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LTR-NRC-12-64

September 13, 2012

Subject: Fuel Criterion Evaluation Process Notification of the 15x15 Robust Protective Grid and Modified Debris Filter Bottom Nozzle Designs (Proprietary/Non-Proprietary)

Enclosed are the proprietary and non-proprietary versions of the Fuel Criterion Evaluation Process (FCEP) Notification of the 15x15 Robust Protective Grid (RPG) and Modified Debris Filter Bottom Nozzle (mDFBN) Designs. This submittal serves as notification to the NRC as required by the safety evaluation report (SER) on the Westinghouse FCEP process (WCAP-12488-A). The NRC approved process documented in WCAP-12488-A was used for validation of the RPG and mDFBN designs.

Also enclosed is:

1. One (1) copy of the Application for Withholding Proprietary Information from Public Disclosure, AW-12-3539 (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-12-3539, and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

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NRC

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AW-12-3539

September 13, 2012

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-NRC-12-64 P-Attachment, "Fuel Criterion Evaluation Process Notification of the 15x15 Robust Protective Grid and Modified Debris Filter Bottom Nozzle Designs" (Proprietary)

Reference: Letter from J. A. Gresham to Document Control Desk, LTR-NRC-12-64, dated September 13, 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-12-3539 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-12-3539, and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

AW-12-3539

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

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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 September 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-12-64 P-Attachment, "Fuel Criterion Evaluation Process Notification of the 15x15 Robust Protective Grid and Modified Debris Filter Bottom Nozzle Designs" (Proprietary), for submittal to the Commission, being transmitted by Westinghouse letter, LTR-NRC-12-64, 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 notification of the 15x15 Robust Protective Grid (RPG) and Modified Debris Filter Bottom Nozzle (mDFBN).

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

(a) Ensure 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.

(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

Fuel Criterion Evaluation Process Notification of the 15x15 Robust Protective Grid and Modified Debris Filter Bottom Nozzle Designs

September 2012

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

1.0 Background

Westinghouse has recently completed the development of a Robust Protective Grid (RPG) design for plants receiving 17x17 type fuel assemblies. This new product was developed as a result of a Root Cause Analysis investigating 17x17 Protective Grid (P-Grid) cracking. More specifically, it was discovered that the 17x17 P-Grids were experiencing cracking due to both fatigue and primary water stress corrosion cracking (PWSCC). The Root Cause Analysis found that the top ligament of the 17x17 P-Grid experienced flow-induced vibration, which resulted in fatigue cracking and is thought to be a contributor to the stress corrosion cracking. Additionally, finite element analysis (FEA) studies of the 17x17 P-Grid confirmed high levels of static stress due to dimple deflection and friction loading. Because of the cracking mentioned above, it was decided to redesign the 17x17 P-Grid in order to reduce both the static and dynamic (vibration-induced) stresses. It was also observed that some of the 15x15 P-Grids were experiencing cracking. As a corrective measure, Westinghouse extended the recently completed 17x17 RPG design to the 15x15 Westinghouse fuel assembly design.

To provide additional debris resistance margin to the fuel assembly, the 15x15 RPG project also includes the implementation of the modified Debris Filter Bottom Nozzle (mDFBN) design which eliminates the communication flow holes present on the current DFBN designs. Westinghouse also eliminated the side skirt communication flow holes from the 17x17 Standardized Debris Filter Bottom Nozzle (SDFBN) as a means of minimizing the possibility that debris could bypass the bottom nozzle by passing through the communication flow holes and potentially causing debris-related fretting leakers in the fuel bundle region. Westinghouse has performed debris testing in which it was observed that debris passed through the side skirt communication flow holes. Furthermore, the debris testing with debris of varying size, for conditions both with and without the communication flow holes, showed that the elimination of the communication flow holes improved the ability of the bottom nozzle to "trap" debris.

1.1 Description of Design Change

The 15x15 RPG design has implemented comparable changes relative to the 17x17 RPG design in order to reduce the probability of cracking and dimple/ligament separation. Figure 1 provides a comparison of the 15x15 P-Grid and 15x15 RPG inner strap designs. The 15x15 RPG incorporates the following new design features:

a,c

[ ]

[

]a,c. The estimated weight of the 15x15 RPG is 0.1 lbs greater than the 15x15 P-Grid.

The inner strap was made taller in order to accommodate the [ ]a,c anti-vibration feature. This feature has been shown through testing to be extremely effective in reducing high frequency strap vibration, with vibration amplitude reductions of an order of magnitude. The vibration is generated by vortex shedding off of the trailing strap edges on the 15x15 P-Grid design. When the vortices combine they tend to excite the strap to vibrate at its natural frequency. The [ ]a,c feature prevents the vortices from combining, thereby preventing the strap from vibrating at its natural frequency.

The dimple windows were shortened laterally in order to provide more material between the window and the intersect slot, which is a common fracture location. Additionally, the height of the slot was doubled in order to decrease the stress concentration at the ends of the windows. The dimple profile was modified to provide for a [ ]a,c. The 15x15 RPG has rod contact forces approximately [ ]a,b,c less than the current design. This decreases the resulting stress in the strap, thus reducing the propensity for stress corrosion cracking. The [ ]a,c also reduces the stresses due to friction between the 15x15 RPG and the fuel rods.

The only difference between the mDFBN (Figure 7) and DFBN (Figure 8) is the removal of the side skirt communication holes. The weight of the mDFBN is 1 lb greater than the 15x15 DFBN.

1.2 Summary of Tests Performed

VISTA Tests

Testing was performed on the 5x5 sections of the 15x15 P-Grid and the 15x15 RPG to investigate the High Frequency Vibration (HFV) of the inner straps. This small-scale testing was performed in the Vibration Investigation of Small-scale Test Assemblies (VISTA) hydraulic test loop.

[

]a,c

VIPER Tests

The objective of the VIPER test was to confirm that the 15x15 RPG will have no top or bottom strap ligament fractures and failures by visual inspection. This test was also used to indicate that the 15x15 RPG

coolant flow is not affected by possible cross flow changes from the removal of the bottom nozzle side skirt communication flow holes.

Zero failure locations were found in the 15x15 RPG, successfully confirming that the 15x15 RPG has no top or bottom strap ligament fractures and failures. Additionally, visual inspections of the bottom grids, clad surfaces and instrument tubes showed the two test assemblies with different bottom nozzles had no adverse affect on one another.

Accelerometer rod data shows there is no affect on coolant flow, thereby helping to ensure that there will be no significant rod vibration.

Fuel Assembly Compatibility Test System (FACTS) Tests

The pressure loss coefficients of fuel assemblies utilizing the 15x15 RPG and mDFBN shall be maintained such that:

a) Excessive flow-induced vibration does not occur,
b) The hydraulic lift forces are acceptable to the top nozzle spring design,
c) The mixed core DNB penalty is minimized so that the predicted DNBR for the limiting design transients will be greater than the DNBR limit.

The fuel assembly utilizing the 15x15 RPG and mDFBN must have acceptable vibration characteristics and top nozzle spring holddown force. Additionally, the design must be able to perform within the constraints of mixed core compatibility and have an acceptable impact on plant systems. To evaluate the impact on inlet region loss coefficients, a FACTS hydraulic test series was performed. This testing was performed using a confirmatory test assembly, to determine if there is a loss coefficient change for the 15x15 RPG and mDFBN. The difference in inlet region loss coefficient was determined between (1) tests with the 15x15 P-Grid with DFBN and (2) tests with the 15x15 RPG and mDFBN. Figure 5 provides a comparison of the loss coefficients as a function of Reynolds number. Comparing just the 15x15 P-Grid vs. the 15x15 RPG, shows a change in inlet region loss coefficient of [ ]^{a,c}. Comparing just the DFBN vs. the mDFBN, shows a change in inlet region loss coefficient of [ ]^{a,c}. The FACTS tests confirm that the combination of 15x15 RPG and mDFBN has a very small [ ]^{a,c} impact on inlet region loss coefficient.

Since there is an insignificant change in hydraulic loss coefficient for the 15x15 RPG and mDFBN inlet region, there will be no impact on the items a, b, and c listed above. Therefore, there is no impact on any thermal-hydraulic criteria including the pressure drop and design loss coefficient.

FACTS-D Tests

Normal reactor operating debris mitigation effectiveness testing was performed in the FACTS hydraulic flow loop located in Columbia, SC. This test was conducted to verify that the debris mitigation effectiveness of the 15x15 RPG with mDFBN was similar to the debris mitigation effectiveness of the 15x15 P-Grid with DFBN. To perform the test, the FACTS loop was modified for debris testing by replacing the pressure vessel and flow housing with specialized inline debris filters and the debris test flow housing. The FACTS testing in this configuration is called FACTS-D testing.

There were [ ]^{a,c} different sets of debris used. The sets can be categorized into [ ]^{a,c} different types of debris. The categorized types were: [ ]^{a,c}. Figure 6 shows the debris used for the test. [ ]^{a,c} For each test, the [ ]^{a,c} sets of debris were injected one set at a time, each set consisted of [ ]^{a,c} pieces of debris for a total of [ ]^{a,c} pieces.

The results of the debris tests are shown in Table 1 and indicate that the debris mitigation effectiveness of the 15x15 RPG with mDFBN is [ ]^{a,c} relative to the debris mitigation effectiveness of the 15x15 P-Grid with DFBN.

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 1), to show that the 15x15 RPG and mDFBN have an insignificant impact on these parameters.

A. Fuel System 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 Criteria

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 Criteria

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

3.0 Evaluation

Each of the parameters under each category listed above has been examined and those impacted by the 15x15 RPG or mDFBN designs are discussed below:

Category A: Fuel System Damage and Fuel Rod Failure Criteria

Parameters "a-h,", "j-m", and "o" in this category are not impacted by the 15x15 RPG nor mDFBN designs since the fuel internal rod pressure, and pressure drop were not altered. Parameters "i", "n", and "p" are discussed below.

Item i: Fuel Rod Clad Fretting Wear

The dimple on the 15x15 RPG is below the active fuel region, and is only in contact with the solid part of the bottom end plug. The mDFBN does not contact the fuel cladding. Therefore, the possibility for fuel failures due to fretting wear is not changed.

Item n: Departure from Nucleate Boiling (DNB)

Since the 15x15 RPG and mDFBN have no impact on any of the NSSS design parameters, nor do the designs have any effect on critical heat flux (CHF) correlations since both components are below the active fuel region and below the bottom Inconel grid, and both components [ ]^{a,c}, the 15x15 RPG and mDFBN designs for 15x15 fuel have no impact on DNB.

Item p: Thermal-Hydrodynamic Stability

Since the pressure drop of the 15x15 RPG and mDFBN [ ]^{a,c} as the P-Grid and DFBN, the assembly design loss coefficient [ ]^{a,c}. Therefore the Thermal Hydraulic Stability characteristics are [ ]^{a,c} (Figure 5).

Category B: Fuel Coolability Criteria

Parameters "a-c" in this category are [ ]^{a,c} by the 15x15 RPG or mDFBN designs since the fuel rod material is unchanged. DNB responses are unchanged and power densities are unchanged. Due to the change in the dimple geometry, the protective grid impact strength and stiffness [ ]^{a,c}, as discussed in Item "d" below.

Item d: Fuel Assembly Structural Response to Seismic/LOCA Loads

Considering the close proximity to the bottom nozzle, the seismic/LOCA loads on the protective grid are [ ]^{a,c} .However, Condition I loading conditions are considered, namely the stresses induced due to [ ]^{a,c} The 15x15 RPG design has a [ ]^{a,c}

Category C: Nuclear Design Criteria

The nuclear design, inclusive of BEACON™ Core Monitoring System, is not affected by a change to the 15x15 RPG and mDFBN since these components are below the active fuel region and are not modeled by the nuclear design. In addition, the 15x15 RPG and mDFBN have no impact on NSSS design parameters.

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

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 their interaction with other materials inside containment.

Following a LOCA, this debris mix could collect on the sump screen and create resistance to recirculating flow that provides long-term core cooling. Some of this debris could be ingested into the ECCS and flow into the reactor coolant system (RCS) and eventually reach the core while the ECCS is in sump recirculation mode. This scenario has been broadly grouped under Generic Safety Issue 191 (GSI-191) as in-vessel effects (Reference 2).

Significant work has been performed by the industry to address the issues associated with GSI-191. This included a PWR Owners Group program that performed fuel assembly testing to assess head loss across the core from the collection of debris and chemical precipitates on core components during sump recirculation mode. This test program utilized a partial length (4.5 foot) 17x17 optimized fuel assembly (OFA) (i.e., 0.360" OD fuel rod) as the bounding fuel assembly design. The results of this test program are presented in WCAP-17057-P, Revision 1, *GSI-191 Fuel Assembly Test Report for PWROG*, dated September 2011 (Reference 3). This report provides an examination of the collection of debris loads on a representative fuel assembly at flow rates representative of both hot-leg and cold-leg break flow rates.

Additional work has been performed by Westinghouse to address GSI-191 in-vessel effects including tests specifically performed for the 17x17 RPG and SDFBN as discussed in References 4 and 5. The GSI-191 testing for the 17x17 RPG and SDFBN was performed consistent with the PWROG test protocol

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.

(Reference 3) and as noted in References 4 and 5, the 17x17 RPG and SDFBN performed consistent with the standard P-grid and DFBN for both the hot leg break and cold leg break test cases. Therefore the 17x17 RPG and SDFBN would be bound by the conclusions of the GSI-191 debris testing reported in Reference 3.

Based on the testing performed with the 17x17 RPG and SDFBN, it is concluded that the implementation of the 15x15 RPG and mDFBN with respect to the GSI-191 issue is justified since the design of the 15x15 RPG and mDFBN is functionally the same as the design of the 17x17 RPG.

At this time, as the resolution of GSI-191 is not yet complete, it is not possible to rule out the need for additional tests or other impacts when the final NRC resolution of GSI-191 occurs.

4.0 Safety Assessment

As part of the overall review of the 15x15 RPG and mDFBN designs, the changes associated with the designs were reviewed by the various nuclear safety engineering groups and were found to be acceptable. There is no significant change in pressure drop, no decrease in debris filtering effectiveness and no increase in the design loss coefficient.

5.0 Conclusion

It is concluded that the 15x15 RPG and mDFBN designs will have no detrimental effect on the performance of the fuel assembly in the design categories listed above. The 15x15 RPG and mDFBN designs may therefore be implemented under the Fuel Criteria Evaluation Process, which requires NRC notification.

6.0 References

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

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

3. Baier, S. and Andreychek, T., *GSI-191 Fuel Assembly Test Report for PWROG*, WCAP-17057, Revision 1, dated September 2011.

4. Gresham, J.A., "Fuel Criterion Evaluation Process (FCEP) Notification of the Robust Protective Grid (RPG) Design," LTR-NRC-11-26, June 2011.

5. Gresham, J.A., "Fuel Criterion Evaluation Process (FCEP) Notification of the Standardized Debris Filter Bottom Nozzle (SDFBN) Design (Proprietary/Non Proprietary)," LTR-NRC-11-33, July 2011.

a, c

[ ]

Figure 1: Comparison of Representative Dimensions for 15x15 P-Grid and 15x15 RPG Design

a, c

[ ]

Figure 2: 15x15 P-Grid with [ ]a,c

a, c

[ ]

Figure 3: 15x15 RPG with [ ]a,c

a, b, c

Figure 4: 15x15 P-Grid and 15x15 RPG HFV Response

a, b, c

Figure 5: Comparison of Pressure Drop for the 15x15 P-Grid, 15x15 RPG, 15x15 DFBN, and 15x15 mDFBN

a, b, c

Figure 6: Test Debris for FACTS Debris Test

a, c

[ ]

Figure 7: modified Debris Filter Bottom Nozzle (mDFBN)

a, c

[ ]

Figure 8: Debris Filter Bottom Nozzle (DFBN)

Table 1:
15x15 Debris Test Results

a, b, c

[ ]