Enclosure 2
TVA Letter Dated December 3, 2010
Attachments

Attachment 4

"Seismic Evaluation of Nuclear Instrumentation System Console 2-M-13
with Gammametrics Equipment for Watts Bar Unit 2,"
EQ-EV-39-WBT-NP, Revision 1, dated March 2009

Westinghouse

SEISMIC EVALUATION OF NUCLEAR INSTRUMENTATION SYSTEM CONSOLE 2-M-13 WITH GAMMAMETRICS EQUIPMENT FOR WATTS BAR UNIT 2

EQ-EV-39-WBT-NP
Revision 1

March, 2009

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RECORD OF REVISIONS

Revision Number	Description of Revision	Author(s)	Page(s)
0	Original Issue	J. J. Zhang	1 through 22
1	1. The number of the NIS Console for Watts Bar Unit 2 is changed from 1-M-13 to 2-M-13 based on the email of the Project Manager Mr. Mike Norrell sending to Westinghouse Jie Zhang on March 13, 2009 (Reference 14). Please note that the configuration of the NIS Console 2-M-13 is the same as the NIS Console 1-M-13 (Reference 14). Therefore, the change of the NIS Console number does not impact the effectiveness of the calculation performed in this report. 2. Reference 14 is added and attached in Appendix A.	J. J. Zhang	1 through 22

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1.0 INTRODUCTION

At Watts Bar Unit 2 (WBT), the Gammametrics equipment is to be used to replace the Westinghouse Source Range and Intermediate Range drawers in the Westinghouse Nuclear Instrumentation System (NIS) console2-M-13. Also, two Shutdown Monitors are to be installed in the NIS console above the Source Range drawers. A similar modification had been conducted on the NIS console at Watts Bar Unit 1 (WAT). Westinghouse Letter WAT-D-9249 (Reference 1) dated April 3, 1993 indicated that this modification at WAT would not adversely impact the seismic qualification of the NIS console documented in WCAP-8021 (Reference 2) and WCAP-8830 (Reference 3). The report WCG-ACQ-0516 (Reference 4) demonstrated that the Gammametrics equipment installed using the existing Westinghouse Slide and Slide Brackets would maintain structural integrity when subjected to the plant specific Safe Shutdown Earthquake (SSE) event. Reference 4 documented that the four-bay NIS console 1-M-13 defined in Drawing [ ]^{a,b,c} (Reference 5) were used and modified at WAT as shown in Figure 1.

a,c

Figure 1 Schematic of the NIS Console Modified at WAT (Reference 5)

Tennessee Valley Authority (TVA) provided the following information in the response (WBT-TVA-0078 25401-011-T1A-GGG-00050-001/002) to Westinghouse letter WBT-TVA-0078 (Reference 6) about the modifications to the NIS console at WBT:

1. The NIS console for WAT is the same as the one for WBT.

   Therefore, the NIS console defined in Drawing [ ]^{a,b,c} (Reference 5) is to be installed at WBT with the modifications shown in Figure 1.

2. Gammametrics equipment used for WBT is different than the one used for WAT in terms of the weight and the height.

Table 1 Comparison of Gammametrics Equipment for Watts Bar Unit 1 and Unit 2 a,c

[

]

3. The drawer Slide for securing the Gammametrics equipment to the NIS console and the Slide Brackets at WBT are the same as those at WAT.

4. The same mounting screws and bolts are used to secure the Gammametrics equipment to the NIS console at WAT and WBT.

5. The shutdown monitors at WBT are identical to the ones at WAT.

6. The Amplified Response Spectra (ARS) applicable to the NIS console at WBT are the same as the applicable ARS at WAT.

   The WAT/WBT ARS Required Response Spectra (RRS) at Elevation 755.5 feet in the Auxiliary-Control Building is applicable to the mounting location of the NIS console (Reference 4).

The seismic evaluation performed herein is to demonstrate that the use of the Gammametrics equipment at WBT will not invalidate the existing seismic qualification of the Westinghouse NIS console. Also, the Gammametrics equipment using the Westinghouse Slide and Slide Brackets will maintain structural integrity when subjected to WBT specific seismic events.

2.0 EVALUATIONS

2.1 Seismic Qualification of NIS Console

The addition of Gammametrics equipment to the Westinghouse NIS console 1-M-13 at WAT was evaluated and documented in Westinghouse Letter WAT-D-9249 (Reference 1) and Westinghouse Calculation Note [ ]^{a,b,c} (Reference 7). The total weight and three weight zones of the NIS console tested are shown in Figure 2, while Figure 3 shows the modified NIS console weight zone data for the WAT application from Reference 7. Table 1 identifies that the WBT Gammametrics Source and Intermediate Range drawers have different weights than the WAT modification. These weight differences result in the WBT modified NIS console weight distribution shown in Figure 4.

a,c

Figure 2 Weight Zones of NIS Console Tested (Data from Reference 7)

a,c

Figure 3 WAT Modified NIS Console Weight Distribution (Data from Reference 7)

a,c

Figure 4 WBT Modified NIS Console Weight Distribution

With respect to the original NIS console, the weight differences of the WBT NIS console modified are as follows,

a,b,c

[ ]

The weight zones and total weight of the WBT NIS console with Gammametrics equipment shift less than 10% with respect to the original NIS console. Therefore, the modification to the WBT NIS console is acceptable and will not discontinue the applicability of the seismic qualification of the NIS console documented in WCAP-8021 (Reference 2) and WCAP-8830 (Reference 3).

At WBT, the reduction of 72 lb in the weight of the modified NIS console would reduce the seismic loadings applied on the cabinet mounting. When subjected to the WAT/WBT specific seismic events, the mounting of the modified NIS console hence would have an increased safety margin.

2.2 Structural Integrity of Gammametrics Equipment Mounting

The Gammametrics Source Range defined in Drawing [ ]^{a,b,c} (Reference 8) and the Gammametrics Intermediate Range defined in Drawing [ ]^{a,b,c} (Reference 9) have identical dimensions. Six Φ0.19" holes are specified in References 8 and 9 for the securing of drawers to the NIS console as shown in Figure 5 and Gammametrics Source Range and Intermediate Range are considered to be secured onto the NIS console with six 8-32 ASTM A307 (SAE Grade 2) screws. As documented on Page 11 of WCG-ACQ-0516 (Reference 4), Gammametrics equipment is mounted in the NIS console at WAT with six 8-32 screws (A307).

At WBT, the Gammametrics equipment is to be installed with the existing Westinghouse Slides and Slide Brackets. The structural adequacy of the screws securing the Gammametrics equipment to the Westinghouse Slides and Slide Brackets when subjected to the applicable WAT/WBT ARS Set (B+C) SSE RRS was demonstrated in WCG-ACQ-0516 (Reference 4). However, the evaluation documented in Reference 4 used the seismic accelerations associated with the floor response spectra rather than the amplified seismic accelerations within the NIS cabinet.

2.2.1 Seismic Loadings

Westinghouse Calculation Note [ ]^{a,b,c} (Reference 7) documented the In-Equipment Response Spectra (IERS) at the mounting locations of Shutdown Monitors, Source Range and Intermediate Range drawers in the NIS console with respect to the applicable WAT/WBT ARS Set (B+C) SSE RRS. Table 2 summarizes the peak accelerations of the IERS at 5% critical damping.

Table 2 Peak Accelerations of WAT/WBT Specific IERS at NIS Console (Reference 7) (5% Critical Damping)

a,c

[ ]

As indicated on Page 15 of WCG-ACQ-0516 (Reference 4), it is not required to evaluate the structural adequacy of the Shutdown Monitors since the Shutdown Monitors maintained structural integrity during the seismic qualification testing documented in Reference 9.13 of Reference 4. The mounting adequacy of the Gammametrics Source Range and Intermediate Range is to be analyzed with the WAT/WBT specific IERS at their mounting locations.

a,c

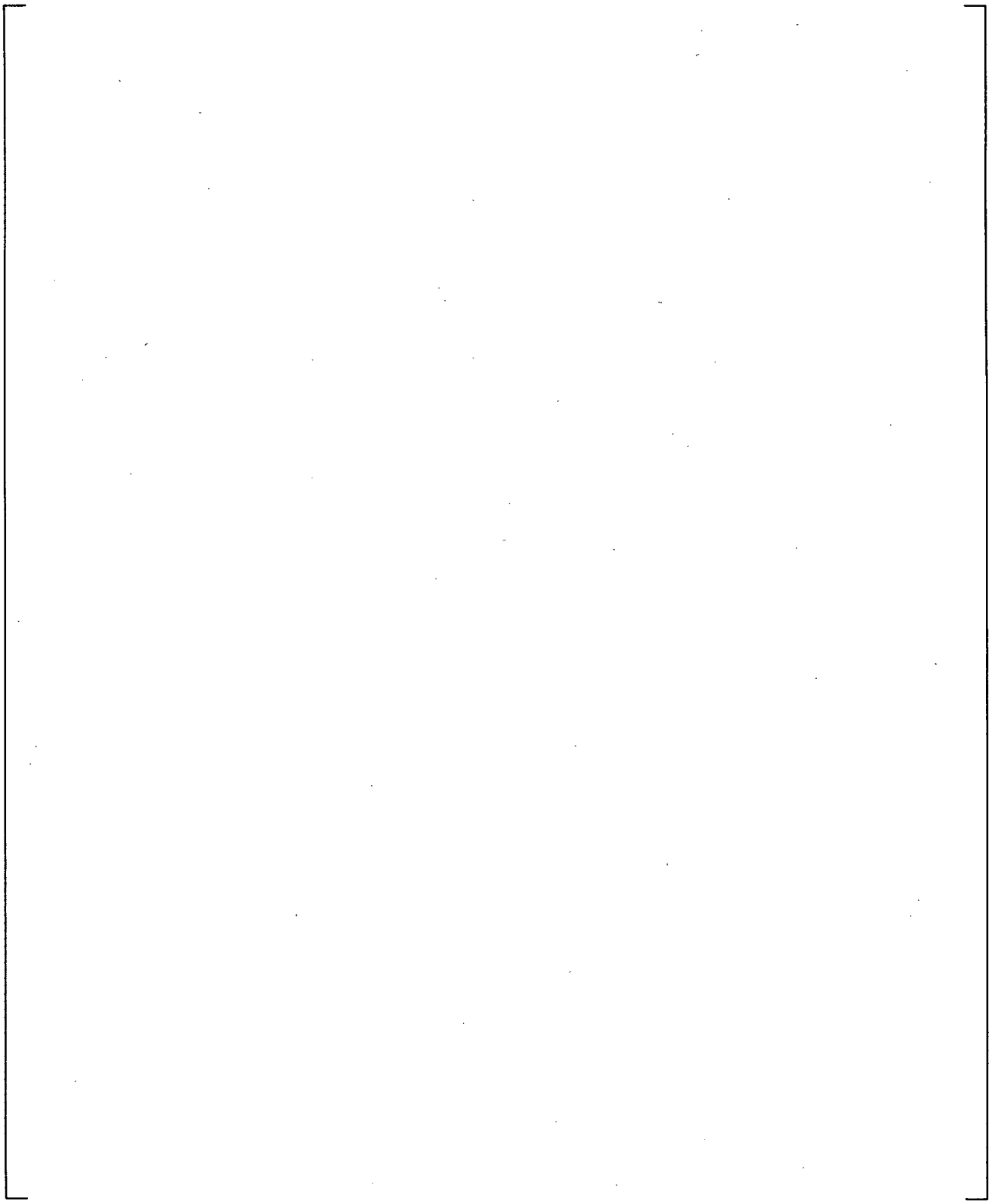


Figure 5 Top and Side Views of Gammametrics Intermediate Range (Reference 9)

2.2.2 Stresses

The Gammametrics Intermediate Range weighs more than the Gammametrics Source Range and will be used for the calculation.

The equivalent static coefficient method with a static coefficient of 1.5 is used to calculate the seismic loading in accordance to IEEE Std 344-1987 (Reference 10). The maximum seismic loadings acting on the Center of Gravity (CG) of the Gammametrics Intermediate Range are calculated as follows,

a,b,c

[ ]

Since the CG of the Intermediate Range is not at the center of the six screw pattern as shown in Figure 5, the seismic forces $F_{F\text{-}B}$ and F_V will produce the torsion on the screws as follows,

[ ] a,b,c

The allowable stress of ASTM A307 (SAE Grade 2) is $\sigma_{allowable} = 20ksi$ and $\tau_{allowable} = 10ksi$ per Table 1.5.2.1 on Page 5-24 of AISC Steel Manual (Reference 11). These allowable stress values are based on the nominal area of the unthreaded portion of the screw. Since the Size 8 screws in question are smaller than the sizes covered by ASTM A307, the tensile stress area of Size 8 screws is used in lieu of the nominal area. Per Table 4a on Page 1750 of Machinery's Handbook (Reference 12), the tensile stress area of a Size 8-32 screw is $A_t = 0.014in^2$.

A 1/3 increase in the allowable stress for the seismic loading permitted by Section 1.5.6 of AISC Steel Manual (Reference 11) is applied. Thus, combined shear and tension is addressed in the following in accordance with Section 1.6.3 and Table 1.6.3 on Pages 5-23 and 5-25 of AISC Steel Manual (Reference 11),

a,b,c

[ ]

For conservatism, it is considered that only four screws at the corners of the screw pattern take the shear induced by the torsion. The polar moment of inertia of screw pattern is equal to

[ ]a,b,c

The maximum shear stress induced by the torsion is calculated as follows,

a,b,c
[ ]

The maximum total shear stress on a screw is

a,b,c
[ ]

The maximum tensile stress on a screw is

[ ]a,b,c

Based on the shear stress, the allowable tensile stress is determined as

a,b,c
[ ]

Therefore, the Factors of Safety are

a,b,c
[ ]

In addition, the front panels of the Gammametrics Intermediate Range and Source Range drawers are to be secured to the Westinghouse securing hardware defined in the Westinghouse Field Change Notice WBTM-10714 (Reference 13). The securing of the drawers front panels to the NIS cabinet will further extend the safety margin of the Gammametrics equipment mounting with six screws.

3.0 SUMMARY OF RESULTS AND CONCLUSIONS

Gammametrics equipment is to be used to replace the Westinghouse Source Range and Intermediate Range drawers of NIS console 2-M-13 installed at Watts Bar Unit 2. In addition, two Shutdown Monitors are to be added to NIS console 2-M-13. Seismic evaluation was performed to demonstrate that this modification to NIS console 2-M-13 will not invalidate the seismic qualification of NIS console 2-M-13 for the Seismic Category I application at Watts Bar Unit 2. The qualification documented herein for the modified NIS console 2-M-13 is based on combined seismic qualification tests reported in WCAP-8021 (Reference 2) and WCAP-8830 (Reference 3), and the seismic analysis performed in Section 2.0.

The seismic evaluation was performed considering the use of the 8-32 ASTM A307 (SAE Grade 2) coarse thread screws for the mounting of Gammametrics equipment. The results of this evaluation are only applicable provided fastening configurations that are equal or greater in strength are used in the application of these results.

The seismic evaluation completed and documented in this report demonstrates that the NIS console 2-M-13 with the use of Gammametrics Source Range and Intermediate Range and Shutdown Monitors is qualified for the Seismic Category I application at Watts Bar Unit 2 in accordance to IEEE Std. 344-1987 (Reference 10). Gammametrics Source Range and Intermediate Range mountings will maintain structural integrity when subjected to the plant specific seismic events.

4.0 REFERENCES

1. Westinghouse Letter WAT-D-9249, "Tennessee Valley Authority Watts Bar Nuclear Plant Unit 1 Weight Zone Evaluation for NIS Console Modification," April, 1993. (Attached in Appendix B)
2. Westinghouse Electric Corporation Report WCAP-8021, "Seismic Testing of Electrical and Control Equipment (PG&E Plants)," May, 1973. (Westinghouse Proprietary)
3. Westinghouse Electric Corporation Report WCAP-8830, "Seismic Operability Demonstration Testing of the Nuclear Instrumentation System Bistable Amplifier," October, 1976. (Westinghouse Proprietary)
4. Tennessee Valley Authority Report WCG-ACQ-0516, "Seismic Qualification of Monitoring Details for Source Range and Intermediate Range on 1-M-13," April, 1993. (Attached in EDMS)
5. [ ]^{a,b,c}
6. Tennessee Valley Authority Response to Westinghouse Letter WBT-TVA-0078 25401-011-T1A-GGG-00050-001/002, "Response to Request for Confirmation of Information Related to NIS Excore Gammametrics Equipment," October, 2008. (Attached in EDMS)
7. [ ]^{a,b,c}
8. [ ]^{a,b,c}
9. [ ]^{a,b,c}
10. IEEE Std 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., 1987.
11. AISC Steel Manual, Eighth Edition, American Institute of Steel Construction, Inc.,1978.
12. Machinery's Handbook, 28th Edition, Industrial Press Inc., 2008.
13. Westinghouse Field Change Notice WBTM-10714, Rev. 0, "NIS Seismic Hardware," March, 1985.
14. [ ]^{a,b,c}

APPENDIX A

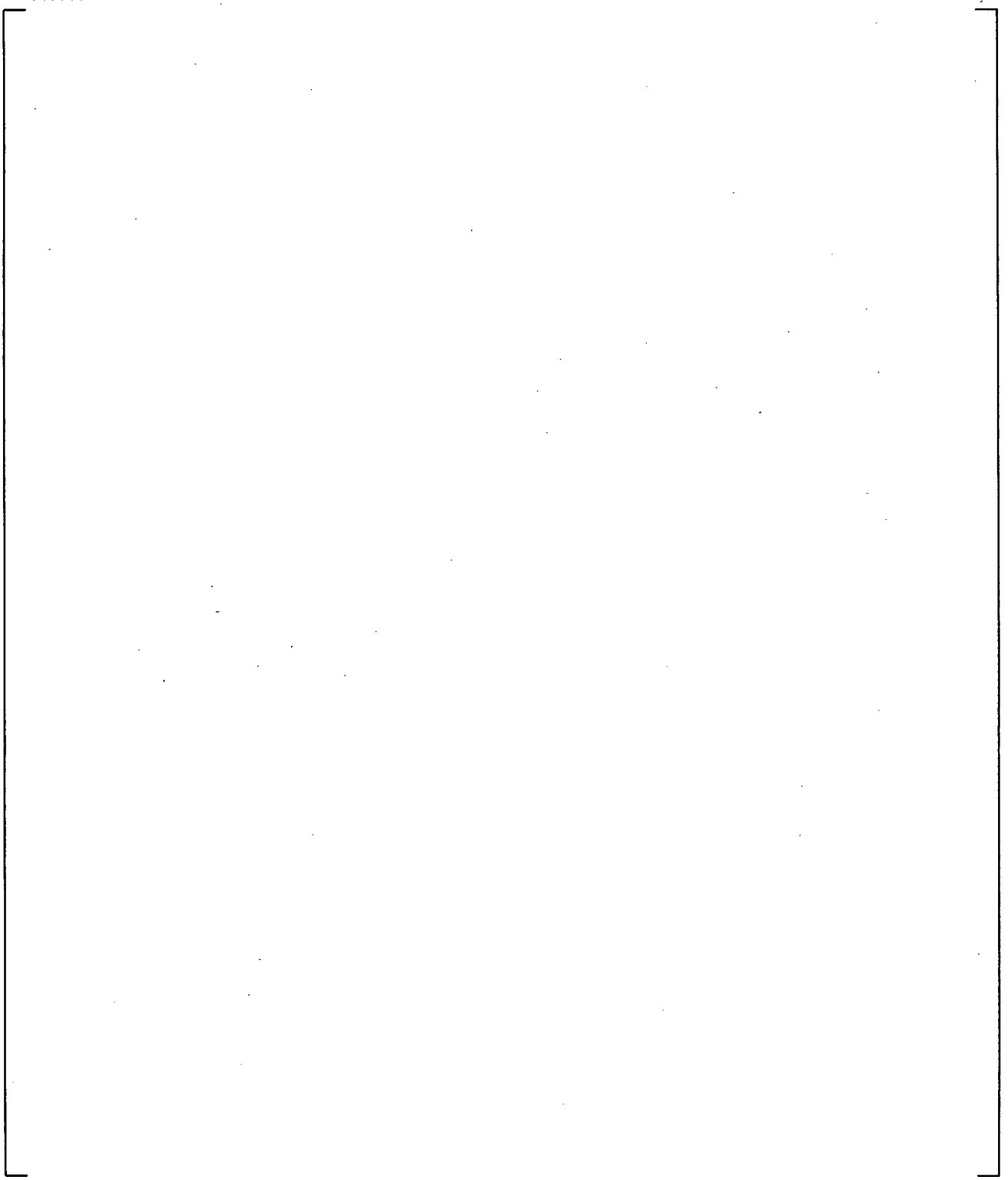
References 1, 8, 9 and 14 are attached here.

Reference 1

a,c

Reference 8

a,c



Reference 9

a,c

Reference 14

a,c

[ ]

APPENDIX B

The following References are attached with this report in EDMS.

Reference 4

Tennessee Valley Authority Report WCG-ACQ-0516, "Seismic Qualification of Monitoring Details for Source Range and Intermediate Range on 1-M-13," April, 1993.

Reference 6

Tennessee Valley Authority Response to Westinghouse Letter WBT-TVA-0078 25401-011-T1A-GGG-00050-001/002, "Response to Request for Confirmation of Information Related to NIS Excore Gammametrics Equipment," October, 2008.