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SUBJECT: Forwards responses to NRC request for info re DNBR core protection calculator & proprietary & nonproprietary CEN-184(S) "Responses to Questions on Documents Supporting Songs-2 Licensing Submittal."

See subject files

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K. P. BASKIN
MANAGER OF NUCLEAR ENGINEERING, SAFETY, AND LICENSING

TELEPHONE
(213) 572-1401

September 3, 1981

Director, Office of Nuclear Reactor Regulation
Attention: Mr. Frank Miraglia, Branch Chief
Licensing Branch No. 3
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

During a meeting with the NRC staff on August 20, 1981 in Bethesda, Maryland, the following items were discussed:

1. Departure from Nucleate Boiling Ratio (DNBR)
2. Core Protection Calculator (CPC)
3. CEN-160-(S)-P, May, 1981, "CETOP-D Code Structure and Modeling Methods for San Onofre Nuclear Generating Station, Units 2 and 3."

With respect to DNBR, consistent with the discussion during the meeting, Enclosure I provides the method which San Onofre Units 2 and 3 will utilize to adjust the CPC calculation of DNBR to accommodate the increase in the DNBR limit from 1.19 to 1.20.

With respect to CPC, the NRC staff requested responses to twelve (12) additional concerns. Enclosure II provides response to these questions. Responses to questions 1, 3, 4, 7 and 8 involve information which is proprietary to Combustion Engineering (CE). Enclosure II also provides three (3) copies (Copy Nos. 002, 003 and 004) of the proprietary document CEN 184(S)-P, Responses to Questions on Documents Supporting SONGS-2 Licensing Submittal including five (5) copies of the non-proprietary version (CEN 184(S)-NP) and an affidavit setting forth the basis on which the information may be withheld from public disclosure by the Commission and addressing specifically the considerations listed in 10 CFR 2.790(b) of the Commission's regulations.

With respect to CEN-160-(S)-P (CTOP-D), Enclosure III provides errata pages to CTOP-D consistent with the clarification requested by the NRC staff during the meeting.

It is respectfully requested that the above information which is proprietary to Combustion Engineering, Inc. be withheld from public disclosure in accordance with 10 CFR 2.790(b) of the Commissions regulations. If you should have any questions concerning the proprietary nature of the material transmitted herewith, please address these questions directly to:

Mr. A. E. Scherer
Director of Licensing (9438-1922)
Combustion Engineering
1000 Prospect Hill Road
Windsor, Connecticut 06095

It is also requested that you provide a copy of any questions concering the proprietary nature of this submittal to SCE and SDG&E.

The enclosed documentation addresses all previously identified NRC requirements relative to these issues and provides the information necessary to resolve the CPC and DNBR Open Items.

If you have any questions or comments, please contact me.

Very truly yours,

WP Baskin

Enclosures

AFFIDAVIT PURSUANT

TO 10 CFR 2.790

Combustion Engineering, Inc.)
State of Connecticut)
County of Hartford) SS.:

I, P. L. McGill depose and say that I am the Vice President, Commercial of Combustion Engineering, Inc., duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations and in conjunction with the application of Southern California Edison Co. and San Diego Gas and Electric Co., for withholding this information.

The information for which proprietary treatment is sought is contained in the following document:

CEN - 184(S) - P, Response to Questions on Documents Supporting SONGS 2 License Submittal.

This document has been appropriately designated as proprietary.

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

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

1. The information sought to be withheld from public disclosure are the sensitivity analysis results of the TORC/CE-1 methodology and the CETOP methodology; and measurement and algorithm uncertainties used in the CPC's, which is owned and has been held in confidence by Combustion Engineering.

2. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a substantial competitive advantage to Combustion Engineering.

3. The information is of a type customarily held in confidence by Combustion Engineering and not customarily disclosed to the public. Combustion Engineering 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 details of the aforementioned system were provided to the Nuclear Regulatory Commission via letter DP-537 from F.M. Stern to Frank Schroeder dated December 2, 1974. This system was applied in determining that the subject documents herein are proprietary.

4. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

5. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

6. Public disclosure of the information is likely to cause substantial harm to the competitive position of Combustion Engineering because:

a. A similar product is manufactured and sold by major pressurized water reactors competitors of Combustion Engineering.

b. Development of this information by C-E required hundreds of manhours of effort and tens of thousands of dollars. To the best of my knowledge and belief a competitor would have to undergo similar expense in generating equivalent information.

c. In order to acquire such information, a competitor would also require considerable time and inconvenience related to performing a sensitivity analysis and generating the measurement and algorithm uncertainties used in the CPC's.

d. The information required significant effort and expense to obtain the licensing approvals necessary for application of the information. Avoidance of this expense would decrease a competitor's cost in applying the information and marketing the product to which the information is applicable.

e. The information consists of the sensitivity analysis results of the TORC/CE-1 methodology and the CETOP methodology; and measurement and algorithm uncertainties used in the CPC's, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with Combustion Engineering, take marketing or other actions to improve their product's position or impair the position of Combustion Engineering's product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

f. In pricing Combustion Engineering's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included.

The ability of Combustion Engineering's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

g. Use of the information by competitors in the international marketplace would increase their ability to market nuclear steam supply systems by reducing the costs associated with their technology development. In addition, disclosure would have an adverse economic impact on Combustion Engineering's potential for obtaining or maintaining foreign licensees.

Further the deponent sayeth not.

P L McGill

P. L. McGill
Vice President
Commercial

Sworn to before me
this 3rd day of September, 1981

Carey J. Wenzel
Notary Public

CAREY J. WENZEL, NOTARY PUBLIC
State of Connecticut No. 59962
Commission Expires March 31, 1985

ENCLOSURE I

DNBR

ENCLOSURE I
DNBR

At a meeting between Southern California Edison, (SCE), the Nuclear Regulatory Commission (NRC) and Combustion Engineering (CE), on August 20, 1981, the NRC's review of the use of the CE-1 correlation with the SONGS core employing HID-2 spacer grids was discussed. The NRC has concluded that the CE-1 minimum DNBR limit in CPC DNBR calculations should be increased from 1.19 to 1.20 when used with the HID-2 spacer grids. The NRC indicated that the increase in the DNBR limit is necessary to compensate for the uncertainty in using the CE-1 correlation to calculate DNBR on San Onofre Units 2 and 3 which used the HID-2 spacer grids. In order to facilitate the licensing review of San Onofre Units 2 and 3, SCE will implement a penalty factor equivalent to the increase in the DNBR limit.

The method in which the Applicants propose to incorporate the increase in the DNBR limit is to impose a penalty on the power level used in the CPC DNBR calculation which is equivalent in terms of thermal margin to the increase in the DNBR limit. This method is proposed as an alternative to changing the DNBR limit in the CPC DNBR algorithm calculations. A change to the DNBR fuel design limit itself would require a great deal of time and effort including a complete rewrite of the CPC disk and extensive modifications to the safety analysis in the FSAR. The equivalent power penalty, on the other hand, can be easily incorporated into the addressable constant BERR1. BERR1 is used to adjust the core power level used in the CPC calculation of DNBR.

The method for providing the equivalent power penalty is to convert the percent increase in DNBR to an equivalent percent change in power. The conversion factor is determined from a sensitivity study of the change in Overpower Margin (OPM) with respect to changes in DNBR. In order to insure conservatism, the most adverse derivative of OPM with respect to DNBR from a large range of operating conditions is used. This sensitivity study is being provided in response to NRC question 4 of the Enclosure II responses. Using this derivative, BERR1 can be adjusted as follows:

$$BERR1_{new} = BERR1 * (1 + (DNBR\ penalty\ (\%) * (\frac{d\ \%\ OPM}{d\ \%\ DNBR}) * .01))$$

This methodology was recommended by the NRC in the Safety Evaluation Report of ANO-2 Cycle 2, Docket No. 50-368 for accomodation of an analogous uncertainty. ANO-2 is operating using this methodology.

ENCLOSURE II

CPC

Question 1

In Table 3.2 of CEN-135(S)-P, Plant-specific constants for SONGS, the narrow-band and wide-band algorithm uncertainty factors (E_1 and E_2) are listed as [ ] and [ ] respectively. However, CEN-175(S)-P Data Base Document lists the values of [ ] and [ ] respectively, for E_1 and E_2.

(a) Explain the discrepancies.

(b) Describe in detail how these values are obtained.

(c) Describe how the narrow-band and wide-band ranges are determined.

Answer

1. (a) The narrow-band and wide-band algorithm uncertainty factors (E_1 and E_2) were reported in CEN-135(S)-P as [ ] and [ ] respectively. These values were preliminary values calculated during the testing of the CPC STATIC algorithm. The final values of the narrow-band and wide-band algorithm uncertainty factors are correctly reported in CEN-175(S)-P as [ ] and [ ] respectively. The discrepancy between the preliminary values and the final values is due to the use of quality assured input data in the final calculation and the correction of some errors in the STATIC (CETOP2) coding.

(b) The narrow-band and wide-band algorithm uncertainty factors are obtained by performing an uncertainty assessment for CETOP2 relative to the CETOP-D code. This assessment consists of dividing the operating space into a narrow range and a wide range and comparing the overpower margin (OPM) calculated by CETOP2 to that calculated by CETOP-D for thousands of cases in each range. From the resulting error distributions 95/95 one sided tolerance factors are determined which then become the algorithm uncertainty factors. These algorithm uncertainty factors provide a 95% confidence that at least 95% of the MDNBR's calculated by CETOP2 are conservative with respect to CETOP-D.

(c) The narrow and wide range limits on the CPC operating space are determined by examining the range of the parameters expected to be observed during AOO's as well as trip limits and limits on the range of validity of the CE-1 correlation. A description of the range limits is given in Table 1.

TABLE 1

CPC OPERATING RANGE FOR SONGS 2 AND 3, CYCLE 1

PARAMETER	UNITS	NARROW RANGE	WIDE RANGE
Core Power (1)	% of full power	0 ≤ power ≤ 130%	0 ≤ power ≤ 130%
CPC-Calculated One-Pin Radial Peak, P1 (2)	-	1.28 ≤ P1 ≤ 2.5	1.28 ≤ P1 ≤ 4.28
Hot Pin Axial Shape Index, ASI (3)	-	-0.3 ≤ ASI ≤ +0.3	-0.6 ≤ ASI ≤ +0.6
Core Flow Rate (4)	% of 143 x 10^6 lbm/hr	90% ≤ flow ≤ 120%	90% ≤ flow ≤ 120%
Core Inlet Temperature, T-cold (5)	°F	530 ≤ T-cold ≤ 571	490 ≤ T-cold ≤ 585
Primary Pressure, P (6)	psia	1960 ≤ P ≤ 2415	1785 ≤ P ≤ 2415

NOTES: (1) CPC's have no explicit range limits on power. However, the CPC's should be valid within the range provided. The upper limit of the range is based upon a 125% analysis setpoint for the high linear power level trip with a 5% allowance.

(2) CPC-calculated one-pin radial peak is conservative with respect to actual one pin peak and includes any penalties for CEA misoperation events.

(3) The ±0.3 ASI limits are based on range of validity for PDIL's. The ±0.6 ASI limits were used for ANO-2. The range limits are based on values of CPC-calculated hot pin ASI. Differences between the CPC-calculated values and the actual values of hot pin ASI are to be accommodated by the CPC uncertainty analysis.

(4) CPC's have no explicit range limits on flow. However, the CPC's should be valid within the range provided. The CPC's generate a trip if more than two pumps have speeds less than 90%. In addition, large conservative uncertainty factors will be applied to DNBR and LPD if one or more pumps have speeds less than 90%. Part-loop operation is not a design basis for 3410 MWt CPC data constant generation.

(5) Narrow range based on contractual transients. Lower limit of wide range based on a low SG pressure trip analysis setpoint of 695 psia minus a 30 psi allowance. Upper limit of wide range based on the SG pressure required to lift the secondary safety valves. Temperatures include a ±5.0°F uncertainty allowance.

TABLE 1 Cont.

(6) Narrow range envelopes contractual transient range. Lower limit of wide range is based on a low pressurizer trip for CPC's assumed in the safety analysis. The upper wide range limit is the highest pressure for which the CE-1 correlation is valid (Reference 4). Pressures include a ±40 psi uncertainty allowance. This uncertainty is not valid for any accident conditions resulting in an abnormal containment environment.

<u>Question 2:</u> In table 3.2 of CEN-135(S)-P the flow starvation factors ($F_{split\ 1}$ and $F_{split\ 2}$) for narrow-band and wide-band operations are listed as .86 and .76, respectively. However, the Data Base Document lists the values as 0.86 and 0.7, respectively.
(a) explain the discrepancy.
(b) describe in detail how these values are obtained.
(c) provide flow test data to justify these values.

<u>Response:</u> (a) The correct flow factor is .70 as shown in the data base document, CEN-175(S)-P. The .76 value was a prelimin-are estimate.

(b) and (c) The flow factor is not determined by using flow model test data in CETOP. It is a factor which is determined by benchmarking minimum DNBR values from CETOP against Detailed TORC values for a specified range of operating conditions. Furhter discussion on the use of the flow factor is included in Section 5 of Reference 1. Two flow factors are determined for SONGS; the .86 for the narrow band and .7 for the wider band of operating conditions.

Question 3

CEN-175(S)-P, Data Base Document, lists the BERR1 value as 1.13. Describe in detail how this value is obtained. Is BERR1 a fixed value or an addressable constant as indicated in CEN-135(S)-P? If BERR1 is an addressable constant, will it be 1.13 for an entire cycle?

Answer

The value of 1.13 for BERR1 (from CEN-175(S)-P) was preliminary. The final BERR1 value for SONGS-2 Cycle 1 is 1.15.

BERR1 is an addressable constant and is utilized in accordance with Section 2.5 of CEN-135(S)-P. The present stipulations of the CE analysis for calculation of the DNBR uncertainty factor (BERR1) require that the BERR1 value of 1.15 remain throughout the entire first cycle.

The details of the methodology used to obtain the value of BERR1 is documented in the response to item 222.129 of CEN-35(A)-P. The following table provides the individual uncertainty components which were used to calculate BERR1 for SONGS-2 Cycle 1.

BERR1 RELATED UNCERTAINTIES

UNCERTAINTY COMPONENT (i)	MAGNITUDE	EQUIVALENT OVERPOWER MARGIN UNITS, % (x_i)
1) Inlet Temperature		
2) CPC Reactor Coolant[(1)] Flow Rate		
3) Reactor Coolant System Pressure		
4) Startup Test Acceptance Criteria[(2)]		
5) Composite Modelling Error[(3)]		
6) Computer Processing		

(1) Uncertainties due to off-line flow measurement, CPC-to-off-line calibration, and reactor coolant pump speed measurement.

(2) Parameter uncertainties include, rod shadowing factors, temperature shadowing factor, and boundary point power coefficients.

(3) Combines the pseudo-hot-pin synthesis error (including ex-core detector signal noise and CEA position measurement error), CECOR planar radial peaking measurement uncertainty and rod bow uncertainty on radial peaking factor.

Question 4

Provide a sensitivity study of DNBR vs. BERR1 for various ASI and flow conditions.

Answer

The BERR1 term is a multiplier on the core power level used in the CPC calculations of DNBR. Therefore the requested sensitivity study is actually a study of how power affects DNBR for various ASI's and flows. This sensitivity study is given below.

A sensitivity study of the derivative, $\frac{d\ \%\ OPM}{d\ \%\ DNBR}$ was performed using the CETOP-D SONGS-2 Cycle 1 model. This study examined the change in overpower margin relative to change in the DNBR limit from [ ] to [ ] for the following conditions:

Pressure: [ ] psia
Inlet Temperature: [ ] °F
ASI 405 shapes from [ ] ASI
Core Flow: [ ] nominal volumetric flow

A plot of $\frac{d\ \%\ OPM}{d\ \%\ DNBR}$ for each condition is given in Figure 1.

This study is similar to that provided for ANO-2 Cycle 2 in the response to NRC Question 492.66.

A sensitivity study of DNBR vs. Power (BERR1) for various flows is also provided.

The methodology used in this study is described below.

1) The pressure, inlet temperature, radial peak, and ASI for this study were held constant at the following values.

Pressure - [ ] psia
Inlet Temperature - [ ] °F
Radial Peak - [ ]
ASI -

The power which results in a MDNBR of approximately [ ] at [ ] flow was determined. Using this power and [ ] flow the MDNBR was calculated by CETOP2.

2) Using the [ ] flow ([ ] Mlbm/ft^2·hr) a multiplier on power (BERR1) is increased in .02 increments until a MDNBR of approximately [ ] is reached. These values of DNBR vs. BERR1 are plotted in Figure 2.

3) Next, the value of BERR1 is held constant at [ ]. The flow is decreased until a MDNBR of approximately [ ] is obtained. This DNBR vs. flow sensitivity is shown in Figure 3.

4) Finally, holding the flow at the value which resulted in a MDNBR of [ ] in step 3, the value of BERR1 is reduced from [ ] to [ ] in intervals of .02. This values of DNBR vs. BERR1 at the lower flow are plotted on Figure 2 also.

FIGURE 1

DERIVATIVE SENSITIVITY VS. ASI

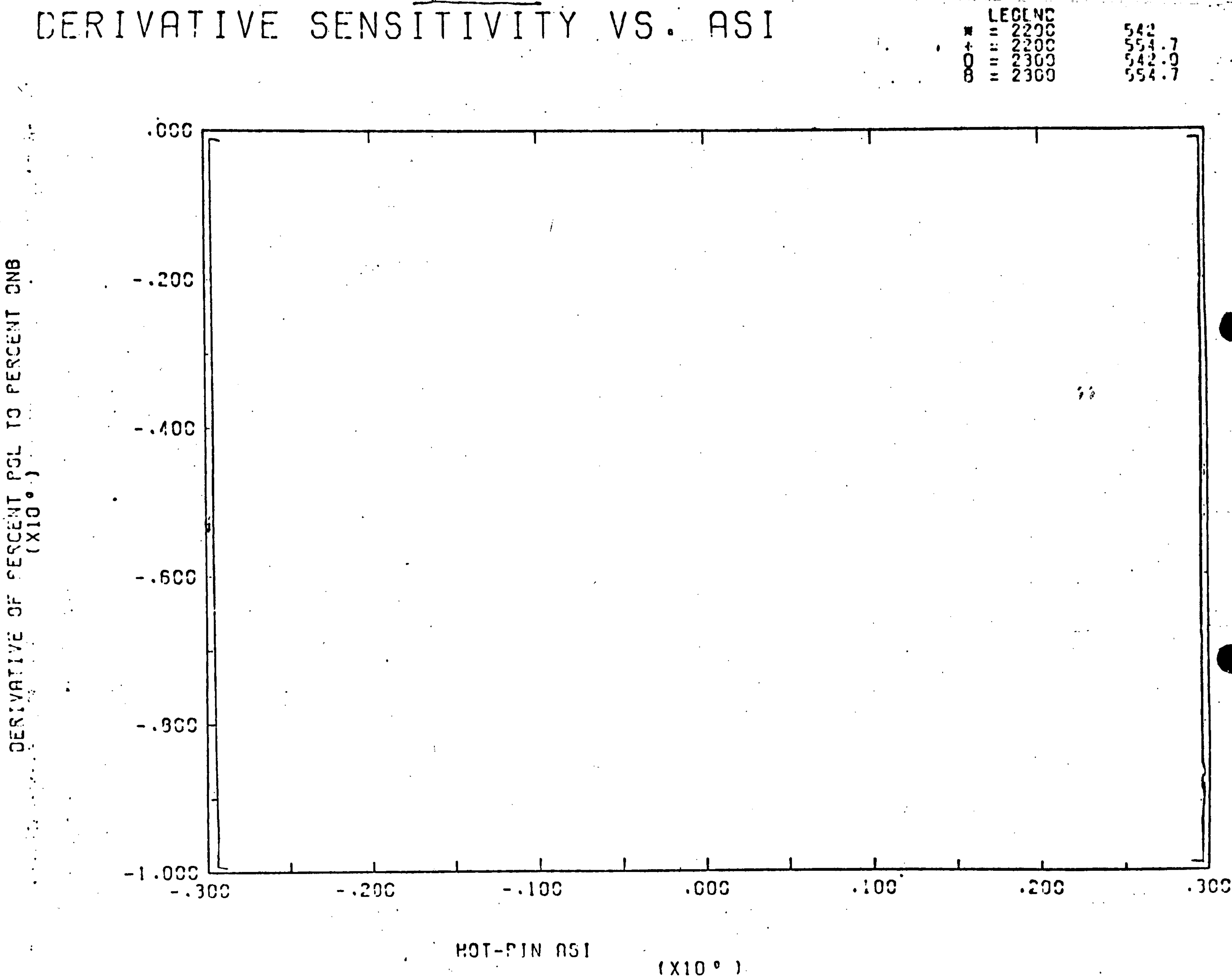


FIGURE 2

MDNBR vs BERR1

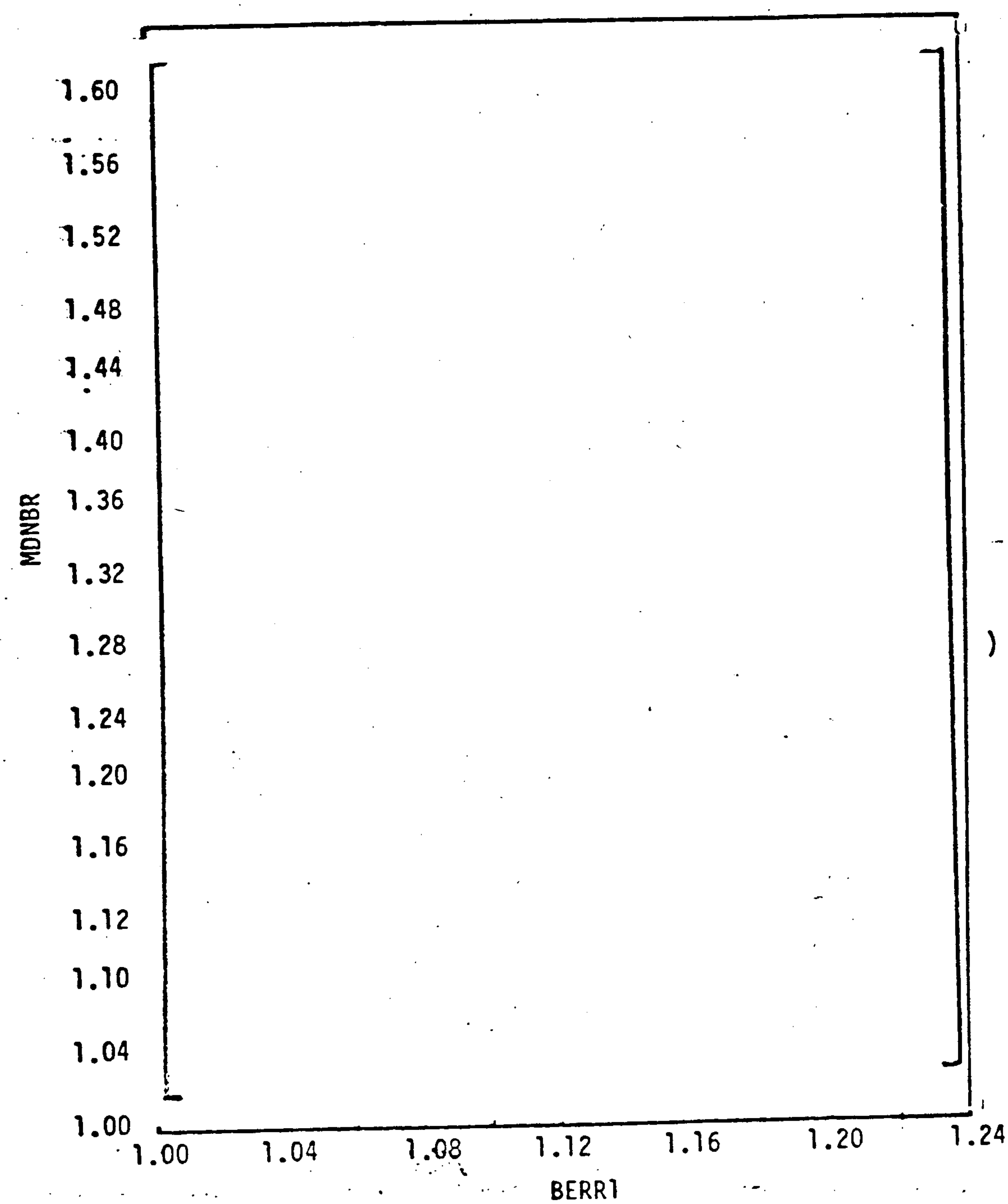
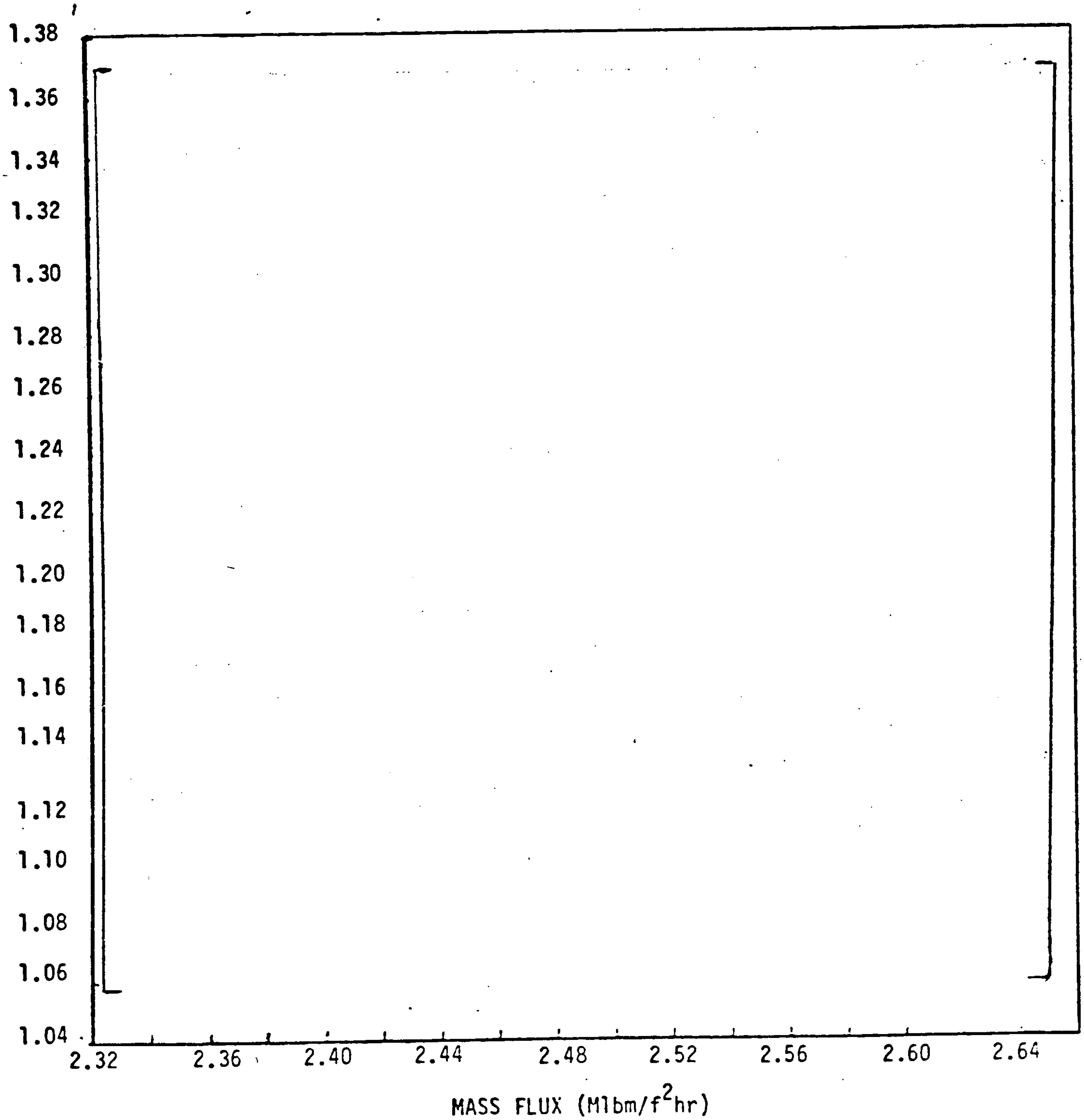


FIGURE 3

MDNBR vs MASS FLUX



Question 5: CEN-175(S)-P lists the spacer grid loss coefficient as 0.45. However, the response to an NRC question (CEN-155(S)-P) indicates that the overall loss coefficients for HID-1 and HID-2 grids are 0.58 and 0.96, respectively. Exalain the discrepancy.

Response: The .58 and .96 loss coefficients are evaluated based upon best estimate calculations and test data. In the CETOP on-line program one loss coefficient was used for both grid types since one value could easily be programmed into the protection system as opposed to using more than one constant or Reynolds number dependent equations. The .45 value was chosen instead of a best estimate value since a lower value produces slightly conservative MDNBRs. This conservatism results from the reduction in cross-flow which is associated with the use of a lower grid loss coefficient. In addition to this conservatism, the CETOP on-line program is benchmarked to the parent design code CETOP-D, which uses more accurate grid loss coefficients. Therefore the DNBRs predicted by CETOP on-line program will be conservative due to the benchmarking and use of the .45 grid loss coefficient.

Question 6: Is the SONGS CETOP-D report identical to the ANO-2 CETOP-D report?

Response: The SONGS report is identical to the ANO-2 CETOP report except for the following differences:

(a) System parameter uncertainties in SONGS CETOP-D are applied deterministically instead of statistically for ANO-2.

(2) Section 5 of the SONGS CETOP-D report is slightly different since it describes thermal margin analyses for SONGS core instead of ANO-2.

Question 7

In Appendix A of CEN-135(S)-P, CETOP-2 Functional Description, there is a discrepancy in the range of applicability of Martinelli-Nelson void fraction correlation between the CETOP-2 algorithm and Table 3.1. These applicability ranges also differ from that described in TORC. Explain the discrepancy.

Answer

The values of the quality ranges used in determining the void fraction correlation in CETOP-2 are the [same as those used in TORC]. The values given in Table 3-1 and on page A-7 of CEN-135 are incorrect. The correct implementation of the void fraction correlation is given on page A-26 of CEN-135(S)-P.

The pressure range for this correlation is the same as in TORC.

Question 8

Describe how the values of energy and momentum transport coefficients are obtained for SONGS CPC.

Answer

The energy and momentum transport coefficients are constants used in the CETOP2 algorithm to model the enthalpy and momentum exchange between the buffer channel or hot channel and the hot assembly. The energy transport coefficient is determined by [

]. Any uncertainty in the CETOP2 calculations due to the use of this constant energy transport coefficient are conservatively compensated by the algorithm uncertainty factors.

The momentum transport coefficient is a constant used in the calculation of the transverse momentum exchange. The calculation of DNBR has been found to be insensitive to this coefficient. Therefore a typical value determined from TORC subchannel calculations is used. The momentum transport coefficient is defined as:

CN = [ ]

where N_p = Pressure Transport Coefficient

= [ ]

Number of gaps = [ ]

CN = [ ]

These transport coefficients and the sensitivity of DNBR to each is discussed in the responses to NRC questions 492.3 and 492.75 of the ANO-2 Cycle 2 licensing submittal as well as in Reference 1.

Question 9: Provide justification for using a guide tube channel modeling for the pseudo hot channel in SONGS CPC. You must show that the minimum DNBR also occurs in a guide tube channel during the entire cycle if the modeling is to be used for one cycle only. The same should be proved for the entire core life if the modeling is to be used for the entire SONGS core life.

Response: The response to this question is the same as that provided in Question 492.77 for ANO-2. (Ref. 2). A copy of this response is included below for SONGS.

The MDNBR in detailed TORC will always be located in the corner guide tube channel throughout the core life, if the following are true:

1. The cold wall correction factor in the CE-1 correlation is used to reduce DNBR in guide tube channels.
2. Present fuel management schemes are used to generate power distributions which produce the largest pin peaks near guide tube water holes throughout the core life.

Since the above items are true for present SONGS design analyses, MDNBR will always occur in the corner guide tube channel in detailed TORC. Therefore a best estimate model for CETOP-D or CETOP-2 should also use the corner guide tube channel as the hot channel.

If in reality MDNBR does not occur in the corner guide tube channel, the MDNBR predicted with detailed TORC (in the corner guide tube channel) will still be lower than any value in the core since the use of the CE-1 correlation in detailed TORC has been verified to produce conservative results relative to test measurements (Ref. 3), which included CHF occurrences in both the guide tube and matrix channels. The CETOP-D MDNBR will also be conservative relative to the actual MDNBR in the core since it is benchmarked to detailed TORC results.

However, the corner guide tube channel does not have to be modeled in CETOP-D as the hot channel since the benchmarking forces CETOP-D to be independent of the location of the hot channel and other model differences between TORC and CETOP-D.

Question #10

"The DSVT (Dynamic Software Verification Test) Case 22-4 of the CPC Phase II Test Report (CEN-173(S)-P) shows the single channel DNBR trip time of 66.35 seconds compared to the acceptable trip range of 66.45 to 66.75 seconds. The report further indicates that the reason is believed to be the difference in machine round-off rather than software error. Please quantify your findings to show that the round-off difference causes the trip time to be 0.1 seconds outside the acceptable trip time range."

Response

Considerable effort was put forth to more fully analyze this dynamic test case, particularly as to the nature of the trip time discrepancy. There are three possible causes of the discrepant trip time:

1) Software errors in the CPC design code or the special DSVT software which overlays portions of the CPC executive, or

2) Differences due to the variation between the precision available to the interdata 7/16 computer which runs the CPC system software and the CDC-7600 (64-bit) which runs the CPC Fortran code, or

3) Errors which may have been made in the running of the DSVT test case itself.

In order to verify that no software errors existed in either the CPC software or the special DSVT software, hand-calculations were performed at times immediately before and after the trip with known inputs recorded. This verification indicated that the DNBR values being calculated by the software programs were correct and were generating the correct trip response. The special DSVT software was verified to be overwriting portions of the executive correctly and to be performing the task of input data interpolation functionally identically to the CPC Fortran code. All of this software is developed and tested in accordance with the approved CPC protection algorithm software change procedure CEN-39(A)-P, Revision 02.

The DSVT case itself was rerun several times during the intitial Phase II testing process, and each time yielded identical results.

By process of elimination, and by confirmation of inputs recorded, it was observed that small differences existed between inputs to the CPC software and Fortran codes. Because it had been verified that the algorithms were functionally identical, it was concluded that this difference must have been due to the difference in machine precision realized in interpolation of the process inputs. This difference, unlike the processor uncertainties for the application programs, is not calculated as part of the input sweep tests, and thus would not have been factored into the DSVT acceptance criteria.

During recent analysis to attempt to quantify this difference and thus answer the staff's question, it was discovered that a minor change in how the test case was executed resulted in a trip time within the Fortran-generated acceptance criteria. It is now evident that while small input differences are present and may (in some cases) results in different trip times, this is not the situation for test case 22-4. The trip time which resulted using the revised (and correct) method was 66.65 seconds, which is within the DSVT acceptance criteria for trip times for this test case.

A brief discussion of test case 22-4 and the source of trip time differences follows:

The transient represented by this test case results in a DNBR trip being set, being reset at a later point in time, and then eventually being set once again. The DSVT program overlays to the CPC system result in stored and displayed values of times at which the DNBR or LPD trips or pre-trips changed state. Thus for this particular case, if run to duration, the final value stored in the DNBR trip location would be that at which the second trip occurred. The test approach used in DSVT for cases which involve trip resets has been to only run the test case long enough to get an initial trip. Reasons for this are that a true trip will result in CEA insertions which are not modelled for the test case (and thus the test case diverges from actual plant conditions under the circumstances) and also because a comparison of the initial trip time is the most significant in ensuring that potential software errors do not exist which might impact plant safety.

The method used to modify the length of a test case is to enter (via the operator's module) a different transient length (in seconds) while the test case is in initialization. During Phase II testing, a transient length of 66.2 seconds was initially entered and following initialization of the test case it was executed. As this did not then result in a trip on low DNBR, the transient was then lengthened in 50 msec. Increments until a trip was obtained at 66.35 seconds. This then became the DSVT single channel result for test case 22.4.

When this test case was reanalyzed recently an initial transient length of 66.8 seconds was entered through the operator's module (O.M.), which when run, resulted in a trip time of 66.65 seonds. In fact, as long as a transient length of 66.65 seconds or longer was entered, the same results were obtained. With transient lengths of less than 66.65 seconds, it was necessary to use the O.M. to provide successive 50 msec. increments to the test case until a trip was obtained. For each of these cases a different trip time was obtained for each different initial transient length.

The source of this difference is that each 50 msec. increment does not result in the CPC application programs being precisely 50 msec. further into the test case transient than previously. Thus the proper method of verifying trip times for cases with resets is to enter an initial test case length through the O.M. (during initialization) which is slightly greater than the expected trip time, but obviously less than the reset time (or any subsequent trip time). This will ensure continuous operation of the CPC software through the initial time-to-trip which is consistent with that of the CPC Fortran code against which it is being verified. This method will be included as part of the DSVT procedure for future tests.

All 39 other SONGS-2 Cycle 1 DSVT test cases were subsequently analyzed to see whether the use of the 50 msec. increment through the O.M. was used to determine a trip time. No other cases were determined to have used this method, thus maintaining all other results as valid. This further analysis has identified that the source of the Phase II trip time discrepancy was not a difference in machine precision as was previously thought, but was rather the result of a testing technique which was not valid for this application. Identification of the correct technique is consistent with the CPC software program and the DSVT program and its application results in acceptable trip times.

Question #11

"Provide the ranges of limits on addressable constants with an evaluation of entry errors as committed in the March 9, 1981 meeting."

Response

Discussion with the NRC staff on the intent of this question indicated that their concern was primarily with preventing incorrect entries of addressable constants, and that an evaluation of the impact of entry errors (as stated) might not be required, provided that the procedure for preventing entry errors was considered acceptable.

This same concern was voiced during the ANO-2 Cycle 2 NRC review of the CPC's at which time it was decided to AP&L by attempt to resolve the concern by incorporation of a Tech Spec (2.2.2) which required plant safety committee review for changes involving:

1) Frequently changed (Type I) addressable constants outside of an "allowable Range" which is more restrictive than the range which the CPC calculators themselves will allow.

2) Infrequently changed (Type II) addressable constants other than those made as a result of post-fuel loading physics tests, or as required for Tech Spec compliance.

The Tech Spec itself was reviewed by CE prior to submittal to and approval by the NRC. AP&L's basis for incorporating the Tech Spec was not technical in nature but in order to expedite the restrictive licensing schedule.

It was initially proposed to the NRC staff that CE would prepare a similar Tech Spec requirement for SONGS-2, and, subject to SCE approval, this would be proposed to the NRC. Based upon further considerations, CE suggested an alternate solution to this concern; namely that administrative controls on changes to addressable constants be established which ensure an adequate means of independent review designed to preclude entry errors.

The objections to the solution of accomodating addressable constant changes via the Tech Specs are as follows:

1) Currently no analog trips require such a review process, despite the greater probability and consequences (in many cases) of entering an incorrect value as an analog trip setpoint. Changes to the internal calculations of the CPC's are easily accomplished and verified via keypunch entries and the operator's module display, respectively. This method is considered more reliable than that currently used for changes to analog trip setpoints which involve adjustments using voltage regulating equipment and verification using meters. Furthermore, changes to analog setpoints hold the potential for voltage drift which is obviously not a factor for the digital system.

2) Including additional requirements on addressable constant changes within the Tech Specs would only serve to "clutter" this document with information on a more detailed level than required. This would further an environment for plant operators already encumbered by numerous Tech Spec requirements, all of which must be simultaneously adhered to. The potential for violating this or other Tech Specs is thus increased. Incorporation of controls on addressable constant changes within plant operating procedures rather than Tech Specs tends to reduce the probability of violating an LCO while maintaining an adequate degree of quality control.

3) Establishing such a restrictive Tech Spec requirement may inhibit plant manueverability, particularly during "nighttime" hours when plant safety committee approval may not be immediately available. Although other than minor changes to Type I and any changes to Type II addressable constants for routine plant operation would generally be anticipated well in advance, the potential for this need nonetheless exists and thus it would be advisable not to include this as a requirement.

Question 12

Provide the qualifications of the software consultant used for independent review of the CPC design as committed in the March 9, 1981 meeting.

Response

Pages 13.1-46 D and E of Amendment No. 25 to the San Onofre Units 2 and 3 FSAR which was transmitted to the NRC by letter dated July 15, 1981 provided the qualifications of the software consultant.

REFERENCES

1. "CETOP-D Code Structure and Modeling Methods for San Onofre Nuclear Generating Station Units 2 and 3", CEN-160-(S)-P, May, 1981.

2. "Responses to Questions on Documents Supporting ANO-2 Cycle 2 License Submittal", CEN-157(A)-P. Amendements 1-P, 2-P, 3-P, 1981.

3. "C-E Critical Heat Flux Correlations for C-E Fuel Assemblies with Standard Spacer Grids", CENPD-162-P-A, Sept. 1976.

4. C. Chiu, et al., "Enthalpy Transfer Between PWR Fuel Assemblies in Analysis by the Lumped Subchannel Model", <u>Nuclear Engineering and Design</u>, 53 pp. 165 - 186, (1979).