PROPRIETARY

Nuclear Innovation
North America LLC
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June 13, 2011
U7-C-NINA-NRC-110079
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 Supplemental Request for Additional Information

Reference: Letter from Tekia Govan to Mark McBurnett, "Request for Additional Information Re: South Texas Project Nuclear Operating Company Topical Report (TR), WCAP-17203-P Fast Transient and ATWS Methodology (TAC No. RG17203), April 18, 2011 (ML111040418)

Attached are the 60-day responses to NRC staff questions included in the reference. The following RAI questions are addressed:

RAI-9b S01	RAI-23 S01
RAI-9c S01	RAI-24 S01
RAI-9d S01	RAI-25 S01
RAI-17 S01	RAI-28 S01
RAI-19 S01	RAI-29 S01
RAI-20 S01	

The responses to RAI-9b S01, RAI-9c S01, RAI-9d S01, RAI-17 S01, RAI-19 S01, RAI-20 S01, RAI-23 S01, RAI-24 S01, RAI-25 S01, and RAI-28 S01 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

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specificity the considerations listed in paragraph (b) (4) of Section 2.390 of the Commission's regulations.

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 11 contain the responses to the above RAI questions. Attachments 12 through 21 contain the non-proprietary versions of the ten (10) proprietary responses. Attachment 22 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-11-3174 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 6/13/11

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

jet

Attachments:

1. RAI-9b S01 (Proprietary)
2. RAI-9c S01 (Proprietary)
3. RAI-9d S01 (Proprietary)
4. RAI-17 S01 (Proprietary)
5. RAI-19 S01 (Proprietary)
6. RAI-20 S01 (Proprietary)
7. RAI-23 S01 (Proprietary)
8. RAI-24 S01 (Proprietary)
9. RAI-25 S01 (Proprietary)
10. RAI-28 S01 (Proprietary)

11. RAI-29 S01
12. RAI-9b S01 (Non-Proprietary)
13. RAI-9c S01 (Non-Proprietary)
14. RAI-9d S01 (Non-Proprietary)
15. RAI-17 S01 (Non-Proprietary)
16. RAI-19 S01 (Non-Proprietary)
17. RAI-20 S01 (Non-Proprietary)
18. RAI-23 S01 (Non-Proprietary)
19. RAI-24 S01 (Non-Proprietary)
20. RAI-25 S01 (Non-Proprietary)
21. RAI-28 S01 (Non-Proprietary)
22. Request for Withholding Proprietary Information

cc: w/o enclosure except*
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AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared T. Rodack, 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:

T. Rodack, Director
Quality and Licensing Programs

Sworn to and subscribed before me
this 8th day of June 2011

Notary Public

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Renee Giampole, Notary Public
Penn Township, Westmoreland County
My Commission Expires September 25, 2013

(1) I am Director, Quality and Licensing Programs, in Nuclear Fuel, 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 "Response to the NRC's Request for Additional Information for WCAP-17203, 'Fast Transient and ATWS Methodology'" (Proprietary), for submittal to the Commission, being transmitted by South Texas Project Nuclear Operating Company (STPNOC) 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 NRC review of WCAP-17203, and may be used only for that purpose.

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

(a) Assist customers in obtaining NRC review of the Westinghouse Fast Transient and ATWS Methodology topical 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).

COPYRIGHT NOTICE

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

RAI-29 S01

In response to RAI-29, the applicant provided additional information that clarified the meaning and purpose of the text in Section 6.4.1.1. Please confirm that the following clarifying methodology steps will be documented in the final LTR.

a) **A transient event may evolve from one transient grouping to another, the process checks to determine if there is an evolution from one transient grouping to another.**
b) **When a transient event evolves from one transient grouping to another, the bounding parameters used for the original transient grouping are verified to remain bounding for the transient event in the evolved transient grouping.**
c) **Confirmatory calculations are performed for limiting transient events that evolve from one transient grouping to another to ensure that the bounding parameters in the original transient event calculation remain conservative for the evolved transient grouping.**

Response to RAI-29 S01:

Westinghouse confirms that clarifying methodology steps a), b) and c) will be documented in the final LTR. Following text will be added to the beginning of Section 6.4 to address these considerations:

6.4 ANALYSIS METHODOLOGY

This section contains a methodology specific for each transient group. As some events may evolve from one transient group to another, the evaluation process should check if any limiting event evolves from one transient group to another.

When a transient event evolves from one transient group to another, the bounding parameters used for the original transient group are verified to remain bounding for the transient event in the evolved transient group.

Confirmatory calculations are performed for limiting transient events that evolve from one transient group to another to ensure that the bounding parameters in the original transient event calculation remain conservative for the evolved transient group.

RAI-9b S01

[ ]a,c

In response to the question related to the ranking of gas composition phenomenon, the applicant does not provide the reason for [ ]a,c assigned in the BWR LOCA PIRT (NUREG/CR–6744). This phenomenon has been ranked [ ]a,c in the BWR LOCA PIRT because of its contribution to [ ]a,c The rational for [ ]a,c this phenomenon provided in Table 5-2 of WCAP-17203 states that [ ]a,c is not addressed in either WCAP-17203-P or in the RAI response.

Provide rational for [ ]a,c

Response to RAI-9b S01

As stated by the NRC, the reason for the [ ]a,c of [ ]a,c in the BWR LOCA PIRT is its contribution to the establishment of [ ]a,c. [ ]a,c

To support the ranking, a sensitivity study is performed with the BISON code to evaluate the influence of [ ]a,c on figures-of-merit. In addition, the influence of [ ]a,c The BISON code includes a built-in model of the NRC approved fuel rod performance code STAV7.2. [ ]a,c

The sensitivity study was performed for an ABWR reactor loaded with SVEA-96 Optima2 fuel and analyzed one event scenario from each transient category in the LTR. The AOO specific figures-of-merit or representative output parameters were studied, see Table 1 below.

Table 1 The sensitivity study of AOO and ATWS Figures-of-Merit on [ ]a,c

Initiating Event	Transient Category	Studied Parameters

a,c

Three cases were studied for each of these events.

1. [

]a,c The results of the sensitivity study are shown in Table 2 through Table 5.

Table 2 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 3 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 4 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 5 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

The following conclusions are made based on the results of the study:

- The influence of [ ]a,c for all transient groups in a broad range of [ ]a,c.
- The influence of [ ]a,c

Consequently, the influence ranking of phenomenon [ ]a,c is kept [ ]a,c in the PIRT.

RAI-9c S01

[ ]a,c

The applicant agrees that the ranking of phenomenon [ ]a,c should be consistent with the ranking of phenomenon [ ]a,c and to update WCAP-17203-P accordingly. The response to RAI-9(c) indicates that the influence ranking for PIRT Item [ ]a,c will be [ ]a,c. Since background information nor the bases for the influence ranking determination of either PIRT item has been provided it is not clear [ ]a,c should be made. The important parameter affecting the response of the fast transient or ATWS is the [ ]a,c which, as noted in the PIRT, is affected by [th]a,c Since the [ ]a,c it is important to understand how the influence ranking for the PIRT table item was determined.

Provide the basis for the determination of the influence ranking for [ ]a,c

Response to RAI-9c S01

The influence ranking for [ ]a,c was primarily based on the judgment of subject matter expert panel. This judgment is confirmed by the sensitivity of the figures-of-merit (FoM) on phenomenon [ ]a,c The BISON code with the built-in NRC approved fuel rod performance code STAV 7.2 was used for the analysis.

The sensitivity study was performed for an ABWR reactor loaded with SVEA-96 Optima2 fuel and for one event scenario from each transient category in the LTR. The Anticipated Operational Occurrence (AOO) specific FoM's or representative output parameters were studied, see Table 1 below.

Table 1 The sensitivity study of AOO and ATWS Figures-of-Merit on [ ]a,c

Initiating Event	Transient Category	Studied Parameters

a,c

The influence of [ ]a,c was studied by varying these parameters by [ ]a,c The results of the sensitivity study are shown in Table 2 through Table 7.

Table 2 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 3 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 4 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 5 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 6 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

Table 7 – Sensitivity of [ ]a,c on [ ]a,c

a,c

[ ]

As shown in Table 2 through Table 7, the influence of both [ ]a,c on the figures-of-merit is [ ]a,c and their [ ]a,c ranking is therefore justified.

RAI-9d S01

[ ]a,c

The applicant agreed to update the ranking of [ ]a,c for RI/RD transients in order to be consistent with the ranking of the [ ]a,c for RI/RD events. However, the response does not clearly explain the[ ]a,c The applicant agrees that the ranking of phenomena [ ]a,c should be consistent for the RI/RD transients. The applicant agreed to update the ranking of phenomena [ ]a,c from [ ]a,c in for the RI/RD transients. However, since background information nor the bases for the influence ranking determination of either PIRT item has been provided it is not clear in which direction a [ ]a,c should be made.

Provide the basis for the determination of the influence ranking for [ ]a,c.

Response to RAI-9d S01

The influence ranking in Table 5-2 of the LTR was based on expert opinion of the influence of specific phenomenon on Figures-of-Merit. The influence ranking of Phenomenon [ ]a,c is confirmed by a sensitivity study performed with the BISON code as described below. The BISON code [ ]a,c.

The sensitivity study was performed for an ABWR reactor loaded with SVEA-96 Optima2 fuel and for one event in the Reactor coolant flow Increase/Decrease (RI/RD) transient category in the LTR. The chosen transient in the study is a representative event within the category of RI/RD events. The Anticipated Operational Occurrences (AOO) specific Figures-of-Merit were studied, see Table 1 below.

Table 1 The sensitivity study of [ ]a,c on RI/RD event specific Figures-of-Merit

Initiating Event	Transient Category	Studied Parameters

a,c

Individual studies were performed for determining the influence of the [ ]a,c and the influence of the [ ]a,c. The importance of [ ]a,c in the fuel considers [ ]a,c whereas the importance of [ ]a,c considers [ ]a,c.

[ ]a,c. The results of the study are in Table 2.

Table 2 The influence of [ ]a,c on AOO 3RPT event a,c

[ ]

[

]a,c. The results of the study are in Table 3.

Table 3 The influence of [ ]a,c on AOO 3RPT event a,c

[ ]

This study shows [

]a,c for the selected event.

Based on the results from the sensitivity study, the following conclusions are made:

- The influence of the [ ]a,c for the Reactor coolant flow Increase/Decrease events
- The influence of the [ ]a,c for the Reactor coolant flow Increase/Decrease events.

Consequently, the influence ranking of phenomena [ ]a,c for the AOO RI/RD category in the PIRT.

Reference

1. Fuel Rod Design Methods for Boiling Water Reactors, CENPD-285-P-A, Rev 0, July 1996

RAI-17 S01

The response to RAI-17 discusses situations in which an AOO is determined to be limiting at off-rated conditions:

a) For first core and new plant designs, please explain how limiting AOOs are determined for the range of possible plant configurations, mechanical variances, and plant operating conditions.

b) Please explain the "evaluation" process (e.g., T&H code calculation, engineering judgment, etc.) that is used to determine the off-rated limiting conditions (Kp and Kf multipliers) for those potentially limiting AOOs determined in Part a.

c) Please describe the process used to determine when a detailed thermal-hydraulic computer code calculation is performed for an AOO or when other methods (simplified analytical solution or expert engineering judgment) are considered to be acceptable.

Response to RAI-17 S01

a) New plant designs have been subjected to NRC evaluation during the combined operating license application process. The plant licensing basis will be described in documents such as the DCD and/or FSAR.

In those documents all SRP Chapter 15 AOOs are analyzed at all plant operating conditions and the potentially limiting AOOs are identified. System design is also determined as part of the process and mechanical variances and other plant operating limitations, including the plant operating domain, are incorporated in the Plant Technical Specifications. Normally the transient analysis included in the FSAR is based on an equilibrium core of a certain fuel type that may differ from the fuel to be loaded as the first core due to the time frames of the licensing process.

For first cores, Westinghouse uses the already licensed process in LTR CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel" to evaluate any plant modification. Although this report has not yet been approved for first cores or the ABWR, it is currently under review by the NRC for such applications. The process outlined in CENPD-300-P-A is plant independent and will be followed for this type of analysis. The process consists of a [

]^{a,c}.

The potentially limiting events to be analyzed using a detailed thermal-hydraulic code are established during this licensing event selection process. Simplified analytical solutions or expert engineering judgment may be used to eliminate certain events, for instance if the eliminated event is bounded by other plant events. The disposition of the events is documented in a first core/reload/plant change methodology basis report according to Westinghouse internal procedures.

In the first core/reload/plant change licensing analysis, the AOOs are evaluated throughout the allowable operating domain. The allowable operating domain is defined through the power-flow map, Technical Specification requirements and other plant specific licensing commitments. The mechanical variances that are incorporated into the analysis are

consistent with the Technical Specification and/or surveillance requirements for the range of possible plant configurations, mechanical variances and plant operating conditions.

b) The potentially limiting AOOs are evaluated for the limiting plant conditions throughout the allowable operating domain using a detailed thermal-hydraulic computer code according to Westinghouse internal procedures. Slow transients as defined in CENPD-300-P-A "Reference Safety Report for Boiling Water Reactor Reload Fuel" are evaluated with the nodal code POLCA7 and fast transients are evaluated with BISON or POLCA-T. As a part of the process referred to above as the "first core/reload/plant change licensing analysis", [ ]^{a,c} according to Westinghouse internal procedures and in accordance with QA requirements. These can also be made available for review during an audit. The [ ]^{a,c} contains all the information about systems operating conditions including mechanical variations and plant states. The [ ]^{a,c} (by reference to NRC approved topical reports) will be used for the AOOs identified in the first part of the process (referred to as the event selection process above). The Licensing Analysis document contains the results of the AOOs analysis including the Kp and Kf multipliers and is the document used as the basis for the Core Operating Limits Report (COLR) which is submitted to the NRC (for information) for each cycle including the first core.

A single operating state or operating boundary (i.e. maximum flow, end of cycle exposure, maximum power etc.) may conservatively bound all other possible states. The single operating state or operating boundary, that is evaluated using a detailed thermal-hydraulic computer code, is established based on engineering judgment and experience from similar plant design and assessments. The Kp and Kf are then calculated at these conditions using the results from the detailed thermal-hydraulic calculations for the potentially limiting AOO events.

c) Westinghouse's process for identifying the potentially limiting AOOs to be evaluated by a detailed thermal-hydraulic computer code, consists of reviewing the existing licensing basis of the specific Nuclear Power Plant, mainly the FSAR or the DCD. The results of this evaluation are the potentially limiting analysis classified as [ ]^{a,c} and are documented in an internal report with a detailed discussion of the basis for selecting the potentially limiting events to be analyzed. [ ]^{a,c}

The systematic process used to determine the potentially limiting events is described in Section 6.3 of the US NRC approved Licensing Topical Report CENPD-300-P-A "Reference Safety Report for Boiling Water Reactor Reload Fuel". Although this report has not yet been approved for first cores or the ABWR, it is currently under review by the NRC for such applications. The process outlined in CENPD-300-P-A is plant independent and will be followed for this type of analysis. The process assures that all applicable potentially limiting events and plant-specific special licensing commitments are covered. Then, the potentially limiting AOO events are evaluated for the limiting plant conditions throughout the allowable operating domain using a detailed thermal-hydraulic computer code.

If the NRC would like to see a concrete example of the process described in a, b, and c; all of these documents and analyses are available for audit.

RAI-19 S01

In response to RAI-19, Part (b), the applicant states, "Statistical independence of the input parameters to the uncertainty analysis is achieved by the selection process described in this topical report, based upon the division of the events to different groups and the selection process where only the relevant input and modeling parameters are considered in the analyses." However, it is not clear what criteria are used to separate events into the group called "Relevant Parameters."

The response to RAI 19 discussed testing distributions for normality, but did not provide a definition of what constitutes failure of a normality test.

In response to RAI-19, Part (b), the applicant stated that the statistical significance of the database used for the parameters is captured by the uncertainty assessment process described in the LTR. If not statistically significant, the parameter is set to a conservative bounding value. However, a definition of "statistical significance" is not provided, nor are the criteria used to determine if data have sufficient statistical significance.

Follow-up RAI:

a) Please describe the criteria used to separate parameters into the Relevant Parameter group.

b) Please describe the criteria used to determine whether there has been a failure of a normality test.

c) Please provide the criteria used to determine if a dataset is statistically significant.

Response to RAI-19 S01:

The original method in CENPD-300-P-A, referred to as Method B, is a method based on the Propagation of Errors. As identified by the reviewer in the original RAI-19, one of the limitations of this method is the necessary criterion on the independence of the input parameters. This criterion arises from the fact that [ ]^{a,c}, which combines the uncertainties from different contributors, neglects the covariance terms between the input parameters. Assuming that the input parameters are correlated (not independent) the influence of the combined effect of these contributors on the final results is not accounted for. This is a direct consequence of the fact that only one uncertainty analysis input parameter is disturbed at a time.

The uncertainty evaluation methods [ ]^{a,c} described in the topical report disturb all input parameters simultaneously therefore capturing their combined effect. That implies that the statistical independence of the input parameters is not strictly required as is the case for the [ ]^{a,c}

a) The original statement in the response to RAI-19 about statistical independence of the input parameters was addressing the fact that the dependency between uncertainty input parameters may be eliminated by minimizing the dataset of candidate uncertainty input parameters to a dataset of "Relevant Parameters" that accounts also for uncertainties in parameters that depend on them. Westinghouse recognizes that the effort to achieve statistical independence of uncertainty input parameters may be hard to implement in

practice and has therefore [

]^{a,c}

The criteria for separating a dataset of "Relevant Parameters" from a dataset of "Candidate Parameters are described in response to RAI-23 S01.

(b) The failure of a normality test (Anderson-Darling) is assumed when the Anderson-Darling modified statistics A^{*2} is larger than 0.751 (hypothesis of normality is rejected with 5% significance level) as described in Reference 1.

(c) A dataset is considered statistically significant when it contains [

]^{a,c}

For a dataset of less than [

]^{a,c}

References

(1) R.B. D'Agostino and M.A. Stephens, Eds. (1986). "Goodness-of-Fit Techniques", Marcel Dekker

RAI-20 S01

In response to RAI-20, Part (a), the applicant stated that medium "ranked parameters in PIRT only moderately affect the figures-of-merit." However, there is no discussion of whether a combination of medium ranked independent phenomena could together have more than a moderate effect of the figure of merit.

Please provide a more complete bases for why the Medium ranked PIRT parameters do not need to have their inputs set to conservative values.

Response to RAI-20 S01:

The selection of which phenomena are considered in the uncertainty treatment is balanced against the robustness (risk of eliminating any significant uncertainties) and the practical applicability of the methodology. It is Westinghouse opinion that it is [

]^{a,c}. The ranking technique is designed to direct the examination of uncertainty to those phenomena having the most significant effect on the figures-of-merit. Westinghouse experience has shown that [

]^{a,c}

If a Medium ranked phenomenon has little impact on the calculated results, [

]^{a,c} Conservative input values require an estimation of the bias and uncertainty, [

]^{a,c}

RAI-23 S01

The applicant's response stated the selection process of "Relevant Parameters" follows the Code Scaling, Applicability, and Uncertainty (CSAU) parameter assessment described in a referenced paper by W. Wulff, et al. But a review of the referenced paper determined that the process of evaluating CSAU is well defined; however, the process does not provide any criteria for judging if the uncertainties in a parameter are very small or if the effect of the parameter on figures-of-merit is similarly small.

Please describe the criteria by which one judges whether uncertainties are so small or the effect on figures-of-merit is so minimal that they can be ignored. Please illustrate with an example.

Response to RAI-23 S01:

1) Westinghouse considers a parameter to have an insignificant effect when its influence on the figures-of-merit is less than the value provided in Table 1. The insignificance of a removed candidate parameter [ ]a,c This effort is performed in order to decrease the number of uncertainty input parameters considered to a manageable size by identifying the parameter with negligible effect on the analysis results.

Table 1 – [ ]a,c

[ ]a,c

To illustrate the process of defining relevant parameters from the list of candidate parameters, assume, for simplicity, that the following is the complete list of candidate parameters selected for phenomenon [ ]a,c

A sensitivity study is performed by varying these parameters according to their distributions as shown in Table 2:

Table 2 – [ ]a,c

a,c

The influence of the parameter variation on AOO figures-of-merit is evaluated and the maximum deviation from the nominal value is compared to the criteria from Table 1. Example of such a comparison is shown in Table 3. This table presents the effect of the minimum and maximum values on the parameters MCPR, LHGR, and RVP. If the change in any of these parameters exceeds the limiting value (defined in Table 1), the parameter is considered relevant. For example, a cladding conductivity change from [ ]a,c results in a change in MCPR of [ ]a,c, which is greater than 0.01, so it is relevant. The pellet conductivity on the other hand, varying between [ ]a,c causes a change in all figures-of-merit that is less than limiting values from Table 1 and therefore considered insignificant.

Table 3 – [ ]a,c

a,c

Similar analysis is performed for ATWS, where the fast transient figures-of-merit are replaced by the ATWS figures-of-merit.

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[1] Values of [ ]a,c in Table 3 are shown to demonstrate the methodology and do not represent any real sensitivity study.

RAI-24 S01

The applicant's response did not explain how biases and uncertainties are propagated in the uncertainty analysis. The provided example assumed a uniform distribution, which the LTR states is unaffected by biases. Taking the Generator Load Rejection with Failure of All Bypass Valves a representative event for ABWR, Please:

a) **Explain why the "Steady-state and transient cladding to coolant heat transfer" category is not carried forward from Table 8-2 into Table 8-3; this entry includes two phenomena that are ranked "High" in sufficiency and relevance. In addition, correct the table and include these parameters in the demonstration case for "c" below if this is determined to be an oversight.**
b) **Explain why the "Rationale" column from the example in Table 7-2 is not included in Table 8-2. In addition, include this information in the response.**
c) **For the demonstration case:**

- **retain the selected figure-of-merit (MCPR);**
- **retain the values used for all "conservative" parameters (Subsection 8.6.1);**
- **retain the values used for all "adjusted" parameters (Table 8-3) with one change. A review of the related topical report (CENPD-390-P-A, Figures 5.33 through 5.38) notes a bias in calculated POLCA core reactivity for hot-full-power calculations. Provide an explanation as to whether such a bias is factored into the BISON model that is derived from the POLCA model, and if so, how.**
- **Use the revised Table 8-3, incorporating appropriately the cited bias, and recalculate the OLMCPR demonstrating how the methodology accounts for biases in the adjusted parameters. Furthermore, discuss changes resulting from including this bias, if any.**

Response to RAI-24 S01:

As identified by the reviewer, the example of how the biases and uncertainties are propagated in the uncertainty analysis uses a uniformly distributed parameter in which a bias is accounted for implicitly. A more explicit example is the treatment of [ ]^{a,c}, as shown in Table 8-3 in the LTR. Here, a [ ]^{a,c} is accounted for in the calculation in the following way:

- For the uncertainty analysis, an [ ]^{a,c} is applied to the value of gas gap size calculated by STAV7.2 correlation according to equation 1:

[ ] a,c

- During the uncertainty analysis, [ ]a,c

Note the following: (1) [ ]a,c, where parameter b accounts for bias and deviation arising from the validation of [ ]a,c (2) [ ]a,c

a) Instead of being included in the uncertainty analysis, both of the high ranked phenomena in the "Steady-state and transient cladding to coolant heat transfer" category [ ]a,c . These phenomena are found in Sections 8.6.1.3 and 8.6.1.4 of the LTR. Fast Transient and ATWS methodology allows [ ]a,c . As these phenomena are treated conservatively, they are not included in the uncertainty analysis and hence the Table 8-3 in the LTR does not need to be corrected.

b) The "Rationale" column of Table 7-2 was not included in Table 8-2 only for simplicity. The emphasis was put on demonstration of the uncertainty analysis process, rather than specific code details. Table 8-2 serves only as an example and the rationale is not included. Instead, code specific applications of the methodology will have a complete table including the rationale.

c) A bias and deviation in power distribution resulting from the comparison of POLCA7 to Traversing In-core Probes (TIP) measurements, shown in Figures 5.33 through 5.38 in CENPD-390-P-A, are [ ]a,c Since the SLMCPR including these uncertainties already is applied in the demonstration analysis, thedemonstration case is not recalculated..

Instead, another demonstration of how the methodology accounts for biases is shown above using parameter D_{gap} as an example.

RAI-25 S01

The response to Part (c) indicated that uncertainties in experimental databases are addressed in two ways.

1) **"Parameters describing thermo-physical data ... have their [ ]a,c," or,**
2) **"[ ]a,c " (an implicit uncertainty).**

However, the following aspects of the response to RAI 25 Part (c) are unclear. Please describe:

a) **the criteria used to determine whether a parameter is a leading parameter,**
b) **the method for determining whether there is a single leading parameter or set of leading parameters for an event to be analyzed,**
c) **how experimental and modeling uncertainties and biases are mathematically combined into either single or multiple leading parameter(s) so that the resulting distribution of these parameter(s) reflects the total uncertainty,**
d) **the situations in which you believe that a single leading parameter may be appropriate for analysis of AOO or ATWS events**

Response to RAI-25 S01:

The PIRT table (Table 5-2 in the topical report) provides a list of high ranked phenomena for each transient event (belonging to a certain transient group). Each phenomenon is simulated by one or several models, where one or several model output parameters are identified. A model specific "leading" parameter accounting for experimental and model uncertainty is defined for each model output parameter. In the end, many leading parameters are applied to analyze the total uncertainty for an event.

A flowchart of all sources of uncertainties [ ]a,c is shown schematically, for a model simulating a high ranked phenomenon, in Figure 1.

[ ]a,c

Figure 1 – Flowchart of Uncertainty Source Terms

Figure 1 defines three sources of uncertainty: [

]a,c

[ ]a,c Typically, during the model validation, a model output parameter is compared to the measurement data and results are compiled as shown in Figure 2. This type of model validation is documented in code-specific topicals.:

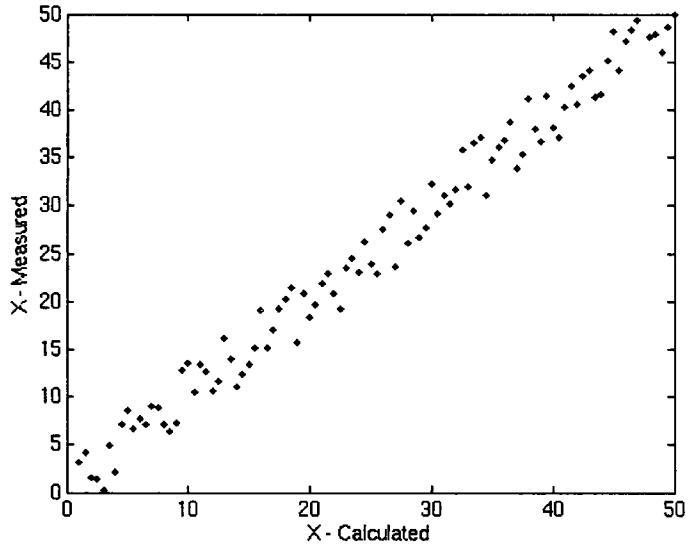

Figure 2 – Example of Model Validation – Comparison of calculated and measured data

Both, model output (X-calculated) and experimental data (X-measured) are stochastic variables. A combined model and experimental uncertainty [ ]a,c is constructed as described in Section B.7.2 of Reference 1. Here, [ ]a,c. The band is then formed as the sum of all these areas. This is a standard technique to be applied when analyzing data with independent uncertainties in measured and calculated values, as can be seen in Reference 2.

Response to part a) of the RAI:

A Leading Parameter is a parameter for which the comparison with separate effects test (SET) data is performed. This parameter is usually the model output parameter.

Response to part b) of the RAI:

Whether there is a single leading parameter or a set of leading parameters for each important phenomenon identified for the transient depends on the nature of the mathematical model. The number of leading parameters is equal to the number of relevant model output parameters.

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[1] Or X-Calculated = X-Measured – bias, in case the values are biased.

Response to part c) of the RAI:

Statistical parameters describing the distribution function for the leading parameter (or model output parameter) are calculated from the comparison of model output with SET data by the method of [ ]^{a,c}. This method is applied and accepted by the NRC in Section B.7.2 of Reference 1 which further refers to Reference 2.

Depending on whether the uncertainty is defined as absolute or relative, [ ]^{a,c} This approach is demonstrated on the following examples:

1. Relative Error
   Assume that the relative bias, μ, of parameter X is equal to 2% and the standard deviation, σ, [ ]^{a,c} is equal to 0.5%. In such a case the model output parameter X used in the uncertainty analysis will be [ ]^{a,c} .
2. Absolute Error
   Assume that the absolute bias, μ, of parameter X is equal to 20 units and the standard deviation, σ, is equal to 5 units. In such a case the [ ]^{a,c}

Response to part d) of the RAI:

A single leading parameter characterizing the combined model and experimental uncertainty (for each high ranked phenomenon) is used for the models that are characterized by only one relevant model output parameter.

References

(1) WCAP-16747-P-A, "POLCA-T: System Analysis Code with Three-Dimensional Core Model", September 2010

(2) A.G.Frodesen, O. Skjeggestad and H. Tøfte, "Probability and Statistics in Particle Physics", ISBN 82-00-01906-3

RAI-28 S01

The applicant provided a rational for selection of the MSIV event as being the limiting overpressure protection event, but did not provide a description of the process used to confirm the MSIV closure event is the most limiting as is stated in the methodology.

Please describe the specific steps and all the analyses and evaluations that are performed to confirm that the MSIV closure event is the most limiting licensing bases over-pressurization event in the Over-pressurization Protection Methodology for the first core ABWR. As noted in the response to RAI-28, "If another pressurization event is identified in the plant specific licensing bases to be potentially more severe, that event is also assessed." Describe the process and methodology used to determine and identify how another pressurization event is identified that may potentially be more severe and the steps that are taken to ensure the most severe pressurization event is identified and analyzed.

Response to RAI-28 S01:

Westinghouse's process for identifying the potentially limiting events consists of reviewing the existing licensing basis of the specific Nuclear Power Plant, mainly the FSAR or the DCD. The results of this review are the determination of the potentially limiting events classified as [ ]a,c and are documented in an internal report with a detailed discussion of the basis for selecting the potentially limiting events to be analyzed. The systematic process used to determine the potentially limiting events is described in Section 6.3 of the US NRC approved Licensing Topical Report CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel". Although this report has not yet been approved for first cores or the ABWR, it is currently under review by the NRC for such applications. The process outlined in CENPD-300-P-A is plant independent and will be followed for this type of analysis. The process ensures that all applicable potentially limiting events and plant-specific special licensing commitments are covered.

[

]a,c