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Datasheet for the decision of 3 May 2012

Case Number: T 1335/09 - 3.5.03

Application Number: 05779342.4

Publication Number: 1782135

IPC: G05B 13/02, G05B 23/02, B01D 53/00, G05D 21/02

Language of the proceedings: EN

Title of invention:
Model predictive control of air pollution control processes

Applicant:
Alstom Technology Ltd

Opponent:
-

Headword:
Model predictive control/ALSTOM

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (sole request) - No"

Decisions cited:
-

Catchword:
-

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Case Number: T 1335/09 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 3 May 2012

Appellant: (Applicant)
Alstom Technology Ltd
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CH-5400 Baden (CH)

Representative:
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 18 December 2008 refusing European patent application No. 05779342.4 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: A. S. Clelland
Members: A. Madenach
R. Moufang

Summary of Facts and Submissions

I. The present appeal is against the decision of the examining division to refuse application No. 05779342.4 on the ground that the subject-matter of claims 1 and 12 of the application did not fulfil the requirement of novelty (Articles 52(1), 54(1) and 54(2) EPC) in the light of

D1: EP 1 382 905 A.

II. The appellant requested that the decision of the examining division be set aside and a patent be granted on the basis of claims 1-22 filed with the grounds of appeal.

III. The board summoned the appellant to oral proceedings. In a communication accompanying the summons, objections *inter alia* under Article 56 EPC were raised in respect of the claims of the then pending request.

IV. In a reply to the summons, the appellant on 3 April 2012 filed new claims 1-24 and requested that the grant of a patent be based on these claims.

V. During the oral proceedings which took place on 3 May 2012 the appellant confirmed its request. At their end, the chairman announced the decision of the board.

VI. Independent claim 1 reads as follows:

"A controller for directing operation of an air pollution control system (APC) to perform a process to

treat a flue gas containing pollutants to control emissions of a pollutant,
having multiple process parameters (MPPs),
one or more of the MPPs being a controllable process parameters [*sic*] (CTPPs) and one of the MPPs being an amount of the pollutant (AOP) emitted by the system, and having a defined AOP value (AOPV) representing an objective or limit on an actual value (AV) of the emitted AOP, comprising:

one of a neural network process model and a non-neural network process model representing a relationship between each of the at least one CTPP and the emitted AOP; and

characterized in that

the controller comprises a control processor (610, 630, MPCC 1500) configured with the logic to predict, based on the one model, how changes to a current actual value (AV) of at least one of the one or more CTPPs will affect a future AV of emitted AOP, to select one of the changes in one of the at least one CTPP based on the predicted affect [*sic*] of that change on the actual value (AV) of emitted AOP, and to direct control of the one CTPP in accordance with the selected change for that CTPP."

Independent claim 14 reads as follows:

"A method for directing operation of an air pollution control system (APC) to perform a process to treat a flue gas containing pollutants to control emissions of an air pollutant, having multiple process parameters (MPPs), one or more of the MPPs being controllable process parameters (CTPPs) and one of the MPPs being an amount of the pollutant (AOP) emitted by the system, and

having a defined AOP value (AOPV) representing an objective or limit on an actual value (AV) of the emitted AOP, comprising:

predicting how changes to a current actual value (AV) of at least one of the one or more CTPPs will affect a future AV of emitted AOP, based on one of a neural network process model and a non-neural network process model representing a relationship between each of the at least one CTPP and the emitted AOP;

selecting one of the changes in one of the at least one CTPP based on the predicted affect [*sic*] of that change on the actual value (AV) of emitted AOP; and

directing control of the one CTPP in accordance with the selected change for that CTPP."

Reasons for the decision

1. *Novelty and inventive step (Articles 54 and 56 EPC):*

1.1 In the oral proceedings before the board the debate centred on the prior art disclosure in the application itself. In particular, the board considers the wet flue gas desulphurisation process as shown in Figures 1 and 2 and described on pages 2-18 of the application as the closest prior art. This is said at page 2, lines 4 to 6, to be the "most commonly used process for removal of SO_2 from flue gas in the power industry". It was not contested by the appellant that this process is well-known in the art.

The known process is a method for directing operation of an air pollution control system (APC) (page 2, lines 25-27 and reference numeral 120 in Figure 1) to perform a

process to treat a flue gas containing pollutants to control emissions of an air pollutant (page 2, lines 3-11).

The known process has multiple process parameters (MPPs) (*e.g.* the pH value of the limestone slurry and the amount of SO_2 in the exhausted desulphurised flue gas), one or more of the MPPs being controllable process parameters (CTPPs) (*e.g.* the pH value of the limestone slurry, see page 5, lines 7-12 in combination with page 28, lines 5-12) and one of the MPPs being an amount of the pollutant (AOP) emitted by the system (*viz.* the amount of SO_2 in the exhausted desulphurised flue gas, see page 5, lines 7-12 in combination with page 28, lines 5-12), and having a defined AOP value (AOPV) representing an objective or limit on an actual value (AV) of the emitted AOP (see page 17, lines 15-19).

4.2 The claimed method differs from the prior art described in combination with Figure 1 in that it comprises:

predicting how changes to a current actual value (AV) of at least one of the one or more CTPPs will affect a future AV of emitted AOP, based on one of a neural network process model and a non-neural network process model representing a relationship between each of the at least one CTPP and the emitted AOP;

selecting one of the changes in one of the at least one CTPP based on the predicted effect of that change and on the actual value (AV) of emitted AOP; and

directing control of the one CTPP in accordance with the selected change for that CTPP.

4.3 The features correspond to a model predictive control (MPC) which allows for a more complex process control

involving more than simply maximising removal of pollutants from a flue gas as in the prior art (page 31, lines 19-23), especially if non-linearities are involved as is the case in the known method for directing operation of an air pollution control system (APC) (see page 11, 17-22).

Model predictive control is acknowledged in the application as being a well-known control technology which is particularly suitable for dealing with complex, interacting dynamic processes more effectively than is possible with conventional PID type feedback control systems as shown in Figure 1 of the application, see page 34, lines 7-30.

4.4 In the board's view the advantages of model predictive control would at the claimed priority date have led the skilled person, without the exercise of inventive skill, to apply model predictive control to the known method which is described in relation to Figure 1.

4.5 As is well-known in the art and as the name already implies, model predictive control models predict the change in the dependent variables of the modelled system that will be caused by changes in the controllable process parameters and direct the control process accordingly (page 34, lines 18-30 and the textbooks acknowledged therein).

As applied to the known method described in relation to Figure 1, it would be self-evident to the skilled person to consider one of the dependent variables to be the amount of SO_2 in the exhausted desulphurised flue gas

since this is the quantity which is eventually to be controlled.

As a consequence, the known method as described in relation to Figure 1 and extended to comprise a model predictive control would make use of predicting how changes to a current actual value (AV) of at least one of the one or more CTPPs will affect a future AV of emitted AOP, selecting one of the changes in one of the at least one CTPP based on the predicted effect of that change and on the actual value (AV) of emitted AOPV; and directing control of the one CTPP in accordance with the selected change for that CTPP.

The feature "based on one of a neural network process model and a non-neural network process model representing a relationship between each of the at least one CTPP and the emitted AOP" comprises in the board's view any network process model representing a relationship between each of the at least one CTPP and the emitted AOP. A relationship between each of the at least one CTPP and the emitted AOP is necessarily required in any kind of sensible model predictive control having the emitted AOP as a dependent variable.

4.6 Hence, the skilled person would arrive in a straightforward way and without any inventive effort at the subject-matter of claim 14. The subject-matter of this claim therefore lacks an inventive step, contrary to the requirements of Article 56 EPC.

4.7 Analogous considerations apply to the subject-matter of device claim 1 which also lacks an inventive step, contrary to the requirements of Article 56 EPC.

5. Since the independent claims of the sole request do not comply with the requirements of the EPC, the appeal is to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

G. Rauh A. S. Clelland