BWR OWNERS' GROUP

Randy Bunt, Chair
Tel: (205) 992-7475
Fax: (205) 992-0391
rcbunt@southernco.com

c/o Southern Nuclear • 40 Inverness Center Parkway • PO Box 1295 • Birmingham, AL 35242

Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

Project Number 691

BWROG-08018
March 28, 2008

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Responses to Requests for Additional Information (RAIs) Dated February 21, 2008, Regarding the Submittal of BWROG Topical Report (TR) NEDE-33213P, "ODYSY Application for Stability Licensing Calculations Including Option I-D and II Long Term Solutions," dated June 5, 2007 (TAC No. MD5743)

ENCLOSURE: Responses to RAIs

Dear Sir or Madame:

Enclosed please find the BWROG responses (enclosure) to the NRC Request for Additional Information on the subject Topical Report NEDE-33213P. NRC provided the RAIs for this report by letter dated February 21, 2008, and we now submit responses to the aforementioned RAIs which address questions raised during NRC review of NEDE-33213P. We look forward to your timely review of these responses, and would be happy to meet with you to discuss any remaining issues.

Please note that Enclosure 1 contains proprietary information of the type that GE-Hitachi Nuclear Energy Americas LLC (GEH) maintains in confidence and withholds from public disclosure. The information has been handled and classified as proprietary

D044
NRR

to GEH as indicated in the enclosed affidavit, which also is included in the report. The affidavit contained in Enclosure 3 identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GEH.

GEH hereby requests that the information in Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. Enclosure 2 is a non-proprietary version of Enclosure 1.

Should you have additional questions regarding this submittal, please contact Michael Iannantuono (BWROG - Project Manager) at 910-602-1956.

Sincerely,

R. C. Bunt
BWR Owners' Group Chair

cc: M.C. Honcharik, NRC
D.W. Coleman, BWROG Vice Chair
K.A. McCall, BWROG Program Manager
BWROG Primary Representatives
J.D. Fisher, Energy Northwest
M.A. Iannantuono, GEH
J.G. Head, GEH

ENCLOSURE 2

Responses to RAIs

Non-Proprietary Version

NON-PROPRIETARY NOTICE

This is a non-proprietary version of the Enclosure 1, Responses to RAIs from which the proprietary information has been removed. Portions of the document that have been removed are identified by white space within double square brackets, as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished solely for the purpose(s) stated in the transmittal letter. The only undertakings of GEH with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than those participating entities and for any purposes other than those for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Introductory Response

Historically, the 0.15 Decay Ratio (DR) adder was introduced to make the ODYSY DR match the results of FABLE/BYPSS, an earlier frequency domain code and predecessor of ODYSY. The models in FABLE/BYPSS were less detailed than in ODYSY and used conservative inputs to perform bounding calculations. The improved models in ODYSY have been demonstrated over time and validated against actual thermal-hydraulic instability (THI) events. The removal of the 0.15 decay ratio adder eliminates a conservative penalty in the ODYSY-based Option I-D and II Exclusion Region (ER) application methodology.

The following contains a restatement of the NRC RAI followed by the GEH response.

RAI-1

The purpose of this RAI is to address modeling uncertainties along the new exclusion region (ER) boundary to support removing the 0.15 decay ratio adder.

Please provide an analysis of the core outlet average void fraction and hot channel void fraction for the ER boundary points on the natural circulation line (NCL) and high flow control line (HFCL) using PANACEA (which employs an identical void quality correlation to ODYN) for a representative Option I-D plant with a maximum extended load line limit analysis (MELLLA) operating domain. Compare this void fraction to the qualification range for the Findlay-Dix correlation.

RAI-1 Response

A PANACEA analysis was performed for a representative Option I-D plant with a MELLLA operating domain. Calculations determined the core outlet average void fraction and hot channel exit void fraction for the ER boundary points on the NCL and the HFCL at the most limiting exposures for stability. The core outlet average exit void fraction was found to be [[ ]] on the HFCL and [[ ]] on the NCL. The hot channel exit void fraction was determined to be [[ ]] on the HFCL and [[ ]] on the NCL. These results fall within the range of the void fraction data, [[ ]], used in the benchmarking of the Findlay-Dix correlation.

RAI-2

Please provide verification that ODYSY05 has attained a Level 2 engineering computer program (ECP) status. Specify the code change acceptance criterion for ODYSY05 and provide a list of the functions and restrictions listed in the user manual.

RAI-2 Response

ODYSY05 was classified and maintained as a Level 2 computer program since Oct. 1997, per GNF Procedure CP 23.1, "Engineering Computer Programs." ODYSY05 was previously approved by the NRC in NEDC-32992P-A. A Level 2 design review is conducted for acceptance of any code changes which includes a review of the changes against the following criteria contained in the LTR (NEDC 33213P) Section 2.7.

> "A code version that involves modifications to the basic models described in References 6 and 7 may not be used for stability licensing calculations without NRC review and approval.
>
> [[
>
>]]
>
> Similarly, the numerical methods may be modified to improve code performance or convergence provided that the changes meet the above deviation criteria."

References 6 and 7 in the above quotation are equivalent to References 6 and 7 in this document.

ODYSY05 performs calculations for core-wide and channel stability. The outputs of the code include the core and individual channel frequency responses, decay ratios, and damping coefficients. The restrictions and limitations relevant to those outputs are as follows.

[[

]]

RAI-3

Explain the relevant physical processes that result in a relative ER boundary insensitivity to a feedwater temperature reduction (FWTR) along the NCL in Section 7 above a FWTR of 50 °F.

RAI-3 Response

The core stability margin may either increase or decrease with increased subcooling depending on the axial and radial power shape, core flow, and core power (Reference 2). The reason for a decrease in the stability margin with increasing feedwater temperature is [[

]]

The effect of the feedwater temperature on the stability margin at the NCL point is discussed below for a typical case, namely Plant C shown in Figure 7-7 of the LTR. A more detailed trend of the decay ratio is shown in Figure 3-1 below for various feedwater temperature and core power values along the natural circulation line. The core flow in this range is approximately constant. Note that in Figure 7-7 of the LTR, the exclusion region boundaries were obtained at the most limiting exposure at each feedwater temperature. A constant exposure [[ ]] is used in Figure 3-1 below to eliminate one variable from consideration.

It can be seen in Figure 3-1 below that, at higher core power, the decay ratio increases continuously as the feedwater temperature is reduced. The dependence of the decay ratio on the feedwater temperature reductions beyond [[ ]] is less pronounced at lower power.

[[

]]

[[

]]

RAI-4

Please calculate the core average void reactivity coefficient at the end of cycle (EOC) using a PANACEA inlet enthalpy perturbation for the Haling and actual exposure histories in Appendix A and compare them.

RAI-4 Response

Delayed neutrons play a key role in controlling reactivity for stability analysis. As such, the dynamic void coefficient (core average void reactivity coefficient divided by the exposure-dependent core average beta) is a better indicator of core stability in general. Dynamic void coefficient has been calculated at several state points for Plant C Cycle N+1. The results are presented in Table 4-1a, Table 4-1b, and Figure 4-1. The dynamic void coefficient based on actual operating history was determined at three exposure conditions (BOC, MOC and EOC) along with the Haling based dynamic void coefficients (H0 and H1). As explained in Appendix A of the LTR, the Haling calculation [[

]]

As shown in Figure 4-1, this procedure results in a dynamic void coefficient that is either conservative or at least similar in magnitude to the actual EOC dynamic void coefficient. It should be noted that the dynamic void coefficient is only one of several parameters affecting stability. The Haling methodology based on a bounding cycle exposure, along with other conservative assumptions, has been shown to provide reasonably bounding results when benchmarked against eight cycles of actual operating data. The eight operating cycles selected for this study included plants with expanded operating domains, extended power uprates, high-energy core loadings and advanced fuel designs. One cycle also captured plant operation with failed fuel and insertion of power suppression control rods. This study, which is documented in Appendix A of the LTR, was well received during the pre-submittal meeting with the NRC on April 18, 2007. The results clearly demonstrate the continued adequacy of the ODYSY methodology for modern cores.

[[

]]

RAI-5

Please provide additional descriptive details regarding the demonstration analyses in Section 5.5.

a) For the Nine Mile Point Unit 2 (NMP2) event, the decay ratio exceeds unity at the point of the SCRAM, the growth rate was measured to be on the order of 1.1 to 1.2. Please comment of the efficacy of ODYSY (a frequency domain code) to predict decay ratios that are greater than unity.

b) Please comment on the capability of ODYSY to account for feedback resulting from feedwater temperature (FWT) decrease with decreased steam flow. In other words describe those features of ODYSY that account for feedback mechanisms for the feedwater heaters and balance of plant.

c) In the analyses in Figures 5-1 and 5-2 of Section 5.5, were the approximate event traces based on plant data, PANACEA calculations, or calculated using another method?

d) For the NMP2 and Perry events, please provide the decay ratio or growth rate prior to suppression and the oscillation frequency. Please update Figures 5-1 and 5-2 with an indication along the traces that indicates the transition to an unstable condition (i.e., where on the map the decay ratio is calculated to be unity).

e) TRACG04 has been used to model the NMP2 event (see NEDE-32177P, Revision 3), the results indicate that the growth rate is sensitive to the FWT showing a difference on the order of 0.15 in growth rate for approximately a 40 K difference in FWT. Please evaluate the sensitivity of ODYSY. Comment on any features of the analysis methodology that ensure results are adequately conservative.

f) The qualification in Section 6 provides descriptions of the ODYSY inputs that most accurately represent the NMP2 event prior to the onset of the instability. Using these same evaluation inputs (as case 3c) evaluate the sensitivity of the decay ratio to a FWTR consistent with FWT measurement uncertainty or typical operating variations based on a state point along the ER in Figure 5-1. Using the case 3c inputs, evaluate the sensitivity of the decay ratio to a variation in core flow consistent with measurement uncertainties.

g) Please clarify the differences between the case 3c evaluation conditions and the proposed evaluation conditions for a standard production analysis.

RAI-5 Response

GEH only included these events as demonstration analyses in order to illustrate the conservatism of the calculated ER boundary relative to the actual power/flow conditions where the THI events occurred. However, responses to each of the staff questions are provided below. It should be noted that the plants in the demonstration analyses have not adopted the Option I-D long-term stability solution. Furthermore, the identity of these Option III plants is not given in the LTR. In some cases plant-specific input data were not available (for example, some time-dependent instrumentation data). In those cases, appropriate inputs were defined (for example, tested characteristics of the BWR product line).

The demonstration events were not intended to provide additional qualification of ODYSY. The ODYSY code has been previously qualified by comparisons with analytical solutions, approved design codes, plant data from stability tests and plant data from actual THI events. In addition, ODYSY has been approved by the NRC for application to BWROG stability solutions (Reference 5) and is used in Amendment 22 GESTAR evaluations for new fuel designs.

RAI-5(a) Response

The ODYSY decay ratio calculation method is applicable to decay ratios greater than unity as long as the oscillation magnitudes stay within the linearity assumptions of the methodology. The uncertainty stated in Section 4.2 of the LTR is applicable while the oscillations are small perturbations. Additional details on ODYSY qualification for decay ratios greater than unity are documented in Reference 7 and the Technical Evaluation Report for Reference 6.

RAI-5(b) Response

The evaluation conditions are specified for instability events as noted in Section 4.3 of the LTR. In accordance with procedures, the ODYSY exclusion region analysis is performed [[

]] This conservatism accounts for balance of plant, steam flow, and feedwater heater feedback in flow runback events. Because ODYSY is not a time domain code, it is not used to calculate a transient response.

RAI-5(c) Response

The event traces in LTR Figures 5-1 and 5-2 are based on the plant data.

RAI-5(d) Response

All the ODYSY inputs required are not available for plant-specific evaluation of these events. For the events discussed in Section 5.5 of the LTR, the core decay ratio and damped frequency of oscillation prior to suppression are calculated by ODYSY using methodology consistent with the calculation of the ER boundary. This is to provide a clear demonstration of DR behavior in the region of interest. These values are reported in Table 5d-1.

[[

]]

The transition to an unstable condition is calculated where the core decay ratio is equal to 1.0. This DR=1.0 Transition Boundary is drawn by calculating intercepts on the HFCL and the NCL and connecting these intercepts with the Generic Shape Function (GSF) to show its relationship with the Option I-D Exclusion Region Boundary (DR=0.8) based upon the same function. For comparison, the DR=1.0 intercepts are also connected with a straight line to approximate a line of constant DR that is consistent with Figure 2-1 in the LTR. These results are shown in Figures 5d-1 and 5d-2.

RAI-5(e) Response

Sensitivity

The decay ratios reported in Figure 7.6-14 of NEDE-32177P Rev. 3 (Reference 4) are obtained from the range of oscillations where the growth rate may be affected by the non-linear effects. Since ODYSY is a linear stability analysis code, the decay ratios calculated by the TRACG code in Figure 7.6-14 are not directly comparable to the decay ratios calculated by the ODYSY code. However, the sensitivity of the core decay ratio calculated by ODYSY to the feedwater temperature variation is on the same order of magnitude. This can be seen, for example, by comparing Figures 7-3 and 7-7 of the ODYSY LTR. The end point of the buffer region boundary on the HFCL in Figure 7-3, where the decay ratio is 0.65, corresponds to the exclusion region boundary on the HFCL obtained for approximately [[ ]] feedwater temperature reduction. In this case, a feedwater temperature reduction of [[ ]] results in a change of [[ ]] in the core decay ratio.

Methodology

During a transient to an off-rated power/flow equilibrium condition, the feedwater temperature decreases from a high initial value to a lower final value over a period of several minutes. The exclusion region analysis procedure is conservative with respect to the feedwater temperature change during a transient since [[

]]

RAI-5(f) Response

The sensitivity of the decay ratio (DR) calculation to (1) feedwater temperature (FWT) and (2) core flow has been evaluated using the LTR Section 6 Case 3c assumptions with appropriate inputs. The exception is the use of a constant xenon model for this 7 minute transient as the change in xenon concentration over such a short time period is negligible.

The values for the sensitivity parameters are conservatively obtained from NEDE-32906P-A Table 5-3 (Reference 3), which gives a one sigma value of [[

]]. The deviation on inlet subcooling is conservatively assumed to be -5°F.

[[

]] The differences between the case 3c evaluation conditions and the standard licensing basis calculations are further detailed in the response to RAI-5g.

RAI-5(g) Response

The Section 6 Case 3c evaluation conditions and the standard production analysis evaluation conditions are compared in Table 5g-1. These evaluation conditions are noted in Sections 5.2 and 5.3 of the LTR, and summarized in Table 5-2.

[[

]]

RAI-6

Deleted

RAI-6 Response

Not applicable. This RAI was retracted by the NRC prior to issuance.

RAI-7

Typically FWT varies during normal operation over a range. Update the TR to provide a greater degree of detail regarding the analysis conditions when performing the ODYSY analysis of the ER boundary. Specifically update the TR to specify an analysis FWT that is reduced relative to the average FWT by one standard deviation based on plant-specific measurements or determine a means for accounting for the uncertainty.

RAI-7 Response

The feedwater temperature varies in a narrow band during normal operation. The feedwater temperature variation over a period of three years was examined for three typical BWR plants. The feedwater temperature range when the power is nearly 100% is summarized in Table 7-1.

Table 7-1 Feedwater Temperature Data

	PLANT 7A Before power uprate	PLANT 7A After power uprate	PLANT 7B	PLANT 7C
Average (°F):	378.5	393.0	365.2	424.4
Minimum (°F):	376.2	391.1	364.0	422.3
Maximum (°F):	378.8	393.3	366.0	425.4
Standard Deviation (°F):	0.2	0.1	0.2	0.6
Rated FW temperature (°F)	376.0	391.5	364.3	424.0

The data shows that the feedwater temperature fluctuations are on the order of a fraction of a degree. The slightly higher standard deviation in Plant 7C is caused by high-pressure turbine replacement. The scatter of the data before and after the turbine replacement is very similar to the other plants.

The difference between the actual and the rated feedwater temperatures is approximately 2 °F. Since the ODYSY Decay Ratio calculation method is not sensitive to such small variations in the feedwater temperature, no updates were made to the LTR regarding the FWT variations.

RAI-8

Provide additional details regarding Figure 2-1, specifically the rated core thermal power, radial peaking factor, maximum nodal peaking factor, core inlet subcooling for the points on the NCL and HFCL, and rated core flow rate.

RAI-8 Response

The purpose of Figure 2-1 in the LTR is to demonstrate that the ER boundaries established by the GSF and the MSF are conservative relative to an ODYSY calculated line of constant core decay ratio.

Several power/flow state points were selected along various rod lines in the proximity of the HFCL. These state points are labeled as HF1 through HF8 in Figure 8-1 of this response. Figure 8-1 is the same as Figure 2-1 of the LTR but with points labeled. Calculations were then performed at forced flow conditions using conservative inputs (e.g., equilibrium steady-state feedwater temperature, constant xenon). The requested data pertaining to the forced flow calculations are provided in Table 8-1.

Several power/flow state points were also selected at various core flows near the proximity of the NCL. These state points are labeled as NC1 through NC6 in Figure 8-1. Calculations were then performed at natural circulation conditions using conservative inputs (e.g., equilibrium steady-state feedwater temperature, zero xenon). The requested data pertaining to the natural circulation calculations are provided in Table 8-2.

[[

]]

RAI-9

Please provide some more detail regarding the radial channel grouping approach for ODYSY. In particular, please confirm whether the channel grouping is such that:

- No single channel group accounts for more than 20 percent of the total core thermal power generation.
- There are at least three channel groups for each bundle type that contributes significantly to the core power.
- There is a hot-channel to model the highest power bundle for each significant bundle type in the core.

If an alternative approach is used, please describe those aspects of the radial channel grouping process that assures core and channel behavior are adequately modeled.

RAI-9 Response

A total of [[ ]] channel groups are utilized in the currently approved licensing basis ODYSY stability methodology. [[ ]] channel groups assures that core and channel behavior are adequately modeled and that no single channel groups accounts for more than 20% of the total core thermal power. Tables 9-1 and 9-2 provide typical examples of the [[ ]] channel grouping scheme utilized in ODYSY-based stability evaluations. Table 9-1 provides a typical example for a plant loading two dominant hydraulic bundle types. Table 9-2 provides a typical example for a plant loading three dominant hydraulic bundle types. For this discussion, a "dominant" bundle type is defined as having a significant contribution to overall core power. For each dominant bundle type, one group is reserved to represent the hot channel. The hot channel is defined as the highest power bundle for that bundle type. For example, in Table 9-1, Groups 1 and 9 represent the hot channel for each dominant bundle type that is loaded in Plant 9A; in Table 9-2, Groups 1, 7 and 12 represent the hot channel for each dominant bundle type that is loaded in Plant 9B.

These examples demonstrate the following:

[[

]]

This is the standard approach used in ODYSY stability methodology. No alternative approach is used.

Table 9-1 Channel Groups for Plant 9A with Two Unique Bundle Types

[[

]]

Table 9-2 Channel Groups for Plant 9B with Three Unique Bundle Types

[[

]]

RAI-10

Please explain the unexpected trend in channel decay ratio with FWTR for Plant C along the NCL; particularly explain why ODYSY predicts such a high channel decay ratio for the 100 °F FWTR. The NRC staff expects that increasing the FWTR would increase the inlet subcooling and would result in increased channel thermal hydraulic instability margin. This trend is not demonstrated for Plant C along the NCL while it is consistently demonstrated for all other plants along both lines. Please explain the unexpected results for Plant C.

RAI-10 Response

As noted in RAI-11, "there are certain conditions where FWTR may be stabilizing." This stabilizing effect appears to be more pronounced along the NCL; that is, at a fixed exposure state point the core and hot channel DR can improve slightly when accounting for FWTR operation. It should be noted that the ODYSY ER calculations are performed at multiple exposure state points as described in the response to RAI-11. At these lower exposures, both core and hot channel DRs increase due to higher radial peaking. The effect of increased radial peaking factor (RPF) appears to have a more pronounced impact on a very stable channel along the NCL, such as Plant C. Consequently, ODYSY predicted a higher hot channel DR at the lower exposure state point, a trend that would be expected for a larger RPF. Although the hot channel DR may increase, the magnitude remains very low and is not a factor in establishing the ER, which is based on an ODYSY solution with a core DR of 0.80. ODYSY calculated hot channel DRs that are very low in magnitude are sensitive to the initial input conditions. The natural circulation conditions with no recirculation drive flow and with a lower core pressure drop tend to introduce a larger calculation uncertainty on the low channel DR relative to forced flow conditions. However, the hot channel DR is not used in establishing the ER for Option I-D plants.

The reported hot channel DR results for the three FWT conditions (normal, minus 50 °F and minus 100 °F) for each plant along the NCL exhibited a nearly consistent trend. That is, the hot channel DR became slightly lower with each decrease in FWT. However, there was one exception for Plant C at the minus 100 °F state point. The hot channel DR increased from a value of [[ ]] at minus 50 °F to a value of [[ ]] at minus 100 °F. In comparison to the reported channel DR results for all NCL state points, [[ ]] remains among the lowest hot channel DR values. Among the four plants selected for the LTR demonstration analyses, Plant C exhibits the highest margin to instability, characterized not only by the lowest hot channel DR values but also by the smallest ER size. Relative to all reported hot channel DRs, a value of [[ ]] does not represent "such a high channel decay ratio" as stated in RAI-10. In addition, these hot channel decay ratios are all below the 0.56 criterion in the ODYSY criteria map, which means that the core-wide decay ratios are what determine the ER boundaries. This is not surprising since all Option I-D plants are core-wide dominant by design. The ER intercepts along the HFCL and the NCL correspond to an ODYSY calculated core DR of 0.80; for this design application the hot channel DR is not a determining factor.

RAI-11

Please clarify how the ODYSY calculations are performed for FWTR specific ER boundaries. The TR does not describe how the core power distribution is determined for a specific FWTR. Is the power shape the same as the nominal FWT Haling EOC shape or is it recalculated using PANACEA based on the new inlet enthalpy? If PANACEA is used how is exposure determined?

The NRC staff has reviewed the demonstration analyses for FWTR specific ER but needs additional clarification, specifically there are certain conditions where FWTR may be stabilizing if the FWTR results in an increase in the single phase to two phase pressure drop ratio and serves to reduce the core average void reactivity coefficient. Explain how analysis input is specified to ensure that the FWTR specific ER boundaries are determined conservatively.

RAI-11 Response

The ODYSY calculation procedure for determining the reduced FWT-specific ER is similar to the procedure for the nominal FWT ER. Both ERs rely on the Haling methodology [[ ]] to establish conservative input conditions. The power shapes are recalculated by PANACEA at the [[ ]]

The purpose of establishing a more conservative ER during FWTR operation is to account for the potentially destabilizing effect of higher subcooling on core operation. The effect of FWTR is most pronounced along the HFCL. ODYSY is used to determine the intercepts along both the HFCL and the NCL. The intercepts correspond to an ODYSY calculated core DR of 0.80. The hot channel DR is also calculated and its magnitude is verified to be lower than the design criterion. However, for Option I-D plants, the hot channel DR is not significant in the

ER design application since these plants are characterized by: (a) relatively tight inlet orifices resulting in a lower two phase to single phase pressure drop ratio and hence a low channel DR (i.e., a more stable channel); and (b) a smaller core size that contributes to a larger reactivity separation between the fundamental and higher harmonic flux solutions, making core wide (in phase) oscillations the dominant mode. The channel DR is more relevant in assessing the stability margin for a plant in which regional oscillation is the dominant mode.

The following event scenarios are assumed for the ODYSY calculations along the HFCL and the NCL.

Forced circulation c alculation on the HFCL

The core is operating at FWTR conditions at EOC prior to a rapid flow runback event (e.g., a two recirculation pump trip). Conservative assumptions for modeling this event include [[

]]

Natural circulation calculation along the NCL

The calculation along the NCL is performed in a similar manner [[

]] The most bounding result produces the lowest core power along the NCL and an expanded and conservative ER relative to the normal FWT conditions. By procedure, the ER for reduced FWT is never smaller than the ER for normal FWT operation.

Finally, with regard to final FWTR application, it should be noted that FWTR is a licensed BWR cycle extension option that is introduced when the end-of-rated power reactivity condition has been reached. Reducing FWT allows the reactor to continue rated power operation by introducing positive reactivity (colder water) into the core. Implementation of FWTR often follows Increased Core Flow (ICF) operation, another licensed BWR cycle extension option.

This means that by the time FWTR has been implemented, the reactor will be operating along the 100% rod line or a lower rod line. However, the ODYSY design calculation assumes operation along the HFCL, the highest licensed flow control line (e.g., the MELLLA line). This results in a conservative ER intercept along the HFCL and a much expanded ER for FWTR operation. As previously noted, the lower left portion of the ER is primarily intended for stability protection during startup as that is the most likely scenario in which this area of the ER would be entered (note that the Buffer Region and on-line stability monitor make this highly unlikely). It can be argued whether FWTR operation during startup is a realistic scenario. Nevertheless, ODYSY calculations are performed to determine an intercept along the NCL for FWTR conditions. The conservatisms in the ODYSY application procedure for FWTR operation, coupled with other Option I-D preventive elements (e.g., Buffer Region, on-line stability monitor) and the detect and suppress element (i.e., flow biased APRM flux scram), provide adequate stability protection for plants that have adopted this long-term stability solution.

REFERENCES

Item	Reference
1	M. Honcharik (Nuclear Regulatory Commission) to R. Bunt (BWROG), *Request for Additional Information Re: Boiling Water Reactor Owners' Group (BWROG) Topical Report (TR) NEDE-33213P, "ODYSY Application for Stability Licensing Calculations Including Option I-D and II Long Term Solutions" (TAC No. MD5743)*, February 21, 2008.
2	BWROG-94078, *BWROG Guidelines for Stability Interim Corrective Action*, June 6, 1994.
3	NEDE-32906P-A, *TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analysis, Licensing Topical Report*, Revision 3, September 2006.
4	NEDE-32177P, *TRACG Qualification, Licensing Topical Report*, Revision 3, August 2007.
5	NEDC-32992P-A, *ODYSY Application for Stability Licensing Calculations, Licensing Topical Report*, July 2001.
6	NEDC-32339P-A Supplement 1, *Reactor Stability Long Term Solution: Enhanced Option I-A, ODYSY Application to E1A*, December 1996. Also Timothy E. Collins, *Request for Additional Information for GE Topical Report, NEDC-32339P, Supplement 1 (TAC No. 89222)*, June 1, 1994, and BWROG 94149, R.A. Pinelli, *Response to NRC Request for Additional Information for GE Topical Report, NEDC-32339P, Supplement 1*, November 9, 1994.
7	NEDC-32661P, *ODYSY Description and Qualification*, October 1996.

ACRONYMS AND ABBREVIATIONS

Item	Term	Definition
1	APRM	Average Power Range Monitor
2	BOC	Beginning of Cycle
3	BWR	Boiling Water Reactor
4	BWROG	Boiling Water Reactor Owners' Group
5	CP	Common Procedure
6	DR	Decay Ratio
7	ECP	Engineering Computer Program
8	ELLLA	Extended Load Line Limit Analysis
9	EOC	End of Cycle
10	ER	Exclusion Region
11	FWT	Feedwater Temperature
12	FWTR	Feedwater Temperature Reduction
13	GEH	GE Hitachi Nuclear Energy
14	GESTAR	General Electric Standard Application for Reactor Fuel
15	GNF	Global Nuclear Fuels
16	GSF	Generic Shape Function
17	HFCL	High Flow Control Line
18	ICF	Increased Core Flow
19	LTR	Licensing Topical Report (NEDE-33213P unless otherwise defined)
20	MELLLA	Maximum Extended Load Line Limit Analysis
21	MOC	Middle of Cycle
22	MSF	Modified Shape Function
23	NCL	Natural Circulation Line
24	NMP2	Nine Mile Point 2
25	NRC	Nuclear Regulatory Commission
26	ODYSY	One-Dimensional Dynamic Code for Stability
27	RAI	Request for Additional Information
28	RPF	Radial Peaking Factor
29	THI	Thermal-Hydraulic Instability

Enclosure 3
GE Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Tim E. Abney, state as follows:

(1) I am Vice President, Services Licensing, GE Hitachi Nuclear Energy Americas LLC ("GEH"). I have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of BWR Owner's Group letter, dated March 28, 2008, BWROG-08018, R. C. Bunt to U.S. Nuclear Regulatory Commission, entitled "Responses to Requests for Additional Information (RAIs) Dated February 21, 2008, Regarding the Submittal of BWROG Topical Report (TR) NEDE-33213P, "ODYSY Application for Stability Licensing Calculations Including Option I-D and II Long Term Solutions," dated June 5, 2007 (TAC No. MD5743)." GEH text containing proprietary information in Enclosure 1, which is entitled "Responses to RAIs", is identified by a dark red dotted underline inside double square brackets [[This sentence is an example.{3}]]. Figures and large equation objects containing GEH proprietary information are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information which, if used 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 of a similar product;

c. Information which reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) above is classified as proprietary because it contains results and details of analysis methods and techniques developed by GEH for evaluations of reactor stability. Development of these methods, techniques, and information and their application to reactor stability calculations was achieved at a significant cost to GEH.

The development of the methodology along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GEH asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 27th day of March, 2008.

Tim E. Abney
Vice President, Services Licensing
GE Hitachi Nuclear Energy Americas LLC