Log # TXX-98004
File # 10035
Ref. # 10CFR50.54(f)
GL 97-04

TU ELECTRIC

January 14, 1998

C. Lance Terry
Group Vice President

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
RESPONSE TO GENERIC LETTER 97-04, "ASSURANCE OF SUFFICIENT NET POSITIVE SUCTION HEAD FOR EMERGENCY CORE COOLING AND CONTAINMENT HEAT REMOVAL PUMPS"

REF: 1) Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps" dated October 7, 1997.

2) TU Electric Letter, logged TXX-97238, "Response to Generic Letter 97-04 ..." from C. L. Terry to U. S. Nuclear Regulatory Commission dated November 6, 1997.

Gentlemen:

On October 7, 1997, the NRC issued Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps." Included in this letter was a request for both a 30 day and a 90 day response from all addressees. TU Electric responded to the 30 day request in Reference 2. TU Electric committed to provide the information requested in the 90 day response by April 7, 1998. Per conversation with members of NRR on December 12, 1997, TU Electric orally agreed to provide as much of the 90 day requested information as practical, during the week of January 12, 1998. TU Electric is providing the requested information as identified at this time in Attachment 2. TU Electric will provide further clarifying information by April 7, 1998, as agreed to by NRR in the phone conversation of December 12, 1997.

Pursuant to Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), TU Electric is submitting a response under affirmation (Attachment 1) to the requested information and requested actions as stated in Reference 1.

A076/1

P. O. Box 1002 Glen Rose Texas 76043

This communication contains the following commitment which will be completed as noted:

ACL Number	Commitment
97-116	TU Electric is providing the requested information as identified at this time in Attachment 2. TU Electric will provide further clarifying information by April 7, 1998, as agreed to by NRR in the phone conversation of December 12, 1997.

The ACL (Action Correspondence Log) number is used by TU Electric for the internal tracking of CPSES commitments which are one time action requirements.

If you have any questions, please contact Randy Blankenship at (254) 897-5890.

Sincerely,

C. L. Terry

C. L. Terry

By: Roger D. Walker
Roger D. Walker
Regulatory Affairs Manager

RTB/rb

Attachments

c - E. W. Merschoff, Region IV
J. I. Tapia, Region IV
T. J. Polich, NRR
Resident Inspectors, CPSES

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
Texas Utilities Electric Company	)	Docket Nos. 50-445
	)	50-446
(Comanche Peak Steam Electric Station,	)	
Units 1 & 2)	)	

AFFIDAVIT

Roger D. Walker being duly sworn, hereby deposes and says that he is Regulatory Affairs Manager of TU Electric, the licensee herein; that he is duly authorized to sign and file with the Nuclear Regulatory Commission this Response to Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps"; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge, information and belief.

Roger D. Walker

Roger D. Walker
Regulatory Affairs Manager

STATE OF TEXAS)
)
COUNTY OF Johnson)

Subscribed and sworn to before me, on this 14th day of January, 1998.

CAROLYN L. COSENTINO
Notary Public, State of Texas
My Comm. Expires 04/04/98

Carolyn L. Cosentino

Notary Public

GL 97-04 requested information regarding Net Positive Suction Head (NPSH) for the emergency core cooling and containment heat removal pumps that meet either of the following criteria:

> (1) *pumps that take suction from the containment sump or suppression pool following a design-basis LOCA or secondary line break, or*
>
> (2) *pumps used in "piggyback" operation that are necessary for recirculation cooling of the reactor core and containment (that is, pumps that are supplied by pumps which take suction directly from the sump or suppression pool).*

TU Electric submits that for Comanche Peak Steam Electric Station (CPSES) the following pumps are inclusive of these classifications for both units.

Emergency Core Cooling Pumps	Suction Source
Residual Heat Removal (RHR) Pump - 01	Sump
Residual Heat Removal (RHR) Pump - 02	Sump
Safety Injection Pump (SIP) - 01	RHR-01 or RHR-02
Safety Injection Pump (SIP) - 02	RHR-01 or RHR-02
Centrifugal Charging Pump (CCP) - 01	RHR-01 or RHR-02
Centrifugal Charging Pump (CCP) - 02	RHR-01 or RHR-02

Containment Heat Removal Pumps	Suction Source
Containment Spray Pump - 01	Sump
Containment Spray Pump - 02	Sump
Containment Spray Pump - 03	Sump
Containment Spray Pump - 04	Sump

With respect to the above 10 pumps for each unit, CPSES presents the following responses as to the information requested per the generic letter.

Item 1 - Specify the general methodology used to calculate the head loss associated with the ECCS suction strainers.

Response:

The general methodology used at CPSES to calculate the head loss associated with the ECCS suction strainer/containment sump is as follows:

The basic equation for calculating NPSH is:

$$NPSH = h_a - h_{vpa} + h_{st} - h_{fs}$$

where:

h_a = absolute pressure on the surface of the liquid supply level.

h_{vpa} = head corresponding to the vapor pressure of the liquid at the temperature being pumped.

h_{st} = static height that the liquid supply level is above or below the pump centerline or impeller eye.

h_{fs} = suction line losses including entrance losses and friction losses.

Additional detail on each of the terms is provided below.

h_a - absolute pressure on the surface of the liquid supply level

This term is the containment pressure that is taken credit for in the analysis. CPSES assumes the pressure on the surface of the liquid is equal to the v[illegible]ressure of the liquid at the pumped fluid temperature. See the response to Question 4 for a discussion on the crediting of containment pressure in the NPSH analysis for CPSES.

h_{vpa} - head corresponding to the vapor pressure of the liquid at the temperature being pumped.

This term requires the determination of the temperature of the fluid being pumped. The temperature used in the limiting NPSH calculation is based on a conservative assessment using a sump fluid temperature equivalent to the saturated conditions in containment, at the containment pressure in the NPSH analysis. CPSES assumes $h_{vpa} = h_a$.

h_{st} - static height that the liquid supply level is above or below the pump datum (e.g., centerline or impeller eye)

This term is simply the minimum static height of fluid above the pump reference point (typically pump centerline or impeller eye). The containment minimum flood analysis is used as a basis for the height of water on the containment floor (Elevation 808'-0") and in the sump (bottom elevation 802'-0") during the pump operating sequence.

h_{fs} - all suction line losses including entrance losses and friction losses.

This term involves suction line losses associated with the pump being evaluated. The following parameters are considered in the NPSH calculation:

1. Suction line friction and entrance losses. The important parameters to consider here are the following:

   - Pipe roughness
   - Pipe aging effects
   - Length of piping
   - Fluid velocity (See Item 4 below)
   - Number and types of valves and fittings in the suction piping

2. Head loss associated with the open area of a strainer/sump screen that is free of debris as confirmed by full scale model testing. The effect of sump screen blockage is considered in the architect/engineer analyses. The analyses by the Nuclear Steam Supply System vendor are performed at the floor level (below the screens) and do not include this head loss.

3. Suction line velocity head losses.

4. The maximum system flow rates through the strainers/sump and associated piping are determined for use in calculating friction losses. Higher flow rates create greater line losses. No design mode of operation reduces flow in the spray pump suction lines such that the flow rate is insufficient to maintain check valves in the full open position. There are no check valves in the RHR pump suction.

Item 2 - Identify the required NPSH and the available NPSH.

<u>Response</u>:

The following tabulation of NPSH analyses by the NSSS vendor provides the available NPSH ($NPSH_A$), during recirculation, corresponding to flood level at containment elevation 808'-0" which is the floor elevation at the top of the 6 foot deep containment emergency sumps. The actual $NPSH_A$ is greater and can be determined by adding the containment flood level above 808'-0" and correcting for head loss across the sump screens. The $NPSH_A$ is greater than the NPSH required ($NPSH_R$).

Pump	GPM	$NPSH_R$	$NPSH_A$	Margin
Residual Heat Removal Pumps	4900*	20'	25'	>5'
Safety Injection Pumps	403*	9'	96.8'	>87.8'
Centrifugal Charging Pumps	409*	15'	62.5'	>47.5'

* Corresponds to one RHR pump supplying two trains of SI and charging operating in parallel. The calculation [Ref. 7] is for the limiting case for RHR pump NPSH.

The following tabulation of NPSH analyses by the architect/engineer provides the $NPSH_A$, during recirculation, corresponding to flood level at containment floor elevation 808'-0". The assumed RHR pump flow rate was conservatively selected as 5300 gpm. The RHR system is designed to limit the maximum flow during recirculation to 4900 gpm. The calculated RHR pump $NPSH_A$ also includes a head loss for 50% screen blockage equivalent to 0.5 feet taken from the full scale sump test [Ref. 6]. The calculated containment spray pump $NPSH_A$ includes a resistance coefficient to simulate 50% screen blockage equivalent to 0.52 feet at 7[illegible]00 gpm taken from the full scale sump test [Ref. 6].

Pump	GPM	$NPSH_R$	$NPSH_A$	Margin
Residual Heat Removal Pumps	5300	23'	23.9'	0.9'
Containment Spray Pumps	3740*	17.1'	18.7'	1.6'

* Per pump

The actual $NPSH_A$ is greater and can be determined by adding the containment flood level above 808'-0". The water height above elevation 808'-0" at transfer to ECCS recirculation, $H_{ECCS} = 1.8'$. From the NSSS analysis above, the RHR pump margin is also at least 3' greater at the maximum flow of 4900 gpm.

This yields NPSH margins for RHR as follows:

RHR Pumps - 0.9' + 3' + 1.8' = >5.7'

and the ratio of NPSH available to NPSH required is:

$NPSH_A$ / $NPSH_R$ = [(23.9 + 1.8) / (20)] = 1.3

The water height above elevation 808'-0" at transfer to containment spray recirculation, H_{CSS} = 3.5'. This yields NPSH margin for containment spray as follows:

Containment Spray Pumps - 1.6' + 3.5' = 5.1'

and the ratio of NPSH available to NPSH required is:

$NPSH_A$ / $NPSH_R$ = [(18.7 + 3.5) / (17.1)] = 1.3

Item 3 - Specify whether the current design-basis NPSH analysis differs from the most recent analysis reviewed and approved by the NRC for which a safety evaluation was issued.

Response:

As documented in the CPSES FSAR [Ref.3] Appendix 1A(N) and 1A(B) and Sections 6.2.2.3.4 and 6.3.2.2.10, the NPSH analyses for the ECCS and Containment Spray Pumps conform to RG 1.1. This acceptance criteria is reflected in the SER [Ref.4] Sections 6.2.2 and 6.3.2.

FSAR Table 6.2.2-1 shows the Containment Spray pump $NPSH_R$ (13 feet) at 3000 gpm. FSAR Figure 6.2.2-2 shows the relationship of NPSH required and available as a function of flow. The $NPSH_R$ values were increased when new impellers were installed as a design modification following issuance of the operating license.

FSAR Section 6.3 2.2.10 notes that the most limiting ECCS NPSH conditions are during injection with charging (and SI) pumps aligned to the Refueling Water Storage Tank (RWST) [see FSAR Table 6.3-1]. NPSH values during recirculation for ECCS are not provided in the FSAR.

The full scale containment sump testing [Ref. 6] discussed in SER and SSER section 6.3.4.2 was performed with design pump flows of 5300 for RHR and 3600 for containment spray.

As documented in Ref. 5 and SSER 9, Appendix L, Section 2.1.1, the NPSH margins were given as 4.23 feet for RHR Pumps and 81 feet for the Containment Spray Pumps. The current NPSH margi[illegible], 5.7 feet and 5.1 feet, respectively, are similar. The NPSH analyses in Ref. 5 were based on the following:

RHR Pump Flow - 5300 gpm

Containment Spray Pump Flow - 3900 gpm per pump

Minimum Containment Flood Level - 814.8 feet

As documented in SSER 17, Appendix A, Open Item F-5; the minimum water level for containment spray pump NPSH analysis (16345-ME(B)-169) reviewed by the NRC was different than the 814.8 feet in Ref. 5 and was 810 feet. The SSER concluded that this was conservative. The current minimum containment flood level analysis is 811'-6" for containment spray NPSH analyses, which remains conservative to the NPSH analyses accepted in SSER 9. The current minimum containment flood level analysis is 809'-9.4" for the RHR Pumps.

Although there are differences in details of the current analyses, the basic methodology, design margins and conclusions are still consistent.

Item 4 - Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.

Response:

In accordance with References 3 and 4 and Reg. Guide 1.1, no containment overpressure is credited in the calculation of available NPSH for any of the ECCS or containment heat removal pumps at CPSES.

Item 5 - When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

<u>Response</u>:

Not applicable, see item 4.

REFERENCES

1. Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps" dated October 7, 1997.

2. TU Electric Letter, logged TXX-97238, "Response to Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps" from C. L. Terry to U.S. Nuclear Regulatory Commission dated November 6, 1997.

3. CPSES Final Safety Analysis Report, Amendment 94.

   Appendix 1A(N), RG 1.1
   Appendix 1A(B), RG 1.1, RG 1.79, RG 1.82
   Section 6.2.2.3.4
   Section 6.3.2.2.10
   Section 6.3.4.2

4. NUREG-0797, Safety Evaluation Report related to the Operation of Comanche Peak Steam Electric Station, Units 1 and 2, July 1981.[SER]

   Sections 6.2.2, 6.3.3.3 and 6.3.4.2.

   Supplements [SSERs]:

   SSER 1, October 1981, Section 6.3.4.2

   SSER 9, March 1985, Appendix L

   SSER 17, November 1988, Appendix A

   SSER 21, April 1989, Appendix L

5. "Evaluation of Paint and Insulation Debris Effects on Containment Emergency Sump Performance, Gibbs & Hill, Inc., Revision 1, October 1984.

6. "Model Testing of the Recirculation Containment Sump," Western Canada Hydraulic Laboratories LTD., November 1981.

7. Calc. FSSE/SS-TBX-1192 (10/17/88)

8. Calc. ME(B)-325R0,CCN-4 (12/3/97); 2-ME-0147R0,CCN-1 (11/10/97)

9. Calc. ME-CA-0232-4006R2 (8/21/97)