AVAILON

UNITED WIND SERVICE

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Availon Iberia

1st Spanish Wind Congress

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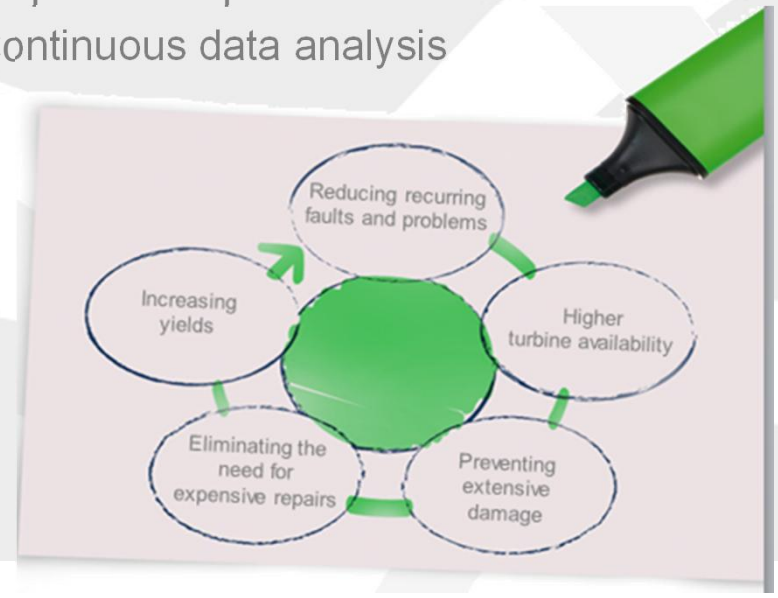
Who we are…

- Brand-spanning and Independent WTG Service Provider
- Established in 2007 in Rheine, Germany
- In continuous Growth:
- Turnover 2015: 66 M€
- More than 400 employees worldwide
- Active in Germany, Spain, Portugal, Italy, Austria, Poland and the USA
- more than 2,500 MW O&M
- Full Service competence for:
  - Tacke® / Enron® / GE®
  - Vestas®
  - Gamesa®
  - DeWind®
  - Nordex®

The innovation engine…

- Competence Centers in Germany, Spain, Italy and USA handle the challenges which Vestas®, Gamesa® and GE® turbines can pose.
- Our team of over 35 engineers and technicians develop solutions to provide customers with the best turbine performance possible:
  - Fault analysis or advice from service technicians on recurring abnormalities.
  - Suggestions from operation managers on possible optimizations.
  - Continuous data analysis



The case

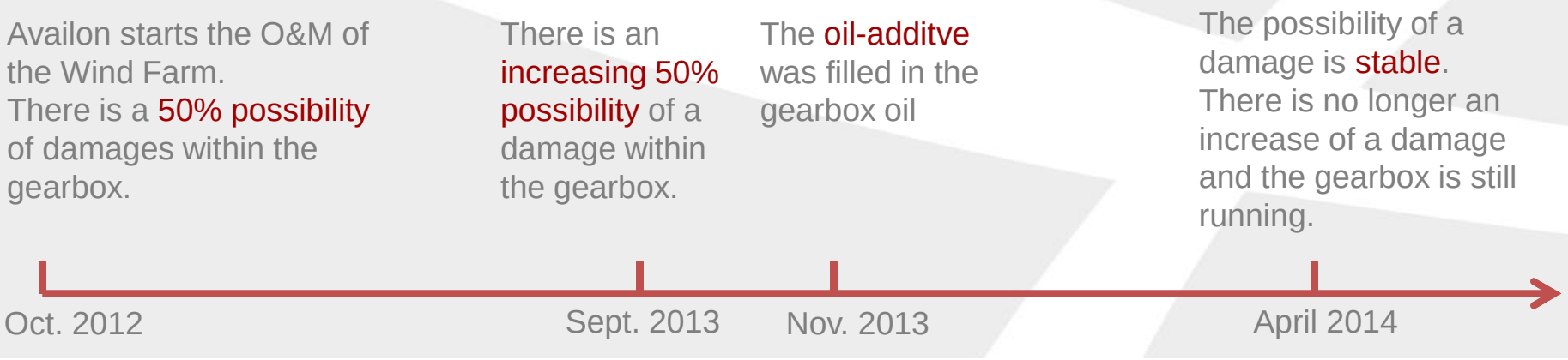
- The gearbox is one of the most expensive components of the WTG. A damage of the gearbox leads to high costs and a long downtime of the WTG. Therefore, Availon was searching for an effective method to extend the lifetime of a gearbox. An innovative oil-additive finished the search of Availon.

Fact sheet:

- The oil-additive contains synthetic particles
- It has to be filled into the gearbox oil in the right proportion (typically 1/100)
- The additive has no effect on the gearbox oil or the other oil-additives

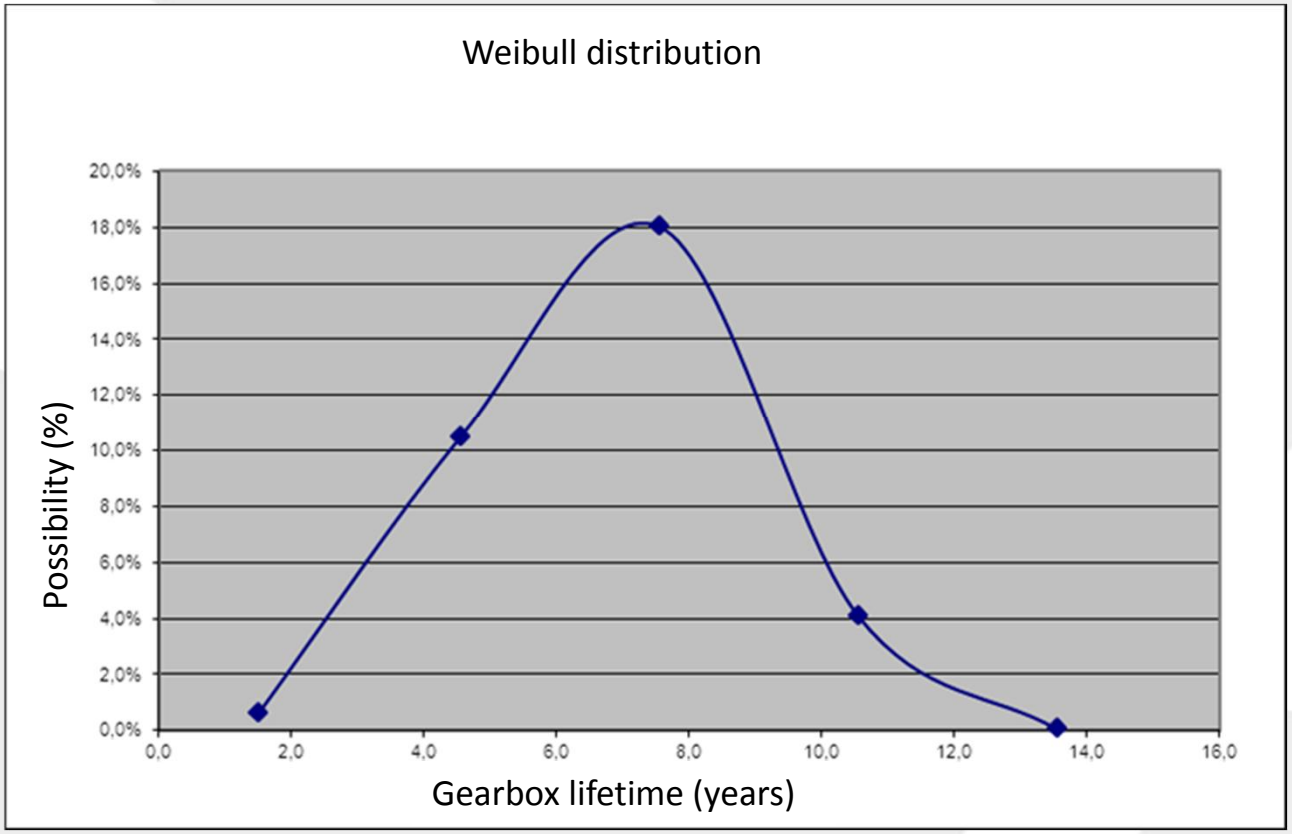
The additives are changing into a special surface on the gearbox during the operation of the turbine.

In this case, a WTG of the O&M fleet of Availon has abnormalities in the gearbox. There was an increasing possibility that there will be damages within a year.



The aim of the oil additive…

- The aim of the product is to extend the lifetime of the gearbox
- The question the product tries to solve is if the gearbox has to be changed once or twice during the 20 years of life time of the WTG



2012: Starting of the O&M service

- 2012: The operator gives Availon the responsibility to do the O&M of the WTG
- The inspection of the drivetrain was done at the end of 2012
- Gearbox type: GPV 451
- Last oil change: 24.10.2008
- Date of measurement: 4.12.2012
- Inspections methods: Endoscopy + frequency measurement

Result:

- **Main shaft:** No abnormalities
- **Gearbox:** The frequency methods detects abnormalities at the bearing of a planetary stage and at the outer ring of the bearing. The endoscopy verified the abnormalities at the bearing of the planetary stage.

The levels of the CMS measurement are as follows:

- < 5 % minimal abnormalities, no need for action
- 20% one of five abnormalities leads to a downtime of the component
- 50% one of two abnormalities leads to a downtime of the component

2012: CMS-report

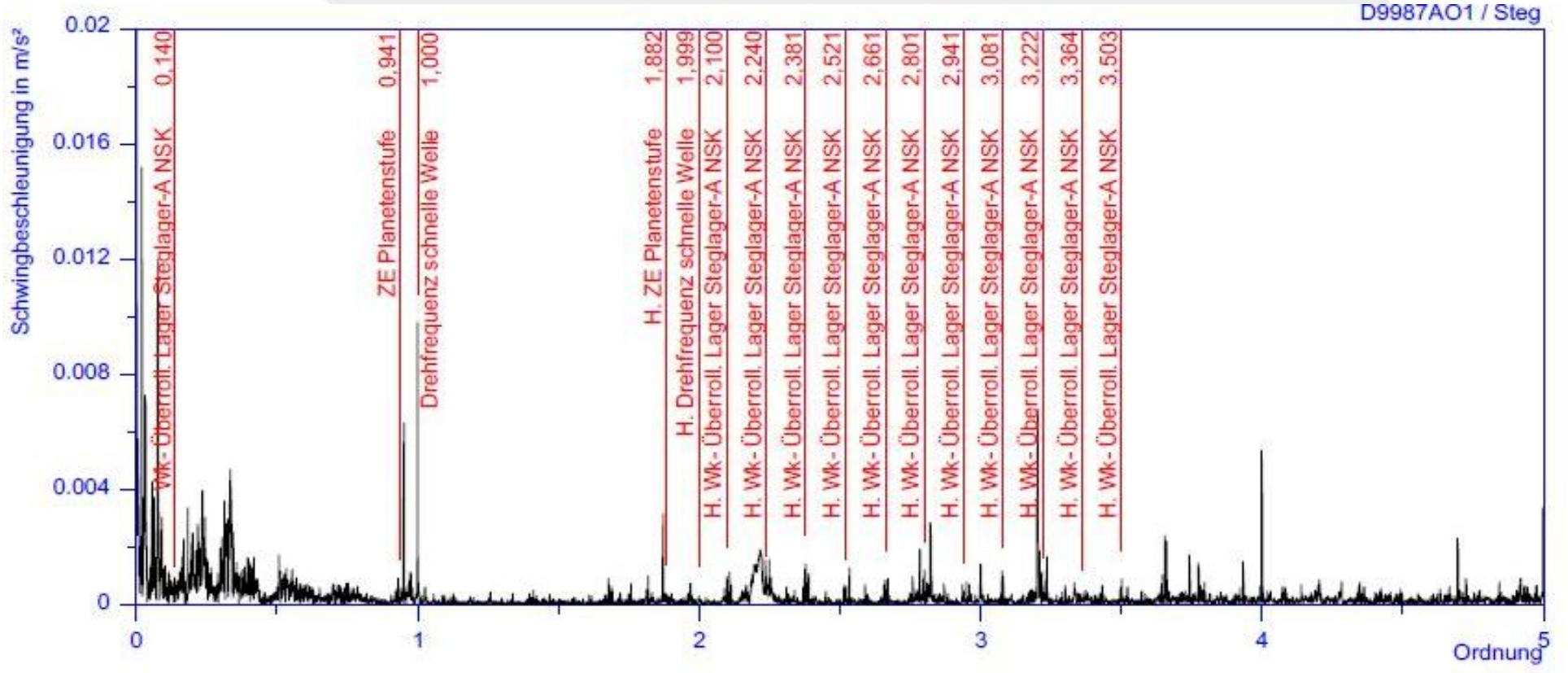
Gearbox Gearing			Tendency	
31	Planetary stage	Signs on local form deviations on the ring gear	→	< 5 %
32	Low stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations on the pinion	→	< 5 %
33	Fast stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations on pinion & gear	→	< 5 %

Gearbox bearing			Tendency	
41	base	Rolling elements, bearing	→	50 %
42	Planets	Rolling elements, kinematics are the same	↑	< 5 %
43	Low stage			
44	Intermediate stage		→	< 5 %
45	Fast stage	Internal ring	↑	< 5 %

2012: The frequency result of the rolling elements

- There is a 50% possibility that the component will have a damage within a year

Overrollings



2013: The condition of the WTG

- The yearly CMS + endoscopy inspection was done in September
- Gearbox type: GPV 451
- Last oil change: 20.02.2013
- Date of measurement: 3.09.2013
- Inspections methods: Endoscopy + frequency measurement

Result:

- **Main shaft:** No abnormalities
- **Gearbox:** There is an increasing tendency that the bearing of a planetary stage will have a damage within a year. The bearing of a planetary stage is not totally reachable by the endoscopy tools, therefore is the frequency method crucial. Abrasion could be also detected on the bearing of the planetary stage .

The levels of the CMS measurement are as follows:

- < 5 % minimal abnormalities, no need for action
- 20% one of five abnormalities leads to a downtime of the component
- 50% one of two abnormalities leads to a downtime of the component

2013: CMS-report

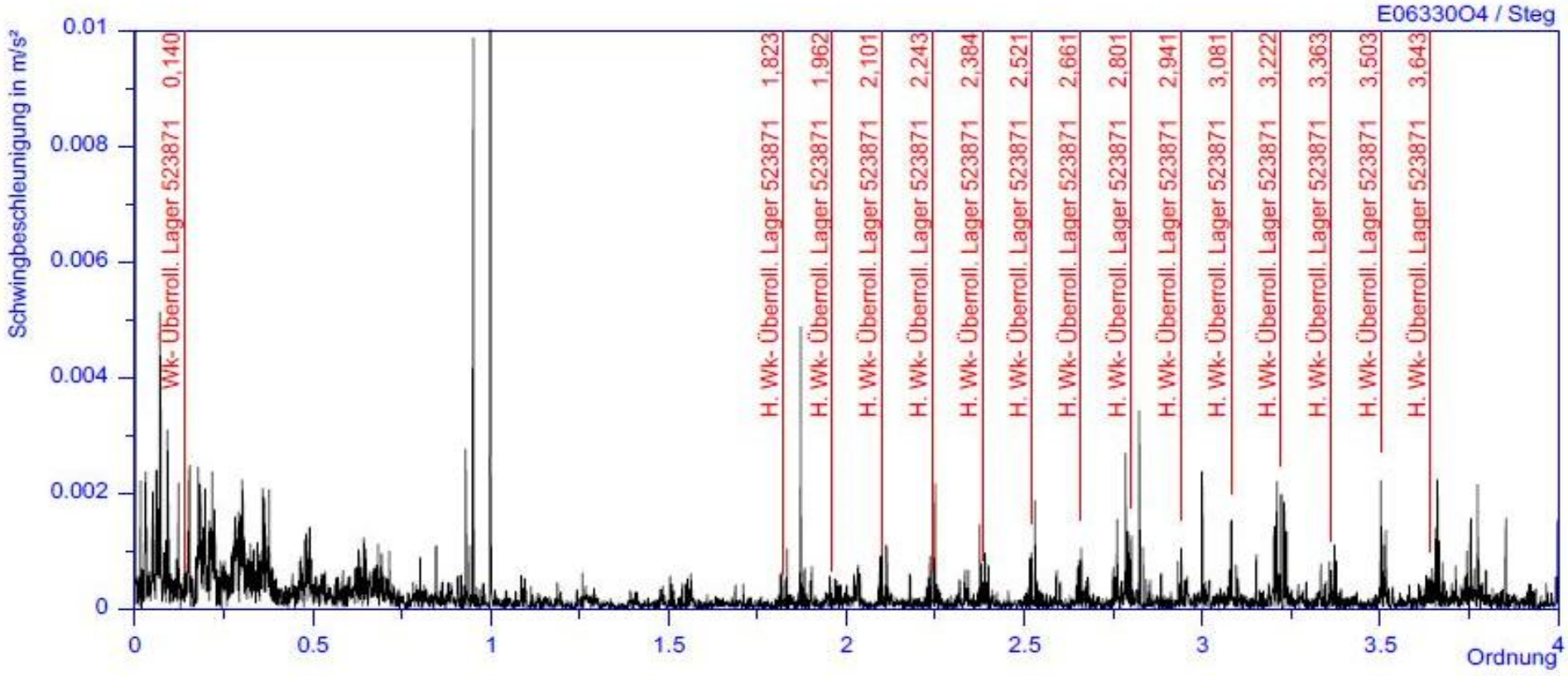
Gearbox Gearing			Tendency	
31	Planetary stage	Signs on local form deviations on the ring gear	→	< 5 %
32	Low stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations on the pinion	→	< 5 %
33	Fast stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations on pinion & gear	→	< 5 %

Gearbox bearing			Tendency	
41	base	Rolling elements, bearing	↑	50 %
42	Planets			
43	Low stage			
44	Intermediate stage	Outer ring	→	< 5 %
45	Fast stage	Rolling elements	↑	< 5 %

2013: The frequency result of the rolling elements

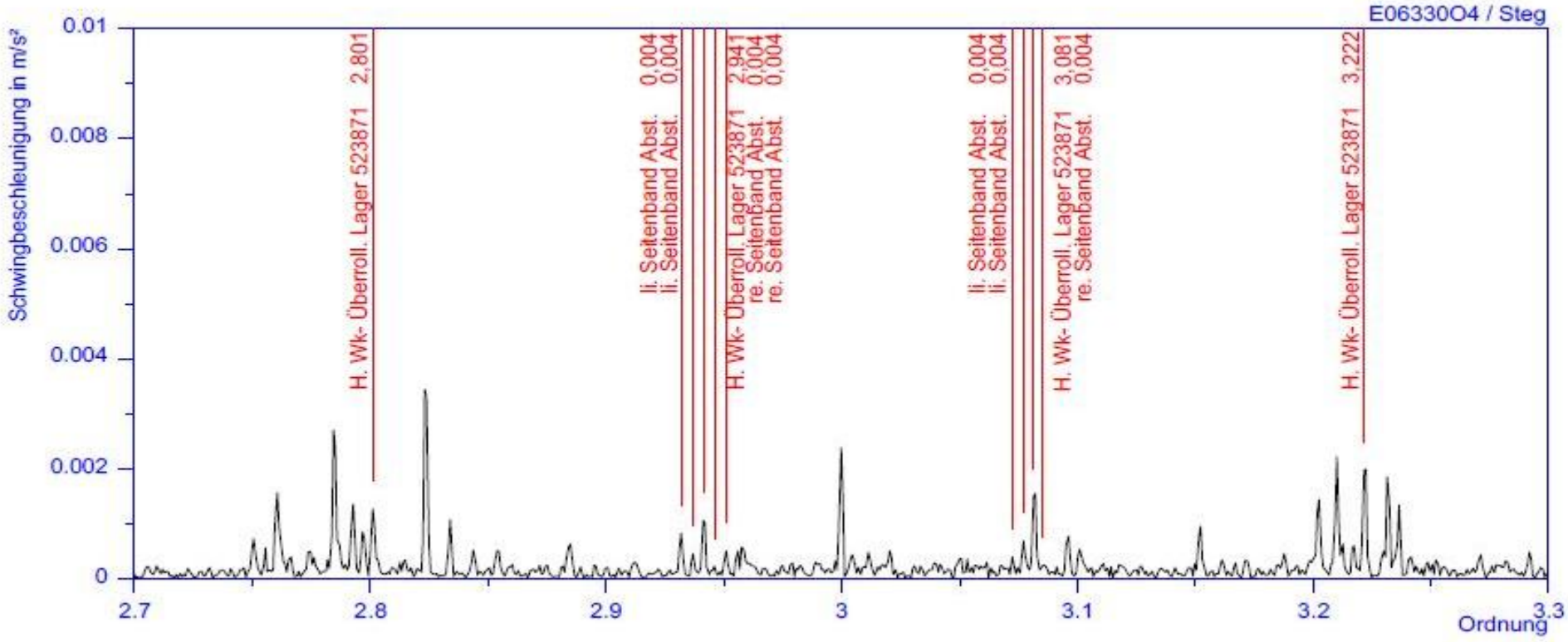
- There is an increasing 50% possibility that the component will have a damage within a year. There is an increasing tendency of a damage.

Overrollings



2013: The frequency result of the rolling elements

- There is also a possibility lower than 5% that the component (bearing) will have a damage within a year. Nevertheless, an increasing tendency of a damage was detected by the CMS



2013:

26/11/2013

The oil-additive was filled in the gearbox oil

2014: The condition of the WTG

- The yearly CMS + endoscopy inspection was done in September
- Gearbox type: GPV 451
- Last oil change: 20.02.2013
- Date of measurement: 11.04.2014
- Inspections methods: Endoscopy + frequency measurement

Result:

- **Main shaft:** No abnormalities
- **Gearbox:** There is no increase of the tendency of the bearing of a planetary stage . The possibility of a damage within a year is stable by 50%. The endoscopy can´t detect this gravity of damages. The base bearing is not totally reachable by the endoscopy tools, therefore is the frequency method crucial.

The levels of the CMS measurements are as follows:

- < 5 % minimal abnormalities, no need for action
- 20% one of five abnormalities leads to a downtime of the component
- 50% one of two abnormalities leads to a downtime of the component

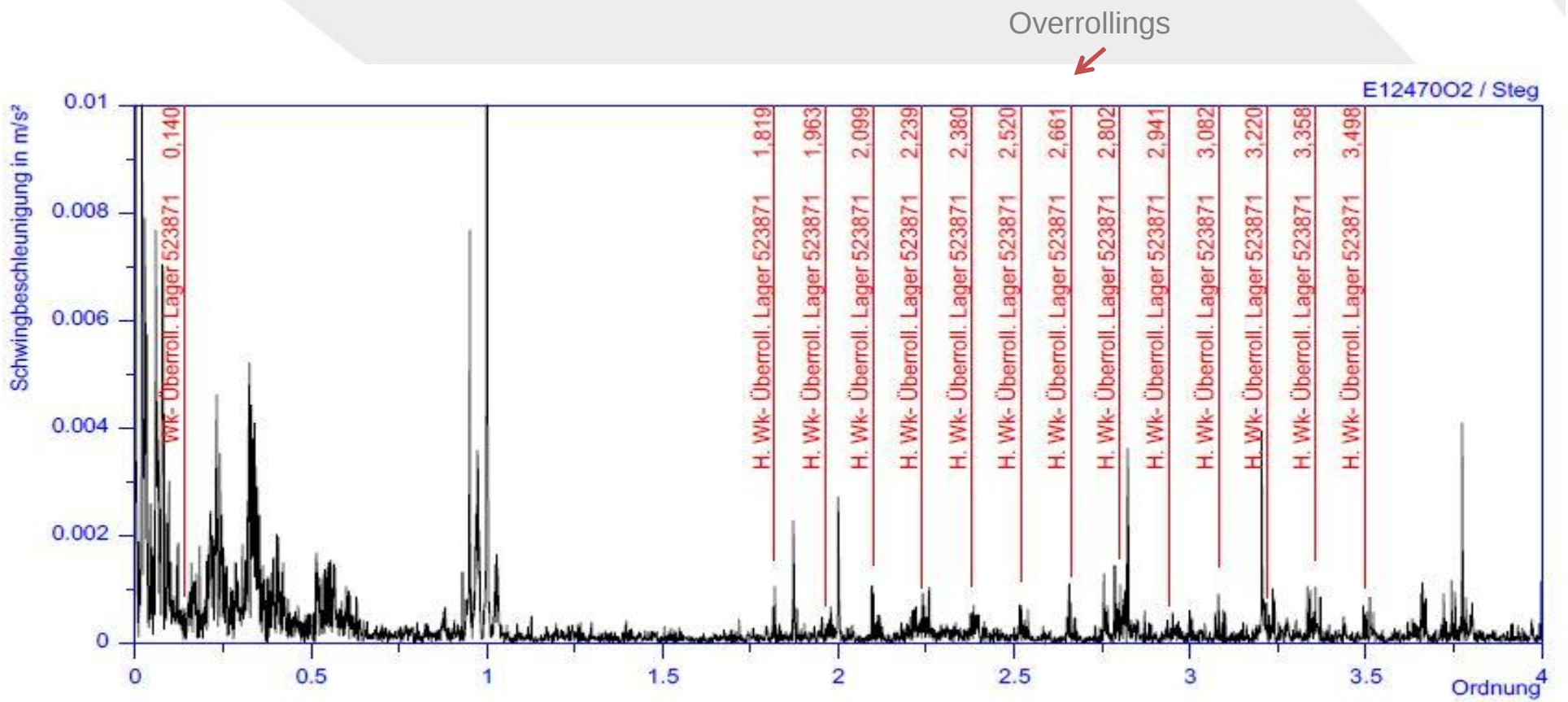
2014: CMS-report

Gearbox Gearing			Tendency	
31	Planetary stage	Signs on local form deviations on the ring gear	→	< 5 %
32	Low stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations	→	< 5 %
33	Fast stage	Signs on local form deviations	→	< 5 %
		Signs on local form deviations	→	< 5 %

Gearbox bearing			Tendency	
41	base	Rolling elements, bearing	→	50 %
42	Planets	Rolling elements, kinematics are the same	→	< 5 %
43	Low stage			
44	Intermediate stage		→	< 5 %
45	Fast stage	Internal ring	→	< 5 %

2014: The frequency result of the rolling elements

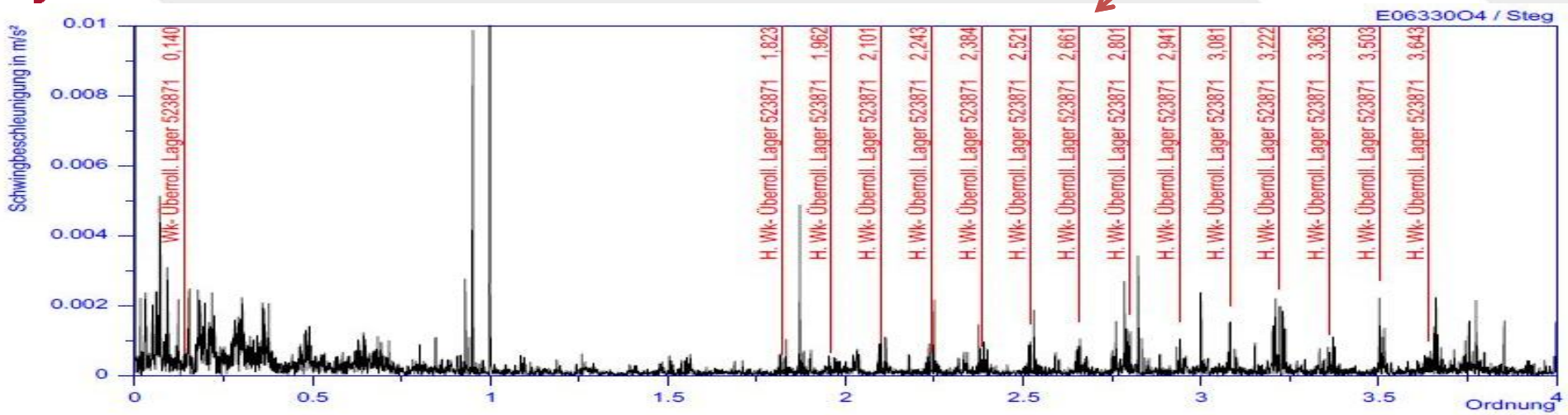
- The increase of the damaged was stopped after the use of the oil-additive.



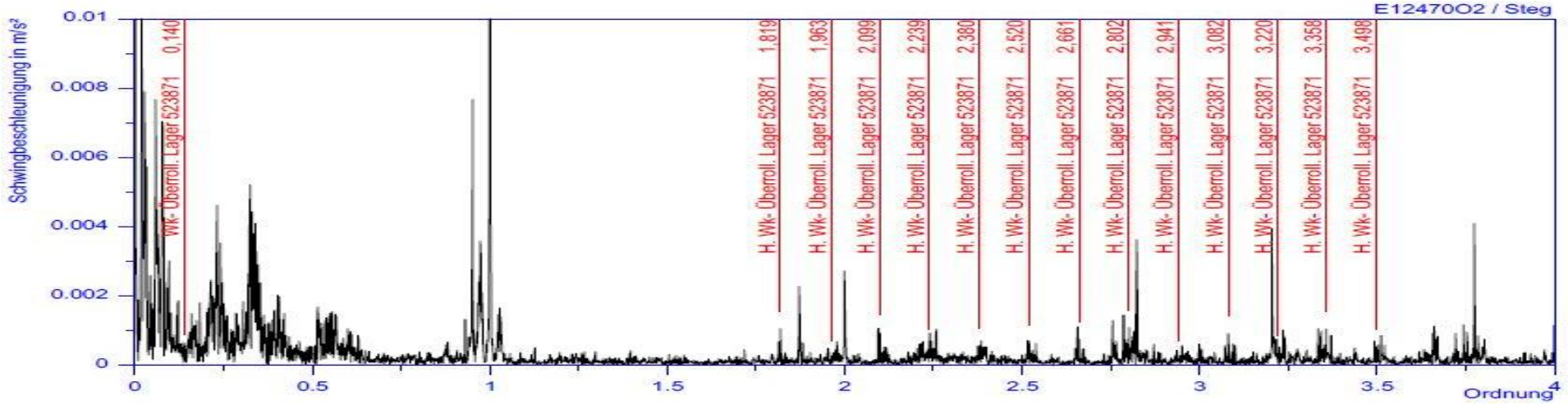
2014 vs 2013: Comparison of the CMS-reports

2013

Overrollings



2014

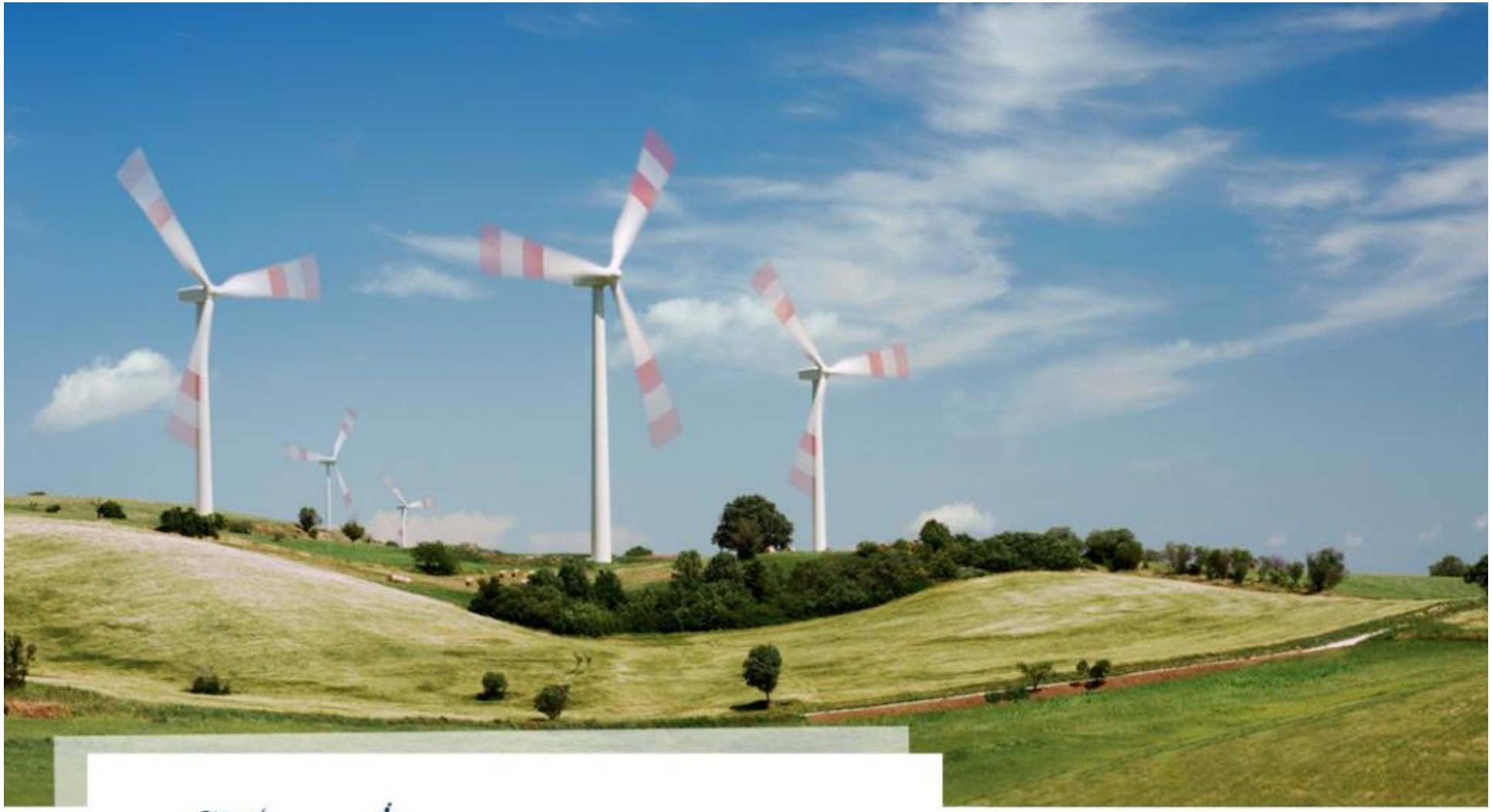


2015: Result

It was possible to stop the increase of the damage. The damage of the gearbox was prevented by the use of the oil-additive so far. The last CMS-report of Sept. 2014 shows a stable condition of the components (base bearing: 50% possibility of a damage, no increase).

The lifetime of the gearbox could be extended by the oil-additive. **There was no probable downtime in the profitable Winter and the gearbox is still running by the time we prepare this paper (status: April 2015).**

Availon has included this method as a standard tool in the life extension of gearboxes in all our fleet under O&M.



Thank you
for your attention.

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