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 SCHWENCER, A. Licensing Branch 2

SUBJECT: Forwards response to NRC concerns in SSER Section 3.10.1.1  
 during SQRT audit regarding frequency tests. Approaches  
 stated in GE Rept NDE-24788 utilized.

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## Washington Public Power Supply System

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Docket No. 50-397

October 25, 1983  
602-83-966

Director of Nuclear Reactor Regulation  
Attention: Mr. A. Schwencer, Chief  
Licensing Branch No. 2  
Division of Licensing  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2  
SQRT AUDIT CONCERN, SINGLE FREQUENCY TESTS


References: a) SSER  
b) Letter, G. C. Sorensen to A. Schwencer, "Equipment  
Seismic Qualification Interim Report", dated  
September 19, 1983

During the NRC Seismic Qualification Review Team (SQRT) audit, the reviewers made observations which resulted in a specific concern expressed in Section 3.10.1.1 in the referenced SSER.

This specific concern is addressed in Attachment 1.

If we can assist you in your review of this matter, please feel free to call on our staff.

Very truly yours,

  
G. C. Sorensen, Acting Manager  
Nuclear Safety and Regulatory Programs

KRW/sms  
Attachment

cc: R Auluck, NRC  
WS Chin, BPA  
J Hayes, GE  
J Singh, EG&G Idaho  
A Toth, NRC Site

*Boo!*  
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## Attachment 1

### NRC CONCERN:

"The motor control center was qualified through single frequency, biaxial input tests. The motor control center has more than one natural frequency below 33 Hz. This technique, in the absence of adequate justification, is not acceptable. The applicant is to review the cases in which single frequency tests have been used in spite of the presence of multiple natural frequencies of the system within the range of 33 Hz. In each case, the applicant is to provide a justification for single frequency testing."

### RESPONSE:

WNP-2's effort to qualify all safety-related electrical equipment is based on IEEE 344-1975, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations". In this standard for testing and analysis, single frequency testing is acceptable when the seismic ground motion has been filtered due to one predominant structural mode. This is again stated in the NRC Standard Review Plan, Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment".

When the tested unit is a composite such as switchgear and motor control centers or other component which has multiple modes below the acceptable zero period acceleration (ZPA), the testing can be justified by combining the required responses of the various equipment modes. NRC Standard Review Plan Section 3.7.2, "Seismic System Analysis" states that when a response spectrum analysis is used to determine the dynamic response of damped linear systems, the most probable response is obtained by the square root of the sum of the squares of the responses from individual modes. When equipment with closely spaced modal frequencies exist (within 10% of each other), the responses are to be absolutely summed. Large composite structures and any equipment with natural frequencies within a seismic frequency range can be considered a damped linear system; thus, this approach can be applied to electrical equipment.

To justify the use of single frequency testing of WNP-2 1E Balance of Plant (BOP) equipment, an evaluation was performed in accordance with the guidelines provided in Standard Review Plans 3.10 and 3.7.2.

A thorough review of all BOP 1E equipment identified four large composite structures for which single frequency testing was used in conjunction with identified multiple modes below the ZPA. The testing performed was of two types, sine beat and sine dwell tests. The natural frequencies of the equipment were first determined through low level sine sweep testing. This was followed by OBE and SSS level testing at the natural frequencies determined by the low level sine sweep test.



The four composite (BOP) structures affected by single frequency testing are:

1. International Switchboard Motor Control Center.
2. ITE Imperial Motor Control Center.
3. Westinghouse 480-volt switchgear.
4. Westinghouse 4.16KV switchgear.

Table I below summarizes the evaluation results. The combined required responses address cross coupling effects by assuming all modes are in the same direction. Additional modal combinations were performed as outlined above.

TABLE I

<u>Composite</u>	<u>Combined Required Response</u>	<u>Tested Response</u>	<u>Margin</u>
(1)	6.3g	7.76g	23%
(2)	4.9g	9.5g	94%
(3)	2.1g	5.4g	157%
(4)	3.8g	4.4g	15%

In conclusion, the single frequency testing performed on the large composite (BOP) structures with multimodal response and potential cross-coupling demonstrates adequate margin for qualification.

The methods used to qualify equipment for the NSSS structures tested to single frequency are discussed in General Electric Report, NDE-24788 (Seismic Qualification Review Team (SQRT) Technical Approach for Re-evaluation of BWR 4/5 Equipment). The approaches described in this report are as conservative and in some respects more conservative than those described above for BOP equipment. Therefore, equipment qualified using these approaches in conjunction with single frequency testing will demonstrate adequate margins to safety.

