Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

RECEIVED
NRC
1987 FEB -4 AM 10:08

January 29, 1987
ANPP-39859-JGH/DJW/DRL-92.11

U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane - Suite 210
Walnut Creek, California 94596-5368

Attention: Mr. D. F. Kirsch, Director
Division of Reactor Safety and Projects
Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, 3
Docket Nos. 50/528, 529, 530

Subject: Final Report - DER 86-32
A 50.55(e) Condition Relating to Discrepancies Between Pipe Support Designs and Stress Calculations
File: 87-006-216

Reference: (A) Telephone conversation between R. C. Sorenson and S. G. Penick on December 31, 1986. (Initial Notification - DER 86-32)

Dear Sir:

The NRC was notified of a potentially reportable deficiency in reference (A). Attached, is our final written report of the deficiency under the requirements of 10CFR 50.55(e). The 10CFR21 evaluation is also included.

Very truly yours,

J. G. Haynes

J. G. Haynes
Vice President
Nuclear Production

JGH/DRL:kp

Attachments

cc: See Page 2

8702190115 870129
PDR ADOCK 05000528
S PDR

IE27 1/1

cc: J. M. Taylor
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

A. C. Gehr (4141)
R. P. Zimmerman (6295)

Records Center
Institute of Nuclear Power Operations
1100 Circle 75 Parkway - Suite 1500
Atlanta, Georgia 30339

FINAL REPORT - DER 86-32
DEFICIENCY EVALUATION 50.55(e)
AIRZONA NUCLEAR POWER PROJECT (ANPP)
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

Pipe stress calculation discrepancies were discovered during the engineering review and reconciliation of the Information and Enforcement Bulletin (IEB) 79-14 walkdown comments for ANPP Unit 3. It was found that the Steam Generator No. 2 Blowdown Sample line had discrepancies between the pipe support designs and the stress analysis calculation (13-MC-SG-520). The pipe supports at data points 58 and 82 were analyzed as two direction restraints (guides) in the computer model. However, these two supports were designed and installed as one direction restraints (Y-stop). Additional review of the calculation's ME-101 computer program stress analysis led to the discovery of the following:

A. Two additional supports as shown on the stress isometric were modeled differently in the computer run. (13-SG-H-181-0AT and 13-SG-H-181-0AU)

B. Stress intensification factors (SIF) of 2.1 were not consistently modeled into the computer run at socket weld fittings.

C. The piping weight was modeled in the computer run as 2.9 lb/ft. Due to the use of reflective type insulation, the current design weight is now 3.5 lb/ft.

At the time these discrepancies were discovered, it appeared that these discrepancies could lead to a condition where calculated piping stresses are underestimated and ASME Code allowable stresses may be exceeded.

Evaluation

A. Investigation and Analyses

The conditions described above resulted from several inconsistencies:

1. The pipe support at data point 58 (13-SG-181-H-0AY) was found to be installed as a vertical (Y)-stop while the stress isometric showed a guide (Y and lateral stop) on a skewed run of pipe. The computer model for the stress analysis also had a guide at this location. Revision 1, dated April 21, 1981, of the stress analysis, indicated that a guide at data point 58 was required. The pipe support drawing was issued Revision 0 on August 20, 1981, and the loads on the drawing indicate that it should be a guide (loads in the Y and Z direction are shown). It should be noted that the "Remark" column of the pipe support load sheet in the stress calculation states "Y-rigid, Z-rigid perpendicular to pipe." However, a Z-direction component of the axial pipe movement is shown since piping is skewed from the global Z-direction. These movements may have led the pipe support designer to believe that the support should be a Y-stop only. The pipe support was designed using a formed plate which provides a vertical restraint to the pipe but does not restrain it in the lateral direction (about 1 inch clearance exists).

2. The pipe support at data point 82 (13-SG-181-HOON) is installed as a Y-stop. The stress computer model, however, shows that a guide is required at this location. Revision 1, dated April 4, 1981, of the stress calculation did show a guide at this location on the stress isometric and on the load data sheet. However, the pipe support load data sheet in Revision 2, dated July 23, 1984, of the stress calculation shows only loads in the Y-direction and the "Remark" column states "Y-rigid". The stress isometric in this revision of the stress calculation also shows a Y-stop at this location.

3. The pipe supports at data points 21 and 35 (13-SG-H-181-OAT and 13-SG-H-181-OAU, respectively) were installed as guides. The stress isometric shows guides. The pipe support load data sheet shows guides at these locations also. Detailed review of the computer model shows that, although the analyst intended the supports to be guides, errors were made in the direction cosines for the horizontal lateral restraints and they were both 28.4 degrees off of the intended direction.

4. The steam generator blowdown sample line is installed using socket fittings and pipe bends. The socket weld fittings are shown on the pipe isometric (the piping installation document). Some are also shown on the stress isometric. The stress analysis was performed using stress intensification factors (SIF) of 2.1 at some of the socket weld fittings, but not at others that were shown on the stress isometric. This results in underestimating the piping stresses at locations where the SIF was omitted.

5. This piping system is currently insulated with reflective insulation of 1.3 inch thickness per the IEB 79-14 walkdown. The latest stress analysis computer model accounts for the weight of reflective insulation on portions of the line, but other areas account for a lower weight of insulation.

   The basic design parameters underwent considerable changes during the design phase. Ultimately, however, these changes should be accounted for in the final design. Review of some of the as-built reconciliation calculations that were completed for Units 1, 2, and 3 do show that where walkdown comments were made regarding insulation type and/or thicknesses; these deviations were evaluated and documented.

B. General Findings

The discrepancies identified can be divided into three general categories:

1. Pipe support discrepancies between the computer model and the design drawings.

2. Inconsistent use of stress intensification factors in the stress analysis at socket weld fittings.

3. Inconsistent use of insulation weight in the stress analysis.

Any potential inconsistency between the computer model and the pipe support design drawing has a possibility of introducing underestimated piping stresses and support loads.

The installation specification for quality class "Q" piping (13-PM-204) states that socket weld fittings are limited to small-bore piping (2 inch and less in normal diameter). Therefore, the inconsistent use of SIF's at socket weld end fittings cannot exist in large-bore piping analysis.

The effect of any potential insulation weight discrepancies could have an affect on small-bore pipe since the weight of insulation is on the same order of magnitude as the piping and process fluid weight. The effect of any potential insulation weight discrepancies on large-bore piping is insignificant.

These individual random discrepancies by themselves were not expected to be sufficient to overcome the conservatism inherent in the design of quality class "Q", seismic category "I" piping systems. Only where a combination of discrepancies occur was it expected for calculated stress to come close to exceeding ASME code allowables for faulted conditions. These expectations were confirmed by the results of the sample evaluation.

C. Review Sample

In order to assess the safety significance of these findings, a review of representative small-bore quality class "Q" stress problems was performed. Since the heavier, reflective insulation is only used inside containment, small-bore quality class "Q" stress problems inside containment were selected for sample. A sample of small-bore quality class "Q" stress problems outside containment was also included. Additionally, High Energy small-bore piping inside and outside containment was included to determine the effect, if any, on postulated pipe break locations since they are based on the stress analysis. In order to assure a suitable representative sample, a minimum sample of 10% is normally selected. For this review, an increased sample population (17%) was utilized to adequately represent the various aspects of small-bore quality class "Q" piping design.

The sample quantities are as follows:

Sample	Total Population	Sample Size
Inside Containment	70*	15*
Outside Containment	168*	26*
High Energy Inside Containment	6	6
Outside Containment	6	6
Total Small-Bore Quality Class "Q" Stress Probes	238*	41*

*The High Energy lines are included in these totals.

D. Safety Significance Assessment

The sample 41 small-bore quality class "Q" stress problems (including the initial finding) were reviewed to determine if similar discrepancies existed in them. This review accounted for 1691 small-bore pipe supports.

1. Assessment Criteria

The design criteria given in the FSAR was used for the initial evaluation of the discrepancies. Alternate (PVRC) damping factors as allowed by Code Case N-411 and accepted by the NRC in Regulatory Guide 1.84, Revision 24, issued in June 1986, were employed in some cases to evaluate safety significance with the following limitations:

a. PVRC damping was only used in response spectral analysis.

b. PVRC damping was only used with enveloping of spectra curves.

2. Results

Although a number of minor discrepancies were noted, none of the stress problems were found to have a safety significant condition and all stresses were below ASME Code faulted condition (Level D) allowables. It was only necessary to employ PVRC damping factors to show three of the piping systems acceptable. Inconsistent use of SIF's occurred in most of the sample stress problems, both inside and outside containment. As expected, a larger percent of insulation weight discrepancies were discovered inside containment since this is where the heavier, reflective type insulation is used. The High Energy line break analysis was not impacted.

Based on the following: A) The large quantity of pipe supports in the review sample (1691), B) The small number (eight) of pipe support discrepancies found that required a piping stress reanalysis to verify that system integrity was still maintained, and C) The fact that ultimately no safety significant condition was found, it can be concluded that these are minor discrepancies that do not represent a safety significant condition.

E. Root Cause

The above indicates that the overall root cause is personnel errors made during the design phase. Some errors were made by pipe support designers and others were made by stress analysts. No procedural deficiencies were identified that led to or contributed to these errors.

F. Transportability

The potential transportability of the identified general findings to other similar designs important to safety were evaluated for seismic II/I (two over one) small-bore piping system analyses and large-bore (2 1/2 inch and larger) piping system analyses. It was concluded that these general findings do not represent a transportable safety concern. The following summarizes the basis of these conclusions.

1. Seismic II/I Small-Bore Piping

   a. Seismic II/I piping systems are typically analyzed using "cookbook" methodology (e.g., Calculation No. 13-MC-ZZ-007) which properly accounts for SIF's at socket weld connections.

   b. This methodology introduces significant additional conservatisms into the piping and its support arrangements to easily accommodate any random insulation weight and/or pipe support discrepancy.

   Considering the above, it is concluded that the general findings associated with computer analyzed small-bore pipe do not represent a transportable concern into Seismic II/I small-bore piping.

2. Large-Bore Piping

   a. Butt-welded fittings (SIF 1.0) and not socket-welded fittings (SIF 2.1) are utilized in the design of these systems. Therefore, the SIF error which was the dominate finding from the standpoint of small-bore pipe stress analyses is not applicable.

   b. Insulation weight discrepancies result in relatively insignificant impact on calculated stresses since its percentage of the total weight drops significantly as pipe size increases. Therefore, the existing margins and conservatisms in the existing calculations should easily accommodate any random insulation weight discrepancy.

   c. The question of transportability of random pipe support discrepancies was not resolved as straightforward as the other general findings. Our conclusions considered many qualitative aspects of the design and design margins with respect to this finding. The most significant are stated below:

1) The design process, methodology, and procedures for large-bore piping design and analyses is identical to that of the small-bore piping design and analyses, and therefore, the results of the sampling program for the small-bore piping is directly applicable to the large-bore piping.

2) The sampling results show a very high degree of compliance in that only eight out of a total of 1691 small-bore pipe supports reviewed (less than 0.5%) contained a discrepancy that would require a reanalysis to evaluate its impact on piping stresses. Review of these discrepancies showed no common mode problem.

3) During the construction phase, many evaluations of requested changes and deviations, which are similar in nature to the discrepancies identified in the sample program, were performed and determined to be acceptable.

4) The design of piping systems was based on Regulatory Guide 1.61 damping values. This results in a highly conservative design since actual piping response will exhibit higher damping and thus lower stresses.A reanalysis of the large-bore piping, utilizing ASME Code Case N-411 as allowed by Regulatory Guide 1.84, Revision 24, would identify this additional margin.

5) The design calculations utilize design seismic spectrums based on .25g ground accelerations versus the licensing commitment of .20g, thereby providing additional margins in the design.

Considering all of the above, it is concluded that the general finding of a small quantity of random pipe support discrepancies in the computer analyzed small-bore piping does not represent a transportable safety concern into the large-bore piping design. In addition, margin has been demonstrated in the past to exist for large-bore piping when similiar non related effects have been analyzed.

In summary, the concern in the computer analyzed small bore piping was the cumulative effect of three general discrepancies. The results of the evaluation due to the cumulative effects, demonstrated that no safety significant concern exists. The evaluation of transportability into large-bore piping and support design indicated that these cumulative effects do not exist, that significant design margins do exist to accommodate random support discrepancies, and therefore, no safety significant concern exists with large-bore piping.

G. Conclusion

The results of the review indicate that errors did occur during the design process. The cumulative efect of these discrepancies was evaluated and not found to be safety significant. These results are documented in Calculation No. 13-MC-ZZ-041.

II. Analysis of Safety Implications

Based on the above review and evaluation, this condition is determined to be Not Reportable under 10CFR50.55(e) and 10CFR21 since, if left uncorrected, it would not represent a safety significant condition.

III. Corrective Action

A. Additional Documentation

A review of the remaining quality class "Q" small-bore piping stress problems will be performed to show ASME Code compliance for any potential SIF, insulation weight, and pipe support discrepancies. This review and evaluation of any findings will be completed and documented prior to Unit 3 initial criticality.

Based on the outcome of this review, if any condition is identified that could create a safety significant concern, ANPP will take the necessary action including issuance of a revision to this report.

B. Physical Modifications

Although the evaluation shows that ASME Code Level D allowables for faulted conditions are not exceeded, there are a few cases where ASME Code equations 8 and 9 (Level B) are exceeded. Where it cannot be shown that all ASME Code equations are met, physical modifications will be implemented to bring the piping system into compliance with project commitments.

The physical work in Units 1 and 2 will be completed during their next normal refueling outage. This work will be implemented in accordance with approved plant change procedures.

The physical work in Unit 3 will be completed before initial criticality.

C. Procedural Modifications

Although no procedural deficiencies were identified that led to or contributed to the errors; a memo to all stress and pipe support personnel has been issued in regard to the importance of proper use of stress intensification factors as given in the ASME Code, insulation type and thickness, and pipe support function and direction in the computer model, stress isometric, and pipe support drawing.