Annexe B

Documents techniques fournis par Enercon

B1 Fiche technique de l'éolienne Enercon, modèle E82, 2MW.

B2 Fiche technique descriptive de la quantité d'huile requise dans la turbine Enercon.

WIND ENERGY CONVERTER CHARACTERISTICS

E-82 E2 2MW

Rotor	
Type	E82 E2
Rotor diameter	82 m
Swept area	5281 m^2
Power regulation	Pitch
RPM	6 –18 min^{-1}
Cut in wind	2,5 m/s
Cut out wind	28 – 34 m/s
Survival wind speed	59,5 m/s

Gear Box	
Not applicable	No gearbox

Blades	
Manufacturer	ENERCON
Blade length	38,8 m
Material	GRP (Epoxy)
Lightning protection	included

Generator	
Manufacturer	ENERCON
Nominal Power	2000 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

Yaw System	
Type	6 electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

Controller	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

Braking System	
Aerodynamic brake	- three independent blade pitch systems with emergency supply - rotor brake - rotor lock, locking at 30°

Tower					
Hub heights	78 m	85 m	98 m	108 m	138 m
Tower	Steel (4 + FS)	Steel + Prefab concrete (2 + 15)	Steel + Prefab concrete (2 + 18)	Steel + Prefab concrete (2 + 21)	Steel + Prefab concrete (2 + 21)
Design Wind Class	II	II	II	II	II

Weights	
Nacelle, excl. Rotor and hub	Approx. 18 to
Rotor incl. Hub/Main pin	Approx. 55 to
Generator	Approx. 62 to
Total Weight	**Approx. 135 to**

Sources: Design Assessment

Safety systems in E-82 wind turbines to prevent water pollutants from leaking

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General information:

Unlike conventional systems, only a minimum amount of water pollutants is required in our gearless E-82 wind turbines. In order to prevent these substances from leaking in the event of a fault, the following safety systems have been developed:

1. Gear: E-82 wind turbines have no main gear as their rotors are directly connected to an annular generator which does not require any increase in speed. For this reason, the usual amount of 200 l gear oil required in conventional systems is not necessary for our wind turbines.

2. Yaw gear: The E-82 turbine has 6 yaw gears which align the nacelle with the wind direction. Each gear contains approximately 7l of oil. The electric motors are seated directly on top of these gears. The gears are installed inside the main carrier which collects the entire amount of oil. In addition oil pans are fitted underneath the yaw drives.

3. Pitch control: A pitch motor activates the pitch gear of each of the three E-82 rotor blades. The pitch gears only contain 4 litres of gear oil. The entire nacelle and rotor head are enclosed in an aluminium casing which collects any oil leakage.

4. Roller bearing lubrication: The tooth flanks and bearings in E-82 wind turbines are greased with special lubricants. The lubricated parts are either encapsulated so that grease cannot leak out or excess lubricant is collected in special pouches fitted to the aluminium casing.

5. Lubricant supply for bearings:

Permanent lubricators supply the roller bearings and pivot bearings of the E-82 turbine with lubricant. Each of these sealed cartridges contains125 ml of lubricant. These are replaced during regular maintenance operations.

The E-82 turbine can be optionally equipped with a central lubrication system for the spinner area. This electronically controlled system comprises a leak monitoring feature and is refilled during maintenance.

6. Transformer oil: The transformer is located either at the base of the tower or in a station outside the tower. In the station, the concrete sump is completely sealed and deep enough to contain the entire amount of transformer oil (870 - 1500 litres depending on the type of transformer. If the transformer is inside the tower base, it is set on a steel floor sump able to contain the entire volume of oil. The oil sumps in the stations and tower bases are oil-tight in accordance with § 19 WHG (German Water Resources Act).

For further questions, do not hesitate to contact us.

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1	**Yaw gear**
Unit / component description	Yaw gear to align nacelle on top of tower with wind direction; fixed position in main carrier
Number	6 gears
Amount of oil per unit	**7 l**
Type of product	Gear oil, liquid
Product name	MOBILGEAR SHC 460, alternative: RENOLIN Unisyn CLP 220
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	1
Technical equipment / safety system	Closed cast metal housing; completely sealed; vertical position in main carrier; main carrier or aluminium sumps collect oil leakage
Inspection	Check for leaks during service inspections (twice a year)
Handling water pollutants	Not in wind turbine as delivered completely assembled
2	**Pitch gear**
Unit / component description	Pitch gear to control blade angle, installation on rotor hub, turns with hub
Number	**3**
Amount of oil per unit	4l (depending on type)
Type of product	Gear oil, liquid
Product name	MOBILGEAR SHC 460, alternative: RENOLIN Unisyn CLP 220
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	1
Technical equipment / safety system	Closed cast metal housing; completely sealed; aluminium rotor casing collects possible oil leakage
Handling water pollutants	No handling in wind turbine, unit already completely assembled on delivery
Inspection	Check for leaks during service inspections (twice a year)
3	**Gear wheel lubrication**
Unit / component description	Yaw and pitch control drive gear wheels (pinion and gear rim)
Number	9 pinions in total
Amount	Grease lubrication
Type of product	Automotive grease
Product name	MOBILGEAR OGL 461
Description	Hydrocarbons and additives
Water hazard class (German regulation)	Class 2 (in accordance with VwVwS dated 17 May 1999)
Technical equipment / safety system	Toothing in sealed housing
Handling water pollutants	No handling in wind turbine, unit already completely assembled on delivery
Inspection	During service inspections, check for conspicuous leaks (twice a year)
4	**Yaw bearing lubrication**

Unit / component description	Nacelle bearing on tower, cartridges for permanent lubrication; type: Perma
Number	1 pivot bearing
Amount	Grease lubrication
Type of product	Roller bearing grease
Product name	Mobillith SHC 460
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	Class 2 (in accordance with VwVwS dated 17 May 1999)
Technical equipment / safety system	Closed four-point bearing
Handling water pollutants	No handling in wind turbine, unit already completely assembled on delivery
Inspection	During service inspections, check for conspicuous leaks (twice a year)
5	Permanent lubricator
Unit / component description	Cartridges for permanent lubrication Type: PERMA, automatic lubricator
Number	24 greasing points in spinner area
Amount	125 ml
Type of product	Roller bearing grease
Product name	MOBILITH SHC 460 (see above)
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	Class 2 (in accordance with VwVwS dated 17 May 1999)
Technical equipment / safety system	Sealed cartridges
Handling water pollutants	Cartridges are ready for use on delivery and replaced as is; ENERCON disposes of used cartridges
Inspection	During service inspections, check for conspicuous leaks (twice a year)
6	Alternative for pos. 6 (permanent lubricator)
Unit / component description	Central lubrication system for spinner area
Number	1 system with 24 greasing points
Amount	4 kg max.
Type of product	Roller bearing grease
Product name	MOBILITH SHC 460 (see above)
Description	Synthetic hydrocarbons and additives
Water hazard class (German regulation)	Class 2 (in accordance with VwVwS dated 17 May 1999)
Technical equipment / safety system	Closed system
Handling water pollutants	Ready for use on delivery; refilled during maintenance (max. 4 kg/a)
Inspection	Leak monitoring via remote monitoring system; additional inspection during maintenance

7	**Transformer station / transformer unit**			
Unit / component description	Transformer station according to separate description (A separate transformer station description is available on request.)			
Number	1 transformer for each wind turbine			
Amount	870 litres – 1500 litres			
Type of product	Transformer oil according to IEC-296 or IEC 836 depending on type			
Product name	DOW-Corning 561	Rhodorsil-Öl 604 V 50	NYNAS-NYTRO 10GBN	MIDEL 7131
Description	Mixture of highly refined mineral oils			
Water hazard class (German regulation)	1	1	1	0
Technical equipment / safety system	Transformer in transformer station: oil sump on station floor collects oil; specialist company installs station in accordance with § 19 WHG (German Water Resources Act), station can also be installed in water protection zones Transformer in tower base: transformer is installed over galvanised steel sump which can collect entire amount of oil;			
Handling water pollutants	No handling in wind turbine, unit already completely assembled on delivery			
Inspection	Check for leaks during service inspections (twice a year)			