

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 229.12(B)

REPORT TYPE: SEQUOYAH ELEMENT

REVISION NUMBER: 0

TITLE: INSTRUMENTATION AND CONTROL DESIGN  
Panel To Equipment Distances

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REASON FOR REVISION:

PREPARATION

PREPARED BY:

Werner M. Blumner (M. Dams)  
SIGNATURE

1/5/87  
DATE

REVIEWS

DEER REVIEW COMMITTEE:

J. B. Violante Karl S. Fredrick H. Parkinson  
SIGNATURE

1-5-86  
DATE

TAS:

SIGNATURE

DATE

CONCURRENCES

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PDR ADDCK 05000327  
P PDR

Paul B. Asstitt 1/6/87  
CEG-H: George R. Mcnulty 1-6-87

SRP:

SIGNATURE

DATE

SIGNATURE

DATE

APPROVED BY:

ECSP MANAGER

DATE

MANAGER OF NUCLEAR POWER  
CONCURRENCE (FINAL REPORT ONLY)

DATE

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1. CHARACTERIZATION OF ISSUES:

Concern:

IN-85-068-N06

"NRC identified the following concern from review of QTC file, 'A lot of instrument panels are located far away from the equipment they control.'"

Issues:

- a. Distances between control panels and controlled equipment are too long.
- b. Distances between instrument racks/panels and sensors are too long.
- c. Possible noncompliance with FSAR commitments or NRC regulations.

The following issues related to this concern are addressed in other reports:

Human factors engineering of main and auxiliary control room (addressed in SQN Element Report 208.1).

480V power receptacles unsafe (addressed in SQN Element Report 235.1).

Hand switch location for maintenance (addressed in WBN Element Report 235.3).

2. HAVE ISSUES BEEN IDENTIFIED IN ANOTHER SYSTEMATIC ANALYSIS? YES NO X

Identified by Not applicable

Date Not applicable

3. DOCUMENT NOS., TAG NOS., LOCATIONS OR OTHER SPECIFIC DESCRIPTIVE IDENTIFICATIONS STATED IN ELEMENT:

No specific locations or identification were given in the concern.

4. INTERVIEW FILES REVIEWED:

The working and expurgated ECTG files did not contain any information on this concern other than the K-form.

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5. DOCUMENTS REVIEWED RELATED TO THE ELEMENT:

See Appendix A.

6. WHAT REGULATIONS, LICENSING COMMITMENTS, DESIGN REQUIREMENTS OR OTHER  
APPLY OR CONTROL IN THIS AREA?

See Appendix A.

7. LIST REQUESTS FOR INFORMATION, MEETINGS, TELEPHONE CALLS, AND OTHER  
DISCUSSIONS RELATED TO ELEMENT.

See Appendix A.

8. EVALUATION PROCESS:

- a. Clarified terminology of the concern.
- b. Investigated possible disadvantages of remote controls and the mitigating features.
- c. Surveyed SQN FSAR, NRC regulatory guides, TVA design criteria, and industry standards for limitations on distance of controls from equipment.

9. DISCUSSION, FINDINGS, AND CONCLUSIONS:

Chronology:

08/08/86: Concern received by TVA.

Discussion:

a. Background:

This concern was originally raised on WBN and is considered applicable to SQN because of the basic similarity of the two plants and the general nature of the concern. NRC identified the concern from review of QTC files. The specific QTC files relating to this concern could not be identified.



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TVA Design Guide (App. A, 5.j) terminology distinguishes between "control panel" and "instrument rack" or "instrument panel," the latter being wall mounted. The NRC's use of the phrase "from the equipment they control," leads the evaluator primarily to the issue of "control panels" being too remote from the controlled equipment. However, the notion of remote "instrument racks" or "instrument panels" resulting in long sensing lines is also entertained as a presumed secondary issue.

b. Control Panels:

Centralized control of large plants with complex system interactions is a well established practice. Localized control is usually restricted to testing and maintenance functions (e.g., setting of limit switches, breakers for power disconnect, etc.). Travel time of electrical control signals is irrelevant for all hydraulic and thermodynamic processes and mechanical equipment encountered. Process and equipment response times are several orders of magnitude longer.

Indicating instrumentation in the centralized control room makes visual observation of the controlled equipment unnecessary. Many process parameters are only detectable by sensors and would not be apparent to observation of the equipment.

Visual observation is required in some instances (physical positioning). Where this is necessary but access is restricted, closed circuit television (CCTV) or mirrors may be employed (e.g., radwaste and irradiated fuel handling, containment survey). These are exceptions to the usual controls in nuclear power plants.

c. Instrument Racks/Panels:

Instrument racks/panels containing transmitters are usually located as close as possible to the process being sensed. Proper installation of liquid-filled instrument sensing (impulse) lines avoids the inclusion of compressible fluids. The subcooled medium propagates the pressure signal at response times that are orders of magnitude shorter than the time it takes process variables to change.

For remote, liquid displacement type level instrumentation, the response time and sensing line length are considered in the design.

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Earlier problems reported by Nuclear Plant Operating Experience Inc. (App. A, 5.e), such as freezing of, or air and dirt in sensing lines at SQN, have been corrected and were not due to sensing line lengths as such.

d. Regulatory and TVA Requirements:

The type of controls required in the main and auxiliary control room for safe plant operation is described in FSAR Section 7.0 (App. A, 5.a). Human Factor Engineering (HFE) practices per TVA Design Guides (App. A, 5.k, l, and m) and NRC Reports (App. A, 5.q and r) have been applied to ensure operability. Verification of HFE compliance is confirmed by ECSP Report 208.1 (App. A, 5.p).

NRC General Design Criterion 21 (App. A, 5.d) requires protective system designs which allow periodic testing. NRC Regulatory Guide 1.22 (App. A, 5.f) and IEEE Standard 338-1977 (App. A, 5.i) require these tests to include the control system response times. These tests have been performed, and any response time deficiencies have been corrected. No TVA design criteria, NRC regulatory guides, notices, bulletins, or industry standards could be identified that limit the distance of controls or instruments from associated equipment or sensors. The Nuclear Plant Operating Experience Inc. reports (App. A, 5.e) were reviewed for response time problems and none were found that related to line length.

Findings:

- a. TVA's instrument and control configuration is consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or safe, efficient operation of equipment because of remoteness could be established.
- b. No adverse effects on response time with properly installed long liquid-sensing (impulse) lines could be established.

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- c. No NRC, TVA, or industry regulation or standard could be found which limits the distance between equipment and control panels/instrument racks numerically. NRC requires periodic testing of controls and instrumentation, including response time, of protective systems. These tests have been performed and any deficiencies corrected.

Conclusion:

The concern is not valid for either electrical control panels or for instrument racks with liquid containing transmitters. No NRC or TVA regulation exists restricting the distance between controls or instruments and the equipment/process they control or sense.

Physical observation of the equipment or process is not necessary for safe and efficient operation. No problems related to this concern have been reported.

10 CORRECTIVE ACTION

No corrective action is required.



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APPENDIX A

5. DOCUMENTS REVIEWED RELATED TO THE ELEMENT:

- a. SNP FSAR Section 7.0, Instrumentation and Controls, (04/14/83), through Amendment 3, (04/86)
- b. Instrument Society of America (ISA) Standards and Practices for Instrumentation, 8th edition, 1986
- c. NRC Regulatory Guide 1.151, "Instrument Sensing Lines," (July 1983)
- d. 10CFR50, Appendix A, "General Design Criteria for Nuclear Power Plants," (02/10/71)
- e. Nuclear Power Plant Experience Inc. Reports, published by The S. M. Stoller Corporation, up to October 1986 for SQN-01
- f. NRC Regulatory Guide 1.22, "Periodic Testing of Protection Systems Actuation Functions," (02/17/72)
- g. TVA ECSP, Element Report SQN 235.1(B), Preliminary, "Electrical Safety, 480 V Power Receptacles Unsafe," (11/24/86)
- h. TVA ECSP, Element Report WBN 235.3, "Electrical Safety, Handswitch Location Violates Regulatory Requirements," (05/20/86)
- i. Institute of Electrical and Electronics Engineers (IEEE) Std 338-1977, "Standard Criteria for the Periodic Testing of Nuclear Generating Station Safety Systems"
- j. TVA Electrical Design Guide DG-E1.1.3, "Clearance Around Electrical and Instrumentation and Control Equipment," (03/29/84)
- k. TVA Electrical Design Guide DG-E18.1.12, "Human Factors Engineering in Control Console, Cabinet, and Panel Layout," (04/30/82)
- l. TVA Electrical Design Guide DG-E18.1.13, "Human Factors Engineering in Alarm Systems," (07/16/82)
- m. TVA Electrical Design Guide DG-E18.1.14, "Human Factors Engineering in Controls and Visual Displays," (04/30/82)

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APPENDIX A (cont'd)

- n. TVA ECSP, Element Report SQN 225.1(B), "480 V Power Receptacles Unsafe"
- o. TVA ECSP, Element Report WBN 235.3, "Hand Switch Location for Maintenance"
- p. TVA ECSP, Element Report SQN 208.1(B), "Human Factors Review Program NUREG-0700"
- q. NRC Report NUREG 0700, "Guidelines for Control Room Design Review," (08/81)
- r. NRC Report NUREG 0737, "Clarification of TMI Action Plan Requirements" (11/80) and Supplement, (01/83)

6. WHAT REGULATIONS, LICENSING COMMITMENTS, DESIGN REQUIREMENTS OR OTHER APPLY OR CONTROL IN THIS AREA?

- a. NRC Regulatory Guide 1.22
- b. IEEE Standard 338-1977

7. LIST REQUESTS FOR INFORMATION, MEETINGS, TELEPHONE CALLS, AND OTHER DISCUSSIONS RELATED TO ELEMENT.

- a. Telephone call from P. Nesbitt, TVA, to L. Damon, Bechtel, IOM #287, (09/23/86)
- b. Telephone call from P. Nesbitt, TVA, to W. Blumer, Bechtel, IOM #501, (12/31/86)