PROPRIETARY

Nuclear Innovation
North America LLC
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February 16, 2012
U7-C-NINA-NRC-120007
10 CFR 2.390

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Number PROJ0772
Responses to Request for Additional Information

Reference: Letter from Tekia Govan to Mark McBurnett, Request for Additional Information RE: South Texas Nuclear Operating Company Project Topical Report (TR) WCAP-17202-P, "Supplement 4 to Bison Topical Report RPA 90-90-P-A" (TAC No. RG0026) dated April 12, 2011 (ML111010099)

Attached are the responses to NRC staff questions included in the reference. The following RAI questions are addressed:

RAI 15.00.02-32	
RAI 15.00.02-33	RAI 15.00.02-36
RAI 15.00.02-34	RAI 15.00.02-37
RAI 15.00.02-35	RAI 15.00.02-38

The responses to some of these RAI questions contain information proprietary to Westinghouse Electric Corporation. Since these responses contain information proprietary to Westinghouse Electric Company LLC, they are supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b) (4) of Section 2.390 of the Commission's regulations.

STI 33241922

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Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Attachments 1 through 7 contain the responses to the above RAI questions. Attachments 8 through 12 contain the non-proprietary versions of the proprietary responses. Attachment 13 contains the request for withholding of proprietary information, the affidavit, the proprietary information notice, and the copyright notice.

Correspondence with respect to the copyright or proprietary aspects of this information or the supporting Westinghouse Affidavit should reference letter CAW-12-3382 and should be addressed to: J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania, 16066. If this letter becomes separated from the proprietary material it is no longer proprietary.

There are no commitments in this letter.

If you have any questions other than those relating to the proprietary aspects of this response, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 2/16/12

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

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Attachments:

1. RAI 15.00.02-32 (Proprietary)
2. RAI 15.00.02-33
3. RAI 15.00.02-34 (Proprietary)
4. RAI 15.00.02-35 (Proprietary)
5. RAI 15.00.02-36 (Proprietary)
6. RAI 15.00.02-37
7. RAI 15.00.02-38 (Proprietary)
8. RAI 15.00.02-32 (Non-Proprietary)
9. RAI 15.00.02-34 (Non-Proprietary)
10. RAI 15.00.02-35 (Non-Proprietary)
11. RAI 15.00.02-36 (Non-Proprietary)
12. RAI 15.00.02-38 (Non-Proprietary)
13. Request for Withholding Proprietary Information

cc: w/o enclosure except*
(paper copy)

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RAI 15.00.02-33

The last paragraph of Section 3.5.1 of WCAP-17202 implies the new model is incorporated in Reference 1. Because Reference 1, RPA-90-90-P-A, was issued in 1989, it is not expected to include the improved model presented in this WCAP. Please explain.

Response to RAI 15.00.02-33

The reference in the last paragraph of section 3.5.1 in WCAP-17202 will be changed from "Reference 1" to "Reference 5".

RAI 15.00.02-37

Proprietary Equation 3-50 of WCAP-17202 contains the final correlation of the steam dome water surface condensation model. Please describe how this equation was derived from Equation 3-49, as it appears some parameters were deleted.

Response to RAI 15.00.02-37

The derivation of the final correlation is provided in RAI 15.00.02-32.

RAI 15.00.02-32

Section 3.5.1 of WCAP-17202 summarizes observations of the current BISON simulation of the Hamaoka-5 start-up tests, but does not reference the supporting documentation.

a. **In order to appreciate the overall improvements in the BISON model predictions after incorporation of the new steam dome water surface condensation model, provide the reference where the BISON calculations of Hamaoka-5 start-up tests are documented or provide the results of comparison of the original BISON code for the Hamaoka-5 start-up tests (pressure in dome, water level, and water subcooling).**

b. **Explain whether the third bullet is an experimental observation or a BISON prediction.**

Response to RAI 15.00.02-32

a. BISON calculations of Hamaoka-5 start-up tests are documented in Reference 5 of WCAP-17202.

b. [

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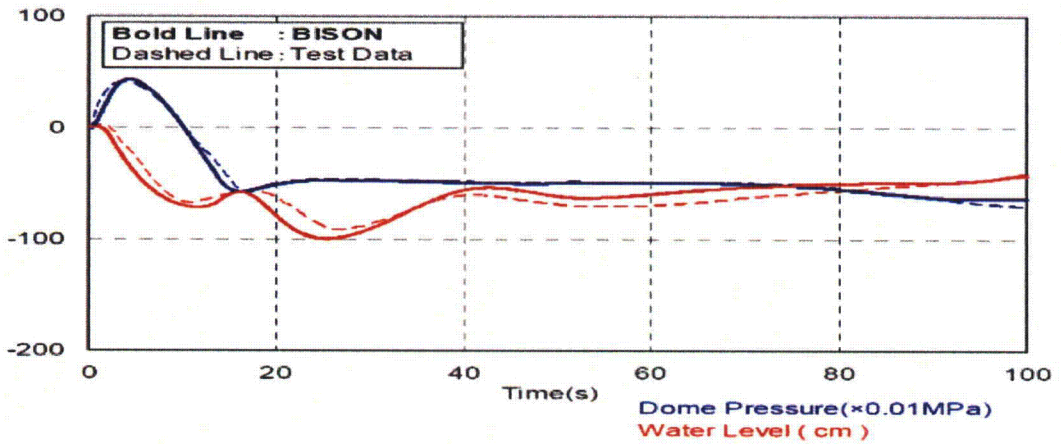

Figure 1: BISON comparision to test data for the Generator Load Rejection Test

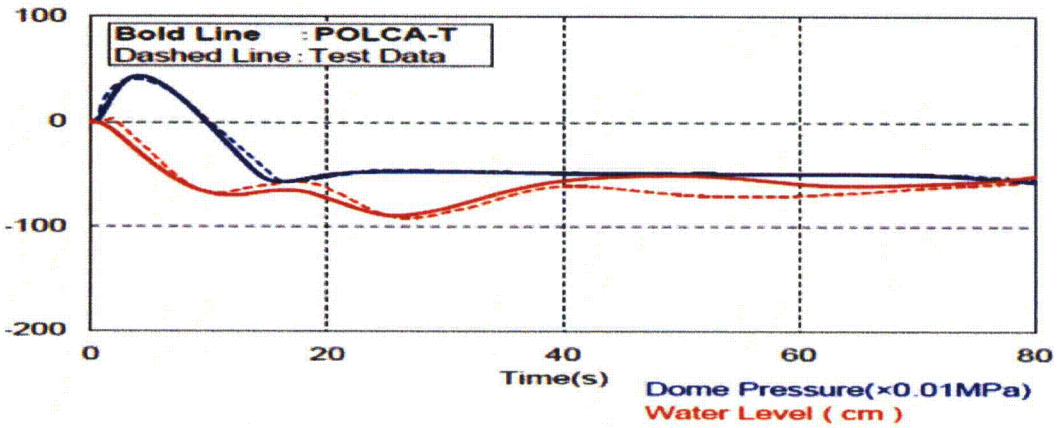

Figure 2: POLCA-T comparision to test data for the Generator Load Rejection Test

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Table 1: Parameters used to develop the steam dome water surface condensation model

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Table 1 (cont): Parameters used to develop the steam dome water surface condensation model

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References

1. Proceedings of the 17th International Conference on Nuclear Engineering ICONE17, May 9-14, 2010, Brussels, BELGIUM, ICONE17-75127, "ABWR Start-up Test Analysis with Transient Code BISON".

2. PHYSOR 2010, May 9-14 2010, Pittsburgh, Pa, USA, "ABWR Start-up Test Analysis with Transient Code POLCA-T".

3. WCAP 16747-P-A "POLCA-T, System Analysis Code with Three-Dimensional Core Model".

4. ABB Atom Report RPA 90-90-P-A, "BISON – A One Dimensional Dynamic Analysis Code for Boiling Water Reactors".

5. WCAP 17202-P, "Supplement 4 to BISON Topical Report RPA 90-90-P-A".

RAI 15.00.02-34

Section 3.5.2 of WCAP-17202 states that "the applied model is a second degree polynomial versus surface subcooling (ΔT_{surf})," which is presented in proprietary Equation 3-49.

a. **Please provide the physical basis for the selection of the polynomial dependence used in the model. Comment on the generality of the purely empirical model for steam dome water surface condensation when applied to all possible ABWR related transient scenarios.**

b. **Discuss the physical significance of each model parameter in Equation 3-49.**

c. **Address the implications of having a finite amount of condensation for zero subcooling.**

d. **Surface condensation is due to transfer of heat from vapors to subcooled liquid surface and the condensation rate is equivalent to the heat transfer rate divided by latent heat. Since the latent heat is function of pressure, the surface condensation rate is also pressure dependent. Discuss the pressure dependence of each model parameter in Equation 3-49.**

e. **The interfacial condensation heat transfer coefficient between vapor space and the subcooled liquid surface is affected by the flow conditions (e.g., laminar, turbulent, natural convection, forced convection) in vapor and liquid phases. These flow conditions can vary during the transient, and can be very different for different type of transients. Discuss how the model captures dependence on flow conditions or the implications of not including it.**

Response to RAI 15.00.02-34

a. The selection of the polynomial dependence is discussed in RAI 15.00.02-32. The steam dome condensation model generally has an effect on long transients. See the response to part (e) for a discussion of application to other possible transients.

b. The physical significance of each parameter is discussed in RAI 15.00.02-32.

c. The zero subcooling case is discussed in the response to RAI 15.00.02-32.

d. The pressure dependency of the latent heat is described in the response to RAI 15.00.02-32.
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e. The empirical condensation model does not distinguish between different flow regimes or different flow conditions. However, as described below, the model is derived for the most limiting flow conditions and may therefore be conservatively applied for different flow regimes.

The different flow regime conditions influence the condensation rate through the thickness of the thermal boundary layers on the steam and water sides (see Figure 1). [

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Figure 1: Temperature profile close to the steam-water interface

The size of the thermal boundary layers is strongly dependent on the flow regime. Clearly, for laminar flow the thickness of the boundary layers is larger than for the turbulent flow. This is due to the enhanced mixing efficiency for the turbulent flow regime compared to the laminar flow regime, effectively reducing the size of the boundary layers. The same applies to forced vs. natural circulation.

The model is based on data from the Hamaoka 5 plant. [

]^{a,c}

RAI 15.00.02-35

Proprietary Figure 3-18 of WCAP-17202 presents a verification of the fitting of the condensation model. The following information is required related to this figure:

a. **Please provide the values of all model parameters from Equation 3-49 used to generate the "Model" curve.**
b. **Provide the experimental conditions (e.g., pressure, flow conditions, test section geometry etc.) for the experimental data presented in the figure. Is this separate effect test data, integral effects data or plant data? Please explain the method used to measure the rate of condensation in the experiment and the uncertainty in the measurement.**
c. **Address the discrepancy in units reported for condensation C in Equation 3-49 versus Figure 3-18, and reconcile it to the units on the right hand side of Equation 3-49.**
d. **The value used for CONDR in Figure 3-18 differs from the value used for CONDR in Section 3.5.5. Please add to Figure 3-18 the model prediction using the CONDR value from Section 3.5.5, which is stated to be the BISON default.**

Response to RAI 15.00.02-35

a. The "Model" curve is based on the final Equation 3-50, the difference from Equation 3-49 is [ ]^{a,c} The values of all model parameters are described in the derivation of the final correlation as provided in the response to RAI 15.00.02-32.

b. The test data in Figure 3-18 in WCAP-17202 is derived from plant data from Hamaoka 5. The selected data points were retrieved during a Load Rejection with Bypass transient (LRWBP). Please see Reference 5 of WCAP-17202 for further information about experimental conditions.

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Table 1: Uncertainty in the measurement

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d. As described earlier in part c) of this response, the steam dome surface condensation model is derived with parameter [

]a,c account for uncertainties and discrepancies coming from the comparison to measurement data (Figure 3-19 and 3-20 in the LTR).

Figure 3-18 serves as an experimental basis for the derivation of the correlation [

]a,c This correlation, when later used in the validation (Figure 3-19 and Figure 3-20) [

]a,c This comparison against the experimental data is indirect (condensation rate is not compared directly; it is the steam dome pressure that is compared). In order to get a quantitative measure of the discrepancy in the form of the condensation rate,[

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[a,c

]a,c

Figure 1 – [

]a,c

RAI 15.00.02-36

Section 3.5.4 of WCAP-17202 presents validation of the steam dome water surface condensation model. Proprietary Figure 3-19 and Figure 4 in Appendix 1 show the predictions of the model for the Load Rejection with Bypass (LRWBP) transient. Similarly, Proprietary Figure 3-20 and Figure 8 in Appendix 1 show the predictions of the model for the Main Steam Isolation Valve Closure (MSIVC) transient.

a. **Please provide the values of all model parameters from Equation 3-49 used for the comparisons presented in each of these figures.**
b. **Consistent with the SRP guidelines in Section 15.0.2.III.2.E related to the use of plant data for model validation, provide the uncertainty in the plant test data, and comparisons of predicted and measured water subcooling (ΔT_{surf}).**

Response to RAI 15.00.02-36

a. The figures presented are based on the final Equation 3-50, the difference from Equation 3-49 is the use of [ ]^{a,c} The values to the final correlation described by Equation 3-50 of WCAP-17202 have been provided in RAI 15.00.02-32.

b. Table 1 shows the instrument loop error data for the plant parameters used in the verification and validation of the model. The loop error contains the error from the [

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Table 1: Uncertainty of plant data

[ ]^{a,b,c}

Comparisons of predicted and measured water subcooling are not possible to provide because it is not possible to measure subcooling at water surface level. However we can measure the steam dome pressure and the water level. The simulated water level agreement to the measured water level is considerably improved after the introduction of the steam condensation model. The steam condensation model is introduced to improve the agreement between the simulated steam dome pressure with the measured steam dome pressure.

RAI-15.00.02-38

In the comparison shown in Figure 4 in Appendix A of WCAP-17202, the BISON prediction using the surface condensation model levels off after 90 seconds, whereas the data shows a continuous decrease in the pressure. Furthermore, the water level is consistently over-predicted between 40 to 80 seconds. Please explain these apparent discrepancies in behavior.

Response to RAI-15.00.02-38

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The water level simulation is dependent on a number of different transient parameters like the feedwater flow and the generated power. Also important for the transient water level are initial parameters like stored energy in the fuel and the void and temperature distributions in the reactor pressure vessel. These vessel volumes primarily include the core, the upper plenum and the steam separators as well as the bulkwater (saturated voided water outside the steam separators above the feedwater sparger elevation). [

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It must however be noted that the introduction of the steam condensation model is a major contribution to improvements in both water level and pressure behavior of the BISON model, especially for long transients that involves reactor scram.

CAW-12-3382

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

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COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared B. F. Maurer, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

B. F. Maurer, Manager
ABWR Licensing

Sworn to and subscribed before me
this 9th day of February 2012

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Cynthia Olesky, Notary Public
Manor Boro, Westmoreland County
My Commission Expires July 16, 2014
Member, Pennsylvania Association of Notaries

(1) I am Manager, ABWR Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 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 should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in WEC-NINA-2012-0006 P-Enclosure, "Fourth Response to the NRC's RAIs for WCAP-17202, 'Supplement 4 to BISON Topical Report RPA 90-90-P-A'" (Proprietary) for submittal to the Commission, being transmitted by Nuclear Innovation North America (NINA) letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the BISON topical report.

This information is part of that which will enable Westinghouse to:

(a) Assist customers in obtaining NRC review of the Westinghouse methodologies and models as applied to current BWR and ABWR plant designs.

Further this information has substantial commercial value as follows:

(a) Assist customer to obtain license changes.

(b) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar fuel design and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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