

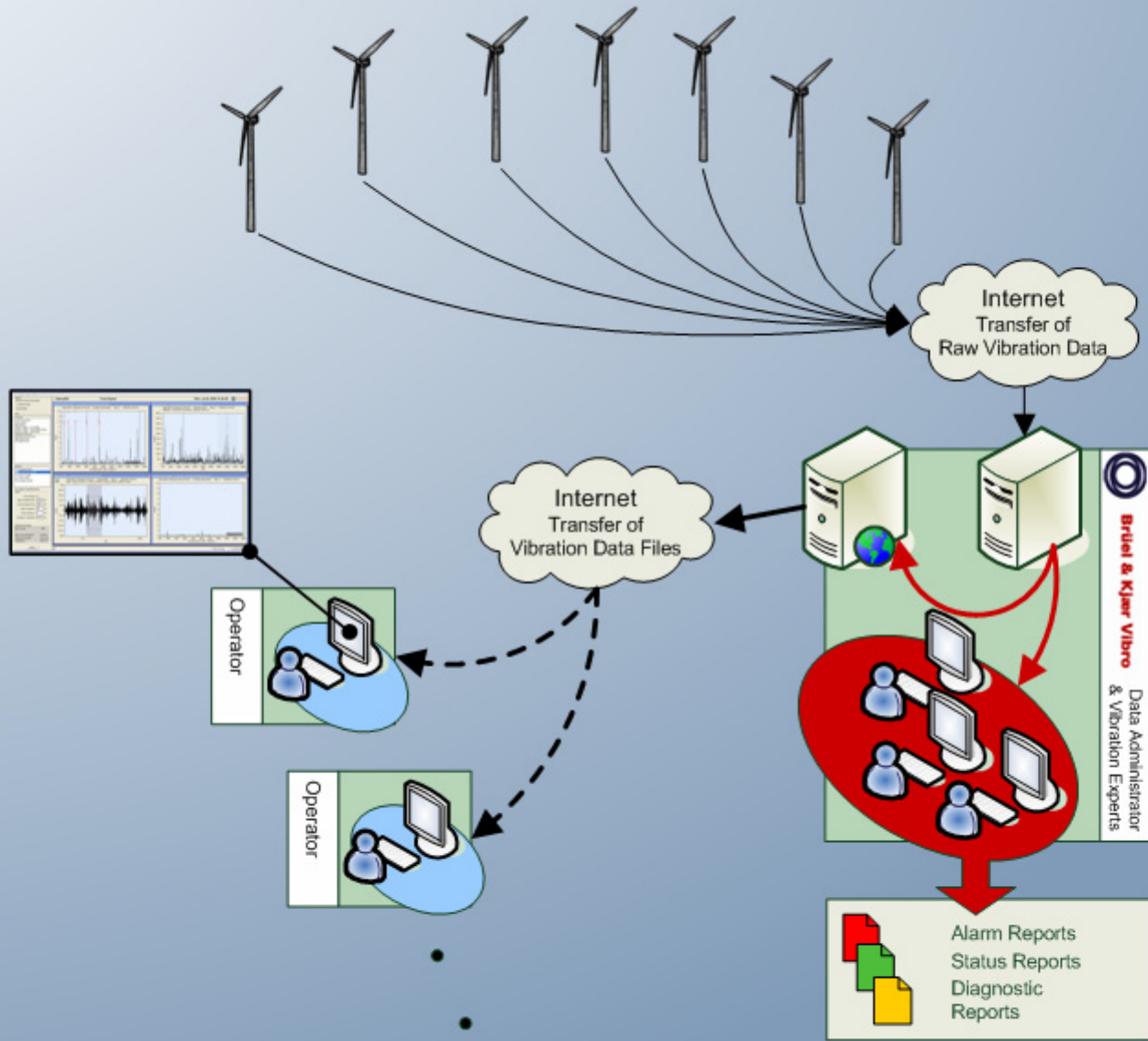


**The WTG
Analyzer**

A Diagnostic Tool for the Operator



System Overview





WTG Analyzer - Zephyr#04 - C:\WTGAnalyzerTest\TEP Files\DDAU111.tep

File Window Help

Options
 Show Process Information
 Replace Mode
 Add Mode

Data

Channel

- Tower Down Wind
- Tower Lateral
- Main Bearing
- Gearbox Stage 1 - Low Speed
- Gearbox Stage 2 - Intermediate Speed
- Gearbox Stage 3 - High Speed
- Generator Drive End
- Generator Non Drive End
- High Speed Tacho
- Low Speed Tacho

Analysis

- Autospectrum#1
- Envelope Spectrum#2
- Timerecord
- BCU Trend
- RMS Trend
- Zoom Spectrum#6

Compass Compatible Setup

Setup

Scan Average:

Centre Frequency: 600 Hz

Frequency Span: 200 Hz

Frequency Resolution: 0.250 Hz

Analysis Information

No. of Lines: 800

Max. Freq. Resolution: 0.098 Hz

Timerecord Length: 10.24 sec.

Samplerate: 25600 Hz

Update

Zephyr#04 Fixed Speed Mon, Jul 04, 2005 15:45:29

Autospectrum#1 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Autospectrum#1 Class: 4 04/07/05 15:45:29
 Harmonic - 1st Order: 91.000 Hz Spacing: 90.571 Hz
 Delta - ΔFreq: 67.144 Hz ΔLevel: 64.676 m ΔRMS: 336.122 m

Autospectrum

Harmonic Cursor

Delta Cursor

Zoom Spectrum#6 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Zoom Spectrum#6 Class: 4 04/07/05 15:45:29
 Sideband - Centre freq: 634.250 Hz Spacing: 16.826 Hz

Zoom Spectrum

Sideband Cursor

Process values - Zephyr#04

OK Gen State Class

0 1 2 3 U 1 2 3 4 5

WTG: Zephyr#04
 Type: Fixed Speed
 Date: Monday, July 04, 2005 15:45:29

Description	Value	Value	Lower Limit	Upper Limit
Power mean	934.412 kW		-200	
Generator state	2		0	3
Power min	596.231 kW		-200	2000
Power max	1213.57 kW		-200	2000
Power act	977.675 kW		-200	2000

Process Values

Idle



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Data

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- Tower Lateral
- Main Bearing
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- Gearbox Stage 2 - Intermediate Speed
- Gearbox Stage 3 - High Speed
- Generator Drive End
- Generator Non Drive End
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Analysis

- Autospectrum#1
- Envelope Spectrum#2
- Timerecord
- BCU Trend
- RMS Trend

Compass Compatible Setup

Setup

Selected Measurement:
 #16 Driven End (BCU)

Select Measurement

Update

Idle

Zephyr#04 Fixed Speed Mon, Jul 04, 2005 15:45:29

Autospectrum#1 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Autospectrum#1 Class: 4 04/07/05 15:45:29

500 m
450 m
400 m
350 m
300 m
250 m
200 m
150 m
100 m
50 m
0

0Hz 50Hz 100Hz 150Hz 200Hz 250Hz 300Hz 350Hz 400Hz 450Hz 500Hz

[m/s²]

[Hz]

(317.00, 138.17 m)

Faults:

- Main Bearing
- Generator Drive End
- Generator shaft#9
- Rotor Faults
 - 1X
 - Harm(1X)
 - 2X
- Bearing Faults
 - Pos.1.1
 - BPF1
 - Harm
 - BPF0
 - Harm(BPF0)
 - BSP
 - 2xBSP
 - Harm(2xBSP)
 - FTF
 - FTF
 - Harm(FTF)

Ball Passing Frequency Inner Ring. High level of BPF1 and its harmonics indicates pitting, spalling or cracks on the inner race of the bearing. The bandwidth broadens as the bearing component degrades. Usually modulated by the running speed. CAUSES: Electrostatic discharge General wear Excessive loading Misalignment, unbalance, bent shaft Performance problems (cavitation, turbulence, etc.) Bearing lubrication problems (too much causes over heating, too little causes increased wear)

Generator Speed 16.0 OK

Scalar Trend#3 - Generator Drive End (Channel_00)

Zephyr#04 Driven End (BCU) Class: 3 Timespan: 15/05/05 - 14/09/05
 Delta - ΔTime: 29 Days 7 Hours 10 Min ΔLevel: 2.387

10
9
8
7
6
5
4
3
2
1
0

15/05/05 00:00:00 14/06/05 18:00:00 15/07/05 12:00:00 15/08/05 06:00:00 15/09/05 00:00:00

[BCU]

Class1
Class2
Class3

- Danger (5.000)
- Alert (2.425)
- Reference (647.835 m)

17/06/05 19:54:10
5.000 BCU

Scalar Trend Delta Cursor

Kinematical Annotations

Fault Browser

Fault Explanations

Scalar Trend

Scalar Trend Delta Cursor



WTG Analyzer - Zephyr#05 - C:\WTGAnalyzerTest\TEP Files\DDAU111.tep

Options: Show Process Information, Replace Mode, Add Mode

Data: Channel: Gearbox Stage 1 - Low Speed, Gearbox Stage 2 - Intermediate Speed, Gearbox Stage 3 - High Speed, Generator Drive End, Generator Non Drive End, High Speed Tacho, Low Speed Tacho

Analysis: Autospectrum#1, Envelope Spectrum#2, Cepstrum#3, Scalar Trend#4

Compass Compatible Setup: Scan Average: , Upper Frequency: 1000 Hz, Lower Frequency: 0 Hz, Clip Data At: 50 dB, Frequency Resolution: 1.000 Hz

Analysis Information: Cepstrum Full Scale: 500.00 m sec., Cepstrum Resolution: 500.00 μ sec., No. of Lines: 1000, Max. Freq. Resolution: 0.100 Hz, Timerecord Length: 10.00 sec., Samplerate: 25600 Hz

Update

Zephyr#05 Fixed Speed Mon, Feb 28, 2005 10:46:25

Autospectrum#1 - Gearbox Stage 2 - Intermediate Speed (Channel_03)

Zephyr#05 / Gearbox Stage 2 - Intermediate Speed Autospectrum#1 Class: 4 28/02/05 10:46:25

Zoomed Spectrum

Kinematical Annotation

Fault Explanation

Tooth Meshing Frequency. High level indicates gear fault that repeats itself for each tooth meshing. Symptoms are: Vibration increase at the tooth meshing frequency and its 2X and 3X harmonics. Sidebands or large energy under the gear mesh frequency usually indicate problems. The frequency is usually modulated by the running speed of the bad gear. Radial direction vibration at the tooth meshing frequency with 5-6 sidebands at gear rpm) is dominant for spur gears. Machining errors during hobbing can cause high 2X or 3X gear rpm vibration. Causes: Wear, Fabrication error, Load

Cepstrum#3 - Gearbox Stage 2 - Intermediate Speed (Channel_03)

Zephyr#05 / Gearbox Stage 2 - Intermediate Speed Cepstrum#3 Class: 4 28/02/05 10:46:25

X: 2.00 Hz, Y: 0.21 dB

Cepstrum

Short User Annotation

User Annotation Text

Conforms presence of sidebands around the gearmesh frequencies at third stage shaft speed.(High Speed Shaft). gearbox 2nd and 3rd stage should be examined as soon as possible. Particular attention should be paid to the gears at the high speed end of the intermediate shaft and the gears on the output shaft.



WTG Analyzer - Zephyr#05 - C:\WTGAnalyzerTest\TEP Files\DDAU111.tep

File Window Help

Options
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Data
 Channel
 Gearbox Stage 1 - Low Speed
 Gearbox Stage 2 - Intermediate Speed
 Gearbox Stage 3 - High Speed
 Generator Drive End
 Generator Non Drive End
 High Speed Tacho
 Low Speed Tacho

Analysis
 Autospectrum#1
 Envelope Spectrum#2
 Cepstrum#3
 Timerecord#4
 Scalar Trend#5

Compass Compatible Setup
 Setup
 Scan Average:
 Upper Envelope Freq.: 10000 Hz
 Lower Envelope Freq.: 1120 Hz
 Upper Frequency: 200 Hz
 Lower Frequency: 0 Hz
 Frequency Resolution: 0.200 Hz

Analysis Information
 No. of Lines: 1000
 Max. Freq. Resolution: 0.100 Hz
 Timerecord Length: 10.00 sec.
 Samplerate: 25600 Hz

Update

Zephyr#05 Fixed Speed Mon, Feb 28, 2005 10:46:25

Envelope Spectrum#2 - Gearbox Stage 3 - High Speed (Channel_04)

Zephyr#05 / Gearbox Stage 3 - High Speed Envelope Spectrum#2 Class: 4 28/02/05 10:46:25

High Speed Shaft - Harmonics of Running Speed

Short User Annotation

Envelope Spectrum

Significant peaks in the envelope spectrum at 16.8 Hz and it's harmonics related to impact type effect occurring at 3rd stage shaft speed.

User Annotation Text

Timerecord#4 - Gearbox Stage 3 - High Speed (Channel_04)

Zephyr#05 / Gearbox Stage 3 - High Speed Timerecord#4 Class: 4 28/02/05 10:46:25
 Delta - ΔTime: 59.529 m s ΔFreq: 16.798 Hz ΔLevel: 11.129 ΔRMS: 4.728

Listen to Vibration Signal

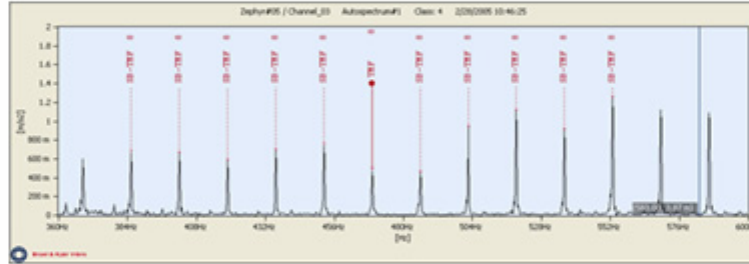
User Annotation

Time Function Display

Delta Cursor

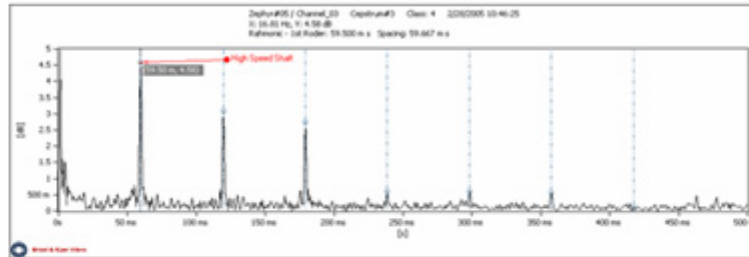
Analysis of the time function reveals impacts of the high speed shaft confirming other findings.

User Annotation Text



Symptom	TMF
Shaft Position	High speed shaft
Frequency/Amplitude	470.400 Hz/0.77944 m
Description	Tooth Meshing Frequency. High level indicates gear fault that repeats itself for each tooth meshing. Symptoms are: Vibration increase at the tooth meshing frequency and its 2X and 3X harmonic. High level sidebands or large energy under the gear mesh frequency usually indicate problems. The frequency is usually modulated by the running speed of the bad gear. Radial direction vibration (1X RPM; gearmesh frequency with 5-6 sidebands at gear rpm) is dominant for spur gears. Machining errors during hobbing can cause high 2X or 3X gear rpm vibration. Causes: Wear, Fabrication error, Load changes, Misalignment

Symptom	SB[TMF]
Shaft Position	High speed shaft
Frequency/Amplitude	452.250 Hz 736.446 m, 465.500 Hz 661.421 m, 478.750 Hz 575.415 m, 492.000 Hz 664.015 m, 505.250 Hz 664.236 m, 485.750 Hz 448.825 m, 502.500 Hz 633.828 m, 519.250 Hz 1.103, 536.000 Hz 901.159 m, 552.750 Hz 1.246
Description	Sidebands around Tooth Meshing Frequency. High level indicates gear fault that repeats itself for each tooth meshing. Symptoms are: Vibration increase at the tooth meshing frequency and its 2X and 3X harmonic. High level sidebands or large energy under the gear mesh frequency usually indicate problems. The frequency is usually modulated by the running speed of the bad gear. Radial direction vibration (1X RPM; gearmesh frequency with 5-6 sidebands at gear rpm) is dominant for spur gears. Machining errors during hobbing can cause high 2X or 3X gear rpm vibration. Causes: Wear, Fabrication error, Load changes, Misalignment



Annotation	High Speed Shaft
X position	59.500 m
Level	4.594
Description	Confirms presence of sidebands around gearmesh frequencies at 3rd stage shaft speed. (High Speed Shaft). Gearbox 2nd and Third stage should be examined as soon as possible. Particular attention should be paid to the gears at the high speed end of the intermediate shaft and the gears on the output shaft.

Reporting – Copy to Wordprocessor

Copy Plot

Copy Kinematical Annotations

Copy Plot – Printer Friendly

Copy User Annotations



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File Window Help

Options
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Data

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- Low Speed Tacho

Analysis

- Autospectrum#1
- Envelope Spectrum#2
- Timerecord
- BCU Trend
- RMS Trend

Compass Compatible Setup

Setup

Scan Average:

Upper Frequency: 1000 Hz

Lower Frequency: 0 Hz

Frequency Resolution: 0.200 Hz

Analysis Information

No. of Lines: 5000

Max. Frequency Resolution: 0.098 Hz

Timerecord Length: 10.24 sec.

Samplerate: 25600 Hz

Update

Idle

Zephyr#04 Fixed Speed

Mon, Jul 04, 2005 15:45:29

Autospectrum#1 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Autospectrum#1 Class: 4 04/07/05 15:45:29

[m/s²]

[317.20, 116.86 m]

0Hz 100Hz 200Hz 300Hz 400Hz 500Hz 600Hz 700Hz 800Hz 900Hz 1 kHz

Envelope Spectrum#2 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Envelope Spectrum#2 Class: 4 04/07/05 15:45:29

[m/s²]

[17.00, 4.16]

0Hz 40Hz 80Hz 120Hz 160Hz 200Hz 240Hz 280Hz 320Hz 360Hz 400Hz

Envelope band: 1000 - 10000 Hz

Timerecord#4 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Timerecord Class: 4 04/07/05 15:45:29

[m/s²]

[4.981546]

5s 5.2s

[s]



WTG Analyzer - Zephyr#04 - C:\WTGAnalyzerTest\TEP Files\DDAU111.tep

File Window Help

Options

- Show Process Information
- Replace Mode
- Add Mode

Data

Channel

- Tower Down Wind
- Tower Lateral
- Main Bearing
- Gearbox Stage 1 - Low Speed
- Gearbox Stage 2 - Intermediate Speed
- Gearbox Stage 3 - High Speed
- Generator Drive End
- Generator Non Drive End
- High Speed Tacho
- Low Speed Tacho

Analysis

- Autospectrum#1
- Envelope Spectrum#2
- Timerecord
- BCU Trend
- RMS Trend
- Autospectrum#6

Compass Compatible Setup

Setup

Scan Average:

Upper Envelope Freq.: 10000 Hz

Lower Envelope Freq.: 1000 Hz

Upper Frequency: 400 Hz

Lower Frequency: 0 Hz

Frequency Resolution: 1.000 Hz

Analysis Information

No. of Lines:	400
Max. Freq. Resolution:	0.098 Hz
Timerecord Length:	10.24 sec.
Samplerate:	25600 Hz

Update

Zephyr#04 Fixed Speed Mon, Jul 04, 2005 15:45:29

Autospectrum#1 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Autospectrum#1 Class: 4 04/07/05 15:45:29

Envelope Spectrum#2 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Envelope Spectrum#2 Class: 4 04/07/05 15:45:29

Autospectrum#6 - Generator Drive End (Channel_00)

Zephyr#04 / Generator Drive End Autospectrum#6 Class: 4 04/07/05 15:45:29

Plot Customization

Printer Friendly