Omaha Public Power District
1623 Harney Omaha, Nebraska 68102-2247
402/536-4000

March 19, 1990
LIC-90-0225

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Gentlemen:

Subject: Licensee Event Report 90-03 for the Fort Calhoun Station

Please find attached Licensee Event Report 90-03 dated March 19, 1990. This report is being submitted per requirements of 10 CFR 50.73(a)(2)(ii)(B).

If you should have any questions, please contact me.

Sincerely,

W. G. Gates

W. G. Gates
Division Manager
Nuclear Operations

WGG/tcm

Attachment

c: R. D. Martin, NRC Regional Administrator
A. Bournia, NRC Project Manager
P. H. Harrell, NRC Senior Resident Inspector
INPO Records Center
American Nuclear Insurers

IE22
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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fort Calhoun Station Unit No. 1	0 5 0 0 0 2 8 5	1 OF 0 5

TITLE (4)

Auxiliary Feedwater Piping Outside Design Basis Due to Design Deficiency

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)
									N	0 5 0 0 0
0 2	1 6	9 0	9 0 —	0 0 3	— 0 0	0 3	1 9	9 0		0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 8 3	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	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)	X 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
	AREA CODE
Larry L. Lehman, Shift Technical Advisor	4 0 2 5 3 1 - 1 6 8 2 9

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	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		0 4	1 6	9 0

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

Reanalysis of the Auxiliary Feedwater lines between the Steam Generators and the containment side isolation valves revealed two 45 degree elbows to be in an overstressed condition as defined by the original design basis. Rigid seismic restraints, installed on the valves to control seismic inertia, excessively restrict the thermal movement of the lines and cause stresses to exceed design basis piping code allowables. Further analysis of the piping demonstrated that the stresses incurred in the piping elbows due to thermal expansion fall within the criteria of ASME approved code exception cases, but outside the normal stress limits of the code used in the USAR. At 1450, on February 16, 1990, the piping was determined to be outside the plant design basis as specified in the USAR. Investigation of the problem revealed that the design deficiency has existed since plant construction.

The corrective actions include functional testing of the Auxiliary Feedwater System, non-destructive examination of the piping elbows, visual inspection for gross discernible damage, and a modification to comply with design basis.

The Fort Calhoun Station Updated Safety Analysis Report (USAR) requires certain piping to be designed within the limits of the United States of America Standard (USAS) piping code B31.7 (1968 Draft). This code was essentially duplicated and expanded with the implementation of the American Society of Mechanical Engineer (ASME) codes for Class 2 and 3 piping and components (1971). Since that time, several exception cases have been documented where piping stresses exceed normal allowable limits, but have been found to be acceptable with an adequate margin of safety. These exceptions have been approved and incorporated into the ASME code (1981) and are considered acceptable per the ASME code (ASME Code Cases N-319 & N-47-28 and ASME Section III NB-3653.7). The USAR does not incorporate these exceptions because it reflects USAS piping code B31.7 (1968 Draft) and was not revised to incorporate the ASME code cases noted above.

As a part of a response to deficiencies found during a Safety System Outage Modification Inspection (SSOMI) in 1985, all large bore Critical Quality Element (CQE) piping at Fort Calhoun Station is currently being reanalyzed for Thermal Anchor Motion (TAM) due to thermal expansion of piping. The reanalysis of the auxiliary feedwater lines between the Steam Generators and the containment side isolation valves revealed two 45 degree elbows to be in a overstressed condition as defined by the USAR Appendix F, Section F.2.1. Rigid seismic restraints, installed on the valves to control seismic inertia, excessively restrict the thermal movement of the lines and cause stresses outside the limits of the USAS code. However, further analysis of the piping demonstrated that the stresses incurred in the piping elbows due to thermal expansion fall within the criteria of the approved ASME code exceptions noted above. Hence, the as-built configuration was allowed by the current ASME code case exceptions, but not allowed by the USAS code referenced in the USAR. For this reason, the piping was potentially outside the design basis, but still considered operable because the stresses calculated fell within that allowed by ASME code exceptions.

At 1450, on February 16, 1990, the piping was determined to be outside the plant design basis as specified in the USAR. At this time, the plant was at approximately 78% power and decreasing as part of a planned shutdown for a refueling outage. Subsequently, a "one hour" report was made to the NRC at 1548 pursuant to 10 CFR 50.72(b)(1)(ii)(B). This event is also reportable pursuant to 10 CFR 50.73(a)(2)(ii)(B). The plant later entered Mode 5, Refueling Shutdown, as planned.

Investigation of the problem revealed that a design deficiency has existed since original plant construction. The original design analysis accounts for stresses due to thermal expansion in the piping without the rigid restraints. During plant construction, the contracted architect/engineer (A/E) altered the design to incorporate the additional rigid supports for seismic considerations without reanalyzing for stresses due to thermal expansion. Since thermal expansion provisions were not incorporated into the as-built configuration, additional stresses resulted.

The piping was reanalyzed in 1979 to address concerns raised in NRC IE Bulletins 79-02 and 79-14. Omaha Public Power District (OPPD) contracted a second outside engineering firm to perform this analysis. The deficiency was not discovered as the consultant did not include TAM loads in the models during the reanalysis. The 1985 SSOMI audit discovered this deficiency and prompted the current generic review of all large bore CQE piping for TAM.

The primary cause of this event is attributed to design deficiency: inadequacies by the original plant A/E in making system design changes during construction. The precise root cause can not be determined due to an insufficient amount of information and documentation concerning practices and procedures utilized by the A/E in 1972.

A secondary cause was the exclusion of TAM considerations during the 1979 reanalysis. A contributing factor to this was inadequate procedural guidance on content of documents for the procurement of services. These procurement documents specify the terms of the agreement for service, or what is required of the contractor. For the 1979 reanalysis contract agreement, the required extent of the reanalysis of the seismic supports was not properly documented.

There was an additional factor which allowed the design discrepancy to remain undetected by OPPD for an extended period. Both the original design and the reanalysis were contracted tasks. Since OPPD did not have the resources required to provide a detailed additional review of each contractor's work, the expertise and the approved Quality Assurance (QA) programs of the contractors were relied upon.

The impact on the ability of the Auxiliary Feedwater System to perform its design function was examined. The TAM loads induce secondary stresses in the piping which could lead to plastic ratcheting and/or fatigue failure of the piping component material or brittle fracture of the cast iron containment isolation valve yoke (which is restrained and acts as a structural load path). An operability analysis based on ASME Code Cases N-319 & N-47-28 and ASME Section III NB-3653.7 has demonstrated that although the elbow stresses exceed normal code allowables, the associated strains and thermal ratcheting check are within acceptable limits to preclude material failure. The valve yoke stresses have been determined to have sufficient margin to prevent brittle fracture. The deflection and bending stress of the valve stem were calculated and determined to be acceptable, and the valve judged to be operable under the predicted loading.

Continuing reanalysis has revealed overloading of some piping supports for the Main Steam and Safety Injection piping in containment due to TAM. This condition was reported to NRC pursuant to 10 CFR 50.72(b)(2)(i) on March 16, 1990, and will be documented in a revised version of this LER to be submitted by April 16, 1990.

The following corrective actions have been completed:

1. Safety Analysis for Operability (SAO) 90-003 was issued on February 18, 1990. The Auxiliary Feedwater System was functionally tested per SP-FW-14 on February 17, 1990. This testing cycled the valves in question under operating loads, which provided further evidence of operability.

2. A third outside engineering firm performed an independent review of the results of the reanalysis completed in 1979. This review found the results of the reanalysis acceptable with the exception of the findings noted in the SSOMI audit.

3. Since 1979, OPPD Design Engineering has augmented the engineering staff with personnel having a higher level of expertise and has made provision for acquiring supplemental contract personnel with expertise in engineering areas as required for independent review. These additional resources help provide a more thorough review of contract work.

4. Fort Calhoun Station Training has begun implementation of a training program for appropriate Design Engineering personnel. These programs address Quality Assurance, System design training, and procurement of materials and services. Currently, the Quality Assurance and Procurement training courses are in place. The on-going training in these areas will aid in preparation of comprehensive procurement documents requesting services and provide a basic knowledge of what type of vendor QA program is required for assurance of quality work.

The following corrective actions will be implemented as follows:

1. A visual inspection for gross discernible damage of the affected Auxiliary Feedwater isolation valve operators, yokes, and restraints will be performed during the current 1990 refueling outage.

2. The affected Auxiliary Feedwater piping restraints will be modified during the current 1990 refueling outage to comply with the USAS code and the USAR design basis. Any further defects or deficiencies found at this time will also be corrected prior to exceeding 300 degrees F in the Reactor Coolant System.

3. Nondestructive examination of the Auxiliary Feedwater piping elbows will be performed during the current 1990 refueling outage to determine if any surface defects, requiring further evaluation per ASME Section XI, are present.

4. The Production Engineering procedure for Procurement of Materials and Services (GEI-32) will be changed to provide guidance concerning content of documents for the procurement of services as specified in the OPPD Quality Assurance Plan (Sec 4.1). These changes will help assure that documentation for procurement of services is completed in accordance with the current QA plan. The changes will be implemented by November 30, 1990.

LER 89-021 also concerned deficiencies in contracted design tasks.