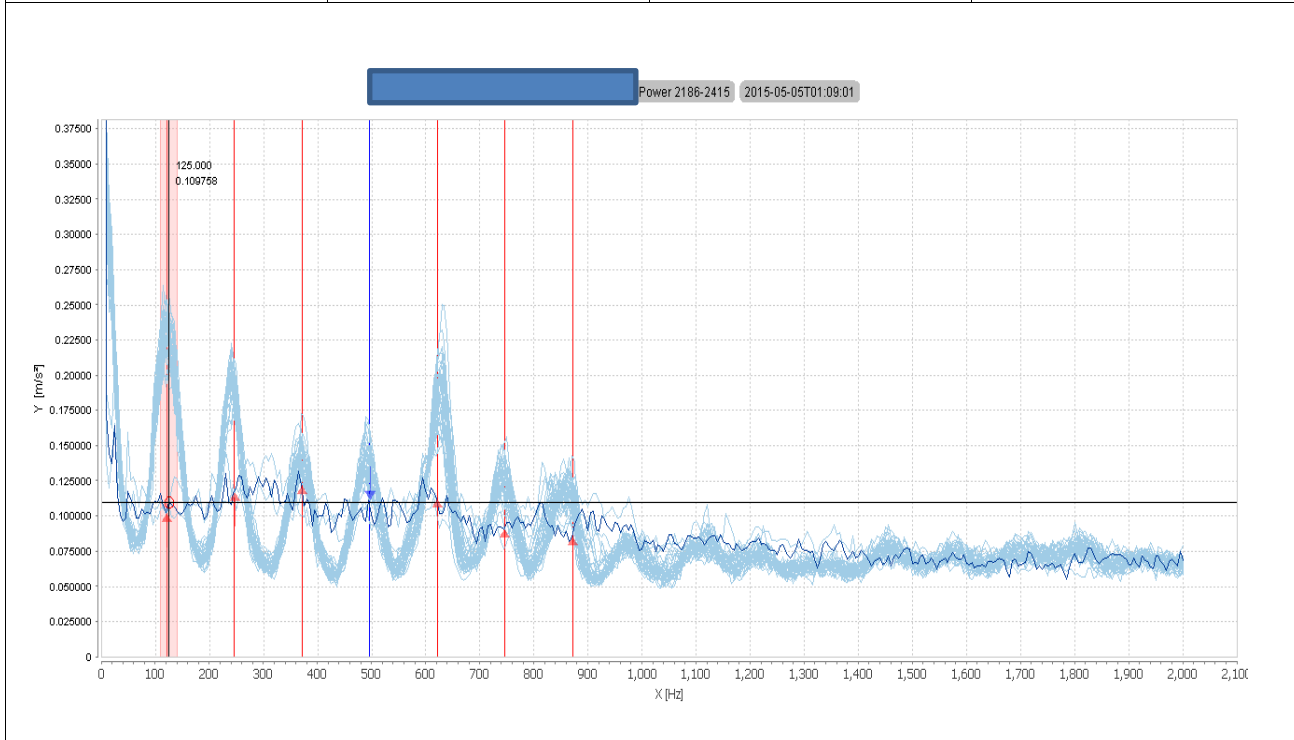


Figure 10

125 Hz with harmonics can not be related to known kinematics and appear after exchange of Hss components - possibly caused by external aggregates. Highlighted curve shows data before exchange. Please check on next occasion turbines condition while running.

Property List of Measurement			
Alarm Status	Green	Condition	Power 1657-1909
ConfigurationName		Delta	30.00
Delta Value	0.23230	Duration	31
Fault Frequency	0	Fault Interval Width	0
Fundamental	496.60	Harmonics	1
Measured RPM	1449.31958	Sideband Gap	125.000
Sidebands	3	WPS-ActivePower	1882.1
WPS-GeneratorRPM	1449.7	WPS-WpsStatus	0
X	125.000	Y	0.109758

Env_6000_Tr - Highspeed

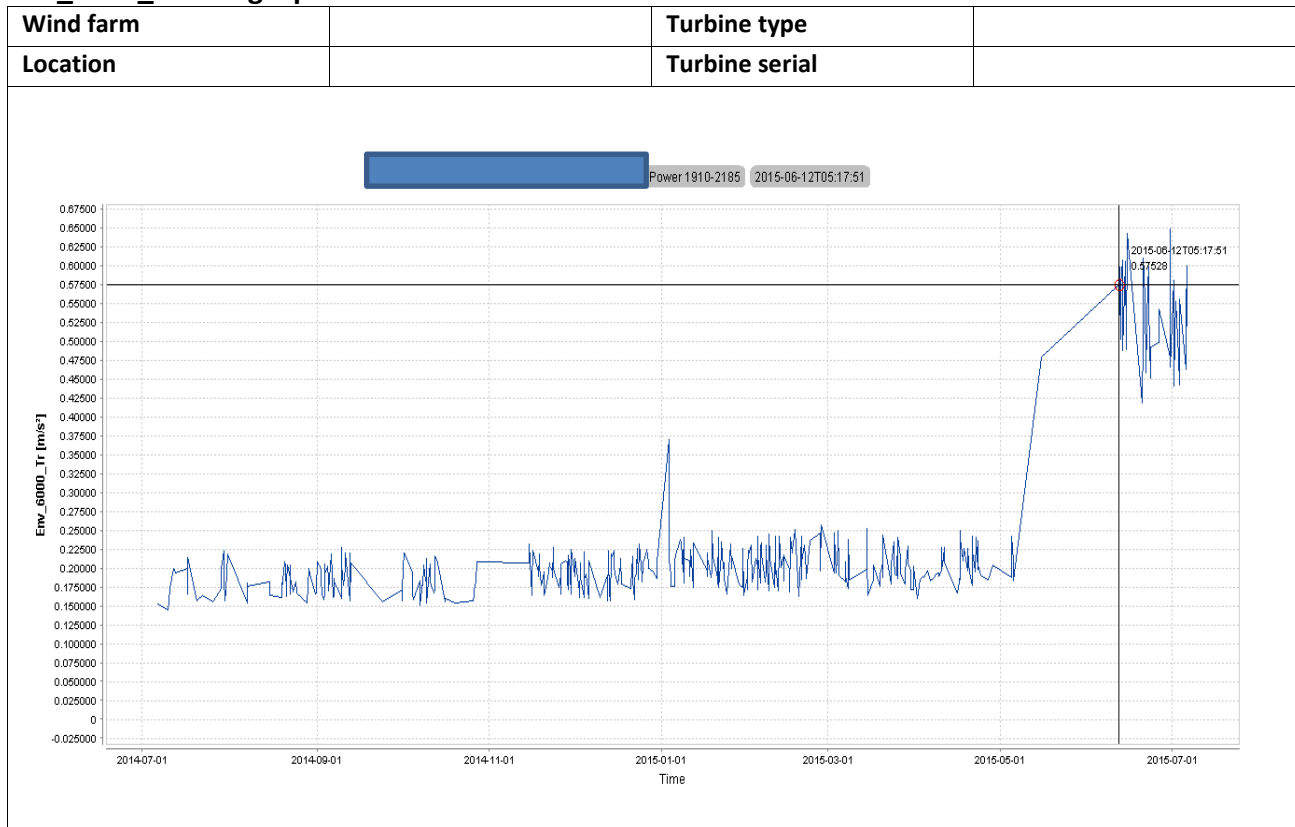


Figure 11

125Hs with clear trend change after exchange of Hss components.

Property List of Measurement			
Alarm Status	Green	Condition	Power 2186-2415
ConfigurationName		Data Points	472
Duration	51	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1465.955078
Trend Bound Lower	105.0	Trend Bound Upper	145.0
WPS-ActivePower	2280.5	WPS-GeneratorRPM	1465.1
WPS-WpsStatus	0	X	2015-06-12T05:17:51
Y	0.57528		

Generator (Gn): Outer race damage

Health Indicator	Description	Report Date	Author
30	(020) Component suspicious / initial fault.	29/02/2016	

Recommended Action

Description	Action	Time for reaction
Pattern of an initial outer race fault is visible. Trend shows first increase of fault related frequencies. Due to same kinematics fault can't be limited to one generator bearing. Abnormalities will be kept under further monitoring.	No inspection needed.	> 3month

Env_7500_4000_Tr - Generator NDE

Wind farm	Turbine type
Location	Turbine serial

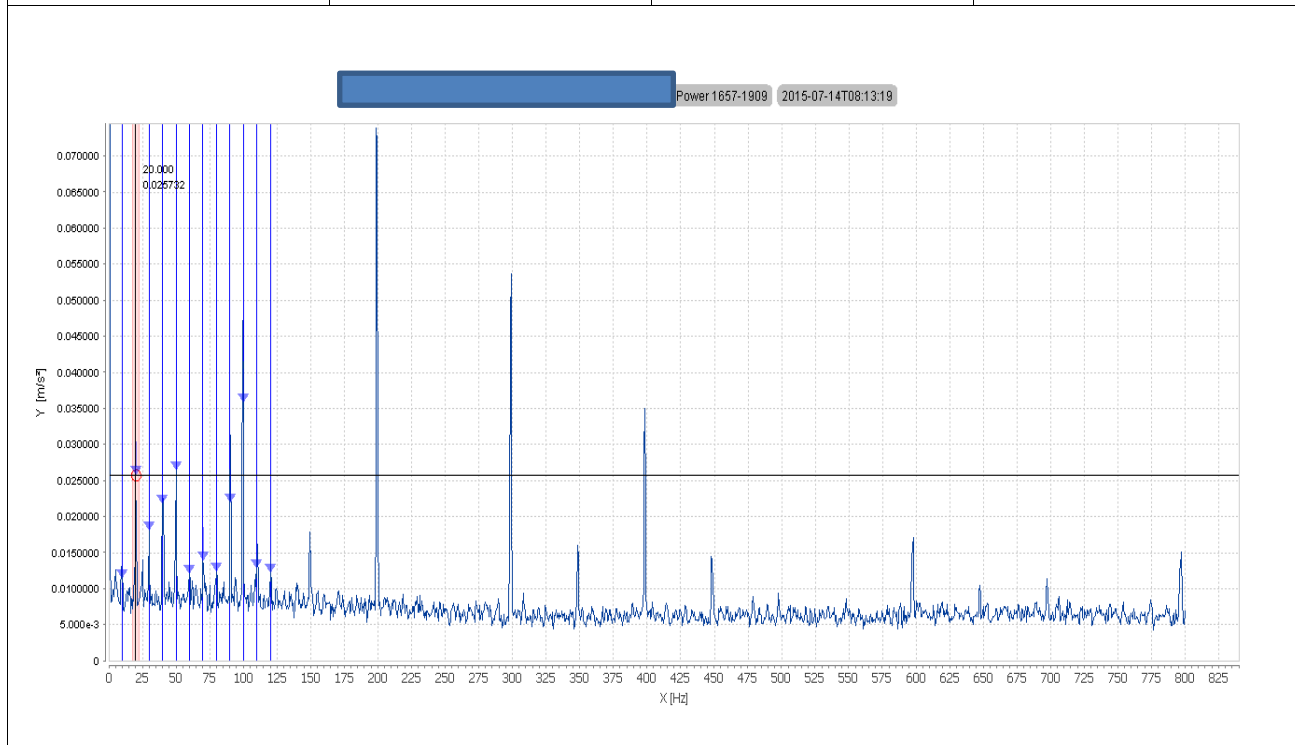


Figure 12

FTF marked with harmonics.

Because of same kinematics fault can't be referred to one of the GnBrg specifically.

Property List of Measurement			
Measured RPM	1422.643311	Condition	Power 1657-1909
Sideband Gap	1.00000	Delta	5.00
Fundamental	10.0026	Harmonics	12
WPS-GeneratorRPM	1469	WPS-ActivePower	1761
Y	0.025732	X	20.000

Env_7500_4000_Tr - Generator NDE

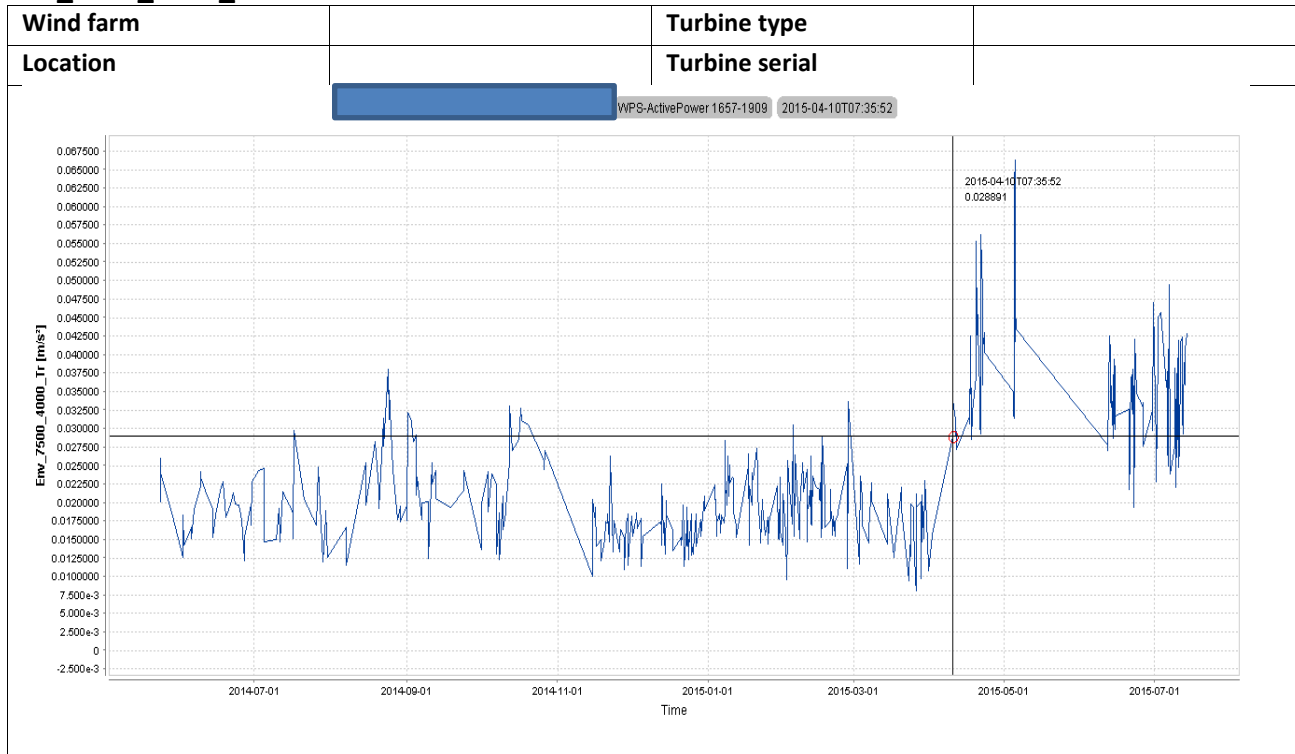


Figure 13

Trend on 2xFTF increased on 10/04/2015.

Property List of Measurement			
Alarm Status		Condition	Power 1657-1909
ConfigurationName		Data Points	500
Duration	22	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1416.046875
Trend Bound Lower	17.5	Trend Bound Upper	22.5
WPS-ActivePower	1808	WPS-GeneratorRPM	1465
WPS-WpsStatus	0	X	2015-04-10T07:35:52
Y	0.028891		

FFT_0-1000_Tr - Generator NDE

Wind farm		Turbine type	
Location		Turbine serial	

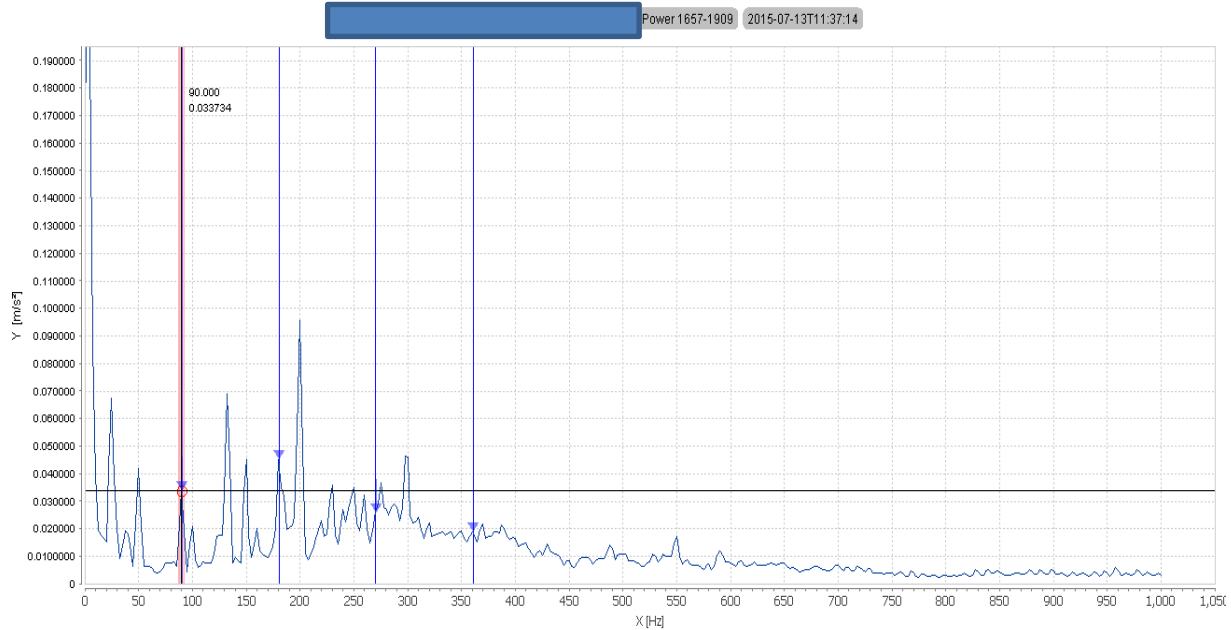
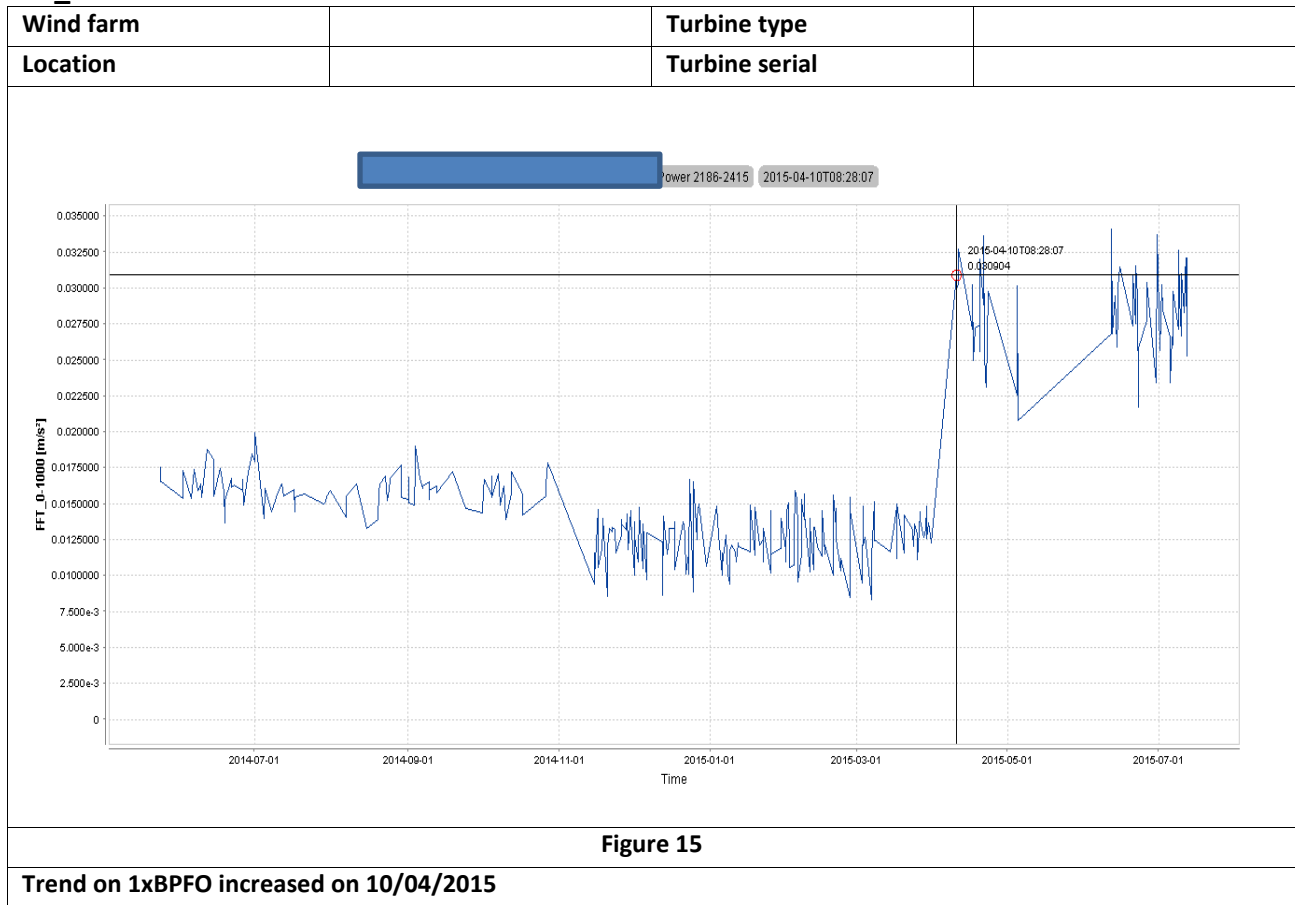


Figure 14

BPFO marked with harmonics.
Because of same kinematics fault can't be referred to one bearing specifically.

Property List of Measurement			
Alarm Status		Condition	Power 1657-1909
ConfigurationName		Delta	5.00
Delta Value	0.034163	Duration	28
Fault Frequency	0	Fault Interval Width	0
Fundamental	90.173	Harmonics	4
Measured RPM	1452.779053	Sideband Gap	27.824
Sidebands	0	WPS-ActivePower	1801.6
WPS-GeneratorRPM	1452.1	X	90.000
Y	0.033734		

FFT_0-1000 - Generator NDE



Property List of Measurement			
Alarm Status		Condition	Power 2186-2415
ConfigurationName		Data Points	312
Duration	21	Fault Frequency	0
Fault Interval Width	0	Measured RPM	1459.337769
Trend Bound Lower	87.5	Trend Bound Upper	92.5
WPS-ActivePower	2303.1	WPS-GeneratorRPM	1459.7
WPS-WpsStatus	0	X	2014-05-23T23:47:58
Y	0.0174913		

Abbreviations:

Abbreviation	Description
1Cp	First coupling
1Ps	First planetary stage
1PsCrFr	First planetary stage, Carrier shaft, bearing front
1PsCrRr	First planetary stage, Carrier shaft, bearing rear
1PsCrShf	First planetary stage, Carrier shaft
1PsPlaBrg	First planetary stage, Planet wheel bearing
2Cp	Second coupling
Brg	Bearing
Fr	Front
FTF	Fundamental Train Frequency
Gbx	Gearbox
Gn	Generator
GnFr	Generator bearing front
GnRr	Generator bearing rear
GnShf	Generator shaft
HI	Health indicator
Hss	High speed stage
Hss2Fr	High speed shaft second bearing front
Hss2Rr	High speed shaft second bearing rear
HssFr	High speed shaft bearing front
HssRr	High speed shaft bearing rear
HssShf	High speed stage shaft
Iss	Intermediate speed stage
Iss2Fr	Intermediate speed shaft second bearing front
Iss2Rr	Intermediate speed shaft second bearing rear
IssFr	Intermediate speed shaft bearing front
IssRr	Intermediate speed shaft bearing rear
IssShf	Intermediate speed stage shaft
MnFr	Main bearing front
MnRr	Main bearing rear
MnShf	Main shaft
Rot	Rotor
Rr	Rear
Su2Rr	Sun shaft second bearing rear
SuFr	Sun shaft bearing front
SuRr	Sun shaft bearing rear
SuShf	Sun shaft
TMF	Tooth Mesh Frequency

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