NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
South Texas, Unit 1	0 5 0 0 0 4 9 8	1 OF 0 2

TITLE (4)

Hydraulic Transients in the Auxiliary Feedwater System Due to a Design Error

EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
											0 5 0 0 0
1 1	0 5	8 7	8 7	—	0 1 6	— 0 1	0 3	1 5	8 8		0 5 0 0 0

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10) 0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
	20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Charles Ayala - Supervising Licensing Engineer	AREA CODE 5 1 2 9 7 2 - 8 6 2 8

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B											

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single space typewritten lines) (16)

On November 5, 1987, while the plant was in Mode 4, prior to initial criticality, a one inch double valve vent line in the pump discharge piping of Auxiliary Feedwater (AFW) Train A broke off. Train A was declared inoperable and the vent line was repaired. On November 8, 1987 a second failure occurred in a double valve instrument tap for the Train D flow element. AFW is not required to be operable prior to Mode 3. An initial assessment determined the cause of these events to be waterhammer attributable to improper venting of the system. Design and procedural changes were made and the Unit went to Mode 3 on November 22, 1987. Subsequently, sustained piping vibration in Trains A and C was observed. Additional piping damage occurred and the unit was returned to Mode 4. Based on concerns about the design of the AFW system this event was reported to the NRC via ENS per 10CFR50.72(b)(2)(iii). Evaluations and testing have determined that pressure pulsations were being set up when the flow control valves were in a highly throttled position. A combination of both hydraulic and structural resonances set up as a result of the pulsations was large enough to cause the damage which occurred. Design changes to eliminate this problem have been implemented and proof testing has been completed. There were no adverse safety or radiological consequences from this event.

NL.LER87016

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
South Texas, Unit 1	0 5 0 0 0 4 9 8	8 7	— 0 1 6	— 0 1	0 2 OF 0 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

A full description of this event was submitted to the NRC by letter ST-HL-AE-2461 dated December 24, 1987.

A full description of the corrective actions taken and results of confirmatory testing were submitted to the NRC by letter ST-HL-AE-2516, dated February 19, 1988 (Attached).

NL-LER87016

The Light company
Houston Lighting & Power

P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

March 15, 1988
ST-HL-AE-2567
File No.: G26
10CFR50.73

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

South Texas Project Electric Generating Station
Unit 1
Docket No. STN 50-498
Revision 1 to Licensee Event Report Regarding Hydraulic Transients
in the Auxiliary Feedwater System Due to a Design Error

Pursuant to 10CFR50.73, Houston Lighting & Power Company (HL&P) submits the attached revision to the subject Licensee Event Report (LER 87-016) regarding hydraulic transients in the Auxiliary Feedwater System due to a design error. This event did not have any adverse impact on the health and safety of the public.

If you should have any questions on this matter, please contact Mr. C.A. Ayala at (512) 972-8628.

G. E. Vaughn
Vice President
Nuclear Plant Operations

GEV/MFH/eeg

Attachments: Revision 1 to Licensee Event Report Regarding Hydraulic Transients in the Auxiliary Feedwater System Due to a Design Error.

Auxiliary Feedwater Hydraulic Transient - Supplemental Report, letter ST-HL-AE-2516, dated February 19, 1988.

IE22
1/1

cc:

Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

N. Prasad Kadambi, Project Manager
U. S. Nuclear Regulatory Commission
1 White Flint North
11555 Rockville Pike
Rockville, MD 20859

Dan R. Carpenter
Senior Resident Inspector/Operations
c/o U. S. Nuclear Regulatory Commission
P. O. Box 910
Bay City, TX 77414

J. R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

R. L. Range/R. P. Verret
Central Power & Light Company
P. O. Box 2121
Corpus Christi, TX 78403

R. John Miner (2 copies)
Chief Operating Officer
City of Austin Electric Utility
721 Barton Springs Road
Austin, TX 78704

R. J. Costello/M. T. Hardt
City Public Service Board
P. O. Box 1771
San Antonio, TX 78296

Rufus S. Scott
Associate General Counsel
Houston Lighting & Power Company
P. O. Box 1700
Houston, TX 77001

INPO
Records Center
1100 Circle 75 Parkway
Atlanta, Ga. 30339-3064

Dr. Joseph M. Hendrie
50 Bellport Lane
Bellport, NY 11713

The Light company
Houston Lighting & Power

P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

February 19, 1988
ST-HL-AE-2516
File No.: G02
10CFR50

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

South Texas Project Electric Generating Station
Unit 1
Docket No. STN 50-498
Auxiliary Feedwater Hydraulic
Transient-Supplemental Report

Reference 1) Letter from M. R. Wisenburg to Document Control Desk, dated December 26, 1987 (SI-HL-AE-2461).

In Reference 1, Houston Lighting & Power Company (HL&P) provided a report on the hydraulic transients which occurred in the Auxiliary Feedwater (AF) System beginning in early November of 1987. The report described the testing and corrective action taken to prevent the observed hydraulic transients. In addition, HL&P committed to perform confirmatory tests to verify the operability of the modified flow control valves and the crossover valves. This testing has been successfully completed. The attached report documents the results of the tests.

In Item "a" on Page 2 of Reference 1 and Item 7 on Page 79 of the AF System Report, HL&P committed to modify and test of the flow control valves in Unit 1 to determine if the need for the positive stop can be eliminated on both units. However, the Unit 1 test results with the mechanical stops installed prove the AF system can readily maintain steam generator level during all plant operating modes. These stops provide a positive method to eliminate the pressure pulsations that induced the hydraulic transients. As such, future elimination of the Unit 1 or Unit 2 mechanical stops is not anticipated at this time.

If you should have any questions on this matter, please contact Mr. S.M. Head at (512) 972-8392.

M. A. McBurnett
Manager
Operations Support Licensing

SLR/SMH/dg

Attachment: Supplemental Report on the Investigation of Hydraulic Transient Events in the Auxiliary Feedwater System

cc:
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

N. Prasad Kadambi, Project Manager
U. S. Nuclear Regulatory Commission
1 White Flint North
11555 Rockville Pike
Rockville, MD 20859

Dan R. Carpenter
Senior Resident Inspector/Operations
c/o U. S. Nuclear Regulatory
Commission
P. O. Box 910
Bay City, TX 77414

J. R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

R. L. Range/R. P. Verret
Central Power & Light Company
P. O. Box 2121
Corpus Christi, TX 78403

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City Public Service Board
P. O. Box 1771
San Antonio, TX 78296

Rufus S. Scott
Associate General Counsel
Houston Lighting & Power Company
P. O. Box 1700
Houston, TX 77001

INPO
Records Center
1100 Circle 75 Parkway
Atlanta, Ga. 30339-3064

SUPPLEMENTAL REPORT
ON THE
INVESTIGATION OF
HYDRAULIC TRANSIENT EVENTS
IN THE
AUXILIARY FEEDWATER SYSTEM

SOUTH TEXAS PROJECT
DOCKET NOs. STN 50-498, STN 50-499
HOUSTON LIGHTING & POWER COMPANY

FEBRUARY, 1988

NL.88.043.01

South Texas Project
Supplemental Report on Auxiliary Feedwater System

Table of Contents

South Texas Project
Supplemental Report on Auxiliary Feedwater System
Executive Summary

This is the supplement to the Auxiliary Feedwater System Report on Investigation of Hydraulic Transient Events, dated December, 1987. The original report, filed with the USNRC on December 24, 1987, (letter transmittal ST-HL-AE-2461) contained commitments to perform further testing and evaluation. This supplement is submitted to document the fulfillment of those commitments and to provide clarification of information previously submitted where additional information or examinations warrant clarification.

The testing data and analysis contained herein confirm the conclusions reached in the original report. The conclusion that the Auxiliary Feedwater System is ready for operation under its design basis flow conditions is shown to be valid. In addition, the testing verifies the root cause documented in the original Auxiliary Feedwater Report. Houston Lighting & Power Company concludes that the Auxiliary Feedwater System is operable for its design basis requirements.

South Texas Project
Supplemental Report on Auxiliary Feedwater System
Introduction

The purpose of this report is to document the additional testing and analysis on the Auxiliary Feedwater System resulting from the original commitment to verify the results of modifications made to system components. In addition, clarifications to the original report and supplemental information are provided.

Section I is the summary of data for the system and component tests. The test performed to simulate operational conditions support the conclusions of this and the original report.

Section II contains the conclusions reached as a result of the testing and analysis and the basis for conclusions reached in the original report.

Section III discusses recurrence control measures taken to limit hydraulic transient events of this nature in the future.

Attachment A provides clarifications to the original Auxiliary Feedwater Report. Excerpts from that report are noted with clarification and justification.

For completeness Attachment B provides the clarifications to the original report as presented in Licensee Event Report 87-0016 (ST-HL-AE-2420)

I. SUMMARY OF CONFIRMATORY TEST RESULTS

I.A. Crossover Isolation Valve Static Stroke Test

Upon completion of the installation of new air operators on Trains A, B, and C and internal valve work, the auxiliary feedwater system valve operability test 1PSP03-AF-0010 was performed. This test established new baseline data for opening and closing times of the crossover isolation valves.

The results of this test were as follows:

Valve	Opening Time (sec)	Closing Time (sec)
Train A-FV-7517	23.2	4.9
Train B-FV-7516	19.1	4.2
Train C-FV-7515	21.7	5.7
Train D-FV-7518	10.8	3.8

I.B. Crossover Isolation Valve Full Flow Testing

Valve operability testing under full flow conditions was conducted on Train A, B and C crossover isolation valves. This testing was performed after installation of stiffer valve spring operators. The test (1TEP07-AF-0008) consisted of opening and closing the crossover valves with a flow of 650 to 675 gpm through the associated test line and recording the closure stroke time of the crossover valve. The design criteria of valve closure within 10 seconds was met. This criteria was met without causing excessive vibration or water hammer.

The results of this test were as follows:

Valve	Closure Time (seconds)
Train A-FV-7517	5.41
Train B-FV-7516	4.6
Train C-FV-7515	5.73

For the crossover valve on train D (FV-7518), a needle valve was installed upstream of the air supply solenoid. The needle valve was adjusted to slow the opening stroke down from the previous 2 to 3 second range to a new range on the order 7 to 10 seconds as noted in test I.A. above. After installation and adjustment of the needle valve, the crossover valve was cycled open and closed. During this time the Train D flow control valve was pre-set for 650 to 675 gpm flow through the test line. The design criteria of closure within 10 seconds was achieved. No excessive vibration or damaging waterhamme. occurred during opening or closing.

The result of this test was as follows:

Valve	Closure Time (sec)
Train D-FV-7518	4.76

I.C. AFW Motor Driven Pump Performance Test

Pump surveillances 1PSP03-AF-0001, 2 & 3 were performed to ensure that no degradation to the pumps had occurred. These test results were compared to the previous motor driven AFW pump surveillance test results and showed no indications of abnormal pump degradation.

I.D.1 Flow Control Valve Testing - Mode 4 - Single Train

An evaluation of the generation of 24 hz pressure pulsations was conducted under test 1TEP07-AF-0010. This test was conducted after machining of the valve seats of the A, C & D flow control valves, the installation of the mechanical stops, and the changing of limit switch settings. The test consisted of physically closing each train's flow control valve hard against the mechanical stop and then opening the containment isolation valve to establish flow to that train's steam generator. The magnitude of pressure pulses between 0 and 100 hz was examined with special emphasis at and around 24 hz. Test pressure data was taken from transmitters installed up and down stream of the flow control valves. Data was first analyzed for the flow control valve hard against the mechanical stop. The valve was then incrementally opened with the handwheel and data evaluated at each step. This process was repeated until a flow rate of 160 gpm or greater was achieved through each flow control valve.

In all instances the modified valve pressure pulsations at or around 24 hz were insignificant and no dynamic response was generated.

I.D.2 Flow Control Valve Testing - Mode 4 - Multi Feed

Test 1TEP07-AF-0010 also examined the pressure pulse amplitudes from 0 to 100 hz for simultaneous feeding of all four steam generators. This test employed the B train auxiliary feedwater pump and the system crossover valves. Flow was established to all four steam generators with each flow control valve manually closed against its mechanical stop. Flow was then increased to each steam generator by approximately 20 gpm. This process was continued until flows of 160 gpm or greater were achieved simultaneously to all four steam generators. At each change of steam generator auxiliary feed flow, the pressure data up stream and down stream of each flow control valve was analyzed. Pressure pulses were insignificant at or around the 24 hz frequency and no dynamic response was generated.

I.D.3 Flow Control Valve Testing - Mode 3 - Single Train

The test as described under II.D.1 was repeated with the plant in Mode 3 operation.

The peak pressure readings obtained were insignificant, and no dynamic response was generated.

I.D.4 Flow Control Valve Testing - Mode 3 - Multi-Feed

The test described under II.D.2 was repeated with the plant in Mode 3 at normal operating pressure and temperature. The peak pressure pulses at or near 24 hz were insignificant, and no dynamic response was generated.

I.E. Flow Control Valve Testing - Turbine Driven Pump - Mode 3 Multi Feed

The pressure pulsation between 0 and 100 hz upstream of the flow control valves of all auxiliary feedwater trains were examined with flow provided by the turbine driven D train AF pump. Again, as in the mode 4 multi feed motor driven tests, the data was analyzed at each change of flow rate. The first data point was for all valves against the mechanical stops. Flow was incrementally increased up to a flow rate of 160 gpm to each steam generator. Special attention was given to pressure pulsations near the 24 hz range.

The peak pressure pulses at or near 24 hz were insignificant, and no dynamic response was generated.

I.F. Auxiliary Feedwater System Safety Performance Test

Test 1TEP07-AF-0009 was conducted to demonstrate that upon Engineered Safety Features (ESF) actuation, the motor driven auxiliary feedwater (AF) pumps start, and regulating valves control flow in both the automatic and manual modes without inducing unacceptable transients in the AF system. These test were completed while monitoring the system pressure and with observers in the Isolation Valve Cubicles. No abnormal pressure transients or abnormal vibrations were encountered for any of the motor driven pumps, and no abnormal dynamic response was generated.

II. CONCLUSIONS

The previously described tests of the auxiliary feedwater system flow control valves have shown these valves ready for operation. Required design and functional parameters of these tests have been met.

The testing of the Auxiliary Feedwater System, conducted as proof of the resolution of this problem, has covered the ranges of system operation in both normal and crossover feeding of steam generators. In no instance was any indication of system hydraulic or structural resonance encountered.

III. RECURRENCE CONTROL

Design change documents have been issued to make the mechanical stops, new limit switch settings and auxiliary feedwater system flow control valve internal expansion chambers part of the design of STP. Vendor manuals governing disassembly and repair of these valves have been revised to ensure these features are retained after any normal maintenance activities.

Based on the installation of stiffer operators on the crossover isolation valves, new baseline data was obtained for the valves and was incorporated into the appropriate surveillance test procedures. In addition the vendor maintenance manual has been revised to reflect new part numbers for stellite coated plug retainer cages which were reinstalled. This stellite coating feature will make these valves less susceptible to foreign material gouging which caused valve damage in the past.

The new crossover operators have added additional hydraulic stability margin to the auxiliary feedwater system and coupled with the above described changes make the auxiliary feedwater system more resistant of any future hydraulic transients.

ATTACHMENT A

Clarifications to Original Report

Attachment A

CLARIFICATIONS OF ORIGINAL REPORT

A. Item "c" of page 2 of transmittal letter ST-HL-AE-2461 dated December 24, 1987 stated.

> "The operation of the Train D crossover valve has been slowed down by the installation of a needle valve in the air operator."

Clarification

Only the opening stroke time of the crossover valve was increased with the addition of a needle valve. The closing stroke time was found to be acceptable based on test results.

B. On page 1 of the Auxiliary Feedwater System Report the Executive Summary should have included the following statement to clarify the resolution of this issue.

Clarification

In addition to the installation of mechanical stops and changes to the limit switch setting on the flow control valves the internal flow geometries of the A, C and D flow control valves were altered by machining. The seat rings of these valves were machined to create expansion chambers comparable to that existing in the B flow control valve (Shown in Figure 8 of the original report). Since the mechanical stops positively prevent near seat operation, the Unit 2 seat rings will not be machined.

C. On page 30 of the Auxiliary Feedwater System Report the following statement is made.

> "Additional tests, including dynamic testing (as suggested in RG 1.68), are scheduled during power ascension testing."

Clarification

The additional dynamic testing consists of testing the four preheater bypass lines connecting the main feedwater system to the auxiliary feedwater system. This testing, to be conducted during power ascension, will be both steady state and dynamic transient testing.

D. On page 51 of the Auxiliary Feedwater System Report the following statement is made in continuation of Section III paragraph 8.4 concerning the D Train Valtek Crossover Valve (FV 7518).

> "The maintenance work history of this valve shows some damage to the internals which is directly attributable to high impact forces caused during the operation of this valve. Action has been taken to slow down the valve response times."

Attachment A

CLARIFICATIONS OF ORIGINAL REPORT

Clarification

As part of the disassembly and examination conducted on this valve, the internals were sent to the valve manufacturer for examination and determination of the cause of internal plug, sleeve and seat damage.

The valve manufacturer established that the damage had been caused by foreign material which became trapped between the valve plug and seat ring. Additional foreign material had been trapped between the plug seat and pressure balanced sleeve. As such, slowing down the closing time of this valve to prevent recurrence of valve internal damage is not required.

E. On page 56 of the Auxiliary Feedwater System Report the following statement is made in continuation of Section III, paragraph 8.5 concerning the Valtek Flow Control Valves.

> "In addition, geometry modifications have been made on the Train A and D flow control valves by machining the valve seats to create the expansion chamber present on Valves B and C."

Clarification

The statement should be corrected as follows:

> In addition, geometry modifications have been made on the Train A, C, and D flow control valves by machining the valve seat to create the expansion chamber comparable to Train B flow control valves.

F. On page 67 of the Auxiliary Feedwater System Report the following statement is made.

> "The Train B crossover valve was found to have a bent shaft. Based on this and a review of the vibration loading conditions, the valves in Trains A , B and C are being rebuilt with new parts including the plug, stem, yoke and actuator. The Train D crossover valve internals are being machined to repair damage done to the plug cage area."

Clarification

To clarify the extent of work performed on the crossover valves the following information is provided.

WKM Auxiliary Feedwater Crossover Valves: (C1AF-FV-7515, B1AF-FV-7516 & A1AF-FV-7517)

Attachment A

CLARIFICATIONS OF ORIGINAL REPORT

1) Actuators were replaced with spare actuators. This increased the spring stiffness from 1900 to 2150 pounds/in. and increased the preload from 14 to 22 psi. The supply air supply was also increased from 31 to 48 psi.

2) Bent or out of tolerance stems were replaced with stems from spare valves. The stem for FV-7516 was apparently bent from excessive handwheel force. The spare valve stems were machined and aligned with the plug centerline. Scoring on the plug and cage was rubbed out and no damage was noted on seating surfaces.

Valtek Auxiliary Feedwater Crossover Valve: (D1AF-FV-7518)

A needle valve was installed in the actuator supply air line in order to slow down the valve opening stroke time. Actual opening time was increased to approximately 10 seconds.

ATTACHMENT B

Clarifications Provided to the Original
Report as Provided in LICENSEE EVENT REPORT
87-016 (ST-HL-AE-2420)

Attachment B

Clarifications Provided to the Original
Report as Provided in LICENSEE EVENT REPORT
87-016 (ST-HL-AE-2420)

1. Section I.A. page 6, 2nd paragraph 4th line:

"An additional test (1TEP07-AF-0002) was successfully performed"

Should read:

"Portions of the system operating procedure were successfully performed"

2. Section I.B. page 11, 3rd paragraph, 11th line:*

"The tee was cut out and replaced."

Should read:

"The tee was cut out and will be replaced."

3. Section III.C.2 page 36 1st paragraph 7th line

"The test was then rerun."

Should read:

"The venting procedure was then rerun."

4. Section III.C. page 37, Section 4:

"The test was run on November 25"

Should read:

"The test was run on November 26"

5. Section III.C. page 37, Section 5:

"This test was initially run on November 25"

Should read:

"This test was initially run on November 27"

6. Section III.C. page 38, Section 6:

"This test was run on November 29, 1987."

Should read:

"This test was run on December 1 and 5, 1987."

Attachment B

Clarifications Provided to the Original
Report as Provided in LICENSEE EVENT REPORT
87-016 (ST-HL-AE-2420)

7. Section IV.A. page 67, 3rd line:

"are being rebuilt with new parts including the plug, stem, yoke and actuator."

Should read:

"are being rebuilt with new parts including the stem, yoke and actuator."

8. Section V.B. page 78, Section 3:*

"has been installed on Trains A, B, and C"

Should read:

"will be installed on Trains A, B, and C."

9. Section V.B. page 78, Section 4:*

"The valve actuator has been fitted with a needle valve in the airline to increase the stroke times."

Should read:

"The valve actuator will be fitted with a needle valve in the airline to increase the stroke times."

10. Section V.B. page 79, Section 5:*

the FCV's have been limited....This was accomplished....

Should read:

the FCV will be limited....This will be accomplished....

*Note: The work indicated in items 2, 8, 9, and 10 has for the most part been completed. Documentation verification is ongoing at this time.