

## Power Curve Warranty

### 1. Definitions

Initially-capitalized terms used herein without other definition shall have the meanings specified in La Flor SUPPLY AND INSTALLATION AGREEMENT to which this Annex 10.1: Power Curve Warranty is attached, unless the context requires otherwise. In addition, the following terms shall have the following respective meanings:

“GL” means the guaranteed level and shall be equal to 100% (1.00) minus the percentage of Test Uncertainty.

“Independent Tester” means any of the independent companies listed in Annex 2 “Approved Independent Tester” which companies are hereby approved by the Parties.

“Initial Measurement Test” means the initial test to verify the Power Curve of the Nominated Turbines conducted by the Independent Tester in accordance with the Measurement Test Standards.

“Measurement Equipment” means all equipment and instrumentation installed by Buyer or the Independent Tester in the Nominated Turbines for purposes of performing the Measurement Tests, including but not limited to data loggers and power measurement devices; provided that such equipment and instrumentation complies with the requirements of the Measurement Test Standards.

“Measurement Test(s)” means the Initial Measurement Test or any Remeasurement Test.

“Measurement Test Standards” means the standards set forth in Section 5 of this warranty.

“MEO” means, with respect to any Measurement Test, the annual average Measured Energy Output, being the average of the  $MEO_i$  for all the Nominated Turbines in the Project, expressed as kWh/Year. In absence of a Measurement Test, MEO shall be deemed equal to WEO.

“ $MEO_i$ ” means, with respect to a Measurement Test on Nominated Turbine number  $i$ , the result of such test, expressed in kWh/Year, as calculated by multiplying the nominal wind speed distribution in column C of ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’ by the measured Power Curve for such Nominated Turbine. The measured Power Curve shall be extrapolated by assuming zero power for all wind speeds below the lowest wind speed in the measured Power Curve and constant power for wind speeds between the highest wind speed in the measured Power Curve and the cut-out wind speed. The constant power shall be from the highest wind speed in the measured Power Curve.

“ $n$ ” means the number of Nominated Turbines (sample size).

“N” means the total number of Turbines in the Project.

“Nominated Turbine(s)” means the Turbine(s) selected for verification of the Power Curve, in accordance with the criteria and methodology set forth herein. The Nominated Turbines are agreed to be representative of all Turbines in the Project.

“Nominal Wind Distribution” means a contractually defined annual wind speed distribution, reflecting the climatic conditions at the Project, and distributed as set out in the attached ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’.

“Power Curve” means the power curve attached hereto and incorporated herein by this reference as ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’.

“Power Curve Liquidated Damages” or “PCLD” means [PCLD] per Turbine, for each one percent (1%) (prorated for fractions thereof) shortfall to compensate for the difference between MEO and the GL of the WEO, when MEO is less than the GL of the WEO.

“Project” means the wind turbine electric generating facility to be installed in [wind farm name, project or location]

“Project Specific Operational Requirements” mean all project specific operational requirements being part of the SUPPLY AND INSTALLATION AGREEMENT to which this Annex/Exhibit: “Power Curve Warranty” is attached.

“Reference Annual Energy Output” or “R<sub>AEO</sub>” means the difference between the GL and the ratio of the MEO and the WEO as calculated according to Section 5.7 of this warranty.

“Remeasurement Test” means, after the Initial Measurement Test, any test to verify the Power Curve of the Nominated Turbines conducted by the Independent Tester in accordance with the Measurement Test Standards.

“Service Agreement” means a service and maintenance agreement signed by the Parties in connection with the Project.

“Site Calibration” means the procedure set out in Annex C of the Standard in order to determine the flow distortion correction factors due to the test site topography.

“Specification” means Annex 1.1 0056-6306\_V02 – Performance Specification V136-3.6MW.

“Standard” means IEC 61400-12-1 Wind turbines – Part 12-1: Power performance measurements of electricity producing wind turbines, First edition 2005-12.

“Test Plan” has the meaning set forth in Clause 5.2 herein.

“Test Reports” means, irrespective of the heading, any measurement data, raw data, documents, reports, or documentation that is collected or made by the Independent Tester.

“Test Uncertainty” means the uncertainty of the Nominated Turbines calculated according to Section 5.3.

“Turbine” means a Wind Turbine being part of the agreement to which this Annex/Exhibit: “Power Curve Warranty” is attached.

“Warranted Power Curve” means the Power Curve as set forth in column D of ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’, subject to the conditions in Section 3.

“Warranty Period” means the period commencing on the Taking Over of the last Turbine in the Project, and continuing to and ending on the sixth (6<sup>th</sup>) anniversary of the Taking Over of the last Turbine in the Project unless terminated earlier pursuant to the terms hereof.

“WEO” means the warranted energy output, being the annual energy production expressed in kWh/Year, as calculated using the Warranted Power Curve and the Nominal Wind Distribution.

## **2. Objectives**

This warranty sets out and defines the Warranted Power Curve for the Turbines and the procedures for measurement in accordance with the Measurement Test Standards, if so requested by the Buyer.

The objective of this document is to define:

- a) the Supplier Warranted Energy Output
- b) the Buyer’s Power Curve Verification Option
- c) the Measurement Test Standards
- d) the Power Curve Liquidated Damages (if any) applicable thereto

## **3. Supplier Warranted Energy Output**

Supplier guarantees that the MEO is above or equal to the GL of the WEO. If a Measurement Test demonstrates that the MEO is above or equal to GL of the WEO, then a Power Curve shall be deemed proven, and Supplier has no further liability under this Power Curve Warranty.

The measured Power Curve shall be compared to the Warranted Power Curve by calculating the corresponding average MEO using the Nominal Wind Distribution as stated in ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’.

The Warranted Power Curve is for an air density that is assumed to be representative of the average conditions of the Project. The Buyer and Supplier acknowledge and agree that the measured average air density from a Measurement Test may differ to the air density in ‘Annex 1’.

If the measured average air density from a Measurement Test differs with more than  $\pm 0,015 \text{ kg/m}^3$  from the reference air density defined in 'Annex 1', the Warranted Power Curve and the reference air density shall be replaced with the Power Curve from the Specification with the corresponding air density that is closest to the measured average air density from a Measurement Test.

#### **4. Buyer's Power Curve Verification Option**

The verification of the Power Curve is not included as part of the services to be performed by Supplier under this warranty. If the Buyer requests a verification of the Power Curve, the Independent Tester shall perform the Initial Measurement Test on behalf of the Buyer and at the Buyer's expense.

Supplier shall be informed about all Test Reports and these shall be made available to Supplier upon request at any time during and after the verification. Copies of Test Reports shall be forwarded to Supplier within 7 days after such Test Reports are forwarded or handed over to the Buyer.

At any time prior to the date that is fifty seven (57) months after the Taking Over of the last Nominated Turbine in the Project, the Buyer may exercise the option to have the Power Curve verified by providing written notice to Supplier specifying a date not later than ninety (90) days after such notice for commencement of the Initial Measurement Test by the Independent Tester and such a test shall be completed with the result submitted to Supplier prior to the date that is sixty (60) months after the Taking Over of the last Nominated Turbine in the Project; provided that no Measurement Test may be performed on a Nominated Turbine during the first thirty (30) days immediately following the Individual Taking Over [Commissioning Completion] of such Nominated Turbine.

On and after the date that is sixty (60) months after the Taking Over of the last Nominated Turbine in the Project, Buyer shall no longer have the right to request a verification of the Power Curve or to present any Test Report under this warranty.

Unless otherwise requested by Supplier, Buyer shall decommission and remove all of the Measurement Equipment installed in the Nominated Turbine(s), at Buyer's expense, not less than sixty (60) days after the Power Curve verification has passed and the Power Curve has been successfully verified.

##### **4.1. Initial Measurement Test**

Provided that Buyer has timely exercised its option to verify the Power Curve, Buyer may cause the Independent Tester to perform the Initial Measurement Test in accordance with the Measurement Test Standards. Buyer must inform Supplier of their intent to exercise its option to verify the Power Curve in writing a minimum of 30 days prior to the commencement of such Initial Measurement Test, and Supplier shall have the right to be present at the said Measurement Test. During the Initial Measurement Test Buyer shall cause the Independent Tester to provide both Parties with all raw data related to the site calibration (if any) and Measurement Test in a monthly basis.

If the result of the Initial Measurement Test demonstrates that the Reference Annual Energy Output is equal to or lesser than zero (0), then Power Curve verification shall be considered as passed and the Power Curve shall be considered as successfully verified. No further Measurement Tests shall be

conducted and Supplier shall have no further liability for payment of Power Curve Liquidated Damages hereunder.

If the result of the Initial Measurement Test demonstrates that the Reference Annual Energy Output is greater than zero (0), then Supplier may conduct Remeasurement Tests in accordance with Section 4.2.

#### **4.2. Remeasurement Test(s)**

If the result of the Initial Measurement Test demonstrates that the Reference Annual Energy Output is greater than zero (0), Supplier may at his reasonable discretion, prior to the expiration of the Warranty Period, modify, improve, adjust, replace parts and carry out repairs to improve the performance of the Nominated Turbines and cause the Independent Tester to conduct one or more Remeasurement Tests of Nominated Turbines. Buyer shall reasonably cooperate with Supplier and the Independent Tester in connection with the performance of such Remeasurement Test(s).

If Supplier has made modifications, improvements, adjustments, replaced parts or carried out repairs to any Nominated Turbine during the Warranty Period in order to pass any Remeasurement Test, then Supplier shall make the same modifications, improvements, adjustments, replaced parts or carried out repairs to all of the other Turbines supplied by Supplier to the Project, provided that these modifications are needed for achieving the Warranted Power Curve.

#### **OPTION 1 (preferred):**

If at any time prior to the expiration of the Warranty Period, the result of any Remeasurement Test demonstrates that the Reference Annual Power Output is equal to or less than zero (0), then the Power Curve shall be considered as successfully verified. No further Power Curve Test shall be conducted and the Supplier shall have no liability for the payment of Power Curve Liquidated Damages hereunder.

If after the expiration of the Warranty Period, the Supplier has failed to demonstrate pursuant to one or more Remeasurement Test that the Reference Annual Power Output is equal to or less than zero (0), the Supplier shall pay Buyer Power Curve Liquidated Damages to Buyer within thirty (30) days from the date the Buyer and the Supplier have approved the calculation made pursuant to the provisions of section 5.

Before the end of the term of the Service Agreement, the Supplier retains the right to make modifications, improvements, adjustments, replace parts or carried out repairs in order to pass any Remeasurement Test. After such repairs or replacements have been made, the Supplier shall have the right, at its own expense, to conduct additional Remeasurement Tests to verify the Warranted Power Curve.

If any subsequent Remeasurement Test performed demonstrate that the Power Curve levels have improved, the Buyer shall repay Power Curve Liquidated Damages received from Supplier.

The amount of Power Curve Liquidated Damages to be repaid to Buyer is to reflect the difference of the increased Measured Energy Output compared to the previous Measured Energy Output

considering the remaining lifetime of the turbine (time based fraction of the initial Power Curve Liquidated Damages).

## **5. Measurement Test Standards**

The purpose of a Measurement Test is to verify the Power Curve for each Turbine in the Project on the basis of a sample of representative Turbines (the Nominated Turbines) in the Project based on the Standard, utilizing database B which, pursuant to Paragraph 7.4 of the Standard does not include power loss due to cut-out hysteresis..

### **5.1.Nominated Turbine Selection**

The Buyer shall bear all costs related to the identification of Nominated Turbines by the Independent Tester.

The number of Nominated Turbines for the Power Curve verification shall be determined in the following manner based on the number of Turbines in the Project:

- a) if N is less than or equal to five (5) Turbines at least one (1) Nominated Turbine shall be selected (n=1)
- b) if N is greater than five (5) Turbines and less than or equal to ten (10) Turbines at least two (2) Nominated Turbines shall be selected (n=2)
- c) if N is greater than ten (10) Turbines and less than or equal to twenty (20) Turbine at least three (3) Nominated Turbines shall be selected (n=3)
- d) if N is greater than twenty (20) Turbines at least four (4) Nominated Turbines shall be selected (n=4)

The locations of the Nominated Turbines shall be chosen so that they comply with the requirements set forth in Annex A and Annex B of the Standard. Only unobstructed Turbines within two (2) to four (4) rotor diameters of the reference met mast(s) can be selected as Nominated Turbines.

No less than thirty (30) days before the date where the first kWh is expected to be produced by one of the Turbines in the Project, Buyer and Supplier, in consultation with the Independent Tester, shall agree on the locations of the Nominated Turbine(s). In the case, the Buyer and Supplier are unable to agree on the Nominated Turbines by such a date, then the Independent Tester shall determine it within the following thirty (30) days.

If no decision is made on the Nominated Turbines neither by the Parties nor by the Independent Expert, by the date the first kWh is expected to be produced by one of the Turbines in the Project, no Measurement Test shall be conducted and the Supplier shall have no further liability for payment of Power Curve Liquidated Damages hereunder.

The final position of the reference met masts and the measurement sectors for the Nominated Turbines shall be agreed between the Buyer, the Independent Tester and Supplier and the final decision shall be made based on the principle of minimizing the measurement uncertainties. The final decision on the Site Calibration requirements shall be made based on a report issued by the Independent Tester

which will comply with the Measurement Test Standard and shall validate all assumptions about the Project by means of a Site visit.



## **5.2. Test Methodology**

The Measurement Test method shall fully adhere to the procedures set out in the Standard and the terms of this warranty including but not limited to the test conditions and filters specified in Section 5.4 and 5.5.

Should any Nominated Turbine not conform to the requirements set forth in Annex B of the Standard, then Buyer shall arrange and cause to have a Site Calibration performed by the Independent Tester for that Turbine locations.

Prior to starting any Measurement Test the Independent Tester conducting the Measurement Test shall prepare and deliver a written Test Plan to Buyer and Supplier that (i) identifies the Nominated Turbine(s) and the final position for the reference met mast(s), including the corresponding free sector and Site Calibration requirements, and (ii) describes the Measurement Equipment and verification methodology that will be employed by the Independent Tester during and in connection with the Measurement Test.

The Site Calibration shall be performed in accordance with Annex C of the Standard. In case the Nominated Turbine has directional curtailment applied, additional analysis must be conducted in order to determine the difference in wind direction between the reference met mast and the temporary met mast. This wind direction offset correction will be applied in the Power Curve if differences of more than 10 degrees are found during the Site Calibration. This Site Calibration(s) shall be completed not later than two (2) weeks before the commencement of works involving equipment which will be considered as an obstacle according to the Measurement Test Standard.

All issues concerning the test methodology, including any deviation from the Measurement Test Standards, must be agreed in writing between the Parties before the commencement of the Initial Measurement Test.

## **5.3. Uncertainty**

The calculation of uncertainty shall be based on the methods of Annex D and Annex E of the Standard and such calculation shall be normative. Unless otherwise documented, the predominant uncertainties in the  $MEO_i$  shall be assumed fully correlated between the Nominated Turbines, and the Test Uncertainty shall be deemed to be the simple average of the uncertainty of the individual  $MEO_i$ .

## **5.4. Test Conditions**

All Measurement Tests are to be conducted in accordance with the Standard and are subject to the following additional requirements:

- a) The meteorological mast(s) must be equipped with at least four (4) anemometers placed at the heights equivalent to: two (2) at HH, one (1) at HH minus R and one (1) at HH minus R/2, where “HH” is hub height and “R” is the rotor radius of the Nominated Turbine(s). For the two (2) anemometers at HH one (1) shall be used as the main anemometer and the other as the reference anemometer. Anemometers shall not be mounted above hub height. In case the Nominated Turbine has directional curtailment applied, meteorological mast(s) must be equipped with at least one (1) wind vane. For



the wind vanes, it should be mounted in same setup for the reference mast and temporary mast during the Site Calibration.

- b) The vertical component of the wind speed shall be measured close to hub height.
- c) Any required Turbine signals (such as Turbine status, nacelle wind speed, blade pitch, generator speed, etc) shall be recorded
- d) All data loggers shall be time-synchronized to the SCADA system (if available).
- e) All anemometers used during any Measurement Test shall be calibrated before and after the test. In case of doubt, Supplier reserves the right to request a wind tunnel calibration instead of the in-situ calibration.
- f) The Nominated Turbines must be undamaged
- g) Blades must be cleaned at the commencement of any Measurement Test if reasonably required, and kept clean for the duration of the measurement.
- h) Supplier shall have the right to check and correct for possible yaw and pitch angle errors.
- i) Supplier reserves the right to perform functionality test (temperature of gear and generator, correct cut-in, transition between generator star and delta winding configuration, etc.) before any Measurement Test. The power production shall be measured on the low voltage side of the Turbine transformer.
- j) Extrapolated Power Curves shall be used.
- k) The Nominated Turbines shall not be subject to any kind of active power regulation during the Measurement Test (active power regulation includes noise reduced operation).
- l) In case directional curtailment is applied, the nacelle position signal shall be recorded by the data logger and used as reference.

### **5.5. Filtering**

All Measurement Tests shall be filtered according with the Standard and are subject to the following additional filtering:

- a) Data outside the limits set forth in the Specification shall be removed by filtering.
- b) Data recorded during precipitation, periods with icing or unusual atmospheric conditions shall be discarded.
- c) Only bins where the Nominated Turbine(s) is/are connected to the grid for the full period of 600 seconds (10 minutes) shall be used to determine the Power Curve.
- d) Only data, measured as means for 10 minutes interval, where the climatic conditions are within the limits regarding inflow, turbulence and wind shear in the Specification shall be included. The limit for wind shear the limits from Specification will be extended as per below:  
Wind Shear,  $\alpha$  - 0.00-0.35 (10 minute average)
- e) In case the Nominated Turbine has directional curtailment applied, only bins where the nacelle position of the Nominated Turbines is outside of the wind direction intervals where directional curtailment is applied, as it is established in the Project Specific Operational Requirements annex, shall be used to determine the Power Curve. The wind direction, shall be for the full period of 600 seconds (10 minutes) average wind direction determined by the signal used by the turbine for the directional curtailment control.

- f) In case the Nominated Turbine has directional curtailment applied, data due to wind hysteresis shall be removed by filtering.

With respect to Section 5.5(d) above the Buyer may choose not to apply initial filtering for turbulence, shear, or inflow angle which will be used to determine the Measured Power Curve(s). However, Supplier reserves the right to apply filtering in Section 5.5(d) in the event that the Measured Power Curve(s) are not successfully verified according to Section 5.7. In any case the completion criteria for the Site Calibration need to be met with all applicable filters outlined in Section 5.5.

### **5.6. Duration of Tests**

Any Measurement Test shall be completed when enough data has been compiled in accordance with the Measurement Test Standard.

## **6. Results of the Test**

For each of the Nominated Turbines tested, the Warranted Power Curve is recalculated in accordance with the principles of the Standard to the reference air density given in ‘Annex 1: Warranted Power Output and Wind Speed Distribution’.

From the recalculated Power Curves and the reference wind speed distribution given in ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’, the annual energy production of the Nominated Turbines is determined.

The results of the Measurement Test are the  $MEO_i$  and their mean value MEO. MEO shall be considered the best estimate of the average of the  $MEO_i$  of all the Turbines at the Project and shall be calculated as follows:

$$MEO = \frac{1}{n} \sum_{i=1}^n MEO_i$$

The Reference Annual Energy Output shall be calculated as follows:

$$R_{AEO} = GL - (MEO/WEO)$$

Such that:

- |     |  |                    |
|-----|--|--------------------|
| (1) | The Power Curve verification has passed if | : $R_{AEO} \leq 0$ |
| (2) | The Power Curve verification has failed if | : $R_{AEO} > 0$    |

## **7. Power Curve Liquidated Damages**

Power Curve Liquidated Damages shall be calculated using the following formula:

$$\text{Liquidated damages} = (100 * R_{AEO}) * N * PCLD$$

Supplier's maximum aggregate liability for Power Curve Liquidated Damages shall not exceed [twenty percent 20% of the Supplier's maximum liability under Section 9.2 of the Agreement. Any amounts paid by Supplier in respect of Power Curve Liquidated Damages under this Agreement shall be applied toward Supplier's maximum liability under the Agreement.

In the event the Power Curve verification has passed, the Buyer shall bear all costs connected to the tests.

In the event the Power Curve verification has failed, Supplier shall bear all costs connected to the tests.

## **8. Remedies not a Penalty**

The Buyer and Supplier acknowledge and agree that it is difficult or impossible to determine with precision the amount of damages that would or might be incurred by Buyer as a result of the failure to achieve the GL of the WEO. It is understood and agreed by the Buyer and Supplier that:

- i. Buyer shall be damaged by the failure of the Turbines to achieve the GL of the WEO,
- ii. It would be impracticable or extremely difficult to fix the actual damages resulting there from,
- iii. Any sums which would be payable under this Annex/Exhibit are in the nature of liquidated damages, and not a penalty, and are fair and reasonable, and
- iv. Each payment represents a reasonable estimate of fair compensation for the losses that may reasonable be anticipated from each such failure.

Payment of liquidated damages set forth in this Annex/Exhibit will be the sole and exclusive remedy of Buyer and the sole and exclusive liability and exclusive measure of damages of Supplier with respect to any failure of the Nominated Turbines to achieve the GL of the WEO. Once payment of such liquidated damages has been paid, Supplier shall be relieved of any and all further liability in respect of such failure.

## **9. Exclusions**

Supplier is not and shall not be held liable for breach of any warranties given in this agreement or be held liable for failure to achieve the GL of the WEO to the extent caused by or arising out of any event described in Section 9.7 of the Supply and Installation Agreement.

## **10. Responsibility**

The Buyer shall be responsible for conducting the entire Initial Measurement Test including but not limited to the installation of the Measurement Equipment in or on the Nominated Turbine.

Supplier shall not be held liable for any damages caused during the presence of the Measurement Equipment connected to, mounted on or in the Nominated Turbine(s).

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**Annex 1: Warranted Energy Output and Wind Speed Distribution.**

The Warranted Power Curve is valid for an annual average air density of 1.200 kg/m<sup>3</sup>.

Annual mean wind speed = 7.5 meters per second  
Annual hours = 8760 hours  
A (Weibull scale parameter) = 8.4 meters per second  
k (Weibull shape parameter) = 2.0

In case of doubt and differences column B shall prevail.

Wind Speed Bin [m/s]	Nominal Wind Speed Distribution in half m/s bins [hours/year]	Warranted Power Curve for reference air density [kW]	Measured Power Curve adjusted to reference air density [kW]	(WEO) Warranted Energy Output [kWh/year] (B x C)	(MEO) Measured Energy Output [kWh/year] (B x D)
A	B	C	D	E	F
0	0	0		0	
0.5	62	0		0	
1	122	0		0	
1.5	180	0		0	
2	235	0		0	
2.5	284	0		0	
3	328	47		15409	
3.5	365	123		44928	
4	396	218		86294	
4.5	419	331		138787	
5	436	470		204710	
5.5	445	637		283309	
6	447	838		374768	
6.5	443	1075		476672	
7	434	1354		587582	
7.5	420	1670		700658	
8	401	2026		812376	
8.5	379	2413		914588	
9	355	2802		993354	
9.5	328	3138		1029998	
10	301	3392		1020715	
10.5	273	3535		965915	
11	246	3589		882187	
11.5	219	3599		788553	
12	194	3600		696809	
12.5	169	3600		610161	
13	147	3600		529666	
13.5	127	3600		455868	
14	108	3600		389047	
14.5	91	3600		329256	
15	77	3600		276358	
15.5	64	3600		230064	
16	53	3600		189975	
16.5	43	3600		155612	
17	35	3600		126448	
17.5	28	3600		101936	
18	23	3600		81529	
18.5	18	3600		64697	
19	14	3600		50940	
19.5	11	3600		39798	
20	9	3600		30853	
20.5	7	3600		23734	
21	5	3600		18119	
21.5	4	3600		13726	
22	3	3600		10320	
22.5	2	3600		7700	
>23	5	0		0	
-		0		14753418.4	

**Annex 2: Approved Independent Tester**

- (i) Risø DTU, Wind Energy Department, Building VEA-118, P.O. Box 49, Frederiksborgvej 399, DK-4000 Roskilde, Denmark;
- (ii) DEWI GmbH – Deutsches Windenergie-Institut, Ebertstrasse 96, D-26382 Wilhelmshaven, Germany;
- (iii) Deutsche WindGuard GmbH, , Oldenburger strasse 65, 26316 Varel, Germany
- (iv) WIND-consult GmbH, Reuterstrasse 9, 18211 Bargeshagen, Germany;
- (v) Energy research Centre of the Netherlands (ECN), Westerduinweg 3, 1755 LE Petten - P.O. Box 1, 1755 ZG Petten, Netherlands;
- (vi) DNV/GL, Tuborg parkvej 8, Hellerup, Copenhagen, DK-2900, Denmark (DNV/GL includes the previous test labs of GEC and WindTest KWK, but not the test lab of Garrad Hassan).
- (vii) SgurrEnergy Ltd., 225 Bath Street, Glasgow, G2 4GZ, UK; and
- (viii) Barlovento Recursos Naturales, Pintor Sorolla Str 8, 1ºA, 26007 Logroño, La Rioja, Spain.
- (ix) AWS Truepower, 463 New Karner Road, 12205 Albany, New York, USA
- (x) K2 Management A/S, Hasselager Centervej 27, 8260 Viby J, Denmark
- (xi) COWI A/S, Parallelvej 2, 2800 Kongens Lyngby, Denmark
- (xii) WSP Inc., 405 18 St SE, Calgary, Alberta, Canada T2E 6J5

For each of the entities all regional offices are also included under the approved entities as long as the regional offices operate under the same quality system as the head office. The Independent Tester has to present a written proof that the same quality system as the head office described above is followed.

**Annex 3: Result of Test with varying Operation Modes (Directional Curtailment and/or Noise Reduced Operation)**

Definition Changes:

“*MEO*” means, with respect to any Measurement Test, the annual average Measured Energy Output, expressed as MWh/Year or kWh/Year. In absence of a Measurement Test, *MEO* shall be deemed equal to *WEO*.

“*MEO<sub>j</sub>*” means, with respect to any Measurement Test, the annual average Measured Energy Output for Operation Mode *j* being the average of the *MEO<sub>i,j</sub>* for all the Nominated Turbines in the Project for Operation Mode *j*, expressed as MWh/Year or kWh/Year.

“*MEO<sub>i,j</sub>*” means, with respect to a Measurement Test on Nominated Turbine number *i* for the Operation Mode *j*, the result of such test, expressed as MWh/Year or kWh/Year, as calculated by multiplying the nominal wind speed distribution in column C of the corresponding ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’ by the measured Power Curve for such Nominated Turbine. The measured Power Curve shall be extrapolated by assuming zero power for all wind speeds below the lowest wind speed in the measured Power Curve and constant power for wind between the highest wind speed in the measured Power Curve and the cut-out wind speed. The constant power shall be from the highest wind speed in the measured Power Curve.

“*Nm*” means the number of warranted Operation Modes.

“*WEO*” means the Warranted Power Output, being the annual energy production expressed as MWh/Year or kWh/Year for all the Nominated Turbines in the Wind Farm as calculated according to section 5.7 of this warranty

“*WEO<sub>j</sub>*” means the Warranted Energy Output for Operation Mode *j*, being the annual energy production expressed as MWh/Year or kWh/Year, as calculated using the Warranted Power Curve(s) as defined in column D in ‘Annex 1: Warranted Energy Output and Wind Speed Distribution’ and the wind speed distribution.

*f<sub>j</sub>* means the percentage of the total energy produced in the wind farm when the turbines are running in Operation Mode *j* calculated by using the Annex 1 for the different operation Modes, *j*, and the Project Specific Operational Requirements defined for the Project

Calculation Changes:

The results of the Measurement Test are the *MEO<sub>i,j</sub>* and their mean value for each Operation Mode *j*. *MEO<sub>j</sub>* shall be considered the best estimate of the average of the *MEO<sub>i,j</sub>* of all the Turbines at the Project and shall be calculated as follows:



$$MEO_j = \frac{1}{n} \sum_{i=1}^n MEO_{i,j}$$

The result of the Measurement Test is MEO and shall be calculated as follows:

$$MEO = \frac{1}{100} \sum_{j=1}^{Nm} f_j MEO_j$$

And the WEO shall be calculated as follows:

$$WEO = \frac{1}{100} \sum_{j=1}^{Nm} f_j WEO_j$$