The Light company
Houston Lighting & Power South Texas Project Electric Generating Station P. O. Box 289 Wadsworth, Texas 77483

October 12, 1992
ST-HL-AE-4211
File Nos.: G25
M33.02
10CFR50.90 10CFR50.91
10CFR50.92 10CFR51

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

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Proposed Revision to the Updated Final Safety Analysis Report
to Reallocate Margin to Address Large Break LOCA Analysis
Initial Containment Temperature Assumptions

Pursuant to 10CFR50.90, Houston Lighting & Power Company (HL&P) hereby proposes to amend its Operating Licenses NPF-76 and NPF-80 by incorporating the attached proposed change to the South Texas Project (STP) Updated Final Safety Analysis Report (UFSAR). The proposed change would add wording to Section 15.6 of the UFSAR to reallocate inherent margin in the Large Break LOCA Emergency Core Cooling System (ECCS) analysis provided by Westinghouse. The new STP analysis uses nominal containment atmosphere pressure and temperature instead of the temperature and pressure limits permitted by Technical Specifications 3.6.1.4 and 3.6.1.5 which were used in the original analysis.

HL&P has reviewed the attached proposed amendment pursuant to 10CFR50.92 and determined that the proposed change is a reduction in a margin of safety, and thus is an Unreviewed Safety Question. However, based on information provided in the Attachments to this submittal, HL&P has determined that it does not involve a significant hazards consideration. Additionally, pursuant to 10CFR51 and based on information contained in this submittal and in the Final Environmental Statement Related to the Operation of South Texas Project, Units 1 and 2, HL&P has concluded that the proposed amendment poses no significant radiological or non-radiological impacts, and will not have a significant effect on environmental quality. The STP Nuclear Safety Review Board has reviewed and approved the proposed changes. In accordance with 10CFR50.91(b), HL&P is providing the State of Texas with a copy of this proposed amendment.

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If you should have any questions concerning this matter, please contact Mr. A. W. Harrison at (512) 972-7298 or me at (512) 972-7138.

S. L. Rosen
Vice President,
Nuclear Engineering

SDP/ag

Attachment: 1. No Significant Hazards Consideration Determination
2. Letter from Westinghouse to HL&P
3. Proposed Changes to UFSAR Section 15.6

UNITED STATES OF AMERICA
NUCLEAR RECULATORY COMMISSION

In the Matter	)	
	)	
Houston Lighting & Power	)	Docket Nos. 50-498
Company, et al.,	)	50-499
	)	
South Texas Project	)	
Units 1 and 2	)	

AFFIDAVIT

S. L. Rosen being duly sworn, hereby deposes and says that he is Vice President, Nuclear Engineering, of Houston Lighting & Power Company; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached proposed revision to the South Texas Project Updated Final Safety Analysis Report Section 15.6; is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge and belief.

S. L. Rosen
Vice President,
Nuclear Engineering

STATE OF TEXAS)
)
)

Subscribed and sworn to before me, a Notary Public in and for The State of Texas this 12th day of October, 1992.

SAVANNA S. FRANKLIN
Notary Public, State of Texas
My Commission Expires 7-16-94

Savanna S. Franklin
Notary Public in and for the
State of Texas

cc:

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Nuclear Regulatory Commission
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Revised 10/11/91

L4/NRC/

ATTACHMENT 1

NO SIGNIFICANT HAZARDS
CONSIDERATION DETERMINATION

BACKGROUND

On April 14, 1992, Westinghouse presented the results of sensitivity studies concerning Peak Clad Temperature (PCT) for accumulator water temperatures over 90°F. The results showed that increasing the accumulator temperature from 90°F to 120°F may increase the large break LOCA PCT by as much as 150°F. On April 24, 1992, a Station Problem Report (SPR) was issued to determine the maximum accumulator water temperature at STP.

On May 19, 1992, a peer review of the issue identified that when the Reactor Containment Fan Coolers (RCFCs) use safety grade Component Cooling Water (CCW) instead of non-safety grade chilled water, a potential exists for accumulator water to exceed 90°F. This may occur if chilled water is not available. On May 22, 1992, as a result of the SPR, HL&P issued Justification of Continued Operation (JCO) # 920154 to confirm that the calculated PCT for the Large Break LOCA analysis remains below the 2200°F acceptance limit. The investigation determined that the accumulator temperature could exceed 90°F during warm weather months with the non-safety chillers unavailable. The Large Break LOCA analysis was determined to not have sufficient margin to offset the PCT penalty associated with accumulator temperatures above 90°F.

The issued JCO requires that reactor power be reduced to less than 50% in the event the accumulator water temperature exceeds 90°F. To remove this restriction, HL&P proposes to incorporate into the STP licensing basis a new methodology developed by Westinghouse. The new Westinghouse methodology is discussed in a letter dated June 9, 1992 from Westinghouse to HL&P. (A copy of the letter is provided in Attachment 2 of this submittal). HL&P concurs with the arguments in this letter and finds them applicable to STP. A 10CFR50.59 evaluation shows the change to be a reduction in margin of safety, and therefore an Unreviewed Safety Question. However, the change is not a significant reduction in margin to safety as discussed in the attached letter.

Since STP is located in a warm climate, a potential exists for the accumulator temperature to exceed 90°F. In accordance with the previously mentioned JCO, this could result in an unnecessary reduction in power. For this reason, HL&P requests that high priority be given to the processing of this request.

DESCRIPTION OF CHANGE

HL&P proposes to incorporate, by reference, into the STP UFSAR a revision to the Westinghouse Large Break LOCA Analysis. The new methodology reallocates margin in the Westinghouse LOCA Emergency Core Cooling System (ECCS) models to account for the fact that the analysis uses nominal containment atmosphere pressure and temperature instead of the limits permitted by Technical Specifications. The Westinghouse letter provided in Attachment 2 of this submittal provides more detail concerning the revised methodology.

SAFETY EVALUATION

The accumulator tanks are located between the primary containment wall and the secondary shield wall at elevation (-)11'3". The tanks are in thermal equilibrium with the surrounding environment. During Modes 1, 2, 3, and 4, a minimum of four RCFCs located in this annulus region blow air inside and outside the secondary shield region. Most of the RCFC supply air (approximately 49,500 ft^3/min) is discharged inside the periphery of the secondary shield wall. The remaining supply air (approximately 4000 ft^3/min) is discharged outside the secondary shield wall and is used for incore instrument cooling. To equalize pressure between the secondary shield region and the annulus region, four vent holes are located on the secondary shield wall. Some of the RCFC air which cools the accumulators blows out of the four vent holes.

The air intake to the RCFC cooling coils enters through four ducts whose inlets are located on the 130' elevation of the Reactor Containment Building. Compliance with the Technical Specification limit of 120°F is determined using the inlet temperature to the RCFC cooling coils. The Design Basis Document for the Chilled Water System gives the design RCFC outlet air temperature as 65°F when the inlet air is 120°F (inlet air temperature is currently limited to 110°F in accordance with JCO # 920698). During normal operation, the RCFC cooling coils are cooled by two of three non-safety related chillers with a maximum design temperature of 56°F. With all three chillers out of service, the RCFC cooling coils are cooled by CCW with a maximum design supply temperature of 105°F.

The CCW system is cooled by Essential Chilled Water (ECW), which is cooled by the Essential Cooling Pond (ECP). During warm weather months, the ECP temperature may exceed the temperature required to maintain the accumulators below 90°F. Therefore, if the RCFC cooling coils are cooled by the CCW during these warm periods, accumulator temperature may exceed 90°F.

SAFETY EVALUATION (Continued)

Thermocouples are located in the air inlet and outlet side of each RCFC. The temperatures are recorded in the Emergency Response Facilities Data Acquisition Display System (ERFDADS) computer and displayed in the control room. There is no remote monitoring of the accumulator temperature; therefore, a surveillance was performed to determine the temperature of air surrounding the accumulator as a function of RCFC outlet temperature. Results of the survey showed that the accumulator temperature could be 15°F higher than the RCFC outlet temperature. Therefore, a 75°F RCFC outlet temperature limit would ensure that the accumulator temperature will not exceed 90°F.

A conservative evaluation was performed to determine the power reduction required to ensure the 2200°F PCT limit is satisfied when the accumulator water temperature exceeds 90°F. The evaluation was based on Westinghouse's experience and judgement, not actual STP computer runs. Results of this evaluation showed that a 50% reduction in power will ensure that the 2200°F PCT limit is satisfied.

HL&P issued JCO # 920154 to ensure that the 2200°F acceptance limit is not exceeded. The JCO requires the following compensatory actions:

1. The average outlet temperature of the operating RCFCs must be maintained below 75°F; this temperature will be monitored once per shift.

2. In the event that the average outlet temperature of the operating RCFCs exceeds 75°F, Operations shall determine, using a figure provided by Engineering, the time necessary for accumulator temperature to exceed 90°F. If the average outlet temperature of the operating RCFCs is not restored to below 75°F before the time predicted for the accumulator to reach 90°F, reactor power shall be reduced to less than 50% power within 6 hours.

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Pursuant to 10CFR50.91, this analysis provides a determination that the proposed change does not involve a significant hazards consideration as defined in 10CFR50.92:

1. The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The proposed change impacts the basis for the Large Break LOCA acceptance limit, and no physical changes to the plant are required. The consequences of a LOCA would remain within the design basis; the peak clad temperature would remain below the 2200°F limit with the new methodology. Also, the dose analysis would not be affected by the proposed change. Therefore, there would not be an increase in the probability or consequences of an accident previously evaluated.

2. The proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

   The proposed change affects the basis for the Large Break LOCA acceptance limit, and only the effects of an accident are considered. The proposed change does not involve a physical change to the plant. No changes to the operation of equipment considered in the safety analysis are proposed. The design basis of the plant is not impacted. Therefore, the subject of this evaluation does not create the possibility of a new or different kind of previously evaluated in the Safety Analysis Report.

3. The proposed change does not involve a significant reduction in a margin of safety.

   As discussed in the attached Westinghouse evaluation, there is sufficient inherent conservatism in the Westinghouse Large Break LOCA ECCS evaluation model to bound any uncertainty associated with the current containment and accumulator temperature assumptions. The inherent conservatism assures with high probability that the criteria of 10CFR50.46 would not be exceeded in the event of a Large Break LOCA.

Based on the reasoning stated above and the previous discussion of the amendment request, HL&P has determined that the requested change does not involve a significant hazards consideration.

IMPLEMENTATION PLAN

Implementation of the proposed amendment, should it be approved, would not require any new surveillances to be performed nor would it affect any surveillance schedules. HL&P requests a 10 day implementation period following issuance of the approved amendment to facilitate completion of administrative tasks concerning distribution of the approved change.

ATTACHMENT 2

LETTER FROM WESTINGHOUSE TO HL&P

Westinghouse Electric Corporation Energy Systems

Box 355
Pittsburgh Pennsylvania 15230 0355

June 9, 1992
ST-WN-HS-1763

Action Req'd: X Y ___ N

Mr. W. J. Jump, Manager
Licensing
Houston Lighting & Power Company
P.O. Box 289
Wadsworth, TX 77483

South Texas Project
Unit Numbers 1 & 2
Contract Number ST-400088
Containment Initial Temperature Assumption For
Large Break Loss of Coolant Accident Analysis

Dear Mr. Jump:

The purpose of this letter is to inform your plant that Westinghouse is informing the U. S. Nuclear Regulatory Commission (NRC) of an issue related to the initial containment temperature assumption used in Large Break Loss of Coolant Accident Evaluation Models. This issue was not reported to the NRC as an actual or potential Substantial Safety Hazard pursuant to the requirements of 10 CFR Part 21. The information provided to the NRC is to clarify the basis for an acceptability of assumptions historically made for the initial containment temperature. Please find attached a copy of the letter (ET-NRC-92-3699 dated 6/1/92) transmitted by Westinghouse to the NRC providing this information.

Should you have any questions regarding this issue, please contact Mr. H. A. Sepp at (412) 374-5282).

Very truly yours,

D. S. Lipman, Project Manager
Midwest Area
South Texas Project

Attachment
0257K

ATTACHMENT 2
ST-HL-AE-4211
PAGE 2 OF 9

Westinghouse Electric Corporation Energy Systems

Nuclear and Advanced Technology Division

Box 355
Pittsburgh Pennsylvania 15230 0355

June 1, 1992
ET-NRC-92-3699

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

Subject: Results of Technical Evaluation of Containment Initial Temperature Assumptions for Large Break Loss of Coolant Accident Analysis

Reference: ET-NRC-92-3695 dated 4/30/92

Westinghouse provided interim report (ET-NRC-92-3695 dated 4/30/92) pursuant to 10CFR Part 21.21(a)(2) requirements regarding the containment initial temperature assumption used in the analysis of the postulated Large Break Loss of Coolant Accident. Please find attached the results of the evaluation performed to date.

Very truly yours,

Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Activities

Attachment

NRC/NPF/PRJ6-92

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Introduction:

Westinghouse has completed its evaluation of a Potential Safety Issue concerning the accumulator initial temperature, the containment initial temperature, and the containment initial pressure assumptions used in the Large Break Loss-Of-Coolant Accident (LBLOCA) Evaluation Models (EMs). A utility initially raised this issue by questioning the 90°F containment initial temperature assumption in its LBLOCA analysis, when the Technical Specifications allow a range of temperatures at 100% power. Upon further investigation of this issue the scope was broadened to include concerns with respect to the containment initial pressure and the accumulator initial temperature assumptions used in the LBLOCA EM.

Under the requirements of 10 CFR 21.21(a)(2), interim reports were issued to the NRC in references 1 and 2. Since the issuance of the interim reports, the evaluation has been completed and it has been concluded that the traditional Westinghouse assumptions for containment and accumulator initial conditions in the LBLOCA Emergency Core Cooling System (ECCS) EMs are appropriate. The basis for this conclusion is outlined below.

Containment Initial Conditions:

Evaluation Models used to calculate the Peak Cladding Temperature (PCT) during a LBLOCA require the calculation of the containment pressure during the transient. This pressure, to which fluid from the broken pipe exhausts, is important when the RCS pressure is nearly equal to the containment pressure. The effect of lower containment pressure is the decrease in the reflooding rate, which ultimately is a PCT penalty. This is addressed by the regulations of 10CFR50 Appendix K (I.D.2):

> "The containment pressure used for evaluating cooling effectiveness during reflood and spray cooling shall not exceed a pressure calculated conservatively for this purpose."

In the branch Technical Position CSB 6-1, the NRC recognizes the effect of other parameters on the containment pressure. The Branch Technical Position specifically identifies a conservative trend for containment initial temperature:

> "Therefore, the following branch technical position has been developed to provide guidance in the performance of minimum containment pressure analysis."
>
> "The minimum containment gas temperature, minimum containment pressure, and maximum humidity that may be encountered under limiting normal operating conditions should be used."

For the LBLOCA EMs, Westinghouse has defined normal operating conditions to be those associated with full power operation, which is consistent with the 102% power assumption required by 10CFR50 Appendix K (I.A). The containment parameters assumed in the LBLOCA EM need not be the same as the Limiting Conditions for Operation (LCO) as defined in the

Containment Technical Specifications. The LCOs in the Technical Specifications often represent extreme conditions that are not typically encountered during normal operation. In addition, the LCOs associated with the Containment Technical Specifications are based upon containment integrity and equipment operability considerations, not ECCS performance considerations. Consequently, some LBLOCA EM values were chosen as being representative of limiting conditions during normal full power operation, and others were set at the Technical Specification LCO value. In all cases the combination of containment parameter values were chosen to assure that the overall calculation of containment pressure during a LBLOCA would be conservative.

Typical Westinghouse assumptions for dry-atmospheric containments are 90°F initial temperature and 14.7 psia initial pressure. For subatmospheric plants Westinghouse uses the Technical Specification minimum containment pressure along with a representatively low temperature of 90°F. Also, ice-condenser containments typically use 14.7 psia and the maximum Technical Specification containment temperature. The use of the maximum containment temperature for an ice-condenser containment provides a lower containment backpressure during the reflood transient and is therefore conservative with respect to 10CFR50 Appendix K requirements.

Westinghouse has always used these assumptions. The containment initial temperature and pressure assumptions in a plant's LBLOCA analysis have been consistently reported to the NRC in the Final Safety Analysis Report. The NRC has reviewed and approved this aspect of the LBLOCA transient via plant specific Safety Evaluation Reports.

The effect of variations in initial containment parameters has been determined for the LBLOCA EMs through sensitivity studies. As expected, ECCS EMs show PCT increases for lower containment pressures. The 1978 LBLOCA EM [3] can experience as high as a 51°F Peak Cladding Temperature (PCT) increase for a 1 psi decrease in containment pressure. However, the sensitivity to containment pressure has decreased as the LBLOCA EMs have evolved. The BASH Evaluation Model [4] has shown a 10°F PCT increase for a 1 psi decrease in containment pressure, and the BART Evaluation Model [5] has an increase of 4°F in PCT for a 1 psi decrease in containment pressure. The WCOBRA/TRAC Two-Loop UPI LBLOCA Best-Estimate Evaluation Model [9] has a 7°F PCT increase for a 1 psi decrease in containment pressure.

In addition, two analyses with the BASH EM for a dry containment plant were performed to assess the effect of the containment initial temperature on the peak cladding temperature. Decreasing the containment initial temperature by 15°F and 30°F resulted in a PCT penalty of 3°F and a PCT benefit of 4°F respectively. Thus, the containment initial pressure and temperature sensitivities for the current BART, BASH, and WCOBRA/TRAC Two-Loop UPI Evaluation Models have a small effect upon the calculated PCT.

It is concluded that the LBLOCA ECCS analyses do not need to assume the containment temperature and pressure Technical Specification limits in order to produce a conservative prediction of ECCS performance. The utilization of representative values in the ECCS analysis does not invalidate the basis for the containment pressure and temperature Technical Specification limits. The traditional Westinghouse assumptions for containment initial conditions in the LBLOCA ECCS EMs are judged by Westinghouse to be appropriate.

Accumulator Water Initial Temperature:

During the containment initial temperature investigation, a related issue arose concerning the accumulator initial temperature assumption. For the LBLOCA analysis, Westinghouse has typically assumed a value of 90°F for the accumulators. As a result of the decreasing influence of containment pressure on the calculated PCT results, a concern was raised with respect to the appropriateness of the 90°F accumulator water assumption.

Westinghouse is not aware of any utilities that measure accumulator water temperature as part of normal operations. Therefore, any estimation of typical accumulator water temperature during normal full power operation can only be inferred from containment temperature conditions. Containment temperatures during full power operation will vary considerably with location inside of containment, with the warmest locations being inside the biological shield near the RCS piping as well as at the higher elevations. The coolest locations are typically in the lower elevations outside of the biological shield. A review of the containment layouts for various plants have shown that the accumulators are typically located in the lower elevations of the containment and outside of the biological shield. Discussions with several utilities have indicated that 90°F is representative of the containment temperature in the lower elevations of the containment outside of the biological shield, and therefore is representative of actual accumulator temperature during normal operation.

Sensitivity studies were performed with the BASH EM to determine the effect on PCT for variations in accumulator initial temperature. A typical three-loop plant, an ice-condenser containment plant, and two four-loop dry containment plants were analyzed. The results of these studies indicate that the effect on the PCT can vary between 49°F and 150°F for a 30°F increase in the accumulator water temperature.

Sufficient inherent conservatism already exists in the Westinghouse LBLOCA EMs to bound the uncertainty associated with the accumulator water temperature assumption. Reference 4 provides information concerning the inherent conservative nature of the BASH Evaluation Model. Specifically, the Technical Evaluation Report for the BASH EM provides the following information in the conclusions and recommendations section:

> "Some of the basis for determining the actual amount of margin existing in current EMs results from our experience reviewing the results of LOCA analyses from other thermal-hydraulic codes. One of the most applicable set of analyses for this discussion was completed by Rohatgi and Yuelys-Miksis at Brookhaven National Laboratory while the BASH review was underway. [7] (That study is briefly referred to in Section 11 of the (BASH) WCAP.) The Brookhaven study concluded that there is approximately 1200°F of conservatism in the peak clad temperature predictions contained in representative EM calculations. Based on their analyses, they attributed almost 650°F of that conservatism to the licensing type operating and boundary conditions and scenarios used by the EM, and the other 550°F, or so, to the physical models required by Appendix K. We and others have previously seen that this estimate of the amount of margin available is realistic."

Some of the conservatism outside of 10CFR50 Appendix K is detailed in reference 4, page 9 of the Safety Evaluation Report, which states:

> "The sources of the conservative margin are attributed to a tendency by the BASH model to underpredict the flooding rate and the hot channel heat transfer."

Furthermore, as detailed in Appendix I of reference 4, the BART Evaluation Model contains approximately 50°F of conservatism over the BASH Evaluation Model. Thus, there is considerable conservatism in the Westinghouse LBLOCA Evaluation Models in addition to those resulting from the 10CFR50 Appendix K requirements.

Reference 9 also indicates that the WCOBRA/TRAC Two-Loop UPI LBLOCA Best-Estimate Evaluation Model has sufficient conservatism to bound any variation in accumulator water temperature. Page 55 of the Technical Evaluation Report in reference 9 states:

> "The four - channel, super - bounded PCT with uncertainties is a conservative estimate of the 95% probability level PCT. The realistic 95% probability level PCT is less than this value and there is a large margin."

During this evaluation available experimental data from the FLECHT-SEASET tests [5] and from the Cylindrical Core Test Facility (CCTF) [8] were reviewed. Figure 1, which is from the FLECHT-SEASET tests, shows that the effect of coolant subcooling on temperature rise is inconclusive. For FLECHT-SEASET and FLECHT Cosine tests, more coolant subcooling (colder ECCS water temperature) was found to give lower peak temperatures. In the FLECHT skewed power tests, the opposite effect was found, greater subcooling resulted in higher cladding temperature. The CCTF tests indicate that the temperature rises during the reflood transient are small over a wide range of initial conditions, including different core inlet subcoolings. However, the CCTF tests do not include a single effect which can be used to establish a clear trend with respect to subcooling.

In conclusion, sufficient inherent conservatism exists in the Westinghouse LBLOCA EMs to bound any uncertainty associated with the traditional 90°F accumulator water temperature assumption. Use of an extremely high accumulator water temperature assumption would unnecessarily add further conservatism to the already conservative LBLOCA EMs.

Summary and Conclusions:

The traditional Westinghouse assumptions for containment and accumulator initial conditions in the LBLOCA ECCS EMs are judged by Westinghouse to be appropriate. There is sufficient inherent conservatism in the Westinghouse LBLOCA ECCS EMs to bound any uncertainty associated with the current containment and accumulator temperature assumptions, and to assure with high probability that the criteria of 10CFR50.46 would not be exceeded in the highly unlikely event of a Large Break LOCA. As new LBLOCA analyses are performed with either the BART, BASH, or WCOBRA/TRAC Two-Loop UPI EMs, these assumptions will be evaluated and justified on a case by case basis.

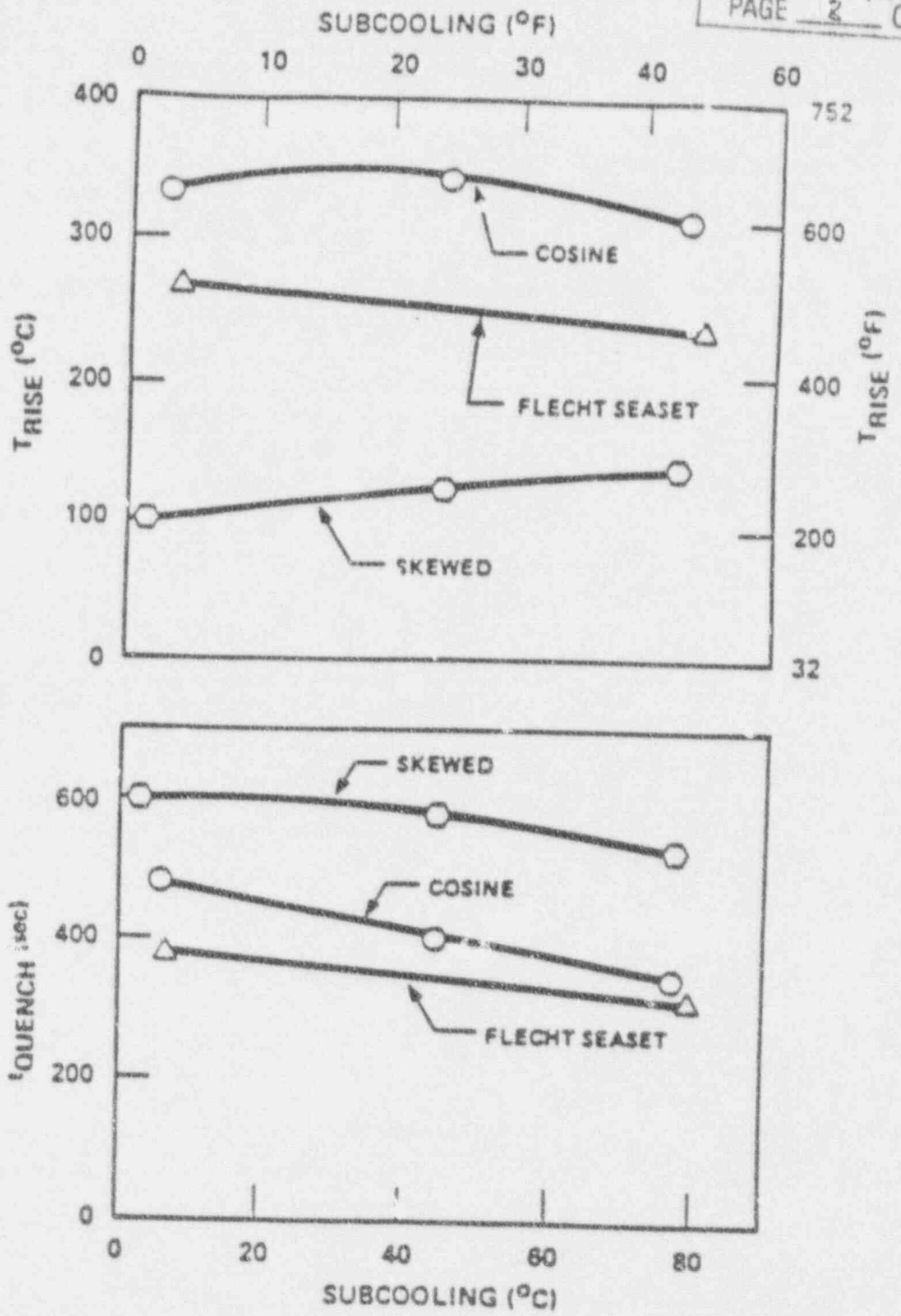

Figure 1. Subcooling Effect on Temperature Rise and Quench Time. From Lee, N. et al., "PWR FLECHT SEASET Unblocked Bundle Forced and Gravity Reflood Task," EPRI NP-2013, WCAP-9891, ebruary 1982.

References

1. ET-NRC-91-3647, Interim Report of Evaluation of a Deviation or Failure to Comply Pursuant to 10CFR21.21(a)(2), December 20, 1991.

2. ET-NRC-92-3695, Interim Report of Evaluation of a Deviation or Failure to Comply Pursuant to 10CFR21.21(a)(2), April 30, 1992.

3. "Westinghouse ECCS Evaluation Model: 1978 Version", WCAP-9220-P-A, February 1978.

4. "The 1981 Version of the Westinghouse ECCS Evaluation Model Using the BASH Code", J. J. Besspiata, J. N. Kabadi, H. C. Yeh, and M. Y. Young, WCAP-10266-P-A Rev. 2, March 1987.

5. "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients", M. Y. Young, J. S. Chiou, J. Kabadi, T. A. Porsching, S. R. Rod, A. C. Spencer, WCAP-9561-P-A, March 1984.

6. Lee, N. et al., "PWR FLECHT SEASET Unblocked Bundle Forced and Gravity Reflood Task," EPRI NP-2013, WCAP-9891, February 1982.

7. "Safety Research Programs Sponsored by Office of Nuclear regulatory Research, Quarterly progress report, October 1 - December 31, 1984." Brookhaven National Laboratory, NUREG/CR-2331, Vol. 4, No. 4, May 1985, pp. 66, 67, and 74.

8. "Research Information Report for the Core Cylindrical Test Facility, Core II Test Series." MPR-934, Volume I of II, April 1988.

9. Hochreiter, L. E., Schwarz, W. R., Takeuchi, K., Tsai, C. K., and Young, M. Y., "Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 2: Application to Two-Loop PWRs Equipped with Upper Plenum Injection", WCAP-10924-P-A, Rev.2, and Addenda, December 1988.