FRAMATOME COGEMA FUELS

July 20, 2000
GR00-79.doc

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Reference: Stewart Bailey to T. A. Coleman, Request For Additional Information – Framatome Topical Report BAW-10133P, Addenda 1 and 2, "Mark-C Fuel Assembly LOCA-Seismic Analysis," (TAC Nos. M99906 and MA5902), June 28, 2000.

Gentlemen:

Enclosed find the responses to the questions in the NRC request for additional information that was included with reference letter. In accordance with 10 CFR 2.790, Framatome Cogema Fuels (FCF) requests that these responses be considered proprietary and withheld from public disclosure. An affidavit supporting this request is attached.

Attachment 1 is the FCF proprietary version of the responses. Attachment 2 is the affidavit identifying the criteria for the proprietary request. Attachment 3 is the non-proprietary version of the responses. These responses will be incorporated into the NRC-approved version of BAW-10133P, Addenda 1 and 2 as an appendix.

Should the staff reviewers have any additional questions or need any clarification on any of the responses, FCF would like to have a teleconference or meeting to discuss and resolve them.

Very truly yours,

TAColeman

T. A. Coleman, Vice President
Government Relations

cc: J. Wermiel, NRC
S. L. Wu, NRC
Carl Beyer, PNNL
M. S. Schoppman
R. N. Edwards
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Attachment 2

AFFIDAVIT OF THOMAS A. COLEMAN

A. My name is Thomas A. Coleman. I am Vice President of Government Relations for Framatome Cogema Fuels (FCF). Therefore, I am authorized to execute this Affidavit.

B. I am familiar with the criteria applied by FCF to determine whether certain information of FCF is proprietary and I am familiar with the procedures established within FCF to ensure the proper application of these criteria.

C. In determining whether an FCF document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by personnel and other management within FCF as designated by the Vice President of Government Relations to assure that the regulatory requirements of 10 CFR Section 2.790 are met.

D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:

(i) The information has been held in confidence by FCF. Copies of the document are clearly identified as proprietary. In addition, whenever FCF transmits the information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the substance of the following provision is included in all agreements entered into by FCF, and an equivalent version of the proprietary provision is included in all of FCF's proposals:

"Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.

Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser shall, prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

(ii) The following criteria are customarily applied by FCF in a rational decision process to determine whether the information should be classified as proprietary. Information may be classified as proprietary if one or more of the following criteria are met:

a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of FCF, its customers or suppliers.

b. The information reveals data or material concerning FCF research or development plans or programs of present or potential competitive advantage to FCF.

c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to FCF.

e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to FCF.

f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is attached hereto and made a part hereof, has been evaluated in accordance with normal FCF procedures with respect to classification and has been found to contain information which falls within one or more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

(iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.

(iv) The information is not available in the open literature and to the best of our knowledge is not known by Combustion Engineering, Siemens, General Electric, Westinghouse or other current or potential domestic or foreign competitors of Framatome Cogema Fuels.

(v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of FCF, taking into account the value of the information to FCF; the amount of effort or money expended by FCF developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".

E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by FCF because it contains information which falls within one or more of the criteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by FCF. This report comprises information utilized by FCF in its business which afford FCF an opportunity to obtain a

competitive advantage over those who may wish to know or use the information contained in the document(s).

THOMAS A. COLEMAN

State of Virginia)
) SS. Lynchburg
City of Lynchburg)

Thomas A. Coleman, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

THOMAS A. COLEMAN

Subscribed and sworn before me
this 21st day of July 2000.

Notary Public in and for the City
of Lynchburg, State of Virginia.

My Commission Expires 8/31/01

EXHIBITS A & B

EXHIBIT A

Responses to NRC Request for Additional Information on Topical Report BAW-10133P, Addenda 1 and 2, "Mark-C Fuel Assembly LOCA-Seismic Analysis," Revision 1," June 28, 2000.

EXHIBIT B

The above listed document contains information which is considered Proprietary in accordance with Criteria b, c, and d of the attached affidavit.

Attachment 3

RESPONSE TO NUCLEAR REGULATORY COMMISSION QUESTION ON BAW-10133P, REVISION 1, ADDENDUM 1 "MARK-C FUEL ASSEMBLY LOSS-OF-COOLANT ACCIDENT (LOCA) AND SEISMIC ANALYSIS" JULY 17, 2000

QUESTION

The March 17, 2000 response to Question 6 of the NRC's request for additional information dated January 4, 2000, mentions that "recent (November 1999) resonance tests performed at CEA in water under axial flow conditions ... " demonstrate that the damping value for higher modes used in Addendum 2 is justified. Please provide this data for the staff to verify that the damping used is valid.

RESPONSE

GENERAL DESCRIPTION AND COMMENTS

The MASSE 99 resonance tests were performed in the same loop (Hermes-T) and under similar conditions as the MASSE 96 pluck tests described in Addendum 2. A full size 17x17 fuel assembly mock-up [b,c,d] was utilized for this testing program. The MASSE 99 tests were performed in air and in water with the axial flow velocity range of [b,c,d] at temperature of [b,c,d].

Resonance test results obtained in water under axial flow conditions are provided in Figures 1 through 3 with some comments provided below.

1. Figure 1 - Damping vs. amplitude diagram for mode 1, from resonance, in air and in water with different flow velocities and amplitude up to [b,c,d].
2. Figure 2 - Damping vs. flow velocity diagram for mode 2, with [b,c,d] amplitude; flow velocity is [b,c,d]. Despite the unfavorable loading position for mode 2, a weak resonance has been obtained up to a [b,c,d] flow velocity. It is shown that this mode features a damping increase under flow, which is similar to that of mode 3, and it is very likely that their respective damping values are very similar or even higher for mode 2.
3. Figure 3 - Damping vs. amplitude diagram for mode 3, in air and in water with different flow velocities and amplitude up to [b,c,d].

b, c, d

Figure 1 Damping Measurement Under Axial Flow for Mode 1

b, c, d

Figure 2 Damping Measurement Under Axial Flow for Mode 2

[b, c, d]

Figure 3 Damping Measurement Under Axial Flow for Mode 3

RESPONSES TO NUCLEAR REGULATORY QUESTIONS ON BAW-10133P, REVISION 1, ADDENDUM 2 "MARK-C FUEL ASSEMBLY LOCA AND SEISMIC ANALYSIS," JULY 17, 2000

1. Regarding simulated seismic and LOCA events, how much of the impact force is attributable to the response of the higher modes compared to that of the first mode?

Response

In the seismic response, the deformed shapes are similar to that of the first mode and the impact force distributions feature a maximum at mid assembly, which shows that the first mode is notably predominant. In addition, the influence of the first mode damping is much larger than for the higher modes damping (see response to Question 7).

In the response to LOCA, the differential motion of the core plates plays a more significant role than any particular mode. The largest impact forces are located near the top of assemblies. They typically do not feature a maximum at mid assembly. In the LOCA, the damping is not important in any mode and its effect remains small because the response is a very short transient, without sustained oscillations.

The previous considerations show that the influence of damping for modes higher than 1 is small in faulted condition analysis. This is favorable to the modeling since damping determination is easier and more reliable for mode 1.

Grid forces are also dependent on the input time histories used. Thus, it is difficult to generalize what percentage of the impact force is attributable to the response of the higher modes compared to that of the first mode. For this reason based on the higher mode test results a conservative value of [b,c,d] was chosen.

2. Were the boundary conditions for the prototype assemblies tested similar to those typical of most reactor seismic and LOCA events? Please discuss any differences and the impact of these differences on seismic and LOCA analyses. Also discuss any differences in boundary conditions between beginning-of-life assemblies and end-of-life assemblies and their impact on seismic and LOCA analyses.

Response

In the test facility, the prototype fuel assembly was supported by mock core plates with guide pins to simulate the end conditions in the reactor. These constraints accurately simulate the stiffness and restraint of the reactor internals interface

with the fuel assembly upper and lower nozzles. Thus, the boundary conditions for the prototype assemblies are very similar to the restraint of the reactor internals interface.

A holddown force was applied on the prototype fuel assembly corresponding to a beginning-of-life (BOL) condition in the reactor. The fuel assembly lateral dynamic behavior is largely independent of axial load. The mechanical interactions between assembly nozzles and guide pins are not modified. Hence, differences between BOL and end-of-life (EOL) boundary conditions (increasing compressive axial load) are negligible.

3. How would the energy dissipation of assembly internals differ between irradiated fuel assemblies and the unirradiated assemblies that you tested? For example, would cracked fuel pellets and the elimination of the fuel-cladding gap influence damping? Please discuss the possible differences in damping and response between the assemblies tested and end-of-life irradiated fuel assembles for seismic and LOCA events.

<u>Response</u>

BOL and EOL conditions affect fuel assembly structural damping which is much smaller than flow-induced damping. The flow-induced damping dominates regardless of BOL and EOL conditions of the fuel assembly. At EOL conditions, the structural damping increases (secondary effect). The main effect of the flow induced damping is on the fuel assembly and not on the fuel rod itself. The structural damping of the fuel assembly in air can be interpreted as mainly resulting from slippage of the fuel rods through the grid cells. An increase of damping from BOL to EOL conditions will tend to reduce the maximum impact force.

4. The testing performed did not allow for any assembly-to-assembly interaction. What influence would assembly-to-assembly interaction have on damping? During seismic and LOCA events what percentage of damping is due to mechanical fuel rod and assembly interactions and what percentage is due to coolant flow?

<u>Response</u>

Assembly to assembly interaction (or with core baffles) corresponds either to friction or to impact at grid levels, both providing supplementary energy losses. This dissipation of energy was not considered in the analysis, which provides additional conservatism for the fuel assembly loading condition analysis. The impact model includes a specific grid damping (see Addendum 1), which is smaller and has a more limited influence than the beam damping considered in the

core model. The damping due to flow rates is so dominant that small changes in damping due to assembly to assembly mechanical interaction are over-shadowed.

According to test results, about [b,c,d] of damping can be attributed to purely structural effects, [b,c,d] to the coolant flow at nominal in-reactor velocity of [b,c,d].

5. The loading of the assemblies in the testing done at the Hermes-T Test Loop Facility consisted of releasing a prescribed displacement at approximately mid span. This type of loading will produce a response which is dominated by the odd modes of vibration (first, third, etc.). Were loading tests performed to study damping effects of even modes in water? If not, please discuss the impact of possible differences in damping between odd and even modes on assembly response during seismic and loca events.

Response

The pluck tests with pull and release near mid assembly can provide useful results for the first mode only. All the determinations relating to higher modes are performed by resonance tests. For damping under axial flow, the resonance tests performed in the Hermes-T loop are recent (end of 1999) and limited to mainly modes 1 to 3 due to specific constraints in the in-loop determination of large damping values. However, under a weak resonant condition, limited damping measurements up to a [b,c,d] flow velocity for mode 2 were taken. The fuel assembly damping for mode 2 is [b,c,d] at the flow velocity of [b,c,d] (design flow velocity [b,c,d] at amplitude of [b,c,d]. The damping values for modes 1, 2 and 3 under axial flow conditions are provided in Figures 1 through 3 respectively. These plots show that the damping for the first mode and the higher modes increases with the flow velocity. The damping is greater than [b,c,d] for a fuel assembly lateral deflection of [b,c,d] for all the modes.

6. For limiting seismic and LOCA events, how does anticipated assembly damage compare when using the previous damping values relative to the new proposed higher damping values?

Response

A comparison study was performed for the limiting seismic time history using the previous damping values relative to the new proposed damping values. For seismic response, an increase of the damping from [b,c,d] to [b,c,d] for the first frequency reduces the maximum impact force on grids by [b,c,d]. For higher mode damping, an increase from [b,c,d] to [b,c,d] leads to an impact force increase by [b,c,d]. This slight increase is insignificant and it confirms the influence of damping for modes higher than 1 is small. For the damping values of [b,c,d] for the first mode and [b,c,d] for the third mode, the maximum impact force is reduced by [b,c,d].

A similar study was performed for LOCA response. The influence of the variations in damping considered in this study is very small for the LOCA response. It caused only minor reduction in impact loads (not greater than [b,c,d] reduction in the maximum impact load).

The maximum impact load on the grid in terms of the % change for each of the comparison study cases is presented in Table 1.

7. The loading tests performed on the assembly models of this study are much less severe (less displacement and stress response) than those expected to be encountered in typical seismic or LOCA events. Justify that damping values arrived at from the "low load" testing are relevant for response levels expected in limiting seismic and LOCA conditions.

Response

Damping from coolant flow is practically independent of amplitude, yet the structural damping (mainly due to rod frictions in the grid cells) increases with increasing amplitude, at least up to [b,c,d]. This [b,c,d] peak to peak amplitude corresponds to the approximate maximum possible fuel assembly deflection (cumulated gap in an assembly row). Hence, the use of damping values derived from low amplitude tests is conservative for high amplitude response expected in limiting seismic and LOCA conditions.

Table 1 Results of Damping Variation Study on Core Structural Model

[b,c,d]

b, c, d

Figure 1 Damping Measurement Under Axial Flow for Mode 1

b, c, d

Figure 2 Damping Measurement Under Axial Flow for Mode 2

[b, c, d]

Figure 3 Damping Measurement Under Axial Flow for Mode 3