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Your ref: Docket No. 52-006
Our ref: DCP/NRC1687

March 23, 2004

SUBJECT: Transmittal of Revised Responses to AP1000 DSER Open Items

This letter transmits Westinghouse revised responses for Open Items in the AP1000 Design Safety Evaluation Report (DSER). A list of the revised DSER Open Item responses transmitted with this letter is Attachment 1. The non-proprietary responses are transmitted as Attachment 2.

Please contact me at 412-374-4728 if you have any questions concerning this submittal.

Very truly yours,

R. P. Vijuk

R. P. Vijuk, Manager
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/Attachments

1. List of the AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses transmitted with letter DCP/NRC1687
2. Non-Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated March 23, 2004

D063

DCP/NRC1687
Docket No. 52-006

March 23, 2004

Attachment 1

List of

Non-Proprietary Responses

Table 1 "List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1687"	
4.5.1-1 Rev. 2 5.2.3-2 Rev. 3	

DCP/NRC1687
Docket No. 52-006

March 23, 2004

Attachment 2

AP1000 Design Certification Review
Draft Safety Evaluation Report Open Item Non-Proprietary Responses

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 4.5.1-1 Response Revision 2

Original RAI Number(s): 252.001

Summary of Issue:

The recent experience with VHP nozzle cracking has identified the need for baseline inspection data to determine if an indication is service-induced cracking, or an artifact from fabrication. The staff requested information on what preservice examinations will be performed on the VHP nozzles. In a letter dated April 7, 2003, the applicant responded that preservice examinations for the closure head will include a baseline top-of-the head visual examination, ultrasonic examinations of the inside diameter surface of each vessel head penetration, eddy current examination of the surface of the head penetration welds and the inside diameter surface of the penetrations, and post-hydro liquid penetrant examinations of accessible surfaces that have undergone preservice inspection eddy current examinations. Any indications exceeding the ASME Code Section III requirements would be removed. The information in the RAI response has been provided in DCD Tier 2 Section 5.3.4.7. The information on preservice examinations also needs to be addressed by a COL applicant, and should be reflected in DCD Tier 2 Section 5.3.6, "Combined License Information." This is identified as Open Item 4.5.1-1 and COL Action Item 4.5.1-1.

Westinghouse Response:

The Combined License applicant commitment to specific preservice examinations of the reactor vessel closure head will be added to the existing commitment in DCD section 5.2.6.2 for the Combined License applicant to provide a plant specific preservice inspection program.

Design Control Document (DCD) Revision:

From DCD Revision 5, page 5.2-32:

5.2.6 Combined License Information Items

5.2.6.1 ASME Code and Addenda

The Combined License applicant will address in its application the portions of later ASME Code editions and addenda to be used to construct components that will require NRC staff review and approval. The Combined License applicant will address consistency of the design with the construction practices (including inspection and examination methods) of the later ASME Code edition and addenda added as part of the Combined License application. The Combined License applicant will address the addition of ASME code cases approved subsequent to design certification.

5.2.6.2 Plant Specific Inspection Program

The Combined License applicant will provide a plant-specific preservice inspection and inservice inspection program. The program will address reference to the edition and addenda of the ASME Code Section XI used for selecting components subject to examination, a description of the components exempt from examination by the applicable code, and drawings or other descriptive information used for the examination.

The preservice inspection program will include examinations of the reactor vessel closure head equivalent to those outlined in DCD section 5.3.4.7.

PRA Revision:

None

NRC Comment from 12/17/03 Status meeting:

Issue: It is not clear if the entire volume of the nozzle is subject to preservice examination. Likewise, it is not clear how much of the outside and inside diameter surfaces will be subject to eddy current examination. Please clarify.

Westinghouse Response (Revision 1):

USNRC Order EA-03-009 currently specifies:

a) *"Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle), AND*

b) *Either:*

  i. *Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two (2) inches above the J-groove weld to the bottom of the nozzle and an assessment to determine if leakage has occurred in the interference fit zone, OR*

  ii. *Eddy current or dye penetrant testing of the wetted surface of each J-groove weld and RPV head penetration nozzle base material to at least two (2) inches above the J-groove weld.*

The preservice examination program proposed for the AP1000 reactor vessel head penetrations will use a combination of examination techniques to provide coverage which meets or exceeds the requirements of the Order.

For the control rod drive mechanisms (CRDM), preservice ultrasonic examination coverage will include the entire volume of each penetration nozzle from an elevation at least two inches above the J-groove attachment weld to an elevation just above the thread relief on the ID surface of the nozzle. This scan plan will provide volumetric coverage of each penetration nozzle to at least one inch below the J-groove attachment weld.

Preservice eddy current coverage on the OD surfaces of the CRDMs will include the entire J-groove weld and the entire penetration nozzle OD surface from the elevation of the J-groove weld to the bottom of the tube.

For the incore instrumentation (ICI) penetration nozzles, preservice ultrasonic examination coverage will include the entire volume of each penetration nozzle from an elevation at least two inches above the J-groove attachment weld to an elevation at least one inch below the J-groove attachment weld.

Preservice eddy current coverage on the OD surfaces of the incore instrumentation (ICI) penetration nozzles will include the entire J-groove weld and the entire penetration nozzle OD surface from the elevation of the J-groove weld to an elevation two inches from the bottom of the tube.

NRC Comment from 1/16/04 electronic mail:

In revision 8 to the AP1000 design control document (DCD), Westinghouse made changes to the combined license information in DCD Tier 2, Section 5.6.2 to address NRC staff issues with the plant-specific inspection program. The NRC staff has reviewed these changes and believes that additional information should be included in the combined license information item for DCD Tier 2, Section 5.2.6.2 similar to that included in italics below. Westinghouse should consider this language and modify their DCD as appropriate.

5.2.6.2 Plant Specific Inspection Program

The Combined License applicant will provide a plant-specific preservice inspection and inservice inspection program. The program will address reference to the edition and addenda of the ASME Code, Section XI used for selecting components subject to examination, a description of the components exempt from examination by the applicable code, and drawings or other descriptive information used for the examination.

The preservice inspection program will include examinations of the reactor vessel closure head equivalent to those outlined in DCD section 5.3.4.7.

The inservice inspection program will address the susceptibility calculations, inspection categorization, inspections of the reactor vessel closure head, and associated reports and notifications as defined in NRC Order EA-03-009, "Interim Inspection Requirements for Reactor Vessel Heads at PWRs" *or NRC requirements that may supercede the Order.*

The COL applicant will identify any areas of inspection required by Order EA-03-009, or required by subsequent NRC requirements that may supercede the Order, that the applicant will be unable to perform or choose to perform an alternate. The applicant will submit to the NRC for review and approval a description of the proposed inspections to be performed, a description *of any differences from the applicable NRC requirements, and an assessment of the acceptability of the inspection the applicant proposes to perform to address NRC requirements.*

Westinghouse Response (Revision 2):

DCD section 5.2.6 will be revised as shown below.

Design Control Document (DCD) Revision:

5.2.6 Combined License Information Items

5.2.6.1 ASME Code and Addenda

The Combined License applicant will address in its application the portions of later ASME Code editions and addenda to be used to construct components that will require NRC staff review and approval. The Combined License applicant will address consistency of the design with the construction practices (including inspection and examination methods) of the later ASME Code edition and addenda added as part of the Combined License application. The Combined License applicant will address the addition of ASME code cases approved subsequent to design certification.

5.2.6.2 Plant Specific Inspection Program

The Combined License applicant will provide a plant-specific preservice inspection and inservice inspection program. The program will address reference to the edition and addenda of the ASME Code Section XI used for selecting components subject to examination, a description of the components exempt from examination by the applicable code, and drawings or other descriptive information used for the examination.

The preservice inspection program will include examinations of the reactor vessel closure head equivalent to those outlined in DCD section 5.3.4.7.

The inservice inspection program will address the susceptibility calculations, inspection categorization, inspections of the reactor vessel closure head, and associated reports and notifications as defined in NRC Order EA-03-009, "Interim Inspection Requirements for Reactor Vessel Heads at PWRs" or NRC requirements that may supercede the Order.
The COL applicant will identify any areas of inspection required by NRC Order EA-03-009, or required by subsequent NRC requirements that may supercede the Order, that the applicant will be unable to perform or choose to perform an alternate. The applicant will submit to the NRC for review and approval a description of the proposed inspections to be performed, a description of any differences from the applicable NRC requirements, and an assessment of the acceptability of the inspection the applicant proposes to perform to address NRC requirements.

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: **5.2.3-2 Response Revision 3**

Original RAI Number(s): **None**

NRC comment from 12/17/03 Open Item status meeting:

The discussion in DCD subsection 5.2.3.1 about J-groove welds of penetrations should be broadened so that stainless steel penetrations are included as well as Alloy 690 penetrations.

NRC comment from 1/16/04 electronic mail:

On 1/13/04 Westinghouse informally provided a proposed revision to DCD Tier 2, Section 5.2.3.1, Materials Specification, and to DCD Tier 2, Table 5.2-1. The staff has the following questions/comments on these proposed revisions:

1. Table 5.2-1 does not include the type of low alloy steel welding materials and their corresponding American Welding Society (AWS) Specifications, for welding RPV, Pressurizer and Steam Generator components.

2. Paragraph 5.2.3.1:

    A. The weld filler material AWS specifications SFA 5.1, 5.2, 5.5, 5.17, 5.18 and 5.20 are applicable for carbon steel welds. Table 5.2-1 does not include any carbon steel materials. Please provide an explanation.

    B. Welding material specification SFA 5.2 applies to oxyfuel gas welding. The staff is not aware of this process being used in the nuclear industry. Please provide an explanation for utilizing this process on reactor coolant pressure boundary welds.

C. Welding material specification SFA 5.20 applies to Flux Cored Arc Welding (FCAW) process. This process can be used without an external shielding gas. Previous experience indicated that this type of process without an external shielding gas can yield lower toughness values in the weld metal. The staff would like to know if Westinghouse intends to use this process on reactor coolant pressure boundary welds.

Westinghouse Response (Revision 3):

This Revision 3 response supplements previous revisions of OI 5.2.3-2 response. AP1000 DCD subsection 5.2.3.1 and Table 5.2-1 will be revised as shown below.

Design Control Document (DCD) Revision:

5.2.3.1 Materials Specifications

Table 5.2-1 lists material specifications used for the principal pressure-retaining applications in Class 1 primary components and reactor coolant system piping. Material specifications with grades, classes or types are included for the reactor vessel components, steam generator components, reactor coolant pump, pressurizer, core makeup tank, and the passive residual heat removal heat exchanger. Table 5.2-1 lists the application of nickel-chromium-iron alloys in the reactor coolant pressure boundary. The use of nickel-chromium-iron alloy in the reactor coolant pressure boundary is limited to Alloy 690, or its associated weld metals Alloys 52 and 152.~~; Alloy 600 may be used in limited areas for welding or buttering. Where Alloy 600 is used, it is not in contact with the reactor coolant.~~ Steam generator tubes use Alloy 690 in the thermally treated form. Nickel-chromium-iron alloys are used where corrosion resistance of the alloy is an important consideration and where the use of nickel-chromium-iron alloy is the choice because of the coefficient of thermal expansion. Subsection 5.4.3 defines reactor coolant piping. See subsection 4.5.2 for material specifications used for the core support structures and reactor internals. See appropriate sections for internals of other components. Engineered safeguards features materials are included in subsection 6.1.1. The nonsafety-related portion of the chemical and volume control system inside containment in contact with reactor coolant is constructed of or clad with corrosion resistant material such as Type 304 or Type 316 stainless steel or material with equivalent corrosion resistance. The materials are compatible with the reactor coolant. The nonsafety-related portion of the chemical and volume control system is not required to conform the process to requirements outlined below.

Table 5.2-1 material specifications are the materials used in the AP1000 reactor coolant pressure boundary. The materials used in the reactor coolant pressure boundary conform to the applicable ASME Code rules. Cast austenitic stainless steel does not exceed a ferrite content of 20 FN. Calculation of ferrite content is based on Hull's equivalent factors.

The welding materials used for joining the ferritic base materials of the reactor coolant pressure boundary conform to or are equivalent to ASME Material Specifications SFA 5.5, 5.23, and 5.28~~5.1, 5.2, 5.5, 5.17, 5.18, and 5.20~~. They are qualified to the requirements of the ASME Code, Section III.

The welding materials used for joining the austenitic stainless steel base materials of the reactor coolant pressure boundary conform to ASME Material Specifications SFA 5.4 and 5.9. They are qualified to the requirements of the ASME Code, Section III.

The welding materials used for joining nickel-chromium-iron alloy in similar base material combination and in dissimilar ferritic or austenitic base material combination conform to ASME Material Specifications SFA 5.11 and 5.14. They are qualified to the requirements of the ASME Code, Section III. ~~Alloy 600 may be used in limited areas but is not in contact with reactor coolant.~~

The fabrication and installation specifications for partial penetration welds with Alloy 52/152 within the ASME Class 1 reactor coolant pressure boundary require successive dye penetrant examinations after the first pass and after every one-fourth inch of weld metal. The specifications for J-groove welds that join ASME Class 1 reactor coolant pressure boundary ~~Alloy 690~~ penetrations require ultrasonic examination of the interface where the weld joins the penetration tube. The specifications for butt welds used for nozzle safe-end welds require these welds to be radiographically inspected. These weld specifications are applicable to the ASME Class 1 reactor coolant pressure boundary portions of the reactor vessel (Section 5.3), the reactor coolant pumps (subsection 5.4.1), the steam generators (subsection 5.4.2), the reactor coolant system piping (subsection 5.4.3), the pressurizer (subsection 5.4.5), the core makeup tanks (subsection 5.4.13), and the passive residual heat removal heat exchanger (subsection 5.4.14).

Table 5.2-1 (Sheet 1 of 3)

REACTOR COOLANT PRESSURE BOUNDARY MATERIALS SPECIFICATIONS

Component	Material	Class, Grade, or Type
Reactor Vessel Components		
Head plates (other than core region)	SA-533 or SA-508	GR B, CL 1 or CL 3
Shell courses	SA-508	CL 3
Shell, flange, and nozzle forgings	SA-508	CL 3
Nozzle safe ends	SA-182	F316LN
Appurtenances to the control rod drive mechanism (CRDM)	SB-167 or SA-182	TP690 or F304LN, F316LN
Instrumentation tube appurtenances, upper head	SB-167 or SA-182, SA312, SA376	TP690 or F304LN, F316LN
Closure studs	SA-540	GR B23 or GR B24, CL 3
Monitor tubes and vent pipe	SA-312 or SA-376 or SB-166, SB-167	TP304LN, TP316LN or TP690
Cladding, ~~and~~ buttering, and welds	SFA 5.4, 5.9, 5.11, and 5.14	308L, 309L, ENiCrFe-7, or ERNiCrFe-7
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Steam Generator Components		
Pressure plates	SA-533	GR B, CL 1
Pressure forgings (including nozzles and tube sheet)	SA-508	CL 3a
Nozzle safe ends	SA-182	F316LN
Channel heads	SA-508	CL 3a
Tubes	SB-163	TP690TT
Cladding, ~~and~~ buttering, and welds	SFA 5.4, 5.9, 5.11, and 5.14	308L, 309L, ENiCrFe-7, orERNiCrFe-7~~, or ERNiCr-3~~
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Manway studs/nuts	SA-193, SA-194	GR B7

Table 5.2-1 (Sheet 2 of 3)

REACTOR COOLANT PRESSURE BOUNDARY MATERIALS SPECIFICATIONS

Component	Material	Class, Grade, or Type
Pressurizer Components		
Pressure plates	SA-533	GR B, CL 1
Pressure forgings	SA-508	CL 3
Nozzle safe ends	SA-182	F316LN
Cladding, ~~and~~ buttering, and welds	SFA 5.4, 5.9, 5.11, and 5.14	308L, 309L, ENiCrFe-7, or ERNiCrFe-7~~, or ERNiCr-3~~
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Manway studs/nuts	SA-193, SA-194	GR B7
Reactor Coolant Pump		
Pressure forgings	SA-182 or SA-336	F304LN, F316LN
Pressure casting	SA-351 or SA-352	CF3A
Tube and pipe	SA-213; SA-376 or SA-312	TP304LN, TP316LN
Pressure plates	SA-240	304LN, 316LN
Closure bolting	SA-193 or SA-540	GR B7 or GR B24, CL 4
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Reactor Coolant Piping		
Reactor coolant pipe	SA-376	TP304LN, TP316LN
Reactor coolant fittings, branch nozzles	SA-376, SA-182	TP304LN, TP316LN
Surge line	SA-376	TP304LN, TP316LN
RCP piping other than loop and surge line	SA-312 and SA-376	TP304LN, TP316LN
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
CRDM		
Latch housing	SA-336	F304LN, F316LN
Rod travel housing	SA-336	F304LN, F316LN
Welding materials	SFA 5.4 or 5.9	308L, 309L

Table 5.2-1 (Sheet 3 of 3)

REACTOR COOLANT PRESSURE BOUNDARY MATERIALS SPECIFICATIONS

Component	Material	Class, Grade, or Type
Valves		
Bodies	SA-182 or SA-351	F304LN, F316LN or CF3A
Bonnets	SA-182, SA-240 or SA-351	F304LN, F316LN, 304LN, 316LN or CF3A
Discs	SA-182, SA-564 or SA-351	F304LN, F316LN or GR 630 or CF3A
Stems	SA-479 or SA-564	F316, F316LN or GR 630
Pressure retaining bolting	SA-453 or SA-564	GR 660 or GR 630
Pressure retaining nuts	SA-453 or SA-194	GR 6 or TP410
Core Makeup Tank		
Pressure plates	SA-533 or SA-240	GR B, CL 1 or 304L, 304LN, 316L, 316LN
Pressure forgings	SA-508 or SA-182, SA-336	CL 3 or F304L, F316L
Cladding, ~~and~~ buttering, and welds	SFA 5.4, 5.9, 5.11, and 5.14	308L, 309L, ENiCrFe-7, or ERNiCrFe-7~~, or ERNiCr-3~~
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Passive Residual Heat Removal Heat Exchanger		
Pressure plates	SA-240	304L, 304LN
Pressure forgings	SA-336	F304L, F304LN
Cladding, ~~and~~ buttering, and welds	SFA 5.4, 5.9, 5.11, and 5.14	308L, 309L, ENiCrFe-7, or ERNiCrFe-7~~, or ERNiCr-3~~
Pressure boundary welds	Low alloy steel	SFA 5.5, 5.23, 5.28
Tubing	SB-163	TP690