PSE&G Public Service Electric and Gas Company

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Robert L. Mittl General Manager
Nuclear Assurance and Regulation

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Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20814

Attention: Mr. Walter Butler, Chief
Licensing Branch 2
Division of Licensing

Gentlemen:

SAFETY EVALUATION REPORT CONFIRMATORY ISSUE 1
HOPE CREEK GENERATING STATION
DOCKET NO. 50-354

Enclosed, please find Public Service Electric and Gas Company's response to Safety Evaluation Report Confirmatory Issue 1. This information will be incorporated into Amendment 12 of the Hope Creek Generating Station FSAR, as noted.

Should you have any questions in this regard, please contact us.

Very truly yours,

R L Mittl

C D. H. Wagner
USNRC Licensing Project Manager

A. R. Blough
USNRC Senior Resident Inspector

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SER Confirmatory Issue No. 1 (SER Section 3.6.2)
Feedwater Isolation Check Valve Analysis

In a letter dated August 15, 1984, the applicant provided a description of the analysis of the feedwater isolation check valves. This analysis is to ensure that the feedwater isolation check valves can perform their function following a postulated break of the feedwater lines outside containment. The applicant stated that the analysis will include:

(1) a thermal hydraulic analysis to determine the peak pressures upstream and downstream of the valve disk as well as the maximum disk angular speed.

(2) a sensitivity analysis to determine the break location and feedwater check valve selection that yield the most conservative results.

(3) an elastic or inelastic analysis of the feedwater check valves including valve internals.

The results of this analysis will be provided in November 1984. Provided the final results meet the applicable allowable limits and design criteria of the feedwater check valves, the staff considers this approach acceptable and will report its final evaluation in a supplement to this SER.

Response

An analysis to determine the feedwater check valve dynamics and stresses following a double ended break of the feedwater line outside containment has been performed. The results of the analysis indicated that the valve is qualified for the faulted condition based on the methods for analysis and design limits contained in Appendix F of the ASME B&PV Code, Section III.

The fluid dynamic analysis used the RELAP 5/MOD 1 computer code with check valve simulation capability based on a generic model developed by Bechtel. The feedwater line was assumed to be at a constant condition of 1000 psig pressure and 420°F temperature. The break opening time was assumed to be one millisecond. A sensitivity analysis was performed for this analysis in which the effect of uncertanties in input data (break opening time, valve resistance, etc.) and modeling aspects were examined.

As part of the analysis, both the in-board and out-board valves were analyzed independently with the higher (out-board) disc angular velocity and peak line pressure at closure being used in the stress evaluation of the valve and disc.

The maximum calculated out-board check valve closure velocity is 81.38 rad/sec. The valve closes in 110 milliseconds after break initiation and the peak pressures upstream and downstream of the valve are calculated to be 290 and 2811 psia respectively.

As part of the stress evaluation, the valve components of disc, hinge arm, valve body, and seat ring were analyzed. In the evaluation, two separate finite element models were used. The first is an axisymmetric model used to predict stresses in the disc and valve body. The second is a two-dimensional model of the hinge arm used to determine the maximum displacements and stresses due to centrifugal and impact loads.

The axisymmetric finite element model and an energy-equivalent quasi-static analysis technique were used to analyze the disc impacting the valve seat. In this analysis, the total energy prior to impact is assumed to be absorbed in the disc/valve assembly through application of a unit static load applied to the disc. The load was then increased incrementally until the total energy absorbed by the system was equal to the kinetic energy prior to impact. The kinetic energy prior to impact was conservatively estimated as 699,500 in-lbs. In addition to the quasi-static loads which simulate the dynamic effects of the impact, the disc is also subjected to a differential pressure load due to the fluid in the pipe.

The stress in the steel components of the disc and seat ring were obtained by averaging the finite element results across appropriate sections. The associated stress intensities are compared to the allowable primary stresses of 0.70 S_u as specified in Appendix F, Table F-1322.2-1 of the ASME Code.

All stress intensities are below stress allowables except for those of the 1/16" stellite facing material. Since the stellite stress intensity exceeds the allowable stress intensity, fracture of the stellite material is predicted. This is acceptable since the stellite is not a primary pressure retaining material. The primary pressure boundary is formed by the steel portions of the disc and valve.

The hinge arm analysis considered the centrifugal force prior to impact and the impact forces produced after closure of the valve. Applying the peak angular velocity and a determination of the system frequency, the maximum centrifugal acceleration and dynamic load factor, the deflections of the hinge arm were calculated. It was determined that the deflections prior to impact were insignificant and that the maximum stresses in the hinge arm are below the stress allowables of Appendix F of the ASME B&PV Code.

As stated earlier, the evaluation of the hinge arm under loads produced by closure of the valve used a quasi-static analysis technique. The total kinetic energy of the hinge arm prior to impact is assumed to be absorbed by the hinge arm in elastic and plastic bending. It is concluded from the analysis that the maximum stress intensities are less than the allowable of 0.70 S_u as specified by Appendix F, Table F-1322.2-1 of the ASME Code. It is also noted that displacement calculations for this loading condition indicate that the disc will seat properly.

The results obtained in this report are considered conservative. In the analysis, all kinetic energy is assumed to be absorbed as strain energy in the disc, seat ring and a portion of the valve body. In reality, some kinetic energy of the disc will be transferred to other portions of the valve body and piping system. Additionally, the flexibility of the piping system was not taken into account. In addition, no increase in yield or ultimate strength was accounted for due to the high loading rates and subsequent strain rates incurred by the material.

In conclusion, for the faulted condition the 24-in 900-lb Anchor Darling feedwater swing check valve is considered in compliance with the applicable requirements of the ASME B&PV Code, Section III Nuclear Power Plant Components, Division I, 1974.

The response to FSAR Question 210.20 has been revised to reflect the above response.

QUESTION 210.20 (SECTION 3.6.2)

Provide the basis for assuring that the feedwater isolation check valves can perform their function following a postulated pipe break of the feedwater line outside containment.

RESPONSE

The feedwater line break outside the containment will be simulated using the RELAP5 computer code. A check valve model which has been developed specifically for calculations of this nature will be used for obtaining the valve dynamics. From this thermal hydraulic analysis, the peak pressures upstream and downstream of the valve disc as well as the maximum disc angular speed will be obtained. As part of this analysis, a sensitivity analysis will be performed to determine the break location and feedwater check valve selection that yields the most conservative stress results.

The stress analysis for the feedwater swing check valve will be performed for fluid transient loads induced by the pipe break event. Elastic and/or inelastic analysis will be performed to determine the primary stress intensities and/or strains at critical locations. For the pressure retaining boundaries such as valve body and valve disk, the calculated primary stress intensities shall not exceed Level D, Service Limit (3.0 Sm). For other valve parts such as seat ring, hinge, and actuator shaft, structural integrity will be evaluated based on strain criteria determined by material properties. The results of this analysis will be provided in May 1985.

An analysis to determine the feedwater check valve dynamics and stresses following a double ended break of the feedwater line outside containment has been performed. The RELAP 5/MOD 1 computer code was used to predict the maximum valve disc angular velocity and the peak pressures upstream and downstream of the valve disc following closure. In addition, a sensitivity analysis was performed to select the feedwater check valve that yields the most conservative stress results.

An inelastic stress analysis was performed on the valve body, disc, hinge arm, and valve seat with the calculated stresses determined to be less than stress allowables. In addition, the maximum displacement of the hinge arm before and after valve disc closure was determined and deemed acceptable. Stresses were evaluated for the faulted condition based on the methods for analysis and design limits contained in Appendix F of the ASME B&PV Code, Section III.