

December 10, 1999 LD-1999-0066

Mr. John S. Cushing - OWFN / 4D7 U.S. Nuclear Regulatory Commission 11555 Rockville Pike Rockville, Maryland 20852-2738

Response to Request for Additional Information regarding CENPD-387-P, Subject: "ABB Critical Heat Flux Correlation for PWR Fuel." (Proprietary Information)

Letter, J.Cushing (NRC) to I.C.Rickard (ABB), "Request for Additional Information Reference: (RAI) Regarding CENPD-387-P, "ABB Critical Heat Flux Correlation for PWR Fuel," (TAC No. MA6109), dated December 8, 1999.

Dear Mr. Cushing:

ABB C-E Nuclear Power, Inc., (ABB) encloses herewith for your use fifteen (15) proprietary and twelve (12) non-proprietary copies of the subject material. This material is required by the NRC staff to complete the review of the referenced ABB topical report.

Certain information contained in the enclosure is proprietary in nature. It is requested that this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and that it be appropriately safeguarded. The reasons for the classification of this information as proprietary are delineated in the attached affidavit.

Please feel free to contact Virgil Paggen of my staff at 860-285-4700 or me if you have any questions.

Very truly yours,

agaen

Ian C. Rickard, Director

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Nuclear Licensing

As Stated Enclosure: **Proprietary Affidavit** Attachment:

ABB Combustion Engineering Nuclear Power, Inc.

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P.O. Box 500

Compation

2000 Day Hill Rd. Phone 860-285-9678 Windsor, CT 06095-0500 Fax 860-285-3253

PDR TOPHP

Proprietary Affidavit Pursuant to 10 CFR 2.790

Attachment to LD-1999-0066

I, A. B. Spinell, Jr., depose and say that I am the Vice President, Engineering Services and Technology, of ABB C-E Nuclear Power, Inc. (ABB), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information.

I have personal knowledge of the criteria and procedures utilized by ABB in designating information as a trade secret, privileged, or as confidential commercial or financial information. The information for which proprietary treatment is sought, and which document has been appropriately designated as proprietary, is contained in the following:

"Response to RAIs on CENPD-387-P concerning ABB CHF Correlation for PWR Fuel," 12/10/99.

Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

- 1. The information sought to be withheld from public disclosure is owned and has been held in confidence by ABB. It consists of experimental and technical data used in the development of the ABB-NV and ABB-TV critical heat flux correlation for PWR fuel.
- 2. The information consists of summary data or other similar data concerning a process, method or component, the application of which results in substantial competitive advantage to ABB.
- 3. The information is of a type customarily held in confidence by ABB and not customarily disclosed to the public.
- 4. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.
- 5. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence.
- 6. Public disclosure of the information is likely to cause substantial harm to the competitive position of ABB because:
 - a. A similar product is manufactured and sold by major competitors of ABB.
 - b. Development of this information by ABB required tens of thousands of dollars and thousands of manhours of effort. A competitor would have to undergo similar expense in generating equivalent information.
 - c. The information consists of technical data and qualification information for ABB-supplied products, the possession of which provides a competitive economic advantage. The availability of such information to competitors would enable them to design their product to better compete with ABB, take marketing or other actions to improve their product's position or impair the position of ABB's product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.
 - d. In pricing ABB's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of ABB's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

Sworn to before me this 10th day of December, 1999

otary Public My commission expires:

A. B. Spinell, Yr., Vice President Engineering Services and Technology

Non-Proprietary Information

ABB Combustion Engineering Nuclear Power

Responses to RAIs concerning CENPD-387-P

December 10, 1999

Topical Report Material

Non-Proprietary Information

<u>RAI No. 1</u>:

In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

RAI No. 2:

On page 3-11, the last paragraph states that "outliers" were weeded out. Does this mean that these outliers were not included in the statistical process?

Response: The outliers in the correlation database identified on page 3-11 were eliminated from the statistical process after being tested with a procedure from Reference 12, <u>Experimental Statistics</u>, National Bureau of Standards handbook 91, described in section 6.1.1. As stated on page 3-11, [] of the data were eliminated from the correlation database and the M/P CHF ratio values for these points were above the value of 1.0 []. The points from [] are also suspect since other points from that test were dropped due to unstable flow conditions near DNB. The inclusion of any or all points identified as outliers in the statistical process would have no impact on the process used to determine the 95/95 DNBR limit, described in Chapter 6, or the calculated 95/95 DNBR limit of 1.13 for the ABB-NV correlation.

RAI No. 3:

The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

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In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.

Response to RAI on CENPD-387-P, Rev 00-P

<u>RAI No. 1</u>:

In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

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The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

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a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

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Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

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The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

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Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

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In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

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a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

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Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

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Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

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The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

RAI No. 4:

In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.

RAI No. 1:

In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

RAI No. 2:

On page 3-11, the last paragraph states that "outliers" were weeded out. Does this mean that these outliers were not included in the statistical process?

Response: The outliers in the correlation database identified on page 3-11 were eliminated from the statistical process after being tested with a procedure from Reference 12, <u>Experimental Statistics</u>, National Bureau of Standards handbook 91, described in section 6.1.1. As stated on page 3-11, [] of the data were eliminated from the correlation database and the M/P CHF ratio values for these points were above the value of 1.0 []. The points from [] are also suspect since other points from that test were dropped due to unstable flow conditions near DNB. The inclusion of any or all points identified as outliers in the statistical process would have no impact on the process used to determine the 95/95 DNBR limit, described in Chapter 6, or the calculated 95/95 DNBR limit of 1.13 for the ABB-NV correlation.

RAI No. 3:

The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

RAI No. 4:

In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.

In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

RAI No. 2:

On page 3-11, the last paragraph states that "outliers" were weeded out. Does this mean that these outliers were not included in the statistical process?

Response: The outliers in the correlation database identified on page 3-11 were eliminated from the statistical process after being tested with a procedure from Reference 12, <u>Experimental Statistics</u>, National Bureau of Standards handbook 91, described in section 6.1.1. As stated on page 3-11, [] of the data were eliminated from the correlation database and the M/P CHF ratio values for these points were above the value of 1.0 []. The points from [] are also suspect since other points from that test were dropped due to unstable flow conditions near DNB. The inclusion of any or all points identified as outliers in the statistical process would have no impact on the process used to determine the 95/95 DNBR limit, described in Chapter 6, or the calculated 95/95 DNBR limit of 1.13 for the ABB-NV correlation.

RAI No. 3:

The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

RAI No. 4:

In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.

RAI No. 1:

In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

RAI No. 2:

On page 3-11, the last paragraph states that "outliers" were weeded out. Does this mean that these outliers were not included in the statistical process?

Response: The outliers in the correlation database identified on page 3-11 were eliminated from the statistical process after being tested with a procedure from Reference 12, <u>Experimental Statistics</u>, National Bureau of Standards handbook 91, described in section 6.1.1. As stated on page 3-11, [] of the data were eliminated from the correlation database and the M/P CHF ratio values for these points were above the value of 1.0 []. The points from [] are also suspect since other points from that test were dropped due to unstable flow conditions near DNB. The inclusion of any or all points identified as outliers in the statistical process would have no impact on the process used to determine the 95/95 DNBR limit, described in Chapter 6, or the calculated 95/95 DNBR limit of 1.13 for the ABB-NV correlation.

RAI No. 3:

The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

RAI No. 4:

In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.

<u>RAI No. 1</u>: In Section 1.2, pg. 1-2, in the last paragraph states that two new correlations were developed, ABB-NV for the 14x14 and 16x16 non-mixing vane (NV) and the ABB-TV for the 14x14 Turbo mixing vane (TV) fuel.

a) Does this mean that there are two databases? (14x14 and 16x16 NV and the 14x14 TV)?

Response: Yes, the ABB-NV correlation is based upon test data taken with test sections representative of the non-mixing vane 14x14 and 16x16 grid designs. The ABB-TV correlation is based upon test data taken with test sections representative of the mixing vane 14x14 grid design only.

b) Is there a 16x16 Turbo mixing vane fuel database?

Response: Presently, ABB does not have a database for the 16x16 Turbo mixing vane grid design. A separate submittal will be made for the 16x16 Turbo mixing vane grid design when the database is completed.

RAI No. 2:

On page 3-11, the last paragraph states that "outliers" were weeded out. Does this mean that these outliers were not included in the statistical process?

Response: The outliers in the correlation database identified on page 3-11 were eliminated from the statistical process after being tested with a procedure from Reference 12, <u>Experimental Statistics</u>, National Bureau of Standards handbook 91, described in section 6.1.1. As stated on page 3-11, [] of the data were eliminated from the correlation database and the M/P CHF ratio values for these points were above the value of 1.0 []. The points from [] are also suspect since other points from that test were dropped due to unstable flow conditions near DNB. The inclusion of any or all points identified as outliers in the statistical process would have no impact on the process used to determine the 95/95 DNBR limit, described in Chapter 6, or the calculated 95/95 DNBR limit of 1.13 for the ABB-NV correlation.

RAI No. 3:

The ABB-NV and the ABB-TV correlations were developed from steady-state data. Justify that the use of these correlations is conservative for each type of transient (power increase, flow decrease, rapid and slow depressurization, etc.) that you plan to analyze.

References:

- 1. CENPD-199-P Rev. 1-P-A, "C-E Setpoint Methodology" January 1986.
- Letter from C. E. Rossi (NRC) to J. A. Blaisdell (NUSCo), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores, Volumes 1, 2, 3 and 4", May 1, 1986.

RAI No. 4:

In Section 7.1.1, it is stated that "options" to the TORC and CETOP-D codes will allow TORC and CETOP-D to use the ABB-NV and/or ABB-TV critical heat flux (CHF) correlations in departure from nucleate boiling ratio (DNBR) calculations. Please state these options and justify their applicability.

Response: The options to the TORC and CETOP-D codes are actually options in the user input for the two codes. These input options allow the user to choose the applicable CHF correlation, (either ABB-NV or ABB-TV correlation), in addition to the existing CE-1 correlation, in the TORC and/or CETOP-D code DNBR calculations.

RAI No. 5:

In Section 7.2.1, it is stated that the methods described in Supplement 2-P-A of reference 18 in the June 1999 submittal remain applicable with application of the ABB-NV correlation. Please provide technical justifications in support of these claims.