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Datasheet for the decision of 19 July 2019

T 0057/16 - 3.2.04 Case Number:

Application Number: 11175580.7

Publication Number: 2551515

IPC: F03D9/00, H02J3/38, H02J3/50

Language of the proceedings: ΕN

Title of invention:

Method and arrangement for operating a wind farm within voltage limit

Patent Proprietor:

Siemens Gamesa Renewable Energy A/S

Opponents:

Vestas Wind Systems A/S ENERCON GmbH

Headword:

Relevant legal provisions:

EPC Art. 54(2), 56

Keyword:

Novelty - (no)
Inventive step - (no)

Decisions cited:

Catchword:



Beschwerdekammern Boards of Appeal Chambres de recours

Boards of Appeal of the European Patent Office Richard-Reitzner-Allee 8 85540 Haar

GERMANY

Tel. +49 (0)89 2399-0 Fax +49 (0)89 2399-4465

Case Number: T 0057/16 - 3.2.04

DECISION
of Technical Board of Appeal 3.2.04
of 19 July 2019

Appellant: Siemens Gamesa Renewable Energy A/S

(Patent Proprietor) Borupvej 16

7330 Brande (DK)

Representative: Aspacher, Karl-Georg

Siemens Gamesa Renewable Energy GmbH & Co. KG

Otto-Hahn-Ring 6 81739 München (DE)

Respondent: Vestas Wind Systems A/S

(Opponent 1) Hedeager 44

8200 Aarhus N (DK)

Representative: Grünecker Patent- und Rechtsanwälte

PartG mbB

Leopoldstraße 4 80802 München (DE)

Respondent: ENERCON GmbH

(Opponent 2) Dreekamp 5

(Opponent 2) Dreekamp 5 26605 Aurich (DE)

Representative: Eisenführ Speiser

Patentanwälte Rechtsanwälte PartGmbB

Postfach 10 60 78 28060 Bremen (DE)

Decision under appeal: Decision of the Opposition Division of the

European Patent Office posted on 22 December 2015 revoking European patent No. 2551515

pursuant to Article 101(3)(b) EPC.

Composition of the Board:

Chairman A. de Vries

Members: G. Martin Gonzalez

W. Van der Eijk

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Summary of Facts and Submissions

- I. The appellant-proprietor lodged an appeal, received on 8 January 2016, against the decision of the Opposition Division posted on 22 December 2015 revoking European patent No. 2551515 pursuant to Article 101(3)(b) EPC, and simultaneously paid the appeal fee. The statement setting out the grounds of appeal was received on 20 April 2016.
- II. Two oppositions were filed under Article 100(a) for lack of novelty and lack of inventive step and under Article 100(b) for insufficiency of disclosure.

The Opposition Division revoked the patent having regard inter-alia to the following evidence:

- (D1) WO 2009/127393 A1
- (D2) Jorge Martinez Garcia: "Voltage Control in Wind Power Plants with Doubly Fed Generators", Ph.D. Thesis, Institute of Energy Technology, Aalborg University, Denmark, September 2010, ISBN: 978-87-89179-92-6
- III. The appellant-proprietor requests that the decision under appeal be set aside and the patent maintained as granted (main request), or, auxiliarily, the patent be maintained in amended form on the basis of one of its auxiliary requests 1-11, filed with letter of 18 April 2016.

The respondent-opponents 1 and 2 request that the appeal be dismissed.

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IV. In a communication of 14 March 2019 in preparation for oral proceedings the Board gave a provisional opinion on the relevant issues.

Oral proceedings before the Board were duly held on 19 July 2019.

- V. The wording of the independent claim 1 of the requests relevant to this decision is as follows:
 - (a) Main request (as granted)

signal;

"Method for determining a limit value of a wind turbine reference operational variable, the wind turbine being connected to a connection node to which a utility grid is connected, the method comprising:

obtaining a first input signal indicative of a connection node limit voltage (Umaxref, Uminref); obtaining a second input signal indicative of a connection node voltage (Umeas); determining the limit value (VMax, VMin) of the wind turbine reference operational variable (U WTREF) based on the first signal and the second

determining a difference between the first input signal and the second input signal,

wherein the determining the limit value of the wind turbine reference operational variable is based on the determined difference,

wherein the wind turbine reference operational variable is a wind turbine reference voltage (U_WTREF) and the limit value of the wind turbine reference operational variable is a voltage limit (VMax, VMin) of the wind turbine reference voltage, or

wherein the wind turbine reference operational variable is a wind turbine reference reactive power and the

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limit value of the wind turbine reference operational variable is a reactive power limit of the wind turbine reference reactive power."

(b) First auxiliary request

Claim 1 is amended vis-a-vis claim 1 of the main request as follows (emphasis added by the Board to indicate modified text):

"Method for determining a limit value of a wind turbine reference operational variable, the wind turbine being connected commonly with plural wind turbines to a connection node to which a utility grid is connected,..."

(c) Second auxiliary request

Claim 1 reads as in the first auxiliary request with the following features added at the end of the claim:

"..., wherein the method further comprises:
controlling the reference operational variable

(U_WTREF) of the wind turbine based on the determined
limit value (VMax, VMin) of the wind turbine reference
operational variable,
wherein the controlling is applied during at least the
following operational modes:
reactive power control at the connection node to
control a reactive power at the connection node; or
voltage control at the connection node to control a
voltage at the connection node; or
power factor control at the connection node to control
a power factor at the connection node,
wherein the operational modes are performable

temporarily separated from each other."

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(d) Third auxiliary request

Claim 1 reads as in the second auxiliary request with the following features added at the end of the claim:

"..., wherein during reactive power control at the connection node the reference operational variable of the wind turbine is further based on a reference reactive power (Q WFREF) at the connection node and a measured reactive power (Q PCC) at the connection node; during voltage control at the connection node the reference operational variable of the wind turbine is further based on a reference voltage at the connection node and a measured voltage at the connection node; and during power factor control at the connection node the reference operational variable of the wind turbine is further based on a reference power factor at the connection node and a measured power factor at the connection node and a measured power factor at the connection node."

(e) Fourth auxiliary request

Claim 1 reads as in the third auxiliary request with the following features added at the end of the claim:

"... wherein the method further comprises:
obtaining a preliminary upper limit value (Umax) of the
wind turbine reference operational variable;
obtaining a preliminary lower limit value (Umin) of the
wind turbine reference operational variable,
wherein the determining the limit value (VMax, VMin) of
the wind turbine reference operational variable is
further based on the preliminary upper limit value
(Umax) and the preliminary lower limit value (Umin),

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wherein in particular the limit value (VMax, VMin) is limited to be within a range defined by the preliminary upper limit value (Umax) and the preliminary lower limit value (Umin),

wherein the preliminary upper limit value (Umax) of the wind turbine reference operational variable is based on the reference operational variable (U_WTREF) of the wind turbine, and/or

wherein the preliminary lower limit value (Umin) of the wind turbine reference operational variable is based on the reference operational variable (U_WTREF) of the wind turbine."

(f) Fifth to eight auxiliary requests

Claim 1 of the fifth to eight auxiliary requests is identical to claim 1 of the first to, respectively, fourth auxiliary requests. These requests differ from the previous ones in amendments to the description, in particular to paragraphs [0008], [0009] and [0032] of the published patent specification.

(g) Ninth auxiliary request

Claim 1 is amended vis-a-vis claim 1 of the first auxiliary request as follows (emphasis added by the Board to indicate modified text):

- "... obtaining a second input signal indicative of a connection node voltage (Umeas) indicating an actual voltage which is present at the connection node;..."
- (h) Tenth auxiliary request

Claim 1 is amended vis-a-vis claim 1 of the ninth auxiliary request as follows:

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"...obtaining a first input signal indicative of a connection node limit voltage (Umasref, Uminref) defining a limit voltage to be achieved at the connection node;..."

(i) Eleventh auxiliary request

Claim 1 is amended vis-a-vis claim 1 of the tenth auxiliary request as follows:

"Method for determining a limit value of a wind turbine reference operational variable, the wind turbine being connected commonly with plural wind turbines to a connection node to which a utility grid is connected, wherein a park transformer is connected between the connection node and the utility grid,..."

VI. The appellant-proprietor argues as follows:

Having regard to documents D1, D2 and to the common general knowledge of the person skilled in the art, the subject-matter of claim 1 according to all requests is new and involves an inventive step. In this context, the features of the fourth auxiliary request related to the definition of the preliminary upper and lower limit values (Umax, Umin) have a technical effect and thus contribute to the inventive step of the invention.

VII. The respondent-opponents argue as follows:

Claim 1 of the main, first, fifth, ninth and tenth auxiliary requests is not new in view of D1. The subject-matter of claim 1 of the second to fourth, sixth to eight and eleventh auxiliary requests lacks an inventive step having regard to the teachings of D1, D2

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and common general knowledge of the skilled person. In this context, the preliminary upper and lower limit values (Umax, Umin) as defined in claim 1 of the fourth auxiliary request do not have a technical effect.

Reasons for the Decision

- 1. The appeal is admissible.
- 2. The invention is concerned with operating a wind farm within voltage limits at a connection node. Customarily each wind turbine in a wind farm is controlled for producing a desired amount of an operational variable, namely voltage or reactive power for satisfying the demands of the utility grid. The claimed invention is aimed at better satisfying the requirements of the utility grid and at preserving life span of components of the wind park by limiting the operation of the wind farm or wind turbine within predetermined voltage limits, see specification paragraphs [0001]-[0006]. With this aim, the claimed method and arrangement are directed at the determination of limit values for the controlled operational variable of each individual wind turbine, namely, based on parameters at the turbine connection node, see paragraph [0008]. In particular the limit value of wind turbine reference voltage or reactive power as operational variable is determined from the difference between input signals indicative of connection node limit voltage and the actual connection node voltage.
- 3. Main request novelty
- 3.1 The appellant-proprietor contests the finding of the Opposition Division that the subject-matter of claim 1 is not new over D1, see written decision section 12.

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The appellant-proprietor merely referred during the oral proceedings before the Board to their written submissions.

- 3.2 In its communication, section 7.1, the Board gave its preliminary opinion that claim 1 of the main request was not new over D1. It established that it was not under dispute that the embodiment of figure 6 of D1 described on pages 22, 23 determined upper and lower limit values (at value shifter 5) for limiting at limiter 59 the wind turbine reference reactive power set value. It was also not seen to be under dispute that the determination was based on the difference between the measured voltage U2 at 51 and the limit voltages Umax and Umin at 51, i.e. at the low voltage side of transformer 8, or with reference to figure 1, at node 13. As also held by the Opposition Division, the low voltage side of the transformer 8 was seen to satisfy the definition of a connection node in the broad sense of the claim terms, that neither require plural wind turbines nor that the measured or limit voltages are specifically those of the utility grid. This was confirmed by paragraph [0032] of the patent specification that reads "...the connection node may refer to a low voltage side or a high voltage side of a park transformer, wherein one or plural wind turbines may be connected...". Thus, on the only point of dispute the Board in its preliminary opinion agreed with the decision under appeal.
- 3.3 Absent any further submissions from the appellant-proprietor the Board sees no reason to change its point of view. It thus holds that the subject-matter of claim 1 of the main request is not new over the embodiment of figure 6 of D1.

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- 4. First auxiliary request novelty
- 4.1 This claim is amended with respect to the main request by now specifying that the wind turbine is connected commonly with, i.e. together with, plural wind turbines to the connection node. The appellant-proprietor submits that this claim 1 is thus new with respect to D1 which describes a single turbine and therefore only local voltage and voltage limits corresponding to a single turbine and not to a connection node with multiple turbines as now claimed.
- 4.2 Document D1, see e.g. page 1, first paragraph, and page 4, final paragraph, is concerned generally with the control of power fed into the grid from a wind turbine via a transformer to protect the turbine, transformer and the grid from excessive voltages. To this end it suggests control of reactive power of the transformer feeding the wind turbine output into the grid. The embodiment of figure 1 illustrates the idea for a single wind turbine connected to the grid, but the top paragraph of page 15 indicates a broader application also to wind parks.

From this passage read in conjunction with the figure 6 embodiment the Board concludes that D1 clearly and unambiguously discloses an embodiment wherein the wind turbine is commonly connected to a connection node to which a utility grid is connected. Thus, the grid 9 to which the individual turbine of the various embodiments of D1 is connected, may be either a utility grid or an internal grid of a wind park, see D1, page 15, lines 8-10. The term "wind park" - a group of wind turbines connected to the grid - implies, for the skilled reader, the common connection of the wind turbines of the park to the grid via a corresponding connection

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node. Therefore, application of D1's teaching to the internal grid 9 of a wind park, as indicated on page 15 implies a common connection node to a utility grid in the sense of the contested claim.

The main point of dispute is whether, when the control 4.3 of figure 6 is applied to a wind park, the input signal can still be said to be indicative of a voltage or a voltage limit at the common connection node of the park. The Board interprets "indicative" broadly to include also voltage values and limits at other, different positions than directly at the connection node, as long as the relevant point is electrically coupled to the node, so as to establish a known voltage relationship. The description confirms this understanding, see specification paragraph [0008], line 48 ff.: "a first input signal (...) indicative of a connection node limit voltage [defines] a limit voltage... at a connection node or at another position different from the connection node but electrically connected to the connection node, ... ".. The locus of the second input signal "indicative of a node voltage" is similarly defined at line 54, ff. of specification paragraph [0008], as "indicating the actual voltage ... at the connection node or at still another point ... different from ... but being electrically connected to the connection node". The connection node itself may be the high or low voltage side of the park transformer, see paragraph [0032] of the patent specification. Because a point on the high or low voltage side of the park transformer is electrically coupled to a point on the turbine side of a wind turbine transformer, voltages or voltage limits determined in either point there will be related to each other. Consequently the voltage or voltage limit at a point on the low voltage, turbine side of a wind turbine transformer, such as

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point 51 in figure 6 of D1, will be indicative of the voltage or voltage limit in the connection node, whether that is on the high or low voltage side of the park transformer. In conclusion, this feature is also seen to be disclosed in D1.

- 4.4 The appellant-proprietor also submits that the connection node limit voltage, according to the claim, is derived from or based on local regulations set by the utility grid operator. This argument appears to have little bearing on the matter at hand. In any case this limitation is not derivable from the claim wording.
- As otherwise (see above for the main request) it is not disputed that the embodiment of figure 6 of D1 when applied to a wind park and connected in common with plural wind turbines to the grid 9 comprises the other claimed features, the Board holds that D1 discloses, in combination, all features of claim 1 according to the first auxiliary request. It concludes that the subject-matter claim 1 of the first auxiliary request is not new over D1.
- 5. Second auxiliary request inventive step
- 5.1 Claim 1 is amended to specify that the method also includes controlling the operational variable (voltage or reactive power) within the previously determined limit values according to at least three operation modes: control of the reactive power, the voltage or the power factor, each effected at the connection node, but not at the same time.
- 5.2 D1 is considered by the Board as an appropriate starting point for the assessment of inventive step.

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Contrary to the submissions of the appellantproprietor, the Board considers that D1 is directed to the same purpose or effect as the claimed invention. Indeed, both are directed to the operation of wind turbines, and in particular to their regulation within voltage limits.

- 5.3 Further to the method for determining the limit values, D1 discloses the following control modes: controlling the reactive power or controlling the power factor, see D1, page 5, lines 19-24 ("Einstellmöglichkeit ..., über die ... Blindleistungswert oder ein Leistungsfaktor eingestellt werden kann. Derartige Regelungen sind an sich bekannt"); and also the description of the control arrangement 4, on page 22, lines 1-9 for the embodiment of figure 6, which shows a feedback control loop from sensor 51 via PI controller 5 and limiter 59 to control converter 3 based on adjusted reactive power entering limiter on line 43.
- 5.4 The appellant-proprietor submits that in D1 the reactive power or power factor are not controlled at the connection node as required by claim 1, but only at an output terminal of a wind turbine converter. In addition D1 also does not disclose voltage control at the connection node.
- 5.5 The first feature of controlling at the connection node is seen to serve the general purpose of maintaining voltage within regulatory limits and increasing life span. Both problems are also addressed by D1, see page 1, line 33, to page 3, line 3; see also the paragraph bridging pages 4 and 5. At best the first feature offers an alternative. The second feature, offering voltage control in addition to reactive power or power factor control, also at the connection node, on the

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other hand is seen to provide control flexibility. The two features are essentially different in substance and effect and can thus be assessed separately for inventive step.

- 5.6 As is clear from page 4, last paragraph of D1, its invention is based on the realization that the key to the problem of protecting the grid, as well as the transformer and wind turbine from excess voltages, lies in the reactive components of the transformer, and that this component - either the reactive power or the power factor - should be controlled, page 5, lines 16 to 24, cited above. In the Board's view, it would be obvious that when applied to a wind park as D1 suggests on page 15, this control should be effected in relation to any of the transformers that connect an individual wind turbine to the grid, i.e. not only the transformer associated with the relevant wind turbine but also, alternatively, to that connecting the entirety of the wind park to the grid, i.e. at the connection node. Clearly all transformers in the transformation chain will be subject to the problem of excess voltage. The Board thus concludes that the feature of control at the connection node is an obvious alternative application of D1's teaching and therefore does not in itself involve an inventive step.
- Turning to voltage control, it is the main focus of regulatory effort, as is apparent from the patent itself, see specification paragraph [0002] in conjunction with paragraph [0008], lines 46 to 53, but also D1, page 5, first paragraph, to maintain electrical properties at the connection node to the grid within defined margins or tolerances. The key idea in D1 to this end is to control the reactive components ("Blindkomponente") at the connecting transformer, in

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particular via reactive power or power factor control. Further D2 teaches effecting reactive control not only via reactive power or power factor control but also via voltage control as an additional, equivalent control mode, see D2, page 21, third paragraph. It is explained there that a reactive control loop or "Q loop can be actuated by either a power factor, either a reactive power or a voltage control". Since the requirements of reactive power to be supplied to the grid as imposed by the grid operator can change according to circumstances, the skilled person would seek to develop the wind turbine control such that it is sufficiently flexible to meet these requirements. Consequently, the skilled person, tasked with providing the control of D1 with improved flexibility, would implement as a matter of obviousness at least one, ideally the possibility of all three control modes taught by D2, though naturally not at the same time. They would thus as a matter of obviousness also adopt the possibility of voltage control at the connection node to the known wind turbine, and thus arrive at a method falling under the claimed subject-matter without the need of inventive skills.

- 5.8 The Board thus concludes that the subject-matter of claim 1 according to the second auxiliary request does not involve an inventive step.
- 6. Third auxiliary request inventive step
- 6.1 This auxiliary request is amended with respect to the second auxiliary request to specify that the control of the operational variables in the three control modes (reactive power, voltage and power factor) is based on the corresponding measured value and reference value at

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the connection node. Therefore, a closed loop control is now specifically required.

Accordingly, claim 1 further differs from the method of D1 in the voltage control mode and in that all three modes (voltage control, power factor and reactive power) require closed loop control based on measurement and reference values at the connection node.

- Not only is closed loop or feedback control a very well known control method to ensure that the controlled output corresponds closely to a desired value, it is also expressly mentioned in D2 on page 2, 2nd paragraph, immediately prior to discussing the three different control modes. Consequently, in adopting the three control modes suggested by D2 in a control scheme as in D1 the skilled person would as a matter of course then realize these modes as feedback controls.
- 6.3 In conclusion, the Board also holds that the subjectmatter of claim 1 lacks an inventive step in the sense of Article 56 EPC in view of a combination of the teachings of D1 and D2.
- 7. Fourth auxiliary request inventive step
- 7.1 With respect to claim 1 of the third auxiliary request, this claim requires additional limits to the turbine reference operational variable (voltage, power factor or reactive power) in the form of preliminary upper and lower limit values Umax and Umin, which are, according to the claim, based on the operational variable itself. The limit values of voltage or reactive power are then also determined based on these further limits.

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- 7.2 D1 also applies additional preliminary upper and lower limit values, namely the maximum and minimum allowable reactive current or reactive power values for the individual turbine, applied by the limiters 57 and 58 of the embodiment of figure 6, see page 23, lines 1 to 11.
- 7.3 As compared to these known preliminary upper and lower limit values, claim 1 of this request requires that these further limit values are "based" on the operational variable.
- 7.4 It is not entirely clear what is meant by this formulation, so that to fully understand the limitations implied, if any, the skilled person must consult the description, cf. CLBA, II.A.6.3.3. The only implementation of this feature is equation 2 on page 8 of the description. In that equation, the reference operational variable is denoted as Uturb ref. The calculated lower limit Umin, when based on the operational variable Uturb ref, is always below that variable: Umin=Uturb ref - 0.02*Unom. Thus the operational variable Uturb ref will never reach the so calculated Umin lower limit value. Therefore, the lower limit values according to this formula cannot effect any limiting function to the operational variable. An intended "lower limit" that in practice does not effect any limiting function does not provide a technical effect. This reasoning also applies, mutatis-mutandis, to the equation for the upper limit.
- 7.5 As regards the submission of the appellant-proprietor that these values are to be used as limits for future iteration steps, this limitation is neither claimed nor taught by the description. There is no suggestion in the whole patent disclosure of any iterative process

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for obtaining any of the limits or reference values of the described methods. The Board thus holds that the skilled person would not read this limitation into the claim, either reading the claim alone or in the context of the whole specification.

- 7.6 In conclusion, the features that the preliminary upper and lower limit values are based respectively on the wind turbine reference operational variable do not provide a technical effect. As they do not provide a technical effect they do not contribute to the technical character of the invention and may be disregarded for the assessment of inventive step, cf. CLBA I.D.9.1.2.
- 7.7 As otherwise the rest of the features are either known or made obvious from the combination of the teachings of D1 and D2 (see inventive step reasoning above for the third auxiliary request), the Board concludes that the subject-matter of claim 1 according to the fourth auxiliary request does not involve an inventive step.
- 8. Fifth to eight auxiliary requests
- 8.1 Claim 1 of the fifth to eight auxiliary requests is identical to claim 1 of the first to fourth auxiliary requests respectively. These requests differ from the previous ones only in amendments to the description.
- 8.2 In the Board's opinion, since they do not amend the features of the claims, the above conclusions of lack of novelty and inventive step for auxiliary requests 1-4 apply to them mutatis-mutandis.
- 8.3 The appellant-proprietor submits that the amendments in paragraphs [0008], [0009] and [0032] are aimed at

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avoiding a broad interpretation of the terms "connection node" and "indicative of" a certain voltage or voltage limit of the claims.

Consequently, according to the appellant-proprietor, the relevant expressions can no longer be interpreted broadly in the light of the description and all arguments based on such broad interpretation would now be moot.

- 8.4 The Board is not convinced by this argument. The claims define the invention for which protection is sought, Art. 84 EPC. The description is used to interpret the claims for the purpose of determining the scope of protection (Art.69(1) EPC), occasionally also if granted claims cannot be understood in their own right because they are unclear, cf. CLBA, II.A.6.3.1. In the present case the above conclusions for the auxiliary requests 1-4 are based on an interpretation of indicative of a voltage value that follows from the claim wording itself. As the claim wording has not changed the Board sees no need to interpret it differently. Such a limited interpretation would have been necessary if the appropriate changes had been made to the claim wording.
- 8.5 The Board thus concludes that the subject-matter of claim 1 of the fifth auxiliary request is not new and of claim 1 of the sixth to eight auxiliary request does not involve an inventive step for the same reasons that apply to the first to fourth auxiliary requests.
- 9. Ninth to eleventh auxiliary requests
- 9.1 The ninth and tenth auxiliary requests further specify the subject-matter of claim 1 of the first auxiliary

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request by requiring respectively that the second input signal indicates an actual voltage present at the connection node and that the first input signal defines limit voltages to be achieved at the connection node.

In this respect, D1 discloses a variant of the embodiment of figure 6 on page 24, lines 4-24 that uses the voltage measured at the high voltage side 51' of the transformer 8 as the second input signal, instead of the voltage value at the lower voltage side of the transformer 8. This measure indicates the actual voltage of the grid 9 or connection node. Thus, the added feature that the second input signal indicates an actual voltage present at the connection node is also disclosed by D1 in combination with the other features of the embodiment of figure 6. As regards the second feature, the limit values Umax and Umin of that embodiment not only represent a limit voltage to be achieved at the lower side of the transformer 8, but also define limit voltages to be achieved at the high voltage side and thus at the connection node 9, since the values on one side are determined by the values on the other side through the transfer function of the transformer. Thus, this feature is also disclosed by the embodiment of figure 6 of D1.

As regards the other claimed features, they are also anticipated by D1, in particular by the embodiment 6 (see novelty discussion of the first auxiliary request above). The Board thus concludes that the subjectmatter of claim 1 of the ninth and tenth auxiliary request is not new in the sense of Article 54(2) EPC.

9.2 The eleventh auxiliary request further restricts the tenth auxiliary request by specifying that a park transformer is connected between the connection node

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and the utility grid. As otherwise the other features are known from D1, see previous section, this is in the Board's view the only differentiating feature of claim 1 of auxiliary request 11 with respect to that prior art disclosure.

For the reasons given in section 5.6 above, the Board holds that it is obvious for the skilled person to apply the teaching of D1 also to the transformer connecting the multiple wind turbines of a wind park to the grid. The Board thus holds that the skilled person tasked with putting into practice the teachings of D1 in a wind park would arrive at the subject-matter of claim 1 of the eleventh auxiliary request without the need of an inventive step.

10. Since all requests filed by the appellant-proprietor are either not novel or do not involve an inventive step, the Board confirms the decision of the Opposition Division to revoke the patent.

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Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



G. Magouliotis

A. de Vries

Decision electronically authenticated