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**Datasheet for the decision
of 9 February 2024**

Case Number: T 2048/21 - 3.5.02

Application Number: 15162469.9

Publication Number: 3076542

IPC: H02P29/00, H02P6/18, H02P9/42,
H02P21/00

Language of the proceedings: EN

Title of invention:
Noise control for a wind turbine

Patent Proprietor:
Siemens Gamesa Renewable Energy A/S

Opponent:
ENERCON GmbH

Relevant legal provisions:
EPC Art. 83, 54, 56

Keyword:
Main request - Sufficiency of disclosure (yes) - Novelty (yes)
- Inventive step (yes)



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Case Number: T 2048/21 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 9 February 2024

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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
13 September 2021 concerning maintenance of the
European Patent No. 3076542 in amended form.**

Composition of the Board:

Chairman R. Lord
Members: C.D. Vassoille
R. Cramer

Summary of Facts and Submissions

I. The appeal of the opponent lies against the decision of the opposition division with which it was found that European patent no. 3 076 542 in the form of auxiliary request 1 met the requirements of the EPC.

II. The following documents are relevant for the present decision:

E7: EP 2 485 388 A1

E11: EP 2 552 012 A1

III. In the decision under appeal, the opposition division came to the conclusion that the invention according to claim 1 of the then auxiliary request 1 met the requirement of Article 83 EPC and that its subject-matter involved an inventive step in view of document E11 in combination with the common general knowledge of the skilled person or with document E7.

IV. The parties were summoned to oral proceedings. In a communication under Article 15(1) RPBA annexed to the summons to oral proceedings, the board informed the parties of its preliminary opinion according to which the main request, corresponding to auxiliary request 1 on which the contested decision is based, met the requirements of Articles 83 and 56 EPC.

V. Oral proceedings before the board took place on 9 February 2024.

The appellant (opponent) requested that the contested decision be set aside and that the patent be revoked.

The respondent (patent proprietor) requested that the appeal be dismissed, or if that was not possible that the decision under appeal be set aside and the patent be maintained in amended form on the basis of the claims of one of the first to fourth auxiliary requests filed with the reply to the statement of grounds of appeal.

VI. Claim 1 of the main request, corresponding to auxiliary request 1 underlying the contested decision, has the following wording (feature numbering added in bold brackets by the board):

" **[1.1]** Arrangement (100,200,300,400) configured to determine a d-component (I_{dref} , I^*d) of a reference current in a dq coordinate system for reducing noise/vibration of a wind turbine (150), the arrangement characterized by:

[1.2] a noise/vibration determination module (419) configured to determine at least one noise/vibration component (421) of oscillations of at least one wind turbine component; and

[1.3] a processing block (402) configured to calculate a first type (407) of the d-component of the reference current based on the noise/vibration component (421) output by the noise/vibration determination module (419), wherein the processing block (402) comprises:

[1.3.1] a noise/vibration processing module (423) configured to obtain an actual characteristic (425) of at least one noise/vibration component of the determined at least one noise/vibration component;

[1.3.2] a reference determination module (427) configured to provide a reference characteristic (429) of the noise/vibration component; and

[1.3.3] a control module (437) configured to calculate the first type (407) of the d-component of the

reference current based on a difference (433) between the actual characteristic (425) and the reference characteristic (429) of the noise/vibration component, **[1.3.2.1]** wherein the reference determination module (427) is adapted to calculate the reference characteristic (429) of the noise/vibration component based on a simulation or offline test using a rotational frequency ($m\omega$) and a torque (T_e) of the generator (161) as input."

Claims 2 to 13 are dependent on claim 1.

VII. The independence method claim 14 of the main request has the following wording:

"Method for determining a d-component of a reference current in a d-q coordinate system for reducing noise of a wind turbine, the method characterized by: determining at least one noise/vibration component (421) of oscillations of at least one wind turbine component; and calculating a first type (407) of the d-component of the reference current based on the noise/vibration component (421) output by the noise/vibration determination module (419), the calculating comprising: obtaining an actual characteristic (425) of at least one noise/vibration component of the determined noise/vibration component; calculating a reference characteristic (429) of the noise/vibration component based on a simulation or off-line test using a rotational frequency ($m\omega$) and a torque (T_e) of the generator (161) as input; and calculating the first type (307, 407) of the d-component of the reference current based on a difference (433) between the actual characteristic (425) and the reference characteristic (429) of the noise/vibration component."

VIII. The relevant arguments of the appellant can be summarised as follows:

The patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, because the subject-matter of claim 1 was not limited to permanent magnet synchronous machines, but the patent did not provide sufficient information to enable the skilled person to minimise noise or vibration in non-permanently excited machines by adjusting a d-component. Additionally, the patent did not provide sufficient information as to how to calculate a first type of the d-component within the meaning of feature 1.3.3.

The subject-matter of claim 1 of the main request was not new in view of documents E7 and E11. At least, the subject-matter of claim 1 did not involve an inventive step in view of document E11, because feature 1.3.2.1 was an obvious design choice for the person skilled in the art. Furthermore, document E7 in paragraph [0083] in connection with figure 4 disclosed a look-up table 470, which implied feature 1.3.2.1, in particular simulation or offline test using a rotational frequency and torque of the generator as input.

IX. The relevant arguments of the respondent can be summarised as follows:

The invention was sufficiently described within the meaning of Article 83 EPC, since the skilled person would understand that the invention is also applicable to other types of generator. Moreover, the invention was described in sufficient detail, in particular as regards the calculation of the first type of the d-

component of the reference current, for the skilled person to carry out the invention.

Furthermore, the subject-matter of claim 1 of the main request was new in view of documents E7 and E11 and, in particular, also involved an inventive step in view of a combination of document E11 with the common general knowledge or document D7.

Reasons for the Decision

1. Main request - Sufficiency of disclosure (Article 83 EPC)

Objection 1: No limitation of the claimed arrangement to permanent magnet synchronous generators

1.1 The appellant argued that the invention of claim 1 could not be carried out over the whole range claimed. The board is not convinced by the appellant's arguments that the invention of claim 1 could only be applied to permanent magnet synchronous generators, which is the only type of generator described in the patent but to which claim 1 is not limited, and that the claimed effect of claim 1 of reducing noise/vibrations of a wind turbine was only achieved for this type of generator.

1.2 It is not apparent to the board that the invention according to claim 1 is not applicable to other types of generators than permanent magnet synchronous generators, in particular generators of the separately excited type. On the contrary, the board agrees with the respondent that the invention as defined in claim 1

does not contain anything specific to or exclusively related to the use of permanent magnets in a synchronous generator. The type of noise/vibration described in the patent and referred to in claim 1 is also not described in such a way as to indicate that the arrangement can only be used for a particular type of machine. This applies in particular to a "cogging torque" referred to by the appellant, which occurs exclusively in permanently excited machines.

It is clear that noise and vibrations in general are not just effects associated with permanent magnet synchronous generators. Rather, the effects of noise and vibration depend on the structural configuration of the machine and the higher-level system in which it is integrated and, consequently, there can be no doubt that noise/vibration can also affect the stator current in other types of machines, such as separately excited synchronous machines, asynchronous generators and, in particular, doubly fed induction generators (DFIG), as argued by the respondent.

- 1.3 Permanent magnet synchronous generators are indeed widely used in various fields, in particular in wind turbines, and accordingly the embodiment described in the patent is based on this type of generator. However, the appellant was unable to demonstrate to the board's satisfaction that the overall disclosure of the patent contains information which would lead a person skilled in the art to believe that the invention could be used exclusively for permanent magnet synchronous generators. Consequently, for the board, there can be no doubt that the person skilled in the art would not have understood the invention of claim 1 to be limited to this type of generator.

- 1.4 Furthermore, the board is convinced that the skilled person working in the technical field of the invention would readily have recognised for which generators the claimed arrangement can be reasonably used to fulfil the intended (and claimed) purpose of reducing noise/vibrations in a wind turbine. There can also be no doubt that in this context the skilled person would have assessed the applicability of the claimed arrangement for a particular type of generator, in particular with regard to the need for noise/vibration reduction and the possibility of implementing the arrangement in the respective control system of the generator.
- 1.5 In conclusion, the mere assertion of the appellant that the invention according to claim 1 was exclusively applicable to permanent magnet synchronous generators described in the patent is in the present case not sufficient to cast doubt on the practicability of the invention over the whole range claimed. Rather, for the reasons set out above, the board agrees with the respondent that it can be reasonably assumed that the claimed invention can be used in other types of generators than permanent magnet synchronous generators while achieving the claimed technical effect of reducing noise/vibrations of a wind turbine.
- 1.6 The board is therefore not convinced by the appellant's objection that the claimed invention cannot be carried out over the whole range claimed because the subject-matter of claim 1 can only be put into practice while achieving the claimed technical effect with generators of the type described in the patent.

Objection 2: Calculation of the first type of the d-component (feature 1.3.3)

- 1.7 The appellant's further objection under Article 83 EPC to claim 1 of the main request concerns the calculation of the first type of the d-component of the reference current in the control module 437. The appellant's main arguments were essentially that the patent did not describe in sufficient detail how the actual characteristic 425 was determined in the noise/vibration processing module 423 and how the difference 433 between the actual characteristic 425 and the reference characteristic 429 was then to be processed in the control module 437 in order to calculate the first type 407 of the d-component.
- 1.8 The appellant has identified the skilled person as a team of development engineers with several years of professional experience in the field of wind turbines and converter technology. The board fully agrees with this definition.
- 1.9 The board further agrees with the appellant to the extent that the patent does not contain a detailed description of exactly which processes are carried out in the noise/vibration processing module 423 and how it is configured. The patent merely discloses in paragraph [0093] that "a suitable signal processing algorithm may be required".

It is also true that the patent does not contain a detailed description of how the "first type 407 of the d-component of the reference current" is generated in the control module 437. In this context, paragraph [0092] states that the control module 437 may for example be configured as a PI controller. According to

paragraph [0021] of the patent, the control module 437 may alternatively be configured as a resonant controller, which is described in this paragraph to be a common alternative to a PI controller when reference signals are sinusoidal signals instead of DC signals.

- 1.10 As indicated above, the appellant's objection is essentially based on the fact that the patent does not contain a description of the details of the components required to generate the first type 407 of the d-component, in particular of the noise/vibration processing module 423 and the control module 437.
- 1.11 However, in the board's view, the appellant's conclusion that the person skilled in the art would not have been able to fill these gaps in the disclosure of the patent does not appropriately take into account the level of common general knowledge of the person skilled in the art as defined in point 1.8 above. The common general knowledge of the skilled person includes profound knowledge of the implementation details of the control system and its components, including those of the processing means required to make measured or estimated signals comparable with other types of signals (such as the reference characteristic 429), as well as technical details of the control module 437 that are necessarily implemented to calculate the Id current command 407 (first type of d-component) on the basis of a difference signal 433.
- 1.12 Furthermore, it is noted that the level of detail which the appellant has objected as being lacking in the patent is not normally found in patents or patent applications in this technical field. This understanding is also supported by the disclosure of documents E7 and E11. The relevant information is

normally limited to a schematic representation of the required processing blocks. Unless otherwise described, their technical implementation requires the use of standard components and/or algorithms, the existence and operation of which are fully known to the skilled person, and to which the skilled person can also make any necessary adaptations, at least within the limits of what is generally known to them.

The patent contains nothing that could lead the skilled person to assume that the components required to carry out the invention and their configuration in the present case involve non-standard means which the skilled person does not know or cannot (re)configure.

- 1.13 Consequently, it can be reasonably assumed that the skilled person in the relevant technical field of the present invention is sufficiently familiar with the technical details required to implement the relevant processing components in practice. This applies in particular to the technical implementation of the noise/vibration processing module 423, which the skilled person would have configured by means of a suitable signal processing algorithm mentioned in paragraph [0093] of the patent so that its output (actual characteristic 425) can be compared with the reference characteristic 429.

Similarly, there can be no doubt that the skilled person would have had the technical knowledge necessary to implement a control module 437 configured to output the Id current command 407 (first type of the d-component), in particular using a PI controller (see paragraph [0092] of the patent). Appropriate process variables and necessary transformations to produce the desired output, i.e. the first type 407 of the d-

component, would have been generally known to the skilled person and would have been applied as required.

1.14 It follows from the above that the person skilled in the art would have been able to supplement the missing technical implementation details of the respective components, in particular of the components 423 and 437, by applying their common general knowledge. Therefore, the appellant's second objection under Article 83 EPC also does not convince the board.

1.15 Consequently, the board has come to the conclusion that claim 1 of the main request meets the requirement of Article 83 EPC. The same applies to the independent claim 14 of the main request, which has features similar to those of claim 1.

2. Main request - Novelty in view of document E7 (Article 54 EPC)

2.1 The subject-matter of claim 1 of the main request is new with respect to document E7, at least because it does not disclose feature 1.3.2.1.

2.2 The appellant essentially argued that feature 1.3.2.1 of claim 1 of the main request was to be understood such that the reference determination module 427 was configured to determine a reference on the basis of a frequency and a torque. A corresponding feature was disclosed in paragraph [0083] of document E7.

2.3 The board does not agree with the appellant on this point. Feature 1.3.2.1 explicitly requires that the reference characteristic of the noise/vibration component is calculated based on a simulation or offline test, which makes a technical contribution to

the claimed subject-matter and as such cannot simply be ignored.

Nor can a calculation based on a simulation or offline test be read as being merely an implicit consequence of the remainder of the wording of feature 1.3.2.1, according to which the rotational frequency and a torque of the generator are used as inputs in the calculation of the reference characteristic. In particular, the appellant argued that the determination of an operating point for the generator necessarily had to be made in advance by a simulation or offline test for the purpose of filling the database 470, which in E7 can be designed as a look-up table (LUT). However, it is not clear to the board why a simulation or offline test should be the only options for filling the look-up table with data, nor has the appellant provided any convincing evidence to support this assertion.

- 2.4 Document E7 in paragraph [0084] discloses that the database 470 receives as input signals the fundamental electric frequency ω_e of the electric generator, the actual rotational angle of the rotor θ_m (rotor position) and a signal representing the actual power production P_g of the electric generator. As further disclosed in this paragraph, in response to these signals θ_m , ω_e and P_g the database 470 provides reference amplitudes and reference phase angles for harmonic currents to the calculation unit 436d, which in response thereto produces the AC current reference signal I_{dcref} . Correspondingly, claim 11 of E7 discloses observing at least one value of operational parameters of the electromechanical transducer and deriving from a database the harmonic control signal (I_{dcref} , I_{qcref}) as a function of the observed values of the operational parameters (θ_m , ω_e , P_g) of the

electromechanical transducer. Furthermore, paragraph [0045] discloses that the database preferably comprises a lookup table, in which appropriate values for the harmonic control signal are stored for a variety of different operational parameters of the electromechanical transducer.

Consequently, document E7 does not provide any explicit or implicit information on how the look-up table is generated, let alone that the reference characteristic of the noise/vibration component is based on a simulation or offline test using a rotational frequency or a torque of the generator as input. Since the appellant was unable to convince the board of its allegations to the contrary, the board concluded that the subject-matter of claim 1 of the main request was new in view of document E7 within the meaning of Article 54 EPC.

3. Main request - Inventive step in view of document E11 (Article 56 EPC)

3.1 The subject-matter of claim 1 of the main request involves an inventive step in view of document E11.

Distinguishing feature

3.2 The subject-matter of claim 1 at least differs from document E11 in feature 1.3.2.1, according to which the reference determination module is adapted to calculate the reference characteristic of the noise/vibration component based on a simulation or offline test using a rotational frequency and a torque of the generator as input.

- 3.3 The appellant has essentially argued that document E11 in paragraph [0063] in conjunction with figure 1 disclosed a fundamental controller 110 whose operation was based on a torque T_{ref} and a rotational frequency ω_e , the rotational frequency being predefined as a fundamental frequency according to paragraph [0015].
- 3.4 On the basis of the arguments put forward by the appellant concerning the alleged lack of novelty of the subject-matter of claim 1 in view of document E11, the board is unable to see by what technical disclosure in document E11 feature 1.3.2.1 is supposed to be disclosed. On the contrary, neither paragraph [0063] nor figure 1 nor any other part of document E11 discloses the simulation or offline test aspect of feature 1.3.2.1 of claim 1.
- 3.5 To the extent that the appellant has argued that the use of the rotational frequency and the torque implied a simulation or offline test, the board refers to the reasons provided under point 2.3 above on novelty with respect to document E7. These reasons apply also to the appellant's arguments based on document E11.
- 3.6 The board concludes that document E11 neither explicitly nor implicitly discloses feature 1.3.2.1. The subject-matter of claim 1 is therefore new with respect to document E11 within the meaning of Article 54 EPC.

Objective technical problem

- 3.7 The objective technical problem arising on the basis of document E11 and in the light of the distinguishing feature was identified by the appellant as the

implementation of the "specified values" mentioned in paragraph [0071] of document E11.

Since this was not disputed by the respondent and since the board found this problem to be acceptable, the question of whether the distinguishing feature was obvious to the skilled person either by the common general knowledge or by document E7 was assessed on the basis of this problem.

Obviousness in view of the further document E7

3.8 The appellant argued that a calculation of the reference characteristic of the noise/vibration component based on a simulation or offline test would have been obvious to a person skilled in the art in view of document E7, since that document already disclosed in paragraph [0083] to determine a reference characteristic based on a rotational frequency and a torque, which, in their view, anticipated a simulation or offline test. Therefore, the skilled person would have been motivated to modify the teaching of E11 so as to use a rotational frequency and a torque as inputs to determine the reference characteristic ("specified value" in E11), which necessarily implied the use of a simulation or offline test.

3.9 Irrespective of the question rightly raised by the respondent as to what reason the skilled person would have had to use document E7 to solve the objective technical problem, feature 1.3.2.1 is neither explicitly nor implicitly disclosed in document E7 (see points 2.3 and 2.4 above). It is therefore sufficient to state that even if the skilled person had taken document E7 into consideration, they would not have arrived at the subject-matter of claim 1.

3.10 Consequently, the board has come to the conclusion that the subject-matter of claim 1 of the main request involves an inventive step under Article 56 EPC in view of a combination of documents E11 and E7.

Obviousness in view of the common general knowledge of the skilled person

3.11 The appellant's main arguments in this respect were that the person skilled in the art would have understood that these "specified values", which were described in paragraph [0071] of document E11 as not being zero but having a different value, could not be constant values, since this would have negative effects for some operating points and would therefore not have been taken into account by a person skilled in the art. Therefore, it would have been clear to the skilled person that the specified values had to be operating point dependent values. Furthermore, there was no other possibility than to determine these operating point dependent values offline, as it was impossible to determine them online, i.e. during operation of the generator. Nothing else was defined in feature 1.3.2.1, which was thus obvious to the person skilled in the art. Furthermore, the calculation of operating points necessarily included the use of a rotational frequency and a torque of the generator.

3.12 The board agrees with the respondent that paragraph [0071], in view of the use of "specified values" not equal to zero, alone cannot be considered as sufficient motivation for the skilled person to provide for a calculation of reference characteristics according to feature 1.3.2.1. In particular, the respondent has rightly argued that the "specified values" to be used

according to paragraph [0071] in E11 could also simply be known to the skilled person in view of the design of the respective generator and set accordingly. There is therefore not even a clear hint in E11 for the skilled person to consider the rotational frequency and a torque to set the "specified values", let alone to carry out a calculation based on simulation or offline test.

Furthermore, the multi-step considerations put forward by the appellant, which allegedly lead the skilled person to feature 1.3.2.1 on the basis of document E11 in combination with the common general knowledge of the skilled person, already demonstrate that it was not possible for the skilled person to arrive at the subject-matter of claim 1 without further elaboration.

Moreover, the appellant's argumentation is flawed by the fact that feature 1.3.2.1 does not claim a mere calculation of the reference characteristic "offline", but by "offline test", which is not the same thing. Thus, even if the reference characteristics (i.e. the non-zero "specified values" in paragraph [0071]) had been calculated offline, this does not mean that the skilled person would have calculated them on the basis of an offline test using the rotational frequency and torque of the generator.

3.13 Therefore, the board has come to the conclusion that the subject-matter of claim 1 of the main request involves an inventive step under Article 56 EPC in view of a combination of document E11 with the common general knowledge of the skilled person.

4. Result

Since none of the appellant's objections prejudiced the maintenance of the patent in amended form, as found to be allowable by the opposition division, the board had to accede to the respondent's main request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



U. Bultmann

R. Lord

Decision electronically authenticated