Westinghouse

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Your ref: Project Number 740
Our ref: DCP/NRC1923

June 7, 2007

Subject: AP1000 COL Response to Request for Additional Information (TR #35)

In support of Combined License application pre-application activities, Westinghouse is submitting responses to NRC requests for additional information (RAI) on AP1000 Standard Combined License Technical Report 35, APP-GW-GLN-010, Rev. 0, AP1000 Steam Generator Description Changes. These RAI responses are submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

The responses are provided for Requests for additional information TR35-1, TR35-2, and TR35-3, transmitted in NRC letter dated April 19, 2007 from Steven D. Bloom to Andrea Sterdis, Subject: Westinghouse AP1000 Combined License (COL) Pre-application Technical Report 35 – Request for Additional Information (TAC NO. MD3727).

Pursuant to 10 CFR 50.30(b), the responses to requests for additional information on Technical Report 35 are submitted as Enclosure 1 under the attached Oath of Affirmation.

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,

D. F. Hutchings for

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

D079
NRO

/Attachment

1. "Oath of Affirmation," dated June 7, 2007

/Enclosure

1. Response to Requests for Additional Information on Technical Report No. 35

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	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
	M. Laubach	-	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

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 7th day
of June 2007.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Debra McCarthy, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Aug. 31, 2009
Member, Pennsylvania Association of Notaries

Debra McCarthy
Notary Public

ENCLOSURE 1

Responses to Request for Additional Information on Technical Report No. 35

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR35-001
Revision: 0

Question:

On page 3 of your technical report, you stated that although you intend to achieve full depth expansion in the tubesheet, you plan to remove the requirement of achieving this by hydraulic expansion. Residual stresses resulting from the expansion method will affect the susceptibility of the tubes to develop degradation (e.g., stress corrosion cracking). As currently proposed, there is no mention of the expansion method to be employed nor the criteria to be used for selecting this method. Please discuss how the expansion method will be chosen and your plans to incorporate such information in the design control document (DCD).

In addition, in Section 5.4.2.2 of Revision 15 of the mark-up, you stated: *"Residual stresses smaller than from other expansion methods result from this process…"* Since as currently proposed there is no expansion method specified, please discuss your plans to modify this sentence.

Westinghouse Response:

The intent of the change is to remove potentially misleading wording from the DCD. Westinghouse's expansion process utilized on recent replacement steam generators begins with a non-hydraulic 'tack' expansion to hold the tubes in place during welding of the tubes to the tubesheet. Once welding is complete Westinghouse has expanded the tube hydraulically from the primary surface to the secondary surface. Hydraulic expansion provides the best residual stress profile of all currently known processes, most importantly at the secondary face of the tubesheet. However, inherent to the hydraulic expansion process, a small crevice remains at the secondary side of the tubesheet. Westinghouse and SG fabricators strive to minimize this crevice, but it can not be eliminated.

However, some recent non-Westinghouse replacement steam generators in the US utilized a slightly different hydraulic expansion process. Whereas Westinghouse hydraulically expanded from the primary to the secondary face of the tubesheet, some fabricators hydraulically expand only from the tack expansion to the secondary face of the tubesheet. The fabricators then mechanically expand the short distance, approximately 1 to 2 inches, from the primary face to the hydraulically expanded section. Initial reports provided to Westinghouse indicate that similar residual stress levels result from this process. This process still utilizes hydraulic expansion for the majority of the tubesheet thickness and, most importantly, at the tubesheet secondary surface.

Westinghouse does not wish to preclude slight variances of the hydraulic expansion process as used by different fabricators. Westinghouse is willing to consider minor variances from each fabricator if they provide extensive and thorough test data showing acceptable residual stresses in the tubes. The wording in this section was proposed to be changed to permit future consideration of these minor variations.

The sentence starting, "Residual stresses smaller than from other expansion methods...," should have been modified as well. "Residual stresses shall be minimized through the expansion process and by tight control of the pre-expansion clearance between the tube and tubesheet hole."

Reference:

None

Design Control Document (DCD) Revision:

Section 5.4.2.2 (*Ninth Paragraph*)
The tubes are fabricated of nickel-chromium-iron Alloy 690. The tubes undergo thermal treatment following tube-forming operations. The tubes are tack-expanded, welded, and ~~hydraulically~~ expanded over the full depth of the tubesheet. ~~Westinghouse has used this practice in F-type steam generators. It~~Full Depth expansion was selected because of its capability to minimize secondary water access to the tube-to-tube-sheet crevice. ~~Residual stresses smaller than from other expansion methods result from this process and are minimized by tight control of the pre-expansion clearance between the tube and tubesheet hole.~~ Residual stresses shall be minimized through the expansion process and by tight control of the pre-expansion clearance between the tube and tubesheet hole.

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR35-002
Revision: 0

Question:

On page 3 of your technical report, you stated that in order to accommodate the 20-inch separator arrangement, the wrapper and feedwater ring configurations also change and that the design change is shown in the revised Figure 5.4-2. Looking at the revised Figure 5.4-2, it is not clear what the changes were to the configuration of these components. Please discuss the configuration changes made to the wrapper and feedwater ring as a result of increasing the moisture separators from 7 to 20-inches. Discuss any technical considerations in making these changes.

Westinghouse Response:

The most significant change is the shift in feedwater ring location from the area between the SG shell and the outermost primary separators, to a location amongst the primary separators. Each of these configurations represents the typical practice for SGs with the corresponding type of primary separator; the 7-inch separators are most efficiently packed closely together, leaving no room for the feedring except at the periphery, whereas the larger 20-inch separators must be further apart from one another (to operate as tested in prototypical laboratory tests and operating plants), thus creating an interior annulus where the feedring can be positioned.

An additional technical benefit realized in this change can be seen in comparing "Section B-B" of the "Current Figure" to "Section CC" of the "Revised Figure." Note that for the previous design, a section of the upper wrapper was blocked off to allow for the upward-sloping portion of the feedring and a reducing tee to be located at the periphery. In the updated design, the upward-sloping section (intended to mitigate thermal stratification and help to prevent water hammer events) and the tee are located in the natural gaps between the 20-inch primary separators, allowing the wrapper and lower deck plate to extend to their full diameter at the feedwater nozzle location, except for a small section notched out for the feedwater nozzle. The benefits of this configuration are (1) to make more complete use of the volume available for primary separators, and (2) to more evenly distribute the steam/water flow entering the primary separators from the tube bundle.

A final benefit of moving the feedwater ring inwards from the shell is that the top-mounted J-nozzles (which were necessary to direct the feedwater flow downwards such that it would not impinge directly on the adjacent SG shell) can be replaced with top-mounted debris-filtering spray nozzles, which help to prevent the ingress of loose parts into the steam generator from the feedwater system. This configuration is standard practice for inclusion on recent Westinghouse replacement steam generators.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR35-003
Revision: 0

Question:

On page 3 of your technical report (Section 5.4.2.4.1), you stated that the phrase *"...and some primary separator parts"* will be removed from the list of items that will be fabricated from nickel-chromium-iron alloys. The staff notes that on page 9 of the report, the 2nd bullet implies that low alloy steel will be used and the chromium content will be selected so as to limit the likelihood/potential for erosion/corrosion. The staff also notes that there is operating experience in which erosion/corrosion has been observed in moisture separators of current operating plants. Please discuss your plans to incorporate (into the DCD) the materials to be used for the primary separator parts exposed to high velocities that could result in erosion/corrosion and any criteria to be used in selecting those materials.

Westinghouse Response:

As the primary separators are not part of the pressure boundary, Westinghouse believes it is not necessary to include non-safety related materials design detail in the DCD. The appropriate location for any general details is in the steam generator design specification, and any specific details will be called out in the appropriate design drawings. In response to the concern about the primary separator materials, both carbon and low alloy steels will be used. Any component that lies in a region of high fluid velocity, e.g., the primary risers and the mid-deck plate, will be fabricated from a low alloy steel. Both the risers and the mid-deck plate are fabricated from ASTM A517 Grade B, which contains 0.40 – 0.65 % chromium. As chromium content is the major indicator of corrosion/erosion resistance, WEC feels that this chromium content will be appropriate in these locations to ensure there is not a significant material loss. Additionally, research has shown evidence that as little as 0.1% Cr content will significantly increase a material's resistance to corrosion/erosion (References 1-3). These materials are consistent with, and have been proven through their use in the Westinghouse-designed replacement steam generators.

References:

1. R.B. Dooley, V.K. Chexal., "Flow-Accelerated Corrosion of Pressure Vessels in Fossil Plants." International Journal of Pressure Vessels and Piping, 2000, pg 85-90.
2. C. Hales, K.J. Stevens, P.L. Daniel, M. Zamanzadeh, A.D. Owens., "Boiler Feedwater Pipe Failure by Flow-Assisted Chelant Corrosion." September, 2000.
3. P.J. King, J.M. Jevec, R.H. Pelger, F.H. Hua., "Flow-Accelerated Corrosion (FAC) of Carbon and Low Alloy Steels at Nuclear Steam Generator Temperatures." 11th Int. Conf. Environmental Degradation of Materials in Nuclear Systems, Stevenson, WA, Aug.10-14, 2003.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None