TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

March 17, 1983

WBRD-50-390/82-93
WBRD-50-391/82-89

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 - SELECTION OF UNDERSIZED SWAY STRUTS - WBRD-50-390/82-93, WBRD-50-391/82-89 - FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector D. Quick on September 1, 1982 in accordance with 10 CFR 50.55(e) as NCR WBN SWP 8244. Our first interim report was submitted on September 30, 1982. Enclosed is our final report. TVA no longer considers this condition to be adverse to the safety of plant operations. Therefore, we will amend our records to delete this NCR as a 10 CFR 50.55(e) item.

Please note that the description of deficiency has been modified from our previous report to envelope the design of linear type supports for the Watts Bar Nuclear Plant.

NRC-OIE Inspector P. Fredrickson was notified on March 1, 1983 that this submittal would be several days late due to final review activities.

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)
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
SELECTION OF UNDERSIZED SWAY STRUTS
NCR WBN SWP 8244
WBRD-50-390/82-93, WBRD-50-391/82-89
10 CFR 50.55(e)
FINAL REPORT

Description of Deficiency

The code of record for design of pipe supports for the Watts Bar Nuclear Plant (WBN) is prior to the issuance of the ASME code subsection NF in 1974. Design criteria for supports was based on AISC, MSS SP-58 and good engineering principles. However, to ensure adequate support design, TVA continually evaluates the criteria to NF requirements.

Allowable stresses in the NF code are similar to those specified for pipe where a uniform section is maintained and secondary stresses tend to shake down. A support is subject to shear of bolts, critical buckling, weld failure, etc., that prohibits a simple application of the shakedown concept adopted by the NF code.

The NF code treats support loads resulting from constraint of free end displacements as a secondary stress in the support. Allowable primary and primary plus secondary stress limits are established by the code. Vendors of standard support components will not consider restraint of free end displacement loads as secondary stress in the support and will only provide one load rating for each operating condition. This load rating is based on code primary stress limits.

TVA considers the code allowable stress for support loads resulting from restraint of free end displacement of the piping system to be unconservative. Except for critical buckling, the Watts Bar criteria is more conservative than the NF code. However, the Watts Bar criteria can potentially result in loads on sway struts (a linear type standard support component) exceeding catalog load ratings.

Safety Implications

I. Introduction

The NF code allowable stress for mechanical plus constraint of free end displacement is three times the stress limits of Appendix XVII-2000 to ASME section II subsection NF for the design, normal, and upset operating condition. In the emergency and faulted condition, constraint of free end displacement loads on the support are not evaluated.

Regulatory Guide 1.124 (issued November 1976) endorses the NF code limits but defines the increase to three times Appendix SVII-2000 as a stress range. This regulatory guide further requires supports whose normal function is required during an emergency or faulted plant condition to be designed to upset limits.

TVA does not agree that the constraint of free end displacement of the piping system can be treated as a secondary stress in the support. Further, as indicated by Regulatory Guide 1.124, the emergency and faulted condition code limits do not ensure functionality. Consequently, TVA developed a support design concept which is in general much more conservative than the code.

Classification of system restraint loads caused by constraint of free end displacements is very controversial. For example, the code permits design of supports by analysis and by load rating. Design by load rating treats all loads on the support as mechanical (or primary) loads, and no primary plus secondary allowable is provided.

Table 1 provides a comparison of allowable stresses of linear type supports designed by analysis for different codes, NRC documents, and the Watts Bar plant.

II. FSAR Commitment:

The WBN FSAR provides a complete summary of support design criteria. On May 27 and 28, 1981, a meeting was held with the NRC in Knoxville. The FSAR support design criteria summary was reviewed. As outstanding item (NRC Mechanical Engineering Support Branch concern B15) on critical buckling resulted from the meeting. As indicated in Table 1, the WBN plant design criteria does not consider two-thirds critical buckling as a design limit. An allowable of 1.6 times normal code allowable approaches 0.9 of critical buckling for $l/r = 30$. As l/r approaches 1, the allowable compression stress approaches yield.

To resolve NRC Safety Evaluation Report item 15, TVA investigated 515 supports from 19 different systems. The results were submitted to the NRC by letters dated November 10 and 18, 1982, to E. Adensam, Chief Licensing Branch No. 4, USNRC, from L. M. Mills, Manager, Nuclear Licensing Staff.

III. TVA Position:

In summary, the WBN support design criteria is in general much more conservative than the NF code. The WBN support design criteria considers all system loads on the support as primary. Constraint of free end displacement loads in the emergency and faulted condition are combined with mechanical loads, and resulting allowable stress is less than yield. As indicated by Table 1, the faulted allowable for WBN is only one-half the NF allowable and additional conservatism results from considering constraint of free end displacement loads as primary.

The WBN upset primary plus secondary allowable is treated as a stress range and is maintained well below code allowable. The allowable upset primary (dead load plus Operational Basis Earthquake (OBE)) inertial loads are calculated to be 1.0. The AISC code has for many years permitted a one-third increase for wind and seismic loads.

Therefore, based on the above there are no adverse safety implications and TVA no longer considers 10 CFR 50.55(e) to apply to this condition.

Corrective Actions

No corrective actions are required.

Table 1
Comparison of Design of Linear Type Supports by Analysis

Condition/ System Load	ASME - NF 1974 through Summer 19 2	ASME - NF Design Work Group Proposed 10/17/79	NRC Reg Guide 1.124 Nov. 1976	AISC Proposed Nuclear Code	NRC Standard Review Plan Section 3.8.3, July 1891	TVA Watts Bar Nuclear Plant (6)
Normal						
Mechanical	1.0[1]	Not considered	1.0[1]	1.0	1.0	1.0
Mechanical plus constraint of free end displacement	3.0[1]	1.0[1]	3.0[1,2]	1.5	1.5	1.5
Upset						
Mechanical	1.0[1]	Not considered	1.0[1]	1.0	1.0	1.00
Mechanical plus constraint of free end displacement	3.0[1]	1.33[1]	3.0[1,2]	1.5	1.5	1.5
Emergency						
Mechanical	1.33[1]	Not considered	1.33[1,2,3]	not provided		1.33
Mechanical plus constraint of free end displacement	Not considered	1.5[1]	Not considered			1.5

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Table 1
Comparison of Design of Linear Type Supports by Analysis

Condition/ System Load	ASME - NF 1974 through Summer 1972	ASME - NF Design Work Group Proposed 10/17/79	NRC Reg Guide 1.124 Nov. 1976	AISC Proposed Nuclear Code	NRC Standard Review Plan Section 3.8.3, July 1891	TVA Watts Bar Nuclear Plant (6)
Normal						
Mechanical	1.0[1]	Not considered	1.0[1]	1.0	1.0	1.0
Mechanical plus constraint of free end displacement	3.0[1]	1.0[1]	3.0[1,2]	1.5	1.5	1.5
Upset						
Mechanical	1.0[1]	Not considered	1.0[1]	1.0	1.0	1.00
Mechanical plus constraint of free end displacement	3.0[1]	1.33[1]	3.0[1,2]	1.5	1.5	1.5
Emergency						
Mechanical	1.33[1]	Not considered	1.33[1,2,3]	not provided		1.33
Mechanical plus constraint of free end displacement	Not considered	1.5[1]	Not considered			1.5

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