TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

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WBRD-50-390/82-02, -391/82-02
WBRD-50-390/82-57, -391/82-54
WBRD-50-390/82-59, -391/82-56
WBRD-50-390/82-73, -391/82-68
WBRD-50-390/82-74, -391/82-69
WBRD-50-390/82-78, -391/82-74
WBRD-50-390/83-19, -391/83-18
WBRD-50-390/83-20 -391/83-19
WBRD-50-390/83-21 -391/83-20

U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2 - PROGRAM DEFICIENCY: ALTERNATELY ANALYZED PIPING - FINAL REPORT FOR UNIT 1 AND THIRD COMBINED INTERIM REPORT FOR UNIT 2

Our submittal of November 24, 1982, on the subject alternate analysis program deficiency combined, for reporting purposes, the following 10 CFR 50.55(e) items: NCR WBN SWP 8160 (WBRD-50-390/82-02, -391/82-02), NCR WBN SWP 8220 (WBRD-50-390/82-57, -391/82-54), NCR WBN CEB 8218 (WBRD-50-390/82-59, -391/82-56), NCR 4164R (WBRD-50-390/82-73, -391/82-68), NCR WBN SWP 8231 (WBRD-50-390/82-74, -391/82-69), and NCR WBN SWP 8238 (WBRD-50-390/82-78, -391/82-74).

Subsequent to the November 24, 1982 submittal, four related nonconformances were identified and determined to be reportable under 10 CFR 50.55(e). These NCRs were initially reported to NRC-OIE Region II as NCRs WBN SWP 8264 (WBRD-50-390/83-19, -391/83-18), WBN SWP 8306 (WBRD-50-390/83-20, -391/83-19), WBN SWP 8311 (WBRD-50-390/83-21, -391/83-20), and WBN SWP 8315 (WBRD-50-390/83-22, -391/83-21). NRC-OIE Region II was notified that these NCRs would be reported as part of the program deficiency and thus were addressed in the April 27, 1983 submittal on the program deficiency.

Because of similarity and for reporting purposes, NCR WBN SWP 8315 has recently (September 30, 1983) been submitted with NCR WBN SWP 8204 WBRD-50-390/82-27, WBRD-50-391/82-24). As indicated in that submittal, any concerns related to alternately analyzed piping would be addressed in TVA's submittal on the Watts Bar alternate analysis programmatic deficiency.

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NRC-OIE Inspector Linda Watson was notified on October 3, 1983 concerning the submittal date for the subject report. A new submittal date of October 14, 1983 was established.

Enclosed is our final report for unit 1 and third combined interim report for unit 2. We expect to submit our next report for unit 2 on or about December 19, 1984.

If you have any questions, please get in touch with R. H. Shell at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Licensing

Enclosure
cc: Mr. Richard C. DeYoung, Director (Enclosure)
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ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
PROGRAM DEFICIENCY: ALTERNATELY ANALYZED PIPING
WBRD-50-390/82-02, -391/82-02; WBRD-50-390/82-78, -391/82-74
WBRD-50-390/82-57, -391/82-54; WBRD-50-390/83-19, -391/83-18
WBRD-50-390/82-59, -391/82-56; WBRD-50-390/83-20, -391/83-19
WBRD-50-390/82-73, -391/82-68; WBRD-50-390/83-21, -391/83-20
WBRD-50-390/82-74, -391/82-69;
10 CFR 50.55(e)
FINAL REPORT FOR UNIT 1 AND THIRD COMBINED INTERIM REPORT FOR UNIT 2

Recently a number of 10 CFR 50.55(e) items have been written against various aspects of alternately analyzed piping. Consequently, TVA determined that an overall program deficiency existed in the Watts Bar Nuclear Plant (WBN) alternate analysis program. The following 10 CFR 50.55(e) items have been reported under this programmatic deficiency; NCR WBN SWP 8160 (WBRD-50-390/82-02, -391/82-02), NCR WBN SWP 8220 (WBRD-50-390/82-57, -391/82-54), NCR WBN CEB 8218 (WBRD-50-390/82-59, -391/82-54), NCR WBN CEB 8218 (WBRD-50-390/82-59, -391/82-56), NCR 4164R (WBRD-50-390/82-73, -391/82-68), NCR WBN SWP 8231 (WBRD-50-390/82-74, -391/82-69), NCR WBN SWP 8238 (WBRD-50-390/82-78, -391/82-74), NCR WBN SWP 8264 (WBRD-50-390/83-19, -391/83-18), NCR WBN SWP 8306 (WBRD-50-390/83-20, -391/83-19), and NCR WBN SWP 8311 (WBRD-50-390/83-21, -391/83-20).

A 100 percent verification of all WBN unit 1 piping supported by alternate analysis methods was carried out by a Personal Services Contractor and TVA's Division of Engineering Design (EN DES) Watts Bar Design Project (WBP) personnel. The verification program involves piping in the scope of responsibility of CEB and WBP. Included in WBP's scope is piping for which WBN Division of Construction (CONST) located supports in accordance with drawing series 47A053 (for process pipes), 47A051 and 052 (for instrument lines) and 47A054 (for control air lines). These drawings provide guidelines for locating and supporting seismic supports.

EN DES Special Engineering Procedure (SEP) 82-18 "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," was written to control the verification program for process piping within WBP's scope. CEB's verification was performed in accordance with their normal analysis procedures. Instrument and control air line qualification was determined by separate calculations by CEB. In all cases, WBP verifies all supports as adequate or corrects them by revised drawings under Engineering Change Notice (ECN) 3213 (for engineered supports) or variances (for typical supports).

CEB 76-5 has been revised to provide additional guidelines and clarify existing procedures. However, in order to minimize additional field work, the verification of qualification of the piping is normally evaluated against code requirements instead of solely the criteria in CEB 76-5. The verification methods utilize hand calculations as well as computer analysis to qualify piping analyses which do not meet the specific rules of CEB 76-5.

EN DES' Sequoyah/Watts Bar Design Project (SWP) Engineering Procedure (EP) 43.21 "Alternate Analysis of Piping Systems - Documenting and Verifying" has been issued to control the analysis of alternately analyzed piping in WBP's scope. In the future CEB will not utilize alternate analysis methods for analyzing WBN piping. Any reanalysis of CEB's current alternate analysis problems will be by rigorous analysis. All class 2 and 3 analysis problem responsibilities have been transferred to WBP where any future alternate analysis problems that were in the scope of CEB will now be analyzed by WBP per SWP EP 43.21 which adequately provides guidance controls for alternate analysis.

Training in alternate analysis methods, has been provided to WBP and CONST personnel. The subjects of these training sessions were CEB 76-5, SWP EP 43.21, and 47A053 drawings as appropriate.

CEB 76-5 has been revised to clarify deficient areas and provide guidelines in some previously unaddressed areas. Portions of SWP EP 43.21 address various technical areas. The 47A053 drawings have been revised under ECN 3542 to clarify some areas and to require all piping supported in accordance with these notes to be reviewed by WBP.

NCR WBN SWP 8160 (WBRD-50-390/82-02, -391/82-02)

Description of Deficiency

Some areas in Seismic Category I buildings requiring maintenance of pressure boundary of the High Pressure Fire Protection System during a seismic event are not noted in design drawings in accordance with the WBN Supplemental Fire Protection Design Criteria and Supplemental Recommendations. These areas are defined to contain essential equipment for safe plant operation. Additionally, piping in these essential equipment areas is not interfaced with adjoining piping (which does not require pressure boundary maintenance) in accordance with WB-DC-40-31.9. This criteria requires that the support analysis be carried two changes of pipe direction beyond the area requiring maintenance of the pressure boundary.

The cause of this deficiency can be attributed to TVA's failure to provide adequate analysis methods, analysis procedures and adequately train personnel in alternate analysis methods.

Safety Implications

Inadvertent water spray from a fire protection system pipe that failed to maintain its pressure boundary within these essential equipment areas could damage essential equipment and consequently could have adverse affects on the safe operation of the plant.

Corrective Action

CEB 76-5, Sections 5.5.1, 5.5.2 and 5.5.3 now addresses the appropriate interface requirements. EN DES-SEP 82-18, Attachments 1, 2, and 3 expand and clarify these requirements.

NCR WBN SWP 8220 (WBRD-50-390/82-57, -391/82-54)

Description of Deficiency

In performing alternate analysis on seismically supported piping for WBN, the TVA analyst did not comply with WBN Design Criteria documents WB-DC-40-31.7 "Analysis of Category I and I(L) Piping Systems" sections 6.4 and 6.5, and WB-DC-40-31.9 "Location and Design of Piping Supports and Supplemental Steel in Category I Structures" sections 6.2.1a and 7.2.6. The nonconforming areas involve the specific methods of preparation of calculation packages and other documentation per instructions in the criteria. The design project (SWP) developed 47A053 drawing notes (based on the alternate analysis criteria) which provided instructions to TVA's Division of Construction (CONST) to be used to locate supports on most 2-inch and smaller piping. These notes did not require appropriate documentation and verification. In addition, the design project did not have an engineering procedure to control the analysis work involved with alternately analyzed piping.

The cause of this deficiency can be attributed to TVA's failure to provide adequate analysis methods, analysis procedures and adequately train personnel in alternate analysis methods.

Safety Implications

Alternate analysis performed on seismically supported piping does not comply with the requirements of design criteria WB-DC-40-31.7 and WB-DC-40-31.9. Due to the lack of documentation of the methods used in preparing the alternate analysis calculation packages and the lack of a procedure to control alternate analysis, TVA lacks the assurance that the subject supports are adequate. Thus, TVA assumes that if this condition had remained uncorrected, a condition exists which could potentially have adverse effects on the safe operation of the plant.

Corrective Action

EN DES-SEP 82-18 "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying" requires the preparation of adequate documentation for process piping. The 47A053 drawings have been revised to require all piping supported in accordance with these notes to be reviewed by WBP. WBP develops the required documentation per SWP EP 43.21. Due to the generic nature of the qualification of the instrument and control air lines, CEB's calculation packages and the 47A051, 47A052, and 47A054 drawing series are adequate documentation.

NCR WBN CEB 8218 WBRD-50-390/82-59, -391/82-56

Description of Deficiency

Flanges joints on ANS Safety Class 2 and 3 systems analyzed using CEB 76-5 have not been evaluated as required by ASME Section III, paragraph NC-3647. Design criteria WB-DC-40-31.7 does not address flange qualification. CEB 76-5 states in the introduction that it is the responsibility of the designer to verify flange design but gives no method of accomplishing this work. This verification has not been done by the designer.

Safety Implications

Flanged joints are used in a number of safety-related systems such as the Essential Raw Cooling Water System and the Component Cooling Water System. Should the flanged joints on these systems become overstressed and fail during a seismic event, this could imply, but not be limited to, a loss of the reactor coolant pressure boundary. This would be a condition adverse to the safety of operations of the plant.

Corrective Action

CEB 76-5 has been revised to add Appendix H to address flanges. EN DES-SEP 82-18 Attachment 6 addresses the qualification of flanges. Design Criteria WB-DC-40-31.7 will be revised by CEB to add verification of flange qualification.

NCR 4164R (WBRD-50-390/82-73, -391/82-68)

Description of Deficiency

Support spacing requirements for spans with concentrated weights listed on TVA drawing 45A053-15B and criteria specified in drawing 45A053-1A have not been followed. Initial investigation of this deficiency indicates that TVA personnel incorrectly interpreted 45A053 notes. In some instances, the apparent cause of the misinterpretations was due to vaguely written criteria.

Safety Implications

This deficiency deals with a number of safety-related systems. Because of improper interpretation of 45A053 notes concerning spacing requirements, seismic criteria for Seismic Category 1 or 1L systems may have been invalidated which could cause supports to fail during a seismic event. This, in turn, could impair the function of safety-related systems which would subsequently adversely affect the safety of the plant.

Corrective Action

All piping supported by CONST in accordance with the 47A053 series drawings before August 27, 1982, were included and reviewed under the 100 percent verification of the alternate analysis program. The 47A053 drawings were revised under ECN 3213 to clarify spacing requirements for spans with concentrated weights.

NCR WBN SWP 8231 (WBRD-50-390/82-74, -391/82-69)

Description of Deficiency

WBN alternate analyses do not meet all the requirements of TVA's Civil Engineering Support Branch (CEB) Report CEB-76-5 (Alternate Criteria for Piping Analysis and Support) and design criteria WB-DC-40-31.7. A joint CEB-SWP review has shown generic technical deficiencies on analyses by CEB and SWP using CEB 76-5 and the 47A053 series drawings in the following areas: (1) maximum seismic spans exceeded, particularly near elbows, tees, and valves, (2) thermal and end point evaluations inadequate, (3) axial supports not specified as required, and (4) some load sources not properly considered.

The cause of this deficiency can be attributed to TVA's failure to provide adequate analysis methods, analysis procedures and adequately train personnel in alternate analysis methods.

Safety Implications

Deficiencies in the application of alternate analyses could have allowed piping to be installed which would not be seismically qualified. During a seismic event, this could lead to failure of some safety-related systems and could adversely affect the safe operation of the plant.

Corrective Action

As previously mentioned, CEB's verification was accomplished in accordance with their normal analysis procedures which requires each of the noted items in the description of deficiency above to be addressed.

The verification methods utilized by WBP as described in EN DES-SEP 82-18 "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying" requires each of the above deficiencies to be addressed. Specifically, Attachment 6 of SEP 82-18 addresses these items for piping qualified by CEB 76-5 and Attachment 7 of SEP 32-18 for piping qualified by other methods.

WBN SWP 8238 (WBRD-50-390/82-78, -391/82-74)

Description of Deficiency

A discrepancy exists in rigorous and alternate support detail drawings in the Essential Raw Cooling Water System. The supports use a unistrut clamp as an axial restraint. However, washers between the unistrut strip and the clamp produce a gap between the pipe and clamp, thus eliminating any axial restraint. The washers were specified in the bill of material for the supports.

Although the washers can physically be placed in either of two positions, one which will restrain the pipe and the other which will not, the location of the washers was not specified. Normal construction practice is to place the washers in the position eliminating axial restraint if a washer is called for. As a result, washers were installed in positions eliminating axial restraint when the designer intended otherwise.

Safety Implications

If a pipe is designed to be supported axially and is not supported axially, then the pipe can be overstressed during a design basis event or during normal operation. This could lead to pipe failure and degradation of a safety-related system.

Corrective Action

All engineered pipe support drawings utilizing unistrut clamps for axial restraint will be reviewed to determine whether washers have been specified to be used. If a washer has been specified for use, the drawing will be revised to eliminate the washer between the unistrut strip and clamp.

NCR WBN SWP 8264 (WBRD-50-390/83-19, -391/83-18)

Description of Deficiency

Some small piping supports were not designed consistently with the allowed installation. Small process piping support drawings have been identified as having the following conditions:

1. Drawing 47A053-151 was analyzed with an overall length of 100 inches in lieu of the 120-inch overall length. The correction will lower the allowable loading capacity.

2. Drawing 47A053-138 is not adequate for use as a typical for the worst possible cases; it will require additional limitations on its use.

3. Drawing 47A053-3 allowed fillet welds between the lug and the support angle which will result in an overstressed weld due to the moment.

4. Drawing 47A053-136 shows a vertical, horizontal, and axial restraint without specifying the maximum axial span lengths. TVA CONST may use this typical for axial spans in excess of the support design.

Safety Implications

The use of fillet welds allowed on drawing 47A053-3 could cause overstressed welds at lugs and support angle connections. The lack of a maximum axial span length on drawing 47A053-136 could allow pipes to be overstressed due to excessive spacing. Thus, deficiencies in these supports could cause safety-related pipe failures under design basis accident conditions which could subsequently affect the safe operation of the plant.

Corrective Action

EN DES has completed its evaluation of these supports. All these supports were revised and issued under ECN 3213 as follows:

47A053-3

Plan Alternate I - Revised to eliminate the torsional moment that will be induced to the pipe by the lugs. Plan Alternate II - The existing standard Riser pipe clamp was replaced by a heavy duty Riser pipe clamp to resist the loads in the negative axial direction and in the positive and negative lateral directions of the pipe. Plan Alternate III - The heavy duty Riser pipe clamp was structurally encased to provide resistance for loads in the positive and negative axial and lateral directions of the pipe.

47A053-136, -138, and 151: Revised to provide limitation of its application by the addition of a note on the applicable drawing clarifying the use of the drawing.

The actions above are adequate for supports that will be installed in the future.

All supports previously installed before this NCR have been identified and are being resolved under the alternate analysis program.

NCR WBN SWP 8306 (WBRD-50-390/83-20, -391/83-19)

Description of Deficiency

Aluminum piping was used for the demineralized water system in many areas. Portions of this piping were alternately analyzed per the Watts Bar alternate analysis criteria, CEB 76-5. The Watts Bar alternate analysis criteria does not include aluminum piping in its scope. Consequently, data and support information for steel piping were used erroneously for aluminum piping.

The cause of this deficiency can be attributed to TVA's failure to provide adequate analysis methods, analysis procedures and adequately train personnel in alternate analysis methods.

Safety Implications

The purpose of seismically qualifying demineralized water piping is to protect safety-related equipment from the effects of a pipe break. Thus, had this condition remained uncorrected, a seismic event could have led to a pipe break which could damage safety-related equipment in the vicinity and consequently impact the safe operation and shutdown of the plant.

Corrective Action

CEB 76-5 has been revised to add Section 5.6.2 which provides criteria for aluminum piping. Piping stress analysis was verified by the use of this criteria and other verification methods.

NCR WBN SWP 8311 (WBRD-50-390/83-21, -391/83-20)

Description of Deficiency

Schedule 10S stainless steel piping was used for portions of the Primary Water Makeup System (6 inches and smaller in diameter). Some of this piping has been alternately analyzed per the Watts Bar Alternate Analysis Criteria CEB 76-5. The scope of the Watts Bar alternate analysis criteria does not include schedule 10S stainless steel piping for diameters 6 inches and smaller. Consequently, analysis and support data for normal weight stainless steel piping was used erroneously for schedule 10S stainless steel piping.

The cause of this deficiency can be attributed to TVA's failure to provide adequate analysis methods, analysis procedures and adequately train personnel in alternate analysis methods.

Safety Implications

The purpose of seismically qualifying Primary Water Makeup System is to protect safety-related equipment from the effects of a pipe break. Thus, had this condition remained uncorrected, a seismic event could have led to a pipe break which could damaged safety-related equipment in the vicinity and consequently impact the safe operation and shutdown of the plant.

Corrective Action

CEB 76-5 has been revised to add Appendix I which provides criteria for Schedule 10 stainless steel piping. Piping stress analysis was verified using Appendix I criteria and other verification methods.

Summary of Corrective Action - Unit 1

All EN DES corrective actions, both programmatic and specific discussed above, will be completed for unit 1 by December 30, 1983. We expect to have all TVA action on unit 1 complete by February 2, 1984.

Interim Progress - Unit 2

The Unit 2 corrective actions will be performed in a similar manner to unit 1 by TVA personnel who have been trained in accordance with CEB 76-5 alternate analysis criteria, SWP EP 43.21 control procedure and 47A053 process pipe typical drawings.