PDR

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

Upton, New York 11973
282
(516) ~~345~~ 2448
FTS 666

Department of Nuclear Energy
Building 129

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Dr. Zoltan Rosztoczy, Chief
Equipment Qualification Branch
MS P-1030
Phillips Building
7920 Norfolk Avenue
US Nuclear Regulatory Commission
Bethesda, MD 20014

Enclosed please find our summary reports for the twenty equipment items that were reviewed by BNL during the site visit to the Shoreham Nuclear Power Station in New York during the week of April 6-10, 1981.

At the end of our visit to the plant site, a number of questions pertaining to the particular equipment reviewed were still not completely resolved. LILCO responded to these open issues in a letter dated May 15, 1981, entitled, "Equipment Dynamic Qualification SER Outstanding Issue No. 8 Shoreham Nuclear Power Station-Unit 1 Docket No. 50-322". The reviews being sent to you herewith have taken account of the LILCO responses.

As noted in the specific reviews and the equipment items, not all of the original open issues were satisfactorily answered in the above mentioned LILCO response. We will of course promptly evaluate reponses to these remaining open issues as soon as they become available to us.

Very truly yours,

Morris Reich, Head
Structural Analysis Group

jm
Enc.
cc: R. Riggs
A. Lee

Shoreham Nuclear Power Station

Plant Visit

Documentation Review

Introduction and Summary

This report deals with the evaluation of the dynamic qualification of the particular equipment that was selected by SQRT for qualification review of equipment located at the Shoreham Nuclear Power Station. A site visit was made during the period April 6-10, 1981. At that time, 30 pieces of equipment were scheduled for review by SQRT. One of the selected (i.e., The Seismic Monitor Panel -1H11-PNL-SMP) was later found to be in a nonseismic category and subsequently was excluded from the list. Thus a total of 29 pieces of equipment was selected for review. The review team consisted of J. Curreri, M. Subudhi, A.J. Philippacopoulos and S. Sharma of BNL and A. Lee and R. Riggs of NRC.

The BNL group was assigned to review the 20 equipment items listed below. Of these 9 are categorized as NSSS equipment and 11 as BOP. The remaining 9 pieces of equipment wre reviewed by NRC personnel.

NSSS

1.	1H11*PNL-613:	Process Instr. Cab.
*2.	1H21*PNL-10:	Jet Pump Inst. Rack
*3.	1H21*PNL-36:	HPCI Leak Det. Rack
4.	1C61*PT006:	Pressure Transmitter

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*Note that the review reports for NSSS equipment numbers 2 and 3 have been combined into a single report.

5. 1E32*PDT035: Diff. Press. Transmitter

6. 1B21*RV092: Safety Relief Valve

7. 1B31*MOV031: Recirc. Suction Valve

8. 1C41*P-024: Stdby. Liq. Pump & Mtr.

9. 1C41*EV010: Explosive Valve

BOP

10. 1R24*MCC1123: Motor control Center Bus 1

11. 1R24*PNL-G1: 480 VAC Ckt. Bkr.

12. 1T48*RC-002: Hydrogen Recombiner

13. 1T48*PNL-68: Drywell Gas Analyzer Pnl.

14. 1T46*L/U-059: Logic Unit-Elec. Anal. Inst.
Rk. 1H21*PNL-060

15. 1E21*P-049B: Loop Level Pump

16. 1P41* MOV036A: Vt. Chill. Water Sply. Isol. Valve

17. 1B31* AOV082: Air Operated Valve

18. 1E11* PCV003A: Pressure Control Valve

19. 1R23* T-102: 4160-480V Transf. Bus 1

20. 1M50* PNL-04: Chiller Control Panel

This summary report reviews the original open issues raised during the BNL site visit, answers to the questions submitted by LILCO, dated May 15, 1981 (Letter No. SNRC 564), and our final conclusions in light of the LILCO letter submitted. Essentially, each of the listed equipment and pertinent qualification documents together with the particular open items are specifically addressed in the reports together with our comments regarding the adequacy of the LILCO responses to our original questions.

In summarizing the results of the review, it was found that the dynamic qualification reports for the above mentioned equipment demonstrate design adequacy, pending submission by the applicant of further documentation for the specific individual equipment items as noted in the report. Details of the partaicular comments on the individual reviews are given in the evaluations that follow.

1H11*PNL-613 Control Room Panel

The control room panel is a cabinet which houses various control relays, switches and other equipment and instrumentation. The qualification document for this equipment is entitled, "Shoreham Nuclear Power Station Unit 1, SAI-029-QA-80-PA-B Rev. 1, Seismic Qualification Reevaluation Class 1E Equipment, Control Room Panels". The report was prepared by E. S. Ramadas, dated April 3, 1981 for Science Applications, Inc., Almaden Blvd., San Jose, California. The report was approved by N. G. Luria of G.E. on 2/26/81.

The control room panel is 30" wide, 90" high and 36" deep. It is located in the control room building at the 63' level.

The control room panel is qualified by tests made on similar control room panels. It is also qualified by identifying the components that are mounted on the panel and comparing the expected peak acceleration with the malfunction level of the various components as determined by previous tests.

The design of the Shoreham Control Room Panel is representative of a generic G.E. NSSS control room panel design. The panels use similar angle iron bracing on top and bottom. The 1H11-PNL 613 panel is compared with the Clinton H22-P028 panel and with the Perry H13-P654 panel. The mechanical characteristics that affect structural response such as damping, section modulus, stiffness, and mass were considered as the basis for similarity. The Shoreham 30" panels are less rigid than the Clinton H22-P028, since it has

fewer stiffeners. However, it is nearly identical to the Perry H13-P654 panel. The tests showed that the H13-P654 panel has a lower transmissibility than the H22-P028. Therefore, the averaged transmissibility of the two was used as a conservative approximation of the Shoreham 30" control room panel transmissibility. The "g" field on the panel was obtained by multiplying the transmissibility at each location by the RRS zero period acceleration. The maximum acceleration indicated by the accelerometers during the tests were transferred to the Shoreham control room panel.

The test results for the two panels, Clinton H22-P028 and Perry H13-P654 indicated the presence of a local breathing mode where high accelerations were monitored on the panel face below the maximum panel height. These accelerations are greater than those experienced at the top of the panel. Accelerometers located in the vicinity of the local mode indicate that an area of the panel skin was not supported structurally by the attached stiffeners on the internal surface which should inhibit free vibration. However, the occurrence of the local mode did not affect the structural integrity during the test. The Class 1E equipment mounted on both panel structures performed according to specifications during the tests. Some mounted devices were independently tested to their malfunction limits: These limits were compared with the maximum expected peak accelerations. The equipment that was mounted directly over the area of the local mode experienced no malfunction. The occurrence of the local mode took place during a test of the properties of the panels. Even so, the test data for the control room panels tested to IEEE 344-1975 specifications demonstrates that local modes are not a normal occurrence for this type of test.

For conservative qualification evaluation the test response spectrum of the comparison panel that was actually tested should adequately envelop the required response spectrum of the Shoreham panel. This was the case, as is shown in the qualifying document. Each of the tested panels has been compared to the worst case floor RRS where Class 1E mounted equipment are located. Figures in the document show that the TRS conservatively envelops the worst Shoreham RRS for NSSS Class 1E equipment. The attached table is a partial list of some Shoreham control room mounted Class 1E equipment which are qualified on tested panels and survived a TRS more severe than the RRS at their mounted location.

The LILCO submittal of May 15 has satisfactorily shown the revised SQRT form and has supplied the Revision 2, of the report on the control room panel.

It is thus concluded, that the Shoreham Control Room Panel 1H11*PNL-613, and the equipment mounted on it, are qualified for the seismic and hydro-dynamic loads that are specified for this plant.

SEISMIC QUALIFICATION REEVALUATION

CONTROL ROOM PANELS CLASS IE EQUIPMENT

Panel MPL Ref: H11-P613

Panel Dimensions: 30" x 90" x 36"

System: Nuclear Steam Supply Shutoff
Process Instrument Panel

Location, Elevation: TB-63

EQUIPMENT MPL NO	DESCRIPTION	PURCHASE PART DWG.	CURRENT SEISMIC CAPABILITY/ MALFUNCTION LIMIT			MAXIMUM EXPECTED PEAK ACCELERATION AT LOCATION			REMARKS
			f-b	s-s	v	f-b		v	
B21A-K02A,B	Relay	145C3238 P001	17	17	10	1.8	2.4	1.0	Malfunction Limit per IEEE-344-71
B31A-K45B,D	Relay	145C3238 P002	17	17	10	1.8	2.4	1.0	Malfunction Limit per IEEE-344-71
E51-K603	Inverter, DC to AC	145C3027 P007	15	15	10	2.5	3.3	0.8	Malfunction Limit per IEEE-344-71
E51-K603-1	Filter	163C1566 P001	10	10	10	2.5	3.3	0.8	"
G33-K01A,B	Relay	145C3238 P001	17	17	10	1.8	2.4	1.0	Malfunction Limit per IEEE-344-71

L/SSM

H21-P036 and H21-P010-Local Panels 30" and 48"

These local panels are cabinets which house various control relays, switches and other similar equipment. The qualification document is entitled, "Shoreham Nuclear Power Station Unit 1 Seismic Qualification Reevaluation Class 1E Equipment," SAI Report No. SAI-029-QA-80-PA. The report dated July 25, 1980 was prepared by E.S. Ramadas, for Science Applications, Inc., San Jose, California. The report was written on General Electric Stationary, and has a line for the approval of the responsible General Electric Engineer, but was not signed. However, discussions with N. G. Luria, Manager, Qualification and Standards Engineering indicated that the report has his approval. The formal signature, therefore, was an open item at the time of the site visit.

The two local panels are similar in structure but different in size. The 30" panel measures 30"x84"x30" and weighs 500 lbs. The 48" panel measures 48"x84"x30" and weighs 900 lbs. Both panels are welded to the base on three sides. The 30" and 48" local panels are open framework steel structures that are structurally reinforced by lateral and longitudinal members. Both types of panels have the same number of lateral and longitudinal members.

The panels are seismically qualified by comparing the panels to similar panels that have been qualified by a test to the IEEE 344-1975 criteria. A multi-frequency, multi-axis test was used on the similar panels that were tested.

The qualifying report discusses the similarities and differences between the panel frames. The local panels and the mounted equipment are considered as a single unit in the qualification evaluation. The test results are evaluated. From these, the expected results for the Shoreham local panels are presented.

As mentioned both 30" local and the 48" local panel at Shoreham are qualified by tests previously made on similar open framework steel local panels. The previously tested panels were investigated to obtain their dynamic characteristics and to ascertain their compliance to IEEE-344-1975 before their installation at Zimmer, LaSalle and Cofrentes. The structural differences between the Cofrentes panels and the Shoreham panels involves the use of side truss members versus lateral members. The report concludes that this difference provides additional capability for the Shoreham panels. The response of the Shoreham panels in the side to side direction is expected to duplicate the response of the Cofrentes panels in that direction. In the vertical direction, the natural frequencies will be different because of individual cross members. This effect is evaluated in the report.

This information is contained in the Seismic Test Reports, GE DRF A00-1138, GE Report No. 994-79-010 Zimmer 1 Local Panel Seismic Design Adequacy, dated 6/20/79 and Test Report GE DRF H22-13. The actual panels that were tested include a 30" H22-P017 and a 48" H22-P005. The tests involved a

resonant search at low levels together with a multi-frequency multi-axis random test over the frequency range of from 1 to 62 Hz. The equipment items that are mounted on the panels are also qualified by comparing the expected peak accelerations with the malfunction level of the various components as determined by previous tests.

The natural frequencies for the 48" panel in the F-B direction were somewhat higher than the coresponding natural frequencies for the 30" panel. Four natural frequencies were noted up to 60 Hz while the natural frequencies in the S-S direction were the same for both panels.

The transmissibilities for both cabinets were similar, which shows similar damping properties. The 'g' field on the panels were obtained by multiplying the transmissibility at each location by the RRS zero period acceleration. The maximum acceleration indicated by the accelerometers during the tests were transferred to the Shoreham local panels.

During the site visit, it was noted that the elevation on the SQRT form for both the 30" local panel and the 48" panel is listed at 203'. In addition, pgs. 3-38 of the G.E. packet that was available uses the ZPA for the RRS at the 203' elevation. The panels are actually located in the reactor building at the 78' level and at the 8' level. However, the ZPA was conservatively taken at the 203' level. Even so, the comparison between the maximum peak acceleration and the malfunction limit shows that there is an adequate margin between the two. The attached sheet shows the comparison. The SQRT forms should be corrected to show the acutal location level of the equipment.

The qualification document shows that the maximum peak acelerations are adequately less than the malfunction limits for both local panels. It is therefore concluded that the panels meets the seismic requirements and will perform the intended function under the specified loads. Both H21-P036 and HP 21-P010 are qualified for the seismic and hydrodynamic loads at Shoreham. The open items that remained after the site visit required that :

1) G.E. approval be given to the qualification document.
2) SQRT forms be corrected to identify elevation of local panels.
3) SQRT forms be corrected to include the actual field installed weld condition.

The LILCO submittal of May 15, has satisfactorily addressed each of these open items. G.E. approval is indicated by the signature of S.E. Hassan, dated 5/6/81 and the new SQRT forms have been corrected. The equipment is therefore dynamically qualified for the seismic and hydrodynamic loads specified at Shoreham.

SEISMIC QUALIFICATION REEVALUATION

30" WIDE LOCAL PANEL CLASS 1E EQUIPMENT

Panel MPL Ref: H21-P036

Panel Dimensions: 30" Wide x 84" High x 30" Deep

Location, Elevation: RB-8

System: Core Spray High Pressure Coolant Injection Leak Detection Panel B

SEISMIC EVALUATION SUMMARY	EQUIPMENT MPL NO.	DESCRIPTION	PURCHASE PART DWG.	ESSENTIAL CODE	MALFUNCTION LIMIT f-b	s-s	vert.	REMARKS
1.0 NATURAL FREQUENCIES	E41-N001BD	Pressure Switch	145C3009P001	A	10	10	10	
f-b: 19.2, 28.7, 48.8, 56.1	E41-N005	Differential Pressure Switch	145C3009P010	A	10	10	10	
s-s 10.6, 18.3, 41.3								
v: 30.5, 57.6, > 60								
2.0 MAX TRANSMISSIBILITY (TR)								
f-b: 6.0								
s-s: 13.6								
v: 4.70								
3.0 ZPA FROM RRS AT 203 ELEVATION								
f-b: 0.5g								
s-s: 0.5g								
v: 0.3g								
4.0 MAXIMUM EXPECTED PEAK ACCELERATION								
f-b: 3.0g								
s-s: 6.8g								
v: 1.41g								

NSSS/283

1C61*PT-006 Pressure Transmitter

(Bailey Meter, 556110E-AAIWEN)

This pressure transmitter is located in the secondary containment area at an elevation of 79'. This device is a part of the reactor plant remote shut down system. It measures pressure to remotely indicate the RPV water level during hot standby and cold shut down conditions. It is mounted on an instrument stand with four 3/8" bolts. The instrument stand consists of a 36"x12"x1/2" plate mounted on building Column No. 11, via a 2" SCH. XS pipe which has two additional instruments attached to it.

The equipment qualification report includes a GE design record file DV136C1186, No. 440, dated March 3, 1972. According to the GE document single frequency single axis tests were carried out in the 1-33 Hz range for operability, and in the 1-100 Hz range for natural frequencies of the pressure transmitter. The test results indicated a natural frequency at 40 Hz in the vertical direction. Another test, described in Report No. 507, dated April 3, 1973 (revised May 25, 1973), showed that the pressure transmitter performed its intended functions before, during, and after exposure to 5.5g horizontal and 3.7g vertical accelerations over the frequency range 1-33 Hz. In subsequent post site visit qualification summary and evaluation reports (Attachment III, Title Pages, Summaries and SQRT Forms for Shoreham Equipment), submitted on May 13, 1981, the malfunction acceleration level above 40 Hz in both horizontal and vertical directions was reported to be 0.26g.

Additional information was requested during the SQRT review regarding the installation of tubes with bends attached to the pressure transmitter and regarding the natural frequencies of the wall-mounted instrument stand. It was felt that both the failure of the tubes and acceleration amplification by the instrument stand could prevent proper functioning of the instrument. The applicant's response to the question of tube installation is included in Attachment I, May 14, 1981, Responses to NRC SQRT Requests for Additional General Information. In reference to this response it should be mentioned that the availability of the reported document, Stone & Webster Engineering Mechanics Technical Guideline No. 16A, was not brought to the attention of this reviewer. The applicant also submitted a frequency analysis for the instrument stand in Enclosure 1, Attachment II (May 14, 1981) which showed a fundamental frequency of 40 Hz associated with a local plate bending mode.

Based upon our review, of the equipment documents, the field installation; and the site and post site responses supplied by the applicant, we conclude that this instrument is qualified for all dynamic loads in the frequency range 1-33 Hz. Above this frequency range, however, it is felt that additional information and supporting data are still required in order to qualify the instrument, especially, for hydrodynamic loads. Since both the instrument and the instrument stand have natural frequencies at 40 Hz, and the instrument shows a sharp drop in its malfunction acceleration level above 40 Hz, the operability of the instrument at and above 40 Hz needs to be demonstrated in greater detail.

1E32*PDT-035-Differential Pressure Transmitter

(Model No. Rosemont 1151 by Rosemont Engineering Co.)

The differential pressure transmitter measures differential pressure of dilution air from RBSVS and is a part of the leakage control system. This instrument is located in the secondary containment area at an elevation of 63'. It is mounted on an instrument stand with four 7/16" bolts together with two other instruments. The instrument stand consisted of a comparatively rigid panel mounted on the floor with two pipes and a rigid base plate.

The differential pressure transmitter was designed according to GE design specification 1E32N059. Experimental test results to qualify the instrument for dynamic loads were reported in a GE design record file ORF A00992, Cofrentes H22P018, 1978. This report was compiled and reviewed by GE and contained a number of Rosemont test reports, namely, 11726A, 4732A, 9726C and 37327B. The instrument stand was designed according to specifications given in Stone and Webster report SH1-343 (11600.02-NM(B)-237, Jan. 30, 1980). The report specifies that the stand should have a fundamental frequency greater than 7 Hz.

Test results showed that the differential pressure transmitter did not have any side/side or front/back natural frequencies over the range 1-70 Hz. In the vertical direction, however, it was reported to have a natural frequency at 62 Hz. The instrument was qualified by input g-level tests and several of these tests were reported over various frequency ranges and input

g-levels. According to the test results, the instrument maintained its operability after being subjected to input g-levels as high as 6 in the side/side and front/back directions and 3 in the vertical direction. This compares with the required side/side and front/back acceleration of 2g and a vertical acceleration of 1.5 g, as provided in the instrument stand design specifications.

Based upon our review of the equipment documents, the field installation, test reports and responses provided by GE, we conclude that this instrument is qualified for all dynamic loads specified for the Shoreham site.

B21-F013 Main Steam Safety Relief Valves

(Model No. 7567F)

The plant is equipped with eleven safety/relief valves which are attached to the main steam lines at the 99' level. All units are located inside the primary containment. During the inspection, the equipment was not mounted on the main steam lines. Only, a typical valve was inspected at the warehouse.

The role of the SRV's is to control possible pressure transients in the primary system. Upon their actuation, the released steam is sent to the suppression pool through a discharge piping system. The units are designed with an air-actuated operator and actuate either upon a command (i.e., relief mode) or automatically (i.e., safety mode) at present pressures (i.e., at: 1090, 1100, 1110 psi). The vendor of the equipment is the Target Rock Co. These values were designed according to GE Specifications 21A9206AF (Rev. 7) and 21A9206 (Rev. 7). The equipment employs 6" inlet and 10" outlet pipes and it is mounted on a 24" main steam line. The inlet and outlet flanges have twelve 1 3/8" and sixteen 1" bolts respectively.

These so called six by ten SRV's with air-actuated operators were qualified by tests. The pertinent qualification report is:

> "Seismic simulation Test Program on a Taget Rock 6" x 10" Safety Relief Valve with Air-Operated Actuator", VPF5485-3-1, by Wyle Lab, 11/2/77.

The required acceleration in each direction was obtained from a piping analysis performed for the main steam lines. In this analysis both seismic and hydrodynamic loads and different load combinations were considered. The SRSS rule was used for combining the loads. The final values for the required acceleration were generated by considering two factors, namely the load combination and the location of the valve on the main steam lines. For this component, the worst case, i.e., valve position and load combination was considered. These acceleration values (i.e., RRS values) were equal to 6.8g and 3.7g in the horizontal and vertical directions respectively.

The natural frequencies were determined by test. A resonance search was performed in the frequency range between 2 and 150 cps. This test showed that the lowest predominant valve bending modes had the following frequencies:

Side/Side	130 Hz
Front/Back	120 Hz
Vertical	125 Hz

Multi-frequency tests were performed by using random input motion consisting of frequency bandwidths spaced at 1/3 octave apart over the frequency range of 1-40 Hz. The duration time of the individual tests was 30 seconds.

During this time a horizontal and a vertical component was applied simultaneously. The input g-level used for the SSE was 8.0g and 6.0g in the horizontal and vertical directions respectively. These values are higher than the required values obtained from the piping analysis. The tests performed by Wyle Lab demonstrated that the equipment had sufficient functional and structural integrity for five OBE and one SSE qualification inputs. No malfunctions or structural degradation was observed during these tests. Nozzle loads obtained by the piping analysis were applied during the tests. The specimen was mounted using the same set of bolts as those intended for in-service mounting. A set of operability tests were performed. The safety mode of the valve was tested by increasing the inlet pressure until the valve actuated by itself. In addition, power actuation capability and steam leakage tests were performed. These tests indicated that the operability of the valve is quailified.

Based on our review of the reports and the clarificaitons provided by GE at the site visit we conclude that this equipment is adequately qualified for both seismic and hydrodynamic loads for the Shoreham plant pending on proper field installation, since as mentioned during the plant site visit the equipment was not installed on the main steam lines.

1B31-MOV031 Recirculation Suction Valve

(Model No. DWG 0200792)

This is a passive piece of equipment which is required for maintenance purposes. Essentially the equipment is a motor operated gate valve which is located inside the primary containment at the 70' level. In view of its intended purpose and operational mode, its only qualification requirement is, that the stresses due to load combinations resulting from seismic and hydrodynamic events should be below the code allowables.

The vendor for this equipment is the Darling Valve Company. The equipment was designed according to GE21A9200 specifications. The equipment is qualified by analysis performed by GE and reported in the GE Document 385HA661. The natural frequencies were found by hand calculations. The required acceleration levels were obtained from the piping analysis of the recirculation loop on which the equipment is mounted. In this analysis both seismic and hydrodynamic loads were considered. The load combinations were obtained by use of the SRSS rule. A lumped mass model was used to represent the equipment in the piping model of the recirculation loop. The required acceleration levels from the piping analysis are equal to 4.43g and 1.90g in the horizontal and vertical directions respectively. The corresponding allowable g-levels are 6.652g and 4.0g. Thus, the accelerations from the piping are below the allowable ones. Stress calculations for the bonnet flange bolts indicated that the stress levels are also below the allowable ones.

Based on our review of the reports, the field installation and the clarifications provided at the site-visit, we conclude that this equipment is adequately qualified for both seismic and hydrodynamic loads.

1C41*P-024: Standby Liquid Control Pump & Motor

(C41-C001, G.E. Model No. 5K324AK2084 - Motor
2x3TD-60 W/Gear Pack - Union Pump Co.)

Two Standby Liquid Control Pump and Motor sets are located in the secondary containment area at an elevation of 112 ft. The pump is a three plunger reciprocating unit coupled with a motor via a gearbox. The motor is mounted to the floor pedestral by four 1/2", bolts whereas the pump and gearbox assembly are held by four 3/4" bolts. On manual SLC initiation, the SLC pump draws boron neutron absorber solution from the storage tank located next to the pump and injects it into the reactor. This equipment is required to operate during faulted condition. The pump motor was designed as per the G.E. specification 21A9255AE.

The qualification documents include several reports as follows:

(1) "Seismic Qualification Test Report on SLC Motor Model 5K324AN2690, Serial No. JM-100" - Report prepared by Approved Engineering Test Laboratory under Report No. 5430-6958 (VPF-5517-2-2), Jan. 28, 1977.

(2) "Seismic Calculation for TD-60" - by Union Pump Co. (VPF-5503-91-5), Feb. 14, 1978.

(3) "Seismic Calculation with Natural Frequency - Motor, 324 T Frame" - by Union Pump Co., VPF-3676-191-2, August 4, 1975.

(4) "Natural Frequency Calculations TD 60 & Fluid Cylinder" - by Union Pump Co., VPF-3676-1, April 10, 1975.

All of the above reports are assembled together in a summary report prepared by Science Application Inc. entiled MPL or EDN Item No. C41-C001, Rev. 01, March 31, 1981 (KS1-C41-C001). The first and third reports deal with the motor, whereas the second and fourth reports deal with the pump.

A prototype SLC Pump Motor was tested using a dual axis single frequency technique. The tested motor was a G.E. type 324 AN, as compared to the 324-T installed at Shoreham. They both however have the same frame size. The frequency search did not find any frequency between 1 to 80 Hz. The analytical model of the actual pump was found to have a natural frequency of 239 Hz. A static analysis with a coefficient of 1.75 g in both horizontal and vertical direction was performed and the stresses were found to be well below the allowable.

The pump qualification report was prepared by the manufacturer using a standard "cook-book" analysis approach using a horizontal and vertical load of 1.75 g. The nozzle loads are also included in the analysis. The calculated natural frequency of the pump was found to be 136 Hz. The calculated stress was within the allowable limit.

In both cases, (i.e., motor and pump) the static coefficients were higher than the actual g-values in the RRS. Since the pump and motor were qualified separately, a question was raised about the operability of the assembly in the

event of dynamic events. G.E. personnel had indicated that this question will be resolved after they complete a similar testing program currently underway at G.E. Results of the test should be available around June 1982.

Based on our review of the reports, the field installation, and the responses supplied by G.E. engineers, we conclude that this equipment has adequate structural integrity to withstand the seismic and hydrodynamic loads. The question of operability still remains open, since it has not been answered in the recent (May 15, 1981) Shoreham submittal. The recent submittal however has corrected the SQRT form to indicate that this equipment needs to be qualified for both seismic and hydrodynamic loads.

1C41*EV010: SLC System - Explosive Valve

(Model No. 1832-159-01 Type Con-O-Cap by CONAX Corp.)

The equipment provides leak-tight shutoff of the Standby Liquid Control System until required. The valve operates by an explosive charge which is actuated at the time of a CRD failure. This is done in order to poison the reactor by boron injection. Two such valves are mounted in a rigidly supported 1-1/2" pipe line by flanges which are connected by four 1" bolts. Both units are located in the secondary containment at an elevation of 112'. The valve is very compact in appreance and is less than 10" long.

The valve was qualified by test only. The first report was prepared by Science Application Inc. (Oct. 27, 1980) under MPL or EDL #C41-F004, MPL Reference No. MPL 238X120 BD Rev. 8, documentation #KS1-C41-F004. The test was conducted by Southwest Research Institute for Conax Corporation (VPF 3394-36-2) and summarized under the SWRI project #02-4681-301 (Dec. 14, 1976). The valve was designed as per the G.E. specification 21A9370AB Rev. 6. We reviewed Appendix B of the original report which includes only the qualification results. Questions were raised concerning the test procedure and the operability of the valve for seismic and hydrodynamic loads. G.E. provided additional information to show that the test procedures were satisfactory and that they confirm the operability of the equipment.

In order to qualify for hydrodynamic loads, the calculations show that the first fundamental frequency is greater than 60 Hz. Hence, the original report on seismic test is sufficient for the additional loads imposed by hydrodynamic effects. A question was also raised regarding the explosive load which triggers the valve. Subsequent information obtained from G.E. shows that this load is small. It is contained inside the valve and does not impose any additional dynamic load to the piping system. According to G.E. the valve should be inspected for its operability and structural integrity as part of the maintenance procedure at each refueling period.

Based on our review, test report and the additional information provided by G.E., we conclude that this equipment is qualified for all of the dynamic loads specified for the Shoreham site.

1R24*MCC1123 480V Motor Control Center

(Model 4 M.C.C. - Square D. Company)

This equipment is one of twenty-eight 480V motor control centers consisting of 20"Wx20"Dx90"H cabinets, circuit breakers type FA, FH, KA, MA, starters NEMA size 1,2,3,4, relays, Square D Class 8501 GO and associated electrical switches and circuits. It is located in the secondary containment area at an elevation of 112'. The cabinet is fastened to two stiff channels on the floor by four 1/2" bolts. The total weight of the motor control center is approximately 600 lbs.

This equipment controls the electrical operation of the 480V station emergency power supply system and is required to withstand both seismic and hydrodynamic loads. Its design specifications are included in the Stone and Webster Report SH1-115. The equipment qualification report consisted of a Square D Company Report 108-1.01-L2, dated August 2, 1974 which was reviewed and found satisfactory by Stone and Webster.

To qualify for dynamic loads, the 480V motor control center was subjected to random multi-frequency biaxial tests over the frequency range 1 to 100 Hz. The TRS acceleration levels enveloped both the horizontal and vertical RRS acceleration levels over the entire frequency range except from 1 to 1.5 Hz. Since the equipment natural frequencies (S/S = 3.6 Hz, F/B = 4.0 Hz, V = 15.0 Hz) were not in the range 1-1.5 Hz, the lower TRS acceleration in this range is not considered to be significant. For these tests the motor control center was fastened by eight 1/2" bolts as opposed to only 4 bolts used for the actual field mounting. The SQRT form showing that the test mounting used only

4 bolts needs correction in this regard. During the SQRT review a question was raised regarding the failure of the bolts if only four bolts were used. An analysis subsequently supplied by Stone and Webster on April 9, 1981 showed that the four bolts could withstand the stresses resulting from the combination of all dynamic loads.

Results from the above tests showed that the motor control center maintained its structural integrity during and after being subjected to the TRS acceleration levels. Sufficient test data were, however, not presented to demonstrate the operability of the various electrical components of this equipment during and after the tests. Also, in the response provided by the applicant in Attachment II, May 14, 1981 - Response to NRC SQRT Requests for Additional Data Concerning Their Selected Equipment Items, no additional test results were given substantiating the conclusions regarding the operability.

Based upon our review of the equipment documents, the field installation, and responses provided by the appplicant, we conclude that the structural integrity of this equipment is qualified for all dynamic loads specified for the Shoreham site. Additional information is, however, requested to verify the operability of the equipment during and after the required tests.

1R24*PNL-G1: 480 VAC Circuit Breaker Panel Board

(MH- 3 WP Cabinet with FAL 36015 Circuit Breaker)

Square D Company

This equipment is one of eight 480 VAC circuit breaker panel boards at Shoreham. The dimensions of the panels are: depth-5.75", width-20", height-23" to 74". Panel weights vary from 50 to 100 lbs. The inspected panel is located in the secondary containment area and is fastened to a wall with six 7/16" bolts. The function of the circuit breaker is to provide overcurrent and short circuit protection for the station emergency 480 VAC power supply. This device is required to withstand combined seismic and hydrodynamic loads for faulted conditions.

The circuit breaker panel board was designed according to Stone and Webster Design Specification SH1-115. The qualification document was a Square D Company report 8998-10.09-L23, dated April 25, 1980. This report was reviewed and approved by Stone and Webster.

Random multi-frequency biaxial tests were conducted on one of the circuit breaker panel boards (74"-H) at TRS acceleration levels that enveloped the horizontal and vertical RRS over the frequency range 1-100 Hz. The dominant natural frequencies of this panel board were 20 Hz in side/side and front/back directions, and 46 Hz in veritcal direction. Test results showed that the panel board and the circuit breaker had sufficient structural integrity to withstand the above TRS acceleration levels. In the original report (Oct. 5, 1979) for the circuit breaker and the associated switches and circuits

operability tests were not adequately addressed (i.e., contact chatter, current and voltage continuity etc.). The report was thus found unacceptable by Stone and Webster. Subsequently, an addendum to the report was submitted on April 25, 1980, demonstrating that the electrical function of the circuit breaker was not compromised. This report was accepted by Stone and Webster.

Based upon our review of the test reports, inspection of the field installation and additional information provided by the applicant, we conclude that this equipment is qualified for the combined seismic and hydrodynamic loads specified for the Shoreham site.

1T48*RC-002 Hydrogen Recombiner Unit

(Atomics Int. SER No. 302)

The function of the hydrogen recombiner is to control the amounts of oxygen and hydrogen in the primary containment system so that safe non-explosive proportions are maintained. There are two such units in the plant. They are located in the secondary containment at elevation 112'. The pertinent specifications are contained in:

"Specification for Hydrogen recombiner Units", SHi-289, by Stone and Webster, dated Sept. 29, 1980.

The equipment is floor mounted with a set of six 7/8" bolts (three bolts on opposite each sides along its long dimension of 13'). It was qualified by test performed at Wyle Labs. The qualification report is:

"Seismic Testing of Recombiner", 54591-2, by Wyle Lab., May 14, 1976.

During testing the equipment was bolted in the normal mounting position with six 3/4" bolts. A set of twenty-two accelermeters were employed. The RRS was obtained by using the SRSS rule to combine responses due to seismic and hydrodynamic loads. The determination of the natural frequencies was accomplished by test. A uniaxial sine-sweep resonance search was perfromed (frequency range: 1-50 Hz) in the three principal orthogonal axes of the equipment. The equipment was qualified by a multiaxial random input which was developed with a spectrum synthesizer in the frequency range: 1.25 to 35 Hz.

Sine beats were used in order to amplify the spectrum generated by the random input between 1.25 and 4.0 Hz. The TRS envelopes the RRS over the frequency range of 1-100 Hz. Five upset and one faulted test were performed. The tests demonstrated that the equipment maintained its structural integrity.

During the SQRT audit the applicant was requested to provide additional information for the following items:

a) Explain how nozzle loads were considered in the qualification.

b) Provide a record of how the hydrodynamic loads were considered.

c) Confirm status of NRC acceptance that T-quencher SRV load is bounded by the ramshead SRV load in the frequency range of interest in equipment qualification.

d) Provide operability evidence for attached accessories after the dynamic test.

e) Revise the SQRT form, particularly to note the frequencies of the related components.

A later submittal by the applicant (Equipment Dynamic Qualification SER Outstanding Issue No. 8, Shoreham Nuclear Power Station- Unit 1, Docket No. 50-322) was reviewed with respect to the particular equipment (Item 12, Attachment II). The responses to the above five items are satisfactory.

Based on our review of the reports, the field installation, and the clarification provided by the manufacturer and the above mentioned (i.e., Docket No. 50-322) applicant submittal, we conclude that this equipment is adequately qualified for both seismic and hydrodynamic loads for the Shoreham site.

1T48*PNL-68 Drywell Gas Monitor

(Model No. K IV)

The function of this equipment is to start the hydrogen recombiner when it is required to maintain the amounts of oxygen and hydrogen in the primary containment at safe proportions. The equipment is contained in a rectangular box which is 72" height and has a square base 30"x30". Its weight is equal to 2500 lbs. The equipment is located inside the secondary containment at elevation to 112". The vender of the equipment is the Cosmip Inc. The equipment was designed according to the following specifications.

"Specification for Primary Containemnt Gas Analyzers",
SH1 344, by Stone and Webster, Dec. 18, 1979.

The drywell gas monitor must be able to withstand both seismic and hydrodynamic loads. It was qualified by test which is documented in the following reports:

1) "Qualification of DELPHI IV Hydrogen Analyzer to IEEE-323-1974", 1035-1 by Engineering Analysis and Testing Co., Dec. 1980.
2) "Seismic Testing of K-IV Monitor Serial Number R-35", 58095, by Wyle Lab., August 12, 1976.

The first of these documents deals only with the qualification of the safety related instruments of the equipment, whereas the second deals with the qualification of its panel together with dummy instrument masses. The required response spectra for the drywell gas monitor were obtained by using

the SRSS method for the combination of the seismic and hydrodynamic loads. These spectra were used for the qualification of both the instruments and the panel. According to the report the corresponding ZPA values are 1.0g in the horizontal direction and 0.4g in vertical direction for the faulted condition, and 0.5g and 0.4g in the horizontal and vertical directions for the upset condition. During the qualification tests the safety related instruments were mounted in a similar manner as in the field installation whereas the panel was mounted to an interface fixture. The latter was welded to the test machine table. The as built mounting is accomplished with a set of fillet welds. The instruments of the drywell gas monitor were qualified by multi-axis multi-frequency random inputs in the frequency range from 1 Hz to 40 Hz. A set of five upset and one faulted conditions were tested. The TRS employed the RRS over the entire frequency range. The operability of the instruments was verified in these tests. The panel of the equipment was also qualified by test. Its natural frequencies were found to be equal to 18 Hz in the S/S direction and over 33 Hz in the other directions. A multi-axis multi-frequency random input was used with additional sine beats imposed for local amplifications. The TRS enveloped the RRS in the frequency range from 1 Hz up to 100 Hz for a set of five upset and one faulted test inputs. The panel maintained its structural integrity.

During the SQRT audit, the applicant was requested to revise the SQRT form to describe the actual installed welded condition, instead of the bolted condition given in the SQRT form for this equipment. The later submittal by the applicant confirms that this revision was indeed made.

Based on our review of the reports, the field installation, the clarification provided by the manufacturer and the recent submittals by the applicant we conclude that this equipment is adequately qualified for the dynamic loads specified for the Shoreham plant.

1T46*L/U 059: Electrical Analyzer Instrumentation Cabinet

with the Logic Unit

(Panel #1H21 * PNL-060 with Logic Unit 1T46 * L/U-059)

This equipment consists of a 36"D x 60"L x 90"H floor mounted cabinet in which a number of logic units were installed. The cabinet is located in the control building at an elevation of 44 ft. No hydrodynamic effects will be seen by this equipment since it is isolated from the reactor building. The logic units contain controls and instrumentations for various ventilating systems. A number of such cabinets are mounted back to back in a row. The bases are bolted to a common base (by 8-1/2" bolts per cabinet) which is buried in the floor. The equipment is designed as per S&W specifications No. SH1-125, Rev. 1 and SH1-421, Rev. 3.

The cabinet was qualified by the Reliance Co. This information is contained in a report entitled "Seismic Analysis of the 1H21-PNL-60 Cabinet", SWEC order No. 310677, Reliance Order No. 99AX400679 (Oct. 4, 1977). The logic units were qualified via tests performed by the Bailey Meter Division of Babcock & Wilcox. Abstracted results are given in Report #QR-3201-E91-720 (ABS) Rev. B, 720 Utility Station w/763 Cables (July 5, 1978). Detailed reports summarizing all of the information required for qualification were however, not available for review. According to the abstract report, the panels were qualified by both test and static analysis whereas the logic units were qualified by test only. The tests were carried out with biaxial, random input motion of tests with 21 g between 5-30 Hz and 7 g for ZPA.

Since the complete report was not available for review, no conclusion was made on the qualification of this equipment at the time of the site visit. The abstract report only summarizes the final conclusions without any details about the test procedure, anomalies and the test mountings etc. Hence, a request was made to provide the detailed report for future review. Moreover, the applicant was also asked to correct the SQRT forms for this equipment at several places.

The later submittal of the applicant includes the qualification report and the revised SQRT forms. After reviewing the report, it is concluded that this equipment is qualified for both seismic and hydrodynamic load specified for the Shoreham plant site.

1E21*P-049B: Loop Level Pumps

(Gould Pump, 3196ST, 1E21*P-049 A&B, 1E41*P-050 and

1E51*P-051 with $\ddot{W}$ 7.5 hp motor)

The loop level pumps are manually operated and function to keep the core spray system completely filled with water. This will insure that air will be kept out of the system. Four pumps are located in the secondary containment at the basemat (elevation - 8 ft). These were manufactured by Gould Pumps Inc. and were coupled with Westinghouse Motors. The pump is mounted to a floor slab by three 1/2" bolts whereas four more bolts secure the motor assembly. The complete assembly was found to be rigidly mounted and no apperturances were found to be loosely attached to the assembly.

The qualification of the pump alone was documented in a report entitled "Seismic-Stress Analysis of ASME Sec. III Class 2 Pumps", Report #ME-320, prepared by McDonald Engineering Analysis Co. for Gould Pumps Inc. The pertinent specifications used was S&W Spec. #SHI-235, Rev. 1. The motor was qualified by the supplier (Westinghouse) and was not reviewed since it was not intended for SQRT review effort.

The pump was qualified by analysis. The pump was idealized by a finite element model. This model was processed by the computer code ICES-STRUDL. An equivalent static analysis approach was employed with a coefficient of 1 g in

each direction for the Upset Condition and 2 g for the Faulted Condition. The fundamental natural frequency of this model was above 60 Hz and hence these coefficients represent an adequate load level. Similar calculations were made for the Westinghouse motor with input g'values above 2 g for both service conditions. The stresses that were computed are within the allowable limits. The two components, pump and motor, are connected by a Fast Type B Flexible Coupling. The operability of this equipment was qualified based on a static analysis which compares the maximum impeller and casing clearances against the allowables for this equipment.

Based on our review and the inspection of the field installation, we conclude that this equipment is qualified for all of the dynamic loads specified for the plant design at Shoreham.

1P4L*MOV-036: Motor Operated Butterfly Valves

(Model No. 10" N-SL 2FII)

This equipment is a motor operated valve mounted on the service water piping and located in the control building at elevation 12'. This device provides for the main steam chill water isolation. There are two such devices located in the plant. Field mounting consists of four 3/8" bonnet bolts. The vendor is the Henry Pratt Co. (Design Spec. SH1-197). The valve was qualified by both analysis and tests. The following reports are related to the qualification of the equipment:

1) "Test on Limitorque Corp. Valve Operator, SIZE SMB000-2H0BC", Report No. 2773C-4773, by Lockheed Electronics Co., May 3, 1972.
2) "Stress Report for 10" N-SL-2-FII", Report No. D-0034-3, by Henry Pratt Co., Sept. 2, 1975.

The equipment was qualified for the required acceleration levels obtained from piping analysis for upset and faulted loading conditions. The valve operator was qualified by a single frequency and single axis tests. In this test higher acceleration levels than those required were used. The laboratory mounting was identical with the in-service mountings. Hand calculations were performed in order to compute the deformations and stress values. The input

accelerations levels for these computations were taken to be higher than those of the RRS values. It was concluded that the bonnet and trunnion bolt stresses for the faulted combination were below the allowable ones. For worst case loading it was found that the deformation would not inhibit the function of the valve.

During the SQRT audit the applicant was requested to clarify some items in the SQRT form of this equipment. This was corrected in a latter applicant's submittal.

Based on our review of the reports, the field installation, the clarification provided by the manufacturer, and the applicant submittal we conclude that this equipment is seismically qualified for the Shoreham plant.

1B31*AOV-082: Air Operated Valve

(Copes-Vulcan D-100-60, 1B31*AOV-081, 1B31*AOV-082)

The air operated valve acts as Sample System Isolation Valve. Two similar pieces of equipment are located in the Reactor building, one in the secondary containment area at elevation 150' and the second one inside the primary containment. These are pipe mounted to a 3/4" pipe line. The body ends of the valve are welded to the pipe system whereas the actuator is flange-mounted to its bonnet. The valve in the secondary containment area was inspected. It is mounted to a 3/4" pipe. A large section of this line is without any supports.

The equipment was qualified by a combination of test and analysis. The report entitled "Seismic Analysis: Air Operated Control Valve", by Copes-Vulcan Inc., Report #10.3.151, Aug. 25, 1980, contains the analysis portion of the qualification. . separate report (#10.3.151 dated Aug. 25, 1980) prepared by Automatic Switch Co. includes the test results for the solenoid valve. In addition, a test report on the limit switch prepared by NAMCO also was submitted for review. The equipment was designed in accordance with the S&W Specification No. SH1-318.

The two test results on the solenoid value and limit switch were carried out up to the fragility level. Thus, the solenoid valve was tested up to 7 g

and the limit switch up to [illegible] g. It was established that these components would function satisfactorily under loads up to these limits. However, the valve inside the primary containment could experience a larger g-load under a dynamic conditions.

For the seismic analysis, a simplified model of the valve body and actuator was represented by a cantilever from the weakest section to the c.g. of the assembly. The first fundamental frequency of the equipment was reported to be well above 60 Hz. In addition, the valve was statically analysed for a 3 g load in each direction. However, the valve inside the primary containment requires the application of larger g-loads. This is because of the higher dynamic loads that occur inside the primary containment building, specifically those due to hydrodynamic loads.

At the time of the site visit six open items remained with respect to this equipment. The submittal of May 15, 1981 by LILCO satisfactorily addressed four of the open questions. These are identified as (a),(b),(d) and (f) in the LILCO letter. Essentially, these can be summarized as follows:

(a) Correction to the SQRT forms,

(b) Calculations which show that a more realistic model will give a natural frequency that is comparable to the original model,

(d) Clearance values between the actuator stem and valve frame which assure the operability of the valve during the dynamic event, and

(f) As-built piping review program which will assure installation of required supports in the 3/4" line line on which the valve is mounted.

Responses to the questions related to items (c) and (e) of the LILCO submittal are however still incomplete. The reason for this is that only the results of the piping analysis were reported upon in the May 15, 1981 submittal. These were listed as 2.5g for AOV081 and 0.6g for AOV082. A review of these calculations is required in order to assess the results in the light of the assumptions made vis-a-vis the as-built pipe support installations and the input excitation spectra.

The qualification of this equipment depends on the answers to these remaining items.

1E11*PCV003A: Pressure Control Valve

(Copes-Vulcan D-100-160, 1E11*PCV-003A&B)

The pressure control valve is used to regulate the steam to the RHR Heat Exchangers in the event of an emergency. There are two such valves at the Shoreham plant. Both are located in the secondary containment section of the Reactor Building at elevation 65'. The equipment is pipe mounted on the 8" RHR Line. The body of the valve is welded to the pipe, whereas the actuator is mounted to the body by flange connection with four 5/8" bolts. The valve was designed according to S&W Specification SH1-318, Rev. 1.

The equipment was qualified by a combination of test and analysis. The report describing the procedure and results is entitled "Seismic Analysis: Air Operated Globe Valve" by Copes-Vulcan Inc., Report Ident. #10.3.115 (Jan. 7, 1977), Rev. 1. The report also includes a test report (#10.3.151) on the solenoid valve prepared by the Automatic Switch Co., dated Nov. 7, 1977.

A single frequency single axis test was conducted on the solenoid valve up to the fragility level. The limit value for the input g'level was respectively 7 g in horizontal and 4.2 g in vertical directions. There was no particular problem observed as a result of the test with respect to the valve's structural and functional capabilities.

A hand calculation was carried out of the valve actuator considering only the weakest section of the valve, rather than the flange connection to the body. The first fundamental frequency of the actuator was found to be 35 Hz

horizontal (S/S) and vertical direction, and 65 Hz in horizontal (F/B) direction. The valve actuator was designed for a static load of 3g in both horizontal and vertical directions and the stress levels were found to be within the allowable limit.

At the time of SQRT visit six open issues with regard to this equipment remained. The submittal of May 15, 1981 has satisfactorily addressed four of these items. These are identified as (a),(b),(d) and (e) in the LILCO letter. Essentially these four items can be summarized as follows.

(a) Calculations which shows that a more realistic model will yield a natural frequency that is comparable to the original model,

(b) Maximum g-level obtained at the valve actuator from the piping analysis, that is lower than the design value of 3g,

(d) Clearance values between the actuator stem and valve frame which would assure the operability of the valve during the dynamic events, and

(e) correction to the SQRT forms.

Responses to the questions related to items (c) and (f) of the LILCO submittal, are however, still incomplete. In order to qualify this valve the following clarifications with respect to items (c) and (f) is still required:

(c) The natural frequency of the valve is about 35 Hz. The valve was originally seismically qualified by the vendor using static analysis for a maximum g-load of 3g. For the hydrodynamic load, however, the valve can no longer be considered to have its natural frequency in the rigid range (i.e.>60 Hz) since the valve frequency is only 35 Hz. An equivalent static analysis with a g-load 1.5 times the peak acceleration of the input responses spectra or a dynamic analysis is required to obtain the stress condition. Hence, use of 3g static load in qualifying the valve is not valid unless it is clearly established that either the valve frequencies are larger than 60 Hz or the static load is equal or larger than 1.5 X peak acceleration. We feel that additional information with regards to this open item is needed for review.

(f) The small (i.e., tubing) instrumentation lines and the various flexible joints were not fastened properly at the time of the visit.

This item was discussed with S&W personnel during the site-visit. According to LILCO May 15, 1981 letter, these lines are designed as per a S&W standard that was available at the site. This particular standard, however, was not available to us when we asked for it during the visit. As discussed during the exit meeting held on Friday, April 10, 1981, we still want to review the standard together with a typical calculation (i.e., computer output) on which this particular standard is based.

Final qualification of this equipment depends on the response to the remaining to the remaining two open issues.

1R23*T-102: 4160-480V Transformer Bus 1

(Model: Type VU-9, ITE Imperial Corporation)

This equipment is a 4160-480V transformer housed in a 58"Dx26"Lx90"H cabinet. This cabinet contains various other electrical devices. It is located in the control building at an elevation of 25'. The cabinet is mounted on the floor, but, the actual mounting configuration could not be clearly determined because the unit was energized at the time of the visit. However, information provided by the applicant, (Attachment III-May 13, 1981), with respect to a similar unit, 1R23*T-103, showed that the cabinet is mounted on the floor by 2 fillet welds (8 total) on each side.

The 4160-480V transformer bus 1 controls electrical circuits for the station emergency 480V power supply system. Its design specifications are given in Stone and Webster document SH1-95, dated July 7, 1980. The seismic qualification reports for this equipment are, No. 33-48359 (April 27, 1976) and No. 33-48359-A,B,C (September 30, 1979). These documents were prepared and reviewed by the ITE Imperial Corporation.

Random multi-frequency biaxial tests were conducted to qualify the 4160-480V Transformer Bus 1 for seismic loads. Simultaneous horizontal and vertical input acceleration levels in the FB/V and SS/V directions were adjusted through the use of a waveform synthesizer until the TRS enveloped the RRS (seismic) over the frequency range 1-100 Hz. Natural frequencies of 5.5 Hz for FB/V excitation and 8.5 Hz for SS/V excitation were obtained by frequency sweep tests. The equipment was monitored for operability during the tests. Additional electrical measurements were taken before and after the

tests were completed to determine any malfunction. On of the basis of these tests it was concluded that the structural integrity and the electrical function of the 4160-480V transformer bus were not compromised.

Based upon our review of the reports, this equipment is qualified for the seismic loads specified for the Shoreham site. It should be noted again, however, that this equipment was not available for a close inspection since it was energized.

1M50*PNL-04: Chiller Control Panel

(Model No. 20)

This equipment is located in the control building at elevation 63' and its function is to balance the capacity of the water chiller with the system cooling loads. It is a 72" high free standing floor mounted panel. The mounting consists of eight 5/8" size bolts which are arranged in two sets of four bolts, each set of bolts located on opposite sides of the long dimension of the base. The vendor of the equipment is the Trane Co. and the pertinent design specification is contained in:

"Specificaiton for Centrifugal Water Chillers",
SH1-106 by Stone and Webster, Add. 3, dated March 12, 1976.

The chiller control panel was qualified for seismic loads. Hydrodynamic loads are not applicable due to its location. The pertinent qualification reports are:

1) "Seismic Qualification of Centrifugal Water Chillers',
NUC102, by Trane Co., Feb. 18, 1977.

2) "Qualification Test of Panel and Machine Mounted
Components", Reprot 58096, by Wyle Lab., Sept. 20, 1976.

During the test the specimen was mounted with eight 5/8" bolts, which is the same as the actual in-service mounting configuration. A continuous sinusoidal sweep was performed in each axis over the frequency range 1 to 60 Hz. This sinusoidal test was carried out at a sweep rate of 2 octaves per min. The

table input was equal to 0.30g. In addition, a damping survey was conducted. The calculated frequencies were 13 Hz for F/B and 18 Hz for S/S directions. The vertical frequency was found greater than 60 Hz. The corresponding damping values for F/B and S/S directions were 3.8% and 4.2%.

The equipment was qualified by a multi-axis, multi-frequency test. The input random motion was generated in the frequency range from 1.25 up to 35 Hz. Each test had a duration equal to 30 seconds and the specimen was energized throughout the tests. The random motion was synthesized by applying a random signal to a group of one third octave filters. The amplitude of the filters was adjusted so that the resulting TRS enveloped the RRS in the frequency range of 1 to 100 Hz. The random motion for each horizontal axis was applied separately but each horizontal axis was excited simultaneously with the vertical axis.

Another item considered in the qualification tests was the phasing of the random input. A random phasing was used for the inputs in the different axes of the specimen (i.e., phase incoherent testing). No visible evidence of physical damage was detected before, during, and after the test. There was no contact chatter/transfer observed.

A fragility test was also performed. The TRS for the fragility test was generated from the RRS corresponding to the faulted condition. These tests were done for 30 seconds duration. The specimen was energized throughout the fragility tests. A set of ten fragility tests were performed in the X-Y axis and four in the Z-Y axis. The input excitation levels were increased

iteratively from the SSE level. At the same time the general shape of the spectrum was kept as closely as possible to the RRS until the fragility limits were reached. The TRS levels for the fragility limits are adequately above the RRS values. During the fragility tests contact chatter/transfer was observed at various locations of the specimen but no evidence of physical damage was indicated.

During the SQRT audit, the applicant was requested to revise the SQRT form to include the weight and frequency range for this equipment. The later submittal by the applicant received at BNL shows that the revisions have been incorporated into the revised forms.

Based on our review of the reports, the field installation, the clarifications provided by the manufacturer and the applicant's recent submittal, dated May 15, 1981, we conclude that this equipment is adequately qualified for the specified seismic loads.