Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

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

Direct tel: 412-374-6306
Direct fax: 412-374-5005
e-mail: sterdia@westinghouse.com

Your ref: Project Number 740
Our ref: DCP/NRC1978

August 21, 2007

Subject: AP1000 COL Response to Request for Additional Information (TR #12)

In support of Combined License application pre-application activities, Westinghouse is submitting a response to NRC request for additional information (RAI) on AP1000 Standard Combined License Technical Report 12, APP-GW-GLR-035, Rev. 0, Consistency of Reactor Vessel Internals Core Support Structure Materials Relative to Known Issues of Irradiated-Assisted Stress Corrosion Cracking (IASCC) and Void Swelling for the AP1000 Plant. This RAI response is submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The response is provided for request for additional information RAI-TR12-CVIB-01. This response completes all requests received to date for Technical Report 12.

Pursuant to 10 CFR 50.30(b), the response to request for additional information on Technical Report 12 is submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of these responses 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,

Mont D Bartley FOR

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

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NRO

/Attachment

1. "Oath of Affirmation," dated August 21, 2007

/Enclosure

1. Response to Request for Additional Information on Technical Report No. 12

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	S. Adams	-	Westinghouse	1E	1A
	G. Curtis	-	TVA	1E	1A
	P. Grendys	-	Westinghouse	1E	1A
	P. Hastings	-	Duke Power	1E	1A
	C. Ionescu	-	Progress Energy	1E	1A
	D. Lindgren	-	Westinghouse	1E	1A
	A. Monroe	-	SCANA	1E	1A
	M. Moran	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	D. Forsyth	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)
NuStart Bellefonte COL Project	)
NRC Project Number 740	)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR COL APPLICATION PRE-APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 21st day
of August 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Notary Public

ENCLOSURE 1

Response to Request for Additional Information on Technical Report No. 12

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR12-CVIB-01
Revision: 0

Question:
Section 4 of WCAP-16620-P states that the reactor vessel internal (RVI) core support structures were evaluated for irradiation-induced void swelling through criteria developed by the Electric Power Research Institute (EPRI). It has been previously established that these criteria are taken from EPRI technical report MRP-175. Based on Section 4 of WCAP-16620-P and your previous response to the request for additional information (RAI) on this topic (RAI-TR12-9), it appears that your interpretation of the void swelling criteria from MRP-175 is as follows:

(1) If the structural temperature for a component equals or exceeds 608 °F during normal operation and the end-of-life (EOL) fluence for that component equals or exceeds 20 displacements per atom (dpa), then void swelling has a potential to occur.
(2) For components where either structural temperature or fluence (or both) do not meet or exceed the above threshold levels from MRP-175, void swelling is not a significant concern.

While the staff agrees with interpretation (1) as stated above, the staff finds that WCAP-16620-P is mistaken in its interpretation of how the void swelling criteria should be applied for components with either temperature or fluence greater than or equal to the above threshold levels for void swelling from MRP-175. The staff's position is that void swelling may be a potential concern if one, but not both, of the above parameters meets or exceeds its threshold. This position is justified because of the hypothetical situation where one of the parameters is significantly greater than the threshold and the other is only marginally less. If such a situation were to occur (for instance, fluence equal to 30 dpa and peak structural temperature equal to 607.9 °F) the staff would find it unacceptable to dismiss the possibility of void swelling in the component just because only one the two thresholds has been exceeded.

While none of the AP1000 RVI core support structure components have both a structural temperature and EOL fluence greater than or equal to the void swelling threshold levels from MRP-175, the staff finds that a number of these components do exceed one of these two threshold levels. The RVI components listed in the table below are designated in WCAP-16620-P as having either an estimated structural temperature greater than the 608 °F threshold or an EOL fluence greater than the 20 dpa threshold from MRP-175. Given that these components exceed one of the two thresholds for void swelling from MRP-175, please justify why each component need not be considered susceptible to void swelling. It is not sufficient to indicate that void swelling is not an issue simply because only one the two parameters meets/exceeds its threshold. This justification must account for the material condition of the component with respect to the onset of void swelling at these temperature and fluence levels.

Westinghouse Response:

Section 4 of WCAP 16620-P defines screening criteria used to identify AP1000 reactor vessel internals structural components potentially subject to void swelling. The criteria used reflect the fact that swelling is known to be a strong function of both temperature and high-energy neutron exposure (expressed in units of dpa). Components operating at temperatures in excess of 608°F and 20 dpa were judged to be potentially subject to void swelling. Nine of the twenty-three structural components identified in WCAP 16620-P have operating temperatures above 608°F (Table 2-3). However the end-of-life neutron exposures (Table 2-2) for these nine components were all less than 20 dpa. In fact, the only structural component with an end-of-life neutron exposure greater than 20 dpa is the core barrel inner wall, which operates at a temperature of 558°F. Therefore the report concluded that there were no structural components with potential swelling concerns.

The Request for Additional Information (RAI) issued by the NRC suggests that swelling may be of concern in components that exceed either the temperature or the fluence thresholds. This interpretation would identify potential swelling concerns in the nine structural components with temperatures greater than 608°F and the core barrel inner wall. The RAI argues that components that exceed one of the screening threshold by a large margin and approach (but do not exceed) the other should also be considered.

In response to the RAI, Westinghouse has examined the ten components identified by the NRC as exceeding one of the two screening threshold values. The Westinghouse analysis, as described below, concludes that there are no significant swelling concerns in these ten items and that the original conclusion that there are no structural components with potential swelling concerns is unchanged.

First it should be noted that none of the ten components in question meets the hypothetical situation proposed by the NRC where "one parameter is significantly greater than the threshold and the other is only marginally less". The highest fluence in any of the components with temperatures greater than 608°F is 1.5 dpa in the upper core plate (UCP) center region. This fluence is well below the threshold value of 20 dpa. The end-of-life fluence at the core barrel inner wall is 24.8 dpa (only marginally above the threshold value of 20 dpa) while the operating temperature of 558°F is well below the threshold.

The conditions listed for the ten structural components listed in the RAI are unlikely to result in significant void swelling. The EPRI report referenced in the WCAP suggests the following swelling equation for Type 304 stainless steel:

$\%\Delta V/V = A(\text{dpa rate}/10\text{-}7)\text{-}0.731(\text{dpa})2$

where $A = \exp(22.106 - (18558/(T+273)))$

Evaluation of the equation requires the following three terms:

dpa: the number of displacements per atom
dpa rate: the number of dpa/second
T: temperature (°C)

The dpa rate may be estimated that the total end-of-life operating time for AP1000 corresponding to 54 EFPY is 1.703x109 seconds (54years* 3.15x107 seconds/year).

Application of this swelling equation to the dpa and temperature values listed in Tables 2.2 and 2.3 of WCAP 16620-P indicate that the predicted end-of-life swelling is less than 0.1% in all ten of the components in question. These extremely low end-of-life projected swelling levels demonstrate that there are no significant swelling concerns for the ten components identified in the RAI. For the purpose of identifying potential swelling issues in the AP1000 structural components, the screening process as applied in WCAP-16620-P is adequate.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None