Westinghouse Electric Company
Nuclear Services
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Direct tel: (412) 374-4643
Direct fax: (724) 720-0754
e-mail: greshaja@westinghouse.com

LTR-NRC-11-33

July 13, 2011

Subject: Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design (Proprietary/Non-Proprietary)

Enclosed are Proprietary and Non-Proprietary copies of the Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design. This submittal serves as Westinghouse notification to the NRC as required by the SER on Westinghouse Fuel Criteria Evaluation Process (FCEP). The NRC-approved process in WCAP-12488-A was used for validation of the SDFBN design.

Also enclosed is:

1. One (1) copy of the Application for Withholding Proprietary Information from Public Disclosure, AW-11-3207 (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 application for withholding or the Westinghouse affidavit should reference AW-11-3207 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

cc: E. Lenning

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NRR

Westinghouse Electric Company
Nuclear Services
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
Rockville, MD 20852

Direct tel: (412) 374-4643
Direct fax: (724) 720-0754
e-mail: greshaja@westinghouse.com

AW-11-3207

July 13, 2011

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-NRC-11-33 P-Enclosure, "Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design" (Proprietary)

Reference: Letter from J. A. Gresham to Document Control Desk, LTR-NRC-11-33, dated July 13, 2011

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 material 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-11-3207 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 this application for withholding or the accompanying affidavit should reference AW-11-3207 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

AW-11-3207

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared J. 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:

J. A. Gresham, Manager
Regulatory Compliance

Sworn to and subscribed before me
this 13th day of July 2011

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Cynthia Olesky, Notary Public
Manor Boro, Westmoreland County
My Commission Expires July 16, 2014
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-11-33 P-Enclosure, "Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design" (Proprietary), dated July 13, 2011, for submittal to the Commission, being transmitted by Westinghouse letter, LTR-NRC-11-33, 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 the FCEP notification of the SDFBN.

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

(a) Assist proper fuel performance of fuel operating in reactors.

(b) Assist customers in improving their fuel (zero fuel defects).

Further this information has substantial commercial value as follows:

(a) Westinghouse can use this design change to further enhance their licensing position over competitors.

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 justification 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

Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design (Non-Proprietary)

Westinghouse Electric Company LLC
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066

Fuel Criterion Evaluation Process (FCEP)

Notification of Change to the Standardized Debris Filter Bottom Nozzle (SDFBN) Design

1.0 Background

The current Westinghouse 17x17 fuel design includes a debris filter bottom nozzle (DFBN). The DFBN has historically been manufactured by more than one vendor. In 1998 it was determined that the DFBN manufactured by Jedinstvo had approximately [ ]^{a,c} pressure drop compared to the L&S manufactured DFBN. This difference was evaluated back in 1998, as documented in Reference 1. The primary difference between the two nozzles was in the [ ]^{a,c} process used on the outlet of the flow holes of the Jedinstvo nozzle.

Westinghouse is pursuing the standardization of these nozzles (Standardized DFBN - SDFBN) such that bottom nozzles provided by any qualified supplier will have a loss coefficient consistent with that of the Jedinstvo DFBN. The SDFBN design specifies precise flow hole outlet chamfer geometry such that a consistent pressure drop will result regardless of the supplier.

1.1 Description of Design Change

Included in the design of the SDFBN is a chamfer on the inlet and outlet of the flow holes, as well as the elimination of the side skirt communication flow holes. The flow holes can be seen on the skirt of the DFBN in Figure 1. The current DFBN only has a chamfer on the inlet of the nozzle. The SDFBN includes an inlet and outlet chamfer as shown in Figure 2.

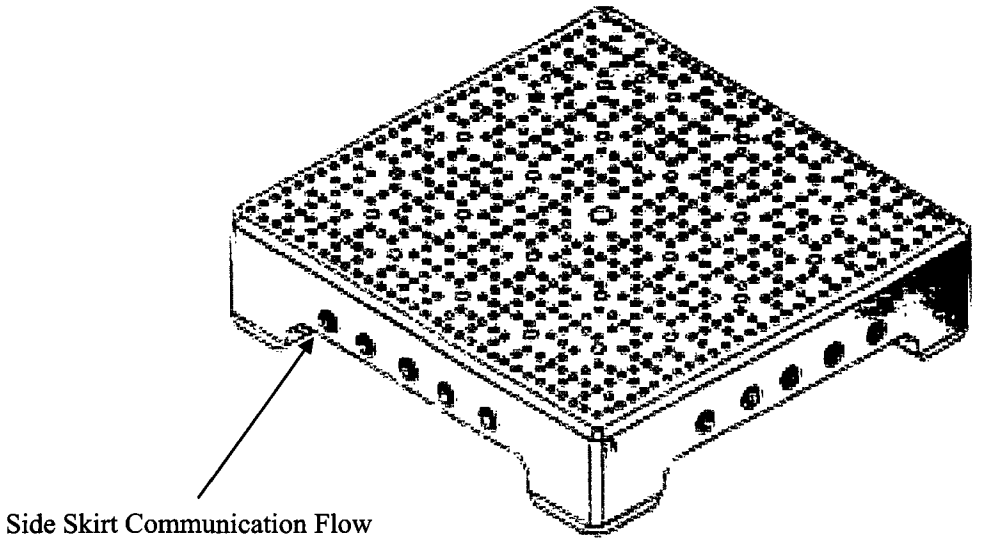

Figure 1: Current 17x17 DFBN

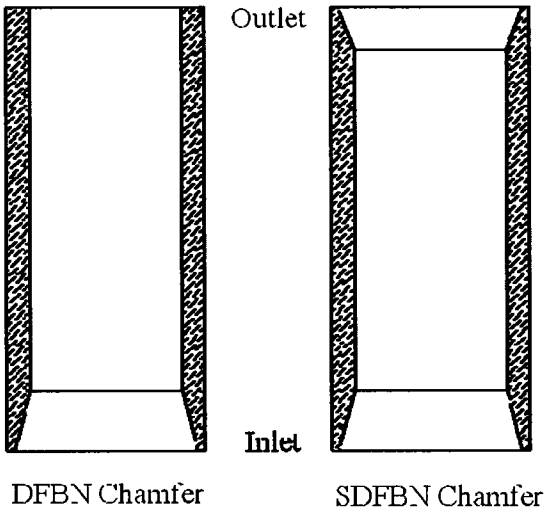

Figure 2: General Comparison of Current 17x17 DFBN and SDFBN Flow Hole Geometries

1.2 Summary of Tests Performed

FACTS Tests

To examine the pressure drops for the Jedinstvo SDFBN and DFBN, the L&S SDFBN and DFBN and the KNFC SDFBN, hydraulic testing in the Fuel Assembly Compatibility Test System (FACTS) loop was performed. The purpose of the FACTS testing of fuel assemblies utilizing the SDFBN was:

a) determine the variability in SDFBN loss coefficient over time by measuring nozzles manufactured at different times by different manufacturers,
b) confirm the loss coefficient of the SDFBNs,

Due to the small variability in nozzles as a result of the manufacturing process, the hydraulic tests produce a population of results for a given nozzle design. The FACTS test results for the inlet loss coefficient of the Jedinstvo DFBN and the SDFBN is shown to be consistent in Figure 3 and Figure 4. This testing also showed that there is [ ]^{a,c} pressure drop change between the historical results for the L&S DFBN and the SDFBN. The [ ]^{a,c} change in inlet pressure drop and impact in a mixed core is discussed further in Section 3.0.

To determine the effect of removing the side communication flow holes on pressure drop, a FACTS test was performed. This test was performed as part of the development of the Next Generation Fuel (NGF) product. The results of this testing show there is no pressure drop change between DFBN's with and without side communication flow holes (Figure 5).

The results of the FACTS testing confirms that the SDFBN design results in a consistent pressure drop which is independent of vendor (Figure 3 and Figure 4).

a, c

Figure 3: Inlet Loss Coefficients

a, c

Figure 4: Inlet Loss Coefficients

a, c

Figure 5: Pressure drop test results for DFBNs with and without communication flow holes

2.0 Design Categories

The following sections will address the design categories and associated parameters in the Westinghouse Fuel Criteria Evaluation Process (FCEP), WCAP-12488-A (Reference 2), to show that the SDFBN has insignificant impact on these parameters.

A. Fuel Damage and Fuel Rod Failure Criteria

a.	Clad Stress	i.	Fuel Clad Fretting Wear
b.	Clad Strain	j.	Fuel Rod Clad Rupture (Burst)
c.	Clad Fatigue	k.	Fuel Pellet Overheating
d.	Clad Oxidation	l.	Non-LOCA Fuel Clad Temperature
e.	Zircaloy Clad Hydrogen Pick-up	m.	LOCA Fuel Clad Temperature
f.	Fuel Rod Axial Growth	n.	Departure from Nucleate Boiling (DNB)
g.	Clad Flattening	o.	Fuel Assembly Hold-Down Force
h.	Rod Internal Pressure	p.	Thermal-Hydrodynamic Stability

B. Fuel Coolability

a. Clad Embrittlement During Locked Rotor/Shaft Break Accident

b. Clad Ballooning and Flow Blockage

c. Violent Expulsion of Fuel (Rod Ejection)
d. Fuel Assembly Structural Response to Seismic/LOCA Loads

C. Nuclear Design
a. Shutdown Margin
b. Fuel Storage Sub-criticality
c. Stability
d. Reactivity Feedback Coefficients
e. Power Distribution
f. Maximum Controlled Reactivity Insertion Rate

3.0 Evaluation

Each of the parameters listed above have been examined and those impacted by the design change to the SDFBN are addressed in the following sections.

Category A Fuel Damage and Fuel Rod Failure Criteria

Parameters "a-i," in this category are not impacted by the SDFBN design change since the fuel rod was not altered. Parameters "j-m" are not impacted because the SDFBN is at the entrance to the core, and does not have an effect on transient temperatures. Parameters "n," "o," and "p" are discussed below.

Item n Departure from Nucleate Boiling (DNB)

The effect of DFBN hydraulic mismatch on DNB is relatively small. Because of the similarity in the loss coefficients, there is no DNBR penalty expected for a mixed core of fuel assemblies with Jedinstvo DFBNs and fuel assemblies with SDFBNs. The maximum transition core effects were evaluated for a mixed core of fuel assemblies with L&S DFBNs and fuel assemblies with SDFBNs. The DNBR penalty is estimated to be about [ ]^{a,c} for fuel assemblies containing the L&S DFBN in a mixed core. Most plants have sufficient DNBR margin to offset the transition core penalty associated with the change from the L&S DFBN to the SDFBN DFBN design.

Item o Fuel Assembly Hold-Down Force

The fuel assembly hold-down force is potentially affected by the implementation of the SDFBN. For cores with the Jedinstvo bottom nozzle there would be no change to fuel assembly hold-down force. For plants with the L&S DFBN, there would be a reduction in the required hold down force as the overall core pressure drop would decrease by a small amount as the DFBN represents a relatively minimal pressure drop when compared to the overall fuel assembly pressure drop. Specifically, there would be an insignificant increase in the flow in those fuel assemblies with SDFBNs and a comparable decrease in those fuel assemblies with the L&S DFBN. Thus, the hold down calculations would remain conservative.

Item p Thermal-Hydrodynamic Stability

The effect of a possible nozzle mismatch on the Thermal-Hydraulic stability was examined. The fuel rod response for the bounding case was determined to remain stable and there is negligible, if any, increase in fuel rod vibration amplitude.

Category B Fuel Coolability

Parameters "a-c" in this category are not impacted by the SDFBN design since the fuel rod, and transient fuel temperatures are unchanged. Due to the possible change in the pressure drop item "d" is discussed below.

Item d Fuel Assembly Structural Response to Seismic/LOCA Loads

The seismic/LOCA analyses are unaffected by the implementation of the SDFBN as the fuel characteristics would remain essentially unchanged. In addition, core plate motions would remain unaffected as these are based on the thermal design RCS flow which is not affected by the SDFBN. Therefore, the existing seismic/LOCA analyses would remain valid and bounding.

Category C Nuclear Design

All parameters in this category are not impacted by the SDFBN design since the implementation of the SDFBN does not affect the input assumptions, models or methodology that are used in the analyses or create conditions more limiting than those enveloped by the current analyses for the respective discipline.

Additional Considerations GSI-191 Assessment of Debris Accumulation on Downstream Effects

Background

Pressurized water reactor (PWR) containment buildings are designed to both contain radioactive material releases and facilitate core cooling during a postulated loss-of-coolant-accident (LOCA) event. In some LOCA scenarios, to support long-term core cooling[1], water discharged from the break and containment spray is collected in a sump for recirculation by the emergency core cooling system (ECCS) and containment spray system (CSS).

The coolant in the sump will contain debris from insulation, both particulate and fibrous, and protective coatings damaged by the jet formed by the release of coolant from the break and from the transport of residual containment debris from upper containment regions into the sump. Also, there will be chemical products from the interaction of boric acid, buffer agents and other materials inside containment.

Following a LOCA, this debris mix could collect on the sump screen and create sufficient resistance to recirculating flow that provides long-term core cooling. This debris could be ingested into the ECCS and flow into the reactor coolant system (RCS) and eventually reach the core. These issues have been broadly grouped under Generic Safety Issue 191 (GSI-191) (Reference 3).

[1] For the purposes of this evaluation, "long-term core cooling" is defined as that period following the realignment of the ECCS and CSS from injecting coolant from the Refueling Water Storage Tank/Borated Water Storage Tank (RWST/BWST) to recirculating coolant collected in the reactor containment building sump, out to a period of 30 days.

Significant work has been performed by the industry to address the issues associated with GSI-191. These have included a PWR Owners Group program which performed testing to assess the effect of the collection of debris and chemical precipitates in core components on head loss across the core at flow rates representative of when ECCS is realigned to recirculation mode from the containment sump. This testing program utilized a partial length (4.5 foot) 17x17 OFA assembly (i.e., 0.360" OD fuel rod) as a bounding fuel assembly design. The results of this testing program are presented in WCAP-17057-P, *GSI-191 Fuel Assembly Test Report for PWOG*, dated March 2009 (Reference 4). This report provides an examination of the collection of debris loads evaluated from plant data on a fuel assembly at flow rates representative of both hot-leg and cold-leg break flow rates.

The resolution of GSI-191, while approaching closure, is not yet complete. Testing to date has been consistent with the PWROG test protocol (Reference 4). The following section describes testing that was performed to specifically assess the SDFBN with respect to GSI-191, and to compare it with the current plant configuration to demonstrate that the SDFBN is equivalent to the existing DFBN design from a GSI-191 Downstream Effects standpoint.

Testing Performed for the SDFBN

To support the evaluation of the SDFBN, a number of GSI-191 tests have been conducted following the approach detailed in WCAP-17057-P (Reference 4). The fuel assembly tested was the same partial length (4.5 foot) 17x17 OFA (V5) fuel assembly with the following components: the Robust Protective grid (RPG), a bottom Inconel grid, a mid-grid, an IFM grid, another mid-grid, a top Inconel grid, a Reconstitutable Top Nozzle (RTN) and either the SDFBN or the DFBN. Testing of both hot-leg breaks and cold-leg breaks were examined under limiting conditions with respect to the particulate-to-fiber (p:f) ratios. For the hot leg breaks, a p:f ratio of 1 to 1 was evaluated and for the cold-leg breaks, a p:f ratio of 45 to 1 was evaluated. Table 1 presents a summary of the pertinent parameters that were assumed for the test case runs. The results of the relevant cases for both the hot-leg and cold-leg break tests are discussed below.

Hot Leg Break Test Results

The hot leg break tests were run with the DFBN replaced by the new SDFBN. Tests were run with various fibrous debris loadings until acceptable results were obtained. Multiple repeat tests were performed to ensure the accuracy of the test results. The final tests that were run with acceptable results had a debris loading of [

]^{a,c} The results of these cases are presented in Table 2. Thus, it is concluded that fuel assemblies containing the SDFBN can support a debris loading of up to [ ]^{a,c}

Cold Leg Break Test Results

Cold leg break tests were performed with a fiber loading of 18 grams at a flow rate of 3 gpm. The results from these cases were [ ]^{a,b,c} as shown in

Table 2. These cases were run to demonstrate that the hot leg break cases remain the limiting cases with respect to the peak ΔP.

Conclusion and Summary

Based on the evaluation presented herein, the SDFBN is evaluated to have no adverse impact on the results of the GSI-191 debris testing or the conclusions presented in WCAP-17057-P, provided that the fibrous debris loading per fuel assembly is not greater than [

]^{a,b,c}

Finally, it is important to note that the GSI-191 issue is still an open issue with the NRC. As such, the conclusions presented herein should be reviewed and potentially re-evaluated when the final SER becomes available.

4.0 Safety Assessment

As part of the overall review of the SDFBN design, the changes associated with the design were reviewed by the various nuclear safety engineering groups and found to be acceptable. There is no change in debris filtering effectiveness and the effect of the pressure loss coefficient has been reviewed and found to be acceptable.

5.0 Conclusion

It is concluded that the design changes made to the SDFBN design will have a negligible effect on the performance of the fuel assembly in the design categories listed above. The SDFBN design change may therefore be implemented under the Fuel Criteria Evaluation Process, which requires NRC notification.

References

1. Westinghouse Safety Evaluation Checklist – SECL-98-129, "Jedinstvo Debris Filter Bottom Nozzle Lower Hydraulic Loss Coefficient Potential Reportable Technology Error (PTRE)," February 18, 1999.

2. Davidson, S. L., (Ed.), et al., "Westinghouse Fuel Criteria Evaluation Process," WCAP-12488-A, Revision 0 October 1994.

3. Generic Safety Issue 191 (GSI-191), *Assessment of Debris Accumulation on Pressurized Water Reactor (PWR) Sump Performance.*

4. Baier, S. and Andreychek, T., *GSI-191 Fuel Assembly Test Report for PWROG*, WCAP-17057, Revision 0, dated March 2009.

Table 1: Summary of Test Conditions

a, c

[

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Table 2: Summary of Test Results for Relevant Hot and Cold Leg Break Cases

a,c

[

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