G. Bagchi

PDR

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

50-416

OCT 22 1981

MEMORANDUM FOR: Zoltan R. Rosztoczy, Chief
Equipment Qualification Branch
Division of Engineering

FROM: T. Y. Chang
Equipment Qualification Branch
Division of Engineering

THRU: Goutam Bagchi, Section Leader
Equipment Qualification Branch
Division of Engineering

SUBJECT: TRIP REPORT FOR SEISMIC CRITERIA IMPLEMENTATION REVIEW MEETING WITH MISSISSIPPI POWER AND LIGHT COMPANY (MP&L) ON GRAND GULF NUCLEAR POWER STATION UNITS 1

The Seismic Qualification Review Team (SQRT), consisting of Engineers from the Equipment Qualification Branch (EQB) and the Idaho National Engineering Laboratory (INEL, EG&G), conducted a site visit to Grand Gulf Nuclear Power Station Unit 1 at Port Gibson, Mississippi, on July 28 to 30, 1981. The purpose of the visit is two-folded: (1) to perform a plant site review of the seismic and dynamic qualification methods, procedures, and results for selected safety-related mechanical and electrical equipment and their supporting structures, (2) to observe the field installation of the equipment in order to verify and validate equipment modeling employed in the qualification program.

The background, review procedures, findings and the required follow-up actions are summarized below. A list of attendees at the conference is contained in Attachment I, and a list of the equipment selected for audit is shown in Attachment II.

1. Background

The applicant has described the equipment qualification program in Sections 3.9 and 3.10 of the Final Safety Analysis Report, consisting of dynamic testing and analysis, used to confirm the ability of seismic Category I mechanical and electrical (includes instrumentation, control and electrical) equipment and their supports, to function properly during and after the safe shutdown earthquake (SSE) specified for the plant. The applicant has also described the program for the combined seismic and hydrodynamic vibratory loads associated with the containment suppression pool.

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In instances where components have been qualified by testing or analysis to other than current standards such as Institute of Electrical and Electronics Engineers Standard, 344-1975, "Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations," and Regulatory Guides 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," and 1.100, "Seismic Qualification of Electrical Equipment for Nuclear Power Plants," or where equipment is affected by and was not qualified for the suppression pool hydrodynamic loads, the applicant has undertaken a re-evaluation and requalification program.

The plant site review was performed to determine the extent to which the qualification of equipment, as installed in Grand Gulf, meets the current licensing criteria as described in the Standard Review Plan (SRP) Sections 3.9.2 and 3.10.

2. Review Procedures

Prior to the site visit, the SQRT reviewed the equipment seismic qualification information contained in the pertinent FSAR sections and the reports referenced therein. A representative sample of Seismic Category I mechanical and electrical equipment, including both NSSS and BOP scopes as shown in Attachment II, were selected for the plant site review. The review consisted of field observations of the actual equipment configuration and its installation, followed by the review of the corresponding test and/or analysis documents. Brief technical discussions were held during the review sessions to provide SQRT's feedback to the applicant on the equipment qualification. An exit conference was held to summarize and conclude the plant site visit.

3. Findings

The results of field observations and the review of the qualification reports and pertinent documents for equipment as listed in Attachment II are summarized in Attachment III for each piece of equipment evaluated.

The plant site review identified the need to provide additional information on certain generic issues as well as to clarify the details of the qualification for some specific pieces of equipment as described in Attachment III. The applicant has committed to submit additional information and clarification for a follow-up review. Subsequently, on 10/9/81 the applicant sent to NRC a post-audit submittal. The follow-up actions are described in Section 4.

4. Follow-Up Actions

The applicant's post-audit submittal of 10/9/81 is currently under review by the SQRT. Following is a summary of the follow-up on the generic open items as well as specific open items as stated in Attachment III.

Generic Open Items

A. Fatigue effect due to seismic loading was considered in the qualification. However, when test method is utilized to qualify equipment, hydrodynamic effect on fatigue is not fully accounted for. Typical samples should be studied to assist in the review of this generic issue: The comparison for NSSS equipment is provided as attachment 2 in the 10/9/81 submittal. The comparison for BOP equipment is currently being evaluated and the applicant is committed to submit the result and conclusion of the study for staff's review by November, 1981.

B. Provide assurance that retesting and redesign on Limitorque Motor Operators for the hydrodynamic loading is completed prior to fuel load. Provide confirmation when retesting, redeisgn, and installation have been completed:
An evaluation is currently being performed and the applicant is committed to provide response by November, 1981.

Specific Open Items

A. Provide clarifying details as described below:

a) Horizontal Fuel Transfer System Containment Closure (NSSS 4).
The applicant is committed to provide documentation describing what means or procedure will be used to assure that the fuel transfer tube closure is closed and latched during reactor operation.

b) Control Room Panel (NSSS 7).
The applicant is committed to address the concerns described in Attachment III.7.

c) ASCO Solenoid Valve (BOP 14).
The applicant is committed to respond to the concerns described in Attachment III. 29.

d) Reactor Core Isolation Coolant Turbine (NSSS 15).
The applicant is committed to address the concerns described in Attachment III.15 by November, 1981.

B. The concerns as described in Attachment III for the following items have been addressed by the applicant in the 10/9/81 submittal. This submittal is currently under review by the SQRT.

a) Horizontal Fuel Transfer System Containment Closure (NSSS 4).
Information concerning verification of computer code "F-1" is provided as attachment 1 in the 10/9/81 submittal.

b) Hydrualic Control Unit (NSSS 8). Information on HCU fatigue calculation is provided as attachment 2 in the 10/9/81 submittal.

c) Standby Service Water Pressure Indicator Switch (BOP 2).

d) RHR Solenoid Valve (BOP 4). The concerns described in Attachment III.19 are addressed as attachment 5 in the 10/9/81 submittal.

e) Standby Diesel Generator Control Panel (BOP 10). The concerns described in Attachment III.25 are addressed as attachment 6 in the 10/9/81 submittal.

f) HPCS Service Water Pump (BOP 11). The concerns described in Attachment III.26 are addressed as attachment 7 in the 10/9/81 submittal.

The review of the applicant's implementation of the equipment qualification program is continuing and the applicant is required to resolve all outstanding items as identified in Section 4 above.

T. Y. Chang
Equipment Qualification Branch
Division of Engineering

Enclosure:
As Stated

cc: R. Vollmer, w/o enclosure
W. Johnston
R. Tedesco
A. Schwencer
D. Houston
G. Bagchi
A. Lee
M. Haughey
R. Riggs
R. Wright
J. Singh, INEL
M. Reich, BNL

ATTACHMENT I

SQRT VISIT TO GRAND GULF

LIST OF ATTENDEES

T. M. Johnston	MP&L
Rufus A. Brown	MP&L
Ricky L. Patterson	MP&L
E. S. Slater	MP&L
Danny G. Bost	MP&L
L. F. Dale	MP&L
Rahim Munshi	MP&L
R. Fron	MP&L
M. F. Haughey	NRC
T. Y. Chan	NRC
W. J. McConaghy	Nutech
Sudhansu Saha	Bechtel
Dan Fouts	Bechtel
Lloyd Schrader	Bechtel
T. R. Mager	Nutech
M. P. Voutyras	Nutech
A. B. Davy	Bechtel
J. C. Rawlings	Nutech
J. E. Sundergill	Bechtel
N. Luria	GE
D. Shamis	GE
W. C. Sherbin	GE
J. Mokri	GE
W. C. Eiff	MP&L
A. Javid	Nutech
D. K. Henrie	GE
Jim Cleveland	GE/SAI
G. Bagchi	NRC
R. W. Hardy	GE
G. Q. Ulpindo	GE
Clarke Kido	EG&G Idaho, Inc.
Clyde Nieh	GE
J. N. Singh	EG&G Idaho, Inc.
T. R. Thompson	EG&G Idaho, Inc.
E. Gibo	GE
D. L. Faulstich	GE
T. L. Bridges	EG&G Idaho, Inc.

ATTACHMENT II

SQRT VISIT TO GRAND GULF

LIST OF EQUIPMENT SELECTED FOR AUDIT

a.) NSSS Equipment

1. Recirculation Flow Control Valve
2. Residual Heat Removal Pump and Motor
3. Relay, Panel Mounted Device
4. Horizontal Fuel Transfer System Containment Closure
5. 48 Inch Wide Panel (H22-P011)
6. Standby Liquid Control Pump and Motor
7. Control Room Panel
8. Hydraulic Control Unit
9. Termination Cabinet
10. Standby Liquid Control System Explosive Valve
11. Head Strongback Carousel
12. Recirculation System Sample Probe
13. Main Steam Safety Relief Valve
14. Reactor Core Isolation Cooling Pump
15. Reactor Core Isolation Coolant Turbine

b.) BOP Equipment

1. 6.9 KV Switchgear
2. Standby Service Water Pressure Indicator Switch
3. Standby Diesel Generator Jacket Water Standpipe
4. RHR Solenoid Valve
5. SRV Air Accumulator
6. 6 Inch CRD Gate Valve and Actuator
7. Load Center Unit Substation
8. 125 V DC Panel Board
9. Trap Door Fire Damper
10. Standby Diesel Generator Control Panel
11. HPCS Service Water Pump
12. 40 MW Fan
13. Containment Polar Crane
14. ASCO Solenoid Valve

ATTACHMENT III

Report of SORT visit to Grand Gulf

EG&G Idaho, Inc.
P.O. BOX 1625, IDAHO FALLS, IDAHO 83415

September 30, 1981

Mr. R. E. Tiller, Director
Reactor Operations and Programs Division
Idaho Operations Office - DOE
Idaho Falls, ID 83401

REVIEW OF DYNAMIC QUALIFICATION OF SAFETY RELATED ELECTRICAL AND MECHANICAL EQUIPMENT FOR GRAND GULF (A6415) - Saff-269-81

Dear Mr. Tiller:

During the week of July 27 to July 31, 1981, EG&G Idaho personnel (J. N. Singh, T. L. Bridges and T. R. Thompson) assisted NRC in the review of selected seismically qualified equipment. The audit which was performed at the plant, consisted of field inspection of the equipment, detailed review of the qualification reports, and resolution of questions or identification of action items encountered during the review.

The enclosed report covers the initial findings from the review and completes A6415 Pert Chart Node JJ-39, Subtask 3, for the Grand Gulf plant. Subtasks 4, 6, and 7 remain to be done for this plant.

Very truly yours,

T R Charlton for

B. F. Saffell, Jr., Manager
Code Assessment and
Applications Division

BLB:acf

Enclosure:
As stated

cc: Y. Chang, NRC-DE
G. Bagchi, NRC-DE
R. W. Kiehn, EG&G Idaho (w/o Attach.)

GRAND GULF
SQRT VISIT REPORT
(Initial)

AUTHORS
J. N. Singh
T. L. Bridges
T. R. Thompson

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3	NSSS-3	RELAY, PANEL MOUNTED DEVICE	
4	NSSS-4	HORIZONTAL FUEL TRANSFER SYSTEM CONTAINMENT CLOSURE	
5	NSSS-5	48 INCH WIDE PANEL	
6	NSSS-6	STANDBY LIQUID CONTROL PUMP AND MOTOR	
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8	NSSS-8	HYDRAULIC CONTROL UNIT	
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10	NSSS-10	STANDBY LIQUID CONTROL SYSTEM EXPLOSIVE VALVE	
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16	BOP-1	6.9KV SWITCHGEAR	
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22	BOP-7	LOAD CENTER UNIT SUBSTATION	

23	BOP-8	125V DC PANEL BOARD
24	BOP-9	TRAP DOOR FIRE DAMPER
25	BOP-10	STANDBY DIESEL GENERATOR CONTROL PANEL
26	BOP-11	HPCS SERVICE WATER PUMP
27	BOP-12	40 MW FAN
28	BOP-13	CONTAINMENT POLAR CRANE
29	BOP-14	SOLENOID VALVE

1. RECIRCULATION FLOW CONTROL VALVE

The Recirculation Flow Control Valve (Equipment No. B33-F060; Model No. SS150) was supplied by Fisher Controls. This straight through ball type 72L X 94H in. valve, weighing about 16000 lbs. (wet) was located in the Drywell at an elevation of 107 feet. It was welded to the piping. The referenced qualification report is the design report for 24 inch SS-150 ball valve "TR-2608-1, Design Report, January 1978." This report was prepared by Fisher controls and reviewed by General Electric. Seismic and hydrodynamic loads are considered in the qualification.

This item was qualified through analysis. The operability of the valve is not a required function for safety. Its main purpose is to maintain the pressure boundary. Structural integrity is the main concern and hence a strength analysis. A hand calculation indicated a minimum frequency of 73Hz in the lateral direction for the overhang and 94Hz for the ball shaft. The feedback rod was exempt from the frequency calculation because the structural failure of it would not compromise the pressure boundary. This system, thus being relatively rigid was analyzed statically. A value of 6.0 g in each of the horizontal directions and 9.0 g in the vertical direction was chosen for the analysis. Housing to body studs were analyzed for this load and showed a stress value of 66.5 ksi against the allowable of 81.0 ksi (2 Sm = 4/3 Sy). These chosen values of accelerations were found to be much higher than the actually required level of 1.2 g in each of the horizontal directions and 0.6 g in the vertical direction from the piping analysis. The load combination method was SRSS. Fatigue effects of constant "dither" were considered in the design, and materials and stresses were selected for a 40-year life of components.

The analyses performed are adequate. Sufficient margin for safety is present.

Based on our observation of the field installation and review of the analysis reports this equipment is adequately qualified for the prescribed loads.

2. RESIDUAL HEAT REMOVAL PUMP AND MOTOR

This item [model number 30DX-Z0CKXHZ (Pump); 5K6339XC186A (motor)] was supplied by Byron Jackson, General Electric Motor Plant. It is a vertical deep well pump 443 inches long including the motor. It is mounted with 24-2 inch bolts in the auxiliary building at elevation 93'-0".

This equipment was qualified through analysis. A lumped mass model was developed and a response spectrum analysis was performed using SAP4GO6. Thirty modes were used in determining the response to input from three orthogonal directions. Responses due to individual modes were combined by SRSS with closely spaced modes combined according to Reg. Guide 1.92.

This equipment is located outside the reactor building so it is not affected by high cycle suppression pool loads. Allowable g levels were approximately 7 to 9 times the maximum calculated response values.

Based on our review of the analysis reports, observed field installations, and clarifications provided by the applicant, this piece of equipment is adequately qualified for the seismic loads.

3. RELAY, PANEL MOUNTED DEVICE

This item (Equipment MPL No. E12A-K40B) measuring about 4 x 1 1/2 x 1 inch (a plug on relay) was supplied by General Electric. It was mounted on panel H13-P618, about 2 feet from the bottom. The panel is located in the control building at an elevation of 166 feet. This device along with its mounting on the panel was qualified on the basis of tests done on a similar Confrentes panel with devices. The referenced document was the "Seismic Test Report H13-P618" prepared and reviewed by General Electric. Seismic load was considered in the qualification.

The test performed on the Confrentes panel was a multifrequency, multiaxis random input. In the range of 1 to 33Hz it had natural frequencies of 19, 27.4 and 33Hz in S/S, F/B and vertical directions, respectively. TRSs generated enveloped the RRSs for the highest location of this kind of panel (189 feet) for Grand Gulf. A number of devices were mounted on it. The required acceleration (peak) level for the device E12-K40B for its location was determined to be 3.3 g (F/B), 1.7 g (S/S) and 0.3 g (V). This particular device had previously been tested (on a similar panel) to a level of 4.0 g (f/b), 3.0 g (s/s) and 1.5 g (v).

An inquiry was made of the applicant about dynamic similarity of the panel and the particular device. He stated that, in general, the two panels had substantially the same dynamic characteristics and in particular his statement included "Device E12A-K40B, on panel H13-P618 has a dual axis seismic capacity of 4 g (f-b), 3g(s-s) and 1.5 g (v). The maximum expected acceleration, by similarity to a tested panel is 3.3 g (f-b), 1.7 g (s-s), and 0.3 g (v)."

Based upon the observation of the field installation, the review of the report and particularly the assurances provided by the applicant this device is qualified for the prescribed loading.

4. HORIZONTAL FUEL TRANSFER SYSTEM CONTAINMENT CLOSURE

This closure is a 38 inch diameter, hinged, stainless steel plate door 1 3/4 inches thick. It is located on the containment side of the fuel transfer tube at elevation 185 ft 4 in. Sundstrand Energy Systems was the manufacturer of the containment fuel transfer tube closure (model No. GE-794E945). It was qualified for seisic and hydrodynamic loadings by analysis performed by Sundstrand Energy Systems (report No. VPF 5520-37-2, dated 9-15-77).

The design and analysis of this closure was performed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code Section III, Division 1, Subsection NE for Class MC Components (winter addenda 1975). The fundamental natural frequency was determined to be 188 Hz. This was based on a closed form solution for circular plates assuming clamped edges. Analysis of the closure for seismic and hydrodynamic loading was performed using the static equivalent method. An acceleration value of 1.75 g's was used which is considerably more than the required ZPA value of 0.75 g horizontal and 0.40 g vertical for combined SSE and SRV spectra. The mass of the closure and water enclosed in the transfer tube was multiplied by 1.75 g acceleration to obtain a seismic equivalent load. This seismic loading combined with the other required loads (dead weight and pressure) was used to determine the required thickness of the closure. The thickness required was determined to be 1.12 inches, which is considerably less than the 1.75 inches actual, thus, providing additional safety. For quick locking closures, the ASME Code requires that the closures be analyzed assuming the loss of one of the locking lugs. This was done using the computer Code F-1, a Sundstrand Energy Systems in-house computer program. Evidence that this program has been verified or approved for this type of application was not available. This information is requested of the applicant. The applicant is also asked to provide documentation describing what means or procedure will be used to assure that the fuel transfer tube closure is closed and latched during reactor operation.

Based on the field inspection of the closure and a review of its analysis, the closure is adequately qualified for seismic and hydrodynamic loading pending receipt of additional information requested.

5. 48 INCH WIDE PANEL (H22-P011)

This panel is an open frame work type panel, 48 inches wide, 84 inches tall, and 30 inches deep. Electric switches and gauges are mounted to horizontal unistrut members of the panel. Field mounting of this panel is accomplished with 4 inch long intermittent welds spaced at 12 inches at the panel base. Panel H22-P0111 is located at elevation 184 feet 6 inches of the containment building. This panel was manufactured by GE, (model No. H22-P011). The panel and associated devices were qualified for seismic and hydrodynamic loading by testing performed by GE, documented by report No. DRF #H22-13.

Tests performed on a similar panel were used to qualify the Grand Gulf panel H22-P011. The similar panel (Confrentes H22-P005) was of the same design with different devices of the same mass. The first test performed on this panel was a resonance search. Five OBE and one SSE level multi-frequency, multi-axis tests were also done. The natural frequencies were determined to be 14 Hz side to side, 15.5 and 43 Hz front to back, and 53 Hz vertical. The Confrentes test spectra for both the SSE and OBE tests envelope the Grand Gulf required spectra. Test mounting was accomplished with 5/8 inch bolts and clamps which is conservative in comparison to the welded base of the Grand Gulf panel. The panel maintained its structural integrity before, during, and after the tests. The safety devices mounted on the Grand Gulf panel (switches-master parts No's CA1A-SO 3A/B) were qualified based on tests performed on these devices on another panel. As shown below, the test acceleration values for these devices were greater than required for the Grand Gulf panel device location.

	Test acc.	Required acc.
F/B	7.5 g	7.0 g
S/S	10 g	5.0 g
Vertical	4 g	1.8 g

Based on the field inspection of the 48 inches wide panel and a review of its testing qualification report, this panel is qualified for seismic and hydrodynamic loading.

6. STANDBY LIQUID CONTROL PUMP AND MOTOR

This item (model number 2X3TD-60, serial number N74226TH516) was supplied by Union Pump Company. It is a horizontal, reciprocating action pump 21-7/8 inches high, 59 inches long, and 43 inches wide. Its function is to inject a neutron absorber into the reactor vessel in case of control rod failure. It is attached with 7-3/4 inch bolts to the floor of the containment building at elevation 185 feet.

This pump and motor assembly is used by General Electric in several nuclear power plants besides Grand Gulf so the qualification was done based on generic considerations. The pump was qualified by analysis. Several conservative calculations for lowest natural frequency of the pump show it to be in the range of 100 hertz, thus rigid. The ZPA for the analysis was taken as 1.75 g, more than twice the ZPA of 0.83 g required at Grand Gulf. The stress levels were less than half the allowables.

The motor was qualified by test. A sine sweep test from 10 to 80 hertz showed no natural frequencies in that range. A single frequency, multi-axis test was used for qualification of the motor with 4 OBE's and 8 SSE's being run. The ZPA used in the test was 2.0 g's. This is considerably more than the 0.83 g requirement at Grand Gulf. No motor failure occurred during seismic testing. Upon completion of the test, the motor was coupled to a dynamometer set for 40 HP and ran successfully for 125 minutes continuously.

Based on our observation of the field installation and review of the vendor's reports this piece of equipment is adequately qualified for the seismic loads at Grand Gulf.

7. CONTROL ROOM PANEL

This panel (Model No. H13-P601), measuring 117.5W X 300 X 84H inches was supplied by General Electric Company. It was at an elevation of 166 feet located in the control room. The mounting consisted of 5/8 inch bolts on 6 inch centers utilizing all the holes at the base. The referenced qualification document was "Seismic Test Report H12-P870" prepared and reviewed by General Electric Company. Seismic load was considered in the qualification.

This control panel was qualified based on its similarity to panel H12-P870, which was tested. The test mounting of H12-P870 utilized all the holes provided in its base. There were a number of devices mounted on it during the test and two kinds of tests were performed. The first was a 0.5 g sine sweep-input resonance search in the range of 2 to 50 Hz.

The indicated natural frequencies were:

F/B: 17.5, 26.5, 29.5 Hz
S/S: 14 Hz
V: none.

The second was multifrequency, multiaxis random input. Several tests of this kind were performed and spectra generated. The TRSs were compared to generic RRSs developed by GE. It utilized a damping value of three percent. The applicant stated that these RRSs enveloped the RRSs for Grand Gulf with sufficient margin. The TRSs also enveloped the RRSs.

A question was asked of the applicant as to the dynamic similarity of the panel H13-P601 to panel H12-P870, he responded in writing as follows:

"Seismic testing was performed on a prototype ACR panel (ACR-P870) for the purpose of qualifying Susquehanna benchboards and all other BWR/6 ACR

panels with the same cross-section. The prototype was built to simulate the right third of Susquehanna H12-P870 and included Grand Gulf equipment.

Since the G.G. panel H13-P601 has a similar cross-section and houses the same type of class 1E equipment (inserts) as ACR-P870, the test results are applicable in qualification of P601 by similarity.

P601 is 117.5"W x 30"D x 84"H and P870 is 64"W x 35.5"D (at base) x 86"H. The difference in height and depth are negligible and would not have a significant effect on panel response. P870, which is narrower, would exhibit higher responses, than would be expected of P601, during side-to-side vibration. Therefore, the differences in overall dimensions between P601 and P870 are such that the safety margin is increased by application of test results to P601.

Dynamic characteristics of the two panels are essentially the same even though the dimensions are somewhat different."

However, the test on H12-P870 reported the following anomalies.

1. Contacts 21 and 22 tripped during test No. 7. Chatter detector was reset and no further trips occurred.

2. Contacts 21 and 22 tripped during test No. 8. Chatter detector was set to 1 ms and no further trip occurred.

3. At the completion of test No. 12 (during post test), it was noted that Section 3 of the mode switch would not activate. This test continued with this anomaly (contacts affected were 21-22 and 23-24). The switch was disassembled following the final run. It was noted that some of the sections appeared slightly warped. This could have been caused (the report states) by overtightening of the assembly bolts which hold all the segments of the switch together.

4. Several of the controllers and recorders were sliding out of their mounting brackets. The movement was no more than two inches at any time and none of the equipment fell out of the cabinet. It is believed that the spring tabs on some of the controllers were not bent into a large enough angle to hold them in place (the report states). Adjustments made during the test eliminated the problem.

In regard to concerns expressed above, the applicant stated the following:

"Mode Switch: The mode switch is not located on the Grand Gulf Control Room Panel H13-P601. It is located on panel H13-P680. The mode switch was tested on prototype panel H12-P870 (prototype for panel H13-P601) only as a matter of convenience.

As mentioned in the test report for prototype panel H12-870, several anomalies were observed concerning the mode switch. Additional seismic qualification was recommended. This additional qualification has been satisfactorily completed and is documented in GE DRF A00-696.

Controllers and Recorders: Movement of several controllers and recorders was observed during the test of prototype panel H12-P870 (prototype for panel H13-P601).

These various components were tested on prototype panel H12-870 only as a matter of convenience. Grand Gulf panel H13-P601 has only one of these components, controller 163C1392. This controller continued to function during the test of prototype panel H12-P870, in spite of the movements observed. It was concluded that no additional requirements need be placed on production panels since normal procedure following a seismic event requires inspection of all safety related equipment."

However, the following concerns remain:

1 & 2: What did the resetting of the chatter detector imply (with respect to anomalies 1 and 2). Assurance is required from the applicant that the device safety function was still verified.

3: With respect to anomaly 3, the concern remains as follows:

What steps are taken to prevent/detect the same overtightening from taking place for the one in the field? Further, the report GE DRF A00-696 was not available during the site-visit.

4: As the applicant states, the controller did function in spite of its sliding. However, is it a singular case or is the functioning of the item reasonably assured? There were some adjustments made during the test (as the report indicated) which eliminated the problem. Were the same adjustments carried out in the field?

In order to complete our review a satisfactory response to the above mentioned operational/integrity concerns is needed from the applicant.

8. HYDRAULIC CONTROL UNIT

Hydraulic control units (model No. GE-767E800) were supplied by General Electric. There are 193 units each consisting of an assembly of valves, tanks, piping and electric controls which operate the control rod drives. Each module measures 22 inches wide, 102 inches high, by 20 inches deep. Field mounting of these units was accomplished using four 3/8 inch diameter bolts at the base and two 3/8 inch diameter bolts at the top of the modular frame work. These hydraulic control units are located at elevation 135 feet 4 inches of the containment building. These units were qualified for seismic and hydrodynamic loading by tests performed by Wyle Lab documented by report No. 58530.

The dynamic tests performed were multi-frequency and multi-axes. These tests were performed for two mounting conditions (one flexible and one rigid) which bound the field installation conditions. The test response spectra enveloped the required response spectra for both mounting conditions. The hydraulic control unit successfully performed its function before, during, and after each seismic test. The applicant considered fatigue effects using the ASME Section III fatigue curves. It was not clear how the stress value was determined to establish an allowable number of cycles using the fatigue curves. The applicant is requested to supply this information. There were five OBE and one SSE level tests.

Based on the field inspection and review of the qualification reports, the hydraulic control unit is adequately qualified for seismic and hydrodynamic loading pending satisfactory resolution to the fatigue concern.

9. TERMINATION CABINET

The termination cabinet (Model No. H13-P701) was supplied by General Electric Company. It was located in the control room of the auxiliary building at an elevation of 166 feet. This cabinet measuring 96 x 102 x 36 inches houses termination and termination connector modules and cables. The field mounting consisted of one inch welds on twelve inch centers between the base of the cabinet and the floor. The qualification document referred to was A00-794-5-1 of October 1, 1980, prepared by David M. Rhuble and Associates and reviewed by General Electric Company. Seismic load was considered in the qualification.

This cabinet was qualified on the basis of tests carried out on a prototype 700 series. The test mounting for this was with 5/8 inch bolts utilizing all the holes provided. This appears to be conservative. A resonance search test indicated natural frequencies of:

S/S:	22.5, 27.5 Hz
F/B:	6, 20 Hz
V:	none

in the 5 to 33 Hz range. Subsequently, it was subjected to a series of multiaxis, multifrequency tests with random inputs. Test spectra were generated and compared to a generic spectra generated by GE which in turn enveloped the Grand Gulf spectra. There was a sufficient number of tests to fulfill the mechanical fatigue criteria.

The tests performed on the 700 series cabinet are adequate. But, the report states that upon the completion of the seismic vibration exposure of the subject termination cabinet it was discovered that the doors of the cabinet were distorted due to input motion stimulation and some welds in the cabinet were cracked. However, neither of the structural deformations caused any anomaly as to the functioning of the cabinet during or after the seismic exposure. Therefore, no class IE function of the cabinet was

aborted. A question was asked of the applicant as to the effect of this apparent structural failure on other adjacent equipment and its margin. The applicant responded as follows:

"The door did not become detached, and therefore, could not damage any adjacent equipment during a seismic event. The test input was 16 g to cause this to occur, whereas the Grand Gulf ZPA is 0.5 g, showing more than adequate margin."

Based on our observation of the field installation, review of the qualification reports and the applicant's response to our questions, the termination cabinet is adequately qualified for the prescribed load.

10. STANDBY LIQUID CONTROL SYSTEM EXPLOSIVE VALVE

This explosive actuated valve is 7 inches in diameter by 4.5 inches long. It was manufactured by Conax with Model No. 1832-159-01. It is installed between two 1500 psi rated 1 1/4 pipe flanges with four 1 inch diameter bolts attaching the valve to each flange. This valve is located at elevation 185 feet of the containment building. It was qualified for seismic and hydrodynamic loads by tests performed by Conax documented by report No. VPF 3394-36-2 dated 12-22-76.

The dynamic qualification consisted of a resonance search and 5 OBE plus 1 SSE biaxial sine beat tests. No natural frequencies of the valve body were found below 35 Hz from the resonance search test. The fundamental natural frequency of the actuator was determined to be above 60 Hz based on closed form hand calculations. The biaxial sine beat test inputs were:

	Side to Side	Front to Back	Vertical
OBE	4.5 g	4.5 g	3 g
SSE	6.5 g	6.5 g	4.5 g.

The required ZPA for combined SSE and hydrodynamic loading is:

S/S 2.144 g, F/B 3.21 g, V 1.363 g.

The valve performed satisfactorily before, during and after the dynamic sine beat tests. No structural damage was sustained by the valve from the tests.

Based on the observed field installation and review of the test qualification reports, the SLC system explosive valve is qualified for seismic and hydrodynamic loads.

11. HEAD STRONGBACK CAROUSEL

This device is a cruciform shaped lifting strongback which provides four point lifting of the reactor vessel head. The strongback has a circular nut tray and crane rail attached to it. Suspended from the circular crane rail are eight hydraulic stud tensioners. This carousel was supplied by GE with model No. 767E572G3. Qualification of this strongback was accomplished by static analysis performed by General Electric (report no. DRF F13-12) and a static load test.

The design and analysis of the head strongback was performed in accordance with the requirements of Crane Specification CMAA-70 (Crane Manufacturers Association of America). The strongback was designed for lifing 125 tons with a minimum safety factor of 5 with respect to the ultimate material strength. The Grand Gulf reactor head weight is 92 tons. The margin between the actual weight of 92 tons and the design value of 125 tons accounts for impact and seismic loading. The two main beams of the strongback were designed assuming that only two arms of the strongback support the lifting load rather than all four arms. The four lifting rods are adjustable so that the load in reality is supported by all four. In reviewing the analysis it was noted that in a couple of areas a total safety factor, as a result of two safety factors, was obtained by adding the two rather than by multiplying the two values. This had no effect on the outcome of the analysis as adequate safety margin was present. In addition to the analysis, the strongback was qualified by a static load test of 156 tons. All load carrying welds were inspected (magnetic particle) per GE specification E50-YP1 before and after the load test. In addition, load carrying members were inspected for permanent deformation after the load test. No deformation or weld cracks were detected. A storage location with support pads is provided for the strongback when it is not in use. The support pads provide adequate support for seismic motion.

Based on the field inspection and a review of the analysis and test reports, the head strongback carousel is adequately qualified for seismic loads.

12. RECIRCULATION SYSTEM SAMPLE PROBE

This item was supplied by Associated Piping and Engineering Corporation, Inc. It is a 3/4 inch pipe welded to the inside of the recirculation pipe at elevation 121 feet 4 1/4 inches in containment. The model number on the installed item was not available. This item is used for testing water chemistry.

This item was qualified by analysis. It is a short, stubby beam with a natural frequency of over 300 hertz, thus it behaves as rigid. The maximum of 1.45 g from the spectra (not the ZPA) was conservatively used in the calculations for seismic loading. The drag force due to fluid flow past the tube was considerably higher than the seismic loading. The combined load yields a stress level of about 6000 psi, well below the 17,000 psi allowable. Stress levels are low enough so infinite cycles are allowed by the ASME code for fatigue considerations.

Based on our review of the analysis reports and procedures, this item is adequately qualified for seismic loads at Grand Gulf.

13. MAIN STEAM SAFETY RELIEF VALVE

The Main Steam Safety Relief Valve (Model no. G471-6/125.04) was supplied by Dikkers. It was located in the drywell on main steamline at an elevation of 157 feet. Its mounting consisted of 12-1 5/8 inch studs on the inlet side and 16-1 inch studs on the outlet side. This spring loaded safety relief valve with pneumatic actuator (24 thick , 36 long x 55 tall, inches) weigns about 3155 lbs wet. It relieves reactor pressure at a set value upon automatic signal or operator command. The referenced qualification report was VPF 5529-25-1 of November 18, 1977 prepared by Wyle Lab. Huntsville, Alabama and reviewed by General Electric Company. Seismic and hydrodynamic loads were considered in the analysis. SRSS technique was used for RRS combination.

This piece of equipment was qualified through test. The laboratory mounting was similar to the field mounting. A sine sweep of 0.2 g magnitude in the range of 1 to 150 Hz indicated natural frequencies of:

S/S:	57 Hz
F/B:	60 Hz
V:	59 Hz.

These frequencies are essentially in the ZPA range of the RRS. It was then subjected to a series of multifrequency, multiaxis random input tests. The input ZPA levels were:

S/S:	6.5 g
F/B:	6.5 g
V:	4.5 g

for OBE tests and

S/S	9.0 g
F/B	9.0 g
V:	6.0 g

for SSE level tests. The TRSs for various tests were generated. It did not nave any RRSs to be compared to. These were, however not required as the unit was essentially rigid. Therefore, the ZPA values were sufficient for comparison. These were obtained from the piping analysis and had a resultant value of 7.2 g for horizontal and 2.27 g vertical (both ZPA). A total of 56 dynamic load tests were run in this program. The acceleration level varied from 0.2 g to 9.0 g horizontally and 0.2 g to 6.5 g vertically over a frequency range of 1 to 150 Hz.

The tests performed are adequate. The accelerometer mountings were satisfactory. In a test the interfacing between the flanges were not exact and the gasket crushed. In response to a question about this, the applicant stated that the gasket problem was corrected and the test repeated satisfactorily. The seat leakage in the test was within the allowable limit.

Based on our observation of the field installation, review of the test report and the clarification provided by the applicant, this item is adequately qualified for the prescribed loadings.

14. REACTOR CORE ISOLATION COOLING PUMP

This item [model number 6XCX10.5-(D-CP), serial number 230520] was supplied by Bingham Willamette Pump Company. It is attached with four 1 1/2 inch bolts to the auxiliary building floor at elevation 93 feet. Its function is to inject cooling water into the reactor during isolation.

This equipment was qualified through analysis. A static analysis was performed using hand calculations. The pump was determined to have a natural frequency of 47 hertz, so no dynamic amplification above the 0.25l g ZPA of the spectra is required. Stress results were all below the allowables.

This pump is located outside the reactor building so it is not affected by high cycle suppression pool hydrodynamic loads.

Based on our review of the analysis reports, observed field installations, and clarifications provided by the applicant, this piece of equipment is adequately qualified for the seismic loads at Grand Gulf.

15. REACTOR CORE ISOLATION COOLANT TURBINE

This equipment (model number GS-2 No. 38175-A) was supplied by Terry Steam Turbine Company. It is attached with six 1 inch bolts to the auxiliary building floor at elevation 93 feet. It is a single stage base mounted turbine whose function is to drive the RCIC pump to inject water into the reactor during isolation.

The turbine was qualified by a test performed by Wyle Labs. The test was quite conservative for Grand Gulf since this turbine is used by General Electric for several other nuclear power plants. The test was conducted at about 7 g's. Several problems were encountered during qualification. The mounting studs loosened after several OBE runs. During retesting at a lower g level a turbine trip occurred due to mounting bolts loosening. Excessive deflection of the lube oil piping was also observed so additional restraint was provided for the lube oil piping to complete the test.

It is recommended that (1) modifications be made to the mounting bolts to prevent their loosening during a seismic event, and (2) that additional lube oil piping support be provided. General Electric has a scheduled in-house requirement to issue a Field Disposition Instruction (FDI) to provide a support bracket on the Grand Gulf RCIC turbine lube oil piping. Verification of the installation of this support bracket is required prior to fuel loading. Therefore, seismic qualification of the RCIC turbine is delayed pending resolution of the two items mentioned above.

16. 6.9 KV SWITCHGEAR

This equipment (MPL No. Q1R22S103C-B) was supplied by General Electric Company. The assembly was a double stack measuring about 72 x 94 x 95 inches. It was located in the auxiliary building at an elevation of 139 feet. The mounting consisted of welds. The qualification documents referred to were G.E. Certified Seismic Report-Req. 311-06659 of July 17, 1978 and Wyle Report 43831-4 and-5 for tests done June 21, 1978 at Wyle Laboratories; Huntsville, Alabama. It was reviewed by General Electric Co: (Switchgear Business Dept.). Seismic load is considered in the qualification.

This item was qualified based on test. The laboratory mounting was same as field. The required ZPA were:

	S/S	F/B	V
OBE:	0.180 g	0.174 g	0.101 g
SSE:	0.361 g	0.349 g	0.202 g.

A resonance search test indicated the following frequencies:

S/S: 5.3-6 Hz; F/B: 13-14 Hz; V: 31-32 Hz

in the range of 1 to 40 Hz. It was also subjected to multiaxis, multifrequency random input tests. TRSs were generated. The ZPA for the inputs were:

	S/S	F/B	V
OBE	1.6 g	0.8 g	0.75 g
SSE	3.2 g	1.6 g	1.5 g

The TRSs enveloped the RRSs. There were five OBE and one SSE level tests performed. Functionally, the power/vac only has to trip upon command. This function was successfully demonstrated 24 times (8 times for each of the 3 breakers) without failure during the double stack test series and 6 times without failure during the single stack test series.

Based on our observation of the field installation, review of the test report and the clarifications provided by the applicant, this item is adequately qualified for the prescribed loading.

17. PRESSURE INDICATOR SWITCH

The Pressure Indicator Switch (Model no. 510DU237028; equipment no. 1P41-P1S-N062A) was supplied by Rosemount, Inc. It measures about 6 31/32 H x 1 1/16 W x 9 7/8 D inches and weighs about 1.38 lbs. It was mounted with two captive screws on panel H13-P871 which was located in the control building at an elevation of 190 feet. The referenced document was: 3768A/Qualification Test Summary for the Trip/Calibration System Rosemount Model 510DU of March 9, 1976. The Seismic test was performed by Environmental Laboratory, Bloomington, Minnesota. Seismic load was considered in the qualification.

This device was qualified through test. The first series of tests indicated that it did not have any resonance below 33 Hz in any of the three directions. Then it was subjected to a series of single axis single frequency sine dwell tests of 30 to 40 seconds duration with input g-levels between 11 to 20. This was a fragility test. It was a nonoperational test conducted to determine if the unit would still be operational after exposure to g-levels greater than 11 g. At 15 g, however, the head screw used to hold one of the front bars to the left end bracket sheared and two wires broke loose. This happened again at 20 g. Finally the screw was replaced with a screw having a higher yield strength.

The device did not have any natural frequency below 33 Hz. Therefore, single axis, single fequency is adequate. The test results showed a maximum shift in trip point of -0.024 percent of span. This was within the specified shift of $\pm$0.13 percent of span.

However, the required g-level at the instrument location from analysis and/or test on panel H13-P871 was not available. Further, the test report from the testing laboratory (Environmental Laboratory) was not available. Only a summary was provided during the review.

In order to complete the review, the following is required:

1. the g-levels for the instrument location, and

2. the laboratory report from Environmental Laboratory.

18. STANDBY DIESEL GENERATOR JACKET WATER STANDPIPE

This item is part of the Standby Diesel Generator Engine and Appendages. The standpipe holds a supply of water used for cooling the jacket of the Standby Diesel Generator. It is located in the Diesel Generator building at elevation 136 feet. It is provided by DeLaval Turbine Inc.

This item was qualified by analysis. It was part of the auxiliary skid analysis. A 3-D finite element response spectrum analysis was performed using ANSYS. Modal responses were combined by SRSS using absolute sum of closely spaced modes. Two modes of the standpipe were obtained from the system analysis. The stresses are below the allowable values.

Based on our review of the analysis reports, observed field installations, and clarifications provided by the applicant, this piece of equipment is adequately qualified for the seismic loads at Grand Gulf.

19. RHR SOLENOID VALVE

The Solenoid Valve with rectifier (Model no. 75GG00L) was supplied by Target Rock Corp., East Farmingdale, N.Y. This two-way, in-line valve measuring about 7 1/2 x 14 3/4 inches was located in the RHR pump room A of the auxiliary building at an elevation of 123 feet. The mounting consisted of in-line socket weld. The intended function is post accident sampling. The referenced qualification reports were:

1. Report 1735, Seismic Report for Solenoid Motor Operated Globe Valve Assemblies, Model No's 75GG-001 and 75GG-002, of May 7, 1976 (Target Rock Corp.).

2. Report 1827, Environmental Test Report on 75GG002 Solenoid Motor Operated Valve, Soft Seated, High Pressure Version of November 4, 1976 (Target Rock Corp.).

3. Report 1500, Environmental Test Report on 72V Solenoid Valve (with rectifier) of October 22, 1974.

Seismic load was considered in the qualification.

This equipment was qualified on the basis of test. The laboratory mounting was similar to field. A resonance search test with 0.2 g input indicated the following frequencies:

S/S: 16.5, 20 and 26.5 Hz.

F/B: 9,17.5 and 26.5 Hz.

V: 21 Hz.

The required g-levels (ZPA) for the location of the device was

S/S = 3 g; F/B = 3 g; V = 3 g.

Subsequently the following single axis, single frequency tests were performed.

a. Major horizontal axis (S/S): Sine dwell for a period of 10 seconds at 16.5, 20 and 26.5 Hz with inputs of 3 and 4.5 g.

b. Minor horizontal axis (F/B): Sine dwell for a period of 10 seconds at 9,17.5 and 26.5 Hz with inputs of 3 and 4.5 g.

c. Vertical axis (V): Sine dwell for a period of 10 seconds at 21 Hz with inputs of 3 and 4.5 g.

The valve operated satisfactorily during the resonance dwell periods and following the dwell tests.

The device has several natural frequencies in the range of interest. Cross coupling may be a factor. Under these circumstances, single frequency, single axis tests are not adequate without sufficient justification.

In order to complete the review, a satisfactory resolution of the above concern is required.

20. SRV AIR ACCUMULATOR

There are 20 SRV air accumulators (Master parts List No. Q1B21A00AA) manufactured by Buffalo Tank Co. They are vertical tanks 3 feet-2 inches long by 12 3/4 inches in diameter. They are supported on four box section legs approximately 3 ft. long. These tanks are located at elevation 161 feet-10 inches of the reactor building drywell. The tank legs are welded to a heavy steel floor. These tanks were qualified for seismic and hydrodynamic loadings by static analysis performed by Buffalo Tank Co. documented by report No. 9645-M-102.0.

The SRV air accumulators were designed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code Section III, Division 1 for Class 3 components. The fundamental frequency of the tank was determined to be 48.5 Hz based on a closed form solution, assuming the entire mass of the tank to be at the top of the support legs. This is slightly non-conservative since the center of gravity of the tank is somewhat above the top of the support legs. The reduction in natural frequency, however, would not be enough to increase the seismic loading significantly considering the margin of safety with these tanks. The maximum stresses for combined seismic and pressure loading were determined to be:

Location	Stress calculated	Stress allowable
Shell	3,721 psi	12,000 psi
Head	3,914 psi	14,000 psi
Support	936 psi	21,600 psi

Based on the field inspection and review of the analysis, the SRV air accumulators are adequately qualified for seismic and hydrodynamic loading.

21. 6 INCH CRD GATE VALVE AND ACTUATOR

This item is located in the auxiliary building at elevation 119'-0". It is part of the control rod drive system and is used for isolation of the auxiliary building from containment. The valve (No. 1523 W.E.) is supplied by William Powell Company. The actuator (model number SMB-000-5) is supplied by Limitorque Corporation.

A static dead load test was used to qualify this valve. An 8 inch valve was tested to generically qualify this 6 inch valve of identical design. The natural frequency of the valve was calculated to be 61 hertz, thus rigid. Static loads representing 4 g's vertical and 3 g's horizontal were applied simulataneously. These loads are quite conservative when compared to the 0.2 g vertical and 0.3 g horizontal ZPA of the spectra at the floor near where the valve is located. The valve opened and closed without failure while the test loads were applied.

Multi-axis, multi-frequency testing of a generically similar actuator was used to qualify the subject actuator. A resonant search indicated no natural frequencies below 100 hertz. The tested actuator is of the same design as the subject actuator with the motor (2 ft-lb DC tested vs 5 ft-lb AC actual) being the only difference. The actuator performed all functions with no malfunctions or physical damage during and after seismic testing at a 6 g level.

The subject actuator was also tested to 6.1 g's input acceleration using single-axis, single-frequency testing. The actuator operated without failure during testing.

The tests were conducted at very conservative inputs of approximately 6 g's compared to the ZPA floor spectra of approximately 0.3 g's. Based on our observation of the field installation and review of the technical reports with clarification provided by the applicant, this valve and actuator is adequately qualified for the seismic loads at Grand Gulf.

22. LOAD CENTER UNIT SUBSTATION

The Load Center (IPL ID No. Q1R20S650-8) was supplied by I-T-E Imperial Corporation. This was a four cubicle line-up, CUB1-5KVATC, CUB2-750KVA XFMR, CUB3&4, low voltage switchgear and measured about 90H X 58D X 138L inches. This was located in SSWT Basin at an elevation of 133 feet. The mounting consisted of four plug welds per frame to the floor. The referenced qualification reports were:

1. 750 KVA XFMR with primary air terminal chamber. Seismic certification report ITE-S.O. No. 33-50481 of June 17, 1976. Wyle Laboratory tested under I-T-E D.O. 960-4107.

2. Indoor low voltage metal clad switchgear seismic certification report I.T.E. S.O. No. 33-50481 of September 3, 1976. Wyle Laboratories No. 42686-1.

   Seismic load was considered in the qualification.

The transformer and the switchgear were qualified through test. The transformer unit was mounted for testing with 4-0.75 inch bolts which is conservative. A resonance search test with an input of 0.2 g indicated the following frequencies in the range of 0.5 to 50 Hz:

S/S: 8.5, 11, 18, 24 and 32 Hz.

F/B: 5.5, 9, 11, 14, 17, 21, 24, 49 Hz.

V: none.

It was then subjected to multiaxis, multifrequency with random input tests.

The required accelerations (ZPA) in each direction were: (Transformer and Switchgear both)

	S/S	F/B	V
OBE	0.175 g	0.180 g	0.107 g
SSE	0.349 g	0.361 g	0.214 g.

The input g-levels (ZPA) were:

	S/S	F/B	V
OBE	1.5 g	1.25 g	0.75 g
SSE	3.0 g	2.5 g	1.5 g

TRSs were generated and they enveloped the RRSs adequately. Functional operability was verified. There were five OBE and one SSE level tests.

The switchgear unit indicated natural frequencies of:

S/S: 4.5, 13, 18, 23, 30, 40 Hz

F/B: 6, 8, 11, 19, 23, 33 Hz.

The laboratory mounting was similar to the field mounting. The unit was then subjected to multiaxis, multifrequency random input tests. The input g-levels were adequate and the TRSs enveloped the RRSs.

The tests performed are adequate. The functional operabilities were verified.

Based on our observation of the field installation and review of the test reports, these units are adequately qualified for the prescribed loadings.

23. 125V DC PANEL BOARD

The Panel Board (MPL No. Q1L21P112A) was supplied by Delta Switchboard Company. This panel measuring 30L x 14D x 90H inches and weighing about 850 lbs. was located in the auxiliary building at an elevation of 119 feet. The mounting consisted of six 1/2 inch bolts attached to a wall. The referenced qualification report was 58039, Seismic Test of Panel IDA2, March 9, 1976. The test was performed by Wyle Laboratories. Seismic load was considered in the qualification.

This panel board was qualified through test. The laboratory mounting was the same as the field. The required g-levels (ZPA) for the location were:

	S/S	F/B	V
OBE	0.144 g	0.157 g	0.097 g
SSE	0.289 g	0.315 g	0.194 g

A series of multiaxis, multifrequency random input tests were performed with the following g-levels (ZPA):

	S/S	F/B	V
OBE	0.21 g	0.30 g	0.28 g
SSE	0.40 g	0.52 g	0.50 g

TRSs were generated. The TRSs do not envelope the RRSs in the region below 1.25 Hz. Five OBE and two SSE level tests were performed. Functionality was verified.

The test is adequate. The nonenveloping of RRSs in the region below 1.25 Hz and a resonance search not being performed for ascertaining the frequency in this range is a shortcoming. However, natural frequency too close to this range may safely be ruled out.

Based upon our observation of the field installation and review of the test reports, this panel board is adequately qualified for the prescribed loads.

24. TRAP DOOR FIRE DAMPER

This item (model number 2217) is located in the Control Building at elevation 177'-0". It is a frame type door installed in the Control Room HVAC duct whose function is to prevent fire from spreading to different areas of the Control Building through the HVAC ducts. The damper is held open with a fusable link and must remain in the open position during and after OBE and SSE seismic loadings. The damper is provided by American Warming and Ventilating, Inc.

This item was qualified by static analysis using seismic considerations based on generic plant application using 1.5 times the maximum for Bechtel generic plant application or 5.4 g's. This is higher than the Grand Gulf requirements. The fusable link was tested to 5 times the maximum rated load. All stresses were within the allowable limits.

Based on our review of the analysis reports, observed field installations, and clarifications provided by the applicant, this piece of equipment is adequately qualified for the seismic loads at Grand Gulf.

25. STANDBY DIESEL GENERATOR CONTROL PANEL

This equipment (equipment number 1H22P113) is located in the diesel generator building at elevation 136'-0". This control panel is part of the Standby Diesel Generator System and houses relays required for operation of the standby diesel generators. It is provided by Delta Switchboard/Delaval.

This panel was qualified by test using multi-axis, multi-frequency testing. Five OBE tests with input accelerations of 0.6 g horizontal and 0.54 g vertical, and three SSE tests with input accelerations of 1.2 g horizontal and 2.3 g vertical were run. These inputs exceed the Grand Gulf requirements.

During the test the ground overcurrent relay malfunctioned due to chatter greater than 10 μs. This was an electromechanical type of relay. It was to be replaced with a solid state device. This device was then retested in a fixture which simulated the in-service mounting. The response spectra near the relay for the retest was greater than the response spectra near the relay in the original test and envelopes the RRS by a factor of approximately three. The relay performed satisfactorily during the retest.

Field inspection found the original electromechanical relay installed in the panel. On questioning, the applicant agreed that the solid state ground overcurrent relay should have been installed. Therefore, seismic qualification of this panel is not accepted until the solid state ground overcurrent relay has been verified as being installed.

26. HPCS SERVICE WATER PUMP

The HPCS service water pump is a 100 horse power vertical 2 stage pump supplied by Goulds (Model No. V1TX-SD-10 x 14 JHC-2). It is powered by a 100 Hp electric motor supplied by General Electric Company (Model No. 5K 6267XH4012A). The pump-motor assembly is located at elevation 140 feet of the service water pump house. The pump base is bolted to the floor with four 3/4 inch diameter bolts. This unit was qualified for seismic loads by analysis performed by McDonald Engineering Analysis Company. The pump report No. is ME-207 dated 5/25/75 and the motor report no. is ME-292 dated March 9, 1976.

The dynamic analysis of the pump was performed using the response spectra method. This was accomplished using the computer code ICES-STRUDL. The maximum critical stresses for combined operating and seismic loading were determined to be:

Location	Stress calculated	Stress allowable
Column	39,231 psi	42,000 psi
Nozzle	29,256 psi	36,000 psi
Discharge flange	24,789 psi	30,240 psi.

To demonstrate operability during seismic loading the following critical deflections were determined:

Location	Calculated deflection	Allowable deflection
Shaft	.015 inches	.05 inches
Impeller	.00001 inches	.012 inches.

The deflection value for the impeller was obtained by subtracting the SRSS of modal deflections of the impeller and impeller casing. This is not a proper way of detemining relative displacement since relative displacements must be determined for each mode.

The analysis of the motor was accomplished using the static equivalent method. The natural frequency of the motor was determined to be 58 Hz. This used the computer code ICES-STRUDL. Static loading of 3.0 g lateral and 2.0 g vertical was used to determine seismic stresses to be combined with operating stresses. The combined maximum stress was 18,228 psi compared to an allowable of 53,200 psi. The motor rotor deflection was calculated to be 0.00348 inches which is much less than the allowable of 0.030 inches. This assures the operability of the motor during seismic events.

Based on the field inspection and a review of the analysis, the HPCS service water pump is adequately qualified for seismic load pending resolution of the relative displacement concern.

27. 40 MW FAN

The 40 MW fans are horizontal motor, centrifugal fans with approximate dimensions of 34 x 44 x 48 inches with a weight of 846 lbs. There are two of these units located at elevation 133 feet of the control building. The fans were manufactured by Buffalo Forge Co. (Type MW, Size 40). The fans have 20 hp electric motors supplied by Westinghouse. The units were qualified for seismic load by analysis performed by McMahon Engineering Co. documented by report No. 76J-1167 dated 6-28-77.

The analysis of the fans was a static equivalent analysis. The acceleration values used for this were 0.323 g horizontal and 0.223 g vertical. The fundamental frequency of the fan was determined to be 66.5 Hz based on hand calculations. From the review it was apparent that the lowest natural frequency had been overlooked. The flexibility of the motor and fan support channels was not considered in the horizontal direction (bending of the channel web section). A preliminary calculation showed that the lowest natural frequency considering this mode of vibration would be considerably less than 33 Hz. The applicant agreed to stiffen these channels with bracing to eliminate this low frequency. This would make the current analysis valid. The critical stresses from the current analysis
are:

Location	Stress calculated	Stress allowable
Motor shaft	2,189 psi	17,250 psi
Inlet stand bottom flange	8,781 psi	24,000 psi
Foundation bolts	5,330 psi	27,000 psi

The maximum displacement for the motor rotor was determined to be 0.00373 inch compared to an allowable value of 0.1406 inch. This assures operability during seismic loading.

Based on the field inspection and review of the analysis, the 40 MW fans are adequately qualified for seismic loading pending confirmation of suitable bracing additions to the fans' support channels.

28. CONTAINMENT POLAR CRANE

This item (model number CN-25035) is located in the containment building at elevation 238 feet. It is part of the Reactor Vessel Servicing Equipment System and is used primarily for lifting the vessel head and strongback, shroud head and separator, and dryer assembly for maintenance and construction. The crane is provided by Harnischfeger Corporation.

This equipment was qualified by analysis. A 3-D finite element analysis was performed using the Stardyne computer code. Twenty modes were used with modal dynamic responses combined by SRSS. A few locations were identified as being slightly over the allowable stress values. Modifications are being made to the structure to reduce the worst of these to below allowable. The other locations are about 2% over allowable. Because of margin in the load combinations and margin from yield to ultimate stress, the applicant provided justification for acceptance of these stress conditions.

Based on our review of the analysis reports, observed field inspection, and clarifications provided by the applicant, this equipment is adequately qualified for the seismic loads at Grand Gulf.

29. SOLENOID VALVE

The Solenoid valve (master parts list no. Q1Z77-F002A) was supplid by Automatic Switch Company (ASCO) with Model No. HT8320. This valve is approximately 8 inches long by 2 inches in diameter. There are eight such valves located in the control building at elevations 111 feet and 133 feet. The valves are mounted to a vertical plate using two no. 10 screws. Qualification of these valves was accomplished by test performed by Isomedix documented by report No. AQ521678/TR dated March 1978.

Qualification consisted of a resonance search and single-axis, single-frequency fragility tests. No natural frequencies were noted below 33 Hz. The fragility test was performed in both horizontal and vertical directions with an input level of 10 g's. This was done in the 1-33 Hz range at one third octave intervals. Operability of the valves was verified during and after testing. An unacceptable mounting of the solenoid valve was noted during the field inspection. The valve was mounted on a rather flexible mounting plate such that impacting could occur between the plate and a heavy air cylinder behind it. Another piece of safety related equipment is also mounted to this plate. Impact loading could result in seismic loads well in excess of that for which the equipment is qualified. The applicant agreed to eliminate this impacting situation by modifying the mounting plate.

Based on the field inspection and review of the test report, the ASCO Solenoid valve is adequately qualified for seismic loading pending confirmation of an adequate modification of the plate to which the solenoid valve is mounted.

LIST OF ATTENDEES

Rufus A. Brown	MP&L
Ricky L. Patterson	MP&L
E. S. Slater	MP&L
Danny G. Bost	MP&L
Rahim Munshi	MP&L
M. F. Haughey	NRC
T. Y. Chang	NRC
W. J. McConaghy	Nutech
Sudhansu Saha	Bechtel
Dan Fouts	Bechtel
Lloyd Schrader	Bechtel
T. R. Mager	Nutech
M. P. Voutyras	Nutech
A. B. Davy	Bechtel
J. C. Rawlings	Nutech
J. E. Sundergill	Bechtel
N. Luria	GE
D. Shamis	GE
W. C. Sherbin	GE
W. C. Eiff	MP&L
A. Javid	Nutech
D. K. Henrie	GE
Jim Cleveland	GE/SAI
G. Bagchi	NRC
R. W. Hardy	GE
C. Q. Ulpindo	GE
Clarke Kido	EG&G Idaho, Inc.
Clyde Nieh	GE
J. N. Singh	EG&G Idaho, Inc.
T. R. Thompson	EG&G Idaho, Inc.
E. Gibo	GE
D. L. Faulstich	GE
T. L. Bridges	EG&G Idaho, Inc.