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**Datasheet for the decision  
of 11 January 2019**

**Case Number:** T 0215/13 - 3.4.01

**Application Number:** 05257693.1

**Publication Number:** 1675127

**IPC:** G21C1/00, G21D1/00

**Language of the proceedings:** EN

**Title of invention:**

Method and system for calculating rod average criteria

**Applicant:**

Global Nuclear Fuel-Americas, LLC

**Headword:**

Reactor simulation / GLOBAL NUCLEAR FUEL-AMERICAS

**Relevant legal provisions:**

EPC Art. 56, 84

**Keyword:**

Inventive step - (no)

Claims - clarity - auxiliary request (no)



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Case Number: T 0215/13 - 3.4.01

**D E C I S I O N**  
**of Technical Board of Appeal 3.4.01**  
**of 11 January 2019**

**Appellant:** Global Nuclear Fuel-Americas, LLC  
(Applicant) 3901 Castle Hayne Road  
Wilmington,  
North Carolina 28401 (US)

**Representative:** Coric, Dragan  
General Electric Technology GmbH  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 22 August 2012  
refusing European patent application No.  
05257693.1 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** P. Scriven  
**Members:** B. Noll  
D. Rogers

## **Summary of Facts and Submissions**

- I. This appeal is against the decision of the Examining Division to refuse European patent application 05257693.1. The decision was by means of a reference to an earlier communication containing the objection of lack of inventive step against claims 1 to 5 filed on 25 August 2011.
  
- II. With the statement of grounds of appeal, the appellant filed a set of claims as an auxiliary request and arguments in support of both the claims underlying the impugned decision and of the auxiliary request.
  
- III. In a communication accompanying a summons to oral proceedings, the Board set out its preliminary view on the case. In particular, the Board saw a lack of inventive step in the two versions of claim 1. Reference was made to the following document:  
  
D1: US 4,333,797.  
  
It was further stated that claim 1 of the auxiliary request was unclear.
  
- IV. The appellant informed the Board that it would not be represented at the oral proceedings and that it maintained its written arguments. Accordingly, the board cancelled the oral proceedings.

V. The appellant requests that the decision under appeal be set aside and that a patent be granted on the claims filed on 25 August 2011 (main request) or the claims filed on 2 January 2013 (auxiliary request).

VI. The claims of the main request read as follows:

1. A computer system for monitoring and calculating a constraint for fuel rods in a fuel assembly in a nuclear reactor, comprising:
  - a core monitoring system for monitoring a reactor operation that is configured to:
    - utilize (S200) a pre-defined process to perform pin exposure and pin power reconstruction to determine the constraint;
    - calculate (S300) rod average exposures and rod average powers in each fuel assembly, where the rod average power is defined as the linear heat generation rate;
      - wherein the calculation of the rod average exposures (APINEXPO (IROD, JROD)) and powers are performed by calculating (S310) pin exposures in each axial fuel node;
      - wherein the calculation of the rod average exposures and powers are performed by calculating (S320) pin powers in each axial fuel node;
      - wherein the calculation of the rod average exposures further comprises obtaining weight factor (S311) of the pin exposures;
    - develop (S500) core maps from the calculated rod average exposures and powers; and
    - output (S500) the developed maps;
  - characterized in that:
    - the core maps are two-dimensional core maps obtained by determining the peak rod average exposure (S510), the peak rod average power (kW/ft) (S520), the ratio of peak rod average power to its limit (S530), and rod average exposure and power in selected assemblies (S540) and:
      - i) if the operation determines to develop the peak rod average exposure at step S510, developing (S511) the rod average power for the rods S510 so as to generate (S512) a 2D core map for the rods in S510;
      - ii) if the operation determines to develop the peak rod average power at step S520 then developing the rod average exposure for the rods in S520 so as to generate (S522) a 2D core map for the rods in S520;

iii) if the operation determines to develop the peak rod average power to its limit at step S530 then performing a ratio-to-limit map wherein only locations for which rod average exposure is greater than the exposure limit for Alternative Source Terms (AST) have a number greater than zero, else setting those locations to zero so as to generate (S531) a 2D core map for the rods in S530; or

iv) if the operation determines to develop the rod average exposure and rod average power in only selected assemblies at step S540, then generating maps of rod average exposure and rod average power in those selected assemblies; and wherein:

the rod-average exposure APINEXPO (IROD, JROD) is obtained as follows:

$$APINEXPO(IROD, JROD) = \frac{\sum_{K=1}^{K=MKC} WTNODE(KC) \delta(KC) PINEXPO(IROD, JROD, KC)}{\sum_{K=1}^{K=MKC} WTNODE(KC) \delta(KC)}$$

where MKC is the total number of axial nodes, the rod average exposure APINEXPO (IROD, JROD) being obtained as an axial (node-wise) weighting of the pin nodal exposures, with the nodal mass WTNODE (KC) being used as a weighting parameter (in units of metric ton of Uranium - MTU), so as to approximately conserve the total energy in the rod (in units of MWD – Mega Watt-Days) in an assembly-weighted nodal sense, to obtain the rod average exposure (MWD/MTU),

where the function  $\delta(KC)$  is defined as follows:

$$\delta(KC) = 1.0 \text{ if } PINEXPO(IROD, JROD, KC) > 0.0$$

$$\delta(KC) = 0.0 \text{ if } PINEXPO(IROD, JROD, KC) \leq 0.0$$

so as to ensure that the axial averaging includes only the nodes in which a rod actually exists.

2. The system of claim 1, wherein said core maps are two dimensional (2D) core maps; and  
said method further comprising:  
editing the output generation 2D maps.
3. The system of claim 2, wherein the calculation of the rod average exposures and powers are performed by calculating pin exposures in each axial fuel node.
4. The system of claim 2, wherein the calculation of the rod average exposures and powers are performed by calculating pin powers in each axial fuel node.
5. The system of claim 2, further comprising inputting (S400) rod average exposure limit and rod average power limit.

Claim 1 of the auxiliary request comprises the features of claims 1 to 3 of the main request.

VII. The appellant's arguments are discussed in the reasons.

### **Reasons for the Decision**

#### *The application*

1. The application relates to the calculation of rod average criteria for a nuclear reactor.
2. The purpose of obtaining rod average criteria is indicated in the application (see paragraphs 2 and 3 of the application as published) as being to support the obtaining of reliable information, during the design and planning phases of a reactor, as to whether operational parameters and constraints comply with the guidelines of the regulatory authority. The amount and type of fission products generated in the reactor and their release from the containment vessel must be acceptably within safety margins given by the technical specifications. According to the application, conventional methods of estimating parameters and constraints suffer either from being cumbersome or from being based on conservative assumptions which have an adverse influence on operation.

*Claim 1 of the main request - inventive step (Article 56 EPC)*

3. D1 relates to the control of power of a nuclear reactor. For monitoring and controlling the reactor, a computer system (e.g. Fig. 4) carries out calculations of rod average exposures and rod average powers in the same manner as specified in the features in the second to sixth text paragraphs of the preamble of claim 1 (see point VI above). The results of these calculations are used in a process for controlling reactor power to follow a requested change of generated power. The results of calculation are presented in terms of parameters J (index number of fuel assembly) and K (index number representing axial position) (D1, text following equation (1) in column 5).
4. The claim further defines that core maps are obtained from the calculated rod average exposures and powers in the way as specifically defined in sub-features (i) to (iv) of claim 1.
5. As regards inventive step, the Examining Division reasoned as follows:

*The inclusion of any of the additional steps (i)-(iv) cannot be considered to be inventive because they merely define a series possibilities of displaying the calculation results made available to the reactor operator, which directly implies that no tangible technical problem is solved by these features. Additionally, the inclusion of any of these possibilities is part of common design options which the*

*skilled person would consider introducing depending on the reactor core operation or reactor operator requirements. In other words, the four distinguishing features are considered to be working instructions and/or user wishes. Thus they merely state objects, e.g. develop the rod average power for the rods and generate a 2D core map for the rods, without however defining any clear technical features for achieving these objects. Moreover, the definition of these working instructions or user wishes is not necessarily based on technical considerations but can also involve business and/or administrative needs.*

6. The board agrees with this reasoning.
  
7. The appellant argued that the invention aimed at providing better information early in the design phase, addressed the problem of how to provide improved operational efficiency and rod management in a nuclear reactor power generator, and that D1 taught away from the invention, since it related to a core monitoring system with a core instrumentation adaption mechanism. The invention, however, concerned a method for calculating a rod average value in a simulator that was primarily "for an alternate source term criteria" that did not include core instrumentation or adaptation.
  
8. The Board is not persuaded by these arguments. In the present case, D1 is a suitable starting point, since it discloses deriving expected operational values of a



reactor from measured values. The skilled person would start out from this prior art also for gaining knowledge about operational parameters of a reactor which does not (yet) even exist, i.e. for the purpose of planning and designing the reactor. The presentation of values of these parameters in a specific format does not serve a technical purpose. It does not contribute to the solution of a technical problem and does not, therefore, contribute to inventive step.

*The auxiliary request*

9. The above reasoning also applies to claim 1 of the auxiliary request, as it is not apparent that defining a core map as being a 2D core map limits the claimed computer system.
10. In addition the term "editing the output generation 2D maps" is unclear. Firstly, it makes no grammatical sense, and secondly, the wording is unclear as it does not specify who or what performs the editing, or to what end such editing is done.
11. Since there is no allowable request, the appeal must be dismissed.

**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:



I. Aperribay

P. Scriven

Decision electronically authenticated