Westinghouse Electric Company
CE Nuclear Power LLC

2000 Day Hill Road
Windsor, CT 06095
USA

13 November, 2000
LD-2000-0057

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

SUBJECT: RESPONSE TO QUESTIONS REGARDING CENPD-132, SUPPLEMENT 4-P, REV. 1
{Enclosure 1-P Contains Proprietary Information}

Reference(s):
1) CENPD-132, Supplement 4-P, Revision 1, "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model", August 2000
2) Letter, P. W. Richardson (CENP) to U.S. Nuclear Regulatory Commission Document Control Desk, "Revision to CE Nuclear Power LLC ECCS Performance Appendix K Evaluation Model", LD-2000-0046, August 30, 2000

Representatives from CE Nuclear Power LLC (CENP) and the Nuclear Regulatory Commission (NRC) participated in a meeting on Friday, November 3, 2000 to discuss the ongoing review of CENPD-132, Supplement 4-P, "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model" (Reference 1). This topical report was submitted to the NRC on August 30, 2000 (Reference 2). A number of NRC questions arose during the meeting to which CENP responses are provided herein. Pursuant to prior agreement, CENP is furnishing one (1) proprietary and one (1) non-proprietary copy of this letter and enclosures to the NRC Document Control Desk and three (3) proprietary copies to Jack Cushing, NRC, CENP Project Manager.

As mentioned above, following submittal of Revision 1 to the Topical Report, a meeting was held on Nov. 3, 2000 for the purpose of addressing NRC questions on the revision. After detailed discussions that covered the entire topical report, seven items remained that required closure. Five of these items were CENP actions and two were NRC. It was also agreed that a conference call would be held to address the final resolution of these items. The phone call was held on Nov. 8, 2000. CENP and NRC verbally described responses to each of the seven items. The material contained in Enclosure 1-P provides the official CENP response to the five action items it was assigned. Also, the NRC's responses to its two action items are summarized along with the required CENP follow-up actions. The non-proprietary responses are provided in Enclosure 3.

CENP has determined that the information provided in Enclosure 1-P is proprietary in nature. Consequently, it is requested that Enclosure 1-P be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and that this information be appropriately safeguarded. The reasons for the classification of this information as proprietary are delineated in the affidavit provided in Enclosure 2.

TOO7

If you have any questions regarding this matter, please do not hesitate to call Chuck Molnar of my staff at (860) 285-5205.

Very truly yours,
CE NUCLEAR POWER LLC

Philip W. Richardson
Licensing Project Manager
Windsor Nuclear Licensing

Enclosure(s): As stated

xc: J. S. Cushing (NRC, with 3 copies of Enclosure 1-P)

CE NUCLEAR POWER LLC

NON-PROPRIETARY RESPONSE TO NRC QUESTIONS REGARDING CENPD-132, SUPPLEMENT 4-P, REVISION 1 CALCULATIVE METHODS FOR THE CE NUCLEAR POWER LARGE BREAK LOCA EVALUATION MODEL

November 2000

CENP Response to NRC
Request for Additional Information (RAI)
During Meeting on November 3, 2000
Regarding CENPD-132-P, Supplement 4-P, Revision 1
(TAC NO. MA5660)

Introduction

CE Nuclear Power LLC (CENP) submitted topical report CENPD-132, Supplement 4-P (1999 EM) to the Nuclear Regulatory Commission (NRC) in April 1999, Reference 1. This topical report submittal describes modifications to the Emergency Core Cooling System (ECCS) Evaluation Model (EM) that is used for the analysis of the large break loss-of-coolant accident (LBLOCA). The modifications include implementation of process changes within the currently NRC-accepted evaluation model (i.e., the 1985 EM), the replacement of the Dougall-Rohsenow film boiling correlation, as well as improved models designed to reduce conservatism. Model improvements are made in the areas of (1) cladding swelling and rupture, (2) steam venting reflood thermal hydraulics, (3) steam/water interaction during nitrogen discharge from the safety injection tanks, (4) reflood heat transfer, and (5) hot rod heat transfer to steam. The 1999 EM submittal presents sensitivity studies and comparisons with experimental data along with the results of a break spectrum analysis for a typical CENP designed Pressurized Water Reactor (PWR).

The NRC notified CENP of the Acceptance for Review of the topical report supplement on October 4, 1999, Reference 2. As a result of the NRC review, the staff determined that additional information is needed to complete the review. The NRC issued a Request for Additional Information (RAI) on December 14, 1999, Reference 3. The RAI identified four (4) items requiring additional information. CENP provided a response to the RAI on February 22, 2000, Reference 4.

After the topical report was originally issued, Westinghouse Electric Corporation acquired ABB Combustion Engineering Nuclear Power and the company name was changed to CE Nuclear Power LLC. Also, during the licensing review process, the NRC suggested that a number of modifications and additions to the topical report should be made to both correct and clarify the technical documentation. Also, with training and usage, the Automated/Integrated Code System was enhanced, which lead to additional documentation changes to incorporate the latest capabilities and user-guidance material. Therefore, prior to completion of the licensing process, Revision 1 of the topical report was prepared and submitted to NRC, Reference 5, for the following reasons:

- Change the company name
- Incorporate the NRC RAI and the responses to the RAI
- Incorporate corrections and clarifications identified by NRC during the licensing review process
- Provide updated user guidance material associated with the content and usage of the Automated/Integrated Code System.

The Acceptance for Review notification, the RAI, and the CENP response to the RAI were inserted into the topical report revision as Appendices B, C, and D, respectively. Also, NRC requested additional supporting information related to the COMPERC-II computer code. The record of that transmittal, Reference 6, was inserted into the topical report revision as Appendix E.

After submittal of the revised topical report, a meeting was held on November 3, 2000 at the NRC headquarters in Rockville, Maryland, for the purpose of addressing NRC questions and issues. After detailed discussions covering the entire topical report submittal, there remained seven issues requiring closure. Five of these issues were CENP action items and two were NRC. It was also agreed that a conference call would be held on or before November 13, 2000, for the resolution of these items. The phone call was held on November 8, 2000. CENP and NRC verbally described responses to each of the seven items. The material contained in the following sections officially responds to the five CENP action items. Also, the NRC's responses to its two action items are summarized along with the required CENP follow-up actions.

Note that the NRC request for information is denoted by a **bold** font in the following material. An *Italics* font denotes the CENP responses and a regular font denotes the NRC responses.

References

1. LD-99-026, "Revision to ABB CENP ECCS Performance Appendix K Evaluation Model," letter from I. C. Rickard (ABB CENP) to U. S. Nuclear Regulatory Commission Document Control Desk, April 30, 1999.
2. Letter from J. Cushing (NRC) to I. C. Rickard (ABB CENP), "Acceptance of CENPD-132, Supplement 4, 'Calculative Methods for the ABB CENP Large Break LOCA Evaluation Model,' for Review," October 4, 1999.
3. Letter from J. Cushing (NRC) to I. C. Rickard (ABB CENP), "Request for Additional Information (RAI) Regarding CENPD-132-P, Supplement 4-P (TAC NO. MA5660)," December 14, 1999.
4. LD-2000-0011, I. C. Rickard (CENP) to U. S. Nuclear Regulatory Commission (Document Control Desk), "ABB CENP Response to NRC Request for Additional Information Regarding CENPD-132-P, Supplement 4-P," February 22, 2000.
5. LD-2000-0046, P. W. Richardson (CENP) to U. S. Nuclear Regulatory Commission (Document Control Desk), "Revision to CE Nuclear Power LLC ECCS Performance Appendix K Evaluation Model," August 30, 2000.
6. LD-1999-0064, I. C. Rickard (CENP) to U. S. Nuclear Regulatory Commission (Attn: Yi-Hsiung Hsii), "COMPERC-II Topical Report Set – Information Copy," December 9, 1999.

1. CENP will evaluate the effects of possible U-tube uncovery and provide justification for its assumption in the steam venting steam generator model that the U-tubes are covered by steam generator secondary side liquid.

CENP Response:

In order to evaluate the effect of steam generator (SG) U-tube uncovery on the application of the 1999 EM to the LBLOCA scenario, a special version of the COMPERC-II code was created which explicitly represents the effect of U-tube uncovery on the system. As described in Section 2.4.1.3 (v) of the Topical Report, the heat transfer rate for each axial section on the steam generator tubes secondary side (i ranging from 1 to 2N, where N is the number of axial layers in the evaporator region) is calculated using the equation

$$Q_{sec,i} = H_{sec,i}\, A_{sec,i}\, (T_{tube,i} - T_{sec,j})$$

where

$Q_{sec,i}$	*Steam generator tube heat transfer rate (secondary side) (Btu/sec) (section i)*
$H_{sec,i}$	*Overall secondary side heat transfer coefficient (Btu/sec ft² °F) (section i)*
$A_{sec,i}$	*Secondary side tube heat transfer area (ft²) (section i)*
$T_{tube,i}$	*Steam generator tube temperature (°F) (section i)*
$T_{sec,j}$	*Secondary side layer temperature (°F) (layer j)*
j	*Secondary side layer in contact with section i of the tubes*

The changes made to this special version of COMPERC-II are as follows:

- *The heat transfer coefficient* $H_{sec,i}$ *is calculated as follows:*

  If axial layer j is liquid, then the heat transfer coefficients are calculated with the [ ] correlation for single phase liquid flow as described in Section 2.4.1.3 (v), and the liquid temperature in contact with the tube is the corresponding secondary side layer temperature.

  If the U-tube is uncovered, then a heat transfer coefficient equal to [ ] is used in the above equation, and the SG secondary side steam temperature is used in place of the secondary side layer temperature. This surface heat transfer coefficient is appropriate for [ ] at the pressures and temperatures typical of this time period of the transient.

- *The heat transfer from the steam phase to the tubes is included in the conservation of energy equation described in Section 2.4.1.2 (iii). That is,* Q_{tube} *in that equation includes the heat transfer from the steam phase described above.*

- *The location of the mixture level in the SG secondary side for this special version of the code is specified through input.*

The computer case in the Topical Report used to determine the effect of activating the 1999 EM steam generator model in COMPERC-II (Table 2.4.3-1) was used for the evaluation of the effect of U-tube uncovery, by reducing the initial liquid inventory in the SGs and by specifying the location of the liquid level in the secondary side through input. The comparison shows the results for the following cases:

Case 1: *Case with U-tubes covered based on nominal initial liquid inventory in the SG (this is the case for the 1999 EM SG Model in Table 2.4.3-1).*

Case 2: *Case with reduced liquid inventory in the SGs leading to U-tube uncovery. This case was run by reducing the initial liquid inventory in the SG by 60% and by reducing the U-tube coverage by 40%. The reduction in the SG inventory was implemented in both the CEFLASH-4A and COMPERC-II codes.*

Case 3: *Case with reduced liquid inventory (like Case 2) but forcing the code to calculate heat transfer coefficients to the liquid phase (consistent with the calculations of the 1999 EM version of the COMPERC-II code). This case isolates the effect of using heat transfer coefficients to liquid instead of heat transfer coefficients to steam in the uncovered region of the U-tubes.*

The comparison of key parameters for these three cases is shown in the following table:

Effect of Steam Generator U-Tube Uncovery

Result	Case 1 Nominal Inventory U-Tubes Covered	Case 2 Reduced Inventory U-Tubes Uncovered	Case 3 Reduced Inventory U-Tubes Covered
[			
			]

These cases show the following:

- *The effect of U-tube uncovery during the large break LOCA event is a*[ ] *Thus, the 1999 EM methodology assuming no U-tube uncovery is* [ ]
- *The effect on PCT of calculating heat transfer to liquid in the upper regions of the U-tubes when U-tube uncovery occurs is*[.]

The following figures show various comparisons for the cases described above.

- *Figure 1-1 shows that the cladding temperature transients on the limiting node (i.e., the PCT node) are*[ ]*between Cases 1 and 2.*
- *Figure 1-2 shows a comparison of the SG pressure response for Cases 1 and 2. Note that since Case 2 is run with a reduced liquid inventory, the SG pressurization during blowdown is*[ ]*liquid temperature at TAD. Also, the fuel average temperature of the hot rod at TAD is* [ ]*change in calculated blowdown hydraulics.*
- *Figure 1-3 shows a comparison of the SG steam temperature in the U-tubes for Cases 2 (U-tubes uncovered) and 3 (U-tubes covered) at 130 seconds into the transient. This comparison shows that the difference in temperature in the upper region of the U-tubes is*[.] *The difference at the U-tube exit is*[ ]*between these two cases.*

In summary, these results show that heat transfer from the secondary to primary is[ ]*for the 1999 EM Appendix K model.*

Figure 1-1
Effect of Uncovery of the SG U-Tubes
Peak Clad Temperature Curve

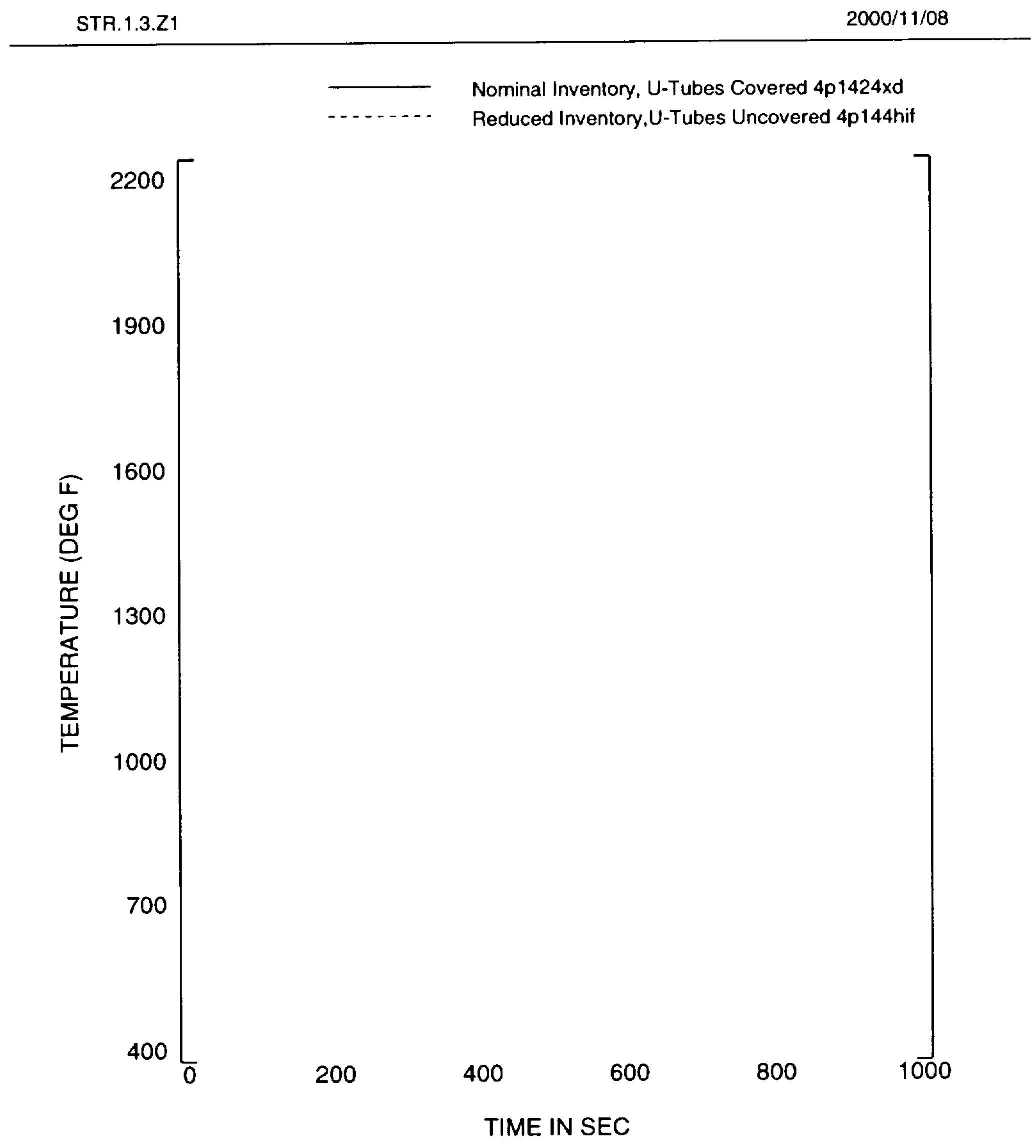


Figure 1-2

SG Secondary Side Pressure

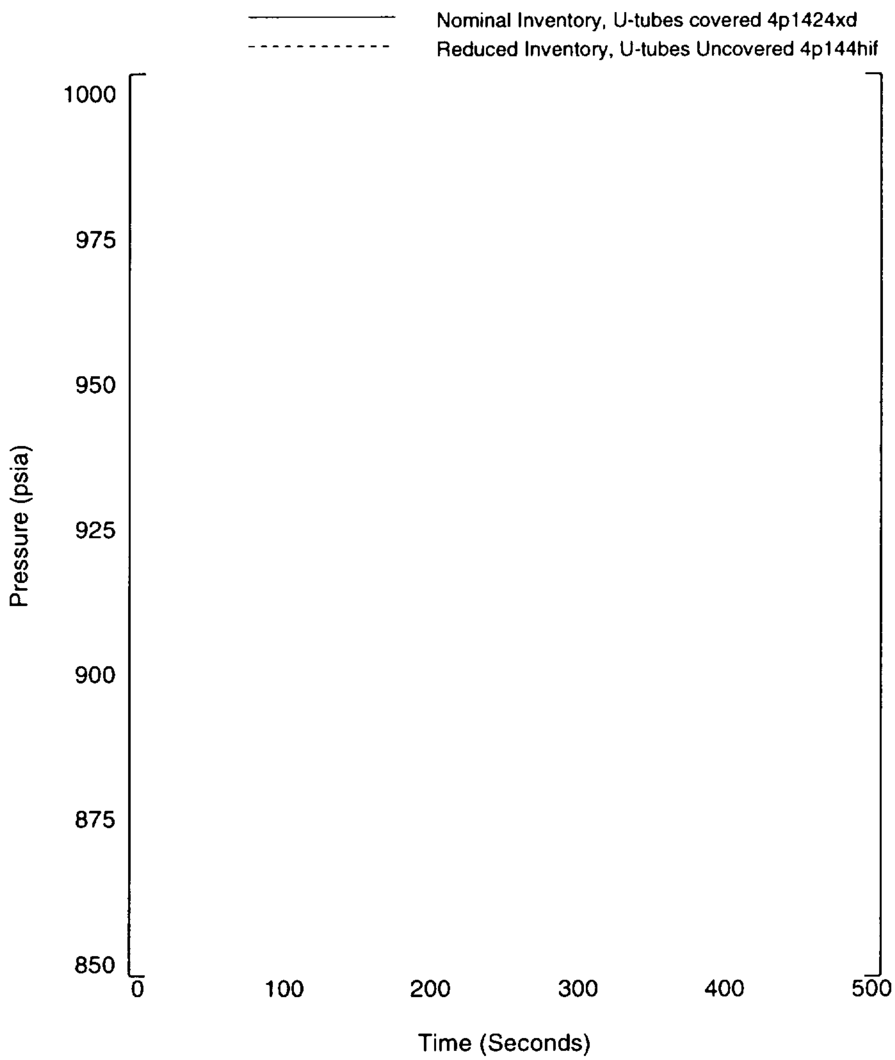
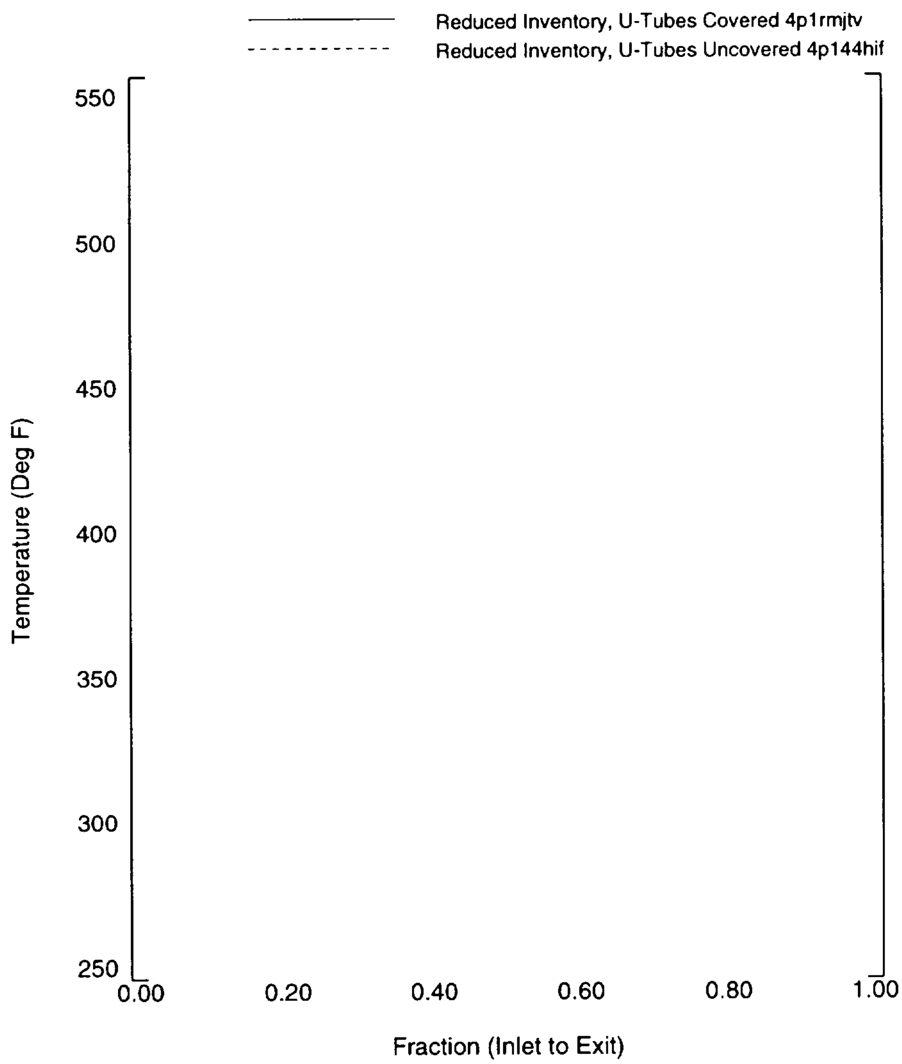


Figure 1-3

SG Tube Steam Temperature (at 130 Seconds)



2. CENP will evaluate the effects of neglecting the wall heat transfer to the SG secondary side steam region in the SG modeling.

CENP Response:

In order to evaluate the effect of wall heat transfer to steam, special versions of the CEFLASH-4A and COMPERC-II codes were created, which model the SG walls in contact with steam. The changes that were made to the codes are as follows:

- *Two separate types of walls were implemented in each SG to represent thick walls in contact with the steam, like the SG vessel and dome, and thin walls in contact with the steam representing the internal structures in the steam generators, like separators and dryers.*
- *The wall heat rate for each of these walls was calculated as follows:*

$$Q_{wall} = H\ A\ (T_{wall} - T_{stm})$$

where

Q_{wall}	= *Heat rate from the wall to the steam (Btu/sec)*
H	= *Wall surface heat transfer coefficient (Btu/sec ft^2 °F)*
A	= *Wall surface heat transfer area (ft^2)*
T_{wall}	= *Wall average temperature (°F)*
T_{stm}	= *Steam region temperature (°F)*

For the analysis, a wall surface heat transfer coefficient equal to [ ] was used. This surface heat transfer coefficient is appropriate for [ ] at the pressures and temperatures typical of this time period of the transient. The wall temperature for each wall was calculated by integrating the energy equation

$$MC_p\ dT_{wall}/dt = -Q_{wall}$$

where

MCp	= *Wall heat capacity (Btu/°F)*
t	= *Time (sec)*

- *The wall temperatures in contact with the steam were initialized in CEFLASH-4A using the SG saturation temperature. The values of the wall temperatures at TAD were transferred from CEFLASH-4A to COMPERC-II to initialize the wall temperatures in COMPERC-II. Since COMPERC-II combines the two SGs into one model while CEFLASH-4A explicitly represents two SGs, the value used for the transfer was the [ ] temperature of each of the walls in the two SGs.*
- *The heat transfer from the wall heat to the steam was added as an extra term in the conservation of energy equation for COMPERC-II described in Section 2.4.1.2 (iii) and in the one for CEFLASH-4A described in Reference 2-1, Page 9.*

The computer case in the Topical Report used to determine the effect of activating the 1999 EM steam generator model in COMPERC-II (Table 2.4.3-1) was used for this evaluation by implementing representative input for the heat capacities and overall heat transfer coefficients for *the thin and thick walls described above in both the CEFLASH-4A and COMPERC-II codes. The comparison shows the results for the following cases:*

Case 1: *Case without wall heat to steam (this is the case for the 1999 EM SG Model given in Table 2.4.3-1).*

Case 2: *Case 1 modified to include wall heat to steam.*

Case 3: *Case 1 modified to include wall heat to steam and reduced liquid inventory in the SGs leading to U-tube uncovery (combining Cases 2 of Questions 1 and 2).*

The comparison of key parameters for these three cases is shown in the following table:

Effect of Wall Heat to Steam

[

Result	Case 1 Nominal Inventory No Wall Heat to Steam	Case 2 Nominal Inventory with Wall Heat to Steam	Case 3 Reduced Inventory with U-Tube uncovery and Wall Heat to Steam

]

These cases show the following:

- *The effect of wall heat to steam on PCT is [.] Since the SGs are isolated at time zero, causing subsequent SG pressurization, the walls in contact with the steam act as heat sinks during the transient, absorbing heat from the secondary side and causing a [.] The SG pressure transient comparison between the reference case (Case 1) and the case with wall heat to steam (Case 2) is shown in Figure 2-1. The secondary side wall temperature responses for the walls in contact with steam and the SG secondary side steam temperature response for Case 2 are shown in Figure 2-2.*
- *The combined effect of wall heat to steam and SG U-tube uncovery [ ] the conclusions of the responses to Question 1. That is, the effect of the use of wall heat to steam for the case with U-tube uncovery (Case 3) compared to Case 2 from Question 1 is [ ]*

Section 3.3.2 of the Topical Report provides a sensitivity study showing the impact of steam generator secondary initial pressure and steam generator physical parameters, in particular, the wall heat capacity for storing and releasing energy to the liquid region is increased by 10% for the study. The results confirm that variations in wall heat parameters, even of this magnitude, have a [ ] on the calculated PCT.

In summary, these results show that wall heat transfer to the secondary side steam region has [ ] on the calculation of PCT using the 1999 EM steam venting model.

Reference:

2-1 *CENPD-133P, "CEFLASH-4A, A FORTRAN-IV Digital Computer Program for Reactor Blowdown Analysis," August 1974.*

Figure 2-1

SG Secondary Side Pressure

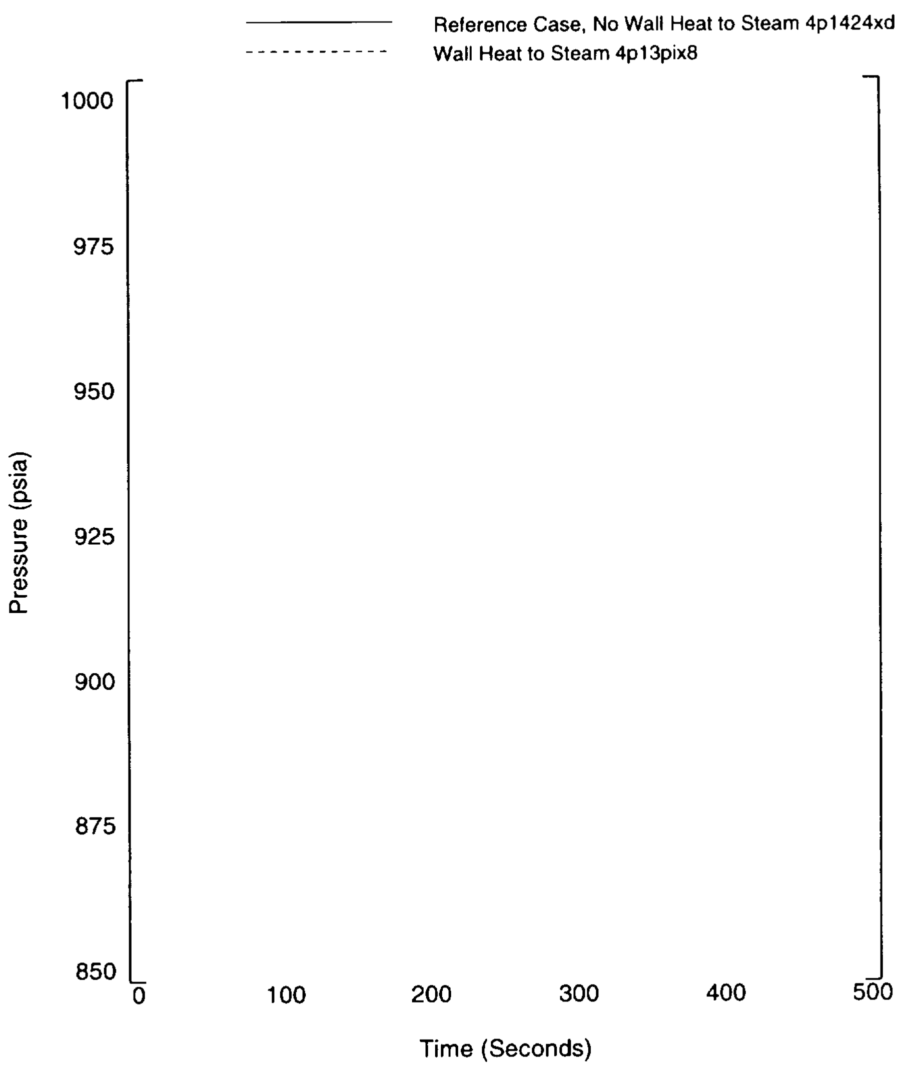
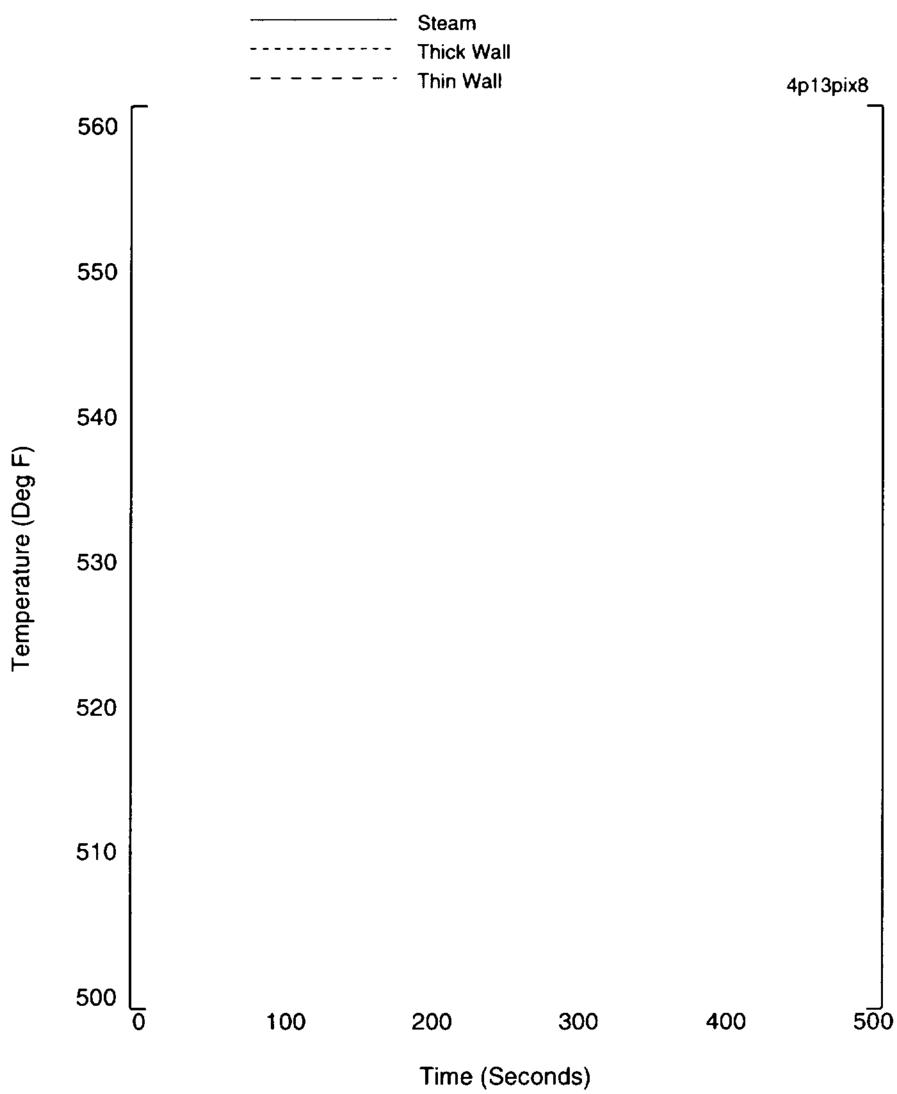


Figure 2-2

SG Secondary Side Temperatures



3. CENP will provide comparisons of two additional FLECHT-SEASET separate effects test cases (Nos. 22010 and 22503) for the validation of the steam venting SG model. CENP will also provide comparisons of the primary side steam temperatures for those cases analyzed.

<u>*CENP Response:*</u>

As requested, two additional FLECHT-SEASET tests have been added to the verification database, Tests 22010 and 22503, References 3-1 and 3-2. These tests are shaded in the table below for comparison to the tests already documented in Topical Report Section 2.4.2.2.

	Primary Side Test Conditions (1)			Secondary Side Initial Conditions (2)	
Test ID	Primary Side Pressure (psia)	Total U-Tube Mass Flow (lbm/sec)	U-Tubes Inlet Quality	Secondary Side Level (ft)	Secondary Side Temperature (°F)
22010	**40.0**	**0.503**	**0.801**	**33.6**	**525**
22503	**19.9**	**0.494**	**0.798**	**33.6**	**525**
20904	60.4	0.494	0.798	32.4	525
22213	40.0	0.991	0.797	33.7	524
22920	39.8	0.493	1.0	32.5	523

Notes:

(1) U-tube boundary conditions are held constant for the duration of the test
(2) Secondary side values are the initial test conditions

Topical Report Section 2.4.2.2.i. defines the FLECHT-SEASET test conditions with the following categories:

- *High pressure (~60 psia), mid pressure (~40 psia), low pressure (~20 psia)*
- *High flow (~0.99 lbm/sec), mid flow (~0.75 lbm/sec), low flow (~0.49 lbm/sec)*
- *High quality (1.), mid quality (~0.8), low quality (~0.7 and below)*

Using these categories, the verification test basis is characterized as follows including the two additional tests:

- *Test ID 22010: mid pressure, low flow, mid quality*
- *Test ID 22503: low pressure, low flow, mid quality*
- *Test ID 20904: high pressure, low flow, mid quality*
- *Test ID 22213: mid pressure, high flow, mid quality*
- *Test ID 22920: mid pressure, low flow, high quality*

The results of the additional test comparisons are shown in Figures 3.1-1 through 3.1-8 for Test 22010 and Figures 3.2-1 through 3.2-8 for Test 22503. These figures include comparisons to data on both the secondary and primary sides.

Similar to the original three tests reported in the Topical Report, the comparisons for Tests 22010 and 22503 provide results that show that the 1999 EM COMPERC-II model[ ] the measured values of the secondary side temperature both at the end of the test, see

Figures 3.1-3 and 3.2-3, and at the tube exit elevation throughout the test, see Figures 3.1-4, and 3.2-4.

The Topical Report figures for the original three tests do not include comparisons to primary side data. Therefore, Figures 3.3-1 through 3.5-4 have been added here to provide these comparisons. For each of the five test comparisons, the primary side temperatures are shown at four axial positions along the 70 ft of U-tube length, that is, at 4, 10, 60, and 69 ft. These test facility locations correspond to the available data. Unlike the inherently uniform conditions measured on the secondary side, the primary side temperature measurements represent the local conditions inside one particular U-tube and variations on the order of ±10 °F are observed. The COMPERC calculated values of average U-tube primary temperature are linearly interpolated from the COMPERC 30 axial node model to correspond to the measurement location.

At the outlet location of 69 ft, the results of the comparisons show that the 1999 EM COMPERC-II model [ ] the measured values of the primary side temperature at the steam generator U-tube outlet position by as much as [ ] at the end of the test for all cases except for Test 22920. Test 22920 is a saturated steam test (no liquid at the inlet), where the agreement between test measurement and COMPERC calculation is excellent, which validates the 1999 EM formulation. These comparisons at the 69 ft location are shown in Figures 3.1-8, 3.2-8, 3.3-4, 3.4-4, and 3.5-4.

The comparisons at the other axial locations are not as important as the outlet condition mentioned above because it is the outlet condition that has the greatest impact on steam venting from the steam generator to the break through the cold leg piping and reactor coolant pump. The comparisons within the axial extent of the steam generator are complicated due to the influence of local conditions within the particular U-tube holding the steam probe on the measurements. For example, a 15 °F difference between the measured temperature and the calculated value can be attributed to just a 10% variation in the local U-tube flow rate from the average flow being used in the COMPERC calculation. The results of the comparisons at the other axial positions are given as follows:

- *At the inlet location of 4 ft, the COMPERC calculations [ ] the measured temperatures by as much as [ ] at the end of the test for all cases except the saturated steam test 22920, which shows excellent agreement. This overall conservatism of the inlet comparisons is related to the outlet comparisons at 69 ft discussed above, because the stratified secondary side fluid temperature strongly influences both inlet and outlet calculations. These comparisons at the 4 ft location are shown in Figures 3.1-5, 3.2-5, 3.3-1, 3.4-1, and 3.5-1.*
- *At the 10 ft location, the COMPERC calculations are an [ ] representation of the measured values for all cases except Test 22213, which is the high flow rate test where the comparison is [ ] at the end of the test), and Test 22920, which is the saturated steam test where the calculation [ ] which is of the same order as the observed range of variation in the measurements. In fact, the comparisons for the other tests at this same location are similarly biased during the early portion of the test by roughly [ ]. After 600 seconds, the calculated values at this location [ ] at the end of the test. These comparisons at the 10 ft location are shown in Figures 3.1-6, 3.2-6, 3.3-2, 3.4-2, and 3.5-2.*

- *At the 60 ft location, the COMPERC calculations are in[ ]agreement with the measured values (within[ ]for the majority of the time of the test) for all tests except Test 22213, which is the high flow test where the calculations[ ]at the end of the test. This measurement location is on the downflow side of the steam generator, where the temperature differential between the primary and secondary sides is small and where the steam temperature is therefore less sensitive to the local U-tube flow rate. Also, the secondary side stratification is not as large at 60 ft as 69 ft, therefore, the temperature comparisons between the calculated and measured values are in[ ]agreement, again showing the adequacy of the 1999 EM steam generator model. These comparisons at the 60 ft location are shown in Figures 3.1-7, 3.2-7, 3.3-3, 3.4-3, and 3.5-3.*

References:

3-1 "PWR FLECHT-SEASET Steam Generator Separate-Effects Task, Data Analysis and Evaluation Report," EPRI NP-1461, NUREG/CR-1534, WCAP-9724, February 1982.

3-2 "PWR FLECHT-SEASET Steam Generator Separate-Effects Task, Data Report," NRC/EPRI/Westinghouse Report No. 4.

Figure 3.1-1

FLECHT-SEASET Test 22010

Primary Side SG Tube Axial Temperature

COMPERC-II Calculation (Every 150 seconds)

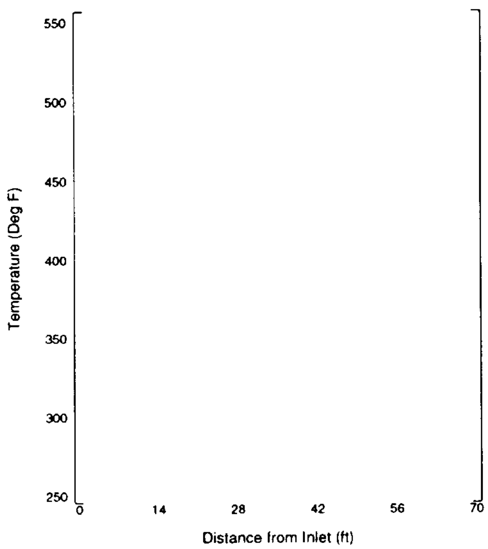


Figure 3.1-2

FLECHT-SEASET Test 22010

Secondary Side Fluid Temperature along SG Tube

COMPERC-II Calculation (Every 150 seconds)

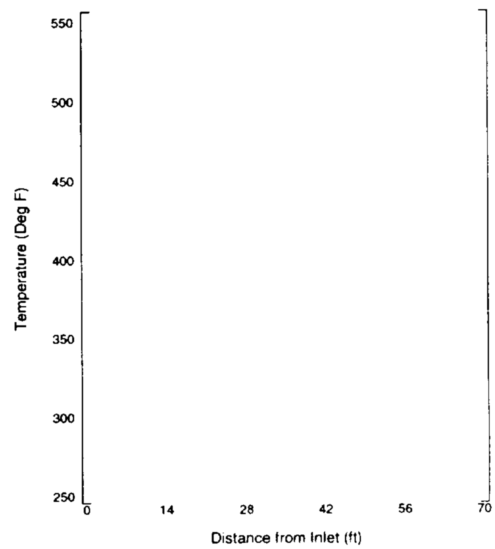


Figure 3.1-3

FLECHT-SEASET Test 22010

Secondary Side Fluid Temperature along SG Tube

Comparison to COMPERC-II Calculation (1500 Seconds)

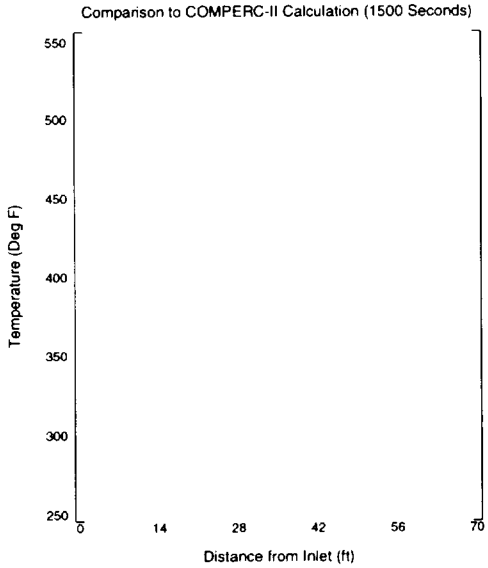


Figure 3.1-4

FLECHT-SEASET Test 22010

Secondary Side Fluid Temperature (at tube exit)

COMPERC-II Calculation

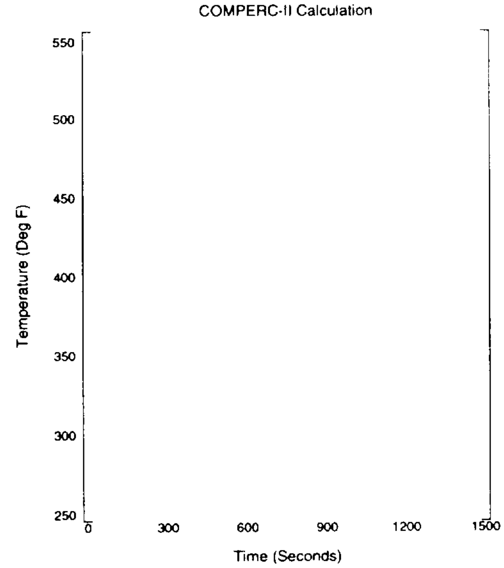


Figure 3.1-5
FLECHT-SEASET Test 22010
Primary Side Steam Temperature (at 4 ft)
COMPERC-II Calculation

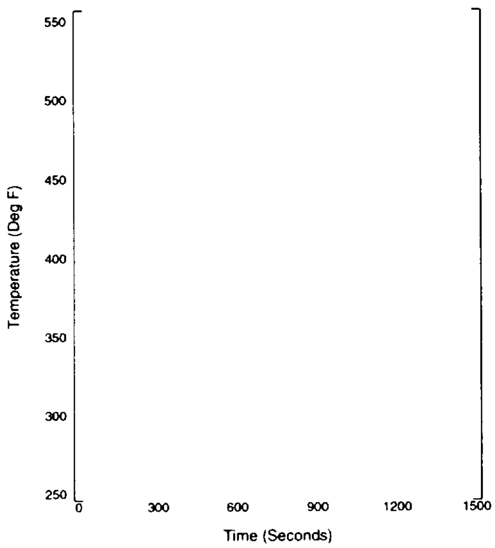


Figure 3.1-6
FLECHT-SEASET Test 22010
Primary Side Steam Temperature (at 10 ft)
COMPERC-II Calculation

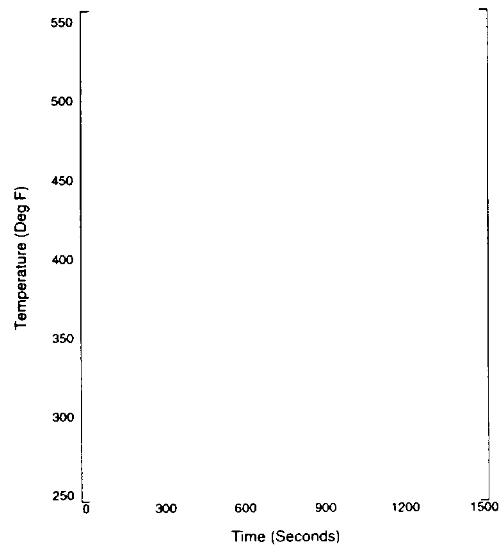


Figure 3.1-7
FLECHT-SEASET Test 22010
Primary Side Steam Temperature (at 60 ft)
COMPERC-II Calculation

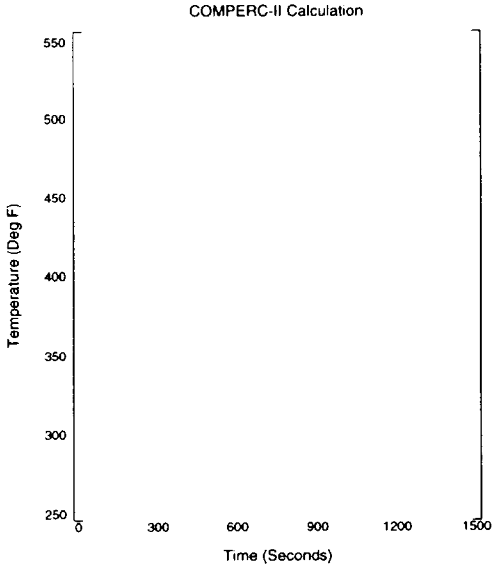


Figure 3.1-8
FLECHT-SEASET Test 22010
Primary Side Steam Temperature (at 69 ft)
COMPERC-II Calculation

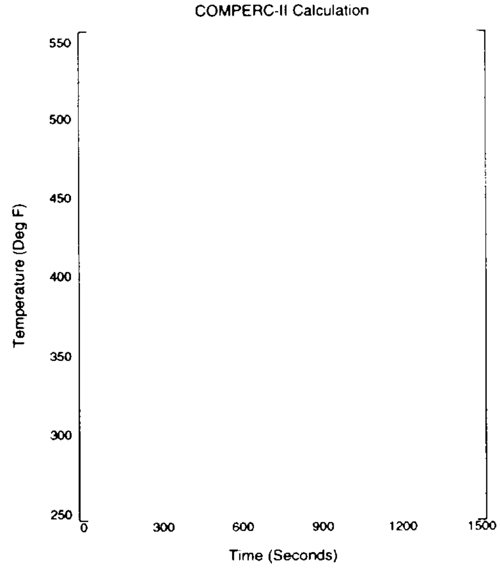


Figure 3.2-1
FLECHT-SEASET Test 22503
Primary Side SG Tube Axial Temperature
COMPERC-II Calculation (Every 150 seconds)

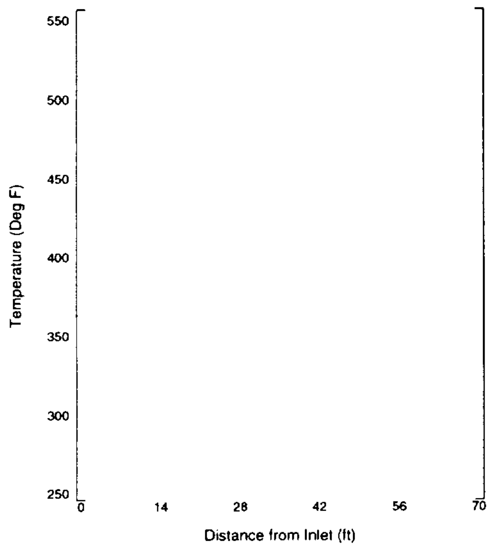


Figure 3.2-2
FLECHT-SEASET Test 22503
Secondary Side Fluid Temperature along SG Tube
COMPERC-II Calculation (Every 150 seconds)

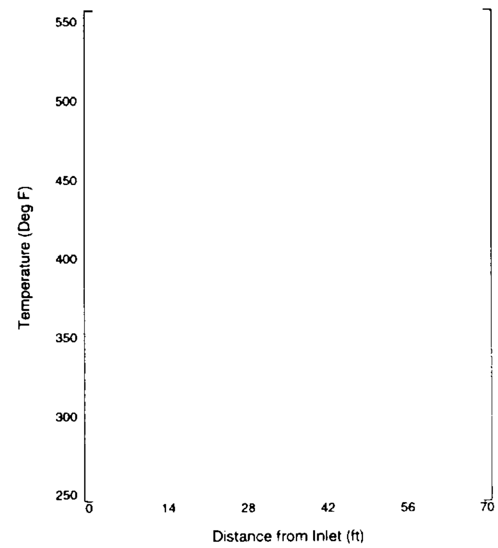


Figure 3.2-3
FLECHT-SEASET Test 22503
Secondary Side Fluid Temperature along SG Tube
Comparison to COMPERC-II Calculation (1500 Seconds)

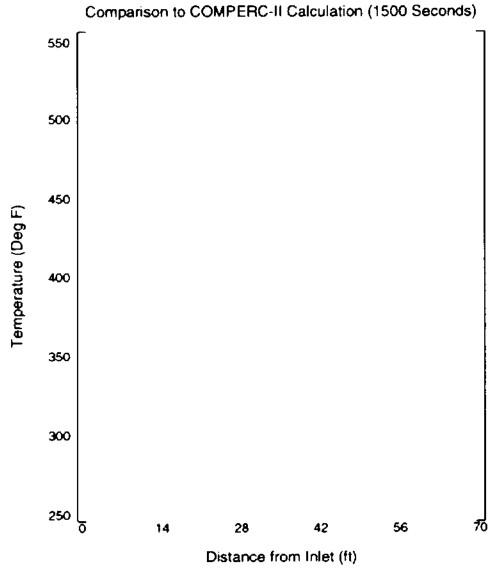


Figure 3.2-4
FLECHT-SEASET Test 22503
Secondary Side Fluid Temperature (at tube exit)
COMPERC-II Calculation

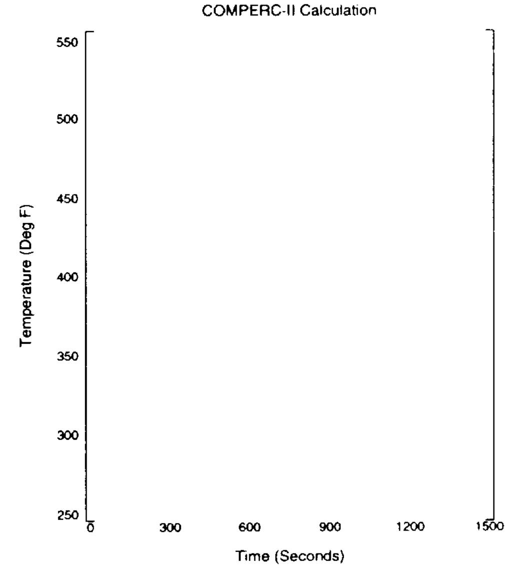


Figure 3.2-5
FLECHT-SEASET Test 22503
Primary Side Steam Temperature (at 4 ft)
COMPERC-II Calculation

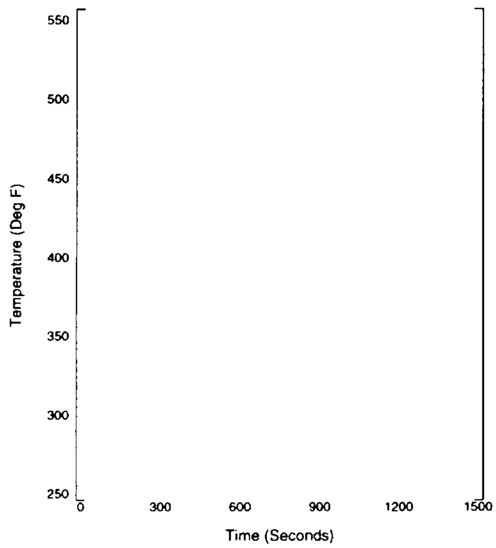


Figure 3.2-6
FLECHT-SEASET Test 22503
Primary Side Steam Temperature (at 10 ft)
COMPERC-II Calculation

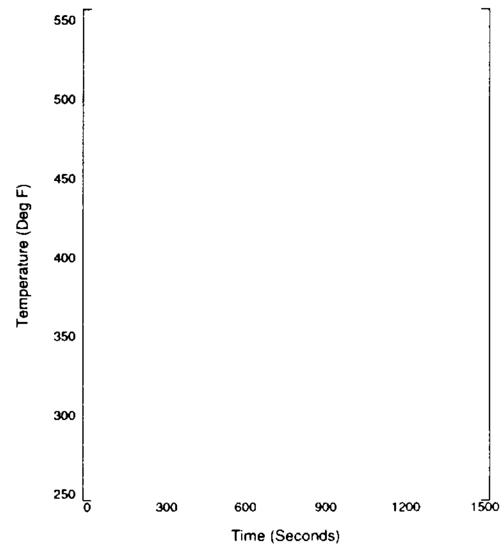


Figure 3.2-7
FLECHT-SEASET Test 22503
Primary Side Steam Temperature (at 60 ft)
COMPERC-II Calculation

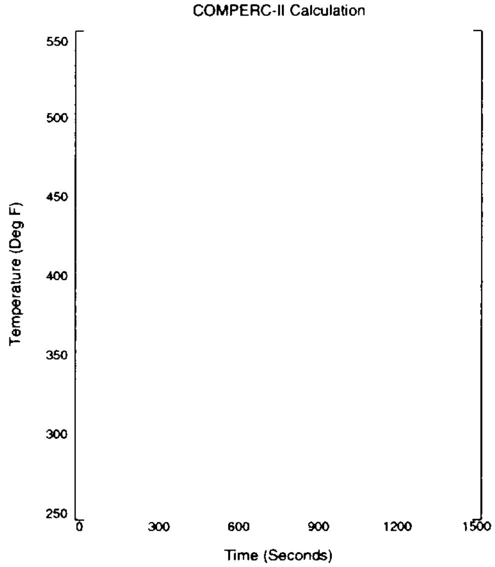


Figure 3.2-8
FLECHT-SEASET Test 22503
Primary Side Steam Temperature (at 69 ft)
COMPERC-II Calculation

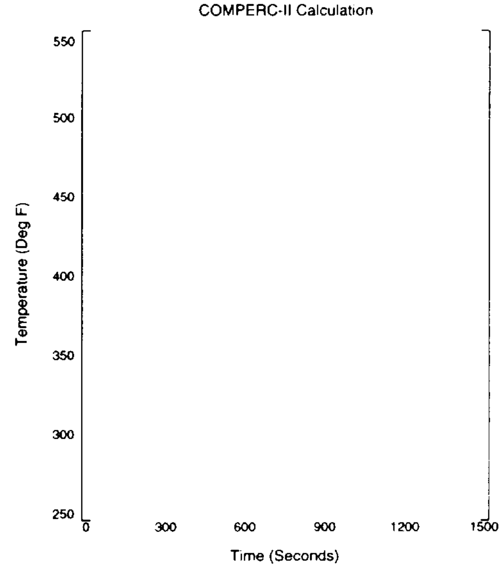


Figure 3.3-1
FLECHT-SEASET Test 20904
Primary Side Steam Temperature (at 4 ft)
COMPERC-II Calculation

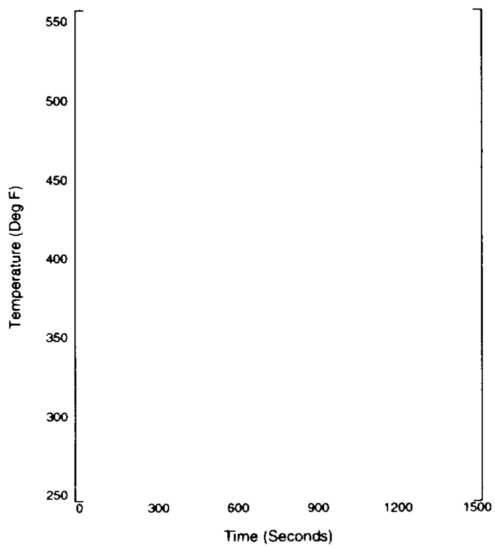


Figure 3.3-2
FLECHT-SEASET Test 20904
Primary Side Steam Temperature (at 10 ft)
COMPERC-II Calculation

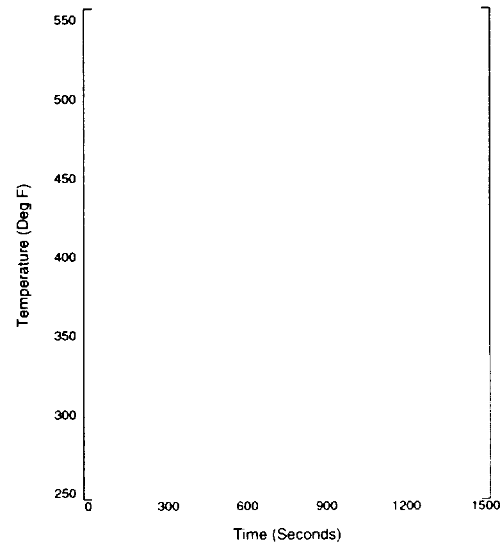


Figure 3.3-3
FLECHT-SEASET Test 20904
Primary Side Steam Temperature (at 60 ft)
COMPERC-II Calculation

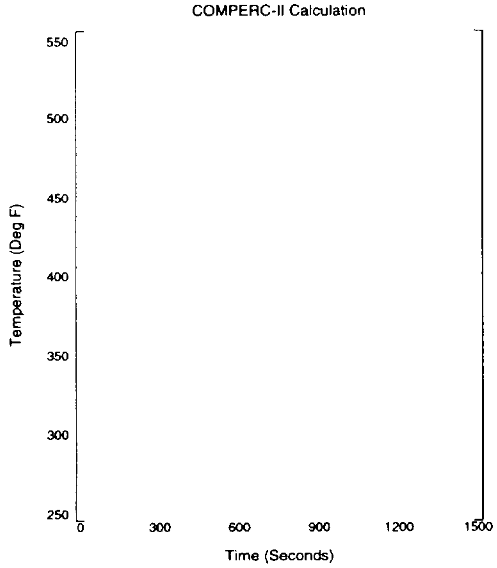


Figure 3.3-4
FLECHT-SEASET Test 20904
Primary Side Steam Temperature (at 69 ft)
COMPERC-II Calculation

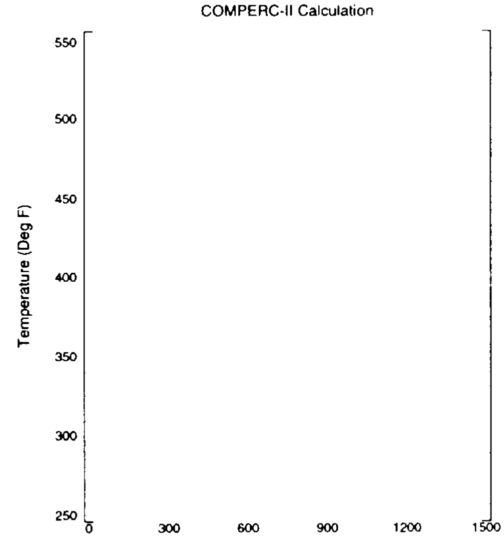


Figure 3.4-1
FLECHT-SEASET Test 22213
Primary Side Steam Temperature (at 4 ft)
COMPERC-II Calculation

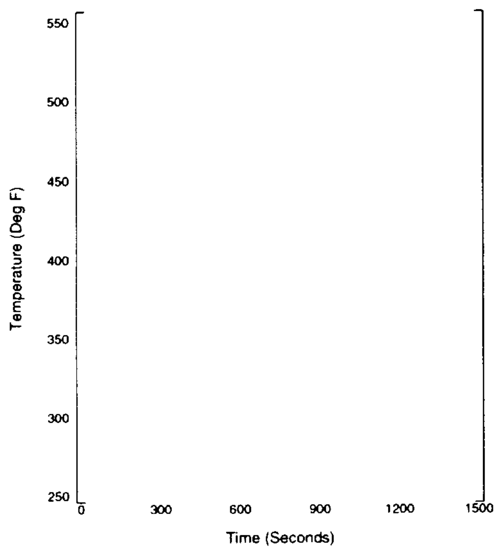


Figure 3.4-2
FLECHT-SEASET Test 22213
Primary Side Steam Temperature (at 10 ft)
COMPERC-II Calculation

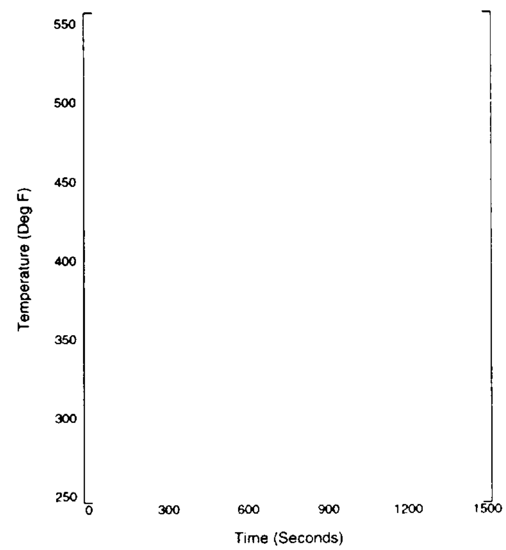


Figure 3.4-3
FLECHT-SEASET Test 22213
Primary Side Steam Temperature (at 60 ft)
COMPERC-II Calculation

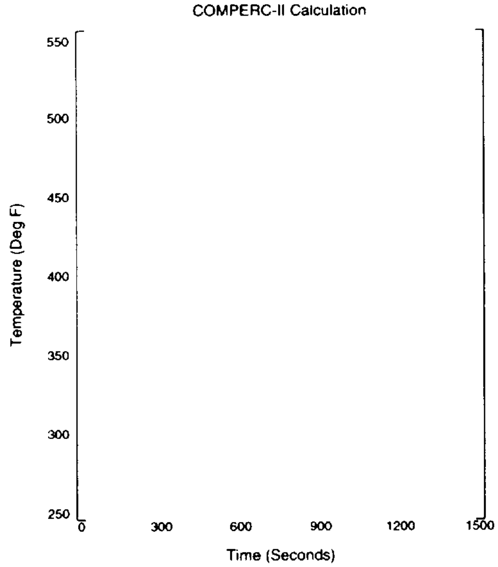


Figure 3.4-4
FLECHT-SEASET Test 22213
Primary Side Steam Temperature (at 69 ft)
COMPERC-II Calculation

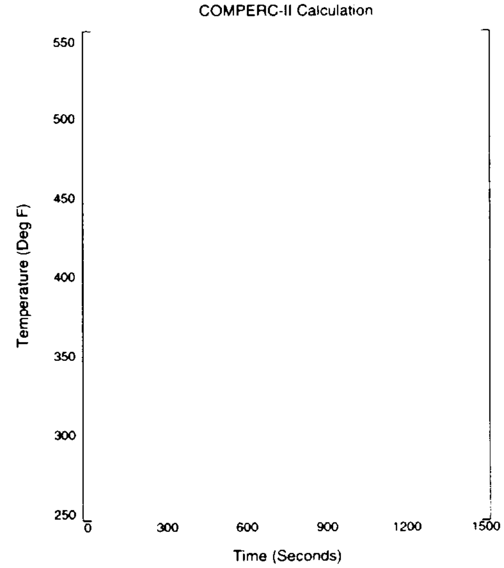


Figure 3.5-1
FLECHT-SEASET Test 22920
Primary Side Steam Temperature (at 4 ft)
COMPERC-II Calculation

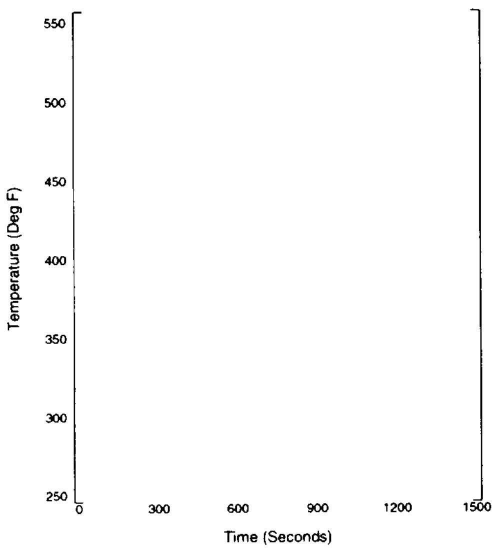


Figure 3.5-2
FLECHT-SEASET Test 22920
Primary Side Steam Temperature (at 10 ft)
COMPERC-II Calculation

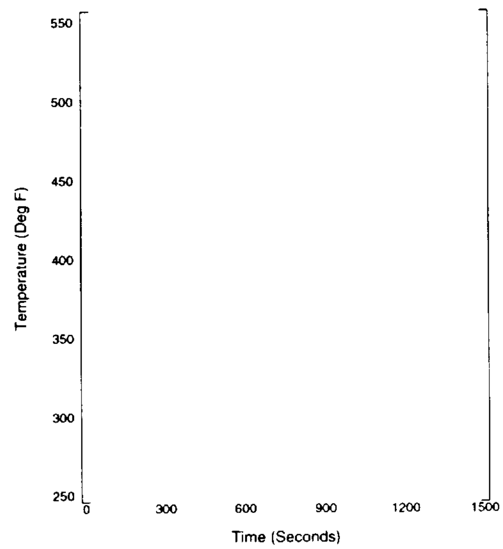


Figure 3.5-3
FLECHT-SEASET Test 22920
Primary Side Steam Temperature (at 60 ft)
COMPERC-II Calculation

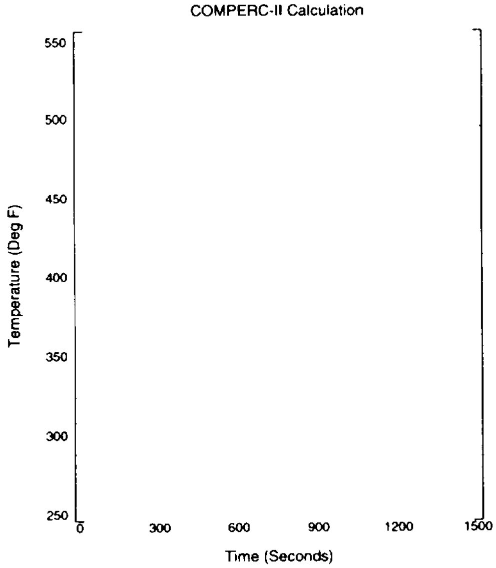
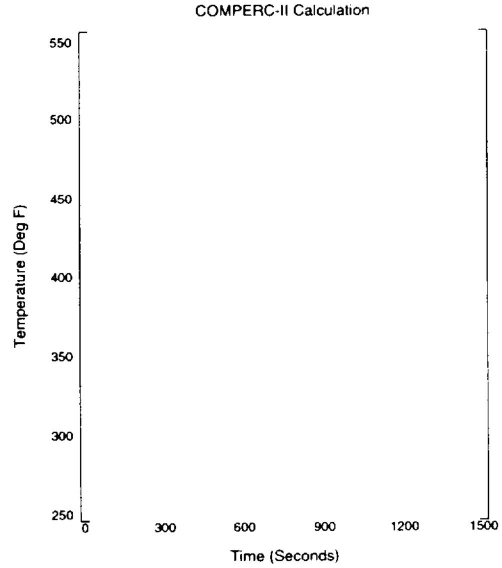


Figure 3.5-4
FLECHT-SEASET Test 22920
Primary Side Steam Temperature (at 69 ft)
COMPERC-II Calculation



4. CENP will provide a brief description of the control logic for the calculation of the injection section differential pressure from nitrogen injection to ensure compliance with the existing safety evaluation report limits on the differential pressures of the safety injection tank injection and pump injection.

<u>*CENP Response:*</u>

Section 2.5.5 of the Topical Report will be modified to include the following information, which explains that the code logic implemented in the 1999 EM ensures that the regulatory limits on injection section differential pressure are not violated by the new model for SIT nitrogen discharge:

> *The differential pressure across the injection line is calculated using Equation (2.5-1). To ensure conformance to regulatory limits on the injection section differential pressure, the updated code logic subjects the results of Equation (2.5-1) to the following limitations:*

- [

-]

5. CENP will provide a summary statement that all of the methodology changes described in CENPD-133 Supplement 4-P, have been included in the 1985 EM.

<u>*CENP Response:*</u>

In Section 3.2 of the Topical Report, Item #2, CENP requested closure on legacy topical report CENPD-133 Supplement 4-P submitted to NRC in 1977, which was inadvertently not cited in the reference list of the SER for the 1985 EM. This is one of the references that comprise the 1985 EM and which will also comprise the 1999 EM. The paragraph in Section 3.2 of the Topical Report will be modified to include the following statement:

> *All of the methodology changes described in CENPD-133 Supplement 4-P, including the change made to conform to the Appendix K requirement on "no return to nucleate boiling," were incorporated into the 1985 EM.*

6. NRC will evaluate CENP's position that the result of a sensitivity study of the refueling water storage tank water temperature used for safety injection and containment spray is generically applicable to all CENP-designed plants.

NRC Response:

In the phone call on November 8, 2000, NRC stated that it could not extend the use of minimum refueling water storage tank (RWST) water temperature as bounding for all applications of the 1999 EM. The NRC indicated that the SER will say that future plant submittals using the 1999 EM for its ECCS performance evaluation must confirm that the use of minimum temperature as described in the Topical Report is bounding.

CENP Follow-up Actions:

As described in Section 2.1.3 of the Topical Report, the use of the automated/integrated code system for the 1999 EM includes consistent modeling of spray and spillage from the break into the containment during the reflood thermal hydraulics portion of the analysis. In this regard, Section 3.3.1 of the Topical Report describes the change from the old approach of using [

] *to the approach of using* [
]

To demonstrate the impact of this change, Topical Report Section 3.3.1 presents a sensitivity study, representative of a typical CENP designed plant, demonstrating that use of minimum temperature for the RWST is roughly [ ] *more conservative in the calculation of peak cladding temperature than using maximum temperature for the RWST.*

Section 3.4.4 of the Topical Report states that a worst single failure analysis will be performed for each application of the 1999 EM. This section will be modified to include the statement that, the worst single failure of an ECCS component must include consideration of the most limiting value of the RWST temperature as described in Section 3.3.1.

7. NRC will evaluate the acceptability of using the 1999 EM automated/integrated code system as a vehicle for performing the 1985 EM licensing calculations.

NRC Response:

In the phone call on November 8, 2000, NRC stated that use of the automated/integrated code system as a vehicle for performing 1985 EM ECCS licensing analyses is a change to the evaluation model that requires NRC review and approval. The NRC stated that because the automated/integrated code system changes the way code inputs are prepared that this alters the analysis process and is therefore a change to the evaluation model. Also, because this represents a change to the evaluation model, the Dougall-Rohsenow film boiling correlation must be removed.

CENP Follow-up Actions:

CENP submitted the Topical Report assuming that since the automated/integrated code system was essentially replicating the manual processes and was performing calculations in conformance with already approved methodologies that this was not a change to the evaluation model and therefore did not require NRC review and approval nor removal of Dougall-Rohsenow. However, in the interest of concluding the review and having the SER issued for the 1999 EM, CENP withdraws its application to use the automated/integrated code system in conjunction with the 1985 EM.

To this end, the following modifications to the Topical Report will be made:

> *In the first paragraph of Section 1.2.1, text will be removed that says the 1985 EM process improvements may be implemented separate from the 1999 EM.*
>
> *The second paragraph of Section 2.1 is removed. This removes text saying that the 1985 EM process improvements may be implemented separate from the 1999 EM.*
>
> *In Section A.1, the words "fully compliant" used to describe the options for user input for the 1985 EM will be replaced with the word "consistent."*

Sections 3.4.1, 3.4.2, and 3.5.1, contain analytical results simulating the 1985 EM using the automated/integrated code system. These results remain in the text of the Topical Report in support of the 1999 EM. These results provide useful comparisons between ECCS performance evaluations using the currently accepted 1985 EM methodology and the 1999 EM.

CE NUCLEAR POWER LLC

RESPONSE TO NRC QUESTIONS REGARDING CENPD-132, SUPPLEMENT 4-P, REVISION 1 CALCULATIVE METHODS FOR THE CE NUCLEAR POWER LARGE BREAK LOCA EVALUATION MODEL

PROPRIETARY AFFIDAVIT

AFFIDAVIT PURSUANT TO 10 CFR 2.790

I, Philip W. Richardson, depose and say that I am the Manager, Windsor Nuclear Licensing, of CE Nuclear Power LLC (CENP), 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 for withholding this information.

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

Enclosure 1-P to LD-2000-0057, "Response to Questions Regarding CENPD-132, Supplement 4-P, Rev. 1", November 2000

This document has been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by CENP in designating information as a trade secret, privileged or as confidential commercial or financial information. Pursuant to the provisions of 10 CFR 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1. The information sought to be withheld from public disclosure, is owned and has been held in confidence by CENP. It consists of the methodology for the evaluation of LOCA pursuant to 10 CFR 50, Appendix K, comparisons to experimental data for model verification and comparison to the previously approved methodology.
2. The information consists of test data or other similar data concerning a process, method or component, the application of which results in substantial competitive advantage to CENP.
3. The information is of a type customarily held in confidence by CENP and not customarily disclosed to the public. CENP 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.
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 CENP because:
   a. A similar product is manufactured and sold by major pressurized water reactor competitors of CENP.
   b. Development of this information by CENP required hundreds of thousands of dollars and thousands of man-hours of effort. 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 to develop methodology for the evaluation of LOCA pursuant to 10 CFR 50, Appendix K, comparisons to experimental data for model verification and comparison to the previously approved methodology.
   d. The information consists of methodology for the evaluation of LOCA pursuant to 10 CFR 50, Appendix K, comparisons to experimental data for model verification and comparison to the previously approved methodology, 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 CENP, take marketing or other actions to improve their product's position or impair the position of CENP's product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.
   e. In pricing CENP's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of CENP's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.
   f. 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 CENP 's potential for obtaining or maintaining foreign licensees.

Further the deponent sayeth not.

Philip W. Richardson
Licensing Project Manager, Windsor Nuclear Licensing

Sworn to before me
this 10th day of November, 2000

Catherine P. McCarthy
Notary Public
My commission expires: 1/31/03