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Datasheet for the decision of 24 April 2023

Case Number: T 0978/20 - 3.2.04

Application Number: 12737573.1

Publication Number: 2736805

IPC: F03D1/00, F03D1/06

Language of the proceedings: EN

Title of invention:
WIND TURBINE BLADE COMPRISING VORTEX GENERATORS

Patent Proprietor:
LM WP Patent Holding A/S

Opponents:
Siemens Gamesa Renewable Energy GmbH & Co. KG
Vestas Wind Systems A/S

Headword:

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 0978/20 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 24 April 2023

Appellant: (Patent Proprietor)	LM WP Patent Holding A/S Jupitervej 6 6000 Kolding (DK)
Representative:	COPA Copenhagen Patents Rosenørns Allé 1, 2nd floor 1970 Frederiksberg C (DK)
Appellant: (Opponent 1)	Siemens Gamesa Renewable Energy GmbH & Co. KG Beim Strohhause 17-31 20097 Hamburg (DE)
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Appellant: (Opponent 2)	Vestas Wind Systems A/S Hedeager 42 8200 Aarhus N (DK)
Representative:	Beetz, Joeri Keltie LLP No.1 London Bridge London SE1 9BA (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 27 March 2020 concerning maintenance of the European Patent No. 2736805 in amended form.**

Composition of the Board:

Chairman	A. de Vries
Members:	C. Kujat
	T. Bokor

Summary of Facts and Submissions

I. The appeals lie from the interlocutory decision of the opposition division of the European Patent Office concerning maintenance of the European Patent No. 2 736 805 in amended form pursuant to Articles 101(3)(a) and 106(2) EPC.

II. The opposition division held that the patent as amended according to auxiliary request 4 and the invention to which it related met the requirements of the EPC, having regard inter alia to the following evidence:

E1: Dayton A. Griffin: "Investigation of Vortex Generators for Augmentation of Wind Turbine Power Performance", NREL Report NREL/SR-440-21399, December 1996

E13: WO 01/16482 A1

E17: G. P. Corten: "Flow Separation on Wind Turbine Blades", Ph.d. thesis, 8 January 2001, ISBN 9039325820

E18: WO 2012/082324 Al

E19: G. P. Corten: "Stall flag diagnostics of the Aerpac 43m rotor", project report ECN-C--01-04, 2 May 2001

E20: R. Gasch, J. Twele: "Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb",4th edition 2005, pages 255 to 266, ISBN 3-519-36334-8

E21: J. N. Sørensen: "VISCWIND - Viscous Effects on Wind Turbine Blades", June 1999, ISBN 87-7475-218-9

E23: J. C. Lin: "Review of research on low-profile vortex generators to control boundary layer

separation", Progress in Aerospace Sciences 38, (2002), pages 389-420

E24: M. O. L Hansen, C. H. Westergaard: "Phenomenological Model of Vortex generators", December 1995

III. In preparation for oral proceedings the board issued a communication pursuant to Article 15(1) RPBA setting out its provisional opinion on the relevant issues. Oral proceedings were duly held on 24 April 2023.

IV. The appellant proprietor (hereafter: proprietor) requests that the decision under appeal be set aside and the patent be maintained as granted (main request). Auxiliarily they request maintenance of the patent in amended form according to one of auxiliary requests 1 to 11, where auxiliary requests 1-4 were filed with the grounds of appeal, auxiliary request 4 with claims as upheld by the Opposition Division, and auxiliary requests 5-11 were filed with letter dated 1 December 2020.

V. The opponents 1 and 2 as appellants (hereafter: opponents 1 and 2) each request that the decision under appeal be set aside and the patent be revoked.

VI. Independent claims 1 and 15 of the relevant main request (patent as granted) read as follows:

"1. A wind turbine blade (10) for a rotor of a wind turbine (2) having a substantially horizontal rotor axis, the rotor comprising a hub (8) from which the wind turbine blade extends substantially in a radial direction when mounted to the hub (8), the wind turbine blade extending in a longitudinal direction (r) along a pitch axis and having a tip end (16) and a root end

(14) as well as a blade length, the wind turbine blade further comprising a profiled contour including a pressure side and a suction side, as well as a leading edge (18) and a trailing edge (20) with a chord having a chord length extending there between, the profiled contour, when being impacted by an incident airflow generating a lift, wherein the suction side of the wind turbine blade is provided with a plurality of vortex generators positioned along a mounting line (36) having a proximal end point (37A) nearest the root end and a distal end point (37B) nearest the tip end, characterised in that the mounting line is a concave line seen from the trailing edge of the wind turbine blade, wherein the proximal end point is located in a blade length interval of 0 - 0.12L from the root end and in a relative chordal position of 2%-20%, and wherein the distal end point is located in a blade length interval of 0.2L to 0.5L from the root end and in a relative chordal position of 25%-75%."

"15. Method for retrofitting a wind turbine blade extending in a longitudinal direction along a pitch axis and having a tip end and a root end as well as a blade length, the wind turbine blade further comprising a profiled contour including a pressure side and a suction side, as well as a leading edge and a trailing edge with a chord having a chord length extending there between, the profiled contour, when being impacted by an incident airflow generating a lift, the method comprising mounting a plurality of vortex generators along a mounting line having a proximal end point nearest the root end and a distal end point nearest the tip end, characterised in that the mounting line is a concave line seen from the trailing edge of the wind turbine blade, wherein the proximal end point is located in a blade length interval of 0 - 0.12L from

the root end and in a relative chordal position of 2%-20%, and wherein the distal end point is located in a blade length interval of 0.2L to 0.5L from the root end and in a relative chordal position of 25%-75%."

VII. The opponents argued as follows:
The subject-matter of independent claims 1 and 15 lacked novelty over each of documents E1, E17 and E19, and does not involve an inventive step starting from the teachings of each of E1, E17, E18, E19 and the LM19.1 blade as shown in E20 and E21.

VIII. The proprietor argued as follows:
The subject-matter of independent claims 1 and 15 was novel and involves an inventive step over the cited prior art.

Reasons for the Decision

1. The appeals are admissible.

2. *Background*

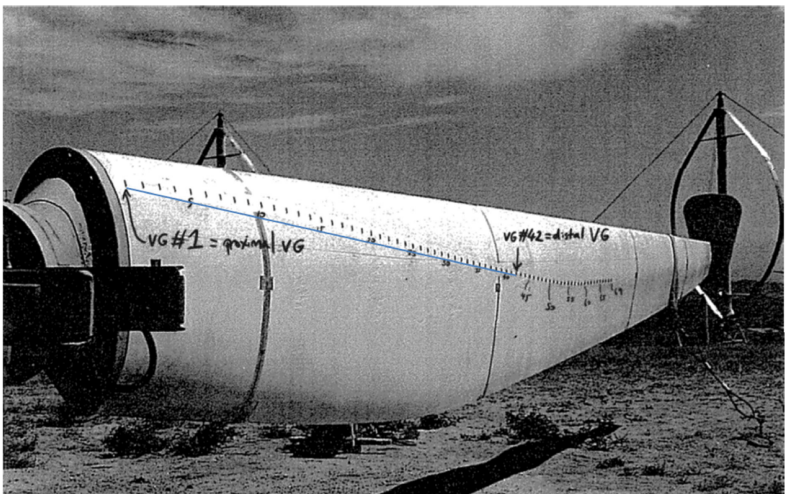
The invention is directed to a wind turbine blade with a plurality of vortex generators positioned along a mounting line on its suction side. The mounting line is concave when seen from the trailing edge of the blade, and its proximal and distal end points are located at specific positions of the blade. These positions are defined lengthwise by their blade length interval (distance from the root end), and widthwise by their relative chordal position (defined as percentage of chord length). As a result of this arrangement of the vortex generators, flow separation on the suction side due to a suboptimum aerodynamic profile of the root region and the transition region of the blade is

avoided or reduced such that the energy yield of the wind turbine is increased (paragraphs 0011 and 0014 of the patent). A method for retrofitting a wind turbine blade is also claimed.

3. Novelty

Novelty has been challenged with respect to documents E1, E17 and E19.

3.1 **Document E1** concerns a study on the use of vortex generators (VGs) for performance augmentation of the stall-regulated AWT-26 wind turbine. In that study, an array of VGs was designed and tested for increasing the power output at moderate wind speeds. The VG array on a blade of the AWT-26 prototype P1 is shown in figure 4-2 as a photo of "VG Configuration #1". An annotated version of that figure provided by opponent 2 is reproduced below. The parties agree that general installation parameters of the "VG Configuration #1" are disclosed in table 5-1 on page 5-9 of E1. According to that table, 69 VGs were installed per blade with a spanwise extent of "blade root to 57.5% radius" and a variable chordwise extent of "from 10% to 45% chord".



It is further undisputed that the above photo is the only representation in E1 of actual positions of the VGs on the rotor blade, see the indications "VG#1" and "VG#42" for the 1st to 42nd VGs. The decision on novelty vis-à-vis E1 depends on, inter alia, whether the mounting line of the VG array in this photo is a concave line seen from the trailing edge of the wind turbine blade. The board finds this not to be so for the following reasons:

3.1.1 In the present case it is undisputed that a mounting line is not a physical object such as a length of cord, piping or wire attached to the outer surface of the wind turbine blade. Instead, the term mounting line refers to a notional line that in some way links a number of vortex generators while no physical line is present on the wind turbine blade. Due to the notional nature of the mounting line, the board must first construe the term *concave mounting line* before it can assess whether it is disclosed in E1.

In its broadest sense the term *concave* means "hollowed or rounded inward like the inside of a bowl or lens" (Merriam-Webster). Applied to the mounting line it is understood to mean that the mounting line as seen from the trailing edge is likewise "hollowed", that is with the points between its proximal and distal ends lying beyond the (straight) line connecting them for an observer on the trailing edge. The vortex generators or VGs are located on the suction side of the profiled contour of the wind turbine blade, *profiled* referring to the aerodynamic profile of the blade as the skilled person would understand it. Indeed this is reflected also in the the term "chordal position" in the claim, which the skilled person would understand as relating to the chord of an aerodynamic profile being the

straight line connecting the trailing and leading edge of an aerodynamic profile. Because of the profiled contour of the blade its surface is curved in a more or less complex manner depending on the shape (and orientation) of the profile as it changes along the length of present day rotor blades. A line connecting VGs on the blade surface will most likely therefore have a complex spatial curvature so that without a clear plane of reference it may be difficult for an observer on the trailing edge to determine the exact nature of its curvature. Thus, as argued by the opponents, a concave mounting line must be construed in the light of the description.

3.1.2 Paragraph 0016 of the patent explains that a concave mounting line is to be understood as a line, which when projected into a chordal plane of the blade is concave, or equivalently that the mounting line may be concave from the trailing edge in a top view of the suction side of the blade. The mounting line is thus not the line linking the vortex generators on the blade surface but rather its projection onto the chordal plane. It is this projection that according to claim 1 must be concave, so that between its proximal and distal ends its points lie beyond the (straight) line connecting them as seen from the trailing edge, and the board reads claim 1 accordingly. According to established case law, it is a prerequisite for a finding of lack of novelty that the claimed subject-matter is directly and unambiguously derivable from the prior art, see CLBA, 10th edition 2022, I.C.4.1. The board must therefore assess whether figure 4-2 of E1 directly and unambiguously discloses a line which meets the above definition.

3.1.3 The photo of figure 4-2 can be said to be a photographic projection of the three dimensional suction side of the blade by a lens onto the image plane of the camera (formed on the negative or its sensing array). As is well-known photographic projection gives rise to lens and perspective distortion, meaning that shape and positional relationships in the image may differ from true shape and true positional relationships to a degree that depends on the conditions under which the photograph was taken. Here, the photo appears to have been taken from somewhere fairly close to the blade root end and at an acute angle with respect to the blade, resulting in considerable distortion as is evident from the great amount of foreshortening in the image. Clearly, the image plane was neither the chordal plane nor that of a top view, where the photo would have to be taken from a position halfway along the axial length of the blade, and at some (ideally infinite) distance away from it. How the projection as visible on Fig. 4-2 might transform to the chordal plane or a top view plane is not clear to the Board as the exact conditions under which the picture was taken are unknown. This is further compounded by the fact that the exact three-dimensional shape of the blade surface is also not known. Consequently, the exact shape of the line along which the VGs are mounted on the blade surface or how that might project onto the blade chordal plane cannot be known with any degree of certainty. Thus, even if the mounting line in the forward root section between the first up to the 42nd vortex generator might *appear* concave in the photo this need not be so at all for its projection onto the chordal plane or when viewing the blade from a top view. For these reasons the Board concludes that figure 4-2 does not disclose directly and unambiguously, i.e. as a matter of objective fact

without any doubt, that the depicted vortex generators are mounted on a concave mounting line as claimed.

It is therefore immaterial whether it would be clear from figure 4-2, as argued by opponent 1 in their grounds of appeal, that an inboard section of the line of vortex generators curves towards the trailing edge with increasing radial distance from the blade root, since this argument relates to the plane of the photo / the image plane of the camera. By the same token, opponent 2's argument in their grounds of appeal that a mounting line drawn through the vortex generators numbered 1-42 would be concave when seen from the trailing edge, or the argument in their letter of 24 February 2023 that a straight line connecting VG#1 and VG#42 does not cross the mounting line also relate to the plane of the photo / the image plane of the camera. In contrast, their argument of 24 February 2023 that figure 4-2 clearly enables the viewer to understand what the mounting line would look like in a top view of the suction side of the blade is not backed by any evidence, and thus, relates to mere speculation.

3.2 With regard to **documents E17 and E19**, it is common ground that both documents concern the same improvement to the stall behaviour of the APX43 wind turbine rotor. E19 is substantially an excerpt from E17. Page 12 of E19 contains an additional figure 14 and provides additional comment. In the following, the board will therefore only refer to E19 but its conclusions are understood to apply also to the shorter document E17.

According to E19, an initial pattern of VGs on the wind turbine blade was optimized inter alia by moving the VGs between 0.45R and 0.6R to larger chord-wise positions, see the paragraph immediately below figure 6

on page 6. The optimized configuration of the VGs, referred to as ECN-1, is shown in figure 6, the upper part of figure 7 and the middle part of figure 14. The relevant parts of these figures are reproduced below:

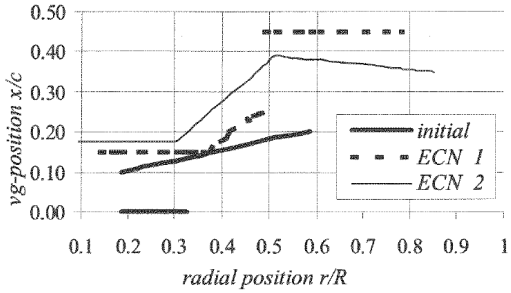


figure 6 *The vortex generator patterns.*

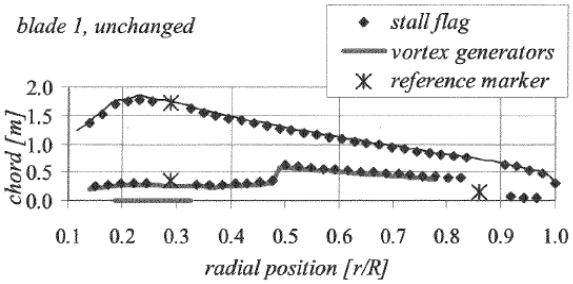


figure 7 (top graph, blade 1)

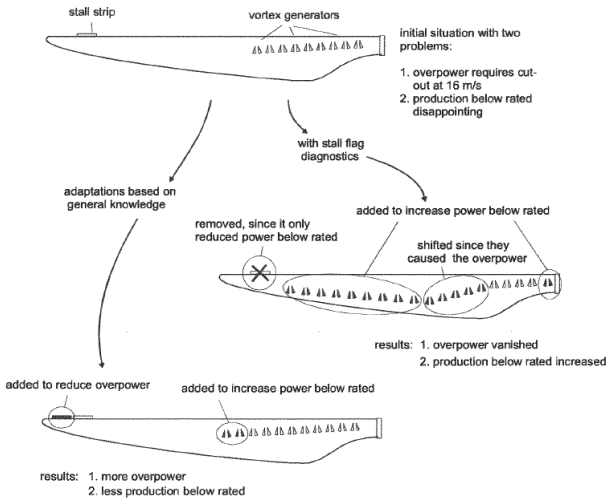


figure 14 *Diagrammatic summary of the project*

The decision on novelty vis-à-vis E19 depends on, inter alia, whether the mounting line of the VGs in the ECN-1 configuration is a concave line seen from the trailing edge of the wind turbine blade. The board finds this not to be so for the following reasons:

3.2.1 In the context of document E1, the board already came to the conclusion that the concave shape of the mounting line in a prior art document must be assessed with respect to the chordal plane of the blade, see paragraph 3.1.2 above. The board therefore concurs with the opponents that figures 6, 7 and 14 of document E19 are relevant for the issue of novelty, since, as all agree, they concern VG patterns in the chordal plane.

3.2.2 In its middle part, figure 14 shows nineteen sets of VGs along the length of the wind turbine blade for the ECN-1 configuration. The 1st to 5th VGs from the root are arranged on a straight line with a smaller inclination towards the trailing edge than that of the straight line joining the 6th to 10th VGs. According to paragraph 0021 of the patent in suit, the concave mounting line can be divided into two or more straight line segments. In the light of this definition, figure 14 of E19 would appear to show that the 1st to 10th VGs are located in a concave arrangement. However, due to the exaggerated size of each VG in relation to the length of the 43m APX43 wind turbine rotor, the board considers figure 14 merely a schematic representation of the rotor blade. The board must therefore assess whether this schematic representation directly and unambiguously discloses a concave mounting line of the VGs, in particular whether and to what degree it is meant to be a true representation of the mounting line.

3.2.3 According to established case law, a document forms part of the state of the art under Article 54(2) EPC only as regards those elements which the person skilled in the relevant art would incontestably infer from the document as a whole. In that respect, the individual sections of a document cannot be considered in isolation from the others but must be seen in their overall context, see CLBA, I.C.4.1. In the present case, it is therefore imperative that figures 6, 7 and 14 of document E19 are construed in the context of the contents of the document as a whole when assessing which shape of the mounting line is disclosed therein.

3.2.4 As claim 1 refers to a concave line "seen" from the trailing edge, the mounting line must be immediately visible when the VGs of a wind turbine blade are projected onto its chordal plane. In other words, the VG patterns in the chordal plane according to figures 6, 7 and 14 can only qualify as a concave mounting line if they relate to absolute positions of the VGs in terms of their blade length and chord. With regard to figure 14, the board concurs with the opponents that the schematic representation of the VG arrangement in that figure *might* be interpreted by a skilled person as absolute positions of the VGs. Whether or not this is so can be inferred by comparing the arrangement of figure 14 with the positional information given in the graphs of figures 6 and 7. Here the graph of figure 6 sets relative chordal positions (see paragraph 3.2 of the present decision: "vg position x/c"), figure 7 sets absolute chordal position (see paragraph 3.2 above: "chord [m]") against relative radial position r/R along the length of the blade. As only figure 7 shows absolute chordal position versus relative radial position, only that figure can provide information

regarding the true shape of the mounting line in the chordal plane and can thus be compared directly with the shape of the mounting line shown in figure 14. Figure 6 can nonetheless be used to check the relative chordal position of the VGs in figure 17.

3.2.5 In the light of figures 6 and 7, the board cannot share the opponent's contention that a concave mounting line unequivocally follows from the teaching of figure 14.

It is common ground that the upper part of figure 7 (reproduced in paragraph 3.2 above) relates to the ECN-1 configuration. Contrary to the opponent's assertions, the board cannot identify a concave mounting line in figure 7 due to its low vertical resolution. In the region of interest of from about 0.13 to below 0.5 r/R radial position, the almost constant chord of about 0.25m rather suggests that (in the chordal plane) the VGs are mounted on an approximately straight line. Indeed this mounting line may even be seen to have a dip at about 0.3 r/R (in the vicinity of the reference marker) towards the leading edge, which would lead to a convex mounting line in that region. From a radial position of about 0.5 r/R (halfway along the blade)a second set of VGs is shown placed further forward towards the leading edge along a second straight line segment that is offset with respect to the first segment. At the same radial position figure 6 shows an abrupt change in the relative chordal position for the ECN-1 arrangement, which leads the Board to believer that the unlikely, rather short step shown in figure 7 at 0.5 r/R for the ECN-1 is in fact a drawing artefact, and that the two line segments are non-contiguous.

In important aspects the shape of the actual mounting line as shown in figure 7 differs from that of the middle arrangement in figure 14, which are both meant to show the same ECN-1 arrangement. In figure 14, the ECN-1 arrangement appears to have *three* separate line segments that are *contiguous* but angled to form a line with two kinks. Indeed it is due to the first kink (between the 5th and 6th VG counted from the root) that the appellant opponents see a concave shape. In the figure each of the three segments is accompanied by an explanation: in the first (from the root) VGs are added, in the second the VGs are "shifted since they caused the overpower", while the third is "added to increase power below rated" (as in the first).

There are also important inconsistencies between figures 6 and 14 regarding the ECN-1 arrangement. For example up to 8th VG (from the root end) which is about a 3rd of the way along the blade the relative chordal position in figure 14 appears to be greater than 0.50 whereas according to figure 6 up to about radial position 0.3 it should be less than 0.2. At the tip end on the other hand, the relative chordal position of the VGs appears to be much further away from 0.5 than shown in figure 6.

Similar discrepancies exist between figure 14 and the text. For example, the corresponding description on page 6 of the document states that "vortex generators between 0.45R and 0.6R" were moved to larger chordal position. In contrast, the shifted 6^{th} to 10^{th} VGs in figure 14 are located between about 0.2 to about 0.4r/R. No corresponding shift in the radial range of from 0.2 to 0.4 r/R is shown in figure 7, and also not in the radial sub-range of from 0.45 to 0.5r/R, i.e. the

first part of the allegedly shifted VGs according to the passage on page 6.

3.3 Summarizing the above, and contrary to the opponents' view, the board finds important discrepancies between figure 14 on the one hand and figures 6, 7 and the text of E19 on the other. Given that figure 14 is indisputably schematic in nature, whereas figures 6, 7 and the relevant text are meant to provide factual, numerical information of the mounting arrangements, the board concludes that only the latter describe the arrangement's true features. It surmises that the purpose of figure 14 was to visualize in a simple diagrammatic manner the various adaptations tested in E19, see its caption on page 12 : "Diagrammatic summary of the project", a *diagram* being "a graphic design that explains rather than represents" (Merriam-Webster). It may be because it was not representative that figure 14, which appeared in what is clearly an intermediate (initially internal) publication documenting the research, was then omitted from the more detailed and authoritative thesis that resulted from that research. The board is therefore not convinced that a concave mounting line of the VGs on the APX43 wind turbine rotor may be gleaned directly and unambiguously, i.e. beyond doubt, from these figures.

3.4 Independent method claim 15 is directed to a method for retrofitting a wind turbine blade with a plurality of vortex generators. As these vortex generators must also be mounted along a concave mounting line seen from the trailing edge, the above assessment of E1 and E19 applies to claim 15 *mutatis mutandis.*

3.5 From the above it follows that none of the documents brought forward against novelty directly and unambiguously disclose a concave mounting line of the vortex generators. Therefore, neither E1 nor E19 is prejudicial to novelty of the subject-matter of claims 1 and 15, Article 100(a) in conjunction with 54 EPC. This is irrespective of whether a concave mounting line according to claim 1 links all or only a subset of the vortex generators on a wind turbine blade, or whether "concave" applies to the entire mounting line or only a segment thereof.

4. Inventive step

Inventive step has been challenged starting from each of documents E1, E18, E19 and the LM19.1 blade as shown in E20 and E21.

4.1 Following on from the discussion of novelty, the subject matter of claim 1 differs from each of **documents E1 and E19** at least in that the mounting line is a concave line seen from the trailing edge of the wind turbine blade. According to paragraph 0014 of the patent, by arranging the VGs on the suction side close to the area of possible or expected flow separation, the wind turbine blade provides an improved separation profile by moving the separation towards the trailing edge or even preventing separation.

4.2 The opponents objected at the oral proceedings before the board that this technical effect would not be achieved over the entire breadth of the claim, or that no effect would be plausibly demonstrated. Leaving aside the question of admissibility of such a late objection under Article 13(2) RPBA, this objection is

wholly unconvincing as it is a mere allegation unsupported by any evidence. In accordance with established jurisprudence, a technical problem set out in a patent is considered to be credibly solved by a claimed invention if there are no reasons to assume the contrary. Under such circumstances, the burden is normally on the opponent to prove the opposite or at least provide evidence casting doubt on the alleged solution of the problem (CLBA, III.G.5.1.1). In the present case, it is common ground that the VGs shift the separation line towards the trailing edge at least for some concave mounting lines whose proximal and distal end points are located within the claimed ranges. The opponents have had ample time to substantiate their objections, because claim 1 was not amended during the opposition or appeal procedure. As they chose not to provide any evidence for their allegations, the burden of proof that the technical effect is achieved over the entire breadth of the claim, or that the effect is plausible, is not shifted to the patent proprietor.

4.3 Consequently, in the light of paragraph 0014 of the patent, the board formulates the objective technical problem as achieving an improved separation profile by moving the separation towards the trailing edge or even preventing separation. The board must therefore now examine whether a skilled person would as a matter of obviousness modify the arrangement of vortex generators (VGs) in E1 or E19 by progressively shifting some of the VGs in order to arrive at a concave mounting line.

4.4 In accordance with established jurisprudence, the boards of appeal apply the "could-would approach". This means asking not whether the skilled person *could* have carried out the invention, but whether he *would* have

done so in the hope of solving the underlying technical problem (CLBA, I.D.5). In the present case, the board accepts that the wind turbine blades of E1 or E19 may well exhibit a concave stall line seen from the trailing edge of the wind turbine blade, as for example disclosed in the context of a different yet comparable wind turbine blade in figure 6-27 of E20 or figures 5.4.1.9 to 5.4.1.11 of E21. The appellant opponents argue that the skilled person could arrive at the claimed wind turbine blade by mounting the VGs of E1 or E19 along its stall line. However, the board is not convinced that the skilled person would do so for the following reasons:

4.4.1 With regard to **E1 as starting point**, the board does not share the opponent's view that, if the skilled person might not be certain that figure 4.2 shows a concave mounting line in the chordal plane, then they would infer such a mounting line as the most likely reading of its teaching. As noted above in regard to novelty the shape of the mounting line in the chordal plane cannot be derived with any degree of certainty from figure 4.2. The mounting line could be straight, convex, concave or may even have a more complicated shape when projected into the chordal plane of the blade. None of these possible shapes seems more likely on the basis of figure 4.2 alone. Instead, in view of the convex shape of the forward stall limit and the forward drag limit depicted in figure 4-1, and the statement "VGs are as far forward as possible" in the second paragraph on page 4-6, the board considers it much more likely that the skilled person would arrange the VGs close to these limits, i.e. along a convex mounting line (in the chordal plane).

4.4.2 During the oral proceedings before the board, the opponents argued for the first time that the first row of table 4-2 in E1 teaches the progressive shifting of the VGs of the blade shown in figure 4-2 (table 4-2: "increase the slope of the chord wise VG locations, so that the array moves aft more quickly with radial position"). Again leaving aside the question of admissibility of such a late argument under Article 13(2) RPBA, this objection in any case does not convince the board. In the absence of any indication of how far aft the array must be moved, it is possible that even after that shift, the mounting line is still convex or only straight. The instruction in table 4-2 therefore does not directly and unambiguously lead to a concave mounting line.

4.4.3 With regard to **E19 as starting point**, as is clear from the discussion of novelty the board considers figure 14 not to represent the true shape of the mounting line. Thus, even if figure 14 might *appear* to show a concave mounting line between the 1st to the 10th VG, the skilled person would reject such a shape as a part of the teaching of E19. They would rather look towards figures 6 and 7 for information regarding the actual placement of VGs, which, as stated above, is not concave. Otherwise, the board sees no obvious reason why the skilled person would deviate from this specific teaching of E19.

4.4.4 The common general knowledge also does not incite the skilled person to arrange the VGs of E1 or E19 on a concave mounting line. The opponents relied on E18 and E24 as proof of that common general knowledge. However, E18 is a patent document and E24 a scientific article in the form of a conference paper, which

according to established jurisprudence is normally not included in the common general knowledge (CLBA, I.C. 2.8.2). Notwithstanding this, E18 only discloses a straight mounting line of the VGs (see paragraph 4.5 below) and E24 only discloses a single VG (see paragraph 4.8 below).

4.4.5 Summarizing the above, neither E1 or E19 alone, nor in combination with the common general knowledge renders obvious a concave mounting line.

4.5 The alternative starting point **document E18** has a priority date of 16 December 2020 and therefore belongs to the state of the art under Article 54(3) EPC for that part of claims 1 and 15 which validly claims priority. Notwithstanding the priority issue, the document acknowledges the concave nature of the stall line on a wind turbine blade, see figure 3, but still proposes a straight mounting line of the VGs at 35% of the maximum chord, see figure 4, page 5, line 14 and page 8, line 4. As this straight line is already sufficient for generating laminar flow over most part of the blade surface, see figure 4, the board is not convinced that the statement "they will be installed very near to the stall line" on page 10, lines 1 and 2 of E18 teaches the skilled person to arrange the VGs in a manner different from figure 4. Nor does the board find otherwise in view of the statement "placing VGs at slightly different locations on other similarly situated wind turbine generators" on page 10, lines 27 and 28. Read in context this somewhat ambiguous statement is understood to mean that all VGs together (not individually) may be located at different (chordal) positions on the blade for different turbines. This is all the more so, since E18 teaches the use of a template for placing a plurality of VGs in

a linear arrangement (figure 8 and page 11, lines 10 and 11) in order to align VG pairs with each other (page 5, lines 7 and 8), and consistently refers to a single location for placing the VGs (page 7, lines 27 and 31; page 9, lines 11 and 28; page 10, line 14).

Thus, even if E18 were prior art under Art 54(2), it would not render obvious the placement of VGs along a concave mounting line as claimed.

4.6 Concerning the **LM19.1 blade shown in E20 and E21** as a starting point, it is common ground that the concave nature of the stall line on a wind turbine blade is disclosed in these documents without any reference to VGs (E20: figure 6-27; E21: figures 5.4.1.9 to 5.4.1.11). The board therefore shares the opponents' view that starting from the LM19.1 rotor blade, and after having decided to add suction side vortex generators to improve its aerodynamic performance, the skilled person is confronted with the objective technical problem of having to decide where to mount the vortex generators.

4.7 The board also accepts that placing a plurality of vortex generators upstream of the concave separation line shown in E20, E21 is an obvious solution to that problem. However, such an unspecific placement is different from the inventive concept of placing VGs along a concave mounting line, which is not disclosed in any of the combination documents:

For **documents E1 and E17**, the board refers to its general conclusion that these document do not disclose directly and unambiguously a concave mounting line in the above section on novelty for E1 and E19 (which essentially corresponds to E17). Also the passage on

page 68 of E17 relied on in opponent 2's grounds of appeal does not disclose any specific chord position of the VGs, and certainly not a concave mounting line as claimed.

Document E4 only discloses a linear arrangement of the VGs, see page 2, last paragraph ("a single row of flat fins perpendicular to the surface near the leading edge (at about 10% chord)"), shown as l "VG Alignment line (~10 percent chord) corresponding to the actual placement of the VGs in the photo of figure 4B.

Document E13 only discloses straight and U-shaped convex patterns (page 4, lines 24 and 25, figure 3).

Document E18, leaving aside whether it belongs to the state of the art under Article 54(2), in any case teaches away from the claimed solution (see above).

Document E22 does not disclose any specific position of the VGs (page 114, fourth paragraph: "perturbation bodies which are installed in the front area of the top of the airfoil. These are small plates mounted at an angle to the direction of flow and often also at an angle to one another in order to enhance the generation of vortices").

Document E23 is specific to aircraft with much higher wind speeds, and thus not relevant to wind turbines.

4.8 It follows from the above that, starting from the LM19.1 blade of E20 or E21, the cited combination do not render obvious the subject-matter of claim 1. This conclusion is not altered by **document E24**, which also relates to the LM19.1 blade, see figure 6, but discloses only a single vortex generator placed on the separation line, see the last paragraph on page 5.

4.9 The board concludes, therefore, that the subject-matter of claim 1 as granted involves an inventive step, Articles 100 (a) and 56 EPC. This reasoning also applies to the method for retrofitting a wind turbine blade according claim 15 *mutatis mutandis*, since the method involves mounting a plurality of vortex generators along a concave mounting line defined by the same parameters as those of claim 1.

5. Hence, contrary to the opposition division's findings, the board considers the subject-matter of claims 1 and 15 of the main request novel and involving an inventive step in the light of the cited prior art, Article 100 (a) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

G. Magouliotis A. de Vries

Decision electronically authenticated