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LTR-NRC-12-80

November 14, 2012

Subject: Proprietary Markings for WCAP-17524, "AP1000 Core Reference Report" Requests for Additional Information (Proprietary/Non-Proprietary)

Enclosed are the proprietary and non-proprietary versions of, "Proprietary Markings for WCAP-17524, 'AP1000 Core Reference Report' Requests for Additional Information."

Also enclosed is:

1. One (1) copy of the Application for Withholding Proprietary Information from Public Disclosure, AW-12-3569 (Non-Proprietary), with Proprietary Information Notice and Copyright Notice.
2. One (1) copy of Affidavit (Non-Proprietary).

This submittal contains proprietary information of Westinghouse Electric Company LLC. In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Commission's regulations, we are enclosing with this submittal an Application for Withholding Proprietary Information from Public Disclosure and an affidavit. The affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference AW-12-3569, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

James A. Gresham, Manager
Regulatory Compliance

Enclosures

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NRO

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AW-12-3569

November 14, 2012

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-NRC-12-80 P-Attachment, "Proprietary Markings for WCAP-17524, 'AP1000 Core Reference Report' Requests for Additional Information" (Proprietary)

Reference: Letter from J. A. Gresham to Document Control Desk, LTR-NRC-12-80, dated November 14, 2012

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10 CFR Section 2.390, Affidavit AW-12-3569 accompanies this Application for Withholding Proprietary Information from Public Disclosure, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the application for withholding or the accompanying affidavit should reference AW-12-3569, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

James A. Gresham, Manager
Regulatory Compliance

Enclosures

AW-12-3569

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared James A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

James A. Gresham, Manager
Regulatory Compliance

Sworn to and subscribed before me
this 14th day of November 2012

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Anne M. Stegman, Notary Public
Unity Twp., Westmoreland County
My Commission Expires Aug. 7, 2016
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

(1) I am Manager, Regulatory Compliance, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in LTR-NRC-12-80 P-Attachment, "Responses to NRC Request for Additional Information on WCAP-17524, 'AP1000 Core Reference Report' Requests for Additional Information" (Proprietary), for submittal to the Commission, being transmitted by Westinghouse letter, LTR-NRC-12-80, and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with Westinghouse's request for NRC approval of WCAP-17524, and may be used only for that purpose.

This information is part of that which will enable Westinghouse to:

(a) Obtain NRC approval of the Advanced First Core for the AP1000 plant, as documented in WCAP-17524, "AP100 Core Reference Report."

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of this information to its customers for the purpose of assisting customers in obtaining license changes for the AP1000 pressurized water reactor (PWR).

(b) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

Proprietary Information Notice

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

Copyright Notice

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

Proprietary Markings for WCAP-17524, "AP100 Core Reference Report"
Requests for Additional Information (Non-Proprietary)

November 2012

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

AP1000 Core Reference Report Request for Additional Information

CRR-001 *(spent fuel pool criticality)*

With the movement to the Advanced First Core (AFC), there is a change from a 3-region design to a 5-region design. With respect to spent fuel pool criticality analyses as described in APP-GW-GLR-029, Revision 3, titled, "AP1000 Spent Fuel Storage Racks Criticality Analysis,"

a) How does the change to a 5-region core affect the previously identified limiting fuel assembly depletion characteristics? For example, the current analysis in APP-GW-GLR-029 identifies the limiting assembly insert combination during fuel depletion as having [

]^{a,c}

b) Considering the AFC and future cycle core designs, how is the limiting assembly insert combination affected?

c) Also, with a change in the core design, it is likely that the axial burnup distributions have also changed. Demonstrate that the change in core design, including the effect of reload core designs, either does not affect the limiting axial burnup distributions as discussed in APP-GW-GLR-029 or update the safety analyses in APP-GW-GLR-029 to include the appropriate distributions and analysis impacts.

d) Demonstrate that the cumulative impact of the AFC and reload core designs still satisfy the appropriate criteria in 10 CFR 50.68.

CRR-002 *(codes and methods)*

The CRR includes various updates to the referenced codes and methodologies used in the nuclear design. WCAP-10965-P-A, "Qualification of the New Pin Power Recovery Methodology," was added to reflect an updated methodology to be used along with the ANC code. The staff's SER (ML102350046) states that this methodology is acceptable as long as the nuclear data generated as input to ANC originates from the PARAGON and NEXUS code systems. During the Phase 2 audit, staff asked if there were any instances where PHOENIX-P is used instead of PARAGON when generating data for ANC since the SER conclusions for the pin power recovery methodology only give approval for use of the methodology with the PARAGON/NEXUS/ANC code system. Westinghouse stated that data from PHOENIX-P is used in a limited capacity with ANC. For clarity, list all PHOENIX-P uses for calculations supporting updates to FSAR Revision 19 for the CRR and justify why the limitations and conditions in the staff SER mentioned above are not violated.

CRR-003 *(codes and methods)*

The CRR includes an update to DCD Section 15.4.8 describing the rod ejection analysis. The updated DCD section now references the rod ejection calculational methodology described in WCAP-15806-P-A, "Westinghouse Control Rod Ejection Accident Analysis Methodology Using Multi-Dimensional Kinetics," which is based on the standalone SPNOVA code. It appears that the codes supporting the 3-D

rod ejection calculation have evolved significantly since staff's 2003 approval of WCAP-15806-P-A. Since the CRR rod ejection analyses are now being performed solely with ANC9.4 due to the migration of the SPNOVA solver into ANC9.4, demonstrate that ANC9.4 produces results that are consistent with previous 3-D rod ejection analyses supported by SPNOVA as a standalone code for the AP1000 design.

CRR-004 *(LBLOCA Analysis)*

In the large-break LOCA analysis (Calculation Note APP-SSAR-GSC-772, Rev. 0, "Evaluation of TCD for AP1000 Advanced First Core Application Program and DCD Rev. 19 Best-Estimate LBLOCA ASTRUM Analyses,") using the ASTRUM method to evaluate the impact of the fuel thermal conductivity degradation (TCD), the average fuel assembly burnups are limited to [ ]^{a,c}

Describe the processes that the average assembly peaking factors and burnups are calculated so as not to underestimate the initial stored energy of the average fuel assemblies. Provide justifications of limiting the burnups of the average assemblies to [ ]^{a,c}

CRR-005 *(LBLOCA Analysis)*

As stated in Supplemental Information to WCAP-17524, "AP1000 Core Reference Report" to Address Thermal Conductivity Degradation" (LTR-NRC-12-46 P-Attachment, June 2012), the large-break LOCA analysis, which accounts for the fuel TCD, is performed with a reduction in the as-analyzed total peaking factor FQ to a value closer to the desired FQ to remove analysis conservatism. Calculation Note APP-SSAR-GSC-772, Rev. 0, states that this input FQ conservatism reduction is done by adjusting sampling values of the power integrals at the bottom and middle 1/3 of the core (i.e., PBOT and PMID) to recover the peak linear heat rate margin in the existing analysis.

(a) Describe the process used for adjusting the PBOT and PMID sampled values to obtain FQ values closer to the desired value.

(b) Explain why this adjusting process is appropriate with respect to the sampling of PBOT/PMID in the ASTRUM methodology.

CRR-006 *(LBLOCA Analysis)*

Supplemental Information to WCAP-17524 (LTR-NRC-12-46 P-Attachment, June 2012) states that the large-break LOCA analysis evaluation of the fuel TCD effects considered peaking factor burndown effects. Table 5-2, "Peaking Factor Assumed in the Evaluation of TCD," of the Supplemental Information provides the values of the peaking factors (FQ and FDH) as a function of rod burnup.

Describe how the values of FQ and FDH in Table 5-2 are determined and how they are implemented in the large-break LOCA analysis.

CRR-007 *(LBLOCA Analysis)*

Calculation Note APP-SSAR-GSC-772 indicated that the large-break LOCA analysis for the evaluation of the fuel TCD effect is performed using RUV reactor coolant pump designed by KSB.

(a) Provide a list of significant differences or changes in the LBLOCA-TCD WCOBRA/TRAC analysis from the analysis in the AP1000 Design Control Document.

(b) Describe why each of these changes is necessary and appropriate.

CRR-008 *(LBLOCA Analysis)*

To properly address fuel thermal conductivity degradation effects on the large-break LOCA analysis for the advanced first core application program, Westinghouse should perform reanalysis of the best-estimate large-break LOCA analysis with total number of runs required by the ASTRUM evaluation method.

CRR-009 *(LBLOCA Analysis)*

It is stated in Supplemental Information to WCAP-17524, "AP1000 Core Reference Report" to address the Impact of Thermal Conductivity Degradation on Additional Events (LTR-NRC-12-56 P-Attachment), that the variations in rod internal pressure relative to burnup are already covered to a large extent in the small-break LOCA burnup studies with NOTRUMP.

Please provide the small-break LOCA burnup studies referred in the Supplemental Information

CRR-010 *(TH design)*

With respect to the AP1000 fuel design that was developed after the NRC approval of WCAP-15063-P-A, Revision 1, "Westinghouse Improved Performance Analysis and Design Model (PAD 4.0),"address the following:

a) Discuss the validation including the development of the thermal conductivity degradation (TCD) model used in the interim version of PAD 4.0, called PAD 4.0 TCD, including all coefficients of the TCD equation.

b) There are several versions of the TCD equation. What considerations were used for selecting the TCD equation used in the STAV 7.3 fuel performance code, which is licensed for BWR fuel but not for PWR, for the PAD 4 code?

c) Identify any modifications made to the STAV 7.3 TCD equation to make it compatible to the PAD 4.0 code and PWR fuel designs.

d) Include the plots of thermal conductivity versus temperature at burnups of 0, 20, 40, and 65 GWd/MTU with/without the burnup coefficients default option enabled.

e) Provide a discussion of the predicted PAD 4.0 data/Halden benchmark data set parameters including the initial/test conditions of the data and identify any deviations between the data sets conditions that may impact evaluation results between the data sets.

CRR-011 *(TH design)*

In the PAD 4.0 code, the thermal conductivity correlation is a function of [ ]^{a,c} The burnup dependent thermal conductivity degradation equation from STAV 7.3 is used in the interim version of PAD 4.0, called PAD 4.0 TCD. The STAV 7.3 code is approved for BWR fuel design analysis and is designed to handle fuel with gadolinium as an integral burnable absorber. The AP1000 fuel design may include axial blankets (fuel pellets of a reduced enrichment), annular fuel pellets in the top and bottom 8 inches of the fuel stack (fully enriched or partially enriched), and integral fuel burnable absorbers (boride-coated fuel pellets or fuel pellets containing gadolinium oxide mixed with uranium oxide). Address the following:

a) What are the impacts that these fuel design features may have on the thermal conductivity correlation?

b) Provide plots of the PAD 4 TCD predicted temperature profile data and the Halden benchmark data with/without the fuel burnup coefficient enabled.

c) Discuss any differences between the data profiles.

d) Discuss the applicability of the burnup dependent thermal conductivity degradation equation from STAV 7.3 for IFBA coated pellets.

CRR-012 NOT USED

CRR-013 *(GSI-191)*

WCAP-17524-P provides a description of fuel design changes to be included in the advanced first core for the AP1000 plant design. Section 2.6 discusses the impacts of the protective grid design change on GSI-191 but does not discuss the impacts of other fuel design changes. Provide an analysis of the impacts on GSI-191 for each design change, including the eIFM and eMidGrids.

CRR-014 *(GSI-191)*

In order to support the staff's review of the new fuel assembly design impacts on GSI-191, provide a comparison of the fuel designs for the following:

a) AP1000 DCD Rev. 19

b) Test assembly used to support AP1000 DCD Rev. 19

c) Fuel assembly design for WCAP-17524-P

d) Test assembly for PWROG which included the Robust P-Grid.

Also provide the test conditions for both the AP1000 DCD Rev. 19 tests and the PWROG tests used to support the Robust P-Grid (e.g. glow rates, debris types/quantities, etc.).

CRR-015 *(GSI-191)*

What is the screening methodology used by Westinghouse to determine the impacts on GSI-191 for each fuel design change.

CRR-016 *(Calc Notes-Open Items)*

During the audit held Aug 14-16, 2012, it was noted that some of the calc notes used to support WCAP-17524-P contain open items. The submitted topical report must be based on final analyses following approved quality assurance programs. Therefore, close all related open items and update WCAP-17524-P if necessary.

CRR-017 *(thermal conductivity degradation)*

The PAD 4.0 code incorrectly excludes burn-up effects in its thermal conductivity model. By using a corrected thermal conductivity model and the existing fission gas model, the code could overestimate the amount of fission gas and the fuel rod internal pressure since the current fission gas model was correlated to the testing data using the the original thermal conductivity model. To correct this, [

]^{a,c} it is unknown if the calculated amount of fission gas released remain conservative for AP1000 applications, considering the differences in geometry, burn-up levels, and power history between the test assemblies used to calculate the fission gas release model and the AP1000 Core Reference Report application design. Demonstrate that this assumption will lead to conservative or accurate predictions of fission gas quantities and fuel rod internal pressure within the power and burn-up range of this application.

CRR-018 *(non-LOCA accidents)*

As part of this topical report, Westinghouse developed a new procedure to mitigate the vessel head vent opening event by discharging high temperature and high pressure primary coolant into the in-containment RWST. Similar approaches have been developed for loss of feedwater heater event, inadvertent opening of CMT valves and CVCS malfunction. It was indicated by Westinghouse that the discharge of primary coolant into the containment will cause high containment air space temperature. Demonstrate that the in-containment equipment qualification program has already taken into account these containment heat up events and that the maximum allowable containment air space temperature for all the equipments required for operation is higher than the maximum containment air space temperature during these AOO events.

CRR-019 *(non-LOCA accidents)*

The rod ejection accident was analyzed using the previous fuel pellet thermal conductivity model, which does not account for burnup effects. With the new pellet thermal conductivity model, it is expected that the fuel pellet initial steady state temperature is significantly higher than what was calculated before,

especially for the end-of-cycle condition. What is the quantitative impact of the corrected TCD model with burnup dependence on the rod ejection accident analysis? In particular, provide the impact on the most limiting DNBR, fuel center line temperature and cladding strain. Demonstrate that they all satisfy the relevant limits.

CRR-020 *(non-LOCA accidents)*

A 3-D kinetics code is used to analyze the AP1000 rod ejection accident . Will the same code be used for the future reload analysis?

CRR-021 *(non-LOCA accidents)*

The FIGHT-H code has been used to support transient analysis to provide fuel rod temperature data at different power and burn-up levels. The accuracy of the code affects the calculated Doppler Feedback Effect and the power level for AOOs and rod ejection accident. Evaluate the difference between the FIGHT-H code and the fuel performance code which models the thermal conductivity degradation properly. Based on the evaluation, determine the limitations of the FIGHT-H code and the impact on the calculated DNBR, peak linear power density, transient power level and cladding strain.

CRR-022 *(non-LOCA accidents)*

Loss of flow and LOOP events are the most limiting in terms of system pressure with a margin of about 50 psid before the thermal conductivity degradation is considered. Westinghouse did not anticipate that the peak system pressure is going to exceed the limit if the thermal conductivity degradation is properly modeled; however, the technical basis supporting the conclusion has not been presented. Provide quantitative evidence to justify this conclusion.

CRR-023 *(LOCA)*

Westinghouse has used the previously approved containment mass and energy methodology to perform containment peak pressure calculation during LOCA. Does the corrected thermal conductivity degradation model affect the peak containment pressure and temperature calculation?

CRR-024 (Fuel Seismic)

What is the basis for assuming the applicability of the Westinghouse damping test data from older fuel assembly designs to the AP1000 Core Reference Report fuel assembly design?

CRR-025 (Fuel Seismic)

Provide justification for the applicability of crush test data/analysis from WCAP-12488-P-A Addendum 1 Rev. 1 to the eMidGrids and eIFMs used in the AP1000 Core Reference Report fuel assembly design.

CRR-026 *(non-LOCA accidents)*

An accurate or a conservative prediction of core initial stored energy is important to the containment peak pressure calculation for a postulated large break loss-of-coolant accident. The core initial stored energy used as input to this calculation is claimed to be the highest at [ ]^{a,c} in contrast to [ ]^{a,c} Describe the core initial stored energy calculation method and explain how the core at [ ]^{a,c} rated power can be the most limiting in regards to initial core stored energy.

CRR-027 (Fuel Seismic)

What is the hydraulic damping coefficient that Westinghouse plans to credit for different flow conditions in the fuel assembly seismic response analysis? How would a coast down be handled?