Westinghouse Electric Company
Nuclear Power Plants
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USA

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

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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002872

May 11, 2010

Subject: AP1000 Response to Request for Additional Information (SRP6.2.2)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 6.2.2. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

A response is provided herein for RAI SRP6.2.2-SPCV-25 R1.

Pursuant to 10 CFR 50.30(b), proprietary and non-proprietary versions of the response to the request for additional information on SRP Section 6.2.2 are submitted as Enclosures 3 and 4. Also enclosed is one copy of the Application for Withholding, AW-10-2816 (non-proprietary) with Proprietary Information Notice, and one copy of the associated 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 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 affidavit or Application for Withholding should reference AW-10-2816 and should be addressed to James A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company, LLC, P. 0. Box 355, Pittsburgh, Pennsylvania 15230-0355.

D063
NRO

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Strategy

/Enclosures

1. AW-10-2816 "Application for Withholding Proprietary Information from Disclosure," dated May 11, 2010

2. AW-10-2816, Affidavit, Proprietary Information Notice, Copyright Notice dated May 11, 2010

3. Response to Request for Additional Information on SRP Section 6.2.2, RAI-SRP6.2.2-SPCV-25 R1(Proprietary)

4. Response to Request for Additional Information on SRP Section 6.2.2, RAI-SRP6.2.2-SPCV-25-NP R1 (Non-Proprietary)

cc:	D. Jaffe	- U.S. NRC	4E
	E. McKenna	- U.S. NRC	4E
	P. Donnelly	- U.S. NRC	4E
	T. Spink	- TVA	4E
	P. Hastings	- Duke Power	4E
	R. Kitchen	- Progress Energy	4E
	A. Monroe	- SCANA	4E
	P. Jacobs	- Florida Power & Light	4E
	C. Pierce	- Southern Company	4E
	E. Schmiech	- Westinghouse	4E
	G. Zinke	- NuStart/Entergy	4E
	R. Grumbir	- NuStart	4E
	D. Lindgren	- Westinghouse	4E
	D. Behnke	- Westinghouse	4E

ENCLOSURE 1

AW-10-2816

APPLICATION FOR WITHHOLDING
PROPRIETARY INFORMATION FROM DISCLOSURE

Westinghouse Electric Company
Nuclear Services
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Your ref: Docket Number 52-006
Our ref: AW-10-2816

May 11, 2010

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Submittal of Proprietary and Non-Proprietary Technical Document Information, Response to Request for Additional Information (RAI) on SRP Section 6.2.2

The Application for Withholding 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 RAI response. In conformance with 10 CFR Section 2.390, Affidavit AW-10-2816 accompanies this Application for Withholding, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectively 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-10-2816 and should be addressed to James A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company, LLC, P.O. Box 355, Pittsburgh, Pennsylvania, 15230-0355.

Very truly yours,

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Strategy

cc: G. Bacuta - U.S. NRC

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ENCLOSURE 2

Affidavit

AW-10-2816
May 11, 2010

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared Robert Sisk, 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:

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Strategy

Sworn to and subscribed
before me this 11th day
of May 2010.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Linda J. Bugle, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires June 18, 2013
Member, Pennsylvania Association of Notaries

Notary Public

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(1) I am Manager, Licensing and Customer Interface, 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" 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 RAI-SRP6.2.2-SPCV-25 R1, in support of the AP1000 Design Certification Amendment Application, being transmitted by Westinghouse letter (DCP_NRC_002872) and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse for the AP1000 Design Certification Amendment application is expected to be applicable in all licensee submittals referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application in response to certain NRC requirements for justification of compliance of the safety system to regulations.

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

(a) Manufacture and deliver products to utilities based on proprietary designs.

(b) Advance the AP1000 Design and reduce the licensing risk for the application of the AP1000 Design Certification

(c) Determine compliance with regulations and standards

(d) Establish design requirements and specifications for the system.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of plant construction and operation.

(b) Westinghouse can sell support and defense of safety systems based on the technology in the reports.

(c) The information requested to be withheld reveals the distinguishing aspects of an approach and schedule 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 digital technology safety systems 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.

ENCLOSURE 4

Response to Request for Additional Information on SRP Section 6.2.2

RAI SRP6.2.2-SPCV-25 R1-NP

(Non-Proprietary)

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP 6.2.2-SPCV-25
Revision: 1

Question:

RAI-SRP 6.2.2-SPCV-25: ZOI Coatings Debris

The DCD limits the amount of coatings debris fines that can be generated by a LOCA jet to less than 50 pounds. This requirement is assumed to apply to both hot and cold leg breaks, which is inconsistent with the discussion on the bottom of page 17 of APP-GW-GLR-079, which states that the containment screen could see extra ZOI-generated particle debris resulting from a hot leg break. Please explain this discrepancy, being sure to include the following:

a) Does the DCD requirement limiting ZOI coating to 50 pounds apply to both hot and cold leg breaks?
b) If ZOI coatings associated with a hot leg break are greater than 50 lbs, what quantity is assumed, how was this determined and how will it be controlled?
c) If ZOI coatings associated with a hot leg break are greater than 50 lbs, what percentage are assumed to transport to the IRWST and CR screens? Provide justification if the hot leg break uses different values than the 100% transport assumptions stated in the DCD.
d) In APP-GW-GLR-079, the epoxy coated surface area is assumed to equal 3 times the inside surface area of a sphere with a diameter equal to 4 times the ID of the CL ID of 22 inches. Per the response to RAI-SRP6.2.2-CIB1-24, Westinghouse considers this approach conservative with respect to operating plants. Please explain how this is conservative, because it was not apparent in the staff's sampling of Generic Letter 2004-02 responses.
e) If the ZOI coatings associated with a hot leg break are also limited to 50 pounds, explain what correlation is used and why this is appropriate.

Additional Question:

While staff concurs with part d) Response to RAI-SRP 6.2.2-SPCV-25, stating that the AP1000 limit on coatings does not have to bound the operating plants, this response does not address the RAI question. The intent of the RAI was to ask for justification of the Westinghouse statement that the formula for epoxy coatings presented in RAI-SRP6.2.2-CIB1-24 "has been compared to what has been determined for operating plants and is conservative". This formula is the only basis for the amount of epoxy coatings used to justify why the HL break is not limiting in TR26, so it's applicability needs to be understood.

The DCD only identifies the ZOI coating particulates associated with a cold leg or DVI break. TR26 acknowledges that the quantity of ZOI coating particulates transported to the CR or IRWST screens will be larger for a HL break, but it states this will not impact test results because the head loss testing showed no pressure drop, thus no thin bed to capture these

particles. While this argument may be valid, the concern is that the DCD is not capturing the entire design basis - it allows a pressure drop of .25 psi, so it is possible future testing could have a thin bed and meet this requirement. If that is the case, how will holders know that additional coatings from a HL break should be considered?

Westinghouse Response: (The original response has been revised as shown below to address the additional question.)

a) The ZOI coating limit listed in the DCD only applies to DECL and DEDVI LOCAs, as was discussed in response to RAI-SRP6.2.2-CIB1-24; item b) addressed the AP1000 ZOI coatings debris. APP-GW-GLR-079 was revised to be consistent with the response to this RAI. In the RAI response it was recognized that a HL LOCA in the AP1000 may create a larger amount of coating debris and allow that debris to enter the RCS through the break and to be transported into the top portion of the core. However, the RAI response discussed why the HL LOCA was not limiting. The reasons that the HL LOCA is not limiting have become even stronger due to additional FA debris testing performed for the AP1000 that has demonstrated that debris in the upper part of the core [

]^{a,c}

b) There is no need to control the ZOI coating debris for the following reasons:
   - The amount of ZOI coatings that could be generated in the AP1000 by a HL LOCA has been determined to be [ ]^{a,c} lb based on AP1000 specific design and layout information as discussed in item d for the CL ZOI. A break located at the HL connection to the SG is limiting. The coating surface areas within a DEHL LOCA ZOI were calculated for the AP1000 to be about [

     ]^{a,c} As a result, the [ ]^{a,c} lb assumed in this evaluation is conservative for the AP1000. Considering that the amount of ZOI particle debris generated in a DECL LOCA is 70 lb, the DEHL LOCA would generate an additional [ ]^{a,c} lb. Therefore, for a HL LOCA the total amount of particles could increase from [ ]^{a,c} lb. Note there would be no additional fiber in this case.
   - In the AP1000, debris (including these additional particles) can transport into the RCS through a flooded HL and possibly into the upper parts of the core. However, AP1000 FA testing has shown (WCAP-17028, Rev 5) that this debris [

]a,c

- For AP1000 there is no mechanism to transport fiber to the core inlet in a HL LOCA. All of the water that enters the core through the down comer will come from PXS injection which is screened in a HL LOCA. With the AP1000 flows/velocities and screen design (hole size) the fiber bypass through screen is 1%. With the small amount of fiber in the AP1000, the bypass of fiber through the screen would result in insignificant fiber transporting to the core inlet through the PXS. As a result, there would be insufficient fiber to form a debris bed in the core inlet.

c) The DP observed in the screen tests was [ ]a,c at the maximum flow during screen tests -4W and -5W. These tests were performed with a particle loading that was about twice the current licensing limit of 193.4 lb. This margin more than accounts for the additional particles that might be generated by a HL LOCA. Therefore, the testing performed for the AP1000 screens demonstrates that the DP would be acceptable even if all of the additional particles generated within the ZOI on a HL LOCA were added to the screen debris load.

d) The approach to determining the amount of coatings located within the CL ZOI has been changed from the approach documented in Revision 0 to the response to this RAI; AP1000 specific design and layout information has been used to determine the amounts of epoxy and inorganic zinc located within the CL ZOI.

The selection of break locations considered for this evaluation is consistent with the guidance in NEI 04-07 as well as the associated NRC SER. Note that this guidance was based on the need to evaluate plant designs that use different types of fibrous insulation such that consideration of break locations needs to be much more detailed than for the AP1000 which uses only metal reflective insulation within the ZOI. The only consideration for selecting the AP1000 break locations is to determine the maximum amount of coatings what could be damaged and create fine particle transportable debris. The AP1000 break locations do not generate any fiber and therefore do not need to look for different amounts and types of fiber.

Because of the unique characteristics of AP1000, CL LOCAs are limiting with respect to GSI-191 (as discussed in item b). In order to support this conclusion the amount of coatings within the HL ZOI also needs to be identified. As a result, the maximum amount of coatings debris within the ZOI for both CL and HL LOCAs has been determined.

The first consideration in selecting the break locations was to determine which CL and HL pipes to quantify. The largest such lines are the main loop pipes which are 22 inches inside diameter (ID) for the CLs and are 31 inches ID for the HLs. The next smaller CL lines are the 8" DVI injection lines (6.8" ID); these lines will generate much less ZOI coatings because

the ZOI sphere would be so much smaller (only 3% of the 22" ZOI sphere volume) and they are generally located in the same areas. The next smaller HL line is the 20" RNS pumps suction line (16.1" ID). This line will generate much less ZOI coatings because the ZOI sphere will be so much smaller (only 14% of the 31" ZOI sphere volume) and it is a short pipe stub that is connected directly to the HL so it is located in the same area as the HL.

The specific break locations quantified for the CLs and HLs were at the terminal ends. These break locations were selected because they are in different areas with potentially different coating inventories. The SER for NEI 04-07 states that it is acceptable to evaluate break locations every 5 ft along the lines. It also says that fewer break locations can be quantified (especially for large break locations) if the break locations are within the loop compartments and by inspection they have similar characteristics, similar debris inventories and transport paths.

The length of CL and HL pipe within the loop compartment is greater than 5', however additional break locations were not quantified because they were within the loop compartment and by inspection have similar characteristics, inventories, and transport paths.

For the AP1000, the limiting amount of CL ZOI coatings results from a break located at the CL connection to the reactor coolant pump. The coating surface areas within this CL break ZOI was calculated for the AP1000 to be [

]^{a,c} As a result, the licensing limit has been increased from 50 to 70 lb to provide a conservative basis for the AP1000. This increase is acceptable because all of the CL LOCA FA tests after #17 were conducted considering [

]^{a,c} In addition, as pointed out in item b), the AP1000 screen tests were performed with a large amount of extra particles.

The limiting amount of HL ZOI coatings is discussed in item b.

e) For the AP1000, the ZOI coatings licensing limit of 70 lb applies to CL LOCAs but not to HL LOCAs. As explained in the response to item b), a HL LOCA might result in more particulate debris however based on AP1000 FA and screen testing this would be acceptable. A statement will be added to DCD subsection 6.3.2.2.7.1 that says that a HL LOCA could generate more coating debris however the CL LOCA is more limiting for the core and the screens because of the limited amount of latent fiber allowed in the AP1000 containment. The specific statement is shown in the markup of APP-GW-GLE-002 at the end of this response.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

DCD section 6.3.2.2.7.1, item 12, second and third bullets, will be changed to increase the licensing limit for CL ZOI coatings from 50 to 70 lb. DCD section 6.3.2.2.7.1, item 12, second bullet, will be changed to clarify that the 70 lb of ZOI coatings only applies to CL and DVI LOCA locations. The Technical Report (TR) Revision section shows the proposed changes.

PRA Revision:

None

Technical Report (TR) Revision:

Changes will be made to 4 AP1000 GSI-191 reports. This includes:

1. APP-GW-GLE-002
2. APP-GW-GLR-079
3. WCAP-16914-P
4. WCAP-17028-P

The proposed changes for each document are shown in the following pages.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

1. APP-GW-GLE-002, Impacts to the AP1000 DCD to Address Generic Safety Issue GSI-191, will be revised as follows to show the DCD changes resulting from this RAI response. DCD section 6.3.2.2.7.1, General Screen Design Criteria, item 12, second bullet, will be changed as follows:

   - In addition to the resident debris, the LOCA blowdown jet may impinge on coatings and generate coating debris fines, which because of their small size might not settle. The amount of coating debris fines that can be generated in the AP1000 by a LOCA jet will be limited to less than 70 pounds for DECL and DEDVI LOCAs. In evaluating this limit, a ZOI of 4 IDs for epoxy and 10 IDs for inorganic zinc will be used. A DEHL LOCA could generate more coating debris however with the small amount of fiber available in the AP1000 following a LOCA, the additional coating debris fines that may be generated in a DEHL LOCA is not limiting.
   - The total resident and ZOI coating debris that are available for transport following a LOCA are $\leq$ 193.4 pounds of particulate and $\leq$ 6.6 pounds of fiber. The percentage of debris that could be transported to the screens or to that core is:

2. APP-GW-GLR-079, will be updated to describe the post-LOCA debris loading of 70 lbm for the limiting double-ended cold leg LOCA. The report will also be updated to discuss how the existing AP1000 screen and single fuel assembly head loss testing results remain valid with this increase in post-LOCA coatings debris.

2.3.2 Coatings Inside the LOCA Zone of Influence (ZOI)

For current operating PWRs, coatings composed of IOZ within a sphere of a radius equal to 10 inside diameters (ID) of the broken pipe will fail as fines (small particles) and as a result will be transported in the recirculating water along with the latent debris. Also, epoxy coatings within a sphere of radius equal to 4 ID of the broken pipe will be assumed to fail as fines and add to the total debris transported by the recirculating water. These same assumptions are applied to the AP1000. Using those assumptions, the quantity of LOCA-generated coatings debris for the AP1000 was determined based on AP1000 specific materials and surface areas located within the ZOIs..

- With an epoxy coating thickness of [ ]^{a,c} mils and a dry film density of [ ]^{a,c}, there would be about [ ] lbm of epoxy debris from the limiting break of a cold leg (CL) pipe which has an ID of 22 inches.

- The amount of AP1000 IOZ debris was also determined. The amount of post-LOCA IOZ debris is [ ]^{a,c} lbm for the limiting DECL LOCA. This result is consistent with the AP1000 limitations on the use of IOZ which, except for the containment vessel, only allow its use on hot surfaces of components where epoxy coatings are not practical.

- The total amount of coating debris inside the ZOI for the limiting DECL break is selected to be 70 lbm including margin.

The limit of 70 lbm of LOCA-generated coatings debris is applicable for DECL and DEDVI LOCAs. The LOCA-generated coatings debris load for a DEHL LOCA could be larger, upwards of [ ]^{a,c} lbm. Since a DEHL LOCA has been shown to not be limiting for the AP1000, the coatings debris loading of 70 lbm that was established for DECL and DEDVI LOCAs will be utilized as a basis in subsequent GSI-191 evaluations. An explanation why the DEHL LOCA is not limiting for AP1000 GSI-191 is discussed in Section 3.3.3. A more detailed discussion of the application of the coatings debris load is discusses in the sections on screen head loss testing (Section 5.1) and fuel assembly head loss testing (Section-6.1).

2.5 Summary of Debris

The latent debris and post-LOCA debris loadings for the AP1000 design are as follows:

- 130 lbm total latent debris.
  - 6.6 lbm of latent debris is fiber.
  - 123.4 lbm of latent debris is particulate.
- LOCA-generated debris:
  - 70 lbm LOCA-generated coatings debris.
  - 57 lbm of post-LOCA chemical precipitates.

3.4 SUMMARY OF DEBRIS TRANSPORT

Based on the previous discussions, Table 3 4 shows the latent debris amounts for the AP1000 for the case in which maximum debris is transported to the core. This table lists the total amounts of debris and how much is transported. This table is based on the limiting LOCA case, a DECL LOCA. The total latent debris in containment is assumed to be [

]^{a,c}

a,c

Table 3-4: AP1000 Debris Summary

5.1.2 Screen Head Loss Testing

Two tests are identified as design basis tests for the AP1000 CR and IRWST screens. Surrogate particulate debris was first introduced to the test flume, followed by the introduction of fiberglass fibers as surrogate fibrous debris. The chemical surrogate was mixed outside of the flume and added to the flume water following the method approved in WCAP-16530-NP-A (Reference 6) for chemical particulate generation for the design basis tests. Negligible pressure drop was observed with these two design basis tests, thus demonstrating acceptable head loss performance for the hydraulic and debris loading conditions for the design basis debris load.

The screen testing for the AP1000 showed that there was no fiber bed formation. This conclusion is based on there being no pressure drop (DP) increase resulting from the addition of debris to the screens. Since there was no fiber bed formation, a small increase in the amount of particles will not impact the screen DP. Therefore the assumption that 70 lbm of the particulate debris load is LOCA-generated coatings debris remains valid. This coatings debris load is applicable to DECL and DEDVI LOCAs. The particle loading [ ]^{a,c} in the two design basis tests was about twice the current licensing limit of 193.4 lbm particles (123.4 lbm latent particles and 70 lbm coatings debris). The margin on the particle debris load [ ]^{a,c} used in these tests also bounds additional coatings debris particles from a DEHL LOCA. No additional screen testing is needed to account for the increase in the coatings debris loading (an approximate [ ]^{a,c} lbm of additional particles) that could be generated from a DEHL LOCA.

6.1.2 Fuel Assembly Testing Summary of Results

Based upon the test results, one test was selected as the limiting test for DEDVI and DECL LOCAs. The test procedure of the limiting test was used as a basis for further testing. The further testing included several repeat tests, tests with an increased water temperature and other chemicals [ ]^{a,c}, and several tests simulating DEHL LOCA conditions. These additional tests demonstrated that the limiting test was indeed limiting for the AP1000. The DEHL tests demonstrated that [

]^{a,c}

The FA head loss testing included an extra 20 lbm of particles, above the previously estimated 50 lbm from LOCA-generated coatings debris. Sensitivity tests performed during the AP1000 FA testing program determined that the limiting DP across the FA was caused with fewer particles in the recirculating water. Therefore the assumption that 70 lbm of the particulate debris load is LOCA-generated coatings debris remains valid. This coatings debris load is applicable to DECL and DEDVI LOCAs. No additional testing is needed to account for the increase in the coatings debris loading that could be generated from a DEHL LOCA. FA testing for a DEHL break has shown that debris transported into the core through the flooded HL break [

]^{a,c}

8 SUMMARY OF RESULTS

a,c

Table 8-1: AP1000 Debris Characterization Summary	

9 REFERENCES

31. APP-PXS-M3C-013, Revision 0, Post LOCA Coatings Debris from Zone of Influence, May 2010.

3. WCAP-16914-P, Table 5-2, will be updated to state the design basis particulate debris loading is now 193.4 lbm. This contains the 70 lbm of post-LOCA coatings debris for a DECL LOCA.

Table 5-2 AP1000 CR and IRWST Screen Loadings vs Test Screen Loadings a,c

4. WCAP-17028-P will be revised to update debris loadings based upon the post-LOCA coatings debris loading increase to 70 lbm for the limiting DECL LOCA.

4.1 COMPONENTS USED IN HEAD-LOSS TESTING

Debris Loads

The AP1000 licensing basis fibrous, particulate, and chemical debris loads that could be transported into the reactor vessel and possibly reach the fuel assemblies, are presented in Table 4-2. These debris loads are based on a total debris load of 200 pounds and a chemical debris load of 57 pounds (Reference 5). Of the 200 pounds of debris, no more than 6.6 pounds may be fiber. The chemical debris load is based on the type and quantity of chemical precipitates which may form in the post-LOCA recirculation fluid for the AP1000 design as reported in Reference 5. It is conservatively assumed that 90% of the fiber, 100% of the particulate, and 100% of the chemical debris is transported to the core in the licensing basis scenario for a cold-leg break case.

Table 4-2 AP1000 Licensing Basis Latent Debris Load	
Totals in Containment, Particulate	193.4 lb (87.72 kg)
Fiber	6.6 lb (2.99 kg)
Chemical	57.0 lb (25.85 kg)
Transported to Core, Particulate (100%)	193.4 lb (87.72 kg)
Fiber (90%)	5.94 lb (2.69 kg)
Chemical (100%)	57.0 lb (25.85 kg)

Table 6-1 Original vs. Current AP1000 Post-LOCA Debris Load Design Basis

a,c

9.1.3 Debris Quantities

Ultimately, a plant design limit of [

]^{a,c}

For a hot-leg break scenario, it was assumed that [

]^{a,c}

The maximum limits for particles and chemicals were developed from the AP1000 design characteristics and not from the FA tests. It was assumed that [
]^{a,c}

The plant design limit for particulate is [
]^{a,c} All of this particulate was assumed to transport into the RCS. [
]^{a,c} of particles used in CIBAP22 through CIBAP26 FA tests. [
]^{a,c} Several lower particulate to fiber loading ratios were tested to determine the most limiting ratio for AP1000 FA testing. Test CIBAP27 was performed with a basis of [
]^{a,c} Test CIBAP28 was performed with a basis of [
]^{a,c} The [ ]^{a,c} particulate to fiber ratio proved to be most limiting and was used through the rest of the tests. Tests CIBAP29 through CIBAP34, CIBAP36, CIBAP37, and CIBAP39 were all performed with this most limiting particulate to fiber ratio, using [
]^{a,c}