



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

JUN 13 1995

CDR-50-390/85-61
CDR-50-391/85-57

10 CFR 50.55(e)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - UNITS 1 AND 2 - CATEGORY I AND I(L)
INSTRUMENT BOLTING REQUIREMENTS - CDR 50-390/85-61, CDR 50-391/85-57 -
REVISION TO FINAL REPORT

The subject deficiency was initially reported to NRC on November 12, 1985, in accordance with 10 CFR 50.55(e) as NCR WBN 6397. NCR WBN 6449 was later added to address the deficiency for Unit 2 instruments. TVA's final report was submitted April 29, 1986.

Enclosure 1 is TVA's revision to the previously stated approach to inspect and rework, as necessary, all instruments in the Seismic Category I structures to new mounting requirements. Alternatively, the seismic adequacy of panel-mounted and locally-mounted instruments is being established through implementation of the Equipment Seismic Qualification (ESQ) Corrective Action Program (CAP) Plan. The ESQ CAP Plan was submitted for NRC staff review on June 29 and July 27, 1989. It was approved for implementation by NRC Safety Evaluation dated September 11, 1989.

The technical basis for this corrective action revision is contained in Enclosure 2, which was discussed with the NRC Region II ESQ CAP implementation review team (inspection 390/95-30) on May 25, 1995.

Recently, TVA received a violation related to this area, 50-390, 391/94-72-01, Example 4, concerning Foxboro pressure transmitter mounting bolt installation. Our response to this violation referenced

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the corrective action commitment for CDRs 50-390/85-61 and 50-391/85-57 as assurance that other transmitter mounting issues would be addressed and properly corrected through the implementation of the ESQ CAP. This corrective action revision supports that conclusion.

If there are any questions, please contact P. L. Pace at (615) 365-1824.

Sincerely,



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Enclosures

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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
CATEGORY I AND I(L) INSTRUMENT BOLTING REQUIREMENTS
CDR 50-390/85-61 AND CDR 50-391/85-57
NCRs WBN 6397 AND 6449
10 CFR 50.55(E)
REVISED FINAL REPORT

Description of Deficiency and Original Corrective Action

As described in the original final report for CDRs 50-390/85-61 and 50-391/85-67, dated April 29, 1986, several component cooling level transmitters and flow instruments were observed as having mounting configurations which differed from the vendor specified recommendations.

As corrective action for this Unit 1 and 2 deficiency, TVA committed that all instruments in Seismic Category I structures be inspected and reworked as necessary to meet the new mounting requirements provided on TVA installation drawing 47W600-0-4.

Additionally, to prevent recurrence, bolting specifications for seismic attachments were to be incorporated into WBN Quality Control Procedure (QCP) 3.06-7, "Inspection of Electrical and Instrumentation Equipment Installation."

Revised Corrective Action

Resolution of the CDR 50-390/85-61 issues was assigned to the WBN ESQ CAP. These were specifically identified in the ESQ CAP Plan (i.e., the basic approach for resolution of issues).

The WBN ESQ CAP included detailed walkdowns for known issues and area walkthroughs for identification of potentially discrepant conditions, in accordance with the approved CAP Plan and procedures. Loose mounting bolts and other potential bolt installation discrepancies important to Seismic Category I qualification of the equipment were identified and Work Requests written to tighten and/or replace the bolts in accordance with approved design output (typically TVA General Engineering Specification G-53 and WBN Engineering Specification N3E-934). (Seismic Category I(L) ESQ activities were performed as part of the Integrated Interaction Program). Additional assurance for correction of remaining loose mounting bolts is being provided by the Modifications Administrative Instructions (MAI)-1.9, "Walkdown Verification for Modifications System/Area Completion Damaged, Loose or Missing Hardware," activities, which are performed before system and area turnovers to WBN Plant Operations.

In accordance with the original final report for CDR 50-390/85-61, instrument mounting notes were modified on drawing 47W600-0-4 (notes 22 through 30). In January 1987, the general notes on 47W600-0-4 were transferred to Specification ER-WBN-EEB-001 (now renamed N3E-934, "Instrument and Instrument Line Installation and Inspection"). Instrument mounting bolt specifications in WBN Quality Control Procedure 3.06-7, "Inspection of Electrical and Instrumentation Equipment Installation," were also replaced by WBN Engineering specification N3E-934 requirements.

Specification N3E-934 defines bolting and torque requirements for instrument mounting in Section 3.9, "Bolting and Torque." As indicated above, N3E-934 (previously ER-WBN-EEB-001) has provided applicable design output since January 1987. The requirements in N3E-934, Section 3.9, provide design output which will prevent recurrence of the instrument mounting bolt condition during current and future modification activities. Adequate bolt tightening for WBN instrument mounting is achieved by applying snug tight requirements in accordance with G-53, unless specific vendor bolt tightening recommendations are specified as design output.

To provide additional instrument bolting clarification and assured recurrence control, N3E-934, Section 3.30, "Plant Operations and Maintenance," was revised (June 1995) to clarify that after equipment is turned over to Plant Operations:

Maintenance activity on instrument/device mounting bolts and associated hardware (e.g., nuts and washers) shall be performed by either:

- a) Maintaining the existing Engineering-approved mounting configuration (as described in Enclosure 2), or
- b) Complying with currently applicable design drawings and vendor manuals as described in N3E-934, Section 3.9.

Additionally, to resolve the remaining issue identified by Violation 50-390, 391/94-72-01, Example 4, an evaluation was performed as documented in Enclosure 2. The following supplementary corrective action was implemented:

Mounting bolts for the Foxboro Seismic Category I pressure and differential transmitters mounted by TVA on local panels using the Foxboro supplied (two bolt) seismic mounting brackets (reference WBN-VTD-F180-010, Tab 16, Page 4) were re-installed. High strength bolts were installed in these Foxboro bracket to panel mountings and torqued (to specific values) as recommended by Foxboro. Existing low strength bolts in these mountings were replaced by high strength bolts.

This revised corrective action has been implemented by the ESQ CAP as described in Enclosure 2.

Enclosure 2

INSTRUMENT MOUNTING BOLTS

(RE: NCO860027003, NCR WBN 6397 SCA, VSR 169, VIOLATION 50-390/94-72)

Background

Mounting bolts (i.e., headed bolts, studs, or machine screws) for instruments mounted on Seismic Category I and I(L) WBN equipment assemblies and systems have typically been designed as bearing (not friction) type connectors. Instrument mounting bolt sizes were usually specified by the equipment vendor based on ASTM A-307 or similar low strength bolt properties. Seismic qualification test specimens utilized mounting bolts similar to those required in the plant.

TVA discouraged the use of high strength bolts for instrument mounting during the equipment procurement and seismic/structural qualification process. As a result, very few high strength instrument mounting bolt arrangements are required (by design output) at WBN. TVA-designed instrument mounting brackets typically required low strength (A-307 or equal) mounting bolts. In some cases "better" (i.e., higher strength) bolts have been substituted for the required low strength bolts by WBN Modifications and Maintenance, as permitted by TVA General Engineering Specification G-53.

Installation of WBN instrument mounting bolts was typically accomplished based on either G-53 requirements or instrument manufacturer/vendor recommendations.

In November 1985, NCR WBN 6397 identified a condition in which seismic Category I and I(L) instrument mounting bolts had not been inspected for bolt tightness or correct materials after installation. Loose mounting bolts were identified on General Electric Bailey Controls Division level transmitter WBN-2-LT-070-0099A-B. Corrective action was defined in NCR WBN 6397 and associated 10 CFR 50.55(e) report WBRD-50-390/85-61. The final WBRD-50-390/85-61 report was the basis for NCO860027003. Vertical Slice Review DR 169 identified the same basic condition in October 1988. The cause was determined to be lack of adequate design output for mounting the instruments.

Resolution of these issues was assigned to the WBN Equipment Seismic Qualification (ESQ) Corrective Action Program (CAP). They were specifically identified in the ESQ CAP Plan (i.e., the basic approach for resolution of issues). NRC reviewed and accepted the ESQ CAP Plan in September 1989. ESQ CAP implementation activities proceeded on that basis and are now in the final completion/closure phase.

In October 1994, NRC identified a related instrument mounting bolt torque issue as Example 4 of Violation 50-390/94-72. Cited examples were Foxboro instruments WBN-1-PDT-003-0122A-A, WBN-1-PT-001-0027A-D, WBN-1-PT-001-0002A-D, WBN-1-PT-001-0002B-E0, and WBN-1-PDT-001-0027B-E. TVA responded to this violation in January 1995. The bolts were torqued to current Foxboro recommendations. Further action was referred to the ESQ CAP (see discussion on Sheets 4 and 5).

Snug Tight Requirement

Since January 1987, bolt torque for WBN instrument mounting has been achieved by applying snug tight requirements in accordance with G-53, unless specific vendor bolt tightening recommendations were specified as design output. Snug tight defines a condition where mating parts are in firm contact with each other and the bolt or nut cannot be loosened by hand. For typical devices, snug tightness is attained by a qualified person using less than full physical effort with a commercial open-end wrench or sprocket type ratchet of proper size. For small threaded fasteners less than about 1/4 inch diameter, commercial type screw or nut drivers (including socket or hex-head keys) may be used as long as the snug tight condition is attained. (Reference TVA Standard Specification CEB-SS-5.10, "Seismic Qualification of Electrical, Mechanical, and I&C Devices").

Test Results and Earthquake Performance Data

Seismic qualification test results and earthquake performance data have consistently shown that mounting bolt torque requirements more restrictive than snug tight, as defined above, are not critical attributes for seismic qualification of safety-related instruments/devices. Low strength bolts tightened to snug tight or similar requirements have performed satisfactorily in both seismic proof tests and actual earthquakes. The basic technical reasons for these results are:

- 1) Historically, most vendors (commercial and nuclear safety-related) have conservatively sized instrument/device mounting bolts and recommended or provided low strength mounting bolts tightened to snug tight, or equal, requirements to ensure reliable commercial installations.
- 2) Conservatively sized low strength bolts tightened to snug tight requirements achieve a long-term residual bolt tensile force which is nearly the same as achieved by higher torque values applied to the same bolts. Higher bolt pre-loads and torques, are not retained in a low strength bolted joint. The tension force typically relaxes to about 1/2 yield stress in the bolt after a period of time (e.g. a year). For A-307 bolts this corresponds to about 10,000 pounds per square inch (psi) on the threaded bolt area.
- 3) Snug tight bearing connections preclude rattling (i.e., high frequency impact forces) and develop the capacity of the mounting bolts.

Seismic test and earthquake experience for floor-mounted equipment mounting bolts also support the conclusion of seismic adequacy using low strength mounting bolts tightened to snug tight requirements.

WBN PRACTICE

As a consequence of the experience described above, most instrument/device mounting installations at WBN now require low strength bolts and snug tight installation. In a few cases, the device vendor has specified special high strength mounting bolts and torque requirements which have been approved by TVA Engineering and provided as design output. When applicable, these special requirements are applied in accordance with G-53 and WBN Engineering Specification N3E-934.

RESOLUTION OF ESQ CAP INSTRUMENT MOUNTING BOLT ISSUES

The WBN ESQ CAP included detailed walkdowns for known issues and area walkthroughs for identification of other potentially discrepant conditions, in accordance with the approved CAP Plan. Those walkdowns and walkthroughs were performed and documented by experienced ESQ engineers in accordance with controlled procedures and instructions. The activities did not include a device mounting bolt torque check. However, loose mounting bolts and other potential bolt installation discrepancies important to seismic qualification of the equipment were identified and Work Requests were written to tighten and/or replace the bolts in accordance with approved design output (typically G-53 and N3E-934).

ESQ CAP walkdown/walkthrough activities with Work Requests identified and corrected loose mounting bolts for seismic Category I and I(L) instruments. (Seismic Category I(L) ESQ activities were performed as part of the Integrated Interaction Program.) Additional assurance of no remaining loose mounting bolts is being provided by the MAI-1.9 "Walkdown Verification For Modifications System/Area Completion Damaged, Loose, Or Missing Hardware" activities, which are performed before system and area turnovers to WBN Plant Operations.

The ESQ CAP corrective action for NCO860027003, NCR WBN 6397 SCA, and VSR 169 will be accomplished upon completion of the ESQ CAP and MAI-1.9 activities described above. NCR WBN 6397 SCA has been closed and rolled into SCR WBN EEB8663SCA. Instrument mounting notes were initially modified on drawing 47W600-0-4 (notes 22 through 30). Then, in January 1987 the general notes on 47W600-0-4 (including notes 22 through 30) were deactivated. At that time the general notes for "Instrument and Instrument Line Installation And Inspection" were transferred to Specification ER-WBN-EEB-001 (now re-named N3E-934). Instrument mounting bolt specifications in WBN Quality Control Procedure 3.06-7 were also replaced by WBN Engineering Specification N3E-934 requirements.

Specification N3E-934 defines bolting and torque requirements for instrument mounting in Section 3.9. As indicated above, N3-934 (previously ER-WBN-EEB-001) has provided applicable design output since January 1987. The requirements N3E-934 Section 3.9 "Bolting and Torque" provide design output which will prevent recurrence of the instrument mounting bolt condition identified by WBRD-50-390/85-61, NCR WBN 6397 SCA, and VSR-167, during current and future Modification activities. Some additional clarification is needed for Maintenance activities as described below.

Before closure of SCR WBN EEB8663SCA, N3E-934 Section 3.30, "Plant Operations and Maintenance" will be revised to clarify that, after equipment is turned over to Plant Operations:

- 1) Maintenance activity on instrument/device mounting bolts and associated hardware (e.g., nuts and washers) shall be performed by either:
 - a) Maintaining the existing Engineering-approved mounting configuration, or
 - b) Complying with currently applicable design drawings and vendor manuals as described in N3E-934 Section 3.9.
- 2) To maintain the existing Engineering-approved configuration, the mounting hardware shall be re-installed as existing prior to the Maintenance activity. If damaged, the mounting bolts/hardware shall be replaced with equivalent bolts/hardware in accordance with G-53. Bolts shall be tightened to snug tight requirements per G-53, unless they are high strength bolts having yield strengths above 40 kips/in² (Reference G-53 Appendix H for bolt head markings). High strength mounting bolts shall be tightened in accordance with the currently applicable design drawings and vendor manuals. If no requirements are specified in the applicable design drawings and vendor manuals, the high strength bolts shall also be tightened snug tight per G-53.

Then, as a final step before closure of SCR WBN EEB8663SCA, the following instrument mounting bolts will be verified to satisfy the clarified N3E-934 section above, regarding bolt materials and tightening.

Mounting bolts for Seismic Category I pressure transmitters and differential pressure transmitters manufactured by the Foxboro Company and mounted by TVA on local panels, using the Foxboro-supplied seismic mounting bracket (reference WBN-VTD-F180-010, Tab 16, Page 4).

High strength bolts will be installed in these Foxboro bracket to panel mountings and torqued to 35 foot pounds, as recommended by Foxboro. Any existing low strength bolts will be replaced with high strength bolts. This action is appropriate because:

- 1) The Foxboro transmitters are heavy (typically more than 40 pounds).
- 2) There are only two 3/8 diameter mounting bolts connecting the Foxboro bracket to the TVA panel.
- 3) High strength bolts are appropriate in order to retain the recommended bolt pre-load and associated friction force in this non-standard bracket to panel joint.

The action is limited to the specific case described above because of the very unusual circumstances of that case. Those circumstances include the fact that Foxboro's recommendations were not clear relative to mounting bolting material and associated torque values when the seismic bracket is mounted to a flat surface (i.e., TVA's panel) rather than a pipe.

This final step will ensure that mounting bolts are properly installed on instruments similar to those identified by Example 4 of Violation 50-390/94-72.

Note that Foxboro recommended torque values were intended for mounting to pipe, an inherently less stable condition than the flat plate mounting installations at Watts Bar. The Foxboro transmitters installed to the current snug-tight requirement develop significant pre-load, as discussed previously. Consequently the as-installed transmitters would be expected to perform well in a seismic event. The installation of high strength bolts with the vendor-recommended torques provides additional assurance of stability.

SCR WBN EEB8663SCA will be complete and closed before closure of the ESQ CAP. NCO 860027003, VSR 169, and Example 4 of Violation 50-390/94-72 will be closed by reference to SCR WBN EEB8663SCA.

The attached table summarizes:

- The existing and proposed processes for maintenance of existing installations.
- The Site Standard Practice (SSP)-2.10 process for the evaluation of new or updated vendor information.

INSTRUMENT MOUNTING BOLTS

| ACTIVITY | CURRENT PROCESS | PROPOSED PROCESS |
|-------------|---|--|
| Maintenance | Review Vendor Manual (VM) and Design Drawings (DD), if any. If DD mounting bolt requirement exists, use VM recommended torques and/or bolts. Alternately, use existing bolts and VM recommended torques, if any, or tighten per N3E-934 Section 3.9. If both DD and VM exist, resolve differences and establish consistency between them. | <ul style="list-style-type: none"> • Identify installations with High Strength bolts per G-53. • <u>High Strength Bolts</u> - Use torque prescribed by VM. If no torque is prescribed by VM, reinstall to snug tight. • <u>Other Bolts</u> - Craft can exercise either of two options, as follows: <ol style="list-style-type: none"> 1) Restore the installation to its previous condition. Apply snug tight requirements. 2) Reassemble in accordance with vendor manuals. Includes consideration of torque, bolt materials, and any other specific details of mounting configuration. |

INSTRUMENT MOUNTING BOLTS

| ACTIVITY | CURRENT PROCESS | PROPOSED PROCESS |
|---|--|-------------------|
| <p>Consideration of New or Updated Vendor Information</p> | <p>New and updated Vendor information is evaluated per SSP-2.10, "Vendor Manual/Information Control." Upon receipt of new vendor information, SSP-2.10 requires an evaluation using the forms contained in Appendix J. This results in the following actions:</p> <ul style="list-style-type: none"> • The Vendor manual program determines if the new or updated requirements are related to equipment qualification, including seismic considerations. If so, the information is sent to Civil Engineering for evaluation of impact on existing installations. • Civil Engineering documents on the Appendix J form either the acceptance or impacts (known or potential) of the new vendor information. • Any unacceptable impacts are defined and resolved. | <p>No change.</p> |