PRELIMINARY

EGG-EA-5643, Rev. 1

June 1982

WATERFORD III SQRT VISIT REPORT

J. N. Singh
R. W. Macek
M. J. Russell

Prepared for the
U. S. Nuclear Regulatory Commission
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6415

PRELIMINARY

EG&G Idaho, Inc.

FORM EG&G-398
(Rev. 11-79)

PRELIMINARY

INTERIM REPORT

Accession No. _____

Report No. EGG-EA-5643, Rev. 1

Contract Program or Project Title:

WATERFORD III SQRT VISIT REPORT

Subject of this Document:

Trip Report on SQRT Visit to the Waterford Nuclear Power Plant

Type of Document:

Informal Report

Author(s): J. N. Singh
R. W. Macek
M. J. Russell

Date of Document: June 1982

Responsible NRC Individual and NRC Office or Division:

T. Y. Chang

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C.
Under DOE Contract No. DE-AC07-76ID01570
NRC FIN No. A6415

INTERIM REPORT

PRELIMINARY

PRELIMINARY

EGG-EA-5643, Rev. 1

WATERFORD III

SQRT VISIT REPORT

(Initial)

J. N. Singh
R. W. Macek
M. J. Russell

Published

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6415

PRELIMINARY

CONTENTS

1. CPC OPERATOR'S MODULE

The module (no model number) was supplied by System Engineering Laboratories. It is mounted in a panel at the 46 ft elevation in the reactor auxiliary building. The module is a 12 x 10 x 8 in., 20 lb cabinet with electronic devices mounted inside. It is mounted to the panel face with twelve 3/8 bolts. A bracket supporting the rear of the module is missing in the field.

The qualification document is from Wyle Laboratory: Seismic Simulation Test Program on an Operator's Module report Number 43130-1 December 22 1975. Single axis single frequency tests at conservative acceleration levels were performed. The lowest natural frequencies found 24 Hz (s/s and v) and 35 Hz (f/b) are well above the 0 to 5 Hz range of significant dynamic excitation. The response of the device will be rigid and the single frequency tests are acceptable. Several tests were performed at the various orientations required to insure full multidirectional testing. The single axis nature of the testing does not compromise the results.

Functional operability was demonstrated both during and after testing.

The module was mounted to the test fixture face with twelve 10-32 bolts which are somewhat smaller than the field mount bolts, hence conservative. A rear support bracket was included in the test support configuration. The utility has agreed to install a similar bracket in the field.

Based on our observations of the field installation, review of the qualification document, and the applicant's responses to questions, the CPC Operator's Module is adequately qualified for seismic loads, pending notification that the missing bracket has been installed.

2. PROCESS INSTRUMENT RACK

The rack (Model Number 7300) is a two bay vertical cabinet located at the 46 ft elevation of the reactor auxiliary building. It has dimensions of 57 x 30 x 94 in., weighs 3550 lb and is bolted to the floor with eight 3/4-in. bolts. Westinghouse supplied the rack and its qualifying document, Equipment Qualification Test Report, Process Protection System (Seismic Testing), WCAP 8687, supplement 2-E-13A, October, 1980.

Several series of multiaxis, multifrequency tests were performed. Natural frequencies found in the range of dynamic interest were 5 Hz (s/s) and 6 Hz (f/b). Test mounting matched field mounting.

The TRS was derated by 34.5 % to meet the RRS requirements of instruments mounted in the rack. This is acceptable because the rack is of a welded beam type of construction whose response is not sensitive to acceleration amplitude. After derating, the TRS still enveloped the RRS.

Tests were performed with the cabinet empty, fully loaded, and loaded to produce the maximum unbalance (one bay empty, one fully loaded). This envelopes all practical field mounting configurations.

No structural deficiencies were found as a result of the testing.

Based on our observation of the field mounting, review of the qualification document, and the applicant's response to questions, the Process Instrument Rack is adequately qualified for seismic loads.

3. CEA POSITION ISOLATION ASSEMBLY

This custom made rack mounted chassis is inside the auxiliary protective cabinet located at an elevation of 46 ft in the reactor auxiliary building. The CEA Position Isolator Assembly was supplied by Electro Mechanics, Inc. The field mounting consists of eight screws in the front. There are two brackets, with holes, mounted in the back of it but left unattached. In the test mounting, however, the equipment was also restrained in the back. The referenced qualification document was Seismic Simulation Test Program on a CEA Position Isolation Assembly, Wyle Laboratory report number 43349-1 of October 6, 1976. Seismic qualification of this item is based on tests performed by Wyle Laboratory for Electro Mechanics.

The first set of dynamic tests was a resonance search. This consisted of sine sweep along each of the three axis in the range of 1 to 40 Hz with a sweep rate of one octave/per min. Various frequencies in the span of 19 through 40 Hz were detected in each direction. Following these, a number of pseudo biaxial with random input tests were performed. The input motion was at an angle of 45° to the specimen (axis) in the vertical plane. It was first performed with side to side and vertical components and then repeated after rotating the specimen 90° about its vertical axis. The same two steps were performed with the front to back and vertical components of input. TRSs were generated in each case. These were then compared to the RRSs obtained by putting an accelerometer at the location of the isolator during the tests on the cabinet. There were 32 OBE and 34 SSE level tests performed.

The TRSs generated by the multiaxis, multifrequency tests satisfactorily envelope the RRSs. There were sufficient number of tests to account for the fatigue criteria. Adequate number of strain gauges placed at strategic locations were monitored during the tests for stress calculation. These are within the allowables.

However, during test number 32, a rattling was detected in the CPIA specimen. The cover was removed. The inspection revealed that the screws holding the lower separation duct had vibrated out and the duct was lying on the bottom. This was reinstalled and the remaining screws were tightened and tests continued. The specimen was inspected again after test number 45. This revealed that the screws holding the duct had loosened again but not separated. It was also detected that the relay mounting bracket for relays K1, K2, K3 and K4 had loosened.

In order to complete our review, a satisfactory response from the applicant to the following concerns are required:

1. That the field mounting of the CPIA is nonconservative. Further, that most of the items mounted inside the auxiliary protective cabinet were unattacned/partially attached on the back side in spite of brackets and holes provided for their restraint.

2. That the operational anomaly of detaching and/or loosening of ducts were evident during the tests.

4. REACTOR COOLANT PUMP SNUBBER

The Reactor Coolant Pump Snubber (Model Number 826 kip) was supplied by Paul Munroe Hydraulics.

This equipment was not installed. No attempt was, consequently, made to qualify this piece. However, we carried a copy of the qualification report for a document review. The results would be reported when the review is completed.

5. PRESSURE SWITCH

Pressure Switch (Model Number 836-C62J Series B) was supplied by Allen Bradley. There are a total of three. Tag numbers PS-224X, Y are mounted on a separate stand consisting of pipes and plates and tag number PS-224Z is attached to the wall. The stand appeared comparatively rigid. The attachment consisted of four bolts each of 3/16-in. size. All these pressure switches are located in the auxiliary building at an elevation of -35 ft. Seismic qualification is done through tests. The tests were performed by Acton Laboratories and documented in report Number 13906 titled Environmental and Seismic Qualification of Various Items for Combustion Engineering, dated March 28, 1978.

The dynamic tests consisted of mutifrequency, pseudo biaxial random input. The equipment was mounted at an angle of 45°. The field mounting and the laboratory mounting were the same. The test were repeated at each 90° rotation about the body vertical axis. TRSs were generated for each test. No resonance search was carried out. The required acceleration (ZPA) were:

	s/s	f/b	v
OBE	0.20g	0.20g	0.15g
SSE	0.32g	0.32g	0.25g.

The accelerations (ZPA) from the test spectra are:

s/s	f/b	v
10.0g	10.0g	10.0g.

The TRSs envelope the RRSs adequately. There were 20 OBE and 5 SSE level tests performed.

The tests performed on the item are satisfactory. The orientation and the number of tests performed are adequate. The switches conformed to the required tolerance before and after the tests. However, during the second

full level test, pressure switch Number 2 showed evidence of contact chatter. Every test following this, also showed evidence of chatter. During the inspection tour, it was noticed that the cover on one of the switches was hanging loose.

In order to complete our review, a satisfactory response as to the functional reliability in the light of chattering, during a seismic event, of these switches is required.

6. ESFAS AUXILIARY RELAY CABINET

This is a four bay vertical cabinet. It measures 144L x 56W x 60W in. and weighs about 13000 lb. It was supplied by ACCO. ESFAS Auxiliary Relay Cabinet is located in the reactor auxiliary building at an elevation of 21 ft. The field mounting consisted of twelve 7/8 bolts to the floor. Seismic loads are considered in the qualification. The document referred is Seismic Simulation Test Program on a ESFAS Auxiliary Relay Cabinet, report number 42913-1 of July 15, 1975. This report was prepared by Wyle Laboratories and reviewed by Combustion Engineering.

A similar relay cabinet was tested for Arkansas Power and Light Nuclear site and the test results extended to Waterford site analytically. The first series of tests were for ascertaining the resonances. A perliminary resonance search was done with a biaxial sine sweep input (s/s plus vertical and f/b plus vertical) of 0.2 g in magnitiude each. Following these, resonance search was again performed with single axis sine sweep for better definition. This indicated natural frequencies of:

s/s:	12 Hz
f/b:	9.5 Hz
v:	27.5 Hz.

Subsequently, a number of biaxial with indeperdent random input tests were performed. During the tests amplitude at each one third octave was adjusted till the TRSs enveloped the RRSs. The ZPA for the test spectra were 1 g horizontal and 0.85 g vertical in comparison to 0.25 g horizontal and 0.20 g vertical for the RRSs. Uniaxial strain gauges were located at various points to evaluate stress levels for structual integrity. The tests were performed with equipment in it for Arkansas site and most of those equipment at Waterford III are the same in that cabinet.

Multiaxis, multifrequency tests were performed on a similar panel. The TRSs enveloped the RRSs everywhere excepting below 2.5 Hz. There are no natural frequency for the equipment in that range. In the Wyle report the ZPA for the location was shown to be 0.4 g instead of 0.25 g as indicated earlier. In response to a question about this the applicant indicated that sometimes the curves are extended in that region and might be dependent upon the individual. However, even if 0.4 g is taken as the value required, the TRS's ZPA is much higher and hence acceptable.

Based on our observation of the field installation, review of the document and the applicant's response to our questions, the ESFAS Auxiliary Relay Cabinet in adequately qualified for the prescribed loading.

7. NUCLEAR INSTRUMENT SAFETY CHANNELS

This device (Model Number ELE 304-3000) is a rack mounted chassis provided by General Atomic. It has dimensions of 10.8 x 24 x 24 in. and weighs 70 lb. The chassis is mounted to the rack with six 10-32 bolts, two in front and four in back. Additional lateral support (s/s and v) is provided at the front of the chassis by the rack structure. The rack is located at the 46 ft elevation of the reactor auxiliary building.

Wyle Laboratory provided the qualification document, Seismic Testing of Safety Channel Electronic Chassis, report number E-115-539, February, 1976.

Natural frequency testing yielded the following: 26 Hz (s/s), 29 Hz (v) and 32 Hz (f/b).

Qualification was by a series of multifrequency, multiaxis tests. Tests were performed with a sufficient number of orientations to insure multidirectional responses. The TRS enveloped the RRS with sufficient conservatism to alleviate concerns about the TRS raised in the discussion of the Plant Protection System Cabinet (item number 15).

A slight difference between field and test mounting was noted for the rear support bracket. An inspection of the spectra indicated the small shift in frequency this could cause would have insignificant effect on response.

Test results indicated structural adequacy and functional operability during and after excitation.

Based on our observaton of the field installation, review of the qualification document and the applicant's response to questions, the Safety Channels are adequately qualified for seismic loading.

8. LOW OIL PRESSURE SWITCH

The low oil pressure switch manufactured by United Electric Controls, with Model Number 9639, was bolted with 2 bolts to the charging pump casing located at the -35 ft elevation in the reactor auxiliary building. The reference document for its qualificaton is the Galvin Corporation Test Report Number 42, entitled NPIS Seismic Vibration Test at A.E.T.C. No date was supplied for this report.

This switch was qualified by single frequency multiaxis testing using a test fixture which included all components on the charging pump skid. The first part of the testing consisted of 0.5 g sine sweep resonant searches which revealed natural frequencies at 12 Hz and 23 Hz. Since no accelerometers were located on the switch, these frequencies are probably for the pump or other components on the test assembly. The qualification testing consisted of sine dwells at 2.5, 10, 20, and 33 Hz. The length of each sine dwell was 30 seconds. Pseudo-multaxis excitation was achieved by four 90° rotations of the equipment on a test fixture inclined at 45° to the test table. The 1.5 g acceleration levels for these tests exceeds the required acceleration, 0.33 g (ZPA), at this location.

From the field inspection and review of the qualification report, several concerns were identified. During the field inspection it was found that the installed Model number of the switch (9596) did not agree with the Number (9639) on the design drawings. From the test report it was found that only 12 accelerometers were used to detect the natural frequences. Since the charging pump assembly consists of a number separate components, it is doubtful that all natural frequencies were detected. In particular there is a concern that the natural frequencies of the safety related components have not been identified and that the sine dwell tests were not performed at their natural frequencies. The report also indicated that the switch chattered during at least one of the tests. The concern with the chattering is that it may inadvertently shut down the pump during a seismic event or prevent its startup immediately after such an event.

In order to determine the adequacy of the qualification, resolution of the concerns identified in the previous paragraph must be supplied.

9. REACTOR DRAIN PUMP

The reactor drain pump (Model Number 306209256599) supplied by the Crane Deming Company is bolted with 4 bolts to a concrete slab at the -35 ft elevation in the reactor auxiliary building. The reference document for its qualification is the Mc Donald Engineering Analysis Company Report, ME-358 Seismic Analysis Report. No date for this report was supplied.

This pump was qualified by both static and dynamic analysis using beam elements in the ICES-STRUDL computer code. The dynamic analysis consisted of determing the natural frequencies of the pump assembly. This analysis revealed that all natural frequencies were greater than 33 Hz and thus a static stess analysis could be performed to qualify the pump. This analysis should be sufficient since the only safety function of the pump is to retain its pressure boundary capability. Using 1.5 g acceleration levels in each of the three directions together with the nozzle loads from the piping, the analysis revealed that the frame adapter bolts were the components with the least margin. Their stress was 29.4 KSI compared to an allowable of 30 KSI. However, it is noted that the required acceleration is only 0.33 g in each direction and thus more margin exists.

From the review of the qualification report several concerns were identified. In the dynamic analysis the number of dynamic degrees of freedom appears to be very low (approximately 15). In addition, the analysis apparently did not consider each component of nozzle loading separately. Thus it is possible that a more severe combination of the nozzle loads may exist than was analyzed.

Based on our observation of the field installation, review of the qualification report, and the clarifications provided by the applicant it is concluded that the pump is adequately qualified for the prescribed loads pending resolution of the concerns identified in the previous paragraph.

10. PRESSURE TRANSMITTER

The Pressure Transmitter (Model Number 1152GP8A22PB) was supplied by Rosemount. This equipment, measuring 9 x 4-1/2 in. without bracket and weighing about 12 lb, is installed in cabinet C-27A located at elevation -35 ft in the reactor auxiliary building. The position of the instrument was about five feet above the floor in the cabinet. Field mounting consisted of four 5/16 in. bolts with a bracket. Laboratory mounting was similar with four 3/8 in. bolts. This instrument, located in the safety injection system, converts pressure to electrical signal. Seismic qualification of this item is based on the tests performed by Wyle Laboratory for Rosemount. The details of these tests are contained in report number 127516 (Wyle Number 43082-1 of December 10, 1975) of December 18, 1975 entitled Seismic Simulation Test Program on a Model 1151DP5A Pressure Transmitter and a Model 1152DP5A Pressure Transmitter.

The dynamic qualification tests for the equipment were of two types. The first set was a proof test with biaxial, phase incoherent, random input in the range of 1 to 31.6 Hz. The second set consisted of pseudo biaxial, multifrequency random input in the same range. This was a fragility test. The second set of tests were repeated at four positions (at 90° intervals about the body vertical axis). TRSs were generated for each test. There were 20 OBE and 4 SSE level tests performed. The required acceleration (ZPA), for SEE level, in each direction was:

s/s = 0.3 g
f/b = 0.3 g
v = 0.25 g.

The test ZPA, in comparison, was:

s/s = 1.25 g
f/b = 1.25 g
v = 0.95 g.

A damping value of 2 percent was used for RRSs and 3 percent for the TRSs. TRSs envelope tne floor RRSs everywhere execpting below 2.5 Hz. No significant difference in calibration after vibration testing was detected. The greatest difference was 0.09 percent.

The tests performed on the equipment are adequate in nature, level and number. These tests were actually performed on a DP model (differential pressure transmitter). However, the conclusion would be equally applicable to HP (high pressure), GP (gauge pressure) or AP (absolute pressure) models due to their similarity. The nonenvelopment of RRSs by the TRSs below 2.5 Hz is of no importance since any natural frequency for the item in this range can, reasonably, be ruled out.

In order to complete our review, however, a satisfactory justification, with respect to the use of floor RRSs (in spite of the fact that it is located about five feet up in a cabinet) for qualification, from the applicant is required.

11. REGENERATIVE HEAT EXCHANGER

The regenerative heat exchanger manufactured by MLW Worthington with Model Number 10400-Q is located in the reactor containment building at the 21 ft elevation. The heat exchanger is supported at two elevations by flanges bolted to support beams. The reference document for the qualification is a report entitled Stress Analysis Report - Transient Conditions and Experimental Analysis, submitted to MLW Worthington by Ecole Ploytechnique in December, 1971.

The heat exchanger was qualified by analysis. The static hand analysis using beam assumptions indicated that the component with the smallest margin was the bottom support weld. This analysis which used 2.0 g horizontal accelerations with a 2.7 g vertical acceleration indicated that the weld shear stress was 9.9 KSI compared to an allowable of 10 KSI. The required accelerations for this location in the Waterford Plant are approximately 0.33 g in each directon. A beam computer analysis was used to determine the natural frequencies, the lowest of which was 49 Hz. Thus it was shown that the static analysis is permissable.

During the review of the qualification report the assumptions which permitted a statically determinant analysis were questioned. After further investigation it was apparent that these assumptions were conservative. Also in the frequency calculations it was not obvious that the tubes within the heat exchanger had been represented adequately. On further inquiry it was found that the tube baffle spacing permitted "lumping" the tubes with the shell as was actually done in the computer model.

Based on our observation of the installation, review of the qualification report and the clarifications provided by the applicant, the regenerative heat exchanger is adequately qualified for the prescribed loads.

12. DEBORATING ION EXCHANGER

The deborating Ion Excnanger supplied by the C-E Air Preheater Co. is a stainless steel tank supported by 4 legs bolted to a concrete pad and is located at the -4 ft elevation in the reactor auxiliary building. No model number for this component was supplied. The reference document for its qualification is a C-E report, C-PEC-14 entitled 42 Inch Ion Exchanger, dated March 19, 1971.

This component was qualified by static hand analysis using beam assumptions. Using 1.6 g horizontal and 0.7 g vertical accelerations the analysis indicated that the most highly stressed component is the shell pad connection which had a stress of 35 KSI, compared to an allowable of 60 KSI. The required accelerations for this component are approximately 0.33 g in each direction.

During the review of tne qualification report the following concerns were identified:

1. The torsional stresses in the shell pad to leg weld had apparently been neglected.

2. The worst case loading for the Bijilard shell analysis was not justified.

3. There was no frequency analysis to justify the static assumption.

4. The nozzle loads were omitted.

To resolve the concerns identified above, the equipment vendor supplied supplemental stress and frequency analyses. Review of the additional analyses which addressed weld and shell stresses, nozzle loads and provided a natural frequency calculation indicated that the original concerns have been adequately resolved.

Based on our observations of the field installations, review of the qualification documents, and the applicants' responses to questions, the Deborating Ion Exchanger is adequately qualified for seismic loads.

13. PURIFICATION FILTER

The purification filter, supplied by Commercial Filters Corp. with Model Number 19224-12TSSCN-200, is located in the reactor auxiliary building at the -4 ft elevation. The component is supported by 4 legs bolted to a concrete pad. The reference document for the qualification is a Commercial Filters Corp. Report, Pressure Vessel Seismic Calculations for Model Number 19224-12TSSCN-200, dated March 30, 1972.

The filter was qualified by static hand analysis using beam assumptions. The analysis which considered 1.0 g horizontal and 0.7 g vertical accelerations indicated that the support legs were the most highly stressed components. They had bending stresses of 17.4 KSI compared to an allowable of 19.8 KSI. The required accelerations for this Waterford location are approximately 0.33 g in each direction. A hand frequency calculations indicated that the lowest natural frequency was approximately 12.5 Hz. Since this frequency is in the ZPA range of the plant spectra at this location, the static analysis is permissible.

During the review of the qualification report a number of items were questioned. It was noted that in the weld calculations the throat area apparently had not been used. However, on further investigation the orientation of the weld indicated that the proper area had been used. In addition there was concern expressed pertaining to the boundary conditions used in the frequency analysis and the apparent neglect of nozzle loads in the stress analysis.

To resolve the concerns identified above, the equipment vendor supplied supplemental stress and frequency analyses. Review of these additional analyses, which addressed nozzle loads and anchor bolt stresses and revised the natural frequency calculation indicated that these concerns have been adequately resolved.

Based on our observations of the field installation, review of the qualification documents, and the applicants responses to questions, the Purification filter is adequately qualified for the prescribed loads.

14. HOLDUP TANK

The holdup tank supplied by C-E Air Preheater is located in the reactor auxiliary building at the -35 ft elevation. No model number was supplied. The tank is supported at the bottom by a skirt bolted to a concrete pad and at the top by lateral seismic lugs. The reference document for its qualificaiton is a C-E Air Preheater Report, Stress Report for Holdup Tank, APCO S.O. Number 26257, Revision 03, dated October 24, 1973.

The holdup tank was qualified by static hand analyses using 1 g horizontal and 0.7 g vertical accelerations. The required accelerations are approximately 0.33 g in each direcion. The analysis, which primarily employed beam assumptions. indicated that the holddown bolts for the skirt were the most highly stressed components. Their stress was 19.9 KSI compared to an allowable of 20 KSI. A crude frequency calculation indicated that the lowest natural frequency was 12.7 Hz. Since this frequency is in the ZPA range of the Waterford spectra for this location, the static analysis is permissible.

During the field inspection and review of the qualification report, a number of concerns were identified. The field inspection revealed that one ring stiffener near the top of the tank had apparently been bent during installation and no incident report filled. The review of the analysis indicated that the design gap on the seismic lugs may permit improper loading (loading not addressed in the design calculations) of the lugs and more importantly the tank itself. After referring to the Architect Engineer drawings it appeared that the interface function of the lugs with the bumpers had not been adequately communicated between the equipment vendor and the Architect Engineer responsible for the bumper design. The review also revealed that fluid sloshing within the vessel had not been addressed in the frequency calculation. In addition, stresses in the tank itself due to seismic loading had apparently not been calculated. Also, significant portions of the report were unreadable due to the reproduction quality; however, a more legible report was sent later for review.

In order to determine the adequacy of the qualification, resolution of the concerns identified in the previous paragraph must be supplied.

15. PLANT PROTECTION SYSTEM CABINET

The cabinet (no model number) is supplied by Electro-Mechanics. It is a four bay vertical cabinet which measures 150 x 54 x 90 in. and weighs 1300 lb. It is connected with twelve 1 in. bolts to a floor of the reactor auxiliary building at an elevation of 46 ft.

The qualification document is Seismic Simulation Test Program on a Plant Protection System Cabinet, report number 42836-1, by Wyle Laboratory. Natural frequencies were established by test at 8.5 Hz (f/b), 10 Hz (v) and 11 Hz (s/s). A series of multifrequency, multiaxis tests were performed to qualify the panel. Both horizontal axes were separately excited in conjunction with the vertical axis so that multdirectional response has been tested. The TRS envelopes the RRS. Field and test mountings were identical. Structural adequacy has been demonstrated by the testing.

A problem was encountered with the method used to derate the instrument location RRS developed from the panel testing. The method consisted of multiplying the equipment RRS at each frequency by the ratio of panel instrument RRS to panel TRS at that frequency. The problem with this is that the RRS value at a particular frequency is dependent on excitation in a range of frequencies around the frequency, and not just at the frequency itself. The method cannot be accepted without justification. All reports for equipment qualified via these derated spectra must be examined for sufficient conservatism to insure acceptability, unless justification of the method is provided.

This cabinet was field mounted beside a similar cabinet with a one-half inch clearance. Since the test did not include this feature, a question was asked about the possibility of contact between the two cabinets. A simple hand calculation based on test conditions indicated that the maximum displacement of the top of the cabinet in the direction of interest to be 0.17 in. This was accepted as an assurance of no contact because of the similarity between the two cabinets and the conservatism of the test conditions.

Based on our observation of the field installation, review of the qualification document, and the applicant's response to questions asked, the Plant Protection System Cabinet is adequately qualified for seismic loads, pending resolution of the concern identified above.

16. NAL2 SAFETY CHANNEL BISTABLES

The Safety Channel Bistables (model number NAL) are 6.25 x 11.5 in., 0.78 lb printed circuit boards mounted in a frame which is in turn mounted in the Process Instrument Rack. The boards are attached to the frame with two 6-32 screws in the front and a Sylvania 42 pin connector in the back. Guides on the top and bottom provide lateral support to the cards. The frame is mounted in the cabinet with sixteen 10-32 screws.

Westinghouse supplied the equipment and the qualification document, Seismic Operability Demonstration Testing of the WISD 7300 Series Process Instrumentation Bistables, WCAP 8828, December, 1976.

Multifrequency, multaxis testing was performed on a fully loaded rack mounted to reflect field mounting. Several orientations were tested to fully check multidirectional response. The TRS enveloped the RRS.

Natural frequencies were not obtained. This is acceptable because the multifrequency test is justifiable without knowledge of natural frequencies.

Test results demonstrated both structural adequacy and functional operability during and after excitation.

Based on our inspection of the field installation and on review of the qualification document, the Safety Channel Bistables are adequately qualified for seismic loads.

17. CONTROL PANEL (CP7)

This custom made Control Panel was supplied by Reliance Electric Co. It is located in the reactor auxiliary building at an elevation of 46 ft. The overall dimensions are 100 H x 90 W x 78 D in. The frame is made from 3 x 3 x 1/4 in. steel angle, 2 x 2 x 1/4 in. steel angle and steel tube. Steel bars of sizes 3 x 1/4 in. 2 x 1/2 in. and 4 x 1/2 in. are used for stiffening. The steel plate used in the board construction is 0.1793 in. and 0.1345 in. The field mounting consisted of 2 in. welds on 6 in. centers both in the front and back. This panel is also connected to other side panel/panels with bolts. Seismic qualification is based on analysis detailed in the report: Order number 99A x 400700RB, March 20, 1978. This document was prepared by Reliance Electric Co. and reviewed by Ebasco.

A dynamic analysis is performed. The control panel is modeled as an assemblage of 3D finite elements with a fixed base. The mass of the instruments mounted on it is included in the model. The first five natural frequencies of the structure from the analysis are: 20.30, 20.52, 21.12, 21.39 and 27.92 Hz. The 'STARDYNE' computer program is used. The analysis utilizes 15 modes, one percent damping and response spectra input. The absolute value summation method is used for resultant values. The maximum stress in the beam and triangular plate element is 1076.5 psi and 204.45 psi, respectively. Allowable values for these cases are 21600 psi and 10800 psi. The g-values (acceleration level) at the locations of instruments are determined from the analysis and used for their qualification.

The stresses from the analysis are within allowable limits. However, the operability of instruments mounted on this panel is not adequately assured by just specifying the acceleration levels. In general, the g-value and the dynamic environment are to specified for the instrument.

Under the circumstance, for each instrument, the following is to be demonstrated:

1. That the dynamic environment at the instrument location is not too severe for the functioning of the item, and/or

2. That the item will not adversely be affected by the prevailing environment due to its own dynamic characteristics.

In order to complete our review, a satisfactory response with respect to the above concerns is required from the applicant.

18. BATTERY CELLS B

Battery Cells B (Model Number NCX-1200) is an assembly of sixty batteries and their support structure. The arrangement is two rows of batteries, thirty per row. The structure measures 20 x 2 x 3 ft and weighs 17800 lb. It is attached to the floor with forty-four 1/2 in. bolts. The location is at the 21 ft elevation of the reactor auxiliary building. The vendor is Gould, Inc.

This item was qualified by Wyle Laboratories. The qualification document is Seismic Simulation Test Program on Three NCX-1200 Battery Cells, Three NCX-900 Battery Cells and Three DC-7 Battery Cells, report number 43167-1, February, 1976.

The multiaxis, multifrequency test series was performed on a rack with one row of three batteries. Attachment was by four 1/2 in. bolts. Enough different orientations were tested to insure adequate testing of multidirectional response. Test mounting was representative of the field mount. The TRS enveloped the RRS. Structual adequacy and functional capability was demonstrated during and after testing.

The testing is considered adequate in all areas except one: Is the test configuration, with only three batteries in a row, conservatively representative of the field configuration with thirty in a row? Note that individual batteries are not attached to the support structure. The entire row of batteries is surrounded by the support structure, closely spaced with foam pads separating individual batteries. Adjacent batteries are electrically connected with bus bars capable of transmitting structural loads.

Based on our observation of the field installation and review of the qualification document, the battery cells and rack are adequately qualified for seismic loading, pending resolution of the question concerning suitability of the test configuration.

19. EMERGENCY DIESEL GENERATOR-LUBE OIL HEATER

The emergency diesel generator lube oil heater, part Number 2-04H069001/R2, is supplied by Cooper Energy Services and is located at the 21 ft elevation in the reactor auxiliary building. The heater is mounted to the diesel generator skid with four 3/8 in. bolts. The reference document for the qualification is the report entitled Emergency Diesel Generator L. O. Heater, CES-0279-15, dated March 18, 1977 and prepared by Hissong Consultants.

The heater was qualified by dynamic response spectra analysis using beam and pipe elements in the ANSYS computer code. The analysis used 4 modes in the frequency range of 1 to 40 Hz and employed generic seismic spectra which enveloped the Waterford specific location spectra except in the low frequency range. The frequency analysis indicated the lowest natural frequencies were 27.5 Hz side-to-side, 14 Hz front-to-back and 37 Hz vertical; thus the generic spectra used envelope the specific spectra at all natural frequencies. The maximum stress of 52 KSI from this analysis occurred in the upper support bolts. This stress is less than the allowable of 75 KSI.

During the field inspection and review of the qualification report, a number of questions arose. During the field inspection it was noted that a cut out had been made in one support leg. Review of the analysis indicated that the effect of the cut out is probably negligible since the nominal streses in this member are very low. The number of dynamic degrees of freedom were considerably less than indicated by the nodes of the model. Although a reduced number of degrees of freedom were used, the retained degrees of freedom should be sufficient to define the modes used in the analysis. The method of combining load cases was also questioned; however, since both plus and minus loads were used to determine the maximum stresses, the combinations are acceptable. The modeling of the heater element was also questioned; however, since the intermediate support was omitted, the computed natural frequencies should be lower than actual. This approach is in general conservative.

Based on our observation of tne field installation, the review of the qualification report and the clarification provided by the applicant, the lube oil heater is adequately qualified for the specified loads.

20. 20 INCH 150 LB CHECK VALVE

This valve (no model number) is supplied by TRW mission. It measures 24 x 20 x 8 in. and weights 540 lb. The valve is mounted in a pipeline between flanges connected by twenty-two 1 in. bolts. The location is at the 35 ft elevation of the cooling tower.

TRW mission provided the qualification document: Seismic Stress Analysis for TRW Mission Duo-check Valves, report number MVP 3374, March 1977. Calcuations indicated no natural frequencies in the dynamic range for either valve body or internals. This justified the equivalent static analysis performed. Acceleration levels used in the analysis (1.0 g both horizontal, 0.67 g vertical) corresponded to the maximum allowable acceleration requirement for valves in the piping analyses. They are acceptable. Functional operability of the valves are assured by the extremely low calculated stress (less than 5 psi) and hence low deflections calculated for the seismic event. The simple operation of this type of valve would not be impaired by this level of deflection.

Based on our field observations and review of the qualification document, the 20 in. 150 lb Check Valve is adequately qualified for seismic loads.

21. 4 INCH 150 LB BUTTERFLY VALVE

These valves (no model number) are supplied by the Jamesbury Corporation. They measure 16 x 12 x 10 in. and weigh 45 lb. The valves are flange mounted with eight 1/2 in. bolts. They are located at the 21 ft elevation of the reactor auxiliary building and at the -4 ft elevation of the Containment Building.

John Henry Associates, Inc. provided the qualification document, Seismic Qualification of Valves Covered by L.P.&L Purchase Order number NY403539 for the Waterford Unit Number 3 Power Station. . .", Report Number JHA-76-51, April 1977.

The valve has been qualified by comparison with a similar valve, 6 in. WSV with an Elliot 1M Actuator. The only difference between these valves is the size of the port. Hence the smaller valve will have a thicker body wall, so that the qualification by comparison is valid.

The 6 in. WSV 1M valve has been qualified in the same report as the 4 in. valve. Except for its shaft, this valve has been qualified by comparison with a third valve, 6 in. WSV with MA-020 operator. The only difference is that the 6 in. WSV 1M valve has a smaller shaft and a shorter, stiffer neck than the 6 in. WSB MA-020. Therefore the qualification by comparison for everything but the shaft is valid.

The calculation qualifying the shaft of the 6 in. WSV 1M valve did not include a seismic load. This presents no problem since the small mass supported by the shaft and the low seismic acceleration values would result in loads insignificant in comparison to the operating loads considered. The 10% margin calculated for operating loads is more than sufficient to accommodate seismic loads.

Valve 6 in. WSV MA-020 has been qualified in a report by John Henry Associates, Seismic Qualification of the Wafer Sphere Butterfly Valve Covered by Jamesburg Order No. JPB-45525 for the Tennessee Valley Authority, Report No. JHA-76-68, April 1977. Qualification was via a detailed finite element analysis. Natural frequency extraction yielded a fundamental frequency of 72.6 Hz. This justifies the static equivalent analysis performed. A conservative seismic acceleration of 3 g was applied in all three directions in combination with operating loads. The controlling stress was found to be shear stress in the shaft, at 58% of allowable. This valve was found to be adequately qualified.

All three valves have hand operated actuators, so that operability during a seismic event is not important. Operability after the event is assured because all stresses were found to be below allowables.

Based on our observations of the field installation, and review of the qualification documents, the 4 in. 150 lb butterfly valve is adequately qualified for seismic loads.

22. INDICATOR

The indicator (Model Number 1136) was supplied by International Instrument. It is mounted, with standard bracket, on control panel CP8. Control Panel CP8 is located in the reactor auxiliary building at an elevation of 46 ft. The indicator is 3.062 x 1.265 x 3.36 in. and weighs about 5 oz. Seismic qualification is done on the basis of tests done by Acton Labs. for International Instruments. The details of these tests are contained in report number SBI-3 dated February 10, 1976. This is for seismic qualification of indicating instrument model 9270 and meter models 1122, 1136 and 1151 (test report Number 11879 of October 7, 1975).

The dynamic tests performed on the instrument consisted of two sets. The first series was a 0.5 g peak pseudo biaxial (input direction 45°), sine sweep at 1/2 octave per minute sweep rate from 1.0 to 35 Hz to establish major resonances. This indicated the following natural frequencies:

s/s = 27 Hz
f/b = 34 Hz
v = None.

The second was a 3.5 g peak, pseudo biaxial (45°), simultaneous vertical and one horizontal sine beat with 10 cycles per beat for 30 seconds or 10 beats, whichever was greater. This was done at each integer frequency from 1.0 to 35 Hz. A pause of ten times the beat period occurred between beats. This process was repeated for four orientations of the speciemen. Each orientation was a rotation of 90°, from the previous, about the vertical axis. the g-level for the location of this instrument was obtained from the analysis of CP8. For SSE, they are:

s/s = 0.10 g
f/b = 0.13 g
v = 1.06 g.

The maximum acceleration on CP8 for any device location was noted to be 1.94 g.

The multifrequency, multiaxis sine beat tests performed on the device are adequate. There were sufficient number of tests to fulfill the requirement for fatigue. The item passed the operability test established according to ANSI C39.1-1972.

However, according to the vendor's document all the meters are designed and balanced for use in the normal mounting positions on a panel in the vertical plane. For a installation on a panel that is not vertical, special specification to the vendor is required as to its position from vertical. This was not done in spite of the fact that this particular device is not mounted in the vertical plane in the field. On inquiry, it was stated that paperwork had been started to replace this device with the right one.

Further, the test report number SBI-3 stated that four of the model 9270 instrument did not operate properly during the test. The applicant was asked whether there were any model 9270 instrument installed in the plant. There was no response.

In order to complete our review, the following should be provided.

1. That the indicator has indeed been replaced by the right one.

2. That there are no model 9270 instrument in the plant or their operability has separately been established.

23. NUCLEAR STANDBY PANEL

The Nuclear Standby Panel (Model Number 541/3576-2A/ES), supplied by Cooper Energy Services, is located at the 21 ft elevation in the reactor auxiliary building. The panel is mounted on the concrete floor with seventeen 5/8 in. bolts. The reference document for its qualification is the Nuclear Standby Panel Report, number 43335-2 dated September 3, 1976 and was prepared by Wyle Labs.

The panel was qualified by random multifrequency multiaxis testing. Resonant searches revealed natural frequencies of 21 Hz in the side-to-side direction, 22 Hz in the front-to-back direction and 33 Hz in the vertical direction. Twelve SSE tests were performed using a generic spectra which enveloped the Waterford spectra for this location at all natural frequencies. The test mounting was identical to the field mounting.

During the field inspection and review of the qualification report several questions and concerns were identified. The actual report reviewed was Number 43335-1 rather than number 43335-2. Report number 43335-2, however, was supplied after the plant visit and was found to be nearly identical to 43335-1. The TRS plots supplied in 43335-2 indicated that the TRS did envelope the Waterford spectra at this location for all natural frequencies. During the field inspection it was noted that the conduits connecting to this panel may couple it with other equipment. Since the rigidity of the conduit could not be evaluated, there is a concern regarding the test simulation which did not include the conduit.

Based on the observed field installation, the review of the qualification report and the clarifications provided by the applicant, the nuclear standby panel is adequately qualified for the specified loads, pending resolution of the concern identified in the previous paragraph.

24. JACKET WATER HEATER

The jacket water heater, supplied by CVI Corp. with Model Number 2-044-070-001, is mounted to the diesel generator skid at the 21 ft. elevation in the reactor auxiliary building. Four 3/8 inch bolts anchor the support legs to the skid. The reference document for its qualification is the report entitled Jacket Water Heater with report number CES-0279-14 dated March 4, 1977. The report was prepared by Hissong Consultants.

The water heater was qualified by dynamic response spectra analysis. This analysis considered one mode in the 1 to 40 Hz range and used a generic spectra which enveloped the Waterford spectra at all natural frequencies. The natural frequencies from the analysis were 44.8 Hz in the side-to-side direction and 32.3 Hz in the front-to-back direction. To supplement the response spectra analysis, a static analysis was also performed using .8 g horizontal and .533 g vertical accelerations. The stresses were then determined by absolutely combining the static and response spectra results. From these analyses the highest stress (27.5 KSI) was found in the lower support bolts. The allowable was 31.0 KSI.

During review of the qualification report several concerns were identified. The analysis indicated that additional nozzle reinforcement was required; however there is some concern because it was not evident that this modification had been implemented. Also the support assumptions used in the analysis appear to deviate from the field installation. The analysis assumed a hinged connection rather than a fixed connection. The load combinations used for several members were questioned; however, the conservatism of the spectra probably compensates for these discrepancies.

Based on our observation of the field installation, the review of the qualification report and the clarifications provided by the applicant, the jacket water heater is adequately qualified for the specified loads pending resolution of the concerns identified in the previous paragraph.

25. LOUVERS (L-1)

The Louvers (Model Number 130FS) was supplied by American Warming & Ventilating, Inc. It measures about 95-1/2 x 95-1/2 in. and weighs approximately 1000 lbs. The mounting consists of sixty-four 3/8 in. bolts. The wall mounted louvers are located at an elevation of 75 ft in the reactor auxiliary building. Seismic qualification was done by American Warming & Ventilating Inc. and reviewed by Ebasco The details are in a report of June 7, 1978, Rev. 1.

A static equivalent analysis was done for qualification. This was supported by the lowest natural frequency of the system of 89.5 Hz. The static analysis had an input of 1.0 g in each of its orthogonal direction. Support system for the model is taken to be hinged. The stresses are calculated for louvers (L-4) which is similar to the louvers (L-1). The values are as follows:

part	governing load	total stress/load	allowable stress/load
blade	DL + SSE + Pressure	12,473 psi	23,400 psi
tension load/bolt	DL + SSE + Pressure	550 lbs	630 lbs
shear load/bolt	DL + SSE + Pressure	25 lbs	830 lbs.

The maximum critical deflection in the blade was calculated to be 0.0037 in.

Based on the observation of the field installation and the review of the analysis report the louvers are adequately qualified for the prescribed loads.

26. DIESEL OIL STORAGE TANK (A&B)

Diesel oil storage tanks (Model Number B5178 and B5179) were supplied by Chicago Bridge and Iron Company. This dome roof vertical cylindrical tank is on a common foundation at an elevation of 35 ft. It is 12 ft 6 in. in diameter and 46 ft high and weighs 21,774 lbs. The mounting consists of twenty 2-1/4 in. diameter bolts. Each bolt has an anchor plate (10 x 10 x 1-1/4 in.) in the pedestal base. It stores diesel oil to be used by the diesel generator for emergency power. Seismic qualification was done by Chicago Bridge and Iron Company and reviewed by Ebasco Services, Inc. The details are contained in the report; 5-4187 A/B 2 -12 -6" dia. by 46'-0 Dome Roof Diesel Oil Storage Tanks of November 1, 1975.

An analysis was performed for qualification. The fundemental frequency, using Rayleigh-Ritz technique, was calculated to be 4.7 Hz. The required acceleration in each direction is as follows:

	s/s	f/b	v
OBE	0.354 g	0.354 g	0.15 g
SSE	0.708 g	0.708 g	0.30 g.

These are corresponding to one percent damping. An equivalent static analysis was performed using computer program E0717A (a program based on TID-7024). Fluid effects was considered in the analysis. The model was taken to be fixed at the base. The shell stresses are in accordance with ASME Code Section III, subsection ND for atmospheric tanks, summer 1974, addenda. Other critical stresses were identified as follows:

identification	location	governing load	total stress	allowable stress
σSSE	anchor bolt	DL + SSE + Hydro	30,500 psi	32,400 psi
σSSE	top plate (anchorage)	DL + SSE + Hydro	29,600 psi	30,000 psi.

The allowable stresses are taken from NFPA which are less than AISC standard.

A question was asked of the applicant whether the seismic adequacy of the suction side lines were verified. The applicant's response was affirmative. It was also ascertained that the backflow line and the feed line to the diesel generator were adequate for seismic loads. However, during the field observation one of the lines to the pump was unconnected and hanging free.

The analysis performed is adequate. The critical stresses are within allowable. However, the adequacy and accuracy of the program E0717A could not be established.

Based on the field observation, review of the qualification report and the response provided by the applicant, the diesel oil storage tank is adequately qualified for the prescribed loads, pending confirmation of verification of the E0717A computer program.

27. Limitorque Valve Actuators

The actuators (Model Number SMB-000-5/HOBC) are supplied by Limitorque Corporation. They are mounted on valves at many different locations throughout the plant. The actuators that were field inspected were located at the -21 ft elevation of the reactor auxiliary building. They were attached to the valves with four 3/4 in. bolts.

Acton Environmental Testing Company supplied the qualification document: Seismic test of SMB-000-5/HOBC Limitorque Actuator, report number 14331-2, March, 1979. Natural frequency testing showed the minimum frequencies (37.5h1, 39.0h2, and 58.5v) to be above the range of dynamic response. This justifies the single frequency qualification testing. Testing was performed with a sufficient number of different orientations to insure full multidirectional response. This justifies the use of a single axis test. Acceleration levels used in the test exceeded required levels by a factor of five.

The test bolting configuration was not available from the report because the bolts are qualified with the valve body rather than the actuator. A report for a valve with the correct actuator (valve number 2-SI-FM318A, SQ-MN-5) was checked. The valve (with actuator) was qualified with 5/8 in. bolts. Hence, the 3/4 in. bolts in the field are acceptable.

Based on our observations of the field installation, review of the qualification documents and the applicant's response to our questions, the Limitorque Actuators are qualified for seismic loads.

28. CCW Heat Exchanger (A,B)

The CCW Heat Exchanger (Model number 45" I.D x 42' - 0" S. ETL) was supplied by Struthers Wells Corporation. This item, weighing 35000 lbs (empty, 69500 lbs. hooded without supports), is located in the reactor auxiliary building at an elevation of 21 feet. The mounting consists of three sets of four 1 inch diameter bolts at three locations. This equipment is essential for cooling water. Seismic qualification of the heat exchanger was done by Struthers Wells Corporation documented in report O. No. 1-74-06-32481 Seismic Analysis CCW Heat Exchanger dated February 27, 1976.

The qualification is based on analysis. The fundamental frequency of the system was calculated to 23.956 HZ. An equivalent static analysis was then performed using a 3D finite element model. The computer program 'ANSYS' was used. The support condition is pinned. The g-values used for the analysis are:

h_1 = 1.0g

h_2 = 1.0g

v = 0.67g.

Some of the critical stresses calculated and the corresponding allowables are as follows:

location	governing load	total stress	allowable stress
shell over supports	SSE + DWT + nozzle loads	12.5 ksi	13.7 ksi
base plate	SSE + DWT + nozzle loads	27.7 ksi	36.0 ksi
foundation bolt	SSE + DWT + nozzle loads	26.6 ksi	29.3 ksi (shear).

However, in the analysis, the natural frequency of the tube was incorrectly calculated. This is to be redone. The impact of the new frequencies on the model is to be evaluated. Further, during the field observation a long stretch of attached piping (≥40 feet) was detected to be rather sparsely supported. A question about this was asked of the applicant. It was revealed that there was a support missing. The applicant further stated that it would be installed. A drawing was produced which showed this support and the relevant number was: CC-RR-464.

In order to complete the review, a satisfactory response from the applicant with respect to the adequacy of the model, in the light of the new natural frequencies is required.

29. Control Components

The two control components consisting of a differential pressure gauge with switch (Model Number 1-04S-187-108-2) and a MICRO switch (Model Number 2-04S-378-001) were supplied by Cooper Energy Services and are mounted on the diesel generator skid in the reactor auxiliary building. The reference document for the qualification of these components is a Dayton T. Brown report entitled Control System Components DTB04R[illegible]5-1310, dated October 13, 1976.

These components were qualified by multiaxis, multifrequency, random testing. The specific components listed above were tested in a group with thirty-four other control components. Resonant searches performed prior to the seismic tests revealed that the lowest natural frequency of any component in the group was 5.8 Hz and that the lowest frequency of the two specific components was 13 Hz. Two SSE seismic qualification test were performed with the components mounted rigidly to the test table. The TRSs did not envelope the RRS at the low frequencies (less than 3 Hz); however, the TRSs did envelope the RRS at all natural frequencies.

During the field inspection and review of the qualification report several concerns were identified. During the field inspection it was noted that several components (specifically gauges) were not fully installed, e.g. set screws were loose. During the review of the qualification report several components exhibited anomalies (switches opening or closing at the wrong setting, etc.) which constituted a malfunction according to the specification. However, neither of the two specific components exhibited any anomalies. Nevertheless, there is a concern that these other components which were not inspected and exhibited anomalies may be installed in other safety systems in the plant. In addition no justification was supplied in the report for neglecting the OBE testing.

Based on our observation of the field installation, the review of the qualification report, and the clarifications provided by the applicant the specific control components are adequately qualified for the specified loading, pending resolution of the concerns identified in the previous paragraph.

30. Emergency SGFW Pump A/B-Turbine

The turbine (Model Number 65-2) is supplied by the Bingham-Willamette Company. It measures 53 H x 75 L x 64 W in. and weighs 2800 lb. It is mounted with six 7/8 in. bolts. The location is at the -35 ft elevation of the reactor auxiliary building.

Keith Feibusch Associates prepared the qualification document: Emergency SGFW Pump A/B-turbine, Seismic Analysis, Appendix D, Report Number 230223-02, December, 1975.

The turbine was qualified by static hand analysis. Natural frequencies were calculated for all major components. The lowest frequency calculated was 14 Hz for the oil cooler tubes. Although this was above the ZPA for the location, a 1.5 factor was applied to the accelerations. The remaining frequencies were 20 Hz or above, and no factor was applied. The static calculation was justified.

Acceleration values of 3.0 g horizontal and 1.0 vertical were used throughout the analysis. This is conservative.

The limiting load was calculated for the thrust bearing, with a margin of safety of -0.07. This negative value is acceptable because it is a very small number resulting from a calculation including very conservative seismic acceleration values. All other margins of safety were positive. This insured operability after a seismic event.

Operability during the seismic event was assured by the extremely small deflections calculated. For instance, the turbine shaft displacement was calculated as 8 mils. This compares to a 14 mil deflection limit allowed for bearing wear.

The full range of allowable nozzle loads was not considered in the analysis. Combined force and moment loads were allowed, as long as a linear combination of the two fell below a limiting value. Only the

maximum force with zero moment was considered in the analysis. A check of the full moment, zero force load was made. It demonstrated that the results are unchanged when the full range of nozzle loads is considered.

Based on the observation of the field installation and review of the qualification report, the Emergency SGFW turbine is adequately qualified for seismic loads.

LIST OF ATTENDEES

Eric Fitzsimmons	CE
Terry MacNair	CE
M. J. Russell	EG&G Idaho, Inc.
Bob Foley	Ebasco
Roy Prados	LP&L
J. N. Singh	EG&G Idaho, Inc.
R. W. Macek	EG&G Idaho, Inc.
Mary Haughey	NRC/EQB
T. Y. Chang	NRC/EQB
Les Constable	NRC/SRI
William Jones	NRC/CO-OP
Jim Cummins	NRC/RI
L. A. Stinson	Ebasco
J. Debruin	Ebasco
R. Alexandru	Ebasco
Z. T. Shi	Ebasco