



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERN  
ELEMENT REPORT 223.2, "INSTRUMENT MOUNTING BRACKETS"

1. SUBJECT

Category: Engineering (EN)

Subcategory: (ISD)

Element: Instrument Mounting Brackets

The basis for Element Report 223.2(B), dated May 6, 1987 is Employee Concern IN-85-973-002 which states:

"Typical instrument mounting brackets consisting of thin gauge, perforated sheetmetal (or similar material) are not strong enough to support the instruments (generic for typical mounts). Constant bumping into, leaning against, and sitting on these brackets or instruments causes damage to both brackets and instruments. CI could not provide specific instrument numbers, locations, etc., but stated all such installations should be subject to re-design. This was reported to manager (known) but no action was taken."

This concern was evaluated by TVA as potentially nuclear safety-related and potentially applicable to Sequoyah (generic).

II. SUMMARY OF ISSUES

Four issues were identified by TVA; the first three are evaluated in this report and the last is addressed in element report 706.1.

1. Instrument mounting brackets are not strong enough to support instruments.
2. In heavy traffic areas, the brackets are susceptible to abusive treatment which causes damage to brackets and instruments.
3. All such installations should be redesigned.
4. This deficiency was reported to the manager, but no action was taken.

III. EVALUATION

Sequoyah's design criteria in FSAR 3.10 and SQN-DC-V-10.3 and 10.4 states that Category I instrumentation shall be designed and installed so that

normally imposed loads plus loads imposed by the design basis earthquake will not cause failure or functional degradation of the instruments or the control systems. The majority of the instruments at Sequoyah are found on floor-mounted panels, although wall-mounted panels are also used.

Typically these panels are a combination of Unistrut-type metal brackets, angles, and clips with metal plates for attaching the instruments. The panel is normally welded and instruments and instrument lines are attached by bolting. The panels are bolted to the floor or the wall, although welds are sometimes used in place of bolts. Most of the Unistrut-type material is steel ranging in thickness from 3/32 in. to 1/8 in. Brackets and plates 1/4 in. thick have also been used.

TVA identified the brackets and design details relevant to the employee concern. A sample calculation was made of the 1/8 in. thick bracket that supports Foxboro pressure transmitter No. E11GM. The results of the evaluation confirmed the support was adequate for design loads. TVA admits that instruments and brackets are not immune to abuse and it is plausible that sitting or leaning on the components or bumping into them may cause damage. As an example, there was damage to two instruments at Watts Bar Nuclear Plant in September 1985. TVA subsequently made a decision to double the thickness of the brackets to 1/4 in.

TVA reviewed construction and engineering nonconformance reports and SCRs and interviewed the cognizant engineers, but did not identify any instance of reported damage to Category I instrument support brackets. TVA admitted that mistreatment could cause damage of the components and stated that this issue is an important plant maintenance issue, but it is not a design issue.

In a related issue involving installation details of locally-mounted instruments, TVA committed to performing field walkdowns of all instrument panel frames supporting category I instruments. If the walkdown discloses damaged brackets, they will be strengthened or protected. Damaged instruments will be repaired or replaced.

In a separate decision, TVA DNE committed to compiling a list of safety-related instruments mounted on light-gage brackets similar to those identified in the employee concern. DNE will identify locations of the instruments and consider their susceptibility in view of the general traffic pattern. TVA will perform a walkdown and identify any discrepancies. TVA will initiate corrective action for each deficiency and, where necessary, develop stronger mounting details for replacing the instrument brackets.

#### IV. CONCLUSIONS

The NRC staff believes that the TVA investigation of the concern was adequate and their resolution of the concern as described in element report 223.2(B) is acceptable. At Sequoyah, a sample calculation showed that the brackets were adequate for their design loads and no damaged

brackets were identified. TVA identified mistreatment of components as an important plant maintenance issue. They committed to performing field walkdowns of all instrument panel frames supporting Category I instruments as well as safety-related instruments mounted on light-gage brackets that are located in the general traffic pattern. The NRC will be monitoring the adequacy of the implementation of the proposed corrective action through the use of inspections and audits.

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SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 223.3-SQN  
"INSTRUMENT SUPPORT DESIGN, LOCAL INSTRUMENT SEISMIC QUALIFICATION"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Instrument Support Design, Local Instrument Seismic Qualification

Concerns: IN-85-886-N04

The basis for Element Report 223.3-SQN, Rev. 2, dated June 3, 1987, is a previous NRC concern related to IN-85-886-001 which arose from review of QTC files that questioned the seismic qualification of local instruments and their supports being installed using "good engineering judgment" and without performing seismic analysis.

This concern was evaluated by TVA as potentially nuclear safety-related for Sequoyah (generic).

II. Summary of Issues

The stated concerns as defined by TVA are: (a) local instruments were installed based on "good engineering judgment;" (b) no seismic analysis was done for different types of installation of local instruments; and (c) no seismic analysis was done for local instruments.

### III. Evaluation

TVA personnel and consultants conducted a review of the seismic qualification documentation and a walkdown of the as-built conditions of three local instruments, i.e., a force balance pressure transmitter, a pressure transmitter, and a temperature switch. Their investigations concluded that issue (a) was valid, that issue (b) was valid for field-mounted but not for panel- and rack-mounted instruments because panels and racks were normally qualified by seismic analysis and/or testing, and that issue (c) was not valid because local instruments were normally qualified by tests in lieu of analysis. The NRC staff reviewed TVA's investigations by performing a walkdown of the plant and auditing the seismic qualification documentation for the three local instruments previously reviewed by TVA, and concurred with TVA's findings. During their walkdown the NRC staff found that the identification tag on the temperature switch was missing. TVA confirmed that such concern with the missing identification tag would be addressed in Element Report 301.15. To resolve the concerns in issues (a) and (b), TVA developed a corrective action plan (CAP) which included three pre-restart and one post-restart items. The pre-restart CAP covered the FSAR Chapter 15 events instruments in SQN Unit 2, and the post-restart CAP was for the remaining (i.e., non-FSAR Chapter 15 events) safety-related instruments in Unit 2 and for all safety-related instruments in Unit 1. The pre-restart CAP was to (1) compile a list of all safety related instruments required for FSAR Chapter 15 events at SQN Unit 2, (2) perform a drawing search and field inspection for each instrument identified in item (1), and (3) perform a seismic qualification documentation search for each instrument identified in item (1). For the post-restart CAP, TVA will perform the document search and field inspection for the remaining safety

related instruments at Unit 2 and all safety related instruments at Unit 1. The NRC staff found the scope of the CAP to be adequate, but could not assess the adequacy of TVA's implementation of the pre-restart CAP because the implementation is not yet completed.

#### IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concern and the CAP developed by TVA to address the concern. The NRC staff believes that the TVA investigation of the concern was adequate, and their resolution of the concern as described in Element Report 223.3-SQN, Rev. 2, is acceptable provided the implementation of the pre-restart CAP is adequately completed.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 224.5-SQN  
"RACEWAY SUPPORT DESIGN, SUPPORT OF CABLES"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Raceway Support Design, Support of Cables

Concerns: MAS-86-005

The basis for Element Report 224.5-SQN, Rev. 0, dated November 20, 1987, is Sequoyah Employee Concern MAS-86-005 which questioned the seismic capability of the non-supported Flamastic-covered cables in the spreading room that penetrate the walls and ceiling.

This concern was evaluated by TVA as potentially nuclear safety-related for Sequoyah.

II. Summary of Issues

The stated concern as defined by TVA is that the non-laterally supported Flamastic-covered cables in the cable spreading room which penetrate the walls and ceilings may not be seismically safe.

### III. Evaluation

TVA personnel conducted a seismic shake table test program to assess the seismic integrity of representative vertical cable bundles. The objective of the testing was to demonstrate that the as-built condition would be acceptable without field modifications. Representative cable loadings and input motions were used during the test program to assess the ability of the cables to perform their intended functions. In addition, walkdowns of the existing condition in the field were performed to verify that the boundary conditions in the field were sufficiently represented by those in the testing, and to investigate other possible aspects related to the employee concern. TVA concluded that the vertical Flamastic-covered cables in the cable spreading room which penetrate walls and ceilings are seismically adequate and that no corrective action is required. To evaluate the validity of TVA's conclusion, the NRC staff performed a walkdown of the cable spreading room and reviewed all pertinent documents including the seismic test report for the vertical cables. The NRC staff found that the seismic test results were acceptable and that the boundary conditions in the field were adequately simulated in the testing. In addition, based on the walkdown, the NRC staff verified TVA's investigation regarding the existence of adequate structural elements at the ceiling penetrations of the cable spreading room that support the vertical cable drops. The NRC staff therefore concurred with TVA's conclusion regarding the seismic adequacy of the vertical Flamastic-covered cable drops in the spreading room.



#### IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concern. The NRC staff believes that the TVA investigation was adequate, and that their conclusion regarding the concern as described in Element Report 224.5-3QN, Rev. 0, is acceptable.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 225.0-SQN  
"BATTERY SUPPORT DESIGN"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Battery Support Design

Concerns: XX-85-122-017

The basis for Element Report 225.0-SQN, Rev. 0, dated April 6, 1987, is Sequoyah Employee Concern XX-85-122-017 which questioned the acceptability of not having tie downs for both Class 1E and non-Class 1E batteries and the acceptability of using Unistrut supports for the batteries.

This concern was evaluated by TVA as potentially nuclear safety related and potentially applicable to Sequoyah (generic).

II. Summary of Issues

The stated concerns as defined by TVA are: (a) Class 1E and non-Class 1E batteries are unacceptably supported since they have no tie downs; and (b) Unistrut supports are unacceptably used.

### III. Evaluation

TVA stated that for non-Class 1E services it was not necessary, from a safety or economic viewpoint, to apply the same seismic design requirements as those for Class 1E services. Thus TVA concluded that non-Class 1E batteries need not have vertical tie downs to accommodate seismic events and that the strut used in their racks is acceptable. The NRC staff concurred with TVA's conclusion that non-Class 1E batteries need not be subjected to the seismic design requirements for Class 1E services and hence the existing design and installation is acceptable.

The Class 1E batteries include the Gould 125V vital battery system (Batteries I to V), which is located in the auxiliary building at Elev. 749', and the C&D 125V diesel generator battery system, which is located in the diesel generator building at Elev. 722' (at grade). Only the C&D battery system was installed with the batteries positively tied down to the racks. The side rails of the racks are Unistrut members. The top side rails are above the center of gravity of the batteries, thus preventing the battery from possibly tipping over during seismic events. The batteries and racks were seismically qualified by testing. In addition, the racks were seismically qualified by analysis. To investigate the employee concern with the Class 1E vital batteries and racks, TVA personnel and consultants first inspected all Unistrut fasteners on the Gould vital batteries I to IV for proper installation. Several bolting installations of Unistrut fasteners in each of the four battery rooms were identified as not meeting design requirements. By means of analysis, however, TVA concluded that the identified deficiencies in the as-built bolting installations of Unistrut fasteners would not affect the structural integrity of the racks

for vital batteries I to IV during seismic events. TVA personnel then inspected the Uni strut fasteners on all vital battery racks for proper bolt torque, and retorques all bolts not meeting the prescribed torque value. Finally, TVA consultants performed a walkdown of the vital battery rooms I, II and V in the auxiliary building, and battery rooms 1A-A and 2A-A in the diesel generator building, to make a general comparison of the as-built battery installation with the installation drawings and seismic qualifications. They identified one discrepancy. That is, while the racks were bolted to the shake table in the seismic qualification testing of all SQN vital batteries, the racks in vital battery rooms I and II were welded to the base embedded plate. However, TVA consultants confirmed the adequacy of such discrepancy in the installation of the base anchor for the racks in vital battery rooms I and II. Based upon the investigations described above, TVA concluded that the Class 1E batteries were acceptably supported with and without the use of vertical tie downs, as evidenced by the seismic qualification testing, and that the vital battery racks were adequately qualified by testing and analysis. Thus, TVA concluded that both issues in the employee concern were not valid and that no additional corrective actions were required.

To evaluate TVA's investigations for the employee concern with the Class 1E batteries and racks, the NRC staff audited (1) battery rack drawings, (2) seismic qualification test reports for all vital batteries, including the test methodology, input motion, mounting of batteries and racks, and required floor response spectrum, (3) TVA calculations which verified the acceptance of the several deficient bolting installations of Uni strut fasteners identified for the racks in vital battery rooms I to IV, and (4) the TVA evaluations that confirmed the adequacy of the welded base

anchor of the racks in vital battery rooms I and II. Based on their evaluations, the NRC staff found TVA's investigations for the Class 1E batteries to be thorough and adequate. The NRC staff therefore concurred with TVA's finding that the employee concern was not valid and hence no further pre-restart actions were required.

#### IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concern. The NRC staff believes that TVA's investigation was adequate, and that their conclusion regarding the concern as described in Element Report 225.0-SQN, Rev. 0, is acceptable.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 226.0-SQN  
"SEISMIC INTERACTION DESIGN, DESIGN OF LIGHTING FIXTURE SUPPORTS"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Seismic Interaction Design, Design of Lighting Fixture Supports

Concerns: WI-85-100-023

The basis for Element Report 226.0-SQN, Rev. 2, dated January 9, 1987, is Watts Bar Employee Concern WI-85-100-023 regarding lighting fixtures not being properly restrained and caged to prevent them from becoming free or swinging missiles during seismic events.

This concern was evaluated by TVA as potentially nuclear safety-related and potentially applicable to Sequoyah (generic).

II. Summary of Issues

The stated concern as defined by TVA is that the lighting fixtures are not properly designed to prevent them from becoming free or swinging missiles which might damage, through seismic interactions, nearby Category I equipment during a seismic event.

### III. Evaluation

Investigations by TVA personnel and consultants concluded that supports for lighting fixtures were adequately designed to prevent them from becoming free missiles but the issue of lights becoming swinging missiles was valid. The NRC staff performed a walkdown of the plant and audited a number of SQN documents including design criteria, drawings, and justifications of seismic interaction, in particular, seismic interaction with small instrument tubings. Based on their evaluations, the NRC staff concurred with TVA's finding that the issue of lighting fixtures becoming free missiles was not valid and the issue of lighting fixtures becoming potential swinging missiles was valid. In addition, the NRC staff performed a second walkdown of the plant to re-evaluate five worst possible cases of potential seismic interaction of lighting fixtures with small instrument tubings, and found TVA's investigation of the seismic interaction for small instrument tubing to be adequate. To resolve the issue of lighting fixtures becoming potential swinging missiles, TVA developed a corrective action plan (CAP) consisting of two pre-restart and one post-restart actions. For the pre-restart CAP, the first action was to provide (a) a complete program to describe and control the seismic interaction evaluation for current and future design activities, (b) a technical basis for the internal TVA memo specifying the seismic interaction inspection criteria, and (c) a re-review for adequacy of the written technical justification of the existing revision to calculation CEB-CAS-214. The second pre-restart CAP action was to provide a walkdown and evaluation of the safety related areas which were excluded from TVA's investigations prior to the development of the CAP. The post-restart CAP requires a 100% walkdown of

lighting fixtures to resolve deficient conditions and to eliminate discrepancies between design drawings and criteria. TVA's justification for this post-restart action as a non-restart item was provided in CAQR SQP-871519, Rev. 0, which states that the possible loss of on-site power emergency lighting system will not affect the plant operability because ECN's L6287 and L5984 added Category I 8-hour emergency light packs in areas that must be manned for safe shutdown and, in addition, portable lanterns have been supplied to the operations staff as part of the compliance to Section III.J of 10CFR50 Appendix R. The NRC staff found the scope of the CAP and the non-restart justification for the post-restart action to be acceptable. The implementation of the pre-restart CAP items were completed, but the adequacy of the implementation has yet to be reviewed by the NRC staff.

#### IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concern and the CAP developed by TVA to address the concern. The NRC staff believes that the TVA investigation of the concern was adequate and their resolution of the concern with lighting fixtures at SQN becoming potential swinging missiles, as described in Element Report 22600, Rev. 3, is acceptable provided the implementation of pre-restart CAP is adequate.



SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 228.0-SQN  
"UNISTRUT SUPPORT DESIGN"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Unistrut Support Design

Concerns: XX-85-122-033

The basis for Element Report 228.0-SQN, Rev. 2, dated January 26, 1987, is Sequoyah Employee Concern XX-85-122-033 which questioned the acceptability of using Unistrut material as seismic Category I supports for instruments, pipes, conduits, control stations and panels, lighting, etc. such that the supported items will not fall or become missiles to damage other safety-related equipment.

This concern was evaluated by TVA as potentially nuclear safety-related for Sequoyah (generic).

II. Summary of Issues

The stated concerns as defined by TVA are: (a) Unistrut is unacceptable for use as seismic Category I supports for instruments, pipes, conduits, control stations, panels, lighting, etc.; and (b) items so supported by Unistrut may become missiles and endanger other safety-related equipment if the support falls.

### III. Evaluation

To address the Employee Concern XX-85-122-033, TVA initially completed a sampling program for bolt tightening of Unistrut clamps and performed the necessary evaluations. They then issued a new torque requirement for Unistrut clamp bolts and committed to a long term bolt tightening program. As a result of their investigation, TVA concluded that Unistrut materials are acceptable for use in supporting seismic Category I conduits, tubing, pipe, etc.; however, two design deficiencies were found: (1) inconsistency in slip-through capacity of Unistrut P2558 series of clamp, size 2" to 4", between TVA Singleton Laboratory and Unistrut Corp. test results, and (2) unsubstantiated design of a double cantilevered conduit hanger in which the Unistrut P1000 member may be overstressed due to torsion. To resolve the design deficiencies, TVA developed a corrective action plan (CAP) consisting of both pre-restart and post-restart actions. To implement the pre-restart corrective actions, TVA (1) re-tested the slip-through capacity of the Unistrut P2558-20 to 40 clamps, in which the new results were consistent with the Unistrut Corp. test results, (2) revised the corresponding slip-through allowables specified in TVA's Pipe Support Design Manual (PSDM), and (3) verified the adequacy of the affected existing in-place supports on the basis of a "fit for service" criteria. Through extensive walkdowns, TVA also verified that the double cantilevered hanger in question has not been installed in the plant.

For the post-restart CAP, TVA will confirm the adequacy of the Unistrut P-2558 series of clamps in the existing designs and installed conduit supports based on the revised PSDM requirements, and provide fixes as needed.

The NRC staff performed a walkdown of the plant and audited TVA's previous investigations of the employee concern as well as samples of TVA's implementation of the pre-restart CAP. The results of TVA's re-test of the slip-through capacity of the Unistrut P2558-20 to 40 clamps were found acceptable and TVA's verification that no double cantilevered conduit hanger has been installed in the plant was found reasonable. The NRC staff therefore concluded that TVA's investigations of the concern and implementation of the pre-restart CAP were adequate. The NRC staff also found the scope of the post-restart CAP sufficient.

#### IV. Conclusions

The use of Unistrut materials for seismic Category I supports, with proper design and installation, has been acceptable to the NRC staff in other licensed plants. The NRC staff reviewed TVA's investigations and implementation of corrective actions, and believes they are adequate as pre-restart resolution of the concern described in Element Report 228.0-SQN, Rev. 2. The NRC staff also found the scope of the post-restart CAP acceptable.