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Your ref: Docket No. 52-006
Our ref: DCP/NRC2193

July 3, 2008

Subject: AP1000 Response to Request for Additional Information (SRP4)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 4. 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 for RAI-SRP4.1-SRSB-01, RAI-SRP4.2-SRSB-02 through -06, RAI-SRP4.3-SRSB-01 and -02, and RAI-SRP4.4-SRSB-01 and -02, as sent in an email from Phyllis Clark to Sam Adams dated May 8, 2008. This response completes ten of eleven requests received to date for SRP Section 4. A response for RAI-SRP4.2-SRSB-01 is scheduled for submittal by July 11, 2008.

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,

Donald H. Dale for

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

/Enclosure

1. Response to Request for Additional Information on SRP Section 4

D063
NRO

| | | | | |
|---|---|---|---|---|
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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 4

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP4.1-SRSB-01
Revision: 0

***Question:***

Table 4.1-1, "Reactor Design Comparison Table," indicates a design change to include neutron panels in the reactor internals design. The addition of four neutron panels attached to the outside surface of the core barrel, along with the addition of a flow skirt in the lower reactor vessel head, is described in TR 29, WCAP-16716-NP, Revision 2, "AP1000 Reactor Internals Design Changes." The NRC staff previously requested that Westinghouse provide an evaluation of the impacts of these proposed changes on the analysis results of each of the transients and accidents in DCD Chapter 15. The evaluation should demonstrate either the analysis results of DCD Chapter 15 remain bounding and valid, or the effects of these changes are insignificantly small that the applicable acceptance criteria for these transients and accidents remain complied with. In its letter of January 3, 2008, Westinghouse responded to the NRC request for additional information (RAI), indicating that it will provide an evaluation to demonstrate that the reactor internals change does not significantly impact the DCD Chapter 15 analysis results, and that the evaluation will be provided as a revision to the RAI response in April 2008 time frame.

Please provide the evaluation results as indicated in your January 3, 2008, letter, if not already provided.

**Westinghouse Response:**

Westinghouse provided an evaluation of the impacts of the addition of four neutron panels attached to the outside surface of the core barrel, along with the addition of a flow skirt in the lower reactor vessel head, on the analysis results of each of the transients and accidents in DCD Chapter 15 in a revised response to RAI-TR29-SRSB-01. This revised response was submitted to the NRC on April 29, 2008 in letter DCP/NRC2128 (Accession Number: ML081260313).

**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-SRP4.2-SRSB-02
Revision: 0

***Question:***

Section 4.2.1.6.2 changes the burnable absorber rods from a Wet Annular Burnable Absorber (WABA) to a borosilicate glass design. WCAP-7113 is referenced as justification of this change, but this document does not demonstrate prior NRC approval.

(a) Please provide proof of NRC approval of the borosilicate glass design.

(b) Please provide supporting documentation that demonstrates the applicability of borosilicate glass burnable absorbers to planned AP1000 conditions, including any operational experience and any post-irradiation examination (PIE) data.

**Westinghouse Response:**

(a) WCAP-7113, "Use of Burnable Poison Rods in Westinghouse Pressurized Water Reactors," October 1967, is the specific reference consistently provided by the Westinghouse RESARs, which have been previously reviewed and approved by the NRC.

(b) WCAP-8183, "Operational Experience with Westinghouse Core," was published on an annual basis between 1973 and December 31, 1994. Section 5.2, "Burnable Absorber Assemblies," addresses the operating experience history for borosilicate glass rodlets. In the final issuance of this report (WCAP-8183, Rev. 23), one failure of a borosilicate glass rodlet was reported in 1988 in which a rodlet detached from its assembly and remained in the guide tube of a fuel assembly.

References:
1. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report"
2. RAI Response Number: RAI-TR18-SRSB-04

**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-SRP4.2-SRSB-03
Revision: 0

***Question:***

Section 4.2.1.6.2 lists multiple burnable absorber designs. Please only include the planned design for the initial core.

**Westinghouse Response:**

Chapter 4 of the DCD describes both the Pyrex (borosilicate glass) and WABA burnable absorbers, thus both design descriptions have been provided in subsection 4.2.1.6.2. Figures 4.3-4a, 4.3-4b, and 4.3-5 provide the cycle 1 core burnable absorber loading patterns which include both the PYREX and Integrated Fuel Burnable Absorber (IFBA) Rods. The reference first cycle core design described in the loading pattern includes the use of Pyrex rodlets (borosilicate glass).

While Borosilicate is identified in the reference first cycle core, the final determination on the appropriate absorber rods to be used in the first core design will be provided in the AP1000 Core Reference report.

The intent to retain the approved WABA design descriptions has previously been presented to the NRC staff. As Westinghouse continues to refine and enhance the first core design, a change to WABAs would be captured in the AP1000 Core Reference Report.

References:
1. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report"
2. RAI Response Number: RAI-TR18-SRSB-04

**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-SRP4.2-SRSB-04
Revision: 0

***Question:***

Section 4.2.2.1 deletes an erroneous reference for the Integral Fuel Burnable Absorber (IFBA) design. Please provide the correct reference instead of only removing the old reference.

**Westinghouse Response:**

The reference for the IFBA design used for the AP1000 is WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report." A reference to WCAP-12610-P-A will be added at the conclusion of the discussion. WCAP-12610-P-A is already included in subsection 4.2.6 as Reference 5.

References:
1. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995.
2. NSBU-NRC-00-5960, "Fuel Criteria Evaluation Process Notification for Axial Blanket Modifications," dated January 24, 2000.
3. RAI Response Number: RAI-TR18-SRSB-05

**Design Control Document (DCD) Revision:**

Add Reference 5 at the end of the last paragraph of subsection 4.2.2.1 as follows:

Page 4.2-11

**4.2.2.1 Fuel Rods**

The AP1000 fuel rods include integral fuel burnable absorbers. . . . The number and pattern of integral fuel burnable absorber rods within an assembly may vary depending on specific application. See WCAP-12610-P-A (Reference 5).

**PRA Revision:**
None

**Technical Report (TR) Revision:**
None

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP4.2-SRSB-05
Revision: 0

***Question:***

Revision 16 of subsection 4.2.2.3.2 changes the design of the Gray Rod Control Assemblies (GRCAs). While it is recognized that the GRCAs are used for load follow maneuvering and are not credited as a safety system, the changes in the GRCA design may have impacts on safety analyses. In particular, can the GRCA design changes result in a more limiting case than the accident analyses described in Chapter 15, such as the rod ejection accident analysis?

**Westinghouse Response:**

The GRCA design as described in Rev. 16 of the DCD yields essentially the same rod worth as the design originally described in DCD Rev. 15. In addition, the absorber material of the GRCA design described in DCD Rev. 16 is more uniformly distributed throughout the assembly compared to the design in Rev. 15, yielding smaller changes in the intra-assembly rod power distribution as the GRCA is moved in and out of the assembly. Therefore, the GRCA design changes will not result in a more limiting case than the accident analyses described in Chapter 15 of the DCD.

**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-SRP 4.2-SRSB-06
Revision: 0

***Question:***

Revision 16 of subsection 4.2.5 references APP-GW-GLR-059 (Reference 25). Reference 25 is listed as APP-GW-GLR-059, "Changes to Reference Reactor Design," and Reference 24 is listed as WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," Revision 0. However, both APP-GW-GLR-059 and WCAP-16652-NP, Revision 0, appear on the cover of the AP1000 Core & Fuel Design Technical Report, indicating they are the same report.

Clarify the inconsistencies in subsection 4.2.5 and associated references 24 and 25. The same inconsistencies exist in subsection 4.3.4 and associated references 64 and 65.

**Westinghouse Response:**

As noted in RAI-SRP 4.2-SRSB-06, both document numbers APP-GW-GLR-059 and WCAP-16652-NP are used to refer to the same document which is correctly titled "AP1000 Core & Fuel Design Technical Report." To clarify the apparent inconsistency, the document description provided in DCD Subsection 4.2.6 for Reference 24 will be revised to appropriately refer to the document as APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report" and Reference 25 will be deleted as no longer needed. The text portion of DCD Section 4.2 does not refer to Reference 25 and is therefore not affected by this change.

This change will similarly be applied to the correct the same inconsistency identified in DCD Subsection 4.3.4 for References 64 and 65.

Also, the description provided in DCD Subsection 4.4.8 for References 87 will similarly be revised to consistently refer to APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report."

Reference:

1. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report"

**Design Control Document (DCD) Revision:**

Revise Subsection 4.2.6, References, as follows:

24. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," Revision 0.

25. Reference deleted. ~~APP-GW-GLR-059, "Changes to Reference Reactor Design," Westinghouse Electric Company LLC.~~

Revise Subsection 4.3.5, References, as follows:

64. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," Revision 0.

65. Reference deleted. ~~APP-GW-GLR-059, "Changes to Reference Reactor Design," Westinghouse Electric Company LLC.~~

Revise Subsection 4.4.8, References, as follows:

87. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," Revision 0.

**PRA Revision:**

None

**Technical Report (TR) Revision:**

None

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP4.3-SRSB-01
Revision: 0

***Question:***

In Section 4.3.2.2.6, "Limiting Power Distributions," it is stated that, "the online monitoring system is not a required element for short term reactor operation".

Please discuss the proposed time frame ("short term") that the online monitoring outage is not a requirement for operation.

**Westinghouse Response:**

In the unlikely event that the Online Power Distribution Monitoring System (OPDMS) should become inoperable, reactor operation can continue with shutdown margin and power distribution controls established by bounding analyses and implemented by Technical Specification Limiting Conditions for Operations (LCOs) 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3 and 3.2.4. These LCOs become applicable immediately or as otherwise specified in the associated Technical Specification applicability statements, when the OPDMS is inoperable. In section 4.3.2.2.6 of the DCD, the phrase "short term" refers to the time needed to restore the OPDMS to operable status.

**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-SRP4.3-SRSB-02
Revision: 0

***Question:***

DCD Section 4.3.2.4.2 deleted specific temperature increase value (4°F) from the sentence that the design change in temperature is conservatively increased by 4°F to account for the control system dead band and measurement errors. TR 18 (WCAP-16652-NP, Revision 0, APP-GW-GLR-059) provided the rationale for this change.

Please explain how the dead band and measurement errors are now calculated.

**Westinghouse Response:**

The control system deadband and measurement uncertainties are accounted for in the shutdown margin control requirements calculation by assuming the moderator temperature is at its maximum possible value prior to plant trip. This conservatively increases the change in moderator temperature when going from hot full power to hot zero power after plant trip, increasing the shutdown margin control requirements.

A preliminary Tavg uncertainty was provided and used in the AP1000 analyses. This uncertainty is based on conservative engineering judgment and includes both instrument errors and deadband.

**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-SRP4.4-SRSB-01
Revision: 0

***Question:***

Revision 16 of DCD Section 4.4, Reference 87 lists WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," Revision 0, which is not referenced in the DCD Section 4.4 text. Revision 16 of DCD Subsection 4.4.7, Combined License Information remains unchanged from Revision 15, contradictory to what was shown in WCAP-16652-NP.

Please clarify the inconsistency.

**Westinghouse Response:**

As noted in the above RAI comments, the changes to DCD Subsection 4.4.7 that were included in APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report," were inadvertently missed when incorporating the revised text into DCD Revision 16.

To clarify this inconsistency, the following changes to Subsection 4.4.7 will be incorporated into a subsequent revision of the DCD. These changes will include Reference 87 in the DCD Section 4.4 text.

Also, DCD Table 1.8-2, "Summary Of AP1000 Standard Plant Combined License Information Items," will be revised consistent with the changes to Sub-section 4.4.7 to similarly reflect the completed status of COL Information Item 4.4-1 and the remaining actions for COL Information Item 4.4-2.

References:

1. APP-GW-GLR-059 / WCAP-16652-NP, "AP1000 Core & Fuel Design Technical Report"

**Design Control Document (DCD) Revision:**
Revise Subsection 4.4.7 as follows:

### 4.4.7 Combined License Information

4.4.7.1

The Combined License information requested in this subsection has been completely addressed in APP-GW-GLR-059 (Reference 87), and the applicable changes have been incorporated into the DCD. No additional work is required by the Combined License applicant to address the Combined License information requested in this subsection.

The following words represent the original Combined License Information Item commitment, which has been addressed as discussed above:

> Combined License applicants referencing the AP1000 certified design will address changes to the reference design of the fuel, burnable absorber rods, rod cluster control assemblies, or initial core design from that presented in the DCD.

4.4.7.2

Following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters as discussed in subsection 7.1.6, and prior to fuel load, the Combined License holder ~~applicants~~ will calculate the design limit DNBR values. The calculations will be completed using the RTDP with these instrumentation uncertainties and confirm that either the design limit DNBR values as described in Section 4.4, "Thermal and Hydraulic Design," remain valid, or that the safety analysis minimum DNBR bounds the new design limit DNBR values plus DNBR penalties, such as rod bow penalty.

Revise Table 1.8-2 COL Information Items No. 4.4-1 and 4.4-2 as follows:

Table 1.8-2 (Sheet 4 of 13)
**SUMMARY OF AP1000 STANDARD PLANT COMBINED LICENSE INFORMATION ITEMS**

| Item No. | Subject | Subsection | Addressed by Westinghouse Document | Action Required by COL Applicant | Action Required by COL Holder |
|---|---|---|---|---|---|
| | | | | | |
| 4.2-1 | Changes to Reference Reactor Design | 4.2.5 | APP-GW-GLR-059 | No | No |
| 4.3-1 | Changes to Reference Reactor Design | 4.3.4 | APP-GW-GLR-059<br>APP-GW-GLR-119 | No | No |
| 4.4-1 | Changes to Reference Reactor Design | 4.4.7.1 | APP-GW-GLR-059<br>~~N/A~~ | No ~~Yes~~ | No - |

| Table 1.8-2 (Sheet 5 of 13)<br>SUMMARY OF AP1000 STANDARD PLANT<br>COMBINED LICENSE INFORMATION ITEMS | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Subject** | **Subsection** | **Addressed by Westinghouse Document** | **Action Required by COL Applicant** | **Action Required by COL Holder** |
| 4.4-2 | Confirm Assumptions for Safety Analyses DNBR Limits | 4.4.7.2 | N/A | – | Yes |

**PRA Revision:**
None

**Technical Report (TR) Revision:**
None

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP4.4-SRSB-02
Revision: 0

***Question:***

DCD Subsection 4.4.7 states that "Following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters as discussed in subsection 7.1.6, Combined License applicants will calculate the design limit DNBR using the RTDP with these instrumentation uncertainties ...." In Revision 16 of DCD, subsection 7.1.6 has been revised to state that "The Combined License information requested in this subsection has been completely addressed in WCAP-16361-P (Reference 17), and .... No additional work is required by the Combined License applicant."

Please clarify the apparent inconsistency in DCD subsections 4.4.7 and 7.1.6 regarding the need for COL applicants to calculate the actual instrumentation uncertainties of the plant operating parameters.

Identify the methodology that will be used for the calculation of instrumentation uncertainties of the operating plant parameters as part of design limit DNBR calculation, and explain why this methodology is acceptable.

**Westinghouse Response:**

*Please clarify the apparent inconsistency in DCD subsections 4.4.7 and 7.1.6 regarding the need for COL applicants to calculate the actual instrumentation uncertainties of the plant operating parameters.*

As noted in the above comments, completion of the Combined License Information (COL Information Item 4.4-2) described in DCD subsection 4.4.7 is dependent upon selection of the actual plant operating instrumentation, as well as on calculation of the instrumentation uncertainties of the operating plant parameters (as discussed in subsection 7.1.6). Subsection 7.1.6 has been revised in DCD Revision 16 to include that the Combined License information requested in subsection 7.1.6.1 has been completely addressed in WCAP-16361-P, "Westinghouse Setpoint Methodology for Protection Systems – AP1000," May 2006. WCAP-16361-P documents the preliminary instrument uncertainty calculations for the Reactor Trip System (RTS) and Engineered Safeguards Features Actuation System (ESFAS) functions for the AP1000 plant. Reconciliation of the final setpoint study for each plant cannot be performed until the instruments for that plant are finalized. This report (WCAP-16361-P) is provided for submission with Combined Operating License (COL) applications, and includes typical industry uncertainty values and assumptions that reflect the AP1000 Instrumentation and Control (I&C) design, to the extent that is required to support a COL application. Prior to initial fuel load, a reconciliation of this setpoint study will be performed.

*Identify the methodology that will be used for the calculation of instrumentation uncertainties of the operating plant parameters as part of design limit DNBR calculation, and explain why this methodology is acceptable.*

The actual calculated instrumentation uncertainties will be used, when available, to recalculate the RTDP DNBR design limits. If these recalculated DNBR design limits are less than those given in DCD 4.4.1.1.2 , then the DCD values are conservatively high and will not be revised. If the calculated values are higher than the values in the DCD, then the design limits will be revised. Note that since conservatively high values of the instrumentation uncertainties were used in the calculations, we do not expect the design limits to change.

References:


1. WCAP-16361-P, "Westinghouse Setpoint Methodology for Protection Systems – AP1000," May 2006

2. WCAP-11397-P-A, "Revised Thermal Design Procedure," April 1989


**Design Control Document (DCD) Revision:**
None

**PRA Revision:**
None

**Technical Report (TR) Revision:**
None