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**D E C I S I O N**  
**of 17 October 2002**

**Case Number:** T 0649/98 - 3.4.1

**Application Number:** 92304243.6

**Publication Number:** 0514117

**IPC:** G21C 3/322

**Language of the proceedings:** EN

**Title of invention:**

Part length rod fuel assembly with steam-water separator for boiling water reactor

**Patentee:**

GENERAL ELECTRIC COMPANY

**Opponent:**

ASEA BROWN BOVERI AB

**Headword:**

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**Relevant legal provisions:**

EPC Art. 54, 56

**Keyword:**

"Main request, novelty (no)"

"Auxiliary requests, inventive step (no)"

**Decisions cited:**

-

**Catchword:**

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Case Number: T 0649/98 - 3.4.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.1  
of 17 October 2002

**Appellant:** ASEA BROWN BOVERI AB  
(Opponent) S-72183 Västerås (SE)

**Representative:** Böcker, Joachim, Dr.-Ing.  
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**Respondent:** GENERAL ELECTRIC COMPANY  
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**Representative:** Frohwitter, Bernhard, Dipl.-Ing.  
Patent- und Rechtsanwälte  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 4 May 1998  
rejecting the opposition filed against European  
patent No. 0 514 117 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** G. Davies  
**Members:** G. Assi  
R. Q. Bekkering

## Summary of facts and submissions

- I. The appellant (opponent) lodged an appeal, received on 30 June 1998, against the decision of the opposition division, dispatched on 4 May 1998, rejecting the opposition against the European patent No. 0 514 117 (application number 92 304 243.6). The fee for appeal was paid on 30 June 1998. The statement setting out the grounds of appeal was received on 2 September 1998.
- II. Opposition had been filed against the patent as a whole and was based on Article 100(a) EPC, in particular on the ground that the subject-matter of the patent was not patentable within the terms of Articles 52(1) and 56 EPC. In the decision under appeal, the opposition division held that the ground of opposition did not prejudice the maintenance of the patent as granted.
- III. During the appeal proceedings, the following documents have been considered:
- (D5): English translation of JP-A-1-176 986,
- (D6): English translation of JP-A-3-51 796.
- IV. Oral proceedings were held on 17 October 2002.
- V. The appellant requested that the decision under appeal be set aside and the patent be revoked in its entirety.

The respondent (patent proprietor) requested that the patent be maintained with the following documents:

*Main request:*

Claims: 1 filed with letter of 17 September  
2002,  
3 to 8 of the patent as granted (to be  
renumbered),

Description: Columns 1 to 8 of the granted patent,

Drawings: Pages 9 to 19 of the granted patent,

*First auxiliary request:*

Claims: 1 filed with letter of 17 September  
2002,  
3 to 8 of the patent as granted (to be  
renumbered),

Description: Columns 1 to 8 of the granted patent,

Drawings: Pages 9 to 19 of the granted patent,

*Second auxiliary request:*

Claims: 1 filed with letter of 17 September  
2002,  
3 to 8 of the patent as granted (to be  
renumbered),

Description: Columns 1 to 8 of the granted patent,

Drawings: Pages 9 to 19 of the granted patent,

*Third auxiliary request:*

Claims: 1 filed with letter of 17 September 2002,  
3 to 8 of the patent as granted (to be renumbered),

Description: Columns 1 to 8 of the granted patent,

Drawings: Pages 9 to 19 of the granted patent.

VI. The wording of Claim 1 of the main request reads as follows:

*"A fuel bundle (B) for a boiling water nuclear reactor, said fuel bundle (B) including;  
a lower tie plate (L) for supporting a matrix of vertically upstanding fuel rods (F) and defining apertures for the inflow of water to said fuel bundle;  
an upper tie plate (U) for maintaining said matrix of fuel rods (F) in vertical upstanding relation and defining apertures for permitting the outflow of water and generated steam;  
a channel (C) surrounding said fuel bundle (B) and extending from said lower tie plate (L) to said upper tie plate (U) for confining fluid flow between said tie plates and through said matrix of fuel rods;  
a plurality of spacers (S) within said channel (C) and around said fuel rods (F) for maintaining the side-by-side spacing of said fuel rods (F) between said tie plates; and  
at least one of said fuel rods being a part length fuel rod (P) resting on and supported by said lower tie plate (L) and terminating at an upper end below said*

*upper tie plate (U), said part length rod (P) defining with respect to surrounding full length rods (F) a void volume (14) overlying said part length rod (P) for defining a steam vent path (14) between the upper end of said part length rod (P) and said upper tie plate (U),*

*characterized by*

*a separation device (30...74) attached to a spacer overlying the end of said at least one part length fuel rod or said upper tie plate and supported by said fuel bundle (B) and placed in said steam vent path (14) overlying said part length rod (P), said separation device defining means for deflecting water entrained in said steam vent path (14) from said steam vent path (14) to said surrounding full length rods (F)."*

Claim 1 of the first auxiliary request differs from Claim 1 of the main request in that it further recites the following feature at the end of the claim:

*", wherein said separation device is in the form of a swirl vane or a downwardly disposed cone attached to a spacer."*

Claim 1 of the second auxiliary request differs from Claim 1 of the main request in that the characterising portion reads as follows:

*"characterized by*

*a separation device in the form of a swirl vane (40, 42, 50, 52) attached to a single spacer (S) overlying the end of said at least one part length fuel rod (P) and supported by said fuel bundle and placed in said steam vent path (14) overlying said part length rod (P), said separation device defining means for*

*deflecting water entrained in said steam vent path (14) from said steam vent path (14) to said surrounding full length rods (F)."*

Claim 1 of the third auxiliary request differs from Claim 1 of the main request in that the characterising portion is as follows:

*"characterized by a separation device in the form of a swirl vane (60, 62, 65, 72) attached to a plurality of spacers (S) overlying the end of said at least one part length fuel rod and supported by said fuel bundle (B) and placed in said steam vent path (14) overlying said part length rod (P), said separation device defining means for deflecting water entrained in said steam vent path (14) from said steam vent path (14) to said surrounding full length rods (F)."*

VII. The appellant submitted that Claim 1 of the respondent's main request lacked novelty with regard to document D5 disclosing a fuel assembly for a boiling water reactor (BWR), the fuel assembly comprising projections or obstacles attached to the spacers above the part length fuel rods (PLRs) for deflecting water entrained into the void volumes above the PLRs. Claim 1 of the respondent's first auxiliary request was novel but did not involve an inventive step in view of the combination of D5 and D6, the latter document disclosing swirl vanes.

Claim 1 according to the respondent's second and third auxiliary request lacked inventive step with regard to the combination of D5 and D6 and further considering

the technical knowledge of the skilled person who knew how to attach a swirl vane to a spacer.

VIII. The respondent submitted that Claim 1 of the main request was novel because the projections or obstacles disclosed by D5 could not be compared to the claimed separation device having a different function. Moreover, the claimed separation device was arranged in a different way within the void volume above a PLR. As regarded the objection of lack of inventive step of Claim 1 of the first auxiliary request on the basis of the combination of D5 and D6, the skilled person had no reason to make such a combination involving hindsight. In particular, it implied an unjustified modification of the arrangement disclosed by D6 and did not follow the teaching of D5, which warned against pressure drop in the fuel assembly.

For the same reasons, Claim 1 of the second and third auxiliary request also involved an inventive step. In case of doubt, the benefit thereof should be given to the patent proprietor.

### **Reasons for the decision**

1. The appeal is admissible.
2. *Respondent's main request*
  - 2.1 Both the appellant and the respondent agree that a fuel assembly for a BWR comprising all the features of the pre-characterising portion of Claim 1 is known from document D5.



Document D5 concerns a fuel assembly for a BWR (see page 1, Claim and paragraph bridging pages 3 and 4). In particular, the known fuel assembly comprises the following features (see D5, page 2, page 3, first paragraph, Figure 2):

- a plurality of fuel rods is arranged within a channel,
- a lower tie plate supports the lower end of the fuel rods, said lower tie plate closing the bottom end of the channel and being provided with apertures for the inflow of the water coolant,
- the fuel assembly comprises a lower single-phase region cooled by water and an upper two-phase region cooled by a mixture of water and steam,
- an upper tie plate is arranged at the upper end of the fuel rods, said upper tie plate being provided with apertures for the outflow of water and steam,
- spacers are provided between the lower tie plate and the upper tie plate for maintaining the fuel rods in spaced apart location along the length of the fuel assembly,
- a plurality of the fuel rods consists of PLRs extending from the lower tie plate towards the upper tie plate, said PLRs terminating within the upper region of the fuel assembly before reaching the upper tie plate,
- each PLR defines with respect to surrounding full length rods a void volume overlying the PLR, the

void volume forming a steam vent path between the upper end of the PLR and the upper end of the fuel assembly.

2.2 The claimed invention according to D5 (see page 1, Claim) consists in that spacer grid portions above the PLRs have an increased wall thickness or are provided with projections or with obstacles to coolant flow. In an embodiment of D5 (see page 5), two spacers are provided above the PLRs in the upper two-phase region of the fuel assembly. The projections or obstacles can be regarded as falling within the scope of the feature recited by Claim 1 concerning a *"separation device ... attached to a spacer overlying the end of said at least one part length fuel rod ... and placed in said steam vent path ... overlying said part length rod"*, the meaning of the term *"separation"* becoming clear when considering that the claimed *"separation device"* defines *"means for deflecting water entrained in said steam vent path ... from said steam vent path ... to said surrounding full length rods"*. Indeed, the known projections or obstacles have the same function because they *"serve to change the direction of flow of the liquid film having flowed on the surface of the short fuel rod to bring the flow into contact with the surfaces of the surrounding normal fuel rods"* (see D5, sentence bridging pages 6 and 7). In other words, the liquid film on the surface of a PLR, once arrived at the upper end of the PLR, is first entrained in the void volume above the PLR (see, in this respect, D6, Figure 10) and then deflected outwards by the projections or obstacles placed in the void volume (see D5, Figure 6(b)).

2.3 The respondent states that the claimed separation means is distinguished from that disclosed by D5 because this document concerns the first class of separation devices referred to in the patent in suit (see column 2, lines 29 to 34), which are intended for preventing water flowing along the surface of a PLR from entering the volume overlying the PLR.

This view is not convincing. Since the known projections or obstacles are attached to the spacers above the PLRs and are placed within the void volume above a PLR (see D5, Figure 6(b)), it cannot be avoided that water flowing along the surface of the PLR enters the void volume. Moreover, the separation means according to D5 is clearly distinguished from the first class of devices described by the patent in suit because it is attached to a spacer above the PLRs and not to the upper end of the PLRs (see Figures 2 to 4 of the patent in suit).

2.4 The respondent narrowly interprets the term "*overlying*" in the characterising portion of Claim 1 as meaning that the separation device is placed just above a PLR. In its opinion, this interpretation is supported by column 4, lines 21 to 24, of the patent in suit and shows that the claimed separation device is distinguished from that known from D5.

The argument is not convincing because, from a linguistic point of view, the term "*overlying*" in Claim 1 refers to "*a spacer*" rather than to "*a separation device*". Thus, the said term cannot establish novelty.

2.5 Therefore, the subject-matter of Claim 1 according to

the respondent's main request is not novel having regard to document D5. The main request is not allowable.

3. *Respondent's first auxiliary request*

- 3.1 Claim 1 of the first auxiliary request differs from Claim 1 of the main request in that the separation device is defined to be a swirl vane or, alternatively, a downwardly disposed cone attached to a spacer.

The appellant admits that the subject-matter of Claim 1 is novel having regard to D5 because this document does not disclose a swirl vane or a cone attached to a spacer.

- 3.2 D5 (see sentence bridging pages 6 and 7) characterises the projections or obstacles through their function consisting in that they "*serve to change the direction of flow of the liquid film having flowed on the surface of the short fuel rod to bring the flow into contact with the surfaces of the surrounding normal fuel rods*".

The same function is also defined for the claimed swirl vane or downwardly disposed cone, which are intended for ejecting water entrained into the steam vent volume overlying the PLRs (see the patent in suit, column 2, lines 34 to 38). With regard to the swirl vane only, this is achieved because the vane, owing to its particular shape, imparts to the liquid phase of the coolant flow in the void volume above a PLR a centrifugal motion component. Steam, being lighter, is not affected and continues flowing upwardly. Thus, a separation effect is obtained consisting in that the liquid phase, but not steam, is ejected towards the

full length fuel rods surrounding the void volume (see the patent in suit, column 7, lines 1 to 3).

3.3 The same separation effect is achieved by the swirl vanes disclosed in Figures 5 and 6 of document D6 (see page 2, last paragraph) concerning a fuel assembly for a BWR, just as in D5. The only difference between these swirl vanes and the claimed one resides in the arrangement within the void volume above a PLR. Whereas the claimed swirl vane is attached to a spacer above the PLRs, the swirl vanes known from D6 are provided at the upper end of the PLRs. Such a difference is considered in the patent in suit (see column 2, lines 29 to 42), in which two classes of separation devices are defined, *ie* a first class of devices for preventing water flowing along the surface of a PLR from entering the void volume above the PLR itself (see Figures 2 to 4 of the patent in suit and D6, Figures 3 to 6) and a second class of devices for ejecting water entrained into the void volume (see present Claim 1). Such a distinction, however, appears to be artificial to the extent that a device of the first class may also fulfil the function of a device of the second class depending on its particular shape and dimensions.

As the appellant maintained at the oral proceedings with regard to Figures 5 and 6 of D6, the water film at the upper end of a PLR 28 is subject to a centrifugal motion component due to the presence of the swirl vane 103 or 106. However, not all the water is ejected outwardly towards the full length fuel rods 23. Indeed, some water will inevitably move further upwards, in particular along the surface of the swirl vane, to be then ejected. It is thus clear that the arrangements of Figures 5 and 6 of D6 are primarily intended to prevent

water from entering the void volume above the PLR but are also suitable, as a secondary effect, to eject, at least in part, water entrained into the void volume.

3.4 Thus, the skilled person, starting from document D5, Figure 6(b) of which shows a vane as an example of the projections or obstacles mentioned in the description, realizes that the swirl vane shown in D6 is particularly suitable as far as the function of ejecting water entrained into the steam vent volume overlying the PLRs is concerned.

3.5 The respondent argues that the skilled person has no reason to combine the disclosure of documents D5 and D6. In its view, such a combination would imply to detach the swirl vanes of D6 from the PLRs to attach them to the spacers above the PLRs as taught by D5. Moreover, the swirl vanes of D6 cause an increased pressure drop, which, however, according to D5, constitutes a disadvantage to be avoided.

This view is not convincing. The combination of D5 and D6 does not mean that the skilled person has to modify the arrangement disclosed by D6. Indeed, D6 is not the starting point but the teaching of D5 that spacer grid portions above the PLRs are provided with projections or with obstacles to coolant flow. D5 leaves the choice of the shape of such projections or obstacles to the skilled person who recognizes that the swirl vane of D6 is suitable for achieving the required effect.

Moreover, it is known that the projections or obstacles to coolant flow according to D5 as well as the swirl vanes known from D6 necessarily cause a pressure drop,

just as the separation device of Claim 1 also does. It will be the task of the skilled person choosing a swirl vane for the projections of D5 to look for dimensions and designs reducing the pressure drop to a desired extent.

3.6 Therefore, the subject-matter of Claim 1 according to the respondent's first auxiliary request lacks inventive step having regard to the combination of documents D5 and D6. The first auxiliary request is not allowable.

4. *Respondent's second and third auxiliary request*

4.1 Claim 1 of these requests further defines the swirl vane as being attached "*to a single spacer*" (second auxiliary request) or "*to a plurality of spacers*" (third auxiliary request).

As the appellant convincingly points out, these features concern specific embodiments of the general and obvious teaching of providing a swirl vane attached to a spacer above the PLRs, embodiments falling within the frame of the routine work of the skilled person designing fuel assemblies for a BWR. The length of the swirl vane is properly selected in accordance with the characteristics of the fuel assembly (see D6, page 3, lines 12 to 15) and results from a compromise between various aspects like, for example, the efficacy of the liquid phase deflection and the pressure drop in the upper two-phase region of the fuel assembly. It is clear that the dimensions chosen, in particular the length, will become decisive for the attachment of the swirl vane to one or more spacers, for instance so as to avoid vibrations caused by coolant flow.

4.2 Therefore, the subject-matter of the respective Claims 1 according to the respondent's second and third auxiliary requests lack inventive step having regard to the combination of documents D5 and D6 and to the technical knowledge of the skilled person. The second and third auxiliary requests are not allowable.

## **Order**

### **For these reasons it is decided:**

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

R. Schumacher

G. Davies