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Docket No. 50-255

APR 25 1980

Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Hoffman:

We have reviewed your letters dated February 14, February 27 (corrected March 3), March 11, and April 14, 1980 regarding seismic design of piping at the Palisades Plant. Our assessment of your corrective actions is enclosed. We have concluded that you are taking appropriate corrective actions for the problems identified and that there is reasonable assurance that the piping systems, as modified, would not fail during the operating basis earthquake or safe shutdown earthquake described in the FSAR.

Sincerely,

Original signed by
Dennis L. Ziemann

Dennis L. Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors

Enclosure:
Safety Assessment

cc w/enclosure:
See next page

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PALISADES PLANT
REVIEW OF PIPING AND SUPPORTS REANALYSIS FOR SEISMIC LOADINGS

SAFETY ASSESSMENT

INTRODUCTION

On January 9, 1980, Consumers Power Company (CPCo) informed us that some of the seismic Category I piping did not conform with the Palisades Plant FSAR acceptance criteria. At the time of the finding, the plant was in an extended shutdown. In License Event Report LER-80-001, dated January 25, 1980, CPCo indicated that the causes of the problem appeared to be (1) differences between as-built conditions and design documents and (2) limitations in the state of the art of piping stress analysis during plant design.

By letter dated February 14, 1980, and supplements dated February 27, 1980 (corrected March 3, 1980), March 11, 1980, and April 14, 1980, CPCo provided further discussion describing their corrective actions and provided their evaluation of the acceptability of these actions. CPCo proposed that prior to startup from the outage, they would assure by means of analysis, evaluation and modifications, that all Category I piping either met the FSAR allowable stress criteria or the allowable stresses in the 1976 Winter Addenda of the 1974 Edition of ASME Boiler and Pressure Vessel Code, Section III, Subsection NC. In their February 14, 1980 letter, CPCo stated that their Plant Review Committee had considered the issue and found that operation in the manner proposed would not involve an unreviewed safety question or changes to the Technical Specifications. By their letter of February 14, 1980, CPCo also committed to performing any modifications needed to upgrade the plant to the FSAR criteria by the end of the next scheduled refueling outage.

DISCUSSION

The CPCo evaluation program included a total of 73 "Pipe Stress Systems" (i.e., portions of total systems routed between fixed anchor or terminal correction points). This program covers all seismic Category I piping, 2 1/2" and larger in diameter. In this effort, new isometric drawings are being prepared that reflect the as-built condition of piping systems and re-analysis of all computer analyzed seismic Category I piping systems (including supports and restraints) is being performed in order to confirm compliance with the original FSAR and/or Code requirements.

Although the intent of this program was to use the original criteria and assumptions contained in the FSAR, some comparisons of results were made using updated acceptance criteria.

Out of the 73 pipe stress systems, 30 have been reanalyzed. Results show that the piping systems and their associated supports and restraints were adequately designed for normal operation of the plant. In the event of an earthquake, however, 6 of these systems did exceed FSAR allowable stresses. In addition, 32 of the 220 existing supports on the 6 pipe stress systems did not meet the pipe support criteria for seismic requirements.

Four of the 6 stress systems that failed to meet FSAR requirements can be directly attributed to the limitations in capacity of seismic computer programs in use at the time of the original design of this product. This resulted in analysis which included decoupling, overlapping and non-conservative assumptions in mass point selections for portions of some systems. Moreover, some of the systems were analyzed using an insufficient number of dynamic modes. Reanalysis of these pipe stress systems showed the early calculation approaches to be less conservative.

Thirty-one of the 32 supports that did not meet the FSAR requirements are due to the changes required by the updated design criteria for pipe supports, such as consideration of the lateral strength of U-bolt type restraints and uplift compression loading on rigid hangers.

Of the 6 pipe stress systems that exceed FSAR allowable stresses, 5 systems do meet the allowable stresses in the ASME Section III, Subsection NC, 1976 Winter Addenda of the code. The remaining one pipe stress system will have to be modified in order to satisfy the Subsection NC allowables. Based on this information, interim design criteria for piping and supports are proposed by the licensee. The attached table displays the proposed interim allowable stresses for both pipe stress and pipe supports. It also shows a comparison with the original FSAR design criteria.

In their letter of February 27, 1980, CPCo informed us that an additional design problem was discovered, namely the stresses of several "stubbed-in" joints (unreinforced branch connections) in certain low temperature, low pressure lines exceeded the code limits for the OBE and SSE conditions. Out of the total 73 stress systems, there are 32 pipe stress systems that have stubbed-in joints (with 160 stubbed-in joints in all), among them 24 stress systems either meet the interim criteria or will meet it after modification; seven stress systems were not analyzed in detail; one stress system, service water return from air coolers, has two stubbed-in branch connections where calculated stresses exceed the interim criteria allowables by 13.6% and 52% for OBE and 11.4% and 36.6% for SSE.

The overstress of the stubbed-in joints stem from the fact that the original design overlooked the effect of the stress intensification factors (SIF's) on all the stubbed-in joints. This error was discovered during the re-evaluation. Subsequent calculations taking into account the effect of the SIF's revealed overstress at a number of stubbed-in joints.

Of the seven stress systems on which detailed computer analysis is unavailable, CPCo has indicated that engineering judgement will be utilized to evaluate potential hanger modifications, additions or deletions, in order to bring stresses at the stubbed-in joints to within the allowables of the interim criteria. For Service Water Return From Air Coolers, the stresses at the two stubbed-in joints exceed the interim criteria allowables by a big margin. As a means to bring the stresses at the two stubbed-in joints within allowables, CPCo has indicated that the overstressed stubbed-in joints will be reinforced. This will be accomplished before the impending start-up.

EVALUATION

(a) Piping

For SSE loading, the proposed interim criteria calls for an allowable of $2.4S_h$, which coincides with the current ASME Code Section III requirements for Class 2 and Class 3 piping under Level D Service Limits. (c.f. NC-3611.2(c)(4) and ND-3611.2(c)(4) of ASME B&PV Code, Section III, 1977 edition). Since the satisfaction of ASME Code Section III allowables will assure the structural integrity and in turn the operability of these piping systems, we consider the licensee's proposal acceptable for interim design.

(b) Pipe Supports

For pipe supports, the proposed interim allowable stresses for OBE loading are $0.75S_y$ for structural members and $0.3S_u$ for catalog items, which are still within the elastic limits of the material. For SSE loading, interim allowables for catalog items are increased from $0.4S_u$ to $0.5S_u$ which remains within the yield stress. We consider these proposed allowables acceptable for interim design.

(c) Stubbed-in Joints

CPCo has proposed to modify the pipe stress systems where seismic stresses in the stubbed-in joints exceed the proposed interim criteria allowables. One of the following two approaches will be utilized:

(1) By modifications, additions, or deletions of hangers or

(2) By addition of reinforcing pads on the stubbed-in joints.

CPCo states these modifications will be completed prior to startup.

For Service Water Return From Air Coolers, where stresses exceed the interim allowable by a big margin, the approach of adding reinforcing pads will be adopted. For the other stress systems the approach of modification of hangers will be utilized.

It is our position that, whenever the stess at joints exceeds the interim allowable by a big margin, the preferable approach to modify any overstressed stubbed-in joint is by means of reinforcing the joints in accordance with the requirement of NC-3643.3 of Section III, ASME Boiler and Pressure Vessel Code. The increase of wall thickness due to the reinforcement will effectively reduce the stress intensification factor and in turn the stresses. However, modifications, additions or deletions of hangers will be an acceptable interim method to bring the

stress to within the interim allowable, whenever the overstress is not of an excessive nature. Furthermore, in order to meet the ASME Code requirements, we consider it mandatory to apply the stress intensification factors on all branch connections as required by the Code, whether it is unreinforced (stubbed-in joint) or reinforced. CPCo has agreed to conform to these positions.

In view of the above, we consider the modifications proposed by CPCo to reduce stressed in stubbed-in joints acceptable.

CONCLUSION

Based on our review we conclude that CPCo is taking appropriate corrective action for the problems identified and that there is reasonable assurance that the piping systems, as modified, would not fail during the operating basis earthquake or safe shutdown earthquake described in the FSAR.

Date: April 25, 1980

DESIGN CRITERIA

(Interim vs FSAR)

	ALLOWABLE STRESS	
	OBE (.1g Earthquake)	SSE (.2g Earthquake)
PIPE		
A. Interim 1974 ASME code*	1.2 S_h	2.4 S_h
B. Long term 1967 pipe code FSAR	1.2 S_h	1.1 S_y
PIPE SUPPORTS		
Struct Members		
A. Interim	.75 S_y	1.1 S_y
B. Long term	.6 S_y	1.1 S_y
Catalog Items (Rods, clamps, etc.)		
A. Interim	.3 S_u	.5 S_u
B. Long term	.2 S_u	.4 S_u

S_h = Allowable Hot Stress
S_y = Minimum Yield Stress
S_u = Minimum Ultimate Stress

* 1976 Winter Addenda of 1974 Edition ASME Section III, Subsection NC