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APR 30 1990

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - DAMPING VALUES FOR HEATING, VENTILATING, AND AIR CONDITIONING (HVAC), CONDUIT, AND CABLE TRAY SYSTEMS AT WBN

Enclosed are the proposed damping values for cable tray, conduit, and HVAC systems at WBN. Justification for the damping values was provided to NRC during engineering team inspection No. 390, 391/89-21 conducted at WBN November 13 through 17, 1989.

TVA requests NRC acceptance of the proposed values for use at WBN as part of the corresponding corrective action program (CAP) plans. These proposed values will also be included in a future amendment to the WBN Final Safety Analysis Report (FSAR).

If there are any questions, please telephone G. R. Ashley at (615) 365-8527.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Ralph H. Shell

for E. G. Wallace, Manager
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Enclosure
cc: See page 2

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ENCLOSURE

PROPOSED DAMPING VALUES FOR QUALIFICATION OF ELECTRICAL CONDUIT AND CONDUIT SUPPORTS FOR DYNAMIC LOADS

I. BACKGROUND

Damping is used to account for varying degrees of energy dissipation in structures and systems consisting of different materials and types of construction under dynamic loadings. The conduit systems at WBN consist generally of welded steel supports with bolted support attachments and rigid steel and aluminum conduit. The conduit is filled with various amounts and types of electrical cables. These characteristics common to the conduit system are sources for energy dissipation and contribute to higher damping values.

II. PROPOSED DAMPING VALUES

Based on damping test data, the proposed values of damping for WBN conduit and conduit supports are 7 percent for rigid steel and aluminum conduit systems. The damping value is for application to operating basis earthquake (OBE), safe shutdown earthquake (SSE) and design basis accident (DBA) events.

III. TECHNICAL BASIS

Testing by TVA (Reference 1) and ANCO (Reference 2) has demonstrated higher damping values for conduit systems. These test programs considered numerous variables including conduit size, cable fill ratio, span length, clamp type, etc., that are common to conduit systems. The results of these tests show 7 percent damping is applicable for conduit systems used at WBN.

IV. SUMMARY/CONCLUSIONS

In summary, supportive test data is available demonstrating that damping values are 7 percent for rigid steel and aluminum conduit systems used at WBN. The proposed damping value is for application to OBE, SSE and DBA events. These damping values are consistent with the Seismic Corrective Action Program (CAP) Plan (Reference 3).

V. REFERENCES

1. TVA, "Summary Test Report on Damping in Electrical Conduit," Report Number CEB-BN-1028, June 23, 1987.

2. ANCO Engineers, Inc, "Cable Tray and Conduit Raceway Seismic Test Program," Prepared for Bechtel Power Corporation, Report Number 1053-21.1-4, Release December 15, 1978.

3. Watts Bar Nuclear Plant Seismic Analysis Corrective Action Program Plan, Revision 1 (L44 890629 807).

PROPOSED DAMPING VALUES FOR QUALIFICATION
OF CABLE TRAY AND CABLE TRAY SUPPORTS FOR DYNAMIC LOADS

I. BACKGROUND

Damping is used to account for varying degrees of energy dissipation in structures and systems consisting of different materials and types of construction under dynamic loadings. Although the WBN Final Safety Analysis Report (FSAR) includes damping values used for general welded or bolted steel structures, it does not specifically address damping values for cable tray systems. These systems consist of welded tube steel supports with bolted tray assemblies, which includes bolted support attachments, fittings, and splices. The majority of the cable tray runs consist of multiple levels of trays on common supports. The trays are fabricated of relatively light gauge formed sheet metal and are loaded with varying amounts and types of coated and uncoated cables. The system damping as well as the system frequency will be controlled by the cables and trays as observed in tests.

II. Proposed Damping Valves

WBN cable tray systems can be expected to exhibit damping levels of greater magnitudes than the more "standard types" of bolted steel structures. A 7 percent damping is therefore proposed for use in evaluating WBN cable tray systems for OBE, SSE, and DBA loading conditions.

III. Technical Basis

Regulatory Guide (RG) 1.61 does not specifically address damping values for bolted or welded cable tray systems although the general damping values for bolted and welded steel structures are provided. Alternatively, RG 1.61 also allows use of test data to support higher damping values. Consistent with this provision a higher damping value was obtained in Reference 1, Section 7.2. Several characteristics inherent to cable tray systems contribute to the observed phenomenon of higher damping.

A. The mass of cable (coated or uncoated) vibrating within the tray tends to dampen tray vibration. Uncoated cables demonstrate higher degrees of damping than coated cables. Tests indicate that the damping is mainly because of the interaction of cable with each other and with the tray.

B. Cable tray bending and support flexibility combine to provide energy dissipation capabilities, which allows for higher system damping.

The above mechanisms for energy absorption (cable movement, cable tray physical characteristics, support types, and attachment details at WBN) are similar to those that were tested in the ANCO Test Program. The WBN cable tray system is similar to the system that was tested. Analysis of the data obtained in the ANCO test program clearly demonstrates that the main energy absorbing mechanics are those noted above. Therefore, the damping values to be expected from the WBN systems are similar to those obtained in the ANCO Test Program.

As shown in Reference 1, the minimum observed damping for the coated cables is 7.5 percent. The damping obtained in the uncoated systems is much greater, 20 percent or more. The test values are valid for a minimum input acceleration of 0.1g. Since the spectral acceleration for WBN structures is 0.1g or greater for both OBE and SSE, the proposed damping value of 7 percent is applicable.

IV. Summary/Conclusions

In conclusion, 7 percent damping is acceptable for use in evaluating WBN cable tray systems for OBE, SSE, and OBA loading conditions. These damping values are consistent with the Seismic CAP Plan (Reference 2).

V. References

1. Cable tray and conduit raceway seismic test program, ANCO Engineers, Inc., Report 1053-21.1-4.

2. Watts Bar Nuclear Plant Seismic Analysis Corrective Action Program Plan, Revision 1 (L44 890629 807).

PROPOSED DAMPING VALUES FOR QUALIFICATION OF
HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)
DUCT AND DUCT SUPPORTS FOR DYNAMIC LOADS

I. BACKGROUND

Damping is used to account for varying degrees of energy dissipation in structures and systems consisting of different materials and types of construction under dynamic loadings. Although the WBN FSAR includes damping values used for general welded or bolted steel structures, it does not specifically address damping values for HVAC duct systems. These systems have large thin walled members, often with many bolted type joints, and with many riveted connections to their supports. The supports are generally bolted to the building concrete with expansion anchors. These bolted types of connections contribute significant sources of energy dissipation that help limit the duct system responses. Due to the complex behavior of HVAC systems, available test data is used to correlate results of simplified linear analysis models with the actual behavior.

II. PROPOSED DAMPING VALUES

Seismic qualification of WBN HVAC duct systems was performed using 7 percent damping for both OBE and SSE. This was based on data obtained from full scale seismic tests on nonwelded ducts performed by Wyle Laboratories for TVA. However, recent review of the damping test data indicates that the following proposed damping values are more consistent with the available test data for nonwelded ducts: 5 percent for OBE and 7 percent for SSE for SMACNA companion-angle duct constructions, and 7 percent for both OBE and SSE for SMACNA pocket-lock duct constructions. Damping values of 2 percent for OBE and 5 percent for SSE are proposed for welded duct constructions. The basis for these damping values is discussed below.

III. TECHNICAL BASIS

RG 1.61 does not specifically address damping values for bolted or welded HVAC duct systems although the general damping values for bolted and welded steel structures are provided. Alternatively, RG 1.61 also allows use of test data to support damping values higher than the ones tabulated therein. Consistent with this provision, TVA conducted damping tests on full scale HVAC duct specimens and evaluated the results (Reference 1). Based on this evaluation, it was concluded that for plants designed to mean value plus one standard deviation spectra, mean values of the damping indicated by the tests should be used for design. (WBN response spectra, which are based on Modified Newmark Spectra, meet the mean plus one standard deviation requirement.) Mean damping values of 6 percent for OBE and 7 percent for SSE for companion-angle ducts, and 10 percent for both OBE and SSE for pocket-lock ducts are indicated by the test data (Reference 1). Therefore, the proposed damping values of 5 percent for OBE and 7 percent for SSE for companion-angle ducts, and 7 percent for both OBE and SSE for pocket-lock ducts are conservatively enveloped by the test data.

For welded types of duct, the proposed damping values of 2 percent for OBE and 5 percent for SSE are within the FSAR ranges of damping for welded structures. Even though the ducts are welded, the supports are usually bolted to the main building structure which results in additional energy dissipation. Since additional energy dissipation is the basis for the FSAR allowance to increase SSE damping from 2 percent to 5 percent on welded steel structures at or near yield, the 5 percent SSE value for welded constructions is justified. These damping values for welded duct systems also correspond to those recommended in Reference 2 for air cleanup systems which typically are also welded constructions.

IV. SUMMARY/CONCLUSIONS

It is TVA's position that the proposed damping values given in Section II should be used to evaluate HVAC duct systems because they have a sound technical basis as discussed in Section III. These damping values are consistent with the Seismic CAP Plan (Reference 3).

V. REFERENCES

1. Sequoyah Nuclear Plant, Units 1 and 2, HVAC Damping Values, Gilbert Commonwealth, Inc., Report 2783.

2. Nuclear Air Cleaning Handbook - Design, Construction, and Testing of High-Efficiency Air Cleaning Systems for Nuclear Application by C. A. Burchsted, J. E. Kahn, and A. B. Fuller, Contract Number W-7045-eng-26, Oak Ridge National Laboratory.

3. Watts Bar Nuclear Plant Seismic Analysis Corrective Action Program Plan, Revision 1 (L44 890629 807).