July 19, 2007

Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RE: WESTINGHOUSE ELECTRIC COMPANY (WESTINGHOUSE) TOPICAL REPORT (TR) WCAP-16606-P, "SUPPLEMENT 2 TO BISON TOPICAL REPORT RPA-90-90-P-A" (TAC NO. MD2952)

Dear Mr. Gresham:

By letter dated August 15, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062360486), Westinghouse submitted for U.S. Nuclear Regulatory Commission (NRC) staff review TR WCAP-16606, "Supplement 2 to BISON Topical Report 90-90-P-A." Upon review of the information provided, the NRC staff has determined that additional information is needed to complete the review. This letter is to document the NRC Request for Additional Information (RAI) for this TR. You have sent responses to the RAI for this TR by letter dated May 14, 2007 (ADAMS Accession No. ML071440450). If you have any questions regarding the enclosed RAI questions, please contact me at 301-415-1119.

Sincerely,

/RA/

Jon H. Thompson, Project Manager
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700

Enclosure: RAI

cc w/encl: See next page

cc:
Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355
gordon.c.bischoff@us.westinghouse.com

Mr. James A. Gresham, Manager . . . . . July 19,2007
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RE: WESTINGHOUSE ELECTRIC COMPANY (WESTINGHOUSE) TOPICAL REPORT (TR) WCAP-16606-P, "SUPPLEMENT 2 TO BISON TOPICAL REPORT RPA-90-90-P-A" (TAC NO. MD2952)

Dear Mr. Gresham:

By letter dated August 15, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062360486), Westinghouse submitted for U.S. Nuclear Regulatory Commission (NRC) staff review TR WCAP-16606, "Supplement 2 to BISON Topical Report 90-90-P-A." Upon review of the information provided, the NRC staff has determined that additional information is needed to complete the review. This letter is to document the NRC Request Additional Information (RAI) for this TR. You have sent responses to the RAI for this TR by letter dated May 14, 2007 (ADAMS Accession No. ML071440450). If you have any questions regarding the enclosed RAI questions, please contact me at 301-415-1119.

Sincerely,

/RA/

Jon H. Thompson, Project Manager
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700
Enclosure: RAI
cc w/encl: See next page

DISTRIBUTION:

PUBLIC	RidsNrrDpr
PSPB Reading File	RidsNrrDprPspb
RidsNrrLADBaxley	RidsAcrsAcnwMailCenter
RidsNrrPMJThompson	RidsOgcMailCenter
Tech Reviewers	RidsNrrDssSnpb

ADAMS ACCESSION NO.: ML071940104 **NRR-106**

OFFICE	PSPB/PM	PSPB/LA	PSPB/BC
NAME	JThompson	CHawes forDBaxley	SRosenberg
DATE	7/17/07	7/17/07	7/19/07

OFFICIAL RECORD COPY

REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

WCAP-16606-P, "SUPPLEMENT 2 TO BISON TOPICAL REPORT RPA-90-90-P-A"

WESTINGHOUSE ELECTRIC COMPANY

PROJECT NO. 700

The report revision proposes to extend the AA78 slip/void correlation for pressures up to 12 MPa[1]. This modification was already submitted and approved by the U.S. Nuclear Regulatory Commission (NRC) in the Exelon Licensing Agreement (sic Amendment) Request, letter RS-05-78, dated June 15, 2005. This is included in the report so that it can be approved for generic application to all boiling-water reactor (BWR) plants.

References:

1. "Request for License Amendment Regarding Transition to Westinghouse Fuel," Exelon Nuclear, letter RS-05-078, dated June 15, 2005. Agencywide Documents Access and Management System (ADAMS) Accession Number ML060620352.

2. "Additional Information Supporting Request for License Amendment Regarding Transition to Westinghouse Fuel," Exelon Nuclear, letter RS-06-009, dated January 26, 2006. ADAMS Accession Number ML060620365.

3. Letter from M. Banerjee, USNRC, to C.M. Crane, President, Excelon Generation Company, LLC, "Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station, Units 1 and 2 - Issuance of Amendments Re: transition to Westinghouse Fuel and Minimum Critical Power Ratio Safety Limits (TAC No. MC7323, MC7324, MC7325 and MC7326," April 4, 2006. ADAMS Accession Number ML060970519.

4 Topical Report RPA 90-90-P-A, Rev. 0, "BISON - A One Dimensional Dynamic Analysis Code for Boiling Water Reactors," ABB Combustion Engineering Nuclear Operations, December 1991.

5. Topical Report CENPD-292-P-A, "BISON - A One Dimensional Dynamic Analysis Code for Boiling Water Reactors: Supplement 1 to Code Description and Qualification," ABB Combustion Engineering Nuclear Operations, July 1996.

6. G. S. Lellouche, B. A. Zolotar, "A Mechanistic Model for Predicting Two-Phase Void Fraction for Water in Vertical Tubes, Channels, and Rod Bundles, Electric Power Research Institute," EPRI NP-2246-SR, 1982.

[1] This value is provided in the requesting letter (LTR-NRC-06-48, August 15, 2006) and not marked as proprietary.

ENCLOSURE

7. Paul Coddington and Rafael Macian, "A Study of the Performance of Void Fraction Correlations used in the Context of Drift-Flux Two-Phase Flow Models," Nuclear Science Engineering and Design, 215 (2002) 199-216.

RAI 1:

In Ref. 1 (Attachment 7, page 10 of 32, or page 6 of the submittal), the stated verified steam quality is 20 percent less than the value presented in Ref. 2 (Attachment 1, page 28 of 46). The staff's safety evaluation (SE) (Ref. 3) does not address this inconsistency but references the responses in its SE, possibly implying the greater value. Clarify Westinghouse's position on the proposed range for the steam quality for this review.

RAI 2:

In the staff SE in Ref. 4, Westinghouse committed to provide justification for the use of the correlation if the pressure exceeds 1305 while the steam quality exceeds 40 percent, or if the pressure exceeds 1450 psia. It is also noted that this same condition was identified in the staff SE in Ref. 5. In part, this request addresses the pressure issue, however it is not clear if there is a similar pressure versus steam quality relationship inferred. Clarify is a similar relationship is inferred for this review, for example a quality-pressure limit.

RAI 3:

Figure 14-3 in Ref. 2 (Attachment 1, page 31 of 46) is supposed to be the same as Figure Q24.1 in Ref. 4, based on the plot titles (with the exception that Fig. 14-3 does not provide the specific value for DT as shown in Fig. Q24.1), with Fig 14-3 adding two additional pressure curves and broadening the steam quality range. Fig. 3-2 in the submittal a the same as Fig. 14-3. The two figures (14-3 and Q24.1) are not the same for the original three pressure curves. There is a consistent difference of more than 10 percent in the peak differentials for the pressure curves. Clarify and explain.

RAI 4:

The proposal requests a pressure range that seems to be about 1 to 2 MPa above the test data used to develop the correlation (based on Ref. 6), although Ref. 4 indicates 1347 FRIGG data points were used but based on an unpublished and, therefore, unavailable report. In addition, the high pressure range data seems to have come from rectangular channel experiments. Given that the apparent data does not directly support the proposed request, explain why the pressure range should be expanded when the only argument put forth is that all the available correlations are equally unable to account for the change in the void as a function of pressure. There is additional data in Ref. 7, but the staff is unable to determine if these data are relevant to the development of the AA78 correlation, other than perhaps supporting the similarity between the other correlation capabilities.

RAI 5:

In considering the error propagation as pressure increases for both the EPRI and AA78 (Fig. 14-2, Ref. 2, or Fig. 3-1 in the submittal) correlations, if the EPRI correlation is considered as the reference, then explain why the AA78 correlation is appropriate for use in licensing analyses given the error differences between the two correlations. Include a discussion of the uncertainty in the correlation and its treatment for licensing analyses.

RAI 6:

The AA78 correlation is based on pressure, flow rate, quality, heat flux and heated perimeter and hydraulic diameter.

(a) The physical channel characteristics are not addressed. Explain the range of these parameters over which the correlation is thought to be acceptable for licensing analyses, or why the geometry is unimportant even though the geometry is factored into determining the drift velocity as part of the correlation. Also, provide a comparison of these values from the tests to those in the nuclear power plant in support of using the correlation.

(b) The heat flux is only noted in Ref. 4 (page 3-15) but not compared to the data base. Explain the range of this parameter over which the correlation is thought to be acceptable for licensing analyses, or why the heat flux is unimportant even though the heat flux is factored into determining the drift velocity as part of the correlation. Also, provide a comparison of this value from the tests to that in the nuclear power plant in support of using the correlation.

Neutronics–Boron Model

1. On page 10 of the August submittal, chapter 4 describes the boron model. The boron model assumes the boron to be mixed uniformly throughout the reactor pressure vessel (RPV) water inventory.

    a) no information is provided in this section regarding the boron settling model after the boron was injected. Provide details of the boron settling model. In addition, describe the model in the code used to account for boron settling in the lower vessel head for BWR design with injection below the bottom of active fuel (BAF).

    b) Several licensees's emergency procedure guidelines (EPGs) recommend reducing the vessel water level during ATWS events to reduce reactor power.

        i) Verify that the boron concentration is based on a RPV water inventory at the nominal vessel level.

        ii) Provide a curve showing the fraction of the stand-by control system (SLCS) tank injected as a function of time for a limiting RPV pressure.

2. On page 12 of the August submittal, Section 4.2 of the topical report states that the kinetic model is based on a one axial dimensional model. To help the staff understand this model, additional details of the kinetics model are required.

   a) Specifically address the influence of the reactor adjoint on prompt nuclear feedback for boron injection into either the top of the core (for SLCS injection above the TAF), and into the bottom of the core (for SLCS injection below the BAF).

   b) At certain points in core life the flux adjoint in the upper axial parts of the core is very low. In cases where SLCS injection is below the BAF, describe the conservatisms in the methodology that ensure that the boron worth is adequately predicted, considering that boron will preferentially migrate from the lower head bundles with a lower two phase pressure drop (i.e. low power bundles) where the flux adjoint is low.

   c) Provide a discussion of the model conservatism in terms of boron settling, reduction of vessel level per EPGs. If possible, provide a best estimate comparison of the time dependent suppression pool cumulative heat load and temperature, neutron power, and integrated boron predicted using a transient plant code with a three dimensional kinetics model to best estimate BISON results.

3. Following the multiple RPTs after an ATWS signal, BWRs are likely to undergo power oscillations due to the high power to flow ratios.

   a) Describe the aspects of the BISON methodology that ensure that 10 CFR Part 100 limits are conservatively met. Specifically address:

      i) the adequacy of the kinetic model to predict core wide oscillations under non-isolation ATWS events,

      ii) the kinetic model aspects that addresses the regional oscillations for larger cores,

      iii) post dry-out heat transfer calculational abilities or conservative treatment of critical heat flux for EPU cores with flat power distributions, and any inherent conservatism in the suppression pool heat load, and

      iv) provide, where applicable, the assessment of specific models to plant or experimental data, such as the LaSalle dual RPT event.

4. On page 17 of the August submittal, the acronym “EOFP” is used. Is EOFP the same as EOL or EOC?

5. On page 17 of the same submittal, Section 5.4 presents the comparison results of the boron calculations by BISON against those of POLCA7 on separate pages. Provide a one/two/three? page Table comprising the calculational results of BISON and POLCA7, (the results already presented in Tables 5-1 through 5-12) and a side by side format for

each plant and time of cycle. On the same pages, please provide the difference in the Dk_{eff} between BISON and POLCA7 results in percentage format.

In addition, provide plots of the BISON and POLCA7 results for each plant and time of cycle, stating if the BISON results are more conservative and why.

6. On page 25 of the August submittal, the first paragraph in Section 5.6 is confusing to the staff. It is possible that there are sentence structure issues. Please provide additional clarification.

7. In the concluding section of Chapter 5, Section 5.7, the first paragraph on page 26, the last sentence states that the expected uncertainty is within a few percent in comparing the BISON results with those of POLCA7 results. Please tabulate these uncertainties and provide plots for each plant and cycle time, demonstrating these few uncertainties, and again, state whether these uncertainties are in the conservative direction, and why.

8. It is not clear from the submittal whether the void correlation was developed based on high void fractions (>90 percent) for current fuel. Tables 3-1 and 3-2 allude to high void fractions, but for low flow and low pressure. Please provide technical justification for application of the void correlation to an ATWS event which is a high pressure event.