

February 14, 2008

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

SUBJECT: FINAL SAFETY EVALUATION FOR WESTINGHOUSE ELECTRIC COMPANY (WESTINGHOUSE) TOPICAL REPORT (TR) WCAP-14565-P, ADDENDUM 2, REVISION 0, "ADDENDUM 2 TO WCAP-14565-P-A, EXTENDED APPLICATION OF ABB-NV CORRELATION AND MODIFIED ABB-NV CORRELATION WLOP [WESTINGHOUSE LOW PRESSURE] FOR PWR [PRESSURIZED WATER REACTOR] LOW PRESSURE APPLICATIONS" (TAC NO. MD3184)

Dear Mr. Gresham:

By letter dated September 20, 2006, Westinghouse submitted TR WCAP-14565-P, Addendum 2, Revision 0, "Addendum 2 to WCAP-14565-P-A, Extended Application of ABB-NV Correlation and Modified ABB-NV Correlation WLOP for PWR Low Pressure Applications," to the U.S. Nuclear Regulatory Commission (NRC) staff. By letter dated January 7, 2008, an NRC draft safety evaluation (SE) regarding our approval of TR WCAP-14565-P, Addendum 2, Revision 0, was provided for your review and comment. By letter dated January 21, 2008, Westinghouse commented on the draft SE. The NRC staff's disposition of Westinghouse's comments on the draft SE are discussed in the attachment to the final SE enclosed with this letter.

The NRC staff has found that TR WCAP-14565-P, Addendum 2, Revision 0, is acceptable for referencing in licensing applications for Westinghouse and Combustion Engineering pressurized water reactors to the extent specified and under the limitations delineated in the TR and in the enclosed final SE. The final SE defines the basis for our acceptance of the TR.

Our acceptance applies only to material provided in the subject TR. We do not intend to repeat our review of the acceptable material described in the TR. When the TR appears as a reference in license applications, our review will ensure that the material presented applies to the specific plant involved. License amendment requests that deviate from this TR will be subject to a plant-specific review in accordance with applicable review standards.

In accordance with the guidance provided on the NRC website, we request that Westinghouse publish accepted proprietary and non-proprietary versions of this TR within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed final SE after the title page. Also, they must contain historical review information, including NRC requests for additional information and your responses. The accepted versions shall include an "-A" (designating accepted) following the TR identification symbol.

J. Gresham

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If future changes to the NRC's regulatory requirements affect the acceptability of this TR, Westinghouse and/or licensees referencing it will be expected to revise the TR appropriately or justify its continued applicability for subsequent referencing.

If you have any questions, please contact Jon H. Thompson at (301) 415-1119.

Sincerely,

/RA/

Ho K. Nieh, Deputy Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700

Enclosure: Final SE

cc w/encl:
Mr. Gordon Bischoff, Manager
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J. Gresham

- 2 -

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ADAMS ACCESSION NO. ML080360381 *No major changes to SE input. NRR-043

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FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
TOPICAL REPORT (TR) WCAP-14565, ADDENDUM 2, REVISION 0,
“ADDENDUM 2 TO WCAP-14565-P-A, EXTENDED APPLICATION OF
ABB-NV CORRELATION AND MODIFIED ABB-NV CORRELATION
WLOP [WESTINGHOUSE LOW PRESSURE] FOR PWR [PRESSURIZED WATER REACTOR]
LOW PRESSURE APPLICATIONS”
WESTINGHOUSE ELECTRIC COMPANY
PROJECT NO. 700

1.0 INTRODUCTION AND BACKGROUND

By letter dated September 20, 2006, Westinghouse Electric Company (Westinghouse) submitted TR WCAP-14565-P, Addendum 2, Revision 0, “Addendum 2 to WCAP-14565-P-A, Extended Application of ABB-NV Correlation and Modified ABB-NV Correlation WLOP for PWR Low Pressure Applications” (Reference 1), to the U.S. Nuclear Regulatory Commission (NRC) staff for review. The TR describes the extension of the ABB-NV Critical Heat Flux (CHF) correlation (Reference 2) to the non-mixing vane (NMV) grid region of the Westinghouse Pressurized Water Reactor (PWR) fuel designs, and also describes the modification of the ABB-NV correlation based on low pressure rod bundle data. The modified correlation accommodates low pressure applications and is designated as the WLOP correlation.

In a similar manner to the NRC staff-approved W-3 correlation (Reference 3), the ABB-NV correlation will be used for predicting departure from nucleate boiling ratio (DNBR) margin in the NMV grid region to supplement the primary departure from nucleate boiling (DNB) correlation for Westinghouse PWR fuel designs with mixing vane (MV) grids. The WLOP correlation will be used for predicting DNBR margin at low pressure conditions that is typically encountered in a steam line break accident analysis, as an alternative to the NRC staff-approved W-3 or MacBeth correlations (References 3 and 4 respectively) for Westinghouse PWR plants and Combustion Engineering PWR (CE-PWR) plants.

The ABB-NV correlation has previously been approved for application for CE-PWR plants with both the TORC code (Reference 5) and the Westinghouse version of the VIPRE-01 (VIPRE) code (Reference 6) thermal hydraulic codes. Westinghouse provided additional supplemental rod bundle data evaluation to confirm the current ABB-NV correlation at a 95 percent probability and a 95 percent confidence level (95/95) DNBR limit of 1.13 with VIPRE for the NMV grid region for Westinghouse PWR fuel designs. Westinghouse also provided supplemental data to extend the applicable range of the ABB-NV correlation.

Westinghouse formulated the WLOP correlation from a modified version of the ABB-NV correlation specifically for low pressure conditions and extended the flow range to cover low flow conditions. Modifications to the ABB-NV correlation form were made using existing CHF data from rod bundles with NMV grids, incorporating many of the tests included in the ABB-NV correlation. The WLOP coefficients were derived based on fluid conditions from VIPRE calculations. The WLOP 95/95 DNBR limit is determined to be 1.18 with the VIPRE code for both Westinghouse PWR and CE-PWR fuel designs. The WLOP 95/95 DNBR limit is also qualified with test data from rod bundles containing MV grids simulating Westinghouse PWR fuel designs.

2.0 REGULATORY EVALUATION

Section 50.34 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Contents of construction permit and operating license applications; technical Information," contains general requirements for the safety assessment of structures, systems, and components important to safety. As part of the core reload design process, licensees (or vendors) perform reload safety evaluations to ensure that their safety analyses remain bounding for the design cycle. To confirm that the analyses remain bounding, licensees confirm that key inputs to the safety analyses such as the departure from nucleate boiling ratio (DNBR) are conservative with respect to the current design cycle. If key safety analysis parameters are not bounded, a re-analysis or re-evaluation of the affected transients and/or accidents is performed to ensure that the applicable acceptance criteria are satisfied.

10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," Criterion 10, "Reactor design," requires that: The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits [(SAFDLs)] are not exceeded during any condition of normal operation, including the effects of anticipated occurrences."

Section 4.4, "Thermal and Hydraulic Design," of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, NUREG-0800, Revision 2, provides DNB acceptance criteria.

NRC Generic Letter 83-11, Supplement 1, "Licensee Qualification for Performing Safety Analyses" provides guidance for the technology transfer process for CHF correlations.

3.0 TECHNICAL EVALUATION

3.1 ABB-NV CHF Correlation

The ABB-NV correlation is based on a linear relationship between CHF and local quality. The correlation includes the following variables: pressure, local mass velocity, local equilibrium quality, distance from grid to CHF location, heated length from inlet to CHF location, and heated hydraulic diameter of the subchannel. Special geometry terms are used in the correlation to correct CHF calculations for grid, heated length, heated diameter (cold wall effect), and guide tube effects. The ABB-NV correlation has been used with the TORC code (Reference 5) and the VIPRE code (Reference 6) for CE-PWR licensing applications. The NRC staff-approved DNBR limit is 1.13 with both codes (References 5 and 6) at 95/95. A more detailed description of the ABB-NV correlation can be found in Reference 2.

Westinghouse provided a summary description of the CHF tests supporting the extended application of the ABB-NV correlation for the NMV grid region of the Westinghouse PWR fuel in Section 2 of TR WCAP-14565, Addendum 2, Revision 0. Two rod bundle tests were used to demonstrate the applicability of the ABB-NV correlation. One used a 5x5 array of electrically heated rods with uniform axial power distribution with brazed Inconel NMV grids, which simulated the geometry of a 17x17 fuel design. The second test was a hexagonal-lattice test with seven rods in a triangular pitch. The test rod dimensions and pitch are similar to the Westinghouse PWR fuel design. Validation of the application of the ABB-NV correlation to an NMV grid test with a different geometry demonstrates that the correlation is robust and may be applied to the NMV grid regions of different fuel configurations. Figures showing the geometry for these qualification test sections are also shown in Section 2 of TR WCAP-14565, Addendum 2, Revision 0, and a summary of the geometric characteristics for the supplemental tests for the ABB-NV database is given in Table 2-1.

3.2 Modified ABB-NV Correlation for Low Mass Flow and Low Pressure Conditions

The WLOP correlation is a modified ABB-NV correlation specifically developed for low pressure conditions. Modifications to the existing NRC staff-approved ABB-NV correlation form were made using existing CHF data from rod bundles with NMV grids, incorporating many of the tests included in the ABB-NV correlation. The correlation data for NMV grids were obtained for test sections of heated lengths ranging from 48 in. to 150 in., grid spacings of 8.0 in. to 21.5 in., rod diameters ranging from 0.374 in. to 0.440 in., flows above 0.15 Mlb/hr-ft², and pressures above 185 psia. The WLOP coefficients were derived based on fluid conditions from VIPRE calculations.

The WLOP correlation was developed based on CHF test data obtained from the Heat Transfer Research Facility of Columbia University. The tests were performed with simulated 5x5 arrays of 14x14, 16x16, and 17x17 fuel assembly geometries for NMV grids. The correlation database includes tests with uniform and non-uniform radial power distributions, with and without guide thimbles, heated lengths from 48 in. to 150 in. and grid spacing from 8.0 in. to 21.5 in. To provide overlap with the ABB-NV correlation, the upper pressure of the database is set at 1800 psia. The lower pressure is determined by the available test data. This upper pressure limit was chosen since it was found that measured CHF varied with pressure in a more complex manner when the pressure range is increased.

The functional form of the CHF correlation is empirical and is based solely on experimental observations of the relationship between the measured CHF and the correlation variables. The form of the correlation is based on a linear relationship between CHF and local quality similar to the ABB-NV correlation documented in Reference 2. The WLOP correlation includes the same variables as the ABB-NV correlation: pressure, local mass velocity, local quality, a grid spacing term, heated length from inlet to CHF location, and the heated hydraulic diameter ratio of the CHF channel. Special geometry terms are applied to the correlation to correct CHF for grid spacing, heated length, and heated diameter effects.

3.2.1 Description of WLOP Test Sections

The data used for the development and validation of the WLOP correlation were obtained from 18 test bundles with a uniform axial power shape. The test sections, described in Table 2-2 of TR WCAP-14565, Addendum 2, Revision 0, simulate a 5x5 array of fuel assembly geometries

without MVs. Thirteen of these test sections are representative of a 14x14 fuel assembly geometry (0.440 in. outer diameter (OD) heated rods and 0.580 in. rod pitch); four test sections are representative of a 16x16 fuel assembly geometry (0.382 in. OD heated rods and 0.506 in. rod pitch); and one test section is representative of a 17x17 fuel assembly geometry (0.374 in. OD heated rods, 0.500 in. rod pitch) with brazed Inconel grids. It is noted that high pressure data from several tests were used in the development of the ABB-NV correlation and that the test-specific geometry has already been documented in Reference 2.

Twelve of the tests were conducted with a simulated guide thimble. Tests were run with the simulated guide thimble placed either near the center of the test section surrounded by heated rods or adjacent to the test shroud. Typical radial geometries for the fuel design tests, with and without a guide thimble, are presented in several figures in Section 2.0 of TR WCAP-14565, Addendum 2, Revision 0; the radial and axial geometries for these individual tests are provided in Appendix E; and a summary of the test section geometry for the 18 tests is shown in Table 2-2. The data from the "correlation formation" test sections were used to develop the coefficients for the WLOP correlation form. The data from the "validation" test sections were used in the evaluation of the correlation. Test sections were selected to provide data at the low flow, low pressure conditions and to cover the range for the geometric parameters such as heated length, grid spacing, and heated hydraulic diameter.

The test grids for all the tests are similar to the reactor fuel design. The standard grids were manufactured with Zircaloy-4 material for the early tests. The stronger Inconel 625 material was used in later tests to provide improved support for the heater rods. The grid material change does not affect CHF performance of the grid design.

Special demonstration tests were run using available data for MV grid designs to demonstrate that the WLOP correlation is applicable or conservative for application to MV grid designs. In general, MV grids have shown substantial performance gains when compared to NMV grids, especially at small grid spacing (Reference 2). Westinghouse has provided the results of the application of the WLOP correlation application to MV fuel design in Table 4-4 of TR WCAP-14565, Addendum 2, Revision 0. Westinghouse noted in this TR that many of these tests that were used to demonstrate the applicability of the WLOP correlation to MV grid fuel, are the same tests used to develop and support previous correlations, such as the ABB-X2, WRB-1, WRB-2, and WRB-2M correlations (References 7 through 10, respectively).

In addition, Westinghouse also conducted calculations with the sub-channel computer code, VIPRE, for each test section in the database based upon the bundle geometry and the axial and radial power distributions.

A request for additional information (Reference 11) was sent to Westinghouse to justify the use of WLOP down to the requested pressure range of the correlation for MV fuel designs. Figure 4-4 of Reference 1 provides the WLOP ratio of measured to predicted (M/P) CHF versus data for PWR tests for MV grids only down to approximately 700 psia. Figure 4-4 also shows that there is a negative trend in the data, which may not hold true at lower pressures. In response to this RAI from the NRC staff, Westinghouse provided additional evaluations and test data conducted by the Electric Power Research Institute (EPRI) for PWRs with MV grids (Reference 12) which still demonstrated a negative trend in the M/P versus data down to approximately 800 psia, although the M/P values were significantly greater than the original data

provided in Figure 4-4. Based upon further discussions with the NRC staff, Westinghouse provided an additional WLOP M/P versus comparison with boiling water reactor (BWR) data for an MV grid- (Reference 13) and NMV grid-designed fuel (Reference 14).

Enhancements in MV grid M/P values obtained from use of these data at approximately 800 psia were similar to those obtained from the use of PWR data. The BWR data also demonstrated that at lower pressures (as low as 360 psia) the M/P values for the MV grid designs are significantly higher than 1.0 and that there was no significant trend in the plot of M/P versus Pressure for the MV grid design. Based on Figure 4-1 of TR WCAP-14565-P-A, Addendum 2, Revision 0, Westinghouse provided a plot of NMV CHF data that showed that at approximately 700-800 psia, there is a transition in the CHF data (an inflection point) and that at lower pressures, the NMV CHF data behavior was consistent down to 185 psia (i.e., no inflection point or discontinuity). Based on Figure 4-4, the additional PWR data, and the additional BWR MV/NMV CHF comparison data, Westinghouse has substantiated that the CHF behavior for the MV grid designs will remain conservative (i.e., M/P will remain greater than 1.0) in comparison to the CHF behavior for the NMV grid design over the NMV CHF data range. Therefore, Westinghouse has demonstrated that the WLOP correlation and the 95/95 DNBR limit are applicable to both NMV and MV grid fuel designs for the pressure range requested in TR WCAP-14565, Addendum 2, Revision 0.

3.3 Statistical Evaluation

This section evaluated all the statistical data that went into the development of the ABB-NV and WLOP correlations. The following topics were considered: outliers, normality distribution, comparison of the various data groups, the homogeneity of variance, and the 95/95 DNBR limit. The means and standard deviations for the ratio of measured to ABB-NV-predicted CHF's were given for the correlation database and the individual test sections and for the validation database and the individual test sections. Similar means and standard deviations were presented for the WLOP correlation. A statistical evaluation was performed with the ABB-NV and the WLOP correlations for each test section and bundle array, the correlation database, the validation database, and the combined correlation and validation database, to determine the one-sided 95/95 DNBR limit applicable to each correlation. Standard statistical tests (the W and D tests) were used to evaluate normality at the 95 percent confidence level: the W test for groups with less than 50 test points and the D test for all other groups.

Standard statistical tests were performed to determine if all or selected data groups belong to the same population in order to be combined for the evaluation of the 95/95 DNBR tolerance limit. In addition, scatter plots were generated for each variable in the correlation to examine the correlation for trends or regions of non-conservatism. The measured to correlation predicted CHF ratio was plotted as a function of pressure, local mass velocity, local quality, heated hydraulic diameter, distance from bottom to adjacent upstream grid, and heated length from beginning of heated length (BOHL) to location of CHF. The NRC staff examined these plots and determined that although trends were evident in some of the plots, Westinghouse provided the NRC staff with satisfactory explanations to justify the trends. The 95/95 DNBR limit was also shown on these plots to show the number of points that fall below the limit and the location of those points. The NRC staff examined all the plots and determined that the results were typical. The NRC staff reviewed the elimination of the outliers and agreed that it was appropriate.

3.4 Application of the ABB-NV and WLOP Correlations

The intended application of the ABB-NV and WLOP correlations for Westinghouse PWRs is similar to the current application of the W-3 DNB correlation (Reference 3) to Westinghouse PWRs. The intended application of the WLOP correlation for CE-PWRs is similar to the current application of the MacBeth DNB correlation (Reference 4) to CE-PWRs. Westinghouse intends to use the ABB-NV and WLOP correlations for evaluating safety margins with respect to CHF and DNB acceptance criteria, but only at core conditions where the primary DNB correlations are not applicable.

Section 4.4, "Thermal and Hydraulic Design," of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, NUREG-0800, Revision 2 (Reference 15), provides DNB acceptance criteria. One DNB acceptance criterion is met with respect to the thermal-hydraulic design when the minimum DNBR of the hot rod in the hot channel is above the 95/95 DNBR limit of the correlation. The ABB-NV and WLOP correlations will be used only with a computer code that has been either used for the correlation development or qualified with its 95/95 DNBR limit. The technology transfer process for the ABB-NV and WLOP correlations will address the recommendations identified in NRC Generic Letter 83-11, Supplement 1, "Licensee Qualification for Performing Safety Analyses" (Reference 16).

Selection of the appropriate DNB correlation, DNBR limit, engineering hot channel factors for enthalpy rise, and other fuel-dependent parameters for a specific plant will still be justified for each application of each correlation. These correlations, like other DNB correlations for PWR safety analyses, were developed from steady-state test data. These correlations will be used with appropriate codes (such as VIPRE) in calculating DNBRs for PWR power ramp and flow coastdown transients, such as complete loss of flow, locked rotor, and control rod malfunctions. The details of each correlation's application are discussed next.

3.4.1 Application of the Extended ABB-NV Correlation

The range of application for the extended ABB-NV correlation is summarized in this section. The extended ABB-NV correlation will be used with the Westinghouse version of the VIPRE code and is in full compliance with the limitations and conditions specified in the safety evaluation (SE) for the TR documenting the VIPRE code and modeling (Reference 6).

ABB-NV will be used as a supplement to the primary DNB correlation for predicting DNBR margin in the fuel region of Westinghouse fuel designs near core inlet. To ensure a continuity of power shape correction in DNBR predictions between the NMV and the MV grid regions, the same F_c factor (F-Factor to make corrections for non-uniform axial power shapes) used with the primary DNB correlation of the Westinghouse PWR MV grid fuel design will be used with ABB-NV correlation. The 95/95 ABB-NV DNBR limit remains at a value of 1.13 for Westinghouse PWR fuel design applications in the parameter range defined in Table 1.

Pressure (psia)	1750 to 2415
Local mass velocity (Mlbm/hr-ft ²)	0.8 to 3.16
Local quality	<0.22
Heated length, inlet to CHF location (in)	48* to 150
Heated hydraulic diameter ratio	0.679 to 1.08
Grid Distance (in.)	7.3 to 24
*Although the heated length below the first MV grid is below 48 in., the minimum heated length used in the correlation is conservatively maintained at 48 in.	

3.4.2 Application of the WLOP Correlation

The range of application for the WLOP correlation is summarized in this section. The WLOP correlation will be used with the Westinghouse version of the VIPRE code and is in full compliance with the limitations and conditions specified in the SE for the TR documenting the VIPRE code and modeling (Reference 6).

WLOP will be applied to all Westinghouse/CE PWR fuel designs, including the 14x14 fuel products with rod ODs of 0.400 in., 0.422 in., or 0.440 in., the 15x15 fuel products with rod OD of 0.422 in., the 16x16 fuel products with rod ODs of 0.360 in., 0.374 in., or 0.382 in., and the 17x17 fuel products with rod ODs of 0.360 in. or 0.374 in.

The WLOP correlations will be used as a supplement to the primary DNB correlation for predicting DNBR margin under low pressure conditions. To ensure a continuity of power shape correction in DNBR predictions between the pressure regions, the same F_c factor used with the primary DNB correlation of the PWR fuel design will be used with the WLOP DNB correlation. The 95/95 WLOP DNBR limit is 1.18 in the parameter range defined in Table 2.

Pressure (psia)	185 to 1800
Local Coolant Quality	< 0.75
Local Mass velocity (Mlb/hr-ft ²)	0.23 to 3.07
Heated Hydraulic Diameter Ratio	0.679 to 1.00
Heated Length, HL (in.)	48* to 168
Grid Spacing Term	27 to 115
*Set as minimum HL value, applied at all elevations below 48 inches	

4.0 LIMITATIONS AND CONDITIONS

1. The applicable range of the ABB-NV and WLOP correlations are presented in Table 1 and Table 2, respectively, of this SE.
2. The ABB-NV correlation and the WLOP correlation must use the same F_c factor for power shape correction as used in the primary DNB correlation for a specific fuel design.
3. Selection of the appropriate DNB correlation, DNBR limit, engineering hot channel factors for enthalpy rise, and other fuel-dependent parameters will be justified for each application of each correlation on a plant specific basis.
4. The ABB-NV correlation for Westinghouse PWR applications and the WLOP correlation must be used in conjunction with the Westinghouse version of the VIPRE-01 (VIPRE) code since the correlations were justified and developed based on VIPRE and the associated VIPRE modeling specifications.

5.0 CONCLUSION

The extension of the ABB-NV correlation to the NMV grid region of Westinghouse fuel, and the modification of this correlation to low flow and low pressure conditions, is based primarily on data taken from 1971 to 1982 and supplemented by more recent data. The following conclusions for the extension of the ABB-NV correlation to Westinghouse PWRs and the application of the WLOP correlation to CE-PWRs apply:

1. Analysis of supplemental NMV grid data with rod diameters of 0.36 in. and 0.374 in. demonstrate the applicability of the ABB-NV correlation to the Westinghouse PWR fuel designs in the heated length below the first MV grid.
2. Analysis of the supplemental data indicates the data are poolable with the original data and the approved DNBR limit of 1.13 for the ABB-NV correlation for CE-PWR applications is

maintained for the Westinghouse PWR applications within the parameter range presented in the abstract of TR WCAP-14565-P-A, Addendum 2, Revision 0, and the clarification given in Reference 14.

3. Analysis of the WLOP correlation for low pressure and low flow conditions and the source and validation data indicates that a minimum DNBR limit of 1.18 for the WLOP correlation will provide a 95 percent probability with 95 percent confidence of not experiencing CHF on a limiting rod.
4. The WLOP correlation with the 95/95 DNBR limit of 1.18 can be applied to the low pressure conditions within the parameter range provided in the abstract of TR WCAP-14565-P-A, Addendum 2, Revision 0, and the clarification given in Reference 14, similar to the application of the W-3 correlation for Westinghouse PWRs and to the application of the MacBeth correlation for CE-PWRs.

The correlation uses an approach employed by a previously-approved correlation, and the statistics are performed in an acceptable manner. The NRC staff has performed a review of the analyses in TR WCAP-14565-P-A, Addendum 2, Revision 0, and concludes that it is acceptable for licensing applications, subject to the limitations and conditions identified in Section 4.0 of this SE.

6.0 REFERENCES

1. J. A. Gresham, Westinghouse Electric Company, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, LTR-NRC-06-54, September 20, 2006 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML062780167).
2. CENPD-387-P-A, Rev. 00, "ABB Critical Heat Flux Correlations for PWR Fuel," May 2000.
3. WCAP-9226-P-A, Rev.01, "Reactor Core Response to Excessive Secondary Steam Releases," February 1998.
4. LD-WO-3900, "MacBeth CHF Correlation Approval," August 2, 1983.
5. CENPD-161-P-A, "TORC Code, A computer code for determining the thermal Margin of a reactor core," April 1986.
6. WCAP-14565-P-A, "VIPRE-01 Modeling and qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Analysis," October 1999.
7. WCAP-8762-P-A, "New Westinghouse Correlation WRB-1 for Predicting Critical Heat Flux in Rod Bundles with Mixing Vane Grids," July 1984.
8. WCAP-10444-P-A, "Reference Core Report -VANTAGE 5 Fuel Assembly," September 1985.
9. WCAP-16523-P, "Westinghouse Correlations WSSV and WSSV-T for Predicting Critical Heat Flux in Rod Bundles with Side-Supported Mixing Vanes," March 2006.

10. Experimental Statistics, National Bureau of Standards Handbook 91, Department of Commerce, August 1963.
11. J. H. Thompson, US NRC, letter to J. A. Gresham, Westinghouse Electric Company, July 18, 2007 (ADAMS Accession No. ML071940060).
12. B. F. Maurer, Westinghouse Electric Company, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, LTR-NRC-07-26, May 14, 2007 (ADAMS Package Accession No. ML071450083).
13. H. A. Sepp, Westinghouse Electric Company, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, LTR-NRC-0318, May 12, 2003, (ADAMS Package Accession No. ML031400807).
14. J. A. Gresham, Westinghouse Electric Company, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, LTR-NRC-07-49P, September 14, 2007 (ADAMS Package Accession No. ML072681067).
15. Section 4.4, "Thermal and Hydraulic Design," Revision 2, of the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," NUREG-0800, Revision 2, March 2007 (ADAMS Accession No. ML072681067).
16. U.S. NRC Generic Letter 83-11 Supplement 1, "Licensee Qualification for Performing Safety Analysis," June 24, 1999 (ADAMS Legacy Library Accession No. 9906210103).

Attachment: Resolution of Comments

Principal Contributors: A. Attard
J. Kaizer

Date: February 14, 2008

RESOLUTION OF WESTINGHOUSE ELECTRIC COMPANY (WESTINGHOUSE)

COMMENTS ON DRAFT SAFETY EVALUATION FOR TOPICAL REPORT (TR)

WCAP-14565, ADDENDUM 2, REVISION 0,

“ADDENDUM 2 TO WCAP-14565-P-A, EXTENDED APPLICATION OF

ABB-NV CORRELATION AND MODIFIED ABB-NV CORRELATION

WLOP [WESTINGHOUSE LOW PRESSURE] FOR PWR [PRESSURIZED WATER REACTOR]

LOW PRESSURE APPLICATIONS”

(TAC NO. MD3184)

By letter dated January 21, 2008, Westinghouse provided 20 comments on the draft safety evaluation (SE) for TR WCAP-14565-P-A, Addendum 2, Revision 0, “Addendum 2 to WCAP-14565-P-A, Extended Application of ABB-NV Correlation and Modified ABB-NV Correlation WLOP for PWR Low Pressure Applications.” Some information in the draft SE for this TR was identified as proprietary (see Comments 14, 15, and 17); therefore, the draft of this SE will not be made publicly available. The following are the NRC staff’s resolution of these comments:

Draft SE comments for TR WCAP-14565, Addendum 2, Revision 0:

1. Change stray typographical symbols to quotation marks for a more grammatically correct statement (Page 2, lines 13-14).

NRC Resolution for Comment 1 on Draft SE:

The final SE will not contain these typographical errors. These errors are not in the official document, but resulted from data transmission.

2. Delete the words “critical power” and replace them with “departure from nucleate boiling,” because these words are more accurate for PWR applications (Page 2, line 19).

NRC Resolution for Comment 2 on Draft SE:

Comment accepted. Change made.

3. Replace “correlations” with “correlation” because this is a single correlation (Page 2, line 38).

NRC Resolution for Comment 3 on Draft SE:

Comment accepted. Change made.

4. Add the word “fuel” after the words “Westinghouse PWR” because the correlation is related to the fuel (Page 3, line 2).

ATTACHMENT

NRC Resolution for Comment 4 on Draft SE:

Comment accepted. Change made.

5. Replace the phrase "Two tests were conducted to demonstrate" with the phrase "Two rod bundle tests were used to demonstrate" for a more technically accurate statement (Page 3, lines 3-4).

NRC Resolution for Comment 5 on Draft SE:

Comment accepted. Change made.

6. Replace "18.25 in." with "21.5 in." to be consistent with Table 2-2 of TR WCAP-14565, Addendum 2, Revision 0 (Page 3, line 30).

NRC Resolution for Comment 6 on Draft SE:

Comment accepted. Change made.

7. Replace the phrase "three specified fuels" with the phrase "fuel design tests" as this is a more technically accurate statement (Page 4, line 12).

NRC Resolution for Comment 7 on Draft SE:

Comment accepted. Change made.

8. Change stray typographic symbols to quotation marks as this is more grammatically correct (Page 4, line 16).

NRC Resolution for Comment 8 on Draft SE:

The final SE will not contain these typographical errors. These errors are not in the official document, but resulted from data transmission.

9. Replace the phrase "reactor design" with the phrase "reactor fuel design" as this is a more technically accurate statement (Page 4, line 22).

NRC Resolution for Comment 9 on Draft SE:

Comment accepted. Change made.

10. Replace "WR13-2" with the correct name of the correlation: "WRB-2" (Page 4, line 35).

NRC Resolution for Comment 10 on Draft SE:

Comment accepted. Change made.

11. Add the missing word "Pressure" before the phrase "for the MV grid design" (Page 5, line 9).

NRC Resolution for Comment 11 on Draft SE:

Comment accepted. Change made.

12. Add the phrase "in some of the plots" after the phrase "although trends were evident" in order to communicate a more technically accurate statement (Page 5, line 44).

NRC Resolution for Comment 12 on Draft SE:

Comment accepted. Change made.

13. Change "NV" to "NMV" to be consistent with nomenclature used throughout the safety evaluation (Page 6, line 38).

NRC Resolution for Comment 13 on Draft SE:

Comment accepted. Change made.

14. Delete proprietary statement identified in Comment 14 of the letter dated January 21, 2008, providing comments on the draft SE for TR WCAP-14565-P-A, Addendum 2, Revision 0 (Page 6, lines 41-42).

NRC Resolution for Comment 14 on Draft SE:

Comment accepted. Proprietary information deleted from final SE.

15. Delete proprietary statement identified in Comment 15 of the letter dated January 21, 2008, providing comments on the draft SE for TR WCAP-14565-P-A, Addendum 2, Revision 0, and make the correction to number that is identified in Table 1 of the draft SE (Page 7, Table 1).

NRC Resolution for Comment 15 on Draft SE:

Comment accepted. Proprietary information deleted from final SE and the correction identified in the draft SE has been made to Table 1.

16. Add the phrase "or 0.440 in.," to the phrase describing the 14x14 fuel products and add the phrase "or 0.382 in.," to the phrase describing the 15x15 fuel products as the WLOP correlation is valid for both the Westinghouse and CE fuel designs (Page 7, lines 10-12).

NRC Resolution for Comment 16 on Draft SE:

Comment accepted. Change made.

17. Delete proprietary statements identified in Comment 17 of the letter dated January 21, 2008, providing comments on the draft SE for TR WCAP-14565-P-A, Addendum 2, Revision 0, and make the correction to number that is identified in Table 2 of the draft SE (Page 8, Table 2).

NRC Resolution for Comment 17 on Draft SE:

Comment accepted. Proprietary information deleted from final SE and the correction identified in the draft SE has been made to Table 2.

18. Change the phrase “ABB-NV correlation to NMV Westinghouse fuel” to “ABB-NV correlation to the NMV grid region of Westinghouse fuel” in order to make a more technically accurate statement (Page 8, line 22).

NRC Resolution for Comment 18 on Draft SE:

Comment accepted. Change made.

19. Change the statement “presented in Table 6.1-1 of TR WCAP-14565-P-A, Addendum 2, Revision 0” to “presented in the abstract of TR WCAP-14565-P-A, Addendum 2, Revision 0 and the clarification given in Reference 14” to be consistent with the previously identified correction in RAI #2 in Reference 14 (Page 9, line 4).

NRC Resolution for Comment 19 on Draft SE:

Comment accepted. Change made.

20. Change the statement “provided in Table 6.2-1 of TR WCAP-14565-P-A, Addendum 2, Revision 0” to “presented in the abstract of TR WCAP-14565-P-A, Addendum 2, Revision 0, and the clarification given in Reference 14” to be consistent with the previously identified correction in RAI #2 in Reference 14 (Page 9, lines 12-13).

NRC Resolution for Comment 20 on Draft SE:

Comment accepted. Change made.