



**PSEG**

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 Phone 201/430-7000

March 23, 1979

Director of Nuclear Reactor Regulation  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Attention: Mr. Olan D. Parr  
Light Water Reactors Branch 3  
Division of Project Management

Gentlemen:

RESPONSE TO REQUESTS FOR  
ADDITIONAL INFORMATION  
NO. 2 UNIT  
SALEM NUCLEAR GENERATING STATION  
DOCKET NO. 50-311

On February 26 - 28, 1979, a meeting was held at the Salem Nuclear Generating Station between Public Service and the NRC Seismic Qualification Review Team relating to the Seismic Qualification data for electrical, instrumentation and mechanical components.

Public Service Electric and Gas Company hereby submits sixty (60) copies of additional seismic qualification information as identified during the meeting.

Very truly yours,

R. L. Mittl  
General Manager -  
Licensing and Environment  
Engineering and Construction

Attachment

SALEM NUCLEAR GENERATING STATION  
UNIT NO. 2  
NRC SEISMIC QUALIFICATION REVIEW  
RESPONSES TO ADDITIONAL INFORMATION REQUESTS

The NRC Seismic Qualification Review Team met with PSE&G personnel at the Salem site on February 26-28, 1979 to conduct a review of the seismic qualification data for electrical, instrumentation and mechanical components. The attached Table 1 lists the items reviewed and a summary of the results. The following information is in response to items requiring additional data as identified at the meeting:

1. Motor Control Centers

- a. Area of Concern: Provide additional justification for acceptance of low frequency test results in the 5 to 10 HZ range in General Electric Test Report 70ICS100 dated 8/21/70.

Response: General Electric's Test Report 70ICS100 was reviewed by Southwest Research Institute for PSE&G. The results of this review summarized in their letter of June 7, 1971 (Attachment 1) did question the extrapolation of the test results for the 5 to 10 HZ range. General Electric prepared a response to the Southwest Research comment via their letter of August 6, 1971 (Attachment 2). Based on this additional information provided by General Electric, Southwest Research accepted the results of General Electric Test Report 70ICS100 in their letter of 2/29/72 (Attachment 3).

- b. Area of Concern: Clarify the input accelerometer data used to monitor test input on General Electric Test Report 70ICS100.

Response: As stated in Test Report 70ICS100, the input accelerometer used in this test was designated as #2 on figure 4-2 (Attachment 4). Table 3-4 of the report (Attachment 5) indicates the specific pages which provide the input data for this accelerometer (e.g. pages 1A, 13A and 25A). These pages are included at attachments 6, 7 and 8 respectively.

2. 5KV Switchgear and Relays

- a. Area of Concern: Provide additional data regarding the following 5KV Switchgear relays -

12HFA51A42F

12IAC66B6A

12IAV74A1A

Include information on the test procedure, functional monitoring and suitable backup data to support manufacturer statements on the seismic capability of the relays.

2. 5KV Switchgear and Relays (Cont'd)

Response: General Electric has performed tests on the above relays and demonstrated their operability when subjected to 1.2 g's horizontal and 1.2 g's vertical. We have contacted the manufacturer to request the actual test data which supports this statement. The information will be forwarded to the NRC when received to resolve this matter prior to initial criticality.

The plant may continue to proceed with coreload and operations up to initial criticality until this matter is fully resolved. The manufacturer has tested the relays and only confirmatory data is the subject of this concern. Plant and public safety will not be compromised on the basis that no power operation is permitted, no radiation hazards exist with the unit in a subcritical state and a minimum of auxiliary systems are operational. Even if the relays should misoperate during a seismic event and auxiliary systems are lost for a period of time, plant safety can still be maintained. Monitoring instrumentation will continue to operate and repairs/modifications can be made following the seismic disturbance to restore power to auxiliary systems. Restoration of power within a critical time period is not required with the unit subcritical as it would be during power operation because of decay heat, etc. There is no evidence to suggest that extensive damage would occur during the seismic event which would not permit manual restoration of power.

3. 600V Switchgear

- a. Area of Concern: Provide additional information regarding effect of resonances identified in ITE Test Report #R-8792.

Response: The resonant conditions identified in the report occurred only on the sheet metal surfaces. ITE Test Report #R-8792 prepared by Applied Devices Corporation states that there were no appreciable resonant conditions of the structure frame itself. (See attachments 9 & 10).

Unlike the ITE unit tested there are no relays in any of the safety related 600V switchgear at Salem Generating Station, nor are any required to perform a safety function. Therefore, the high transmissibility of the sheet metal surfaces would not affect the operation of the 600V switchgear during a seismic event.

Based on the above evaluation, the test report was found to be acceptable.

4. 28V and 125V Batteries

- a. Area of Concern: Update FSAR Table Q7.18-1, "Summary of Seismic Qualification For Safety-Related Equipment" to reference subsequent testing performed on C & D batteries which supports the functional operability of the batteries.

Response: Table Q7.18-1 will be updated to reference the additional testing performed on C & D batteries. A revised table will be submitted shortly.

5. 28V and 125V Battery Chargers

- a. Area of Concern: Update FSAR table Q7.18-1, "Summary of Seismic Qualification For Safety-Related Equipment" to indicate that the test results for the 28 volt battery charger were acceptable.

Response: Table Q7.18-1 will be updated to indicate the acceptability of the test results. A revised table will be submitted shortly.

- b. Area of Concern: Indicate the voltage and current values used for the 28 volt C & D battery charger during seismic testing.

Response: Batelle's report on the seismic testing of the C&D 28 volt battery charger, dated 1/11/72, indicates that the charger was energized as follows: "The battery charger was powered by 240-volt, 3 phase, a-c electrical power, and the charger output was connected to a resistive load bank. The d-c output voltage and current were monitored continuously using both meters and a Brush Mark 260 recorder. The battery charger was set to deliver 28.5 volts and 120 amps." As indicated in section A above, the results were acceptable.

- c. Area of Concern: Indicate the voltage and current values used for the 125 volt Exide battery charger during seismic testing.

Response: Exide Power Systems Division Report, "EPSD Seismic Test Facility", Public Service designation, "Salem Electrical Division File/Item #10-2505" provides the following information on the battery charger testing. "The charger is electrically connected to both a nominal AC supply and a test battery. It is then operated at full load at float voltage by applying resistive load." For Salem's charger this would be an input of 208 volts, 3 phase AC with a DC output of 250 amps at 130 volts.

6. Electrical Penetrations

- a. Area of Concern: Confirmation that the penetration area and containment cable trays and conduit hangers are designed to seismic Class I criteria.

Response: Cable trays and conduit hangers which are in seismic Class I structures have been designed and installed as seismic Class I. This includes the penetration area and containment.

7. WCAP 7817 - SSPS, NIS, Process Racks

- a. Area of Concern: Confirm that Salem is part of the Westinghouse Seismic Requalification Program and that the restrictions/modifications resulting from that program are not applicable to Salem.

Response: The seismic requalification of Westinghouse supplied safety-related equipment to higher accelerations does not have an effect on Salem. Salem is considered a low seismic plant under the Westinghouse generic qualification program. There are no known modifications or restrictions on operation of Westinghouse safety equipment due to additional seismic testing. Table Q7.18-1 will be updated to include supplemental qualification data. A revised Table will be submitted shortly.

8. Wyle Report 42441-1, Control Console

- a. Area of Concern: Provide a supporting statement regarding the operability of post accident recorders on the console.

Response: A portion of the Unit 2 Control Room Console was seismically tested by Wyle Laboratories which included post-accident recorders. The recorders were tested with the console and did not fail structurally. The console was installed on Unit 2 after the test and the indicators and recorders are working satisfactorily.

9. PSE&G Valves - Velan B12354 B 13MS

- a. Area of Concern: Submit SQRT forms on the valves reviewed during the meeting which have not already been submitted.

Response: The SQRT forms for the above noted valve are attached.

10. Service Water Pumps

- a. Area of Concern: Submit SQRT forms for the Service Water Pumps based on the qualification data which was reviewed at the meeting.

Response: The SQRT forms for the Service Water Pumps are attached.

11. Diesel-Generators and Vital Appurtenances

- a. Area of Concern: Provide information regarding the functional operability of the diesel-generator differential protection relay 12CFD22A1A during the seismic test of the generator control panel (Wyle Report 42551-1).

Response: During the seismic test of the generator control panel, a number of relays were monitored for operability. The diesel-generator differential protection relay 12CFD22A1A is in the circuit for the diesel unit trip relay (DUTR). Refer to attachment 11 for a portion of the circuitry. The DUTR circuit was energized and monitored during the seismic test. Unacceptable operation of the CFD relay would have tripped the DUTR. The DUTR did not trip during the test which signifies that the input relays to the DUTR did not misoperate. Pre-operational and post-operational testing of the DUTR verified its operability. The acceptable operation of the DUTR provides acceptance of the diesel-generator differential protection relay.

- b. Area of Concern: Provide information on the functional operability of the diesel-generator appurtenances such as the governor when subjected to a seismic disturbance.

Response: ALCO has performed an analysis of the diesel-generators to prove their operability during a seismic event. We have contacted the manufacturer to request supplementary data on the diesel-generators. The information will be forwarded to the NRC when received. Another approach that PSE&G may take is to perform a startup test of the diesel-generators with accelerometers mounted on vital appurtenances to determine that operational stresses exceed those induced by a seismic disturbance. The information to resolve this item will be submitted prior to initial criticality.

The plant may continue to proceed with coreload and operations up to initial criticality until this matter is fully resolved. Plant and public safety will not be compromised on the basis that no power operation is permitted, no radiation hazards exist with the unit in a subcritical state and a minimum of auxiliary systems are operational. Even if the diesels fail

11. Diesel-Generators and Vital Appurtenances (Cont'd)

b. Response (Cont'd)

to operate during a seismic event causing power loss to auxiliary systems, plant safety can still be maintained. Monitoring instrumentation will continue to operate and the diesels restarted following the seismic disturbance to restore power to auxiliary systems. Restoration of power within a critical time period is not required with the unit subcritical as it would be during power operation because of decay heat, etc. The seismic analysis of the diesel-generators by the manufacturer demonstrated that there are not any unacceptable stress levels. There is no evidence to suggest that extensive damage would occur during the seismic event which would not permit restart of the diesels if required.

TABLE 1

SALEM NUCLEAR GENERATING STATION  
UNIT NO. 2  
NRC SEISMIC QUALIFICATION REVIEW SUMMARY

<u>Review Item</u>	<u>Test Inspect/Data</u>	<u>Functional Operability</u>
Motor Control Centers	Response Item 1	Accepted
Control Room Recorder Panels	Accepted	Accepted
5KV Switchgear	Accepted	Response Item 2
600V Switchgear	Response Item 3	Accepted
Battery Racks	Accepted	Accepted
28V and 125V Batteries	Accepted	Response Item 4
28V and 125V Battery Charger	Accepted	Response Item 5
Electrical Penetrations	Accepted	Accepted*
Vital Instrument Bus and Inverters	Accepted	Accepted
WCAP 7817 - SSPS, Process Racks, NIS	Accepted	Accepted**
Battelle Report of 4/27/73 - Instr. Panel & Misc.	Accepted	Accepted
Wyle Labs Report 42897 - Misc. Transmitters	Accepted	Accepted
Wyle Labs Report 42441 - Control Console	Accepted	Response Item 8
Wyle Labs Report 42367 - 28V & 125V Distr. Cab.	Accepted	Accepted
Wyle Labs Report 43870 - Unit 2 RMS (Controls)	Accepted	Accepted
Wyle Labs Report 44215 - NEMA 12 Cab. & Misc.	Accepted	Accepted
Wyle Labs Report 43728 - NEMA 12 Cab. & Misc.	Accepted	Accepted
Wyle Labs Report 43166 - Misc. Components	Accepted	Accepted
Typical Safety Related Valve	Response Item 9	Accepted
Service Water Pump and Aux. Feedwater Motor	Response Item 10	Accepted
Diesel Generators and Associated Components	Accepted	Response Item 11

\*Required confirmation of Seismic I design for cable trays - Response Item 6

\*\*Confirmation of Salem in Westinghouse Requalification Program - Response Item 7



## SOUTHWEST RESEARCH INSTITUTE

P.O. BOX 375

BLOOMFIELD, CONNECTICUT 06002

ATTACHMENT #1

P. S. E. &amp; G.

JUN 12 1971

June 7, 1971

QA Received

Mr. R. L. Mittl  
Chief Mechanical Engineer  
Electric Engineering Department  
Public Service Electric and Gas Company  
80 Park Place  
Newark, New Jersey 07101

Salem  
Electrical Division  
File #      Item #

40      10680

Subject:      Southwest Research Institute Project 17-2150-01  
                Salem Nuclear Generating Station  
                Your Reference QA-66, dated May 13, 1971.

Dear Mr. Mittl:

General Electric Test Report 70ICS100, Vibration Testing and Analysis of 7700 Line Motor Control Center, has been reviewed by our San Antonio offices and the following comments are offered:

"The report concludes that the equipment as tested is suitable for applications up to at least 0.5 G base input acceleration through a frequency band from 5 to 500 Hz. Since the unit was tested under the conditions as specified and it appears from a brief investigation that the tests were conducted in a professional and competent manner, the conclusions seem valid.

The only question about the data was how accurate was the extrapolation of the test results from 5 to 10 Hz. In this frequency range the input G level was only approximately .25 G. Since this was also near the resonant frequency in the horizontal direction, the extrapolation might not be justified from a reliability standpoint.

One question which must be answered is how well the test depicts the satisfactory operation of the unit under upset conditions. The horizontal and vertical response spectra curves give an indication of expected input "G's" as a function of frequency for the maximum credible earthquake (20% G horizontally and 13.3% G vertically)

Mr. R. J. Mill  
June 7, 1971  
Page 2

and design base earthquake (10% horizontally and 6.7% G vertically). This data shows that for vertical response the input levels will be less than .5 G as long as the damping is 2% or greater. For the horizontal response the input levels will be greater than .5 G's for both the maximum credible earthquake and the design base earthquake. These curves have been replotted (Figures 1 and 2) to illustrate the frequencies that the input levels exceed .5 G. Figure 1 indicates that the input level could be 1.1 G at 5 Hz and 2.4 G at 10 Hz. Figure 2 shows that the G level of 1.0 G at 5 Hz and .9 G at 12 Hz exceeded the .5 G input test level. The significance of these facts are: (1) the motor control unit could be subjected to more severe vibrations than those to which it has been tested, assuming that the damping is less than 5%, and (2) the maximum response corresponds to the natural frequency of the motor control unit, which is undesirable."

Should you have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

*R. P. Shimkus*

R. P. Shimkus  
Project Manager

Prepared by:

J. E. Gallivan  
Senior Quality Assurance Engineer

JEG:mj

cc: A. Nassman

C. E. Lautzenheiser

Attachments

ACCELERATION LEVEL, G

5.  
4.  
3.  
2.  
1.0.  
0.9.  
0.8.  
0.7.  
0.6.  
0.5.  
0.4.  
0.3.  
0.2.

HORIZONTAL RESPONSE Spectrum At Earth  
Acceleration 177' Kingston, Georgia  
EARTH QUAKE (20% G)

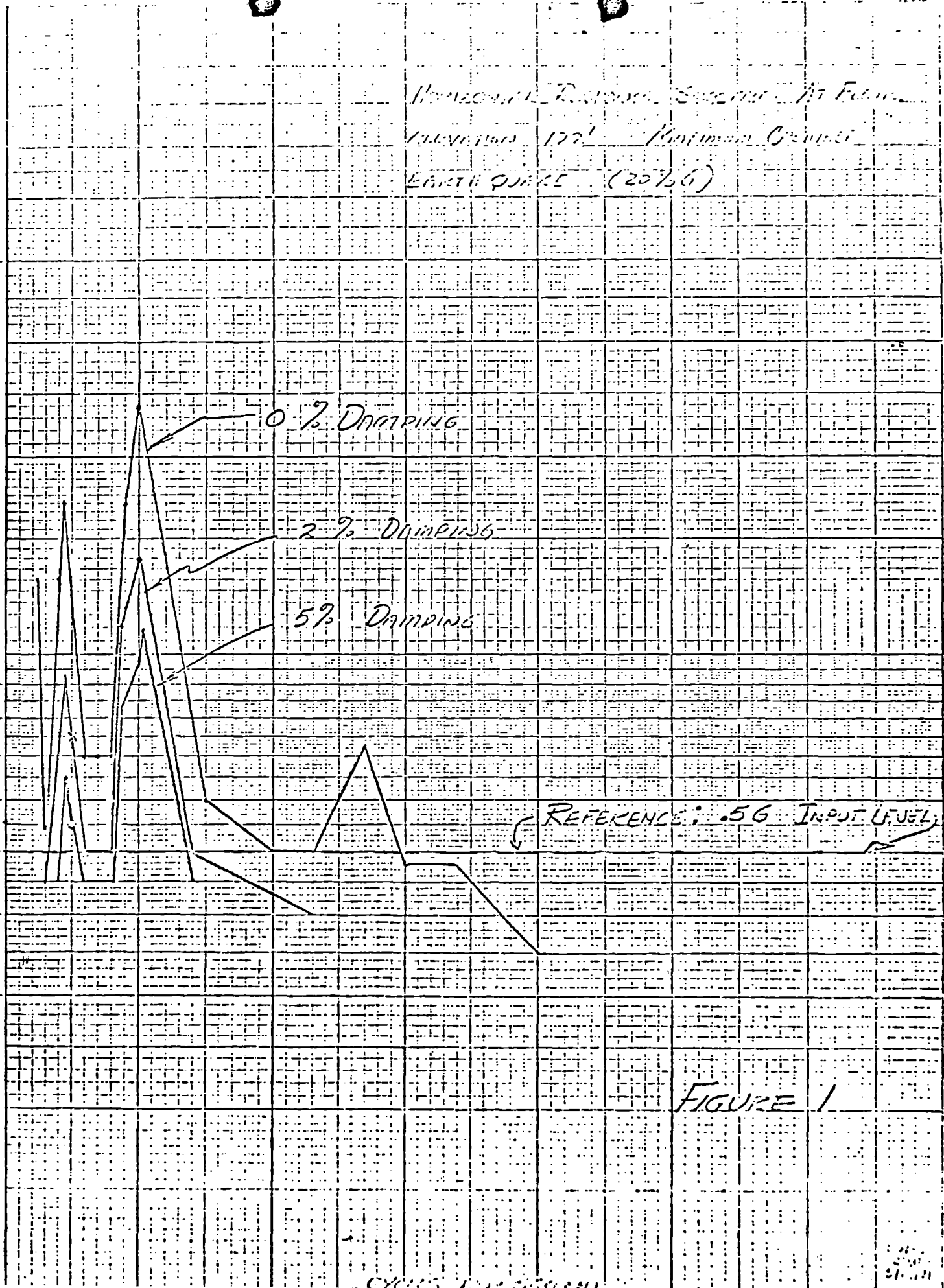
0% DAMPING

2% DAMPING

5% DAMPING

REFERENCE: .56 INPUT LEVEL

FIGURE 1



ACCELERATION LEVEL, G

Национальное Радио-Сеть в Ташкенте  
вместе с Евразией (1976)

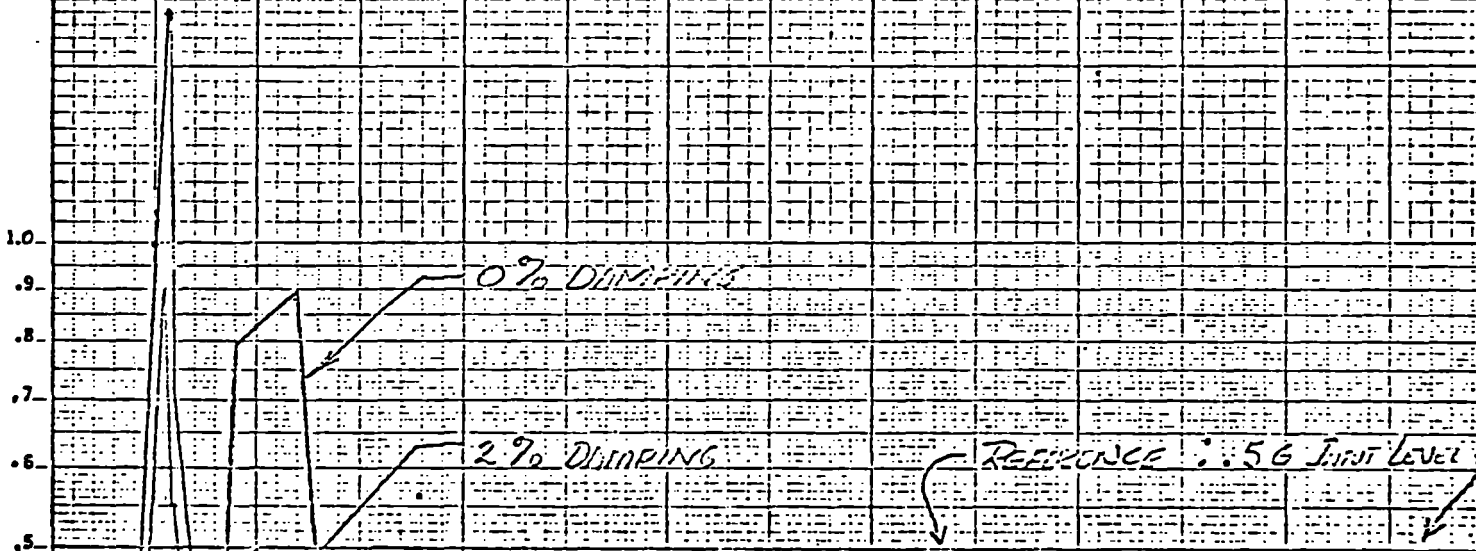


FIGURE 2

61A

**GENERAL ELECTRIC  
COMPANY**

25 EAST WILLOW STREET, MILLBURN, NEW JERSEY 07041 . . . TELEPHONE 376-9000

ELECTRIC UTILITY

SALES

OPERATION

ATTACHMENT #2

August 6, 1971

Re: Salem Nuclear Generating Station  
Units #1 and #2  
Motor Control Centers  
Seismic Analysis Report

Mr. R. R. Bast  
Chief Electrical Engineer  
Public Service Electric and Gas Company  
80 Park Place  
Newark, New Jersey 07101

ELECTRICAL DIVISION	RRB 11-1-7
AWG	GWS
AUG 11 1971 / 1	
FFK	FVB
HAP	EHE
KC	PB
SL	PRHL

Dear Mr. Bast:

In response to your letter of July 1, 1971, we submit the following additional information regarding the seismic withstand capabilities of our Motor Control Centers.

The input amplitude between 5-10 hz represents machine capabilities in this frequency span. A maximum transmissibility factor of 3:1 between the base of MCC and the motor starters was determined. Individual tests conducted separately on motor starters indicated that they could withstand considerably more than  $0.5 \times 3 = 1.5$  g's, so that the analysis is substantiated.

Individual components have been tested by themselves and found to withstand over 6g's force in all three planes without malfunction. The structure and components can stand considerably more than these forces without damage, and operate normally on return to normal condition.

The MCC bolted structure is, by design, a good shock absorber. With the transmissibility measured, the damping factor is actually greater than 5%.

This data on the individual components was obtained from tests which were not made part of the formal report previously submitted.

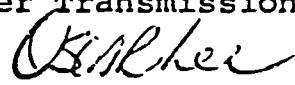
Public Service Electric and Gas Company

August 6, 1971

- 2 -

I hope this information will be sufficient to answer those questions posed by your Seismic Consultant, Southwest Research Institute, in their June 7th letter to you.

Very truly yours,

J. A. Miller  
Power Transmission Sales  
By: 

O.D.Lee, III/ma

# SOUTHWEST RESEARCH INSTITUTE

P.O. BOX 375

BLOOMFIELD, CONNECTICUT 06002

P. S. E. & G.

ATTACHMENT #3

February 29, 1972

MAR 6 1972

QA Received

Mr. R. L. Mittl  
Chief Mechanical Engineer  
Electric Engineering Department  
Public Service Electric and Gas Company  
80 Park Place  
Newark, New Jersey 07101

P. S. E. & G. CO.		
O. A. ROUTING		
CJH	CJH	
WFE	WFE	7/72
ETI	ETI	7/72

Subject: Southwest Research Institute Project I7-2150-01  
Salem Nuclear Generating Station  
Your Reference QA-79, dated January 26, 1972  
Seismic Calculations 7700 Line Motor Control Center

Dear Mr. Mittl:

The information contained in General Electric's letter of August 6, 1971 has clarified the questions raised in our original comments of June 7, 1971. We have no further comments.

Very truly yours,

R. P. Shimkus  
R. P. Shimkus  
Project Manager

RPS:JEG:mj

cc: A. Nassman

C. E. Lautzenheiser

sent to R. Mayer  
5/19/72



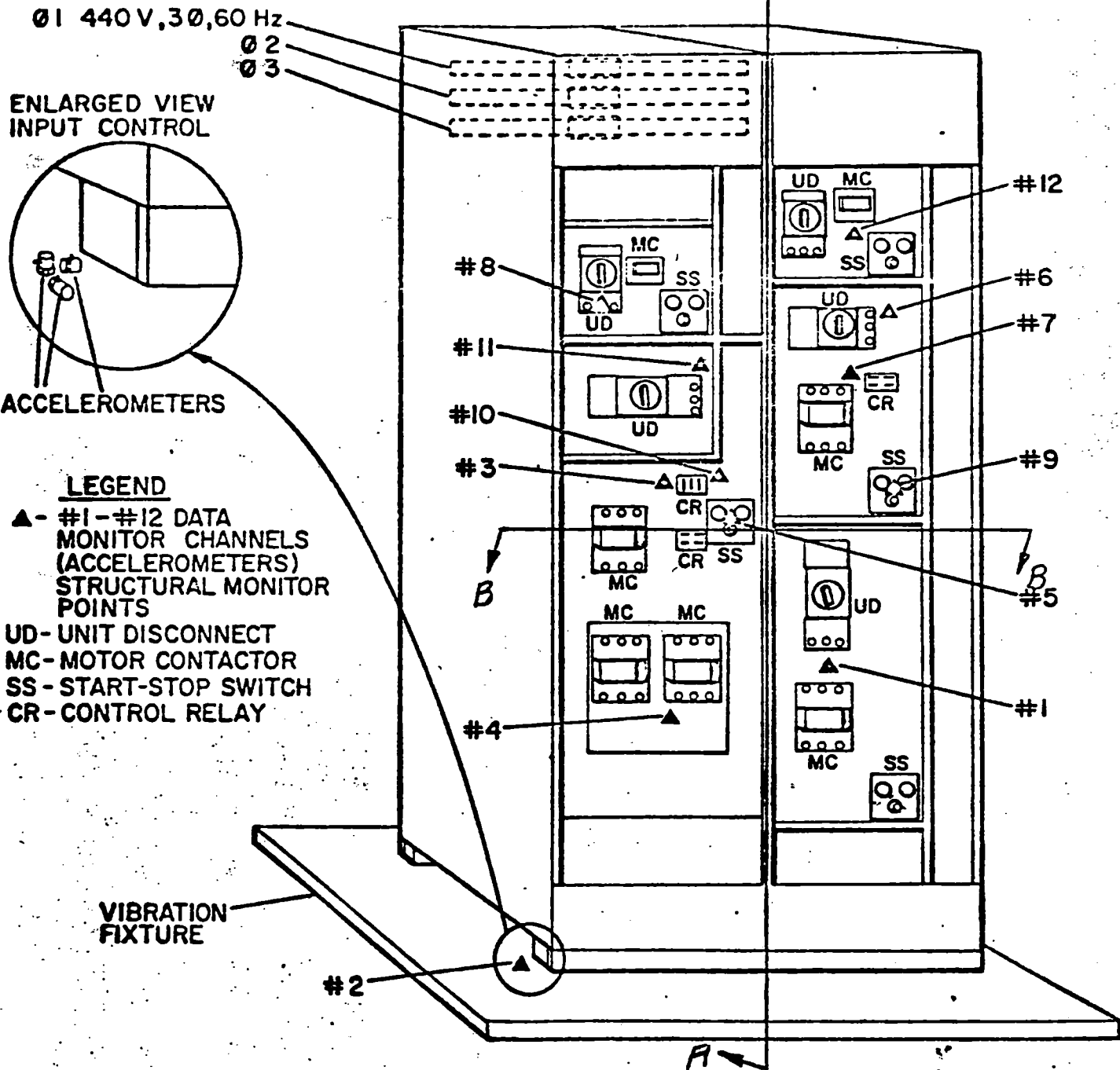


FIGURE 4-2  
MOTOR CONTROL CENTER - ACCELEROMETER MOUNTING LOCATION

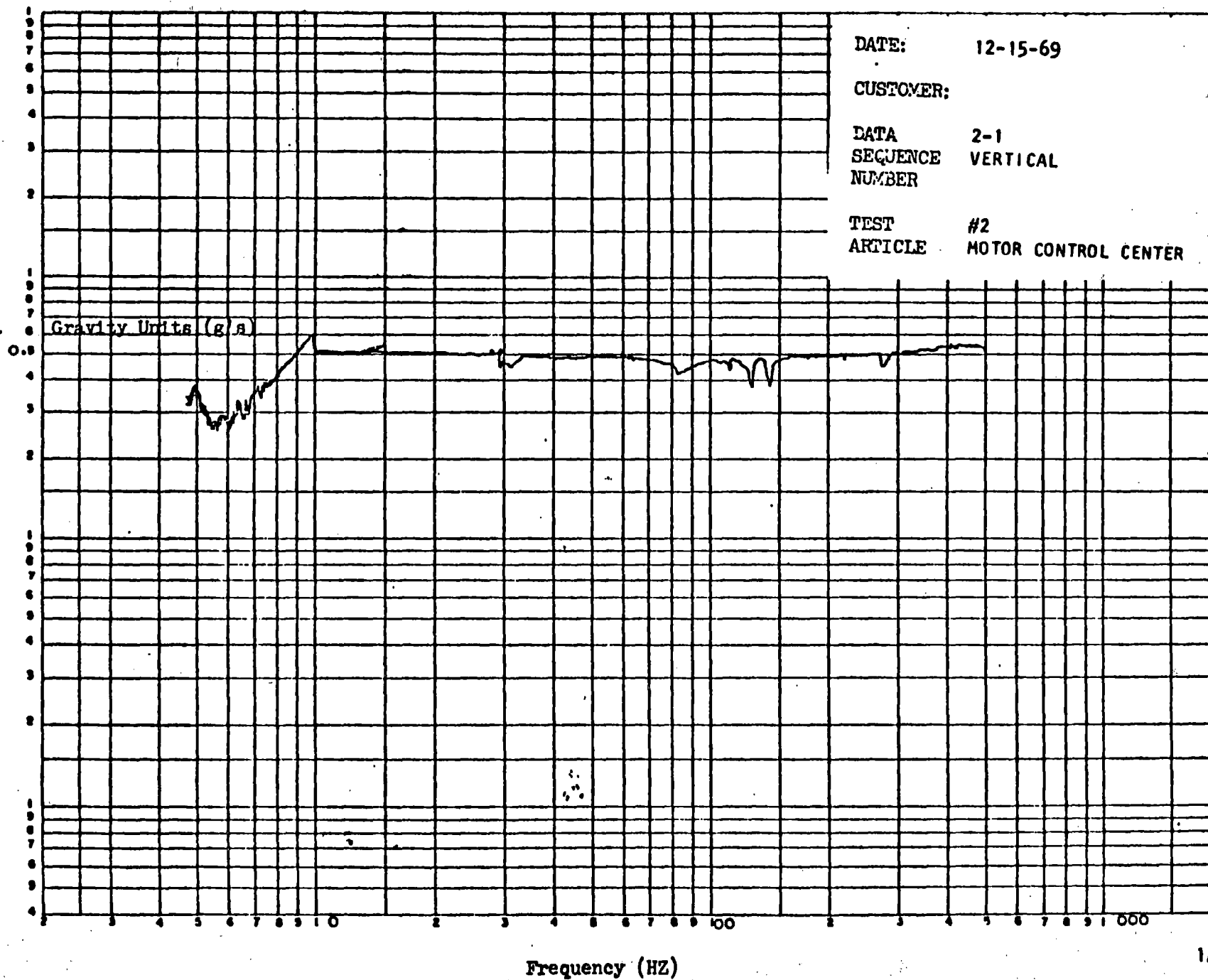


RESPONSE ACCELERATION PLOTS - PG. 1A - 36A

<u>ACCELEROMETER NO.</u> (SEE FIG. 4-2)	<u>VERTICAL ACCEL.</u>	<u>HORIZ. ACCEL. IN-BREADTH</u>	<u>HORIZ. ACCEL. FORE-AND-AFT</u>
1	2A	14A	26A
2	PAGE 1A	PAGE 13A	PAGE 25A
3	3A	15A	27A
4	4A	16A	28A
5	5A	17A	29A
6	6A	18A	30A
7	7A	19A	31A
8	8A	20A	32A
9	9A	21A	33A
10	10A	22A	34A
11	11A	23A	35A
12	12A	24A	36A

TABLE 3-4 - INDEX - ACCELEROMETER NO'S & ASSOCIATED X-Y PLOTS

# ATTACHMENT #6



# ATTACHMENT #7

DATE: 12-17-69  
 CUSTOMER:  
 DATA 2-13  
 SEQUENCE HORIZONTAL  
 NUMBER IN-BREADTH  
 TEST #2  
 ARTICLE MOTOR CONTROL CENTER

Gravity Units (g's)

*Handwritten scribbles*

Frequency (HZ)

13A

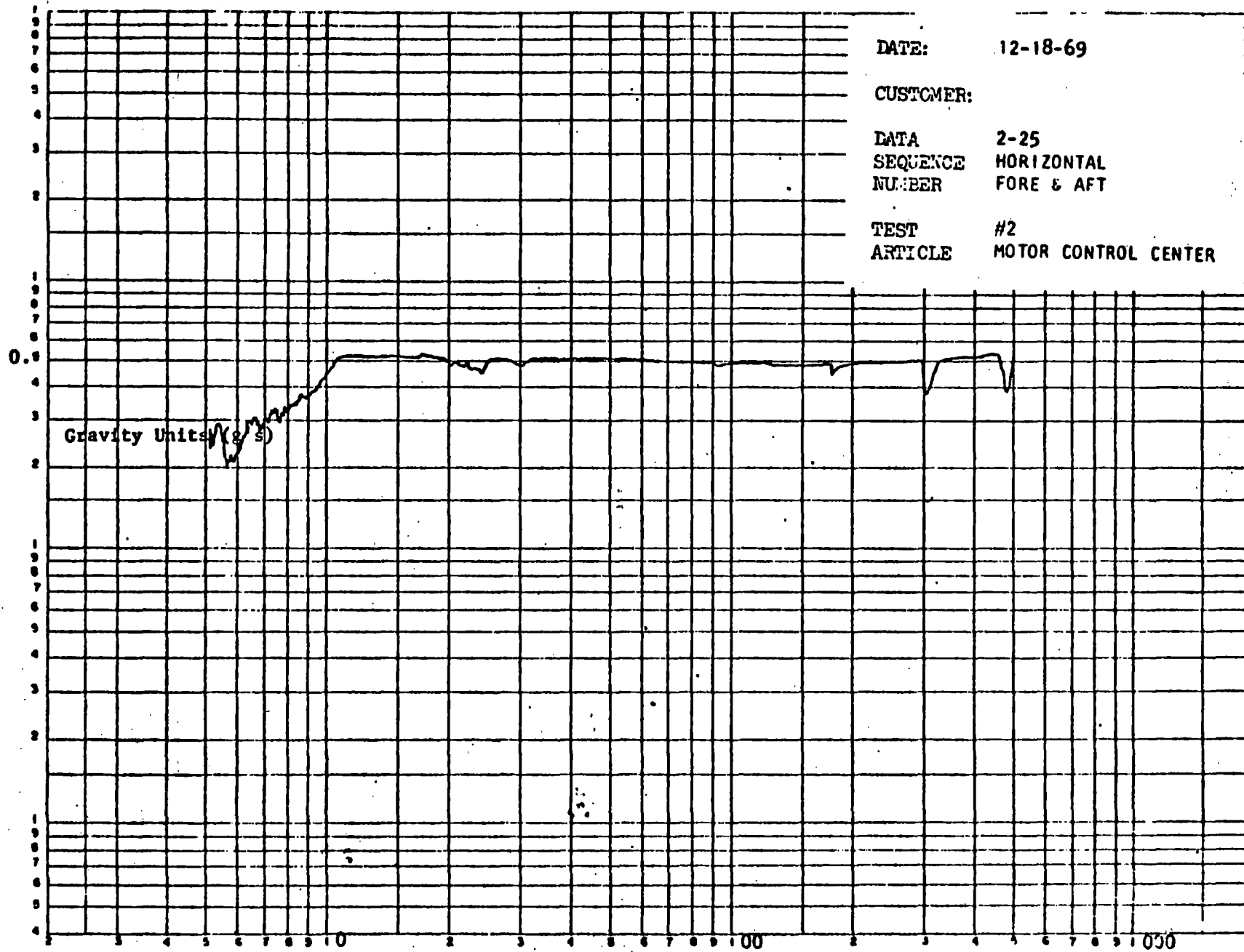
# ATTACHMENT #8

DATE: 12-18-69

CUSTOMER:

DATA 2-25  
SEQUENCE HORIZONTAL  
NUMBER FORE & AFT

TEST #2  
ARTICLE MOTOR CONTROL CENTER



Frequency (Hz)

## ACTUAL DATA (continued)

10. RESONANT SURVEY:

At the completion of shock tests, the 600 V Switchgear was removed from the shock machine and then mounted to the table of a L.A.B. Low Frequency Vibration Machine.

The unit was subjected to a vibration scan in a frequency range from 5 to 33 cps. For this scan, accelerometers were attached to the unit at the same points as monitored during the shock tests. Resonant conditions of these points, if any, were noted and recorded. This scan was performed in each of the two horizontal axes:

Monitored Points	Axis	Resonant Freq. (cps)	Transmissibility (output/input)
2	Front to back	19.0	29.0
3	Side to Side	12.0	3.5
4	Side to Side	10.0	1.75
5	Front to back	16.0	35.0
6	Front to back	22.0	60.0

There were no appreciable resonant conditions of Points 1 or 7, nor the structure frame, in the frequency range scanned.

Note: Transmissibility is defined as a ratio of the output amplitude divided by the input amplitude.

11. SUMMARY:

There was no apparent physical damage to the unit as a result of the shock tests reported herein nor was there any disconnect or chatter of the contacts monitored.

Applied Devices Corporation

COLLEGE POINT LONG ISLAND NEW YORK 11558

ETL 3718

S.O. 502-901

I-SEE IMPERIAL CORPORATION  
PHILADELPHIA, PENNSYLVANIA

# 600 V SWITCHGEAR

## Locations of Output Accelerometers During Tests:

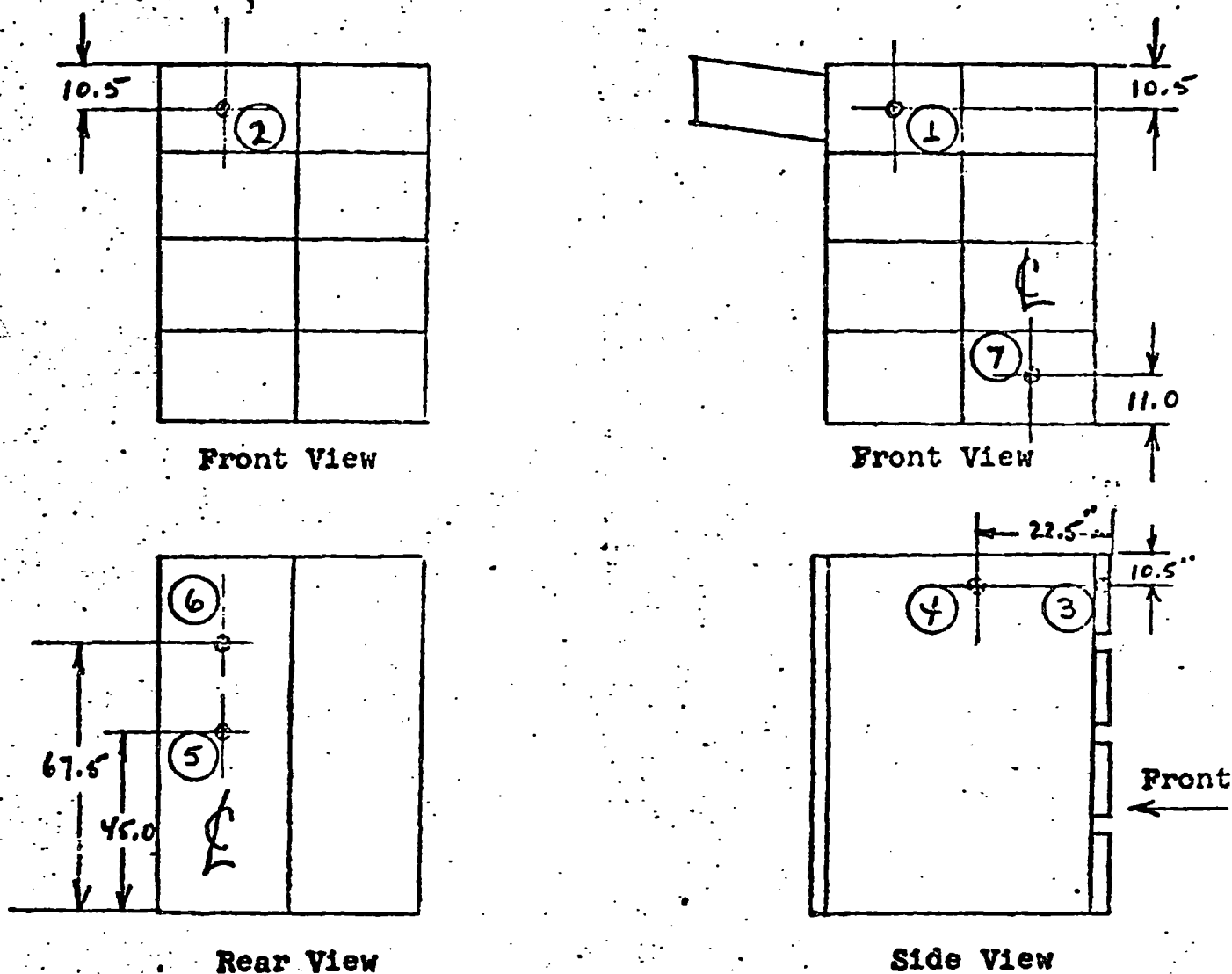


FIGURE NO. 2

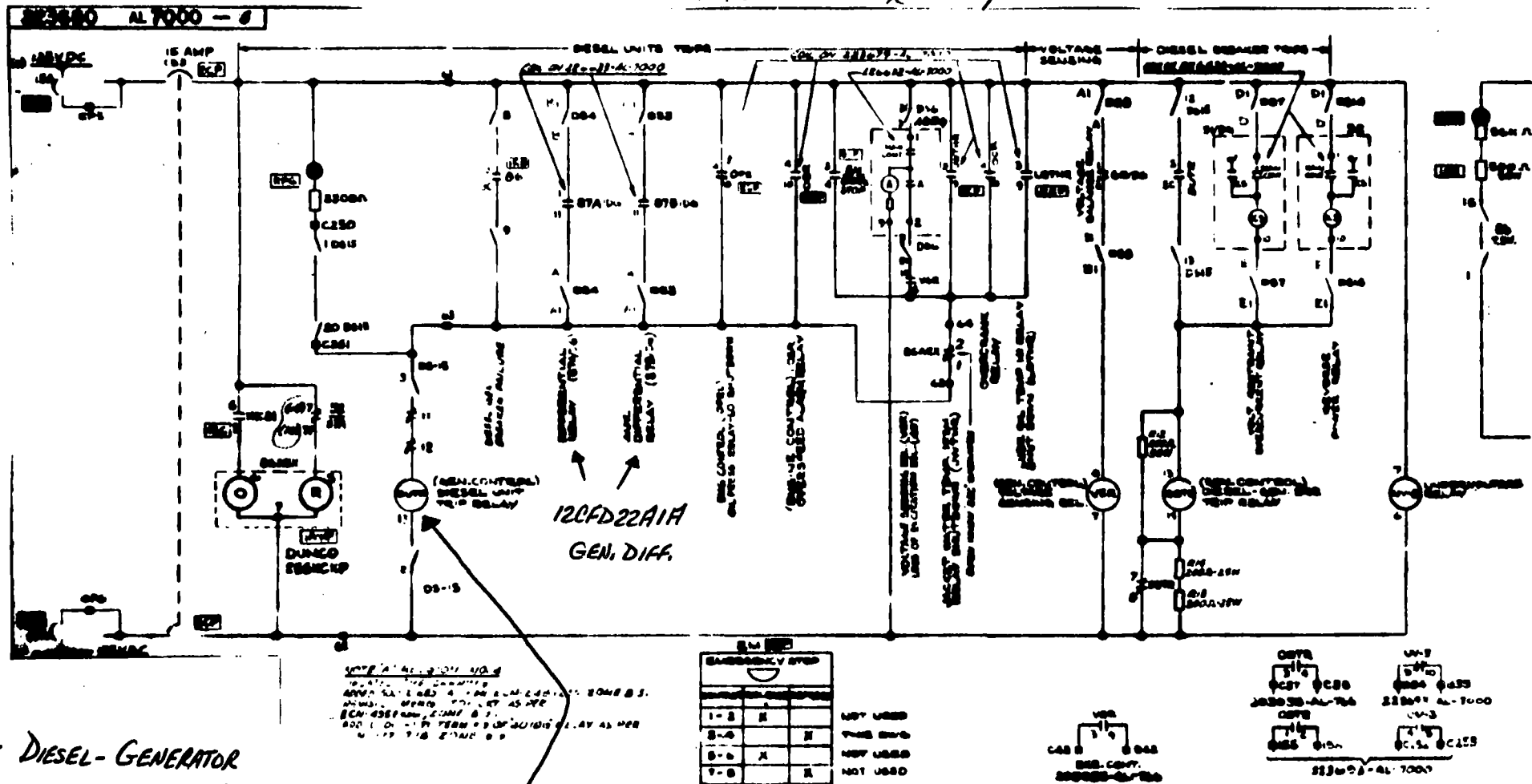
Applied Devices Corporation

COLLEGE POINT LONG ISLAND NEW YORK 11560

ETL 3718

S.O. 502-901

Portion of PSE&G DWG. 223680-AL-7000  
Diesel-Generator Unit Trip Protection



ATTACHMENT 11

THE DIESEL-GENERATOR  
CIRCUITRY HAS BEEN REVISED  
TO MEET NRC BTP EICSB 17,  
"DIESEL-GENERATOR PROTECTIVE  
TRIP CIRCUIT BYPASSES".

The DUTR Relay was energized and monitored during the seismic test (125V DC was supplied at terminals CP5 and CP6 thereby energizing the entire circuit). There was no any misoperation of the DUTR which indicates the proper performance of the generator differential relay.

Seismic Qualification Summary of Equipment

I. Plant Name:

SALEM NUCLEAR GENERATING STATION

Type:

1. Utility: PUBLIC SERVICE ELECTRIC & GAS CO.

PWR ☒

2. NSSS: WESTINGHOUSE

BWR ☐

3. A-E: PSEdG

II. Component Name

Valve

1. Model  
Number Velan B12354 B 13MS

2. Vendor Velan Engineering Companies

3. Physical Description 4 - inch - 1500 lb. forged bolted  
bonnet motor or manually operated gate valve

4. Location: Building: Containment  
(In Plant) Elevation: 145 ft.

5. Natural Frequencies in Each Direction: 59.85 Hz weakest axis

6. Functional Description: Maintenance valves for pressurizer  
spray valves ; no motor operator in this application.

7. Pertinent Reference Design Specifications: P.S. Specification  
72-6347

III. Is Equipment Available for Inspection in the Plant: ☒ Yes ☐ No

Comments:



IV. Seismic Qualification Method: Test: \_\_\_\_\_  
Analysis: X \_\_\_\_\_  
Combination of Test and Analysis: \_\_\_\_\_

## V. Seismic Input:

1. Required Response Spectra (attach the graphs): \_\_\_\_\_
- Required
2. Acceleration in each Direction: 5.00g in each horizontal  
direction

**VI. If Qualification by Test, then Complete:**

1. ☐ Single Frequency ☐ Multi-Frequency
2. ☐ Single Axis ☐ Multi-Axis
3. Frequency Range: \_\_\_\_\_
4. TRS enveloping RRS using Multi-Frequency Test ☐ Yes (attach TRS graphs)  
☐ No
5. g-level Test at  $h_1$  = \_\_\_\_\_  $h_2$  = \_\_\_\_\_  $V$  = \_\_\_\_\_
6. g-level Required  $h_1$  = \_\_\_\_\_  $h_2$  = \_\_\_\_\_  $V$  = \_\_\_\_\_
7. Mounting:
1. Seismic Report: \_\_\_\_\_
2. Field Check: \_\_\_\_\_
8. Functional Verification Performed ☐ Yes ☐ No ☐ Not Applicable

**VII. If Qualification by Analysis or by the Combination of Test and Analysis then, Complete**

1. Description of Test including Results: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Method of Analysis:

☒ Static Analysis   ☐ Equivalent Static Analysis   ☐ Dynamic Analysis  
☐ Response Spectrum   ☐ Time-History

3. Model Type (each direction): \_\_\_\_\_

4. Computer Codes: \_\_\_\_\_


5. Damping: \_\_\_\_\_

6. Support Considerations: \_\_\_\_\_

7. Critical Structural Elements:

A.	Identification	Location	Governing Response Combination	Seismic Stress	Total Stress	Stress Allowable
	Yoke-Section 2-2				15,000 psi	26,250 psi
	Summary of analysis attached					

B.	<u>Max. Deflection</u>	<u>Location</u>	<u>Effect Upon Functional Operability</u>
	N/A		

	VELAN ENGINEERING COMPANIES	ENGINEERING CALCULATIONS
	BB4-1500GA-100	

4"

FORGED BOLTED BONNET NUCLEAR VALVE

\*\*\*\*\*

# SUMMARY OF RESULTS :

## SECTION 2-2 STRESS INTENSITY:

S12 = 15000. ALLOWABLE = 26250  
15000. < 26250.

CONDITION SATISFIED

## SECTION 3-3 STRESS INTENSITY:

S12 = 14177. ALLOWABLE = 26850.  
14177. < 26850.

CONDITION SATISFIED

## SECTION 4-4 STRESS INTENSITY:

S12 = 11582. ALLOWABLE = 26850.  
11582. < 26850.

CONDITION SATISFIED

## SECTION 5-5 BOLT STRESSES:

SB = 2415. ALLOWABLE = 31700.  
2415. < 31700.

CONDITION SATISFIED

## NATURAL FREQUENCY:

FREQ = 60. ALLOWABLE = 33.  
60. > 33.

CONDITION SATISFIED

DATE: 11 MAR 74	BY: S.I.	REV.:	PAGE No.: 2
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**VELAN ENGINEERING COMPANIES**

ENGINEERING DEPARTMENT

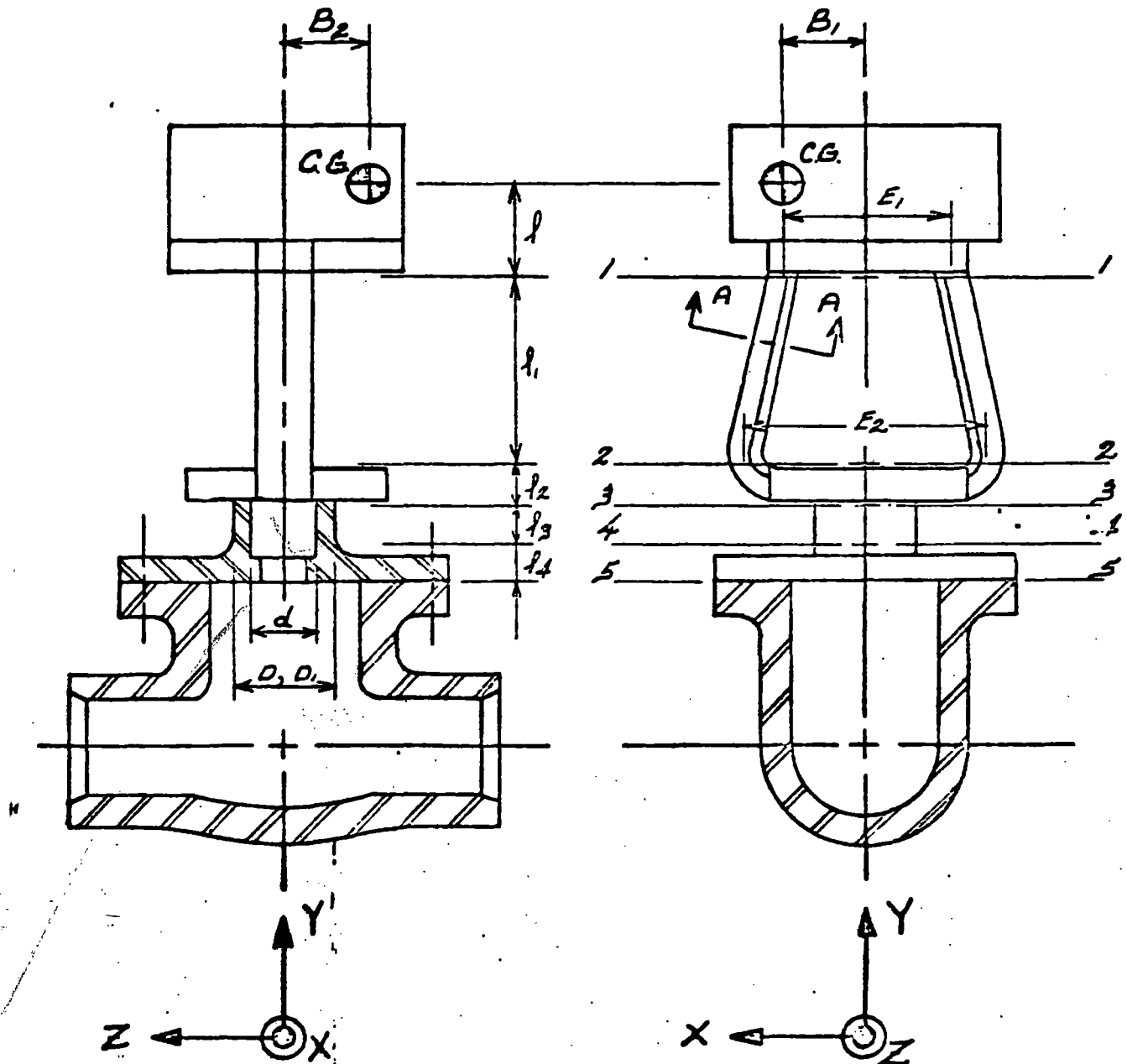
SUBJECT: SEISMIC ANALYSIS

Project: BB4-1500GA-100

Name: S. ISBITSKY

Date: MARCH 11, 1974.

SEISMIC ANALYSIS FOR 4" - 1500 LB FORGED BOLTED BOLINET  
MOTOR OR MANUALLY OPERATED GATE VALVE. NUCLEAR CLASS I, II & III



Seismic Qualification Summary of Equipment

I. Plant Name:

SALEM NUCLEAR GENERATING STATION

Type:

1. Utility: PUBLIC SERVICE ELECTRIC & GAS CO.

PWR ☒

2. NSSS: WESTINGHOUSE

BWR ☐

3. A-E: PSE&G

II. Component Name

Service Water Pump

1. Model  
Number

Serial No. D-26081 (typ.)

Quantity: 6/Unit

2. Vendor Aurora Pump

3. Physical Description Service Water Pump - (vertical wet-pit)

4. Location: Building: Service Water Intake Structure  
(In Plant) Elevation: 92 - ft. 6 - In.

5. Natural Frequencies in Each Direction: See Attached Table I

6. Functional Description: Supplies river water for safety  
related plant cooling loads

7. Pertinent Reference Design Specifications: PSE&G Specification  
69-6389

III. Is Equipment Available for Inspection in the Plant: ☒ Yes ☐ No

Comments:

IV. Seismic Qualification Method: Test: \_\_\_\_\_  
Analysis: X \_\_\_\_\_  
Combination of Test and Analysis: \_\_\_\_\_

V. Seismic Input:

1. Required Response Spectra (attach the graphs): \_\_\_\_\_

See Attached Graphs

Required

2. Acceleration in each Direction: \_\_\_\_\_

VI. If Qualification by Test, then Complete:

1. ☐ Single Frequency ☐ Multi-Frequency

2. ☐ Single Axis ☐ Multi-Axis

3. Frequency Range: \_\_\_\_\_

4. TRS enveloping RRS using Multi-Frequency Test ☐ Yes (attach TRS graphs)  
☐ No

5. g-level Test at  $h_1$  = \_\_\_\_\_  $h_2$  = \_\_\_\_\_  $V$  = \_\_\_\_\_

6. g-level Required  $h_1$  = \_\_\_\_\_  $h_2$  = \_\_\_\_\_  $V$  = \_\_\_\_\_

7. Mounting:

1. Seismic Report: \_\_\_\_\_

2. Field Check: \_\_\_\_\_

8. Functional Verification Performed ☐ Yes ☐ No ☐ Not Applicable

VII. If Qualification by Analysis or by the Combination of Test and Analysis then, Complete

1. Description of Test including Results: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

2. Method of Analysis:

☐ Static Analysis    ☐ Equivalent Static Analysis    ☒ Dynamic Analysis  
☒ Response Spectrum    ☐ Time-History

3. Model Type (each direction): Multi-Degree of Freedom-Lumped Mass

4. Computer Codes: CANBM, MDLDF, STRESS

5. Damping: 1/2% Critical

6. Support Considerations: Bolted to concrete floor - bolt loads considered in calculations.

7. Critical Structural Elements:

A.	<u>Identification</u>	<u>Location</u>	<u>Governing Response Combination</u>	<u>Seismic Stress</u>	<u>Total Stress</u>	<u>Stress Allowable</u>
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See Attached Table II

B.

Max. Deflection

Location

Effect Upon Functional Operability

Dynamic deflections much less than bearing clearances - No effect upon operability

SERVICE WATER PUMP HOUSE · OBE vertical response spectra at floor elevation 90': multiply by 0.333  
 DBE vertical response spectra at floor elevation 90' multiply by 0.667

# RECOMMENDED RESPONSE SPECTRA

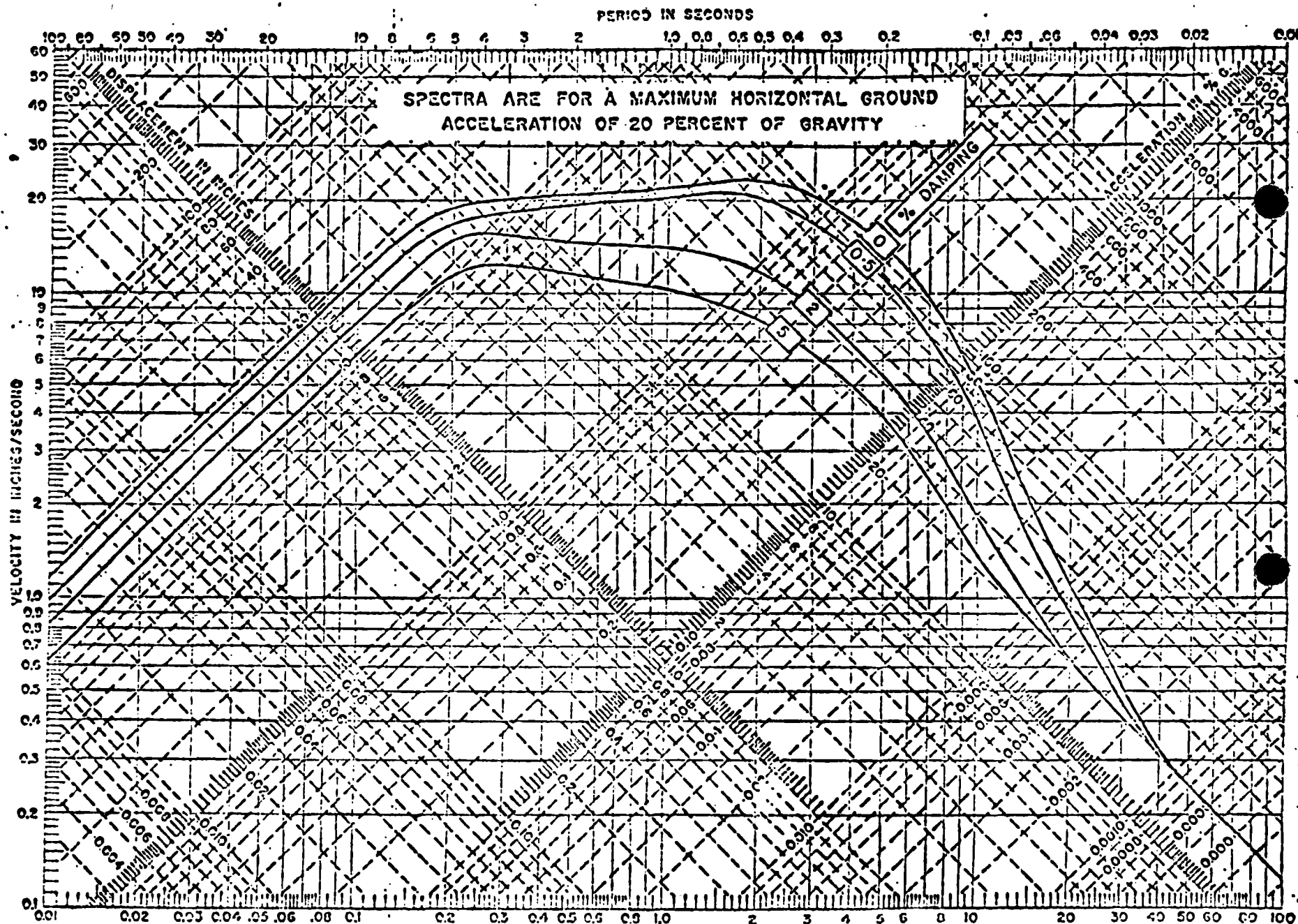






TABLE I

## TABLE OF FREQUENCIES

Pump Operating Speed		19.75 Hertz				Calc. Page
Pump Column	Transverse	22.75	73.99	228	1148	15
	Vertical	58.1				19
Lineshaft	Transverse	61.2				25
	Vertical	106				24
Shaft Tube	Transverse	29.6				27
Discharge Head and Motor						
	Transverse	47.8	720	1735		6
Motor	Transverse	177				4

# MATERIALS AND STRESSES

Location	Material	Allow. Stress (3)	Calc. Stress (2)	Margin (1)	Calc. Page
<b>Head - Motor Assembly</b>					
Motor Mounting Bolts	A 36	14,500	956	14.2	8
Base of Head	SA516 Gr. 70	17,500	1663	9.5	29
Head Mounting Bolts	SA325	20,200	7354	1.75	29
Discharge Nozzle Flange	SA516 Gr. 70	17,500	12,652	.38	30
Flange Bolts	N. F.	-	26,290	-	30
Sole Plate	A 36	14,500	2820	4.14	33
Anchor Bolts	N. F.	-	7094	-	32
<b>Pump and Column Assembly</b>					
Flange (Sta. 4)	SB148 CDA 954	18,900	5433	2.48	23
Flange Bolts	SB164 Gr. 400	54,000 (4)	15,693	2.45	23
Column Pipe	SB169 CDA 614	18,000	5173	2.48	23
Discharge Case Flange	SB143-2A	8500	6143	.38	23
Lineshaft	K500 Monel	21,000 (5)	13,728	.53	26
Shaft Tube	SB143-2A	8500	121	69.2	27

## Notes:

1. Margin is defined as  $\frac{\text{Allowable Stress}}{\text{Calculated Stress}} - 1$
2. Calculated Stress is at DBE and includes operating, nozzle and seismic loads.
3. Allowable Stress is at OBE unless noted.
4. Allowable Stress at DBE
5. Based on 30% of Y.S. per ANSI B58.1. As this is not a pressure boundary, margin is based on operational criteria only.