LOUISIANA POWER & LIGHT / 142 DELARONDE STREET
P. O. BOX 6008 • NEW ORLEANS, LOUISIANA 70174 • (504) 366-2345
MIDDLE SOUTH UTILITIES SYSTEM

January 21, 1982

L. V. MAURIN
Vice President Nuclear Operations

W3P83-0251
A-A1.01.04
3-A20.08

Mr. Thomas H. Novak
Assistant Director for Licensing
U. S Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: Waterford SES 3
Docket No. 50-382
Formal submittal of follow up items from SQRT audit

Dear Mr. Novak:

Please find enclosed documentation of the progress and/or completion of all confirmatory items identified in the Seismic Qualification Review Team audit for Waterford 3 SES.

A review of these documents; as agreed upon in a January 18, 1983, telecon with Messrs. Jim Wilson, Jerry Jackson, and Jack Singh; should be sufficient to show that NSSS-PE-25, Boric Acid Tank Circulating Valve, is the only remaining confirmatory item.

Resolution of Generic Issues is in progress. Reports/Analyses pertaining to these issues will be submitted as they are completed.

If you have any questions, please advise.

Sincerely,

L. V. Maurin

LVM/SMJ/jcb

Attachments

cc: Jim Wilson, Jerry Jackson, Jack Singh (EG&G), E. L. Blake, W. M. Stevenson

B001
Limited Dist

bcc: (w/o Attachments): R. P. Barkhurst, F. J. Drummond, D. B. Lester,
T. F. Gerrets, G. B. Rogers, R. W. Prados, C. J. Decareaux, R. F. Bruski,
P. V. Prasankumar, J. R. McGaha, S. A. Alleman, G. R. Peeler,
T. K. Armington, K. R. Iyengar, M. I. Meyer, L. L. Bass, Richard Hymes,
M. G. Williams, S. M. Jones, Kanti Gala, H. B. Mulliken (CE), John Hart
(Ebasco), John Tompeck (Ebasco), John Zudans (NUS), Central Records,
Nuclear Records (3), Licensing Library

Before the

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-382

In the Matter of

LOUISIANA POWER & LIGHT COMPANY

RESPONSE TO SQRT AUDIT

Louisiana Power & Light Company, Applicant in the above captioned proceeding, hereby files a Response to Seismic Qualification Review Team Audit.

Respectfully submitted,

LOUISIANA POWER & LIGHT COMPANY

BY: L.V. Maurin
L.V. Maurin
Vice President
Nuclear Operations

DATE: 1-25-83

STATE OF LOUISIANA)

) SS

PARISH OF ORLEANS)

L. V. Maurin, being duly sworn, states that he is Vice President-Nuclear Operations of Louisiana Power & Light Company and that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this report.

LV Maurin

L.V. Maurin

SUBSCRIBED AND SWORN to before me, a Notary Public, in and for the Parish and State above named, this 25th day of JANUARY, 1983.

Notary Public

MY COMMISSION EXPIRES:

WITH LIFE

"LIST OF ENCLOSURES"

ENCLOSURE	ATTACHMENTS	CURRENT AS OF
1	(1) Response to PE-31 (2) Response to BOP E-68	9/17/82
2	(1) Status of Confirmatory Items (2) Seismic Qualification Completion Schedule	10/4/82
3	(1) Seismic Qualification Completion Schedule	10/15/82
4	(1) Status of PE Confirmatory Items (2) Seismic Qualification Completion Schedule (3) Seismic Analyses of Muellor 3" Y-Type Strainer (4) ME-894 Certified Design Report of Horizontal Pump	11/10/82
5	(1) Status of PE Confirmatory Items (2) Seismic Qualification Completion Schedule	12/3/82
6	(1) Documentation of Telephone Conversation	1/18/83

CONFIRMATORY ITEMS

Item Description	SQRT NO.	Answered by
1. Control Components	BOP-E-68	Enclosure 1
2. Pressure Switch Low Oil Pressure Switch	NSSS-ICE-16 NSSS-PE-13	Enclosure 1
3. Boric Acid Make up Pump	NSSS-PE-14	Enclosure 2
4. Boric Acid Tank Circulating Valve	NSSS-PE-25	Response expected 1/24/83
5. Holdup Tank C	NSSS-PE-33	Modification in pregress
6. Resister imput card	NSSS-ICE-5a	Enclosure 3
7. 1151 Indicator	NSSS-ICE-8-1	Analysis in progress
8. CEDM Reed Switch Position	NSSS-ICE-15	Enclosure 2

NOTE: Items 1, 2, 3, and 8 closed by above mentioned telecon.
Generic Issue 5 (neglected nozzle loads in stress analysis) closed by telecon and Enclosure 5.

Documentation of Telephone Conversation, January 18, 1983 Enclosure 6

ENCLOSURE 1

SEISMIC QUALIFICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) LW3-1196-82
Attachment (2) LW3-1174-82

September 17, 1982

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N Y 10048

ROUTING COPY

EBASCO

September 14, 1982
LW3- 1174-82
File: 7Q-C-5 (1-S-1)
7-D-1

Mr G B Rogers, Site Director
Louisiana Power & Light Company
P O Box B
Killona, Louisiana 70066

RE: WATERFORD SES UNIT NO. 3
SQRT AUDIT FOLLOW-UP CONFIRMATORY ITEMS -
BOP E-68

Ref: LP&L Seismic Qualification Audit - Summary sheet used at NRC exit interview on September 3, 1982

Dear Mr Rogers:

Please transmit the following information to Mr R Macek of EG&G with regards to BOP Item E-68:

Via telephone conversation with Mr W W Schaff of Dayton T Brown Labs, Inc., Ebasco was advised that all control components tested did pass the seismic testing program. The anomolies noted were not malfunctions as all components were operable during and after the seismic testing and this determines whether or not the item is seismically qualified.

If you have any questions, please contact A DeVito on (212) 839-3861.

Very truly yours,

R K Stampley
Project Manager

AD:as

cc: Central Records - W3 (2)
Nuclear Records - GO (2)
D C Gibbs
L V Maurin

RECEIVED
NUCLEAR RECORDS

SEP 22 1982

ILN: 82-5162

EBASCO SERVICES INCORPORATED

EBASCO

Two World Trade Center, New York, N.Y. 10048

September 17, 1982
LW3-1196-82
File: 2Q-A-3C

Mr G B Rogers, Site Director
Louisiana Power & LIght Company
P O Box B
Killona, Louisiana

SUBJECT: WATERFORD SES UNIT NO. 3
SQRT AUDIT - RESPONSE TO CONFIRMATORY ITEM
PE-31 FROM ORIGINAL SEPTEMBER, 1981 AUDIT

Ref:
1. C-CE-7358, dated 10-26-81
2. LW3-120-82, dated 2-2-82
3. C-CE-7541, dated 2-24-82

Dear Mr Rogers:

The NRC and their consultant EG&G decided during the audit held August 31-September 3, 1982 that the subject confirmatory item would have to be reviewed by EG&G's INEL group to close out this item. The information provided below should be forwarded to EG&G to assist them in that review.

In Reference 1, it was proposed by CE to eliminate the charging pump lube oil switch from the protective circuit of that pump on account of their inability to establish seismic qualification for the pressure switch. In the same referenced letter, it was assumed that the pressure switch would develop a chatter in its contact during the seismic event that will result in automatic tripping of the pump.

Our detailed review of the charging pump protective circuit indicates that it is not necessary to expose the charging pump to the damage on loss of lube oil, through elimination of pressure switch, since the circuitry is of such a nature that the chattering contact, due to the seismic event, will not be able to trip the charging pump.

Our reasoning in arriving to that conclusion is as outlined below:

Please refer to the attached Control Wiring Diagram Dwg No. LOU 1564B-424, Sheet E365.

The N.O. contact of lube oil pressure switch is closed when lube oil pressure is normal and is keeping coil of relay PX continuously energized. On loss of lube oil pressure, the pressure switch contact will drop off the relay PX, and provided the charging pump is in operation, will energize the coil of time delay relay 2-2. A time delay of up to 15 seconds may be established on relay 2-2 before it will pick up and close a contact to trip the charging pump. This time delay of between 10 and 15 seconds will be a positive indication that the contact on lube oil pressure switch opened because of loss in pressure rather than because of chatter.

Furthermore, we have suggested that the wiring of the tripping contact 2-2 be modified to connect contact 2-2 in series with N.O. of SIS relay, this will prevent 2-2 from tripping the charging pump during the emergency operation, at the same time we will not suspend the protective function of the lube oil pressure switch. The existing lube oil pressure low alarm remains active during normal and emergency operation of the charging pump.

The above reasoning was reviewed and concurred to by CE in their Reference 3 letter.

If you have any questions, please advise.

Very truly yours,

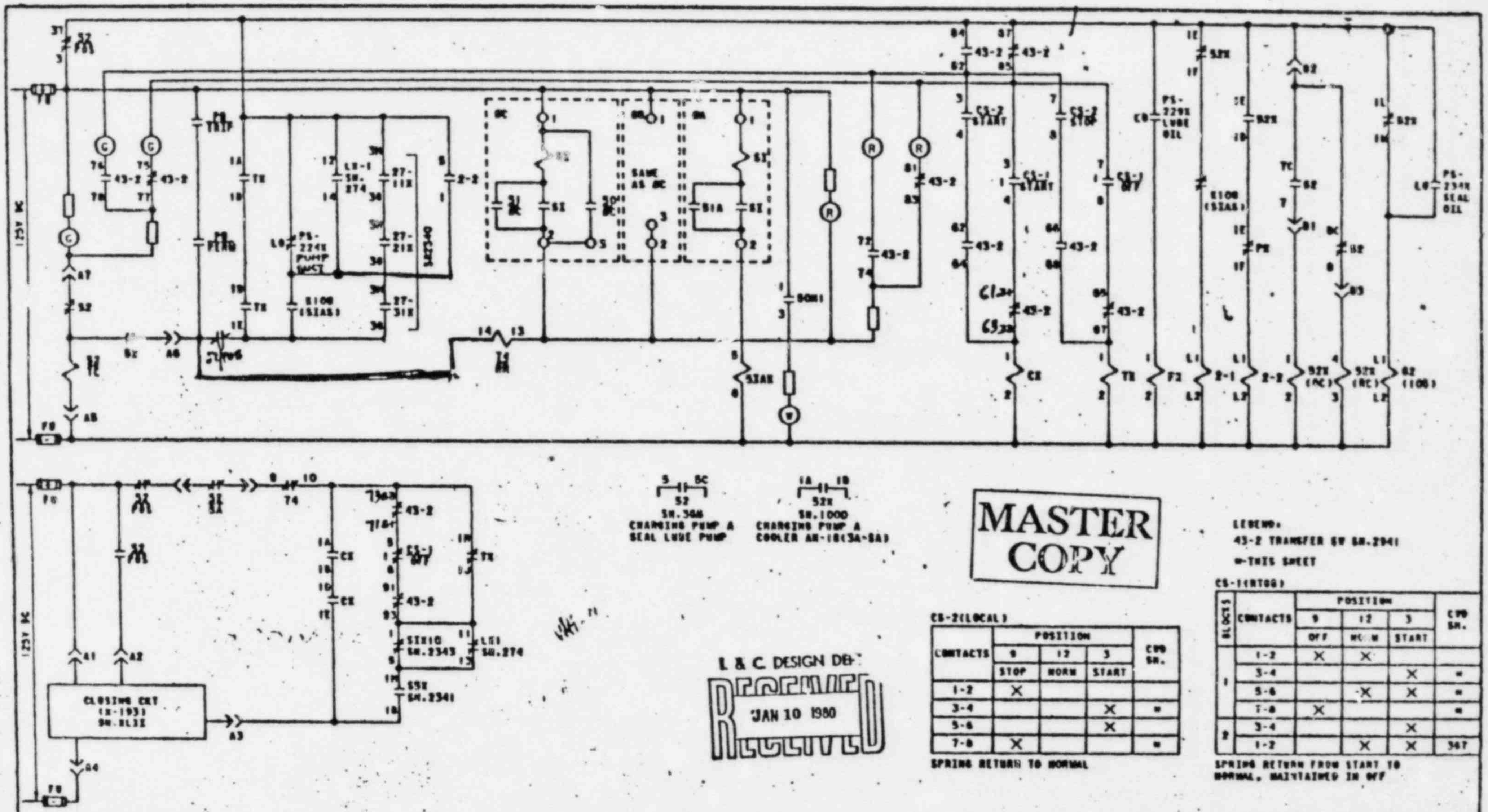
R F Driver

for R K Stampley
Project Manager

RKS:JKT:as

cc: Central Records - W3 (2)
Nuclear Records - GO (2)
D C Gibbs
L V Maurin
M Williams (LP&L)

LW3-1196-82.



MASTER COPY

I & C DESIGN DEPT
RECEIVED
JAN 10 1980

LEGEND:
43-2 TRANSFER SW SH.2941
*-THIS SHEET

CS-2(LOCAL)

CONTACTS	POSITION 9 STOP	POSITION 12 NORM	POSITION 3 START	CPD SH.
1-2	X			
3-4			X	*
5-6			X	
7-8	X			*

SPRING RETURN TO NORMAL

CS-1(RTGB)

BLOCKS	CONTACTS	POSITION 9 OFF	POSITION 12 NORM	POSITION 3 START	CPD SH.
1	1-2	X	X		
	3-4			X	*
	5-6		X	X	*
	7-8	X			*
2	3-4			X	
	1-2		X	X	347

SPRING RETURN FROM START TO NORMAL, MAINTAINED IN OFF

REV	DATE	CH	APPROVED	REV	DATE	CH	APPROVED

EBASCO SERVICES INCORPORATED
DIV I&C DR RS
CH S. LIN
DATE DEC. 19, 1979
APPROVED

LOUISIANA POWER & LIGHT CO.
WATERFORD S.E.S. UNIT NO.3
CONTROL WIRING DIAGRAM
CHARGING PUMP A

LOU-1564
B-424
SHEET E345

ENCLOSURE 2

SEISMIC QUAI FICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) Status of Confirmatory Items
Attachment (2) Seismic Qualification Completion Schedule

October 4, 1982

NSSS-ICE	SEISMIC QUALIFICATION COMPLETION SCHEDULE	Page 1 of 10 Revision 1 10/15/82

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
9403341 (P.O.) 9270-ICE-0005 Rev.01 (Spec.)	See attachment A1	NSSS-ICE-5 NSSS-ICE-5a thru 5h	Equipment has been qualified according to vendor (Westinghouse). Proprietary reports will be released to LP&L pending resolution of proprietary agreement between Westinghouse and LP&L. (See C-CE-7987 of 10/4/82)	Equipment installed
same P.O. and Spec. as above	See attachment A2	NSSS-ICE-9-1 NSSS-ICE-9-2	Original seismic test (Westinghoue # EL991) not approved-_Westinghouse resubmitted with new test report (#EL1348) C-E technical review completed but adminsitrative work not completed. QTR-1010 and QTR-1008 should replace EL991 as the applicable qualification references for the Veri-Trak Recorders. EL1348 is contained in QTR-1010. Retesting by Westinghouse is required. Testing completion is scheduled for May 1, 1983.	Equipment installed.

NSSS-
Plant Engineering (PE)

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
910204 9270-PE 704 Rev 04	BM 307 (CE Tag) Fisher 3" valve	NSSS-PE-36 Rev 1	Oct. 30, 1982	
9102040 9270-PE 704 Rev. 04	CH 210 Y Fisher 1" valve	NSSS-PE-26 Rev 1	Oct. 30, 1982	
9102040 9270-PE 704, Rev. 04	CH 512 Fisher 3" Valve	NSSS-PE-27 Rev 1	Oct. 30, 1982	
9204018 9270-PE 404 Rev. 2	Fuel Pool Pump	NSSS-PE-38	Jan. 1, 1983	
Not Available	3" "Y" Type Strainer	NSSS-PE-16	Oct. 30, 1982	

BOP-I&C

SEISMIC QUALIFICATION COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
403641	FE-HV 5296S 5294S 5295S (Air Flow Measuerment station-Pitot Tube)	File no not assigned	Revised Test Report expected by 11/15/82.	Installed
403485	See attachment A3	SQ-IC-4 SQ-IC-4A	Report received. Review in progress.	Installed
403642	See attachment A4	SQ-IC-4B	By 9/83	Installed

BOP-Electrical

SEISMIC QUALIFICATION COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
403657 LOU 1564 279C	(1) 120V & 125 VDC POP's 390-SA;391-SB 394-SA;395-SB 3A1-DC-S 3B1-DC-S	SQ-E-15	Recieved copy of Seiesmic Report 8/20/82. To be reviewed for approval. Review in progress.	Installed
	(2) Battery Disconnect Panels 3A-S 3B-S 3AB-S	SQ-E-15A	Recieved report approval letter not written - will be complete by 9/15/82 - Complete	Installed
403659 LOU 1564 [illegible]9D	Refueling Disconnect Assembles; Reactor Vessel Head Assemblies; Cable Seal Assemblies	SQ-E-86	Received copy of report from BIW. SAG group reviewed with comments on 8/25. To resolve open items before report is accepted	Installed

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

BOP - Mechanical

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
NT-403458 LOU-1564099A		No File Established Yet		
267	2CS-V311 2CS-V312	" "	Schedule for report submittal by 9/10/82 Certification Received. Review in Progress.	

SEISMIC QUALIFICATION COMPLETION SCHEDULE

BOP - Mechanical

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
NY-403501 LOU-1564.102				
1	5MS-V650 (8)	No File Established Yet	Report SR-6684 R2 has been reviewed with comments. Awaiting supplier response.	
3	5MS-V652 (2)	"		
53	3EG-V616B	"		
265	5FW-V1522	"		
352	6AC-V721	"		
395	3AE-V615	"		
421	3CC-V642 (4)	"		
444	5FW-V1522 (g)	"		
447	2FW-V1531 (6)	"		
494	3AC-V778A	"		
	3AC-V779A	"		
	3AC-V780A/B	"		
	3AC-V781A/B	"		
	3AC-V782	"		
	3AC-V783	"		
498	2CC-V652 (14)	"		

BOP - Mechanical

SEISMIC QUALIFICATION COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
577	6AC-V785	No File Established Yet	Report has been reviewed with comments	
	6XX-V316	"	"	
	V317	"	"	
	V318	"	"	
	V319	"	"	
	V320	"	"	
	V321	"	"	
578	7CF-V640	"	"	
	7CF-V642	"	"	
	7XX-V322	"	"	
628	2MS-V1524 (8)	"	"	
629	3NG-V684 (8)	"	"	
	3IA-V613	"	"	
	3IA-V611	"	"	
630	3AC-V809 (g)	"	"	
631	2XX-V700	"	"	
	thru V809 (110)	"	"	
632	2XX-V810	"	"	
	thru V849 (40)	"	"	
633	2XX-V850	"	"	
	thru V-860 (10)	"	"	
634	2XX-V860	"	"	
	thru V-863 (4)	"	"	

BOP - Mechanical

SEISMIC QUALIFICATION COMPLETION SCHEDULE

P.O./SPEC / Item	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
NY-403506				
LOU-1564.083B				
246	1SI-V2510 (2)	No File Established Yet	Report has been reviewed with comments	
247	1SI-V1592 (6)	"	"	
248	2CH-V1530	"	"	
249	2CH-V1542	"	"	
250	2XX-V500 (59)	"	"	
	thru V558	"	"	
251	2XX-V559	"	"	
	thru V583	"	"	
252	1XX-V900 (27)	"	"	
	thru V926	"	"	
NY-403522				
LOU-1564.103A				
219A	3WM-V223 (2)	No File Established Yet	Seismic report received. Review in progress.	
226A	3WM-V224	"		

SEISMIC QUALIFICATION

COMPLETION SCHEDULE

BOP - Mechanical

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
NY-403572 LOU-1564.089A 5	Dry Clg. Twr. Area Sump Pump Motors (2)	No File Established Yet	Report being reviewed.	

BOP - Mechanical

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

P.O./SPEC/Item	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
NY-403661 LOU-1564.105A 1	2MS-R613A 2MS-R614A 2MS-R615A 2MS-R616A 2MS-R617A 2MS-R618A 2MS-R619B 2MS-R620B 2MS-R621B 2MS-R622B 2MS-R623B 2MS-R624B	No File Established	Report being reviewed.	
NY-403674 LOU-1564.068 5	2SI-E1587A 2SI-E1588B	No File Established "	Report being reviewed. "	

SYSTEM Plant Protection

ITEM	TAG OR IDENTIFICATION	EQUIPMENT AVAILABILITY FOR INSPECTION IN FIELD	SQ REPORT FILE NO.	ACCESSORIES
16	CPC/CEAC Central Processing Unit	Later	NSSS-ICE-2b	
17	CPC/CEAC MACS Chassis	Later	NSSS-ICE-2c	
18	CPC/CEAC Power Supply	Later	NSSS-ICE-2d	
19	CEA Position Isolation Amplifiers	Later	NSSS-ICE-2e	
20	SY-103A, B, C, D	Yes	NSSS-ICE-2f	
21	RY-010A, B, C, D	Later	NSSS-ICE-2g	
22	Reactor Trip Switchgear Cabinet	Yes	NSSS-ICE-3	
23	ESFAS Auxiliary Relay Cabinet	Yes	NSSS-ICE-4	
24	Process Instrument Rack	Yes	NSSS-ICE-5	
25	TY-112CA-1/TY-112HA-1/ TY-122CA-1/TY-122HA-1/ PY-1013A-1/PY-1013A-2/ PY-1023A-1/PY-1023A-2/ LY-305A-1/PY-352A-1/SPARES PY-101A-1/PY-101A-2/ PY-102A-1/PY-102A-2/ LY-1113A-1/LY-1113A-2/ LY-1123A-1/LY-1123A-2/ PY-351A-1/SPARES TY-112CB-1/TY-112HB-1/ TY-122CB-1/TY-122HB-1/ PY-1013B-1/PY-1013B-2/ PY-1023B-1/PY-1023B-2/ PY-101B-1/PY-101B-2/ PY-102B-1/PY-102B-2/ LY-1113B-1/LY-1113B-2/ LY-1123B-1/LY-1123B-2/ PY-351B-1/SPARES TY-112CC-1/TY-112HC-1/ TY-122CC-1/TY-122HC-1/	Yes	NSSS-ICE-5a	

SYSTEM: Plant Protection

ITEM	TAG OR IDENTIFICATION	EQUIPMENT AVAILABILITY FOR INSPECTION IN FIELD	SQ REPORT FILE NO.	ACCESSORIES
25 (Cont'd)	PY-101C-1/PY-101C-2/ PY-102C-1/PY-102C-2/ LY-305C-1/PY-352C-1/SPARES PY-1013C-1/PY-1013C-2/ PY-1023C-1/PY-1023C-2/ LY-1113C-1/LY-1113C-2/ LY-1123C-1/LY-1123C-2/ PY-351C-1/SPARES TY-112CD-1/TY-112HD-1/ TY-122CD-1/TY-122HD-1/ PY-1013D-1/PY-1013D-2/ PY-1023D-1/PY-1023D-2/ LY-305D-1/PY-352D-1/SPARES PY-101D-1/PY-101D-2/ PY-102D-1/PY-102D-2/ LY-1123D-1/LY-1123D-2 PY-351D-1/SPARES	Later		
26	TY-303X, TY-303Y, TY-351X, TY-352X, TY-351Y, TY-352Y	Later	NSSS-ICE-5b	
27	TY-112CA, TY-112CB, TY-112CC, TY-112CD, TY-122CA, TY-122CB, TY-122CC, TY-122CD, TY-112HA, TY-112HB, TY-112HC, TY-112HD, TY-122HA, TY-122HB, TY-122HC, TY-122HD, PY-101A, PY-101B, PY-101C, PY-101D, PY-103, PY-104, PY-303X, PY-303Y, PY-102A, PY-102B, PY-102C, PY-102D, LY-305A, LY-305B, LY-305C, LY-305D, PY-1013A, PY-1013B, PY-1013C, PY-1013D, PY-1023A PY-1023B, PY-1023C, PY-1023D, LY-1113A, LY-1113B, LY-1113C, LY-1113C, LY-1123A, LY-1123B, LY-1123C, LY-1123D, LY-110X, LY-110Y, PY-105, PY-106, PY-351A, B, C, D PY-352A, B. C, C	Later	NSSS-ICE-5c	

SYSTEM: Plant Protection

ITEM	TAG OR IDENTIFICATION	EQUIPMENT AVAILABILITY FOR INSPECTION IN FIELD	SQ REPORT FILE NO.	ACCESSORIES
28	JC-002A/JC-002A-1/ PC-103/PC-103-1/SPARE/ PSFA-A, JC-002B/JC-002B-1/ PC-104/PC-104-1/SPARE/PSFA-B JC-002C/JC-002C-1/PC-105/ SPARE/SPARE/PSFA-C, JC-002D/ JC-002D-1/PC-106/SPARE/SPARE/ PSFA-D	Later	NSSS-ICE-5d	
29	JA-002A/JA-002A-1 JA-002B/JA-002B-1 JA-002C/JA-002C-1 JA-002D/JA-002D-1	Later	NSSS-ICE-5e	
30	PA-103/PA-103-1, PA-105 PA-104/PA-104-1, PA-106	Later	NSSS-ICE-5f	
31	TY-351X-1, TY-351Y-1, TY-303X-1, TY-303Y-1 PY-1023A-3, PY-1023A-4 LY-110Y-1, LY-101Y-2 PY-1013B-3, PY-1013B-4 TY-352Y-1, TY-352X-1, PY-102A-3, PY-102A-4 LY-1113A-3, LY-1113A-4 JY-001A, JY-001A-1 PY-102B-3, PY-103B-4 PY-1013A-3, PY-1013A-4 LY-1123B-3, LY-1123B-4	Later	NSSS-ICE-5g	
32	JY-001C, JY-001D JY-002A, JY-002A-1 LY-1123A-3, LY-1123A-4 LY-110X-1, LY-110X-2 LY-113B-3, LY-113B-4 PY-1023B-3, PY-1023B-4 JY-002B, JY-002B-1 JY-002C, JY-002C-1 JY-002D, JY-002D-1	Later	NSSS-ICE-5h	

LOUISIANA POWER & LIGHT COMPANY
WATERFORD SES UNIT NO. 3
SEISMIC QUALIFICATION SUMMARY

SYSTEM: Nuclear Instrumentation

ITEM	TAG OR IDENTIFICATION	EQUIPMENT AVAILABILITY FOR INSPECTION IN FIELD	SQ REPORT FILE NO.	ACCESSORIES
1	JI-RC-0003A JI-RC-0004A JI-RC-0003B JI-RC-0004B JI-RC-0003C JI-RC-0004C JI-RC-0003D JI-RC-0004D JI-RC-0001A JI-RC-0001B JI-RC-0001C JI-RC-0001D	Yes	NSSS-ICE-8-2	
2	JR-RC-0002A JR-RC-0002B JR-RC-0002C JR-RC-0002D	Yes	NSSS-ICE-9-1	
3	JR-RC-0001	Yes	NSSS-ICE-9-2	
4	Nuclear Instrument Detector	Later	NSSS-ICE-13	
5	Nuclear Instrument Preamplifier	Later	NSSS-ICE-14	

LOUISIANA POWER & LIGHT COMPANY
WATERFORD SES UNIT NO. 3
SEISMIC QUALIFICATION SUMMARY

SYSTEM: Reactor Coolant

ITEM	TAG OR IDENTIFICATION	EQUIPMENT AVAILABILITY FOR INSPECTION IN FIELD	SQ REPORT FILE NO.	ACCESSORIES
1	TT-112CA, CB, CC, CD TT-122CA, CB, CC, CD TT-112HA, HB, HC, HD TT-122HA, HB, HC, HD	No	NSSS-ICE-51	
2	PI-101A, PI-101B, PI-101C PI-101D, LI-110X, LI-110Y	Yes	NSSS-ICE-8-1	
3	TI-102HA, TI-102HB, TI-102HC, TI-102HD TI-102CA, TI-102CB TI-102CC, TI-102CD PI-102A, PI-102B, PI-102C, PI-102D	Yes	NSSS-ICE-8-2	
4	TR-102HA, TR-102CA	Yes	NSSS-ICE-9-1	
5	LR-110X, PR-102A	Yes	NSSS-ICE-9-2	
6	TE-111X, TE-121X TE-112CA, CB, CC, CD TE-122CA, CB, CC, CD TE-112HA, HB, HC, HD TE-122HA, HB, HC, HD	Yes	NSSS-ICE-10-1	
7	PT-100X, Y PT-101A, B, C, D PT-102A, B, C, D PT-103, 105	Yes	NSSS-ICE-11-1	
8	LT-110X, Y	Yes	NSSS-ICE-11-2	
9	PT-104, 106	Yes	NSSS-ICE-11-6	
10	PS-224X, Y, Z	Yes	NSSS-ICE-16	

Attachment A3

SPECIFICATION: 1364.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
B6	Flow Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	FIS-FW-8331-AS
B7	"	"	"	"	FIS-FW-8331 BS
A66	"	"	"	"	FIS-FW-8330 AS
A67	"	"	"	"	FIS-FW-8330 BS
A8	Differential Pressure Indicating Swtich	"	"	"	DPIS-FW-8320 AS
A9	"	"	"	"	DPIS-FW-8320 BS
A10	"	"	"	"	DPIS-HV-5051 AS
A11	"	"	"	"	DPIS-HV-5051 BS
A12	"	"	"	"	DPIS-HV-5055 AS
A13	"	"	"	"	DPIS-HV-5055 BS
A14	"	"	"	"	DPIS-HV-5056 AS

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A15	Differential Pressurre Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	DPIS-HV-5056 BS
A16	"	"	"	"	DPIS-HV-5061 AS
A17	"	"	"	"	DPIS-HV-5061 BS
A18	"	"	"	"	DPIS-HV-5220 AS
A19	"	"	"	"	DPIS-HV-5220 BS
A20	"	"	"	"	DPIS-HV-5221 AS
A21	"	"	"	"	DPIS-HV-5221 BS
A22	"	"	"	"	DPIS-HV-5257 AS
A23	"	"	"	"	DPIS-HV-5257 BS
A28	Flow Indicating Switch	"	"	"	FIS-AC-5001 S
A29	"	"	"	"	FIS-AC-5002 S

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A30	Flow Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	FIS-AC-5004-S
A31	"	"	"	"	FIS-AC-5006 S
A32	"	"	"	"	FIS-AC-5010 S
A33	"	"	"	"	FIS-AC-5011 S
A34	"	"	"	"	FIS-AC-5012 S
A35	"	"	"	"	FIS-AC-5013 S
A36	"	"	"	"	FIS-AC-5030 AS
A37	"	"	"	"	FIS-AC-5030 BS
A38	"	"	"	"	FIS-AC-5030 CS
C1	"	"	"	"	FIS-AC-5040 AS
C2	"	"	"	"	FIS-AC-5040 BS

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A39	Flow Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24, 1981 LW3-818-80 August 1? 1980	FIS-CC-5070 AS
A40	"	"	"	"	FIS-CC-5070 BS
A41	"	"	"	"	FIS-CC-5070 CS
A42	"	"	"	"	FIS-CC-5770 AS
A43	"	"	"	"	FIS-CC-5770 A1S
A44	"	"	"	"	FIS-CC-5770 A2S
A45	"	"	"	"	FIS-CC-5770 BS
A46	"	"	"	"	FIS-CC-5770 B1S
A47	"	"	"	"	FIS-CC-5770 B2S
A48	"	"	"	"	FIS-CC-5770 CS
A4	"	"	"	"	FIS-CC-5770 C1S

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A50	Flow Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	FIS-CC-5770 C2S
A51	"	"	"	"	FIS-CC-5770 DS
A52	"	"	"	"	FIS-CC-5770 D1S
A53	"	"	"	"	FIS-CC-5770 D2S
A80	Level Switch	"	"	"	LS-MS-0311 S
A81	"	"	"	"	LS-MS-0312 AS
A82	"	"	"	"	LS-MS-0312 BS
A83	"	"	"	"	LS-MS-0313 AS
A84	"	"	"	"	LS-MS-0313 BS
C3	Pressure Switch		"	"	PS-NC-0940 AS
C4	"	"	"	"	PS-NC-0941 BS

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
C5	Pressure Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	PS-NG-0942 AS
C6	"	"		"	PS-NG-0943 BS
C7	"	"	"	"	PS NG-0944 AS
C8	"	"	"	"	PS-NG-0945 BS
C9	"	"	"	"	PS-NG-0946 AS
C10	"	"	"	"	PS-NG-0947 BS
E1	"	"	"	"	PS-CC-3081
E2	"	"	"	"	PS-CC-3082
E3	"	"	"	"	PS-CC-3083 A
E4	"	"	"	"	PS-CC-3083 B
E5	"	"	"	"	PS-CC-3083 C

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 40348
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
E6	Pressure Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	PS-CC-3083 D
E7	"	"	"	"	PS-CC-3084 A
E8	"	"	"	"	PS-CC-3084 B
E9	"	"	"	"	PS-CC-3084 C
E10	"	"	"	"	PS-CC-3084 D
E11	"	"	"	"	PS-CC-3086
E12	"	"	"	"	PSIA-9740 A
E13	"	"	"	"	PSIA-9740 B
1	Level Indicator	"	"	"	LI-CS-7123 AS
2	"	"	"	"	LI-CS-7123 BS

SPECIFICA N: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A57	Flow Indicating Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	W3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	FIS-CC-7651 AS
A58	"	"	"	"	FIS-CC-7651 BS
A59	"	"	"	"	FIS-CC-7750 AS
A60	"	"	"	"	FIS-CC-7750 BS
A61	"		"	"	FIS-CC-7850 AS
A62	"	"	"	"	FIS-CC-7850 BS
A63	"	"	"	"	FIS-CC-7850 CS
A64	"	"	"	"	FIS-CD-2202 A
A65	"	"	"	"	FIS-CD-2202 B
	Pressure Switch	"	"	"	PS-SI-3149 A
	"	"	"	"	PS-SI-3149 B

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
	Pressure Switch	SQ-IG-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	PS-SI-3148 A
	"	"	"	"	PS-SI-3148 B
	"	"	"	"	PS-CH-0206
	"	"	"	"	PS-CH-0208
	"	"	"	"	PS-CH-0224 X
	"	"	"	"	PS-CH-0224 Y
	"	"	"	"	PS-CH-0224 Z
	"	"	"	"	PS-CH-0229 X
	"	"	"	"	PS-CH-0229 Y
	"	"	"	"	PS-CH-0229 Z
	"	"	"	"	PS-CH-0234 X

SPECIFICATION: 1564.421
PURCHASE ORDER: NY 403485
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
	Pressure Switch	SQ-IC-4 SQ-IC-4A	Qualification Testing in Progress Test Report R3-580-1 R3-288A-1	LW3-1855-79 (Waiver) LW3-1345-81 December 24,1981 LW3-818-80 August 12, 1980	PS-CH-0234 Y
	"	"	"	"	PS-CH-0234 Z
	"	"	"	"	
	"	"	"	"	
[illegible]3	"	"	"	"	PS-CC-7032 A
D4	"	"	"	"	PS-CC-7032 B
D45	"	"	"	"	PS-SI-7140 AS
D46	"	"	"	"	PS-SI-7140 BS
E3	Level Switch	"	"	"	LS-EG-1979 AS
E4	"	"	"	"	LS-EG-1979 BS

Attachment A4

SPECIFICATION 1564.402A
PURCHASE ORDER: NY 403642
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A01	Low Differential Pressure Transmitter	SQ-IC-48	Qualification Testing in Progress Seismic Qualif. Test Procedure Code IND N05991 Document Number 999.5002.2	Attachment to Letter LW3-111-78	DPT-HV-5067 AS
A02	"	"	"	"	DPT-HV-5067 BS
A03	"	"	"	"	DPT-HV-5068 AS
A04	"	"	"	"	DPT-HV-5068 BS
A05	"	"	"	"	DPT-HV-5105 AS
A06	"	"	"	"	DPT-HV-5105 BS
A09	"	"	"	"	DPT-HV-5270
A10	"	"	"	"	DPT-HV-5271 AS
A11	"	"	"	"	DPT-HV-5271 BS
A12	"	"	"	"	DPT-HV-5272 AS

SPECIFICATION: 1564.402A
PURCHASE ORDER: NY 403642
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A13	Low Differential Pressure Transmitter	SQ-IC-4B	Qualification Testing in Progress Seismic Qualif. Test Procedure Code IND N05991 Document Number 999.5002.2	Attachment to Letter LW3-111-78	DPT-HV-5272 BS
A14	"	"	"	"	DPT-HV-5273 AS
A15	"	"	"	"	DPT-HV-5273 BS
A16	"	"	"	"	DPT-HV-5274 AS
A17	"	"	"	"	DPT-HV-5274 BS
A18	"	"	"	"	DPT-HV-5275 AS
A19	"	"	"	"	DPT-HV-5275 BS
A20	"	"	"	"	DPT-HV-5276 AS
A21	"	"	"	"	DPT-HV-5276 BS
A22	"	"	"	"	DPT-HV-5277 AS

SPECIFICATION: 1564.402A
PURCHASE ORDER: NY 403642
VENDOR: ITT BARTON

PO ITEM NO.	GENERAL DESCRIPTION OF EQUIPMENT	SQRT FILE NO.	VENDOR SEISMIC REPORT NO.	LW3 ACCEPTANCE NO.	TAG NO.
A23	Low Differential Pressure Transmitter	SQ-IC-4B	Qualification Testing in Progress Seismic Qualif. Test Procedure Code IND N05991 Document Number 999.5002.2	Attachment to Letter LW3-111-78	DPT-HV-5277 BS
A24	"	"	"	"	FT-HV-5065 AS
A25	"	"	"	"	FT-HV-5065 BS
A26	"	"	"	"	FT-HV-5066 AS
A27	"	"	"	"	FT-HV-5066 BS
A28	"	"	"	"	FT-HV-5294 S

ENCLOSURE 3

SEISMIC QUALIFICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) Seismic Qualification Completion Schedule

October 15, 1982

RESPONSE TO CE/PLANT ENGINEERING CONFIRMATORY ITEMS FROM WATERFORD UNIT #3 SQRT RE-AUDIT

ITEM	COMMENTS/RESPONSE
GENERIC	<u>Comment:</u> It was noticed that during the review of NSSS-PE-10 (Deborating Ion Exchanger), NSSS-PE-15 (Purification Filter) and NSSS-PE-33 (Holdup Tank), nozzle loads were negelected in the stress analysis. This seems to be a generic pattern. <u>Response</u> Nozzle loads for this equipment (seismic category tanks, HXS, Filters and Ion Exchangers) were originally simulated in the seismic analyses by increasing the sesimic acceleration loading imposed on these components. This simulation was considered to be conservative because the component supports were judged to be more highly loaded than they would be if the appropriate seismic and nozzle loads were considered. In response to the SQRT audit concern, a follow-on effort has been initiated to confirm that the original approach was conservative. All of the design reports for the applicable CE equipment have been reviewed and nozzle loads have been directly evaluated to determine their effect on component supports. In all cases, the original support loadings were more severe. All components are also being evaluated to confirm that nozzle-to-shell juncture stresses are within acceptable levels. This effort will be completed shortly and the results of the evaluation will be forwarded.
GENERIC	<u>Comment</u> Status of equipment not yet seismically qualified and their qualification schedule should be provided to NRC. This status should be submitted monthly until completion of qualification of all safety related equipment. <u>Response</u> Status is given on Attachment (2)

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-1 SQRT NO. NSSS-PE-14 BA MAKEUP PUMP SPECIFIC ITEM: PUMP B	Comment 1. Explain basis for load cases 4 & 5 and show that they are conservative. Response Load Case 4 is "nozzle plus impeller loads in the x-direction". Load Case 5 is "nozzle plus impeller loads in the z-direction". CE has reviewed these loading cases in detail and confirms that these loadings encompass the most severe direction possible for the application of nozzle loads Comment 2. Explain load combinations used for computing bolting stress and show that they are conservative. Response The load combinations used for computing bolt stresses include those loads from seismic accelerations in both transverse directions (note that a vertical acceleration would have no effect on the bolts), impeller loads, and nozzle loads in the most severe direction. CE has reviewed these loads and confirms that they are conservative.
ITEM NO. NSSS 2 SQRT NO. NSSS-PE-25 BORIC ACID TANK CIRC. VALVE SPECFIC ITEM: 3CH-F171B	Comment 1. Provide certification that the computer calculations based on Engineering Standard ES100 Rev. B dated 4/8/75 have been verified. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before 10/31/82. Comment 2. Confirm that deflections calculated in Seismic Analysis for Order 1-46610 dated April 3, 1976 for tag number CH-511 will not interfere with valve closure. Response Same as Previous Response.

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS 5 SQRT No. NSSS-PE-52 FW CONTROL VALVE SPECIFIED ITEM: 5FW-FM834 .	Comment Verification of computer program ES100, Rev. B (4/8/75) is being performed for Item NSSS-PE-25. Results will also be applicable here. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before 10/31/82.

RESPONSE TO OUTSTANDING ISSUES DEVELOPED AT
THE LP&L SQRT AUDIT FOR NSSS I&C EQUIPMENT

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-7 SQRT NO. NSSS-ICE-8-1 1151 INDICATOR SPECIFIC ITEM: PI-101B	**Comment** 1. The test on the indicator shows a 5% variation between the reading before and after test. The spec required 1.5% variation. Why was the indicator operability variation accepted? **Response** As explained at the SQRT Audit, the specified 1 1/2% required accuracy is a purchase specification, but is not meant to account for earthquake - induced uncertainties. These uncertainties are reviewed for acceptability by an Instrument Uncertainty Analysis. This analysis is to be performed on all safety-related applications of the Sigma 1151 and 1251 indicators. This analysis will be performed using the 5% uncertainty found in the current documentation. The Uncertainty Analysis will be completed for the Sigma indicators by January 14, 1983. **Comment** 2. Provide a spectra at the location of the instrument in the panel. **Response** Closed - See Ebasco Letter LW3-1131-82 dated 8/31/82.
ITEM NO. NSSS-6 SQRT NO. NSSS-ICE-5a RESISTOR INPUT CARD SPECIFIED ITEM:	**Comment** 1. Verify by means of test data that operability of resistor input card was demonstrated during the test. **Response** Letter, W. J. Ritter - Westinghouse, Industry Electronics Division, to T. A. MacNair - Combustion Engineering, I&CE Department; Subject - NCI Resistor Card Seismic Operability Documentation, dated September 10, 1982 (attached). **Comment** 2. Determine if loose cables in cabinet will be tied down at a later date (supply date). Indicate procedures to secure cables in cabinet. **Response** Closed. See Fishback & Moore procedure CP-307 page 5 of 23. Also, Ebasco letter from Wills to DeBevin dated 9/2/82.

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-12 SORT NO. NSSS-ICE-15 CEDM REED SWITCH POSITION INDICATOR SPECIFIED ITEM:	**Comment** 1. The CEDM which houses the transmitter was tested biaxially, but only in one horizontal axis. This was based on the assumption that the CEDM is symmetrical about the vertical axis. While this may be true for the CEDM, it is not true for the transmitter, and there is no assurance of seismic qualification. An investigation revealed that this oversight was caught and transmitter qualification for subsequent nuclear projects included testing in two arthogonal horizontal axes. These subsequent tests were performed at levels substantially higher than those required for Waterford 3. The reed switch design was the same as Waterford 3. This strongly suggests an adequate seismic design for the Waterford 3 transmitter. Receipt of a test report confirming the above will close this issue. **Response** Combustion Engineering Nuclear Laboratories Seismic Test Report #TR-ESE-442 for ANPP 150" Reed Switch Position Transmitter.

Westinghouse Electric Corporation

Industrial Control Divisions

Industry Electronics Division

200 Beta Drive
O'Hara Township
Pittsburgh Pennsylvania 15238
(412) 782 1730

September 10, 1982

Combustion Engineering, Inc.
Nuclear Division
1000 Prospect Hill Rd.
Windsor, CT. 06095

Attention: Mr. T. MacNair

Subject: Louisiana Power & Light
Waterford SES Unit No. 3
C.E. P.O. 9403341-9270
(W) IED W8000
Seismic Qualification Review
Team Audit
Item NSSS 6 NCI
SQRT No. NSSS ICE-5A Resistor Card
Reviewer: R. W. Macek
Audit Date: Sept. 1, 1982

Reference: Westinghouse Electric Corp. Seismic Test Report - WCAP 8828 Seismic Operability Demonstration Testing of the Westinghouse IED 7300 Series Process Instrumentation Bistables

Gentlemen:

The subject audit concluded with one action for Westinghouse Industry Electronics Division (WIED) as follows:

> "Verify by means of test data that operability of resistor input card was demonstrated during the test".

Mr. Macek noted that WCAP 8828 included the NCI card in its equipment listing, Table 2-1, demonstrating the cards inclusion in the test. He also noted there was no direct mention of, or data to show, the cards operability during the test.

Westinghouse stated that the evidence of NCI operability could be provided but it would be in the nature of raw data, i.e. block diagram sketches, schematic sketches, copies of strip chart recordings and explanations showing linkage between WCAP 8828, the NCI card, signal names, sketches and recordings.

The followinng is a list of attachments to this letter which will serve to demonstrate operability of the NCI card:

Attachment A. Block diagram of circuitry in Card Frame #1
Attachment B. Schematic of Card Frame #1 Wiring
Attachment C. Strip Chart recording of NCI outputs

Attachment A defines, in block diagram form, the circuitry of card frame #1. Attachment B defines the hardware and wiring which implements the block diagram. Attachment C shows strip chart recordings of signals described in Attachments A & B.

The relationship of NCI card output, signal name and recorder/pen number are as follows:

NCI Output	Signal	Recorder No.	Pen No.
TD/411A	Δ TLL	2	3
TD/411E	TC	2	4
TD/412A	TAVG	2	5
TD/411B	OPSP	2	6
TD/411C	OTSP	2	7

In Attachment C, the signal on Pen #2 was purposely changed in order to vary the input to bistables to demonstrate that they change state. The signals on recorder pens 3,4,5 & 6 are not functionally affected by the signal on Pen #2, and therefore, remain at a steady state value. The signal on Pen #7 is functionally affected and, therefore, moves as expected. The Attachment C recording was run during the seismic test and showed no anomalies.

Therefore, the operability of the NCI card is demonstrated.

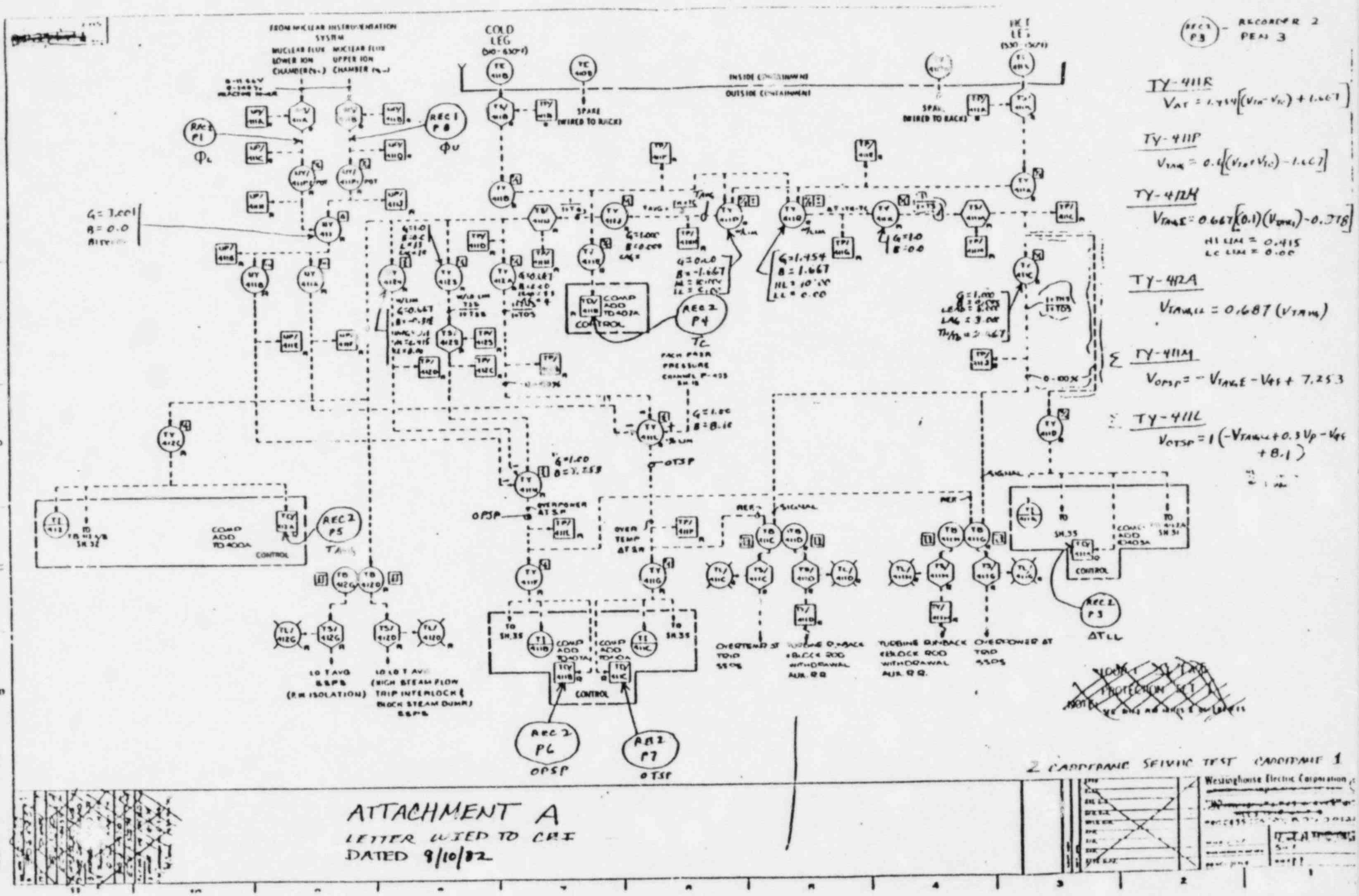
If I can be of any further service, please advise.

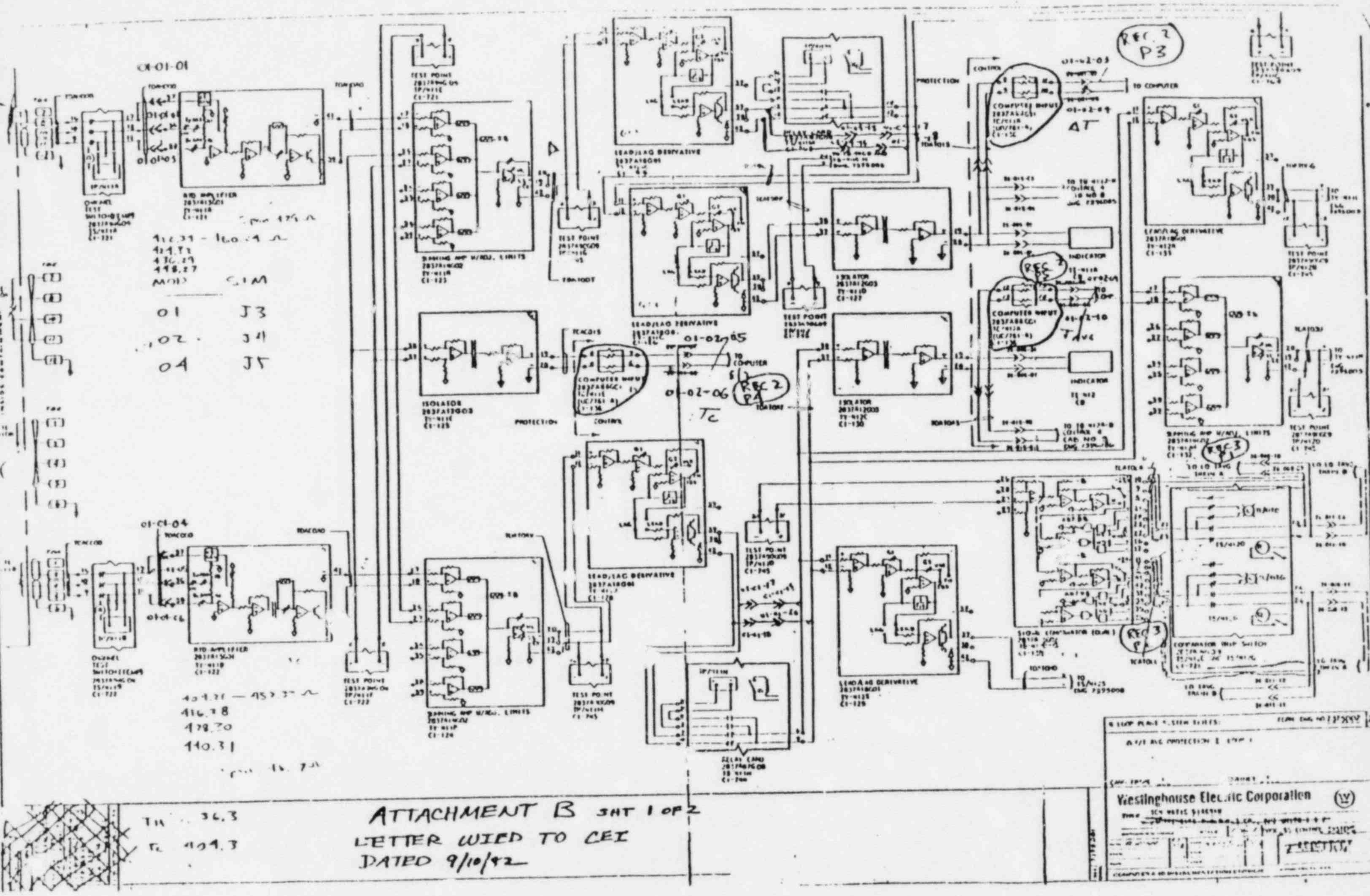
Very truly yours,

W. J. Ritter
Projects Director

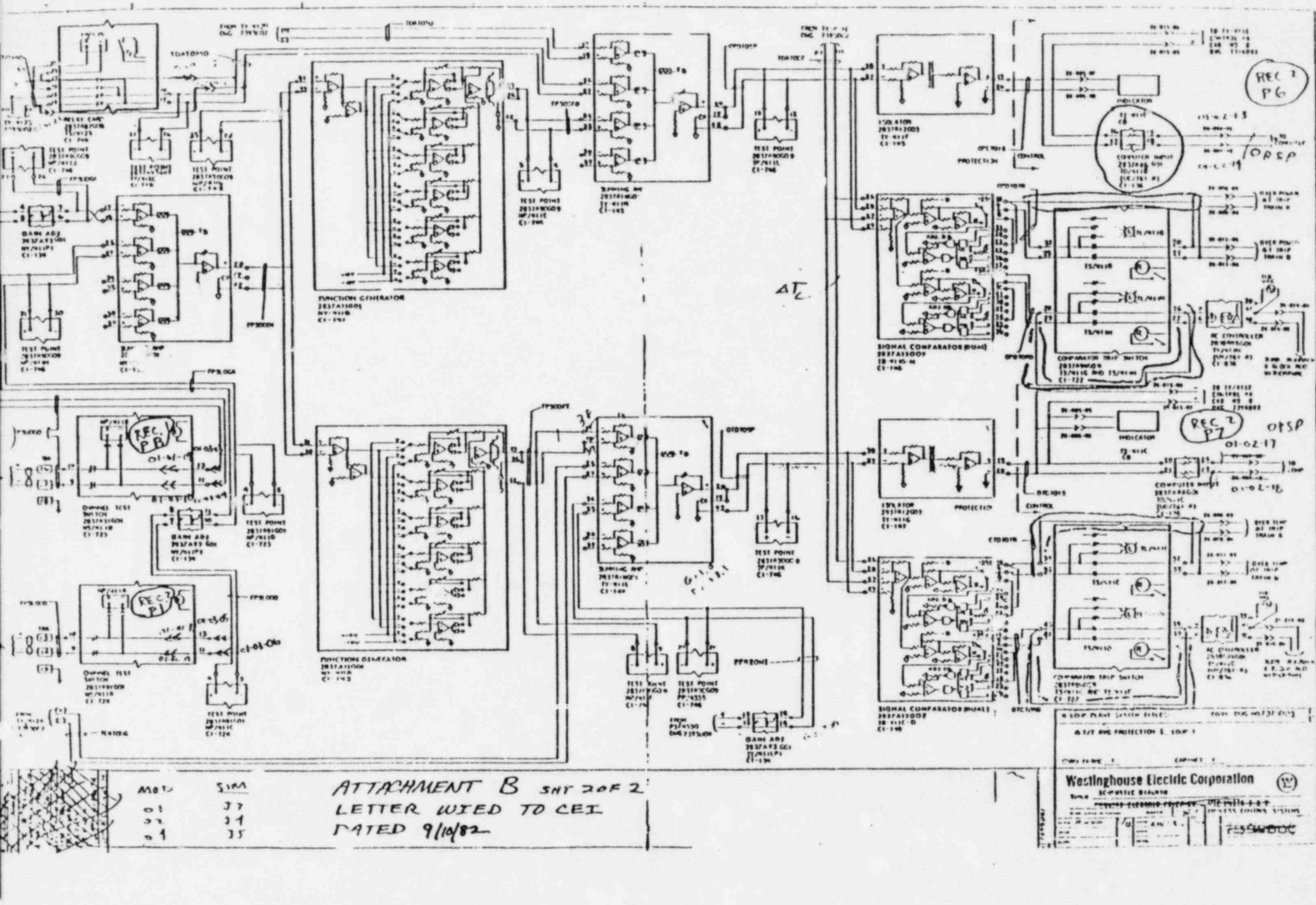
WJR:msb

cc: Mr. J. W. Veirs - Combustion Engineering
Mr. L. Karl - (W) IED


FROM NUCLEAR INSTRUMENTATION SYSTEM
COLD LEG
HOT LEG
INSIDE CONTAINMENT
OUTSIDE CONTAINMENT
SPARE (WIRED TO RACK)
REC 1 P8
ΦU
ΦL
REC 2 P1
G = 3.001
B = 0.0
REC 2 P4
TC
REC 2 P5
REC 2 P6
OPSP
REC 2 P7
OTSP
REC 2 P3
ΔTLL
COMP ADD
CONTROL
OVERPOWER ΔT SP
OVER TEMP ΔT SP
SIGNAL
REC 1 P3 - RECORDER 2 PEN 3
TY-411R
$V_{AT} = 1.454[(V_{TH} - V_{TC}) + 1.667]$
TY-411P
$V_{TAVG} = 0.4[(V_{TH} + V_{TC}) - 1.667]$
TY-412H
$V_{TAVG} = 0.667[(0.1)(V_{TAVG}) - 0.378]$
HI LIM = 0.415
LO LIM = 0.00
TY-412A
$V_{TAVG} = 0.687(V_{TAVG})$
Σ TY-411M
$V_{OPSP} = -V_{TAVG} - V_{45} + 7.253$
Σ TY-411L
$V_{OTSP} = 1(-V_{TAVG} + 0.3V_P - V_{45} + 8.1)$
ATTACHMENT A
LETTER WIRED TO CRI
DATED 8/10/82
Westinghouse Electric Corporation



ATTACHMENT B SHT 1 OF 2
LETTER W/IED TO CEI
DATED 9/10/92
Westinghouse Electric Corporation
REC 2 P3
REC 3
AT
Tavg
Tc
01-02-05
01-02-06
TO COMPUTER
COMPUTER INPUT
LEAD/LAG DERIVATIVE
ISOLATOR
INDICATOR
TEST POINT
SUMMING AMP W/ADJ. LIMITS
RTD AMPLIFIER
RELAY CARD
PROTECTION
CONTROL
MOD SIM
01 J3
02 J4
04 J5



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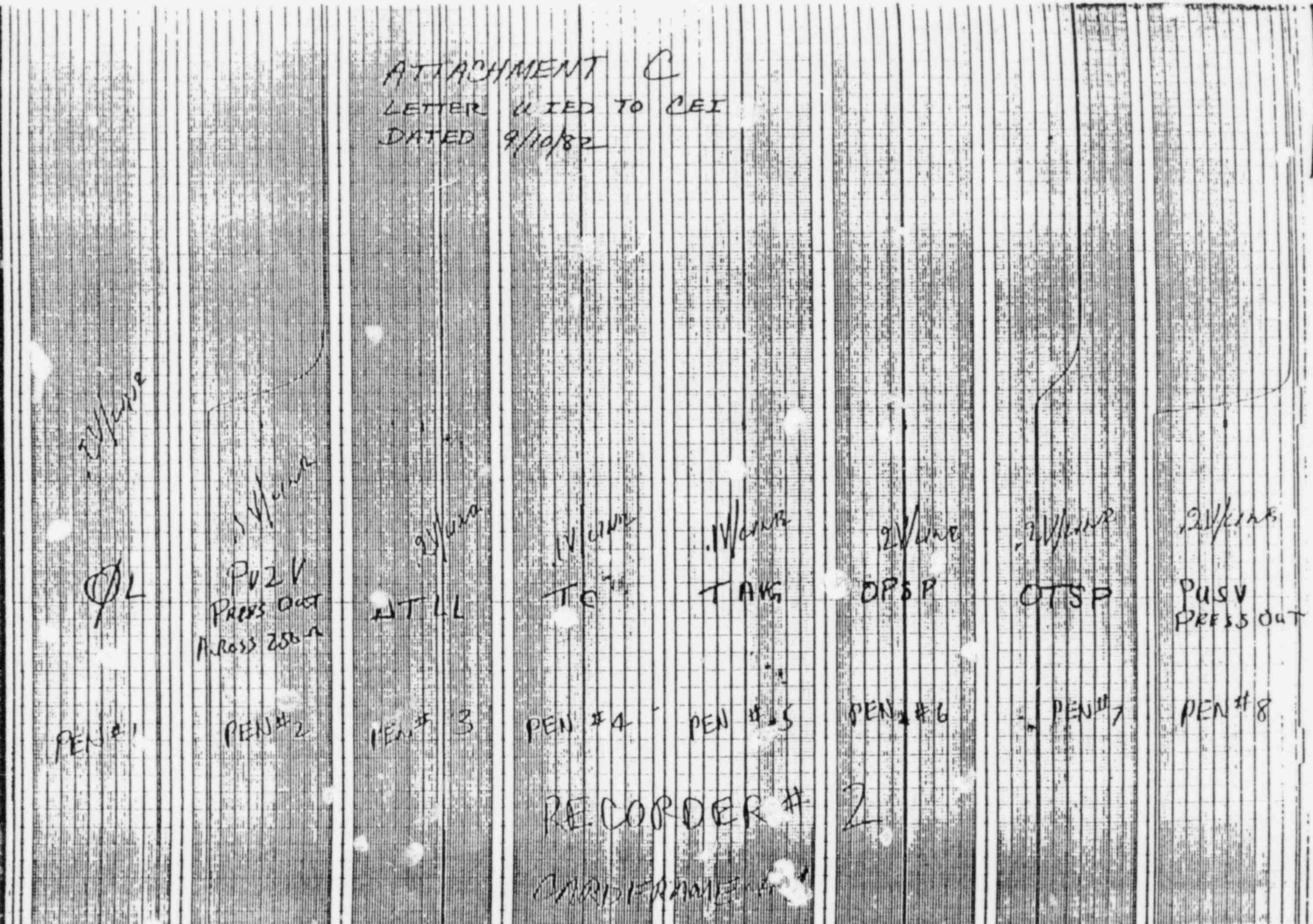
02	34
01	35

ATTACHMENT B SHT 2 OF 2
LETTER WIED TO CEI
DATED 9/10/82


ATTACHMENT C
LETTER TO CEI
DATED 9/10/82
ØL
PEN #1
PV2V
PRESS OUT
ACROSS 250 Ω
PEN #2
ATLL
PEN #3
TC
PEN #4
TAVG
PEN #5
OPSP
PEN #6
OTSP
PEN #7
PUSV
PRESS OUT
PEN #8
RECORDER # 2

REC'D NOV 30 1981

ARIZONA NUCLEAR POWER PROJECT

150" Reed Switch Position Transmitter and Litton Electrical Connector

SEISMIC QUALIFICATION TEST
(Sine Sweep Testing)

Test Report
TR-ESE-442
NUCLEAR LABORATORY

POWER SYSTEMS
COMBUSTION ENGINEERING, INC.

COMBUSTION ENGINEERING

DEVELOPMENT DEPARTMENT

TEST REPORT

SEISMIC QUALIFICATION TESTING
SYSTEM 80 REED SWITCH POSITION TRANSMITTER
AND LITTON ELECTRICAL CONNECTOR

ARIZONA NUCLEAR POWER PROJECT - PALO VERDE

NUCLEAR GENERATING STATIONS 1, 2, AND 3

777009

PREPARED BY: ______________ K. H. Haslinger   REVIEWED BY: ______________

REVIEWED BY: ______________ Quality Assurance

DOCUMENT NO.: TR-ESE-442   DATE OF ISSUE: 10/9/1981

Test Request No. SF40

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1.0 INTRODUCTION

The 150" Reed Switch Position Transmitter (RSPT) and the Litton connector are electrical devices which must function in an environment of high temeprature, radiation, humidity and vibration during normal plant operation. In addition, as a Class 1E electrical component, the instrument must perform adequately during seismic environments up to SSE intensities as transmitted up to its mounting location (namely, the CEDM shroud) in a plant.

The subject report describes the procedures which were undertaken to demonstrate the RSPT's ability to withstand the seismic intensities stipulated for the ANPP reactor when it is installed in a representative CEDM. The test specimens had already undergone temperature and radiation aging.

2.0 SUMMARY

2.1 Sine Sweep Testing

Sine sweep tests confirmed the analytically predicted dynamic behavior (natural frequencies) of the ANPP type CEDM. This fact gave assurance that the subsequently conducted qualification effort would address the worst seismic response condition for the ANPP reactor.

The large amount of frequency, damping and mode shape data reported in this document will serve for future correlation efforts with analytical models.

2.2 Seismic Qualification Testing

The two RSPT samples as installed in a representative ANPP type CEDM were exposed to a sufficient number of biaxial "random" multi-frequency input motions of intensities greater than the required OBE and SSE response spectra. The RSPTs were tested in four orientations to allow for their asymmetric design. No adverse transients of failure modes in the electrical performance of the RSPTs were observed in any of the numerous tests. Therefore, the conducted test is proof that the RSPT assembly meets the seismic requirements imposed by the References 2 and 10.

3.0 OBJECTIVES

3.1 Sine Sweep Testing

The objective of the sine sweep test was to identify the dynamic characteristics of the RSPT support structure; namely, of the ANPP type CEDM with the longest nozzle. Natural frequencies and associated mode shapes, as well as modal damping parameters were to be obtained prior to the qualification tests for correlation with analytical predictions.

3.2 Seismic Qualification Testing

The objective of this program was to seismically qualify the ANPP RSPT and the associated Litton electrical connector for commercial service in accordance with the purchaser's requirements of References 3 and 4. Proof was to be established that the RSPT design would remain functional when installed at its permanent location during or following a seismic event of an intensity up to SSE magnitudes. The RSPT was to be exposed to a minimum of five OBE events and one DBE event following the appropriate temperature and radiation aging test programs.

4.0 EQUIPMENT DESCRIPTION

4.1 RSPT

The production RSPT is a transducer device used to determine the position of the CEA within the reactor core. The instrument is housed in a stainless steel tube within the shroud which is positioned adjacent to the extension shaft upper pressure housing of a CEDM.

The production RSPT is essentially a voltage divider network comprised of an array of magnetically actuated reed switches wired to a series chain of resistors. The reed switches, resistors, and wire are mounted on an extruded plastic strip at precise 1.5 inch intervals. A permanent magnet attached to the top of the extension shaft generates the magnetic flux necessary to actuate and deactuate the switches yielding voltage signals proporational to the CEA position. Three additional separate circuits provide contact closures which indicate the Upper Electrical Limit, Lower Electrical Limit, and Dropped CEA position. The RSPT is fabricated in compliance with the drawing of Reference 8 and specifications of Reference 7.

A 150" full length RSPT has been randomly selected from the production line for qualification testing. This test specimen has already undergone thermal and radiation aging.

4.2 Litton Electrical Connectors

The component is a bayonnet locking electrical connector providing the interface connection between the head area cabling and the RSPT. The cable penetrations are designed to seal against fluid entry into the connector. The head area cabling connector is the Litton CIR06-CE-20-33S straight plug. The mating box mounting receptacle which is attached to the RSPT is the Litton CIR02-CE-20-33P.

5.0 TEST DESCRIPTION

5.1 Mechanical Test Set-Up

A full-size 150-inch Control Rod Drive Mechanism (representative of the ANPP design), including the drive shaft, water, conduit and

2 RSPTs (Serial Nos. 597 and 604), were assembled onto the seismic simulation fixture. For this purpose, a special test nozzle had been designed and fabricated. The test set-up simulated the longest CEDM nozzle which, by analysis, had been shown to yield the highest CEDM response characteristics.

For the sine sweep, as well as the seismic qualification tests, the hydraulic actuator of the seismic shaker system was set at a 45° angle, thus providing excitations of similar magnitudes to both axes. Although the CEDM itself is symmetric about its vertical axis, the RSPTs are not, thus, in accordance with the Guidelines of Reference 2, four test orientations were required. This was accomplished by rotating the test nozzle plus CEDM structure once by 90° and by switching the two RSPT samples in each of the two nozzle orientations. Figure 16 depicts the four test orientations. The two RSPT samples provided for the test were inserted in the CEDM shroud and clamped into place. The actuating magnet was attached to the drive shaft and was located near the top position inside the upper pressure housing.

5.2 Instrumentation Set-Up

Two control accelerometers, mounted in a mutually perpendicular arrangement to the base plate (which simulated the reactor head elevation) were used to monitor the excitation levels in the horizontal and vertical axes. Figure 1 indicates the strain gauge locations at the test nozzle which is the highest stressed component of the CEDM design. The stress levels at this location, although not a criterion for the RSPT qualification, were used as an index for the intensity of the seismic event and to help avoid overtesting (failure) by correlating measured stress values to analytically predicted ones.

The response accelerometers indicated in Figure 1 were used to monitor CEDM deflections during sine sweep testing. Accelerometer locations 9, 7, 5, and 3 were also recorded on magnetic tape during the seismic qualification program to be later displayed in the form of time histories and/or response spectra.

All strain gauges (1/4 Bridge Hook-up) and accelerometers were connected over the replay panel to the patch panel of the Digital Vibration Control System. For signal conditioning of the strain gauges, the Unholtz Dickie, Type R, Charge/Voltage Amplifiers were used. Unholtz Dickie, Type H, Charge Amplifiers were used for the response accelerometers and the model 2216-X units for the two control accelerometers.

Selected CEDM nozzle strain gauges were monitored on the visicorder during preliminary and actual test runs. The RSPT electrical performance was monitored on the visicorder during all qualification phases.

For the sine sweep testing, the "SN21T Version - 04" software package of the digital vibration control system was used. This program allows the monitoring of 4 channels of data simultaneously.

For synthesis and on-line analysis of the generated seismic environments, the "SS20T, 3.0 Decade" software package of the digital vibration control system was used. During the tests, selected transducer signals were recorded on a 7-channel tape recorder. Test response spectra of the table input or CEDM component motions were then developed off the tape by playback into analysis software portion of the "SS20T" package.

Documented strain measurements are accurate within 5%, and the acceleration measurements within 10% of indication. All accelerometers had been calibrated within the last 12 months of testing. One non-critical response accelerometer, which showed erroneous indications, was replaced during the early phase of the test program.

5.3 Sine Sweep Test Procedure

The "SN21T Version - 04" software package of the digital vibration control system was employed for the tests. Figure 4 is a typical listing of an input file. For interpretation of the various input parameters, Reference 12 is to be used.

The C-E sinusoidal vibration control system, in conjunction with the MTS hydraulic actuator and control units (See Figure 3), is a closed loop, digital system that provides four-channel, multi-strategy control for performing a variety of swept-sine vibration tests. The system accepts analog input from the seismic table, digitizes the analog data, and continuously controls the amplitude of the resulting control signal so that it matches the amplitude of the specified reference spectrum. The control signal amplitude is regulated by controlling the amplitude and frequency of a sinusoidal drive signal that is generated by a programmable frequency synthesizer.

During the test program, the horizontal table motion was controlled using channel A of the D.V.C. system. The remaining channels B, C, and D monitored selected, calibrated transducer signals and stored them on disc. In this fashion, while maintaining constant acceleration input amplitude over a frequency range as wide as 1 to 33 Hertz, frequency response data was accumulated for all

monitoring locations in consecutive sweep cycles. The data was later retrieved from the disc and displayed in a suited manner as phase, response amplitude or transfer function versus frequency. At the completion of the test program, all pertinent files were transferred to tape NL-014 and stored at the Bldg. 5 data center. The developed hard copies, along with the reduced data, are stored in the Nuclear Laboratories, Bldg. 2, Records Room.

5.4 RSPT Electrical Performance Monitoring

With the magnet held in a fixed position (close to the full withdrawn position of CEA travel), the voltage output signals of both RSPTs were recorded on a Visicorder oscillograph and also stored on tape during all seismic test phases of test orientations 3 and 4. Figure 14 renders a block diagram of the basic monitoring scheme. The resolution of the oscillograph recorder was sufficient to detect any transient upset conditions or voltage signal changes down to five millivolts.

5.5 RSPT Inspection Requirements

The operational specifications and the inspection requirements of the RSPT position indication and the limit switch circuits are outlined in Sections 4.0 and 6.5 of Reference 10, respectively. Prior to and following the seismic qualification test programs, the electrical and functional characteristics of the RSPT assembly were inspected under laboratory ambient conditions in compliance with Section 6.5 of the reference test procedure. The results of inspections were recorded on the pertinent data sheets and are included in Appendix A of this report.

5.6 Simulation of Seismic Test Environment

The test specimens were subjected to 32 seconds of simultaneous horizontal and vertical inputs of random waveform motion. This random waveform consisted of frequencies spaced 1/6 octave apart over the frequency range of 1 Hertz to 25 Hertz as necessary, to envelope the Required Response Spectra of Figures 11 & 12. The technique used to synthesize the shock spectrum was to generate a series of wavelets at discrete frequencies (spaced 1/6 octave apart within the desired frequency range). The occurrence of these wavelets at each frequency (within the available time frame of 32 seconds) was specified in an arbitrary (random) fashion and the amplitude in g's for each wavelet was controlled by the Required Response Spectrum (RRS). At least 3 wavelets, spaced randomly throughout the event, were used at each sixth octave frequency close to the CEDM natural frequencies. The Digital Vibration Control System was used to sum up all the wavelet parameters and to produce a composite waveform that contained energy at all frequencies across the band. At a low test level, this waveform was then converted into shaker table motion by the shaker control units. Initiallly, the program automatically approximated the amplitude of each wavelet assuming that the transfer function of the shaker system is flat. The shock response spectrum of the table response waveform (in horizontal axis only) was then analyzed and compared with the specified RRS. The difference between the two spectra was then used to adjust automatically the wavelet amplitudes and to thereby compensate the drive waveform. This process was repeated until acceptable agreement had been demonstrated. Next, the output level was increased to arrive at the OBE and the DBE test levels. Following each increase in test level, several steps of synthesis were normally required to arrive at a satisfactory drive signal.

In addition to the on-line analysis of the horizontal table motions, both horizontal and vertical control accelerometer response signals were stored on tape and analyzed later over a frequency range of 1-50 Hertz using the "SS20T, 3.0 Decade" software package. Figure 15 shows a listing of the input file for the SSE event analysis. For interpretation of the various input parameters, Reference 14 is to be used. The software capabilities were verified in accordance with the Q.A. requirements as documented in Reference 15.

Figure 17 depicts a horizontal table time history for Test Run 26 (SSE event). The duration of this event was 32 seconds. The maximum value of this acceleration time history (approximately 0.7 g's) is representative of the actual Zero Period Amplitude (ZPA) level reached during this event which easily exceeded the requirements of 0.4 g's (see Figure 12). The character of the wave form reflects the superposition of low, medium, and high frequency pulses which resulted in the generation of a "random" type, multifrequency waveform similar to those of actual earthquakes. The required low frequency excitations for the high ANPP response spectrum peak (at about 2 Hertz) are noticeable even in this acceleration trace.

5.7 Test Procedure, Test Matrix

For more detailed guidelines about the test performance, refer to the test procedure of Reference 10. A listing of all data runs is enclosed as Appendix B to this test report.

6.0 DISCUSSION AND RESULTS

6.1 Sine Sweep Testing

Tables 1 through 5, along with Figures 5 through 10, summarize the results obtained from the sine sweep test. Appendix B renders the complete Test Matrix.

Initial low level sine sweep testing verified the analytically predicted natural frequencies of interest. The experimental frequencies of 2.32, $\sim$9.2, and $\sim$11.6 Hertz compare favorably with the theoretical values of 2.39, 10.08 and 11 Hertz for vibration modes 1, 2, and 3, respectively. Slight variations in these experimental frequencies with test level were observed especially for the somewhat non-linearly responding vibration modes 2 and 3. Figure 5 exhibits a series of transfer function plots developed for all 9 accelerometer locations along the CEDM height. The three resonance modes can clearly be discerned. The transfer function amplitudes at these resonances were taken from all available frequency response graphs and are listed in Tables 1, 2, and 3, along with damping and strain level information. Figures 8, 9, and 10 render comparisons of experimental and analytical mode shapes. For the purpose of this illustration, the deflections are shown with similar amplitudes. However, no attempt was made here to match the actual test levels analytically. Generally, the mode shapes agree quite well. But, it is also noted that the transfer function levels vary with test intensity, a fact which reflects the variation of damping with test level (especially modes two and three), as well as a certain amount of scatter between repeat test runs. For these reasons, one must view the entire range of test results, rather than using a single test run for possible input to model correlation efforts or

extrapolation of results to other plants or higher excitation levels.

Figure 7 shows some blown-up plots of resonance peaks. These graphs were used to determine the modal critical damping properties employing the half-power point technique.

$$c/c_r = \frac{\Delta f}{2f_n} \times 100$$

where

c/c_r = Critical Damping Ratio in (%)

Δf = Width (in Hertz) of Resonance Peak at 0.707 times Peak Amplitude Value

f_n = Resonance Frequency in (Hertz)

For a variety of transducer locations, modal damping properties were obtained, averaged, and listed in Tables 1, 2, and 5. First mode damping values varied between 2.2 and 3.09 percent of critical. The two percent value assumed in the CEDM analyses appears somewhat conservative, however, based on this data, three percent could not be justified.

Second mode damping ranged between 3.5 and almost 6 percent. Surprisingly, this variation showed up when results taken on different test days were compared. The damping values obtained for a wide range of excitation levels (.05 to .25 g's - Table 5), on a single day, is quite consistent. Apparently, the CEDM structure condition (e.g. looseness of coilstack and rotation) as affected by test levels, can change.

Third mode damping values ranged from 2.2 to 3.3 percent of critical. It is of interest to note here that the ANPP CEDM has no additional tie between the upper pressure housing and shroud. This tie, which exists for the TVA and WPPSS plant, has the effect of eliminating one mode and combining the second and third ANPP modes into one.

Modal Strain levels are summarized in Tables 1, 2, and 4. For correlation with analytically predicted stress levels, one must determine the associated deflections by converting transfer function levels into displacements. Considering test file RSSN02 (Table 1), this is done as follows:

ACC/9/Horizontal Control Acc = 59.39 (g/g)

Acceleration Level = Transfer Fct x Excitation

= 59.39 x 0.02 = 1.19 (g's)

$$\text{Deflection Amplitude} = \frac{9.8 \times g}{f^2} = \frac{9.8 \times 1.19}{2.32^2} = 2.16 \text{ (inches)}$$

The associated maximum nozzle strain = 175 $\mu\varepsilon$ or 81 $\mu\varepsilon$/inch deflection at CEDM Top (First Mode).

Following the seismic qualification program, static load deflection tests (incrementally deflect CEDM top and monitor strain gauges 7 & 8), as well as simple dynamic tests (manually excite first mode), were conducted to verify the observed CEDM strain versus deflection ratio. The detailed results given in Appendix C confirm the shaker table data.

6.2 Seismic Qualification Testing

The ANPP reactor design calls for 87 CEDMs with 16 different nozzle lengths. Earlier analyses has shown that the CEDM type with the longest nozzle would tend to respond in the most critical manner. Therefore, this nozzle condition was selected for testing. The stipulated seismic intensities for the reactor head elevation are shown in Figures 11 and 12 for the OBE and the SSE event, respectively. It had been decided earlier to perform the tests with the hydraulic actuator set up at a 45^{o} angle with the horizontal plane, thereby providing equal input motions in the vertical axis and in the horizontal axis. During the tests, the horizontal control accelerometer was used for the synthesis of the random type waveforms. The Required Response Spectra (RRS) used for the synthesis represented the envelope of the vertical RRS and the horizontal RRS, whereby the latter was constructed from two horizontal spectra (using the Root-Sum-of-the-Square technique).

Figure 13 shows a diagram of the instrumentation hook-up and control logic. The RSPTs were placed inside the CEDM shroud and connected to recording equipment as shown in Figure 14. The RSPT locations during the four test orientations are identified on Figure 16.

During the course of the test program, the RSPTs were exposed to at least 30 and 10 seismic disturbances, each intensity range equal to at least that of the OBE and the SSE type earthquakes, respectively. The official test log is enclosed as Appendix B, which includes a minimum of 5 OBE and 1 SSE events in each test orientation. In all test cases, no transient upset or anomalous conditions were found in the RSPT signal traces.

The signal loss observed during one test run was due to a monitoring cable break (cable was inadequately secured at power supply). The inspections conducted prior to and following the seismic qualification tests revealed no changes in the functional characteristics of the two specimens as provided for testing (Appendix A).

Figure 17 shows the synthesized table acceleration time history for an SSE event. Since the Required Response Spectrum has a high spectrum peak at about 2 Hertz, the waveform clearly reflects these large, low frequency components superimposed by higher frequency contributions. Typical strain and RSPT time histories are shown for the OBE and the SSE events in Figures 18 and 19, respectively. With the exception of a small "ripple" (less than 3 milliseconds), all RSPT monitoring traces are undisturbed. The strain gauges reflect the response characteristics of the CEDM and reveal an overwhelming response (proportional to deflection) at its fundamental frequency. Peak CEDM component strain levels are listed in Table 6 for all test runs. The maximum values (635 με for OBE and 770 με for SSE events) are well within material allowables.

Figure 20 renders OBE Test Response Spectra for all four test orientations. The analyses of the table motions was performed at 1/6th octave increments over a frequency range of 1 to 50 Hertz. In all cases, the graphs demonstrate complete envelopment of the Required Response Spectra (vertical lines show actual test intensity, spectrum curve reflects RRS). A seismic table resonance was responsible for the high spectrum peak above 30 Hertz.

Horizontal and Vertical Test Response Spectra are shown in Figure 21 for the SSE event. Again, complete envelopment of the requirement is demonstrated. Additional table acceleration time histories are given in Figure 22.

In order to capture the resulting seismic intensities at the RSPT mounting locations (CEDM shroud), four response accelerometers Nos. 3, 5, 7, and 9 were monitored and recorded on tape. Unfortunately, the tape channel recording the CEDM top motions was set up improperly which resulted in attenuation of higher frequency signal components. The test response spectra shown in Figures 23 and 24 capture the true seismic intensities at all four shroud elevations, whereby the Acc 9 curve was extrapolated using data from the other 3 locations. These response spectra (2% damping) exemplify the large CEDM response at about 2.3 Hertz. Some contribution from CEDM Mode 2 is apparent at 10 Hertz. The response spectrum peaks above 30 Hertz are due to the table resonance mentioned earlier.

Figures 25 and 26 summarize the acceleration time histories as recorded at the four shroud elevations during OBE and SSE event simulations. Accelerometer 3, 5, and 7 traces are basically unfiltered and some of the higher acceleration spikes may actually be caused by impacts (e.g. coilstack shifting at Acc 3 location). However, this fact would not influence the response spectrum character across the frequency range of interest (1-30 Hertz) which is shown in Figures 23 and 24.

Prior to seismic testing, RSPT Sample No. 604 was removed from test Loop 7A after 1730 hours of thermal aging at 375°F for a performance check and a visual inspection. The visual inspection showed some deterioration of the silgard encapsulant and the diallyl phthalate mounting strip. Based on this inspection, it

was decided to waive future visual inspections of both RSPT's until the entire qualification program had been completed. Therefore, details of the above visual inspection and the final visual inspection will be documented in the final qualification report.

7.0 REFERENCES

1. IEEE Standard Number 323, 1974, General Guide for Qualifying Class 1 Electrical Equipment for Nuclear Power Generating Stations.

2. IEEE Standard Number 344, 1975, Guide for Seismic Qualification of Class 1 Electrical Equipment for Nuclear Power Generating Stations.

3. Specification Number SYS80-MD-0311, Revision 02, Design Specification for Control Element Drive Mechanism.

4. Specification Number 14273-MD-0311, Revision 02, Project Design Specification for CEDM for Arizona Nuclear Power Project - Palo Verde Nuclear Generating Stations, 1, 2, and 3.

5. Document Number QC-28-05 EW NPM-W CEDM/PLCEDM Design Control Procedure, dated 9/19/74.

6. Document Number 00000-NLE-070, Revision 0, Procedure for Control of Measuring and Test Equipment.

7. Manufacturing Specification for the Class 1E Reed Switch Position Transmitter, Specification Number 00000-ESE-203, Revision 01.

8. Drawing CEDM-E-R1000, Revision 02, Reed Switch Assembly.

9. Drawing D-STD-162-003, Revision 01, Magnet Assembly and Details.

10. Test Procedure 00000-ESE-323, "Seismic Qualification Testing System 80 RSPT and Litton Electrical Connector - ANPP," K. H. Haslinger, July 31, 1981.

11. Test Report TR-ESE-285, "SCE CEDM-RSPT Seismic Qualification Test," K. H. Haslinger, May 15, 1979.

12. Operating Manual for Sinusoidal Vibration Control System," Time/ Data Division. Document 1923-5124, December, 1977.

13. Q.A. Verification of Time/Data Sinusoidal Vibration Control Code Version 04, C-E Analysis Report Nos. S669-100 and S669-101.

14. Operating Manual for Shock Spectrum Synthesis and Analysis System, Time/Data Division, Document 1973-5127, July, 1977, TR-ESE-424.

15. J. P. Thompson, "Q.A. Verification of 3.0 Decade WAE Synthesized SRS Analysis Program," S863-113, dated May 2, 1979.

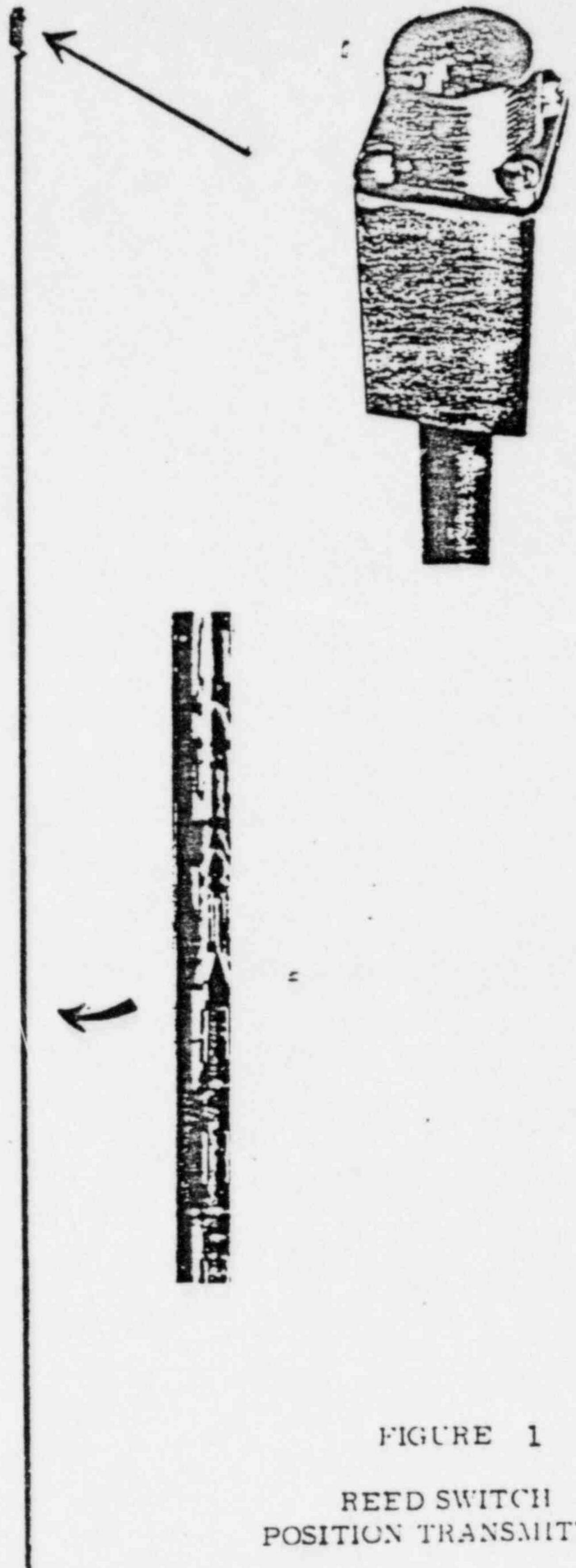


FIGURE 1

REED SWITCH
POSITION TRANSMITTER

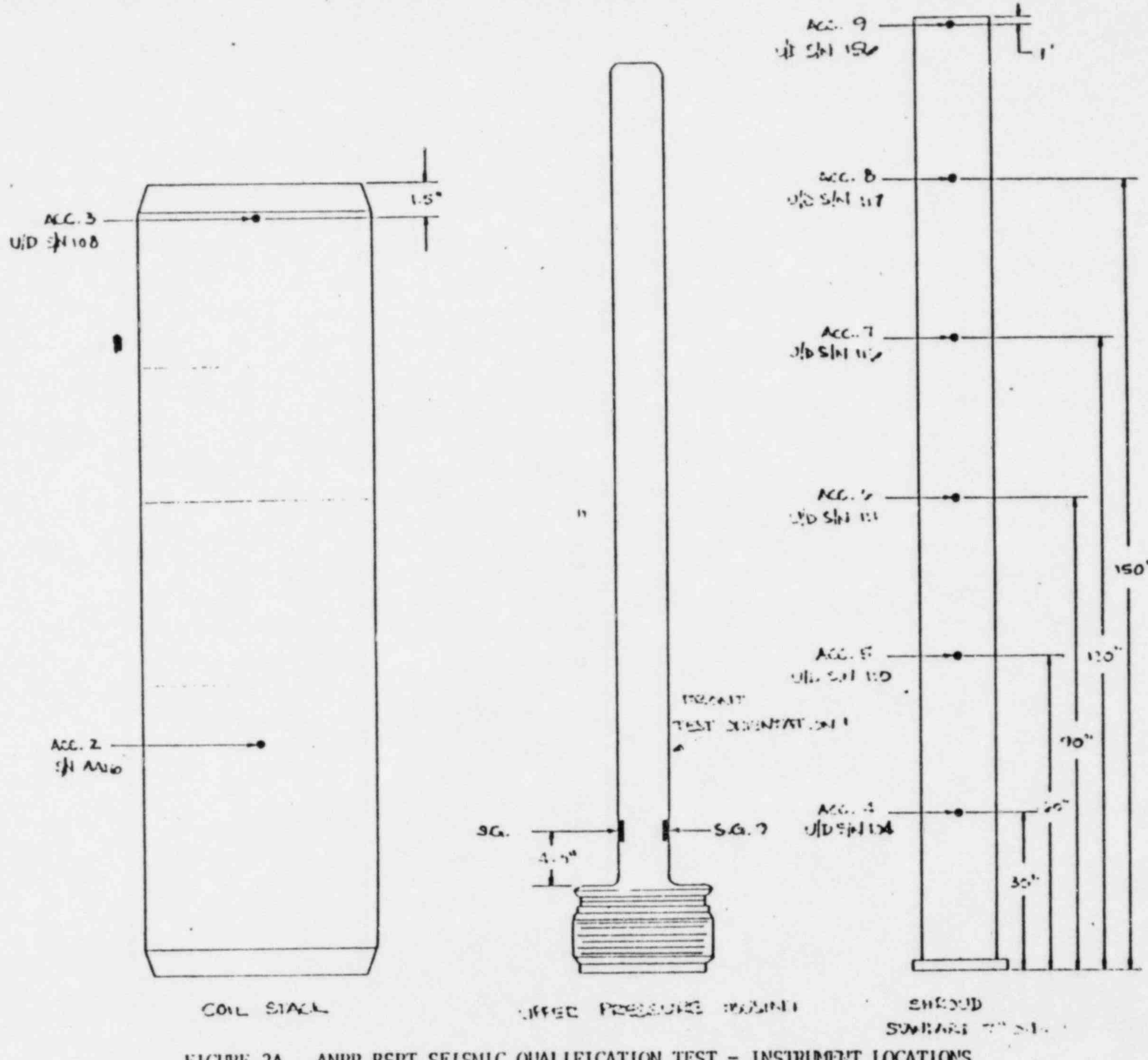


FIGURE 2A ANPP RSPT SEISMIC QUALIFICATION TEST - INSTRUMENT LOCATIONS

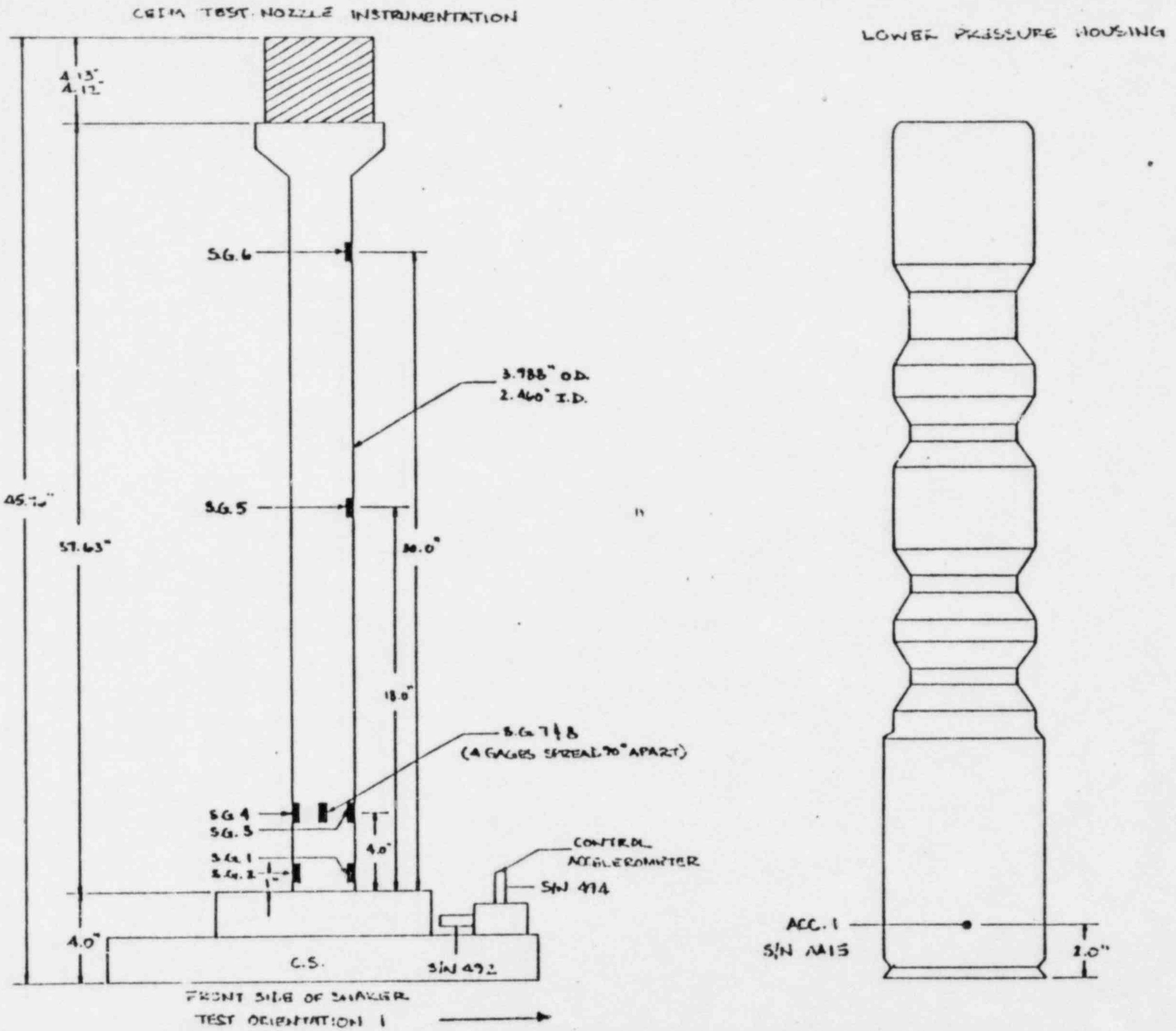


FIGURE 2B ANPP RSPT SEISMIC QUALIFICATION TEST - INSTRUMENT LOCATIONS

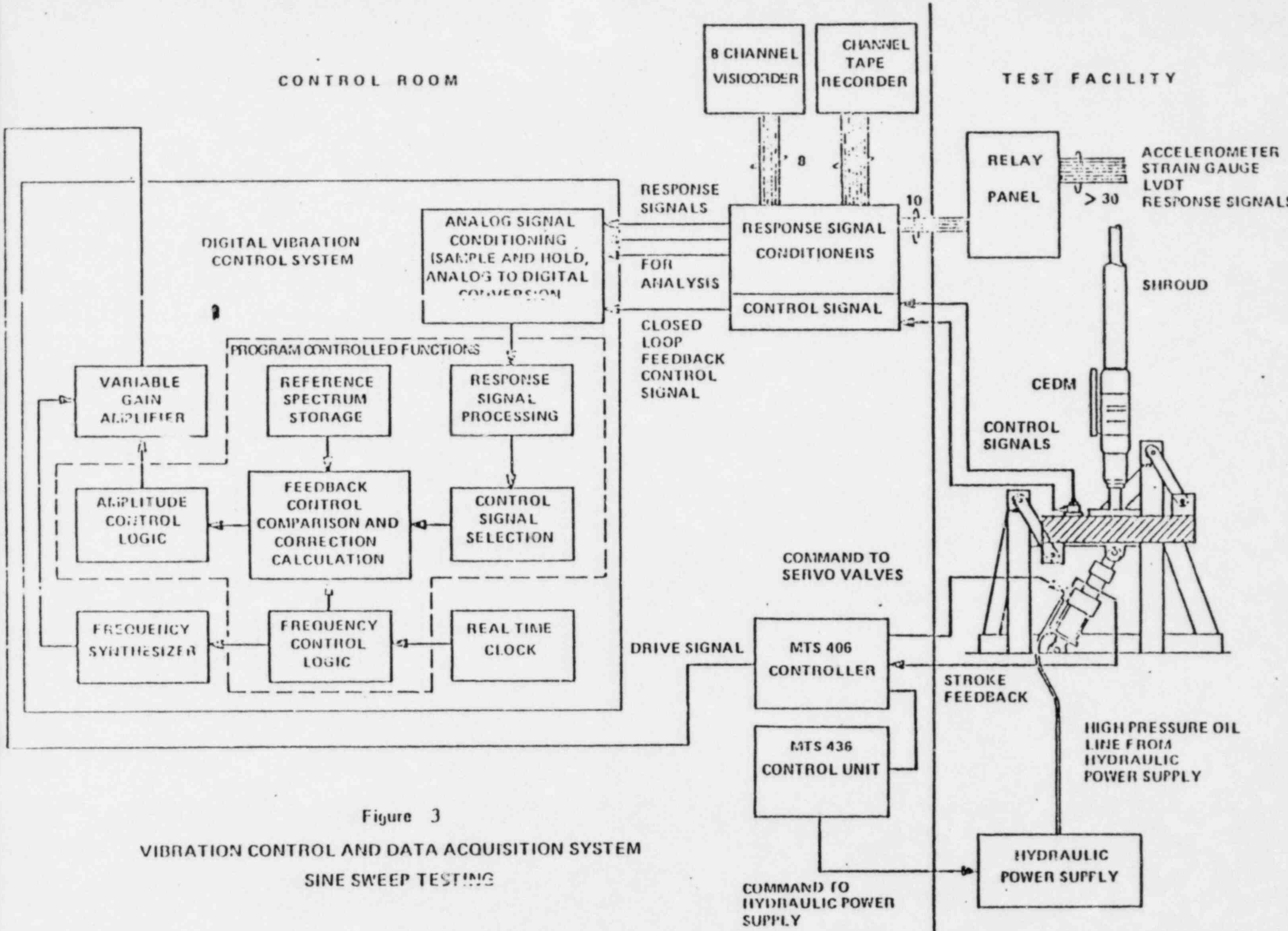


Figure 3

VIBRATION CONTROL AND DATA ACQUISITION SYSTEM

SINE SWEEP TESTING

```
1 TEST ID: RSSNO2
2 HEADING: ANPP RSPT SINE SWEEP

SWEEP PARAMETERS:
3 MODE  2-LOG(DEC), 1-LOG(OCT), 0-LIN: 2
4 START, END FREQ, HZ: 1.000,28.00
FREQ RANGE, DEC=1.447
5 SPECIFICATION  1-RATE, 0-DURATION: 1
  RATE, DEC/MIN: .2000
SWEEP DURATION — HRS, MIN, SEC: 0,7,14

TEST LENGTH:
6 SPECIFICATION  1-TIME, 0-SWEEP CYCLES: 0
  CYCLES: 1.000
TEST TIME — HRS, MIN, SEC: 0,7,14
7 START-UP TIME, SEC: 15.00
8 SHUT-DOWN TIME, SEC: 5.000

REFERENCE SPECTRUM:
9 UNITS 1-METRIC, 0-NON-METRIC: 0
10 SPECTRUM LIMITS:
   DISPLACEMENT, IN(P-P): 4.000
   VELOCITY, IN/SEC: 12.50
   ACCELERATION, G: .2500

11 TYPE, VALUE, FREQ: 2,.02000,28.00
   ALARM LIMIT +DB, -DB: 3.000,-3.000
   ABORT LIMIT +DB, -DB: 10.00,-10.00

12 TEST LEVEL (DB BELOW REF): 0.

13 CONTROL CHANNELS: 1
   PROCESS 3-AVG ABS, 2-FUND, 1-PEAK, 0-RMS: 2

14 LIMIT CHANNELS: 0
15 AUXILIARY CHANNELS: 2,3,4
   PROCESS 3-AVG ABS, 2-FUND, 1-PEAK, 0-RMS: 2
   MAXIMUM EXPECTED G: 3.000
16 ACCEL SENS, MV/G:
   CH 1: 10000.
   CH 2: 10000.
   CH 3: 10000.
   CH 4: 10000.
17 FILTER  1-PROPORTIONAL BW, 0-FIXED BW: 1
   BW, %: 50.00

18 REFERENCE CHANNEL: 1
19 RESPONSE CHANNEL: 2
20 MONITOR CHANNEL: 1

21 COMPRESSION SPEED  2-HIGH, 1-NORMAL, 0-LOW: 2
22 LOOP-CHECK FREQ(HZ), MAX DRIVE(VOLTS): 5.000,.2000

REFERENCE LEVELS:
 MAX DISPLACEMENT, IN(P-P): .3914
 MAX VELOCITY, IN/SEC: 1.230
 MAX ACCELERATION, G: .02000
 MIN ACCELERATION, G: .02000
 ACCELERATION RANGE, DB: 0.

CORRECTIONS? N
SAVE? Y
1-RT11, 0-PUNCH: 1
DEVICE: RK0

 STORED RSSNO2

>
```

FIGURE 4

TYPICAL INPUT LISTING - SINE SWEEP TEST

APPENDIX B

LOG SHEETS

TAPE DATA LOG SHEET

TEST ANPP RSPT SEIS. QUAL

DATE 7/31/81

RECORDED BY S. K

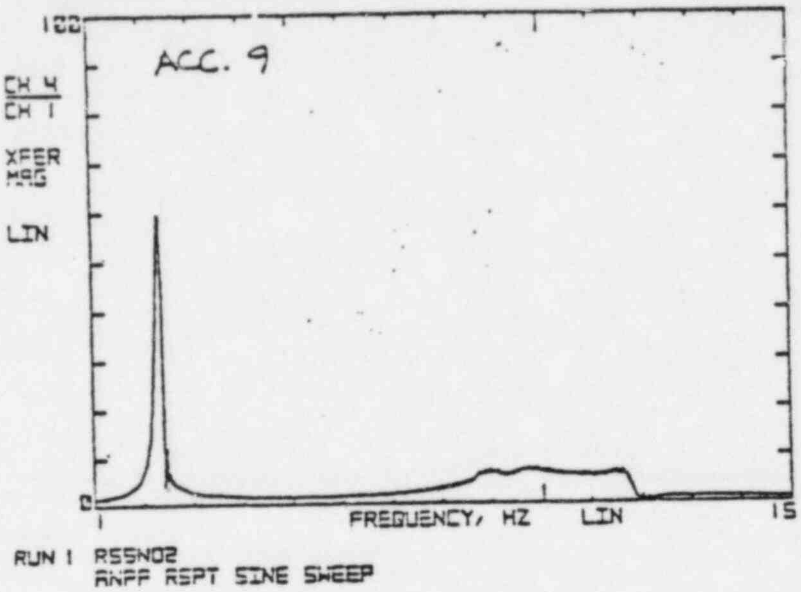
LOG SHEET NO. 01

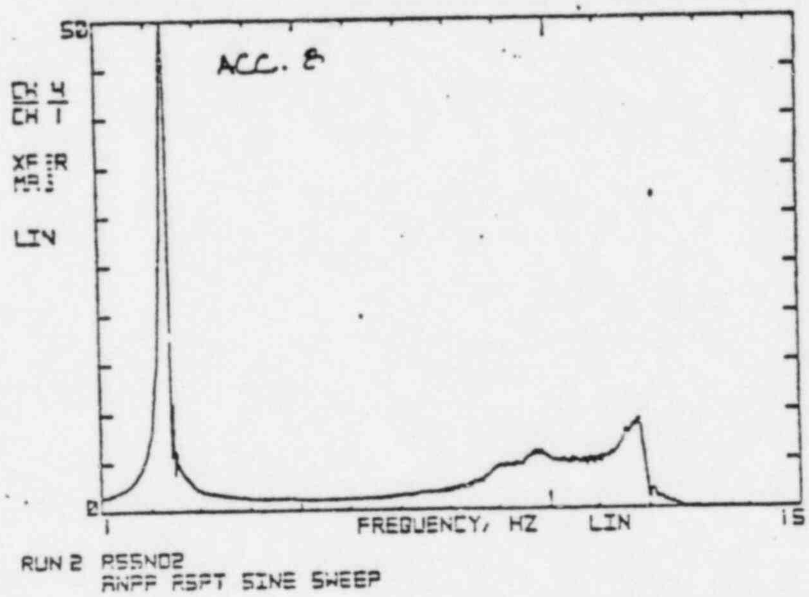
HOOKUP SHEET NO.

RECORD SPEED 3 3/4

RECORD BAND WB I

REEL NO.	~~[illegible]~~ RUN NO.	FOOTAGE	ATTENUATOR/AMP. SETTING 1	2	3	4	5	6	7	COMMENTS
S-01	# TAPE FT.	—	H.C	V.C.	Acc 9	Acc 7	Acc 5	Acc 3	Trigger [illegible]	Transducers
		—	10V 1G	10V	10V	10V	10V	10V	10V	[illegible]
	1	50								~~OBE~~ OV SHORTED INPUTS CAL
	2	65	#1 only: 9v pk 100 Hz [CAL ONLY]							ALL INPUTS F.S. CAL SIGNAL 2-6: 10v pk 100 Hz 7:
	3	90	10v	10v	10v	10v	10v	10v	~5v NOM	ALL INPUTS F.S. CAL 10 v pk, 100 Hz
	4	108								ORIENTATION 1: OBE 1
	5	124								ORT 1 OBE 2
	6	141								ORT 1 OBE 3
	7	161								ORT 1 OBE 4
	8	179								ORT 1 OBE 5
	9	199								ORT 1 SSE 1
	10	226								~~ORT 2~~ ABORT ~~SSE~~ 1
	11	238								ORT 2: SSE 1
	12	259								ORT 2 SSE ~~OBE~~ 1, 2nd run
	13	278								OBE 1 ~~[illegible]~~ ORT 2





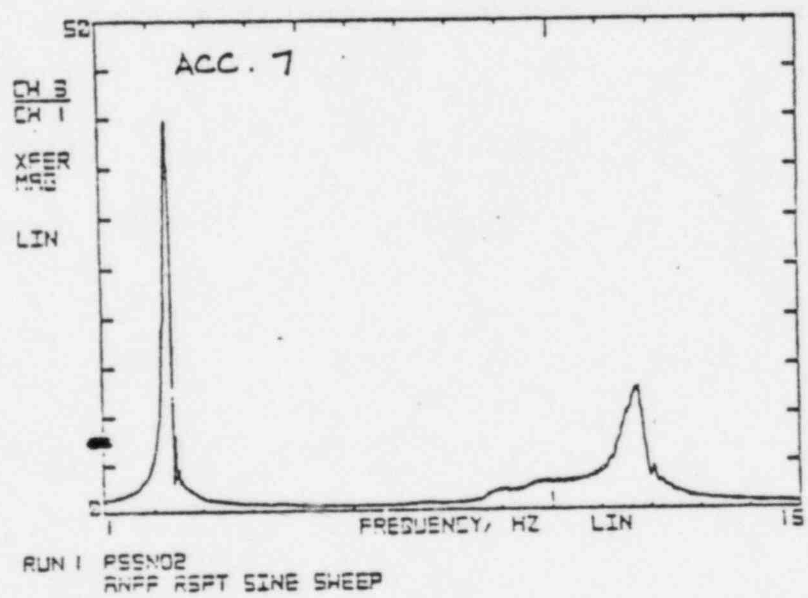
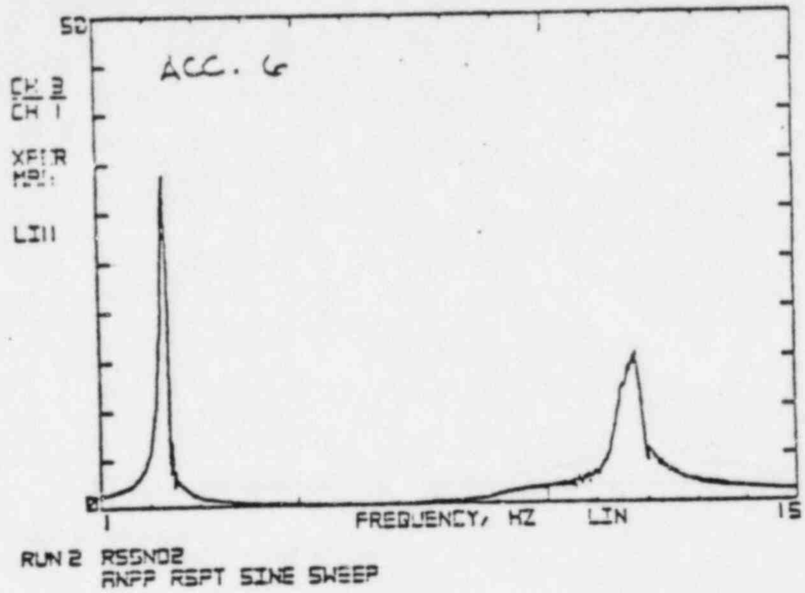
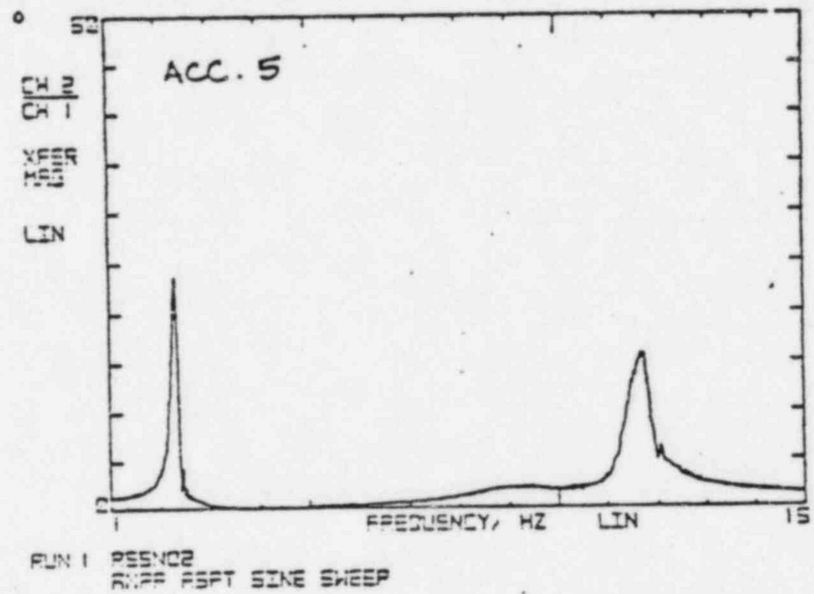


FIGURE 5A TYPICAL SINE SWEEP TRACES - TRANSFER FUNCTION
TEST FILE RSSN02 - 0.02 g's EXCITATION





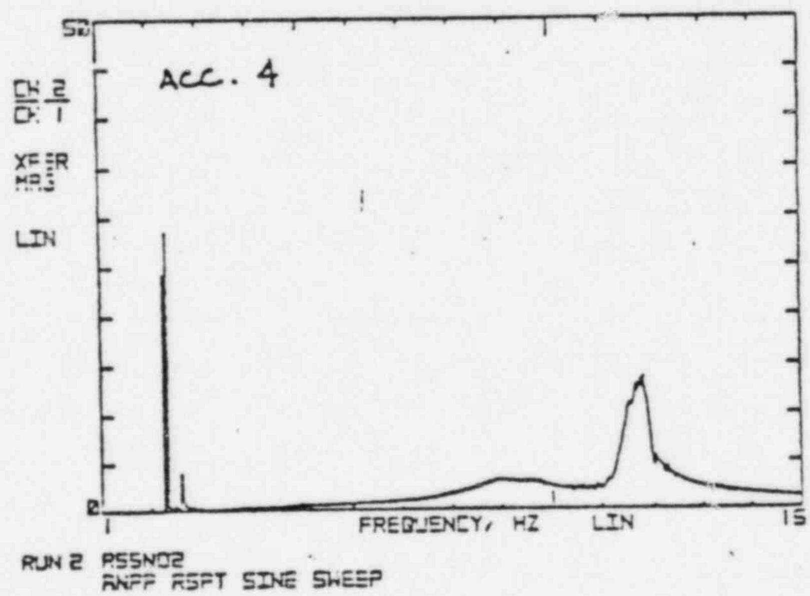
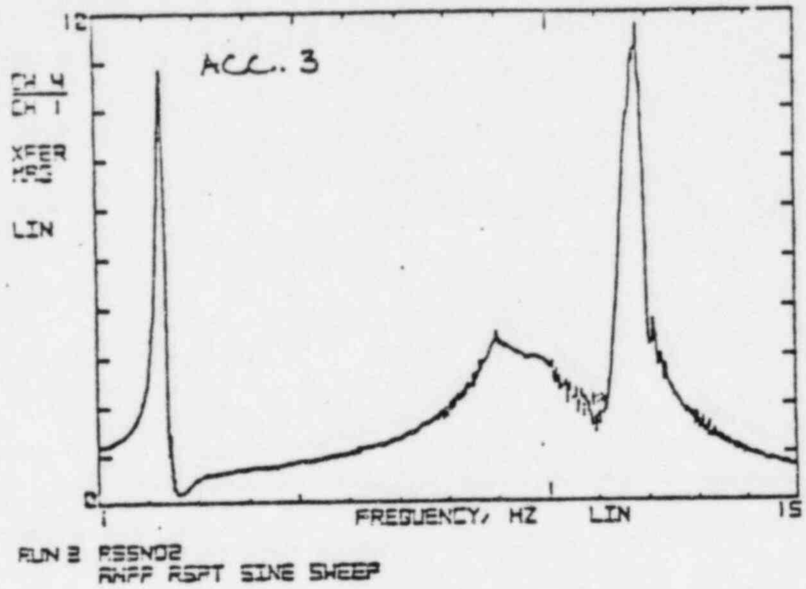
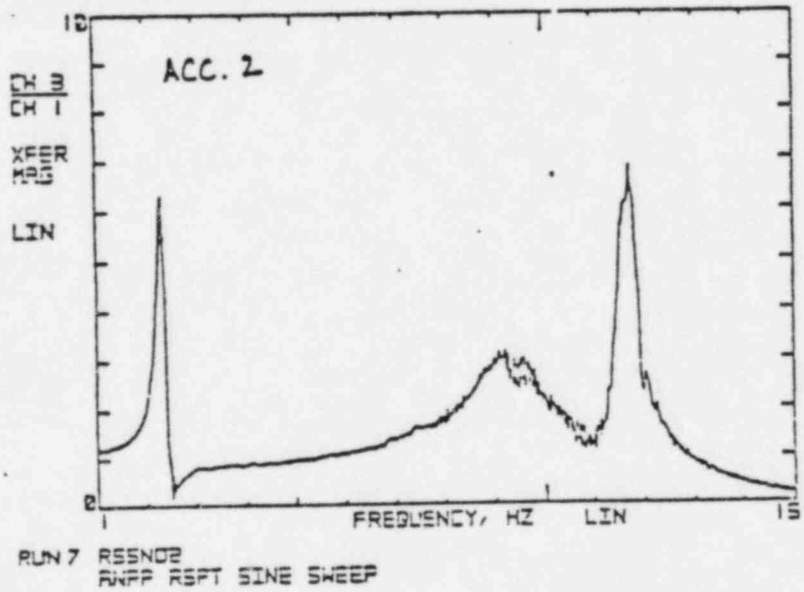


FIGURE 5B TYPICAL SINE SWEEP TRACES - TRANSFER FUNCTION
TEST FILE RSSNO2 - 0.02 g's EXCITATION





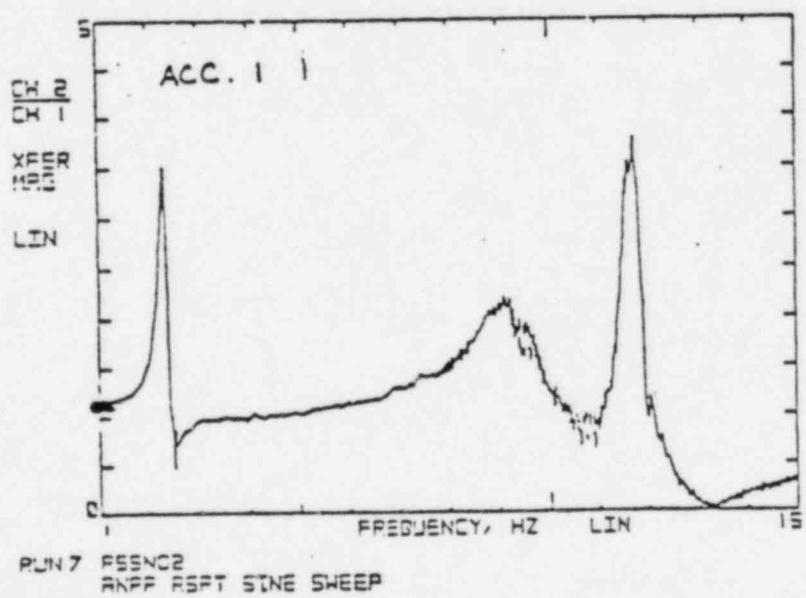


FIGURE 5C TYPICAL SINE SWEEP TRACES - TRANSFER FUNCTION
TEST FILE RS3N02 - 0.02 g's EXCITATION

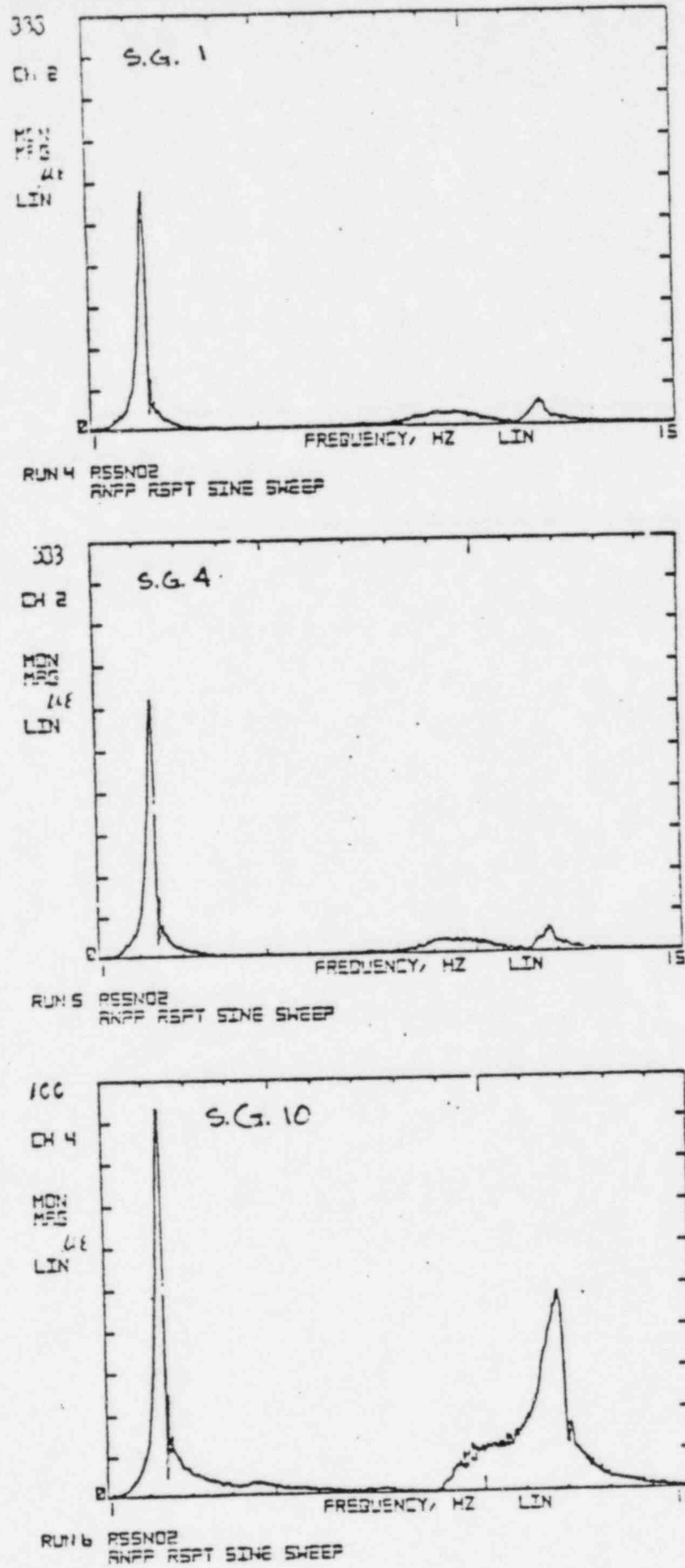
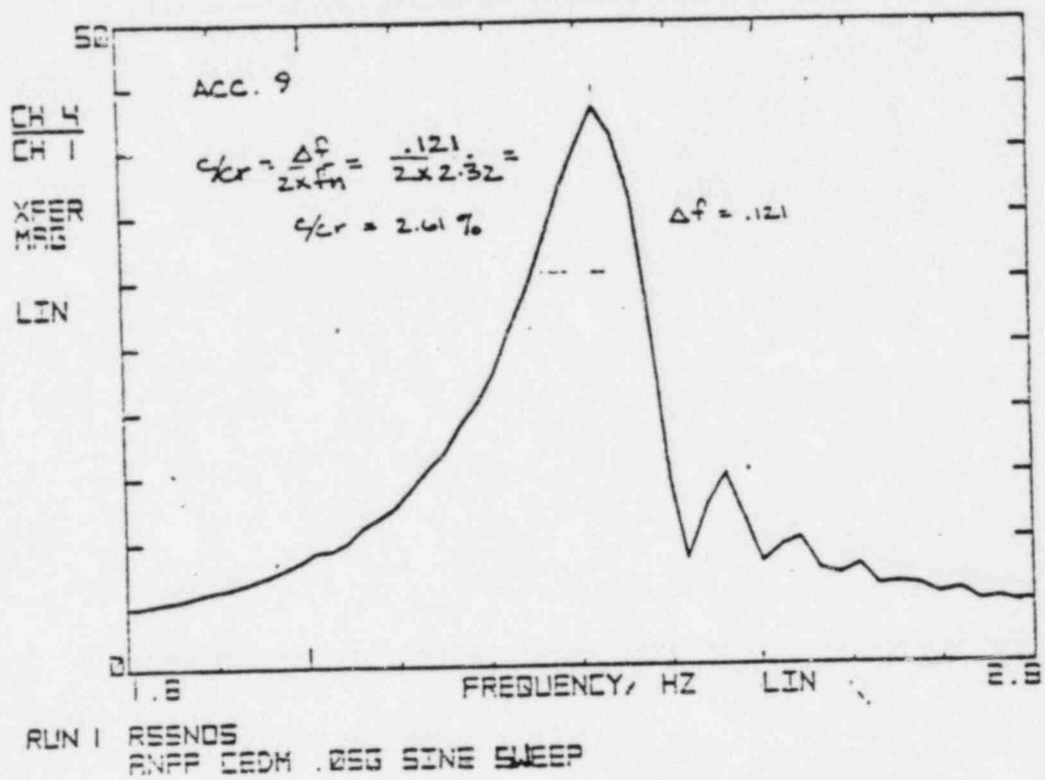


FIGURE 6 TYPICAL SINE SWEEP TRACES - STRAIN FREQUENCY RESPONSE PLOTS 0.02 g's EXCITATION



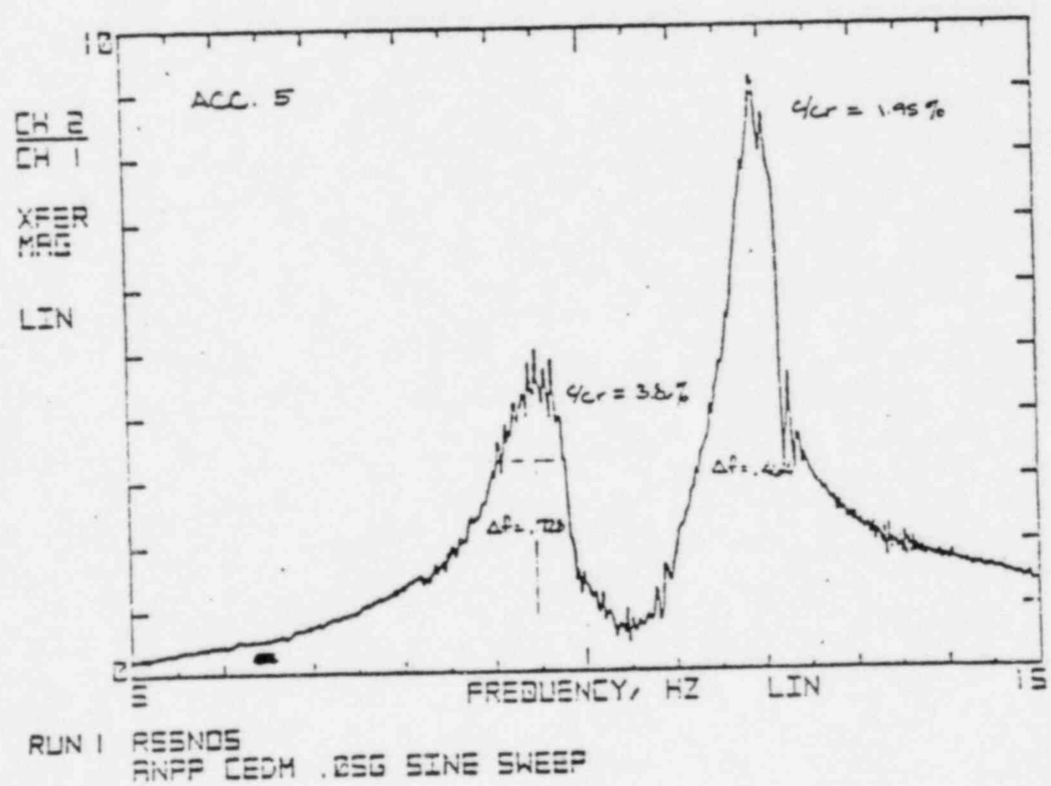


FIGURE 7

DETERMINATION OF MODAL DAMPING PROPERTIES FROM BLOWN-UP SINE SWEEP TRACES

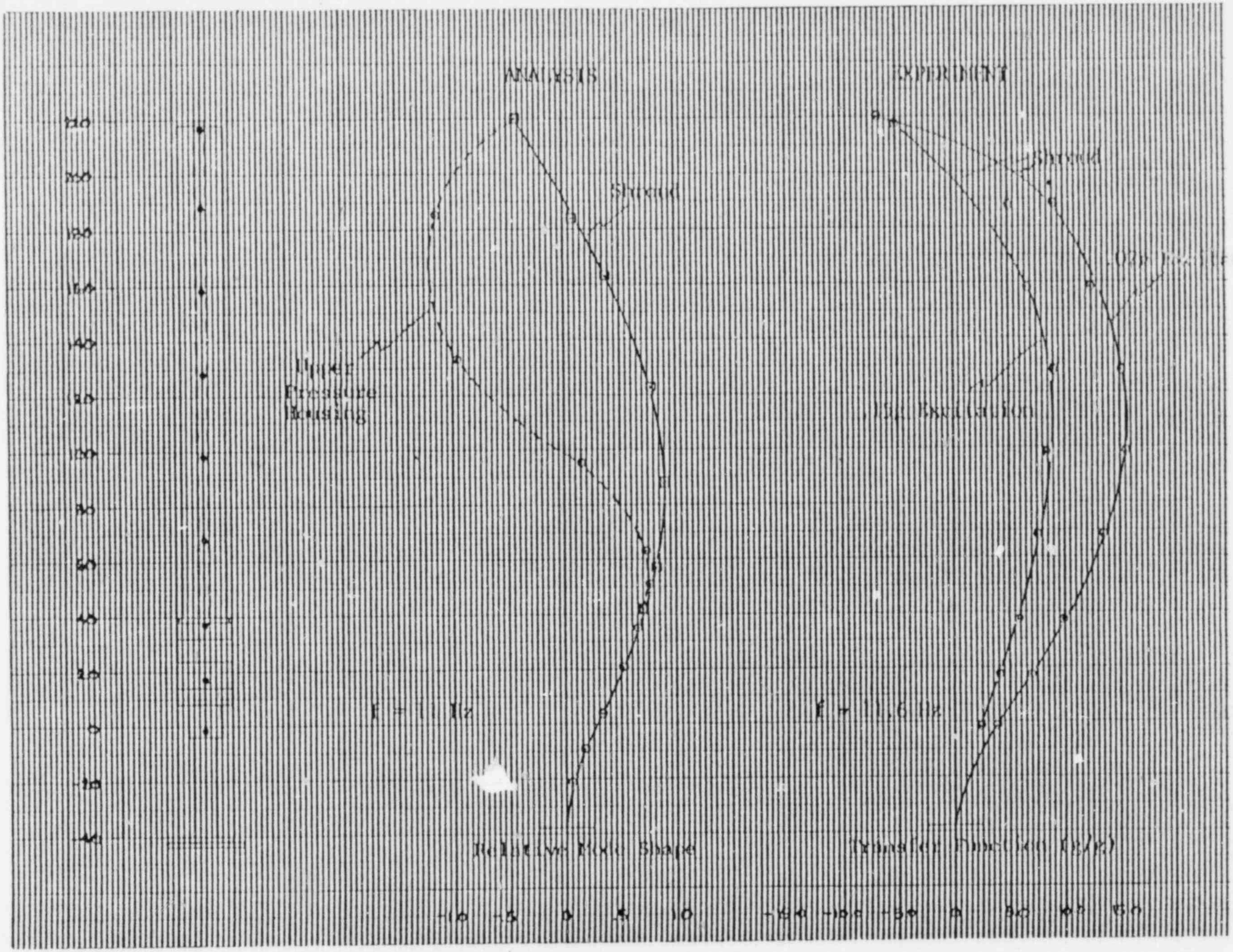


FIGURE 10 COMPARISON OF EXPERIMENTAL AND ANALYTICAL MODE SHAPES - THIRD MODE

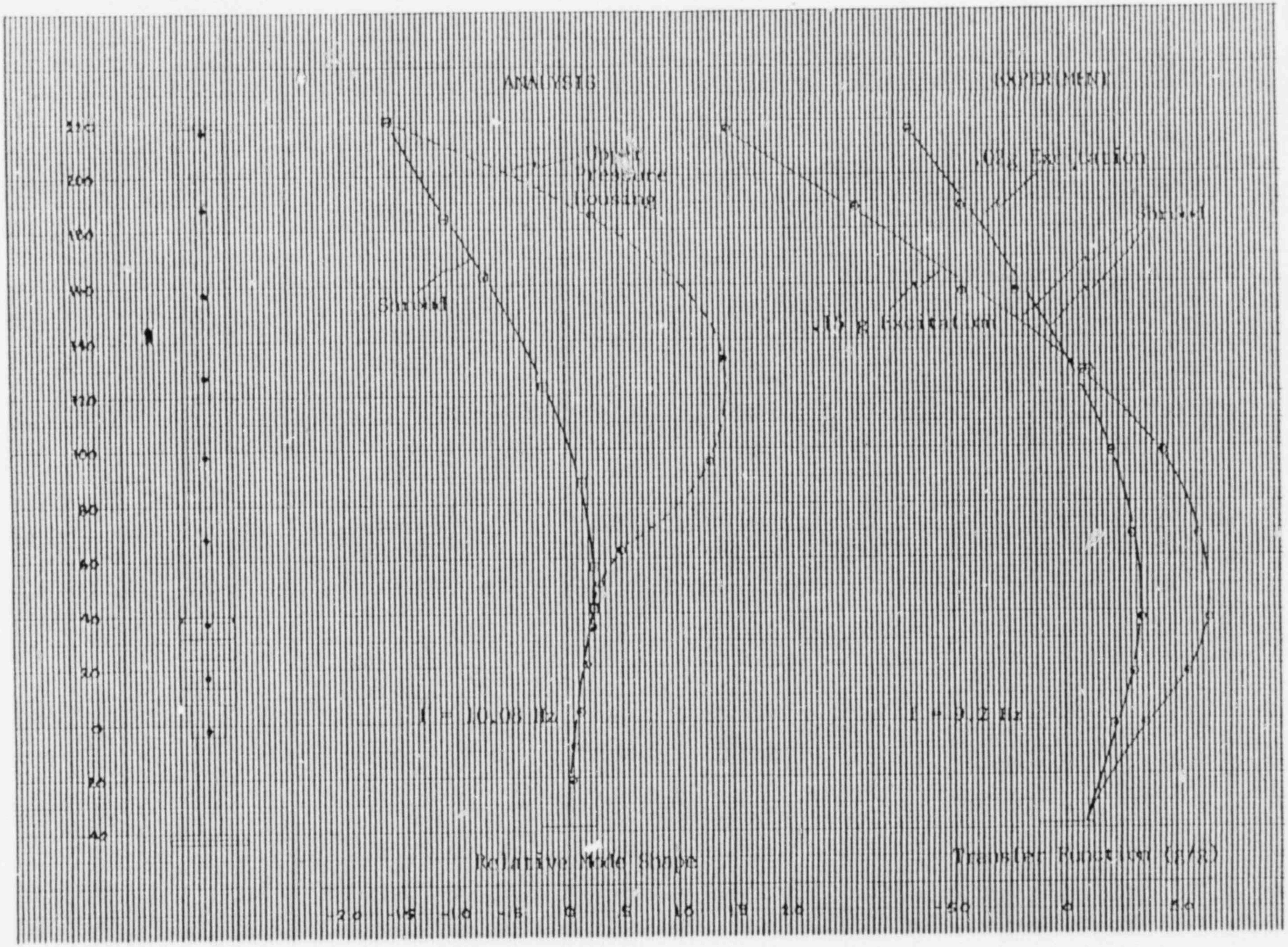


FIGURE 9 COMPARISON OF EXPERIMENTAL AND ANALYTICAL MODE SHAPES - SECOND MODE

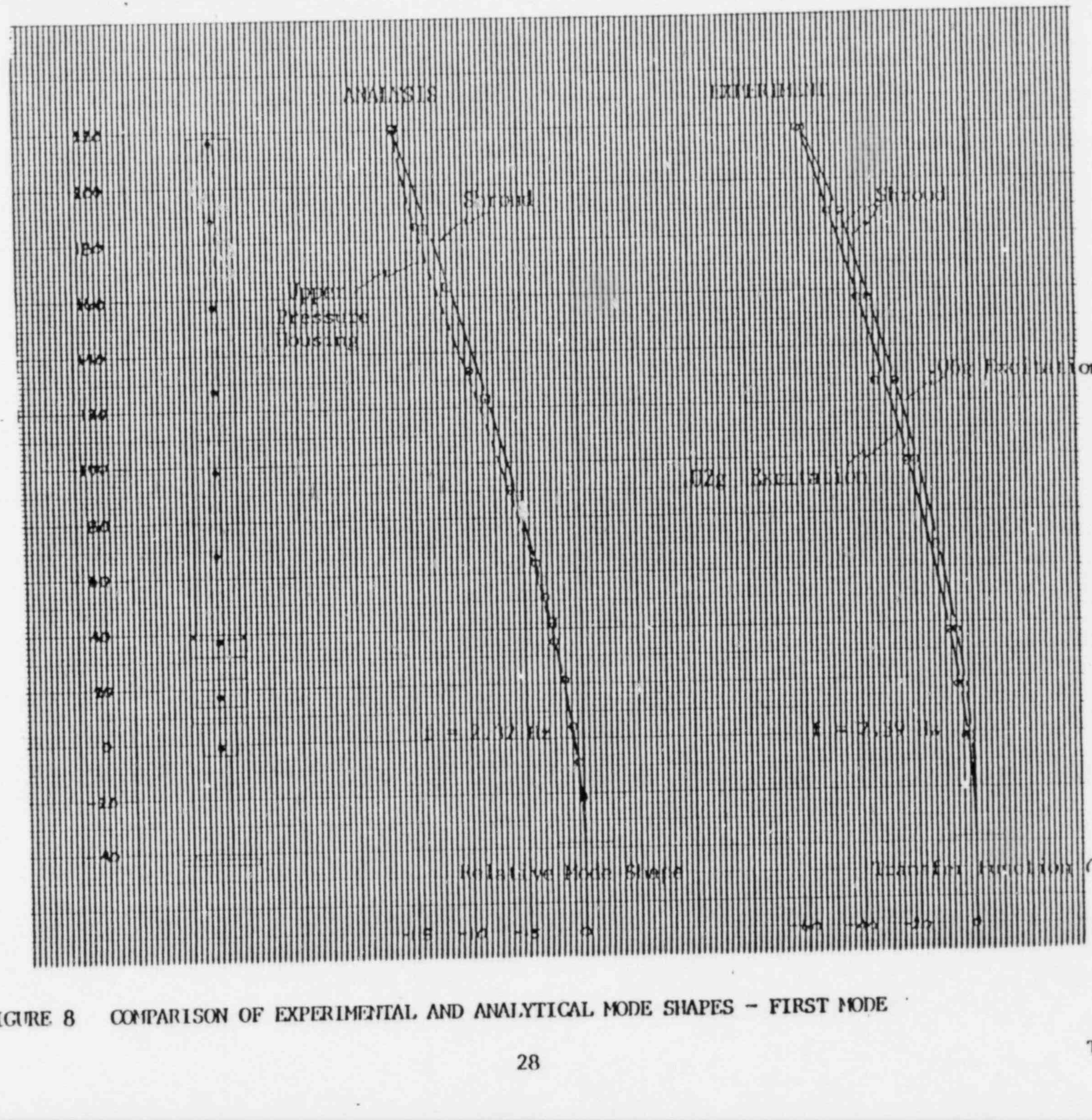


FIGURE 8 COMPARISON OF EXPERIMENTAL AND ANALYTICAL MODE SHAPES - FIRST MODE

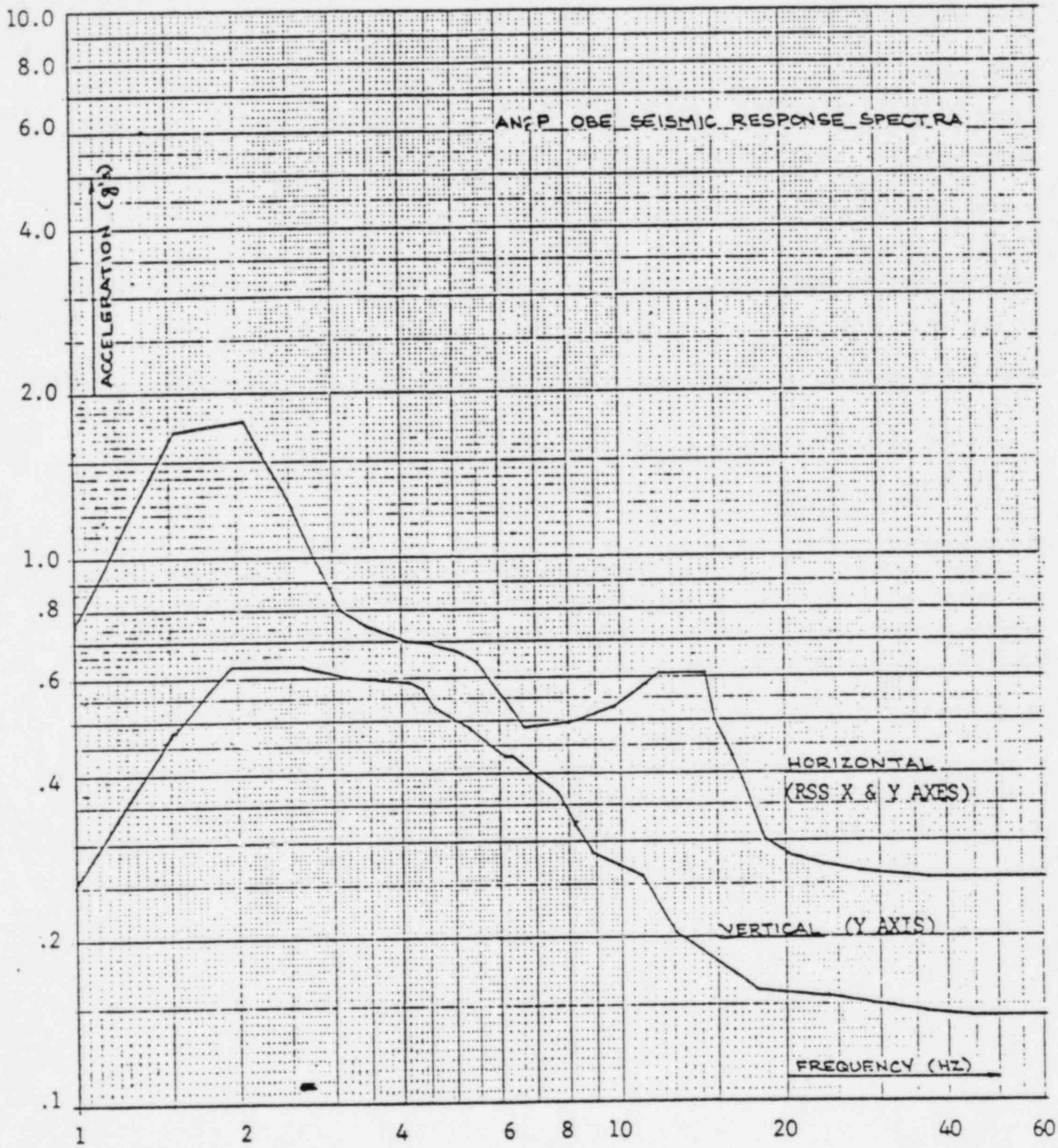


FIGURE 11 OBE REQUIRED RESPONSE SPECTRA - ANPP RSPT QUALIFICATION TEST, 2% DAMPING

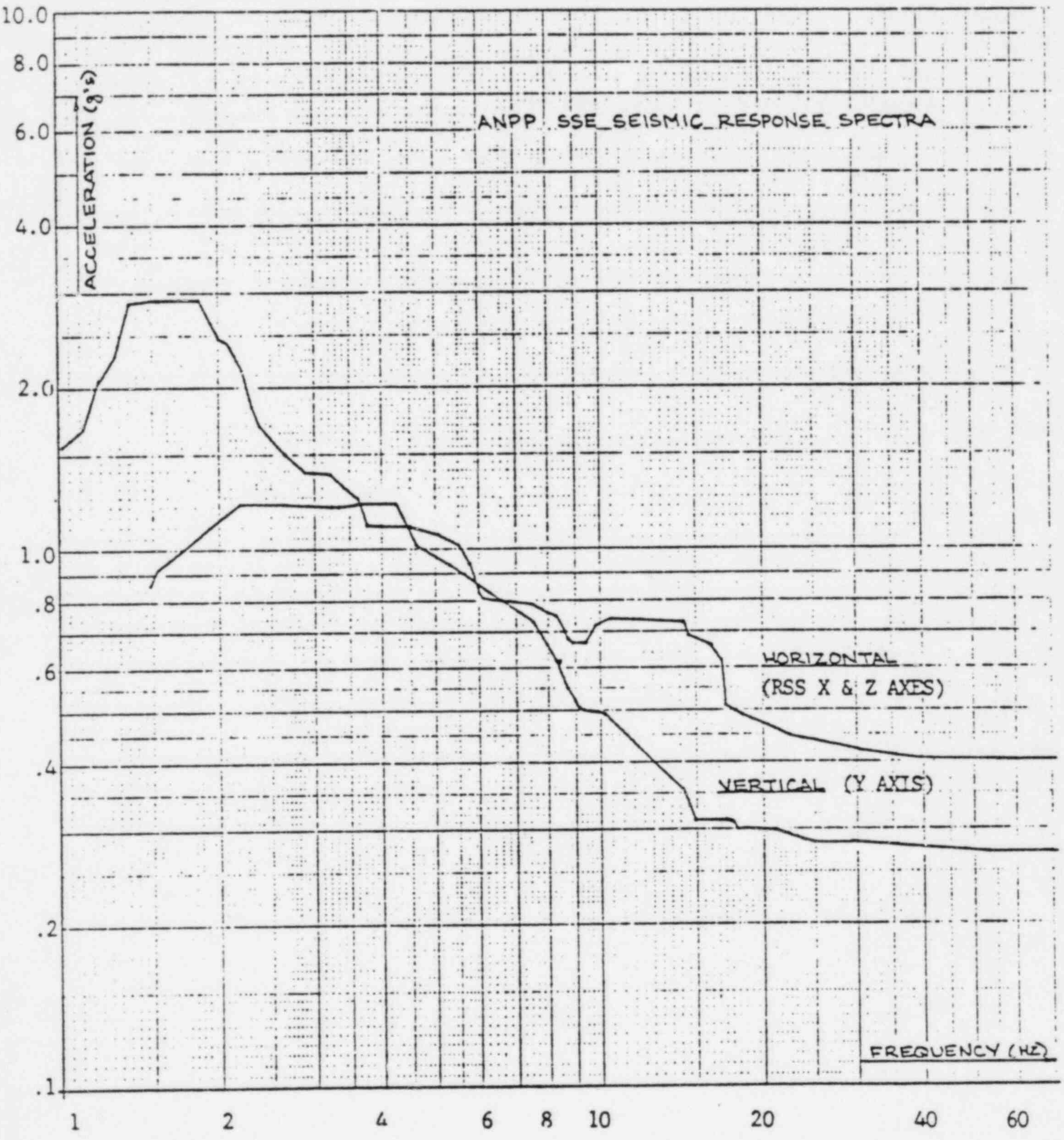


FIGURE 12 SSE REQUIRED RESPONSE SPECTRA - ANPP RSPT QUALIFICATION TEST, 2% DAMPING

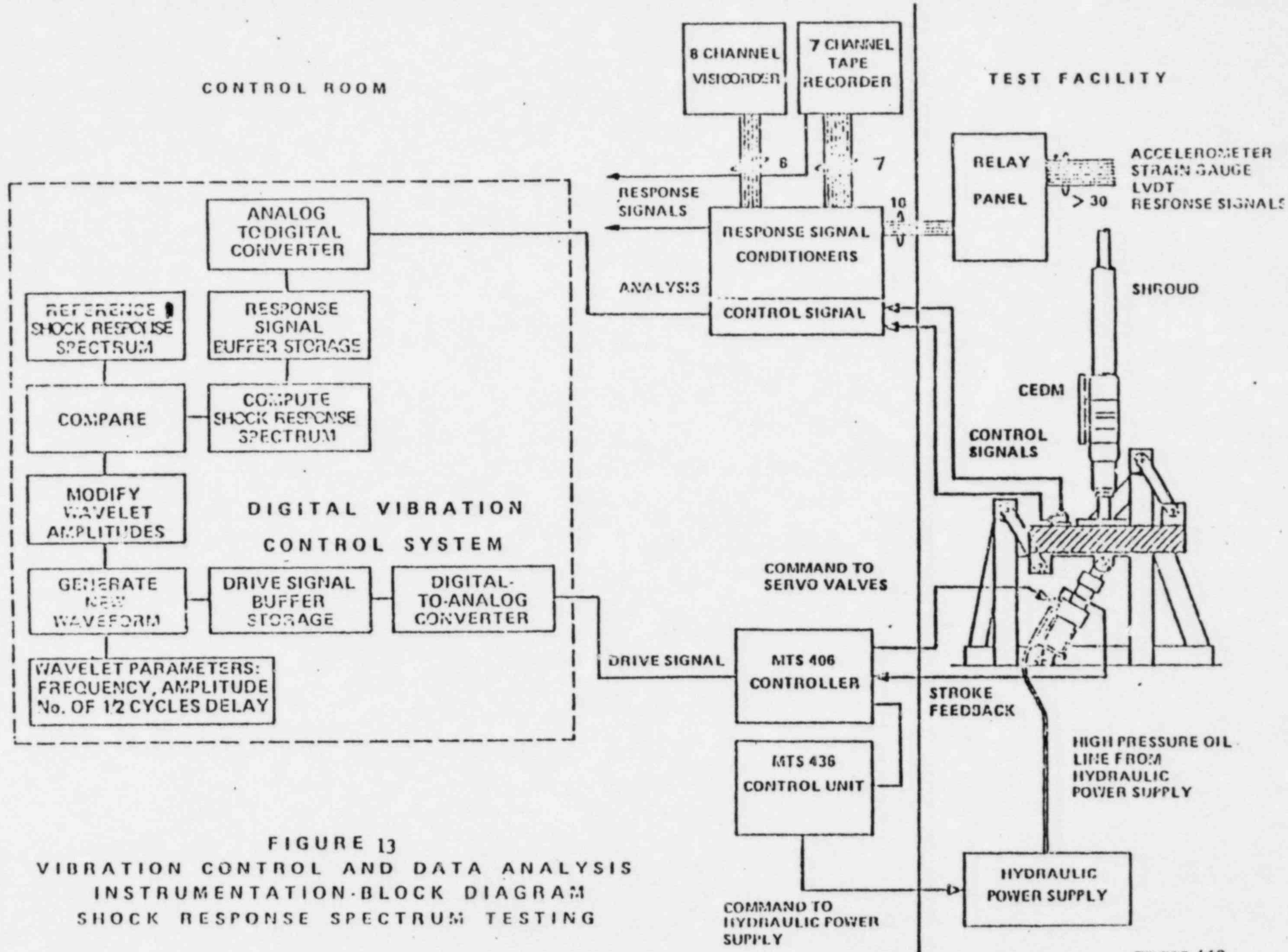


FIGURE 13
VIBRATION CONTROL AND DATA ANALYSIS
INSTRUMENTATION-BLOCK DIAGRAM
SHOCK RESPONSE SPECTRUM TESTING

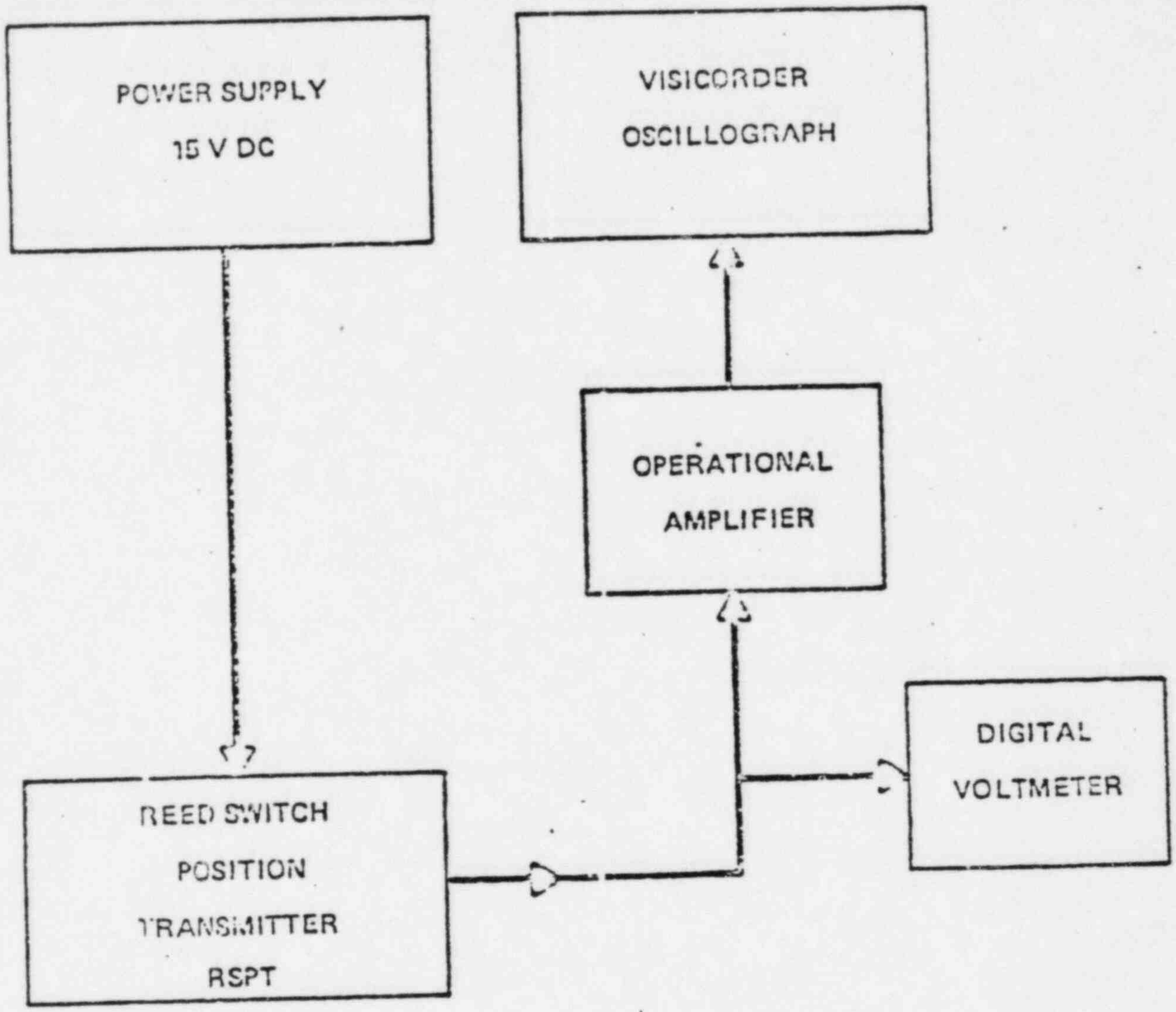


FIGURE 14

BLOCK DIAGRAM FOR MONITORING OF RSPT ELECTRIC OUTPUT DURING SEISMIC QUALIFICATION TEST

```
1 HEADING:ANPP SSE
2 SENSITIVITY(MV/G):990.
3 SHOCK RESP DEFN 0=ABS ACCEL 1=REL DISPL:0
4 DAMPING COEFF:.02
5 MAX FREQ:50
6 # OF DECADES 0=2 1=2.3 2=2.6 3=3:3
7 WAVE PARAMETERS
        FREQ     AMPL
  1     1.        1.53
  2     1.12      1.95
  3     1.25      2.21
  4     1.41      2.87
  5     1.58      2.92
  6     1.77      2.92
  7     1.99      2.5
  8     2.23      2.07
  9     2.51      1.61
 10     2.81      1.42
 11     3.16      1.38
 12     3.54      1.26
 13     3.98      1.21
 14     4.46      1.1
 15     5.01      1.07
 16     5.62       .98
 17     6.3        .83
 18     7.07       .79
 19     7.94       .76
 20     8.91       .66
 21    10.         .72
 22    11.21       .73
 23    12.58       .73
 24    14.12       .73
 25    15.84       .66
 26    17.78       .49
 27    19.95       .47
 28    22.38       .44
 29    25.11       .44
 30    28.17       .44
 31    31.62       .44
 32    35.48       .44
 33    39.81       .44
 34    44.65       .44
 35    50.1        .44
8 PEAK WAVELET AMPL(V):10.
9 AUTO MODE LEVEL SEQ 0=FULL 1=1/2 2=1/4 3=1/8 4=1/16 5=DONE
  FIRST:5
10 EXTERNAL TRIGGER MODE 0=NO 1=YES:1
11 ALARM BAND 1
    +DB LIMIT:3.
    -DB LIMIT:-3.
    UPPER FREQ, HZ:50.
```

FIGURE 15 TYPICAL INPUT LISTING - SHOCK RESPONSE SPECTRUM TEST
ANPP - SSE EVENT

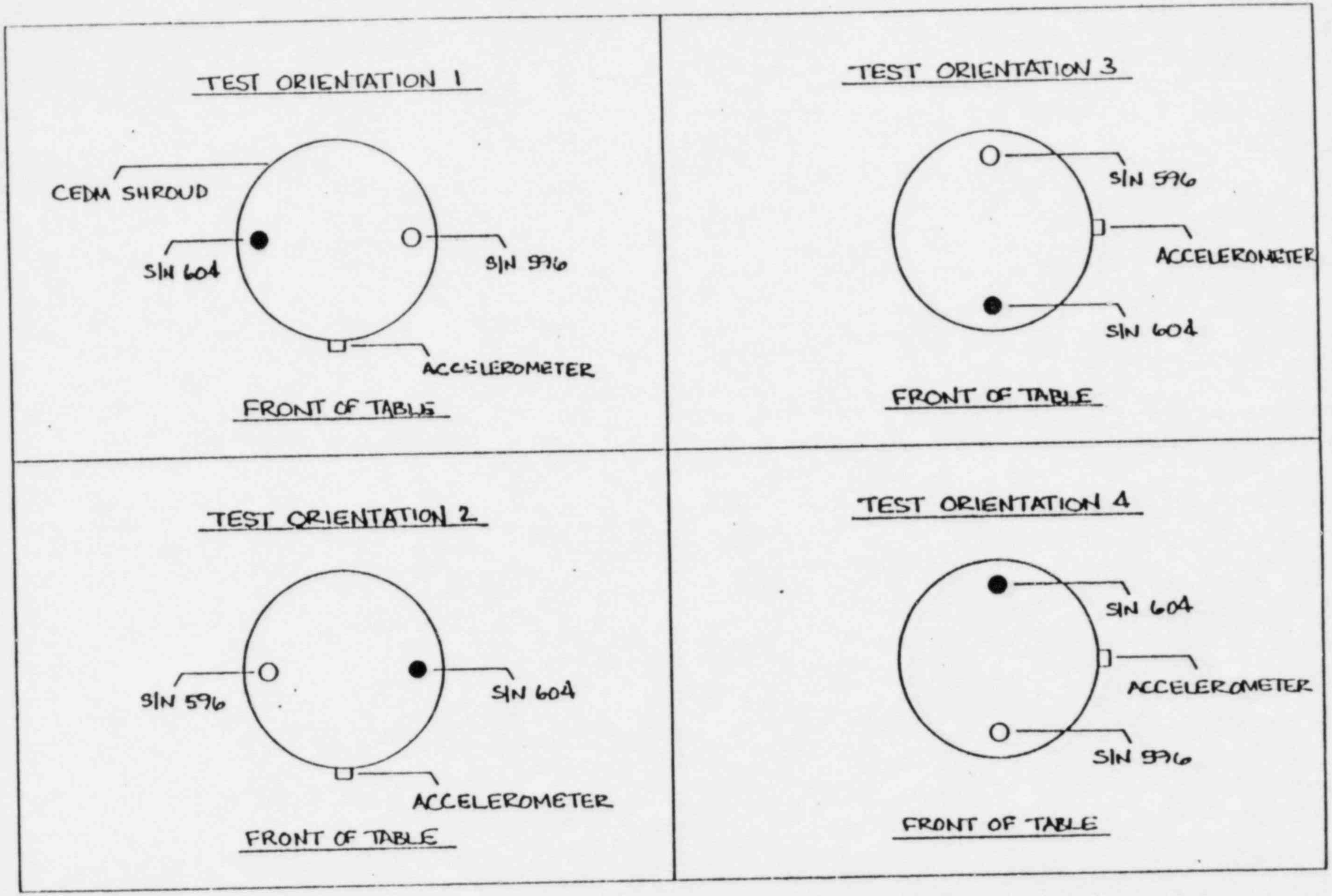


FIGURE 16

POSITION OF TEST SPECIMENS DURING TEST ORIENTATIONS 1 THROUGH 4 - TOP VIEW

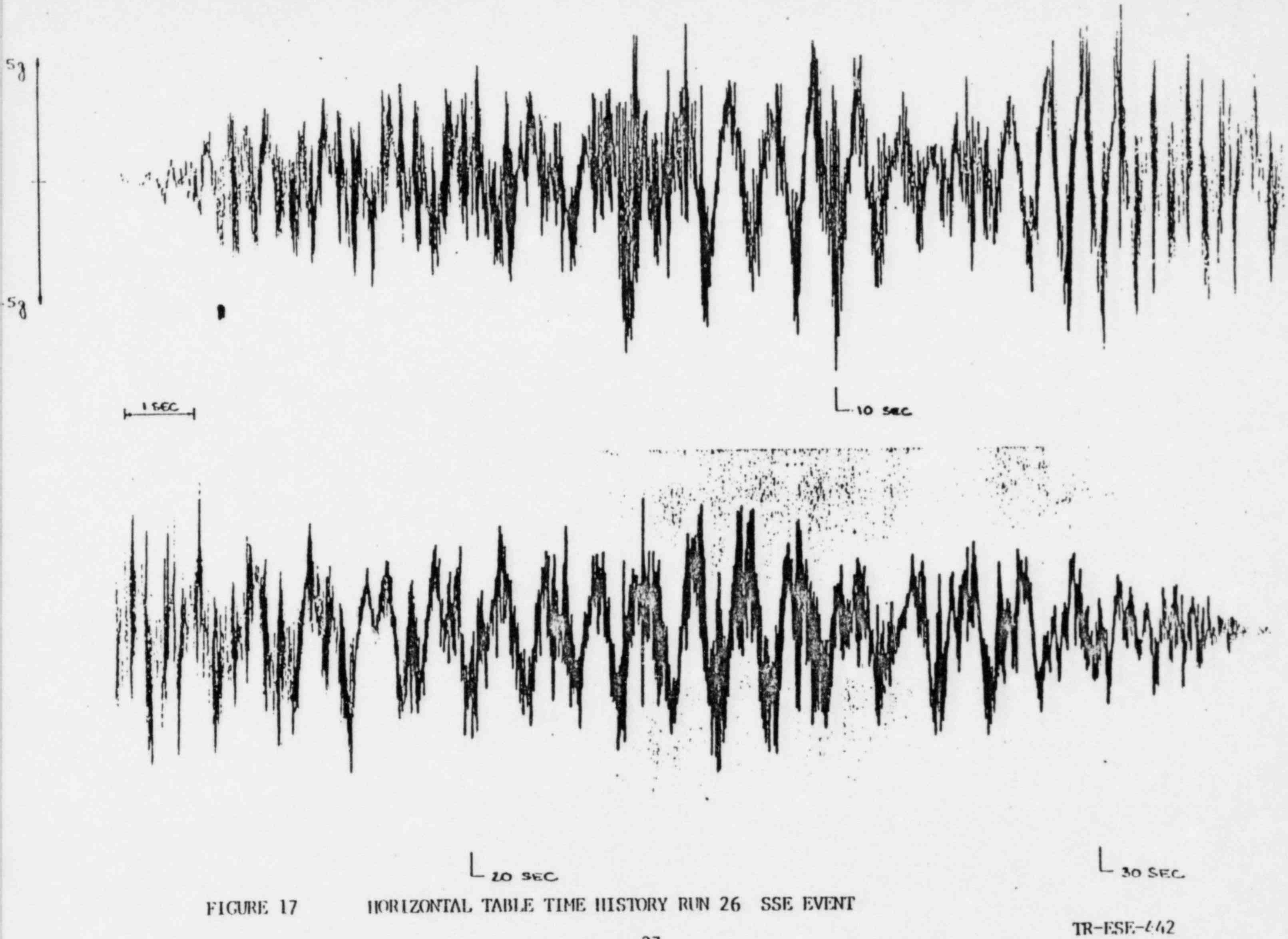


FIGURE 17 HORIZONTAL TABLE TIME HISTORY RUN 26 SSE EVENT

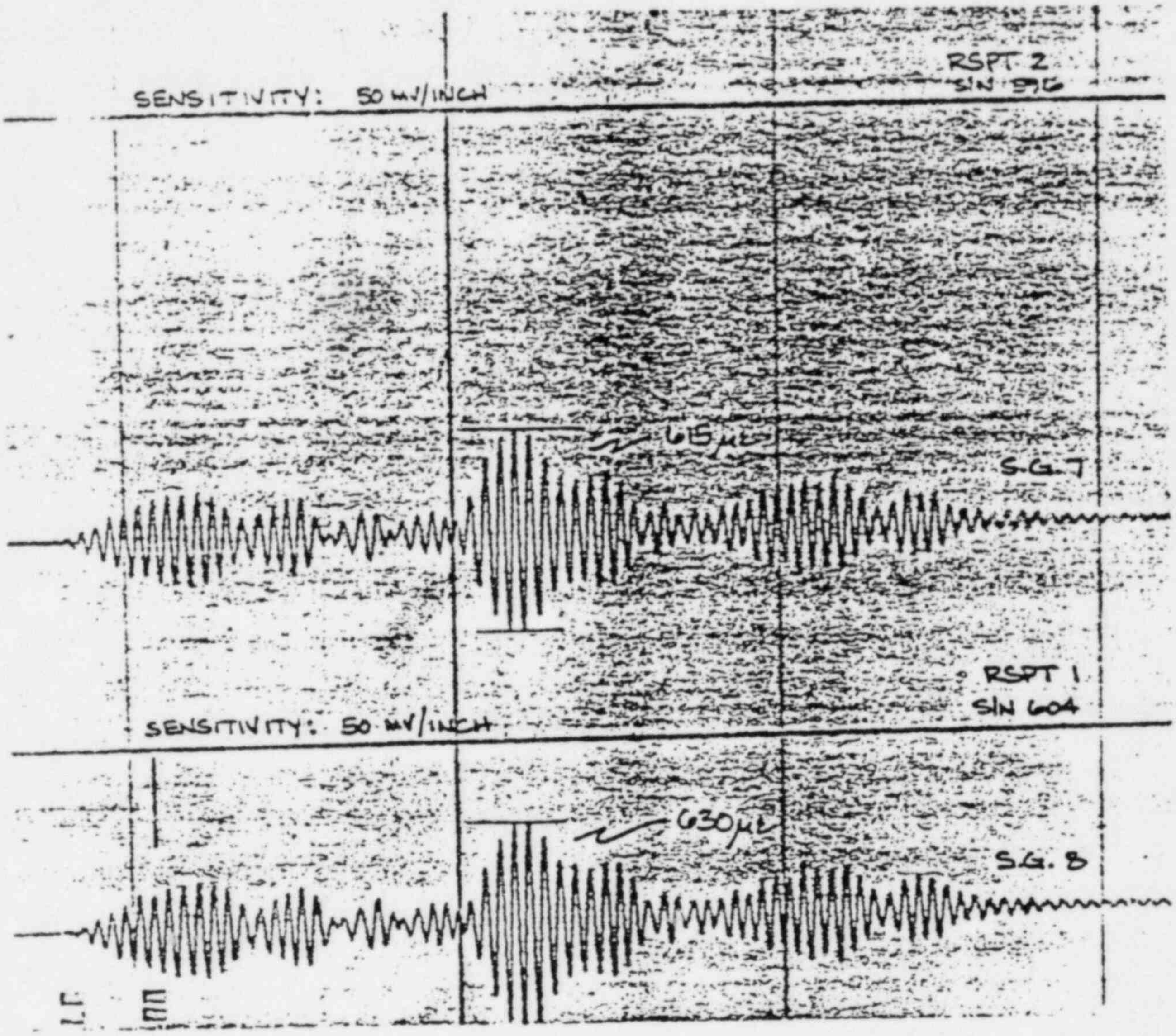


FIGURE 18

STRAIN AND RSPT TIME HISTORIES
OBE EVENT TEST ORIENTATION 3

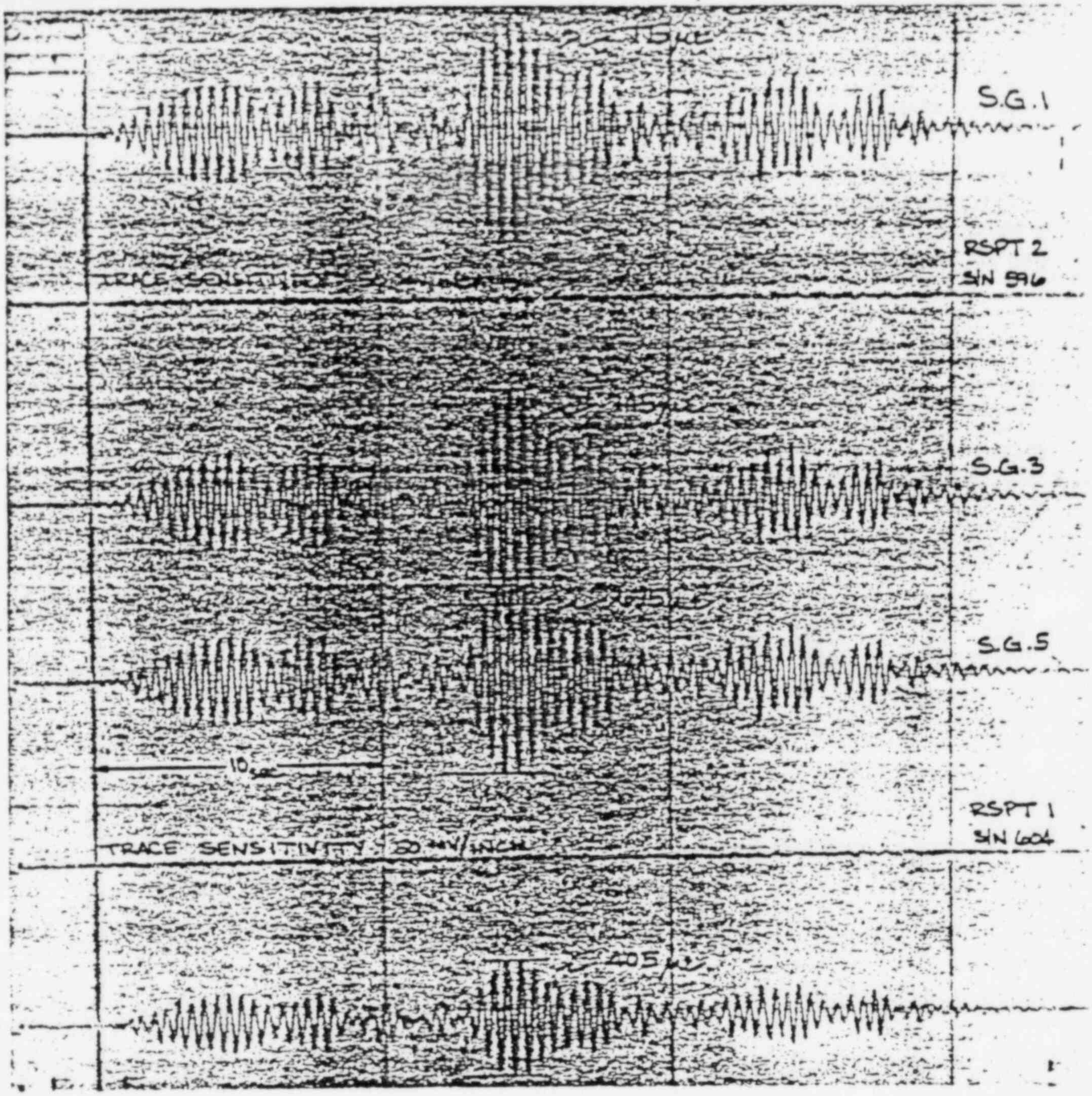


FIGURE 19

STRAIN AND RSPT TIME HISTORIES
SSE EVENT TEST ORIENTATION 1

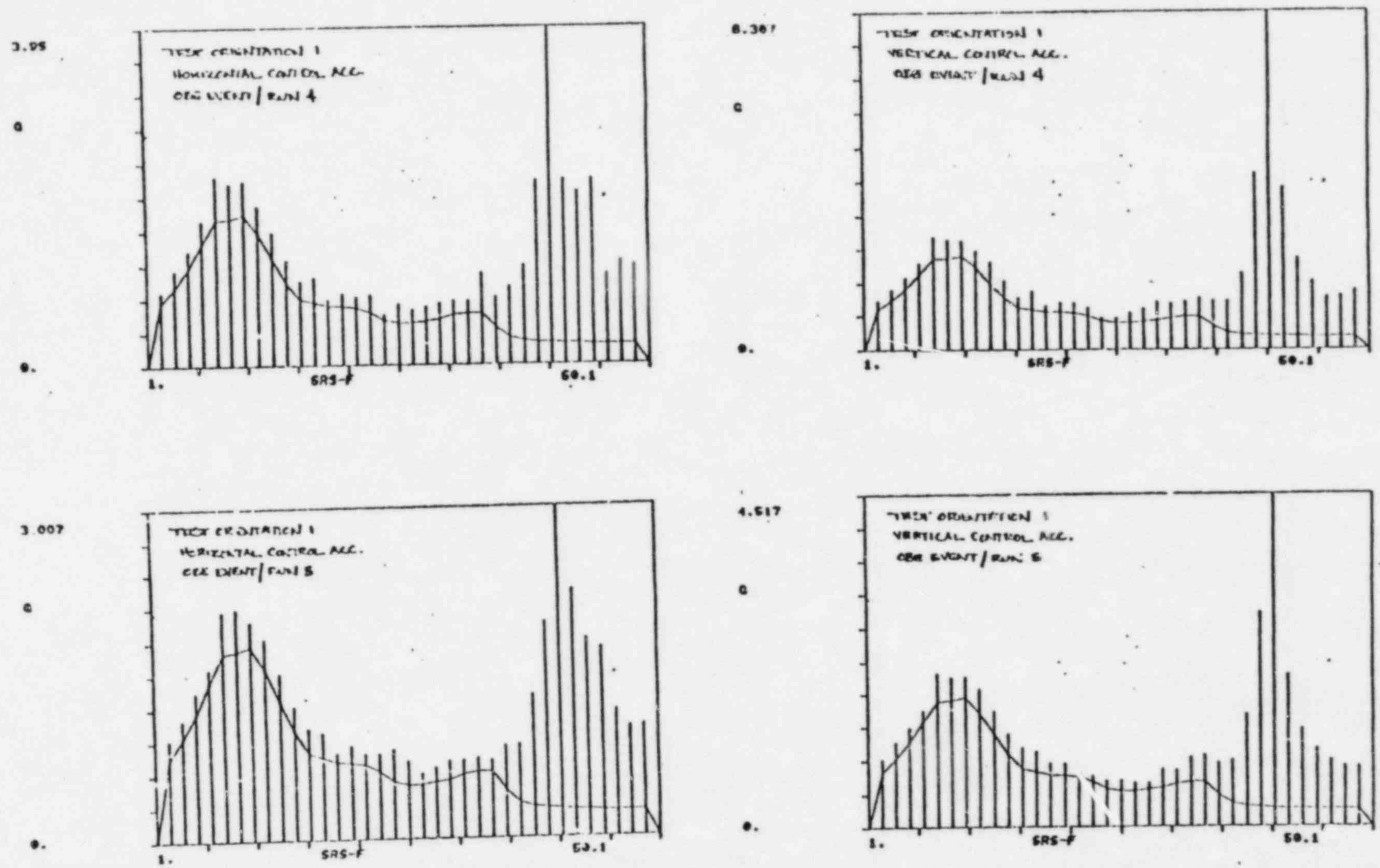


FIGURE 20A HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA - OBE EVENT
TEST ORIENTATION 1 - RUN NOS. 4 & 5

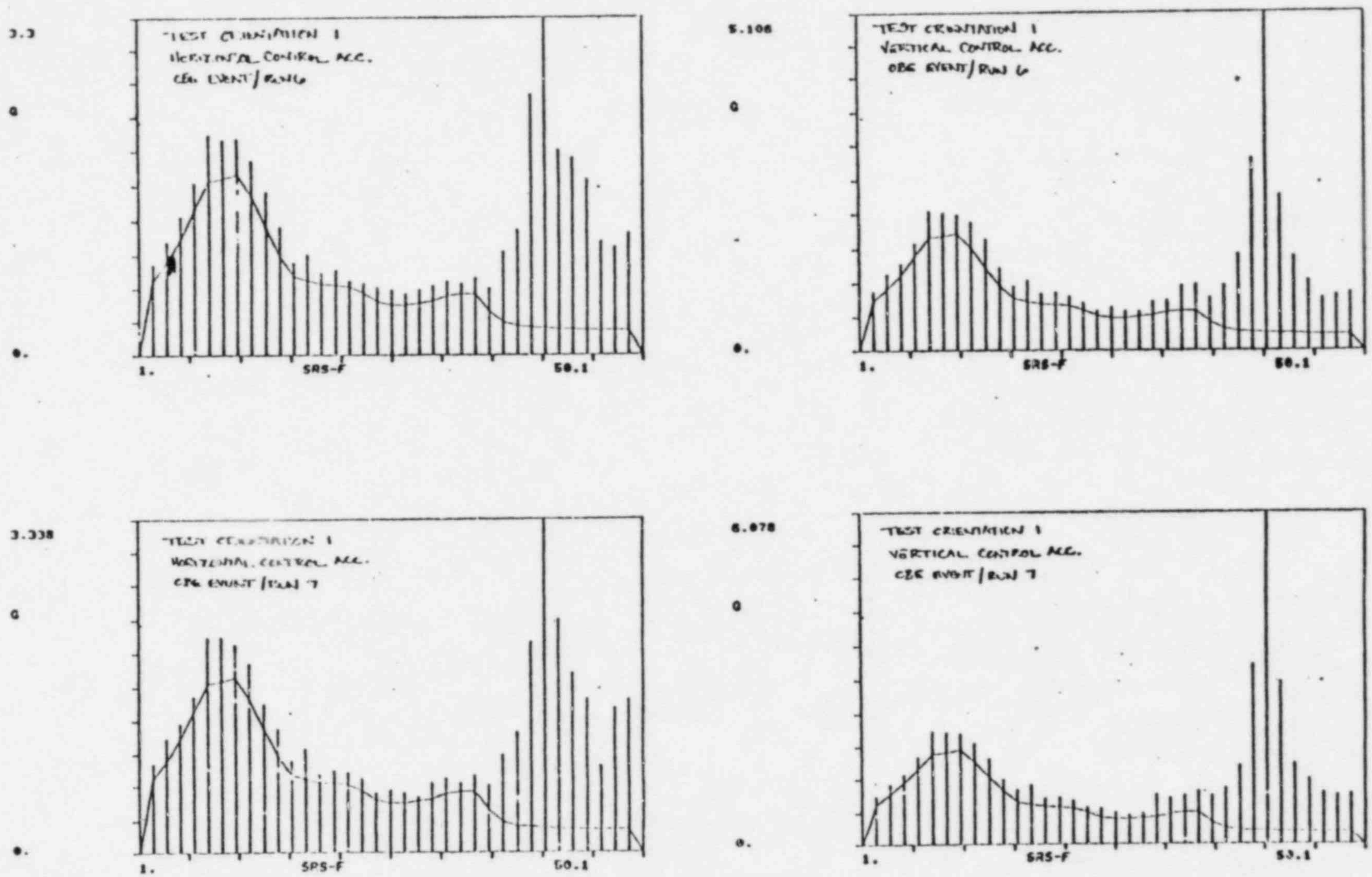


FIGURE 20B HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA - OBE EVENT
TEST ORIENTATION 1 - RUN NOS. 6 & 7

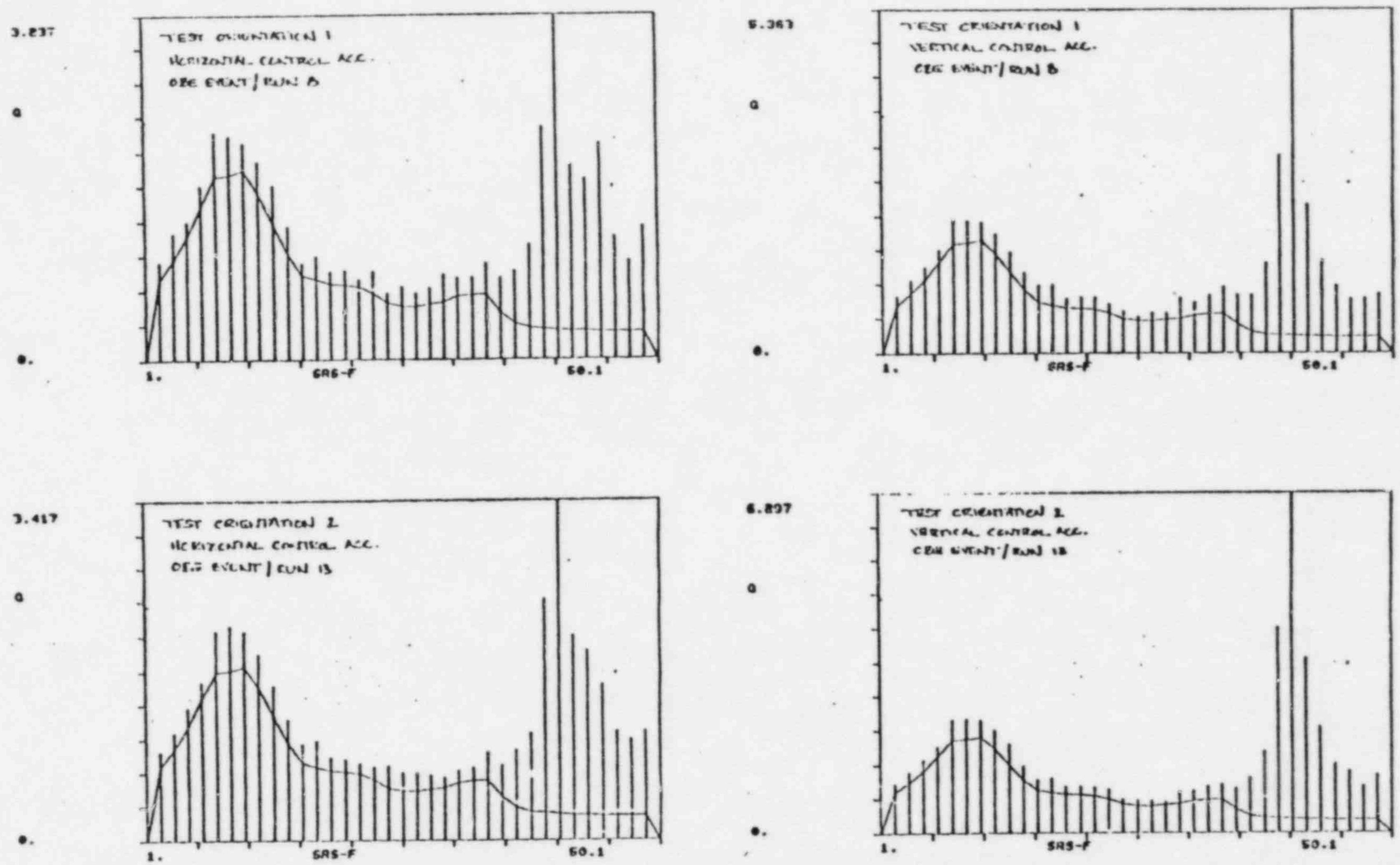


FIGURE 20C HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA - OBE EVENT
TEST ORIENTATION 1 - RUN NO. 8, TEST ORIENTATION 2 - RUN NO. 13

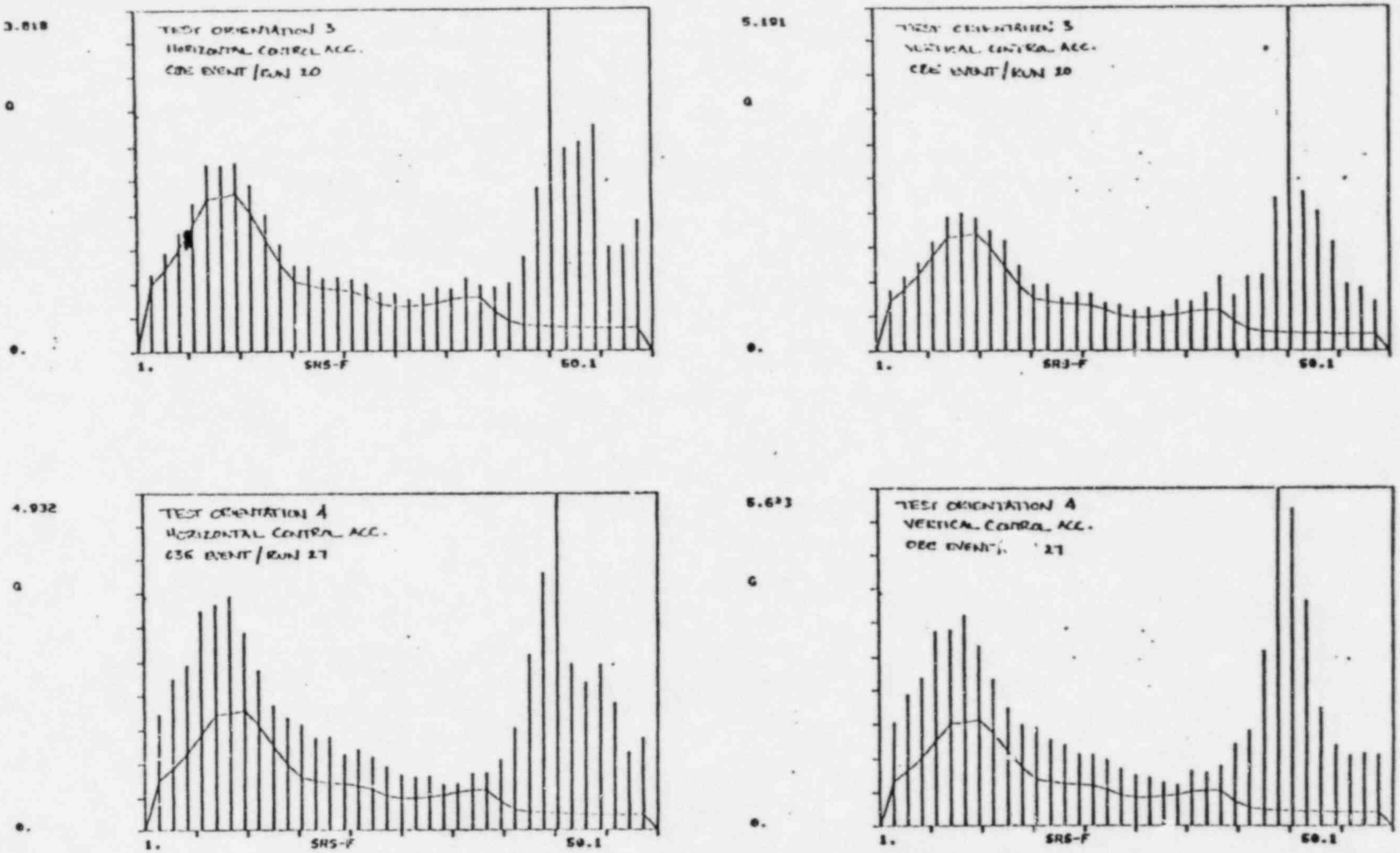


FIGURE 20D HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA - OBE EVENT
TEST ORIENTATION 3 - RUN NO. 20, TEST ORIENTATION 4 - RUN NO. 27

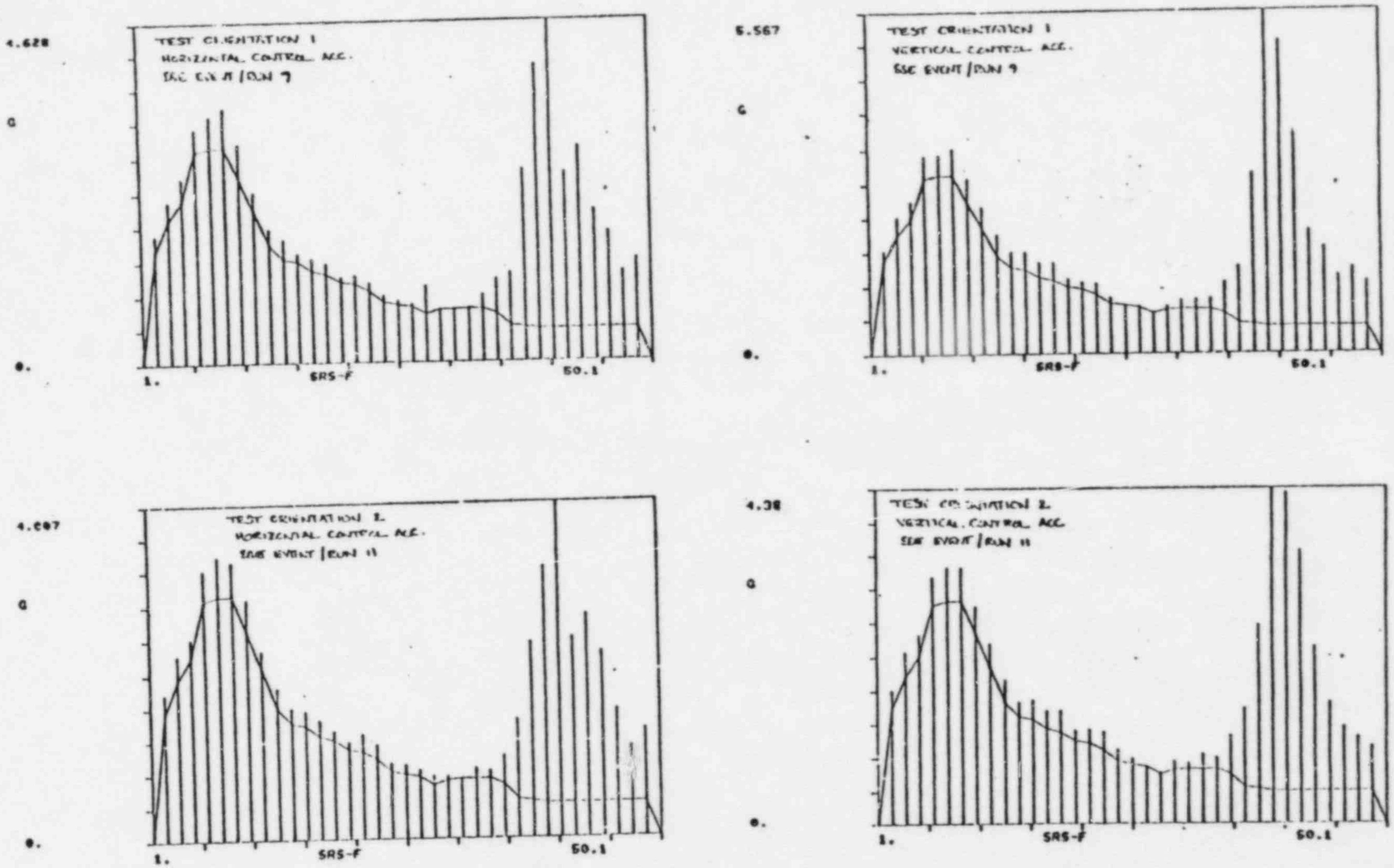


FIGURE 21A HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA SSE EVENT
TEST ORIENTATION 1 - RUN NO. 9, TEST ORIENTATION 2 - RUN NO. 11

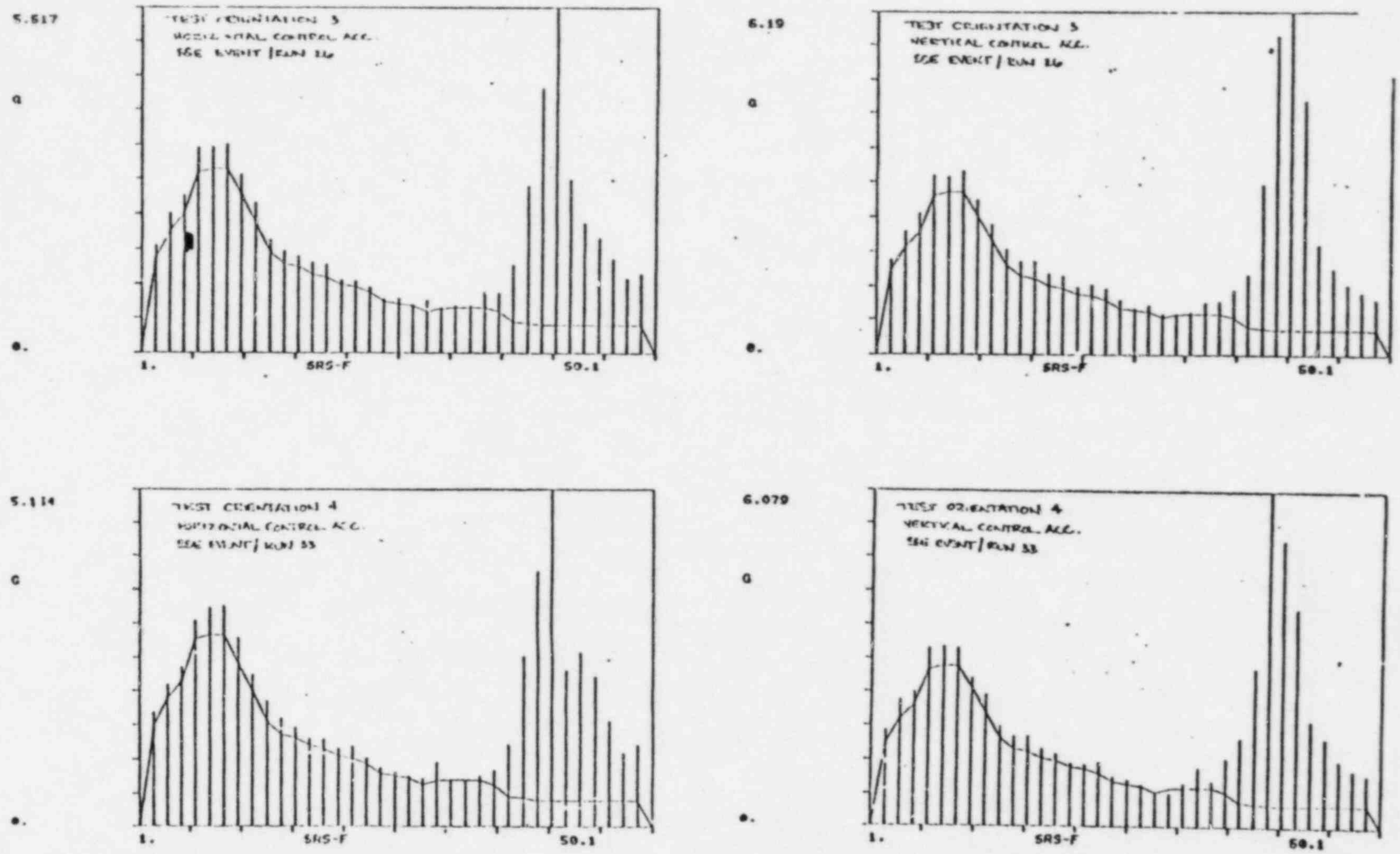


FIGURE 21B HORIZONTAL AND VERTICAL TEST RESPONSE SPECTRA SSE EVENT
TEST ORIENTATION 3 - RUN NO. 26, TEST ORIENTATION 4 _ RUN NO. 33

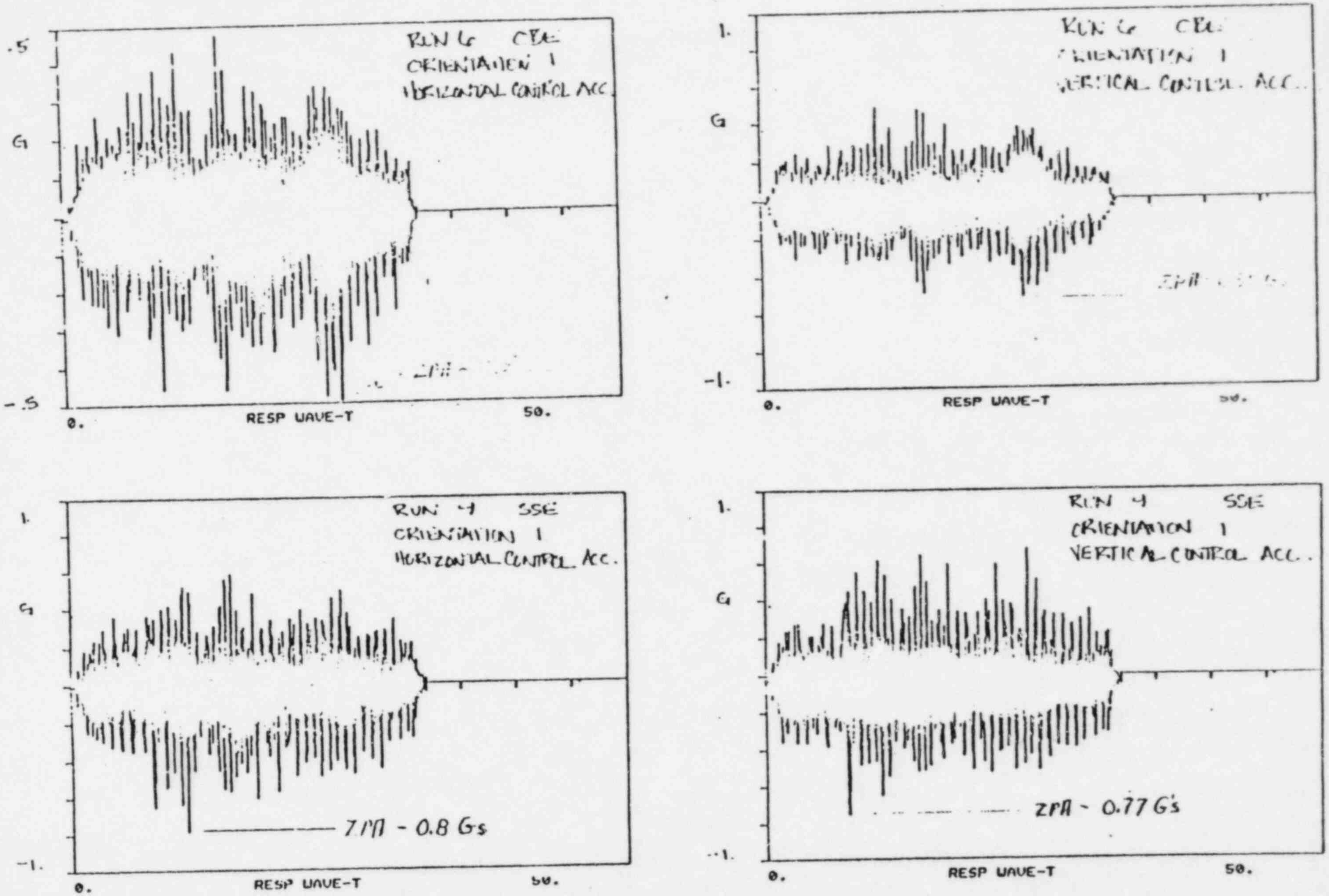


FIGURE 22 HORIZONTAL AND VERTICAL TABLE TIME HISTORIES, OBE AND SSE EVENT TEST ORIENTATION 1

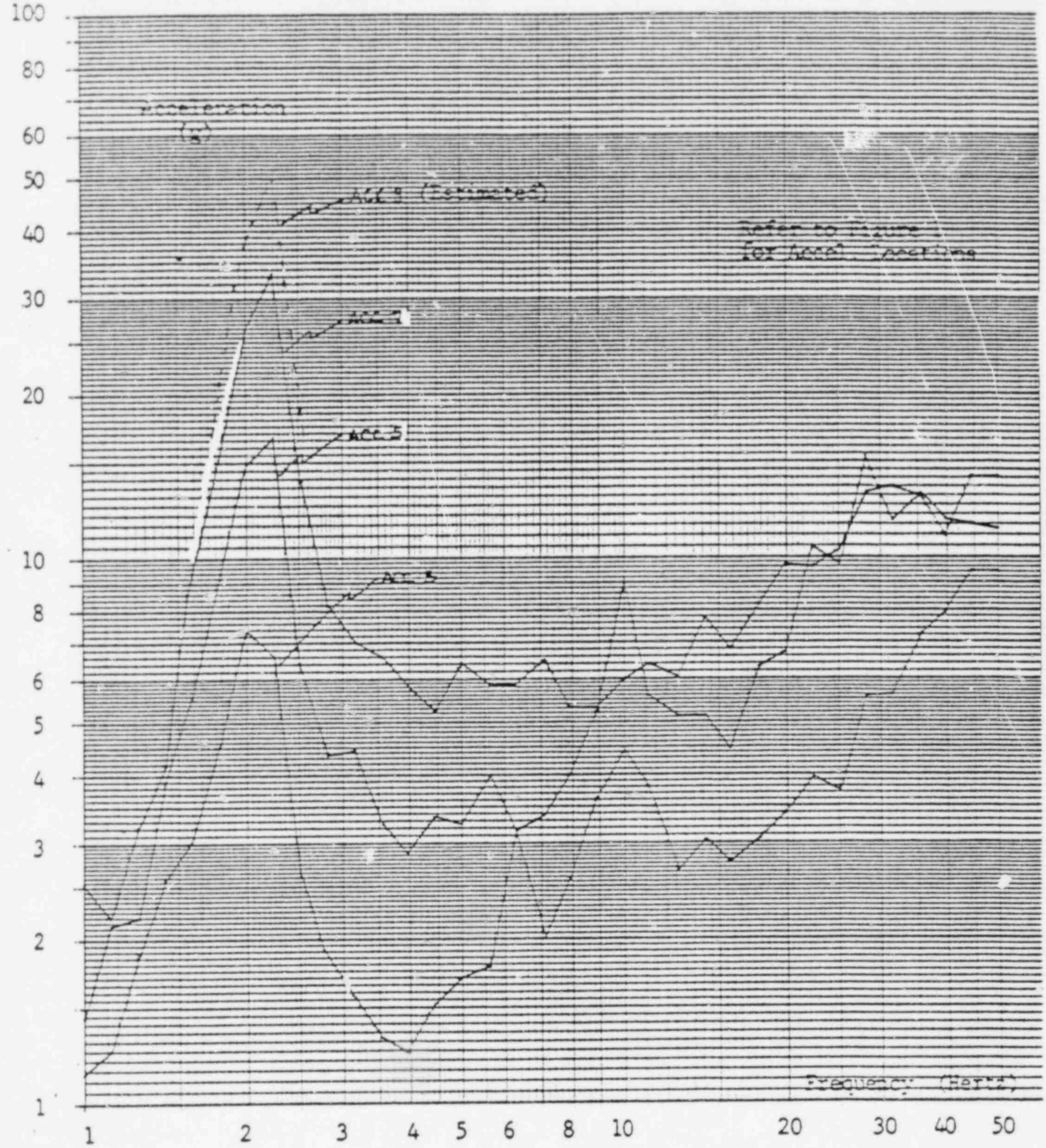


FIGURE 23

RESPONSE SPECTRA OF DIFFERENT SHROUD ELEVATIONS
OBE EVENT ORIENTATION 1 2% DAMPING

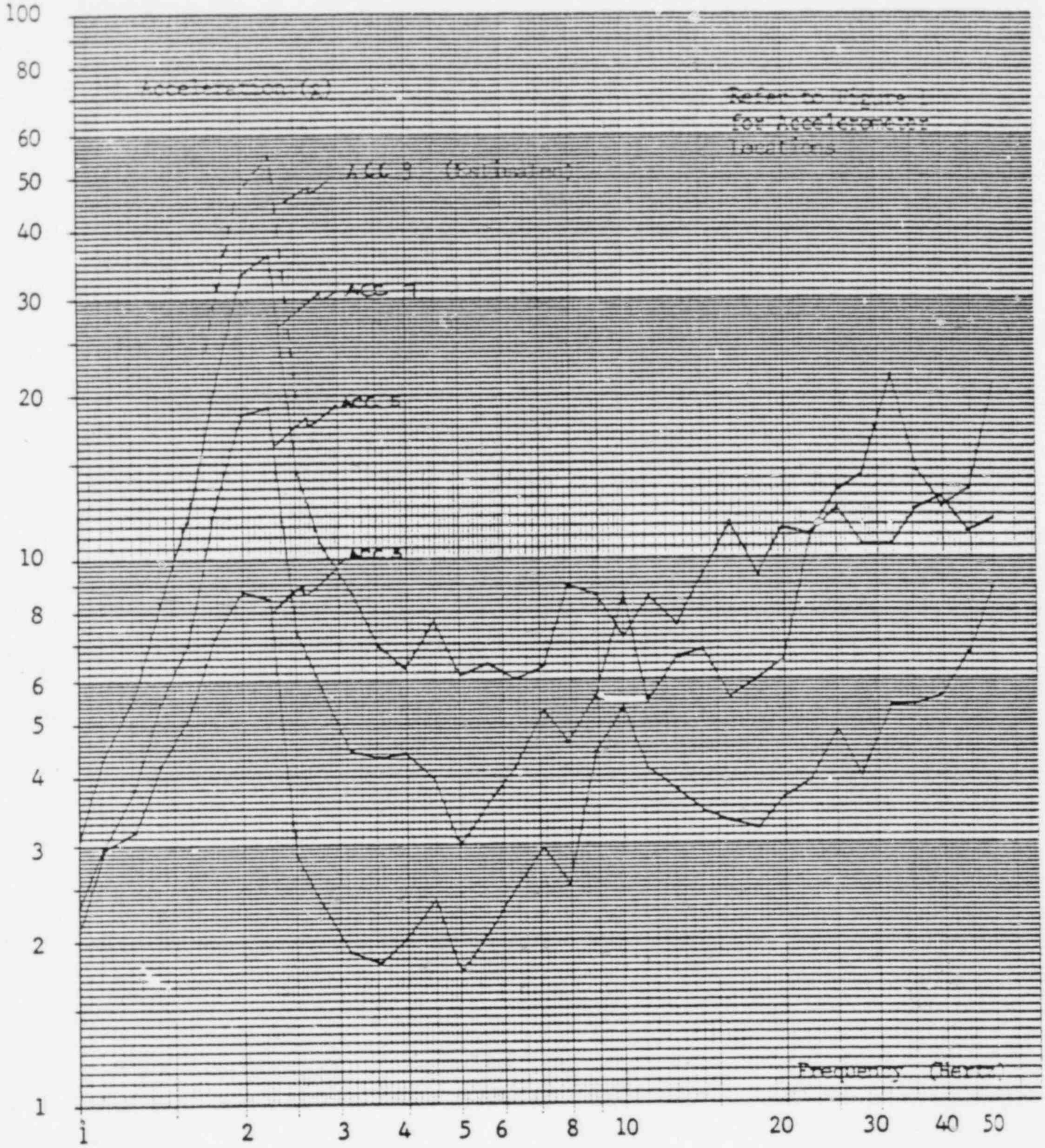


FIGURE 24

RESPONSE SPECTRA AT DIFFERENT SHROUD ELEVATIONS
SSE EVENT ORIENTATION 1 2% DAMPING

APPENDIX C

RESULTS: STATIC LOAD DEFLECTION TESTS AND FIRST MODE DYNAMIC TEST

Static Deflection Tests

Using a pull wire arrangement (connected to the CEDM top), the CEDM was deflected incrementally up to 5 inch total displacement. The deflection at the CEDM top was measured by an LVDT with ± 5 inch travel. The strain gauges (Nos. 7 and 8) were connected to a balance box and measured by a digital readout unit. The results from the static load deflection tests are summarized on page C-3. A linear deflection characteristic was observed with a strain to deflection ratio of about 111 με/in, whereby the strain was measured 4 inches above the base plate and the deflection at the CEDM top.

First Mode Dynamic Test

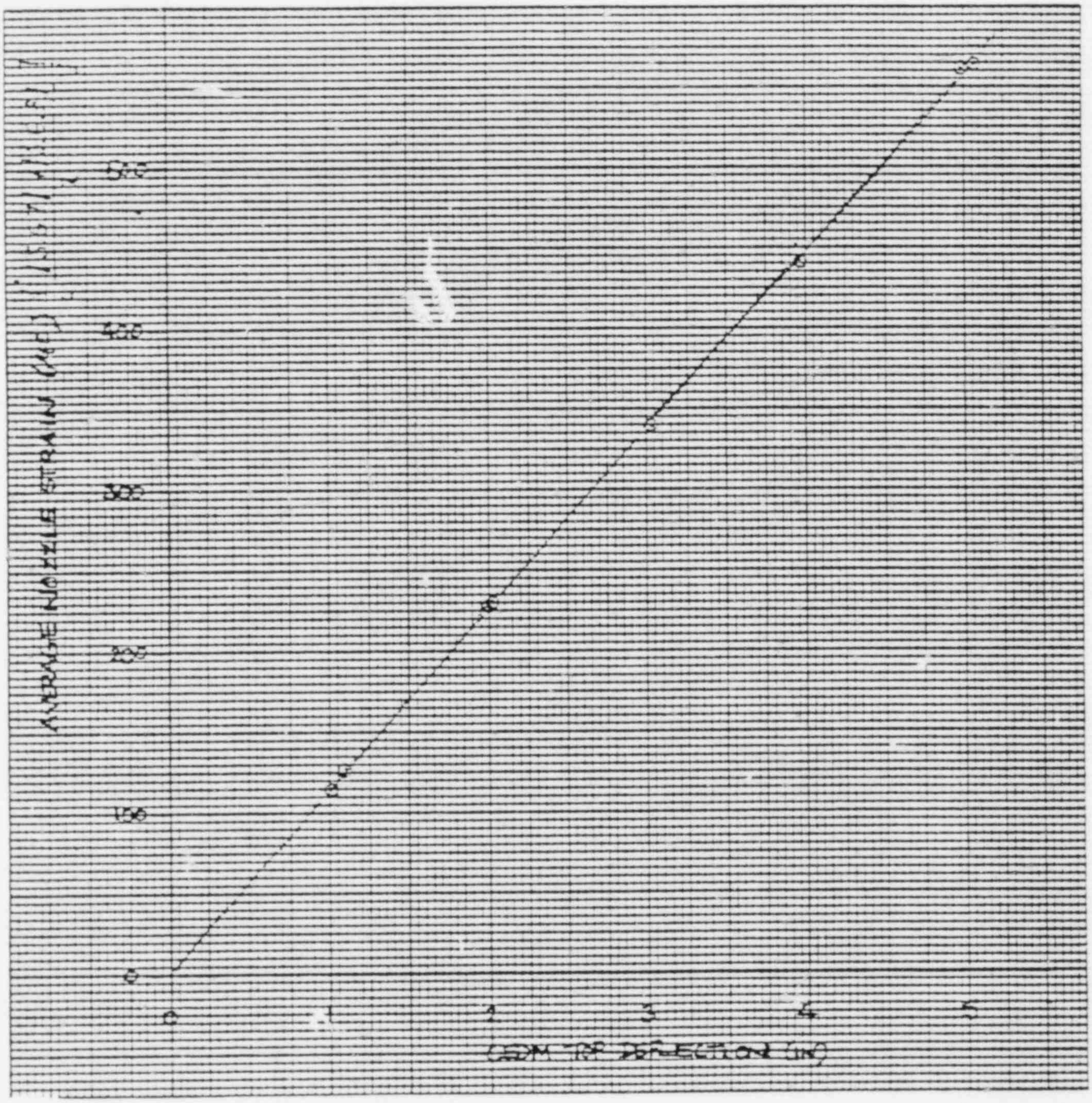
Strain gauges 7 and 8 were connected over two dynamic signal conditioning units (same as described in main report) to the visicorder readout device. The 5" stroke LVDT was displayed on a third visicorder channel. The CEDM was set into vibratory motion by exciting it manually above the coilstack. The resulting CEDM top motions, as well as the nozzle strain levels were then recorded on calibrated visicorder traces and converted into engineering units. The figure on page C-4 shows a typical visicorder trace and an average nozzle strain of about 240 με per 2.41 inch top deflection (or 100 με/in.) is observed. This value is slightly higher than those recorded for strain gauges 1 through 4 of the shaker table tests. The differences may be explained by the fact that these two tests were run with the CEDM set-up in two different orientations and/or by some flexibility of the shaker table suspension system.

List of Test Equipment in addition to items listed in Table 7.

LVDT Schaevitz Model M/N 5000 HPD, S/N 192, Calibrated 1/16/80.

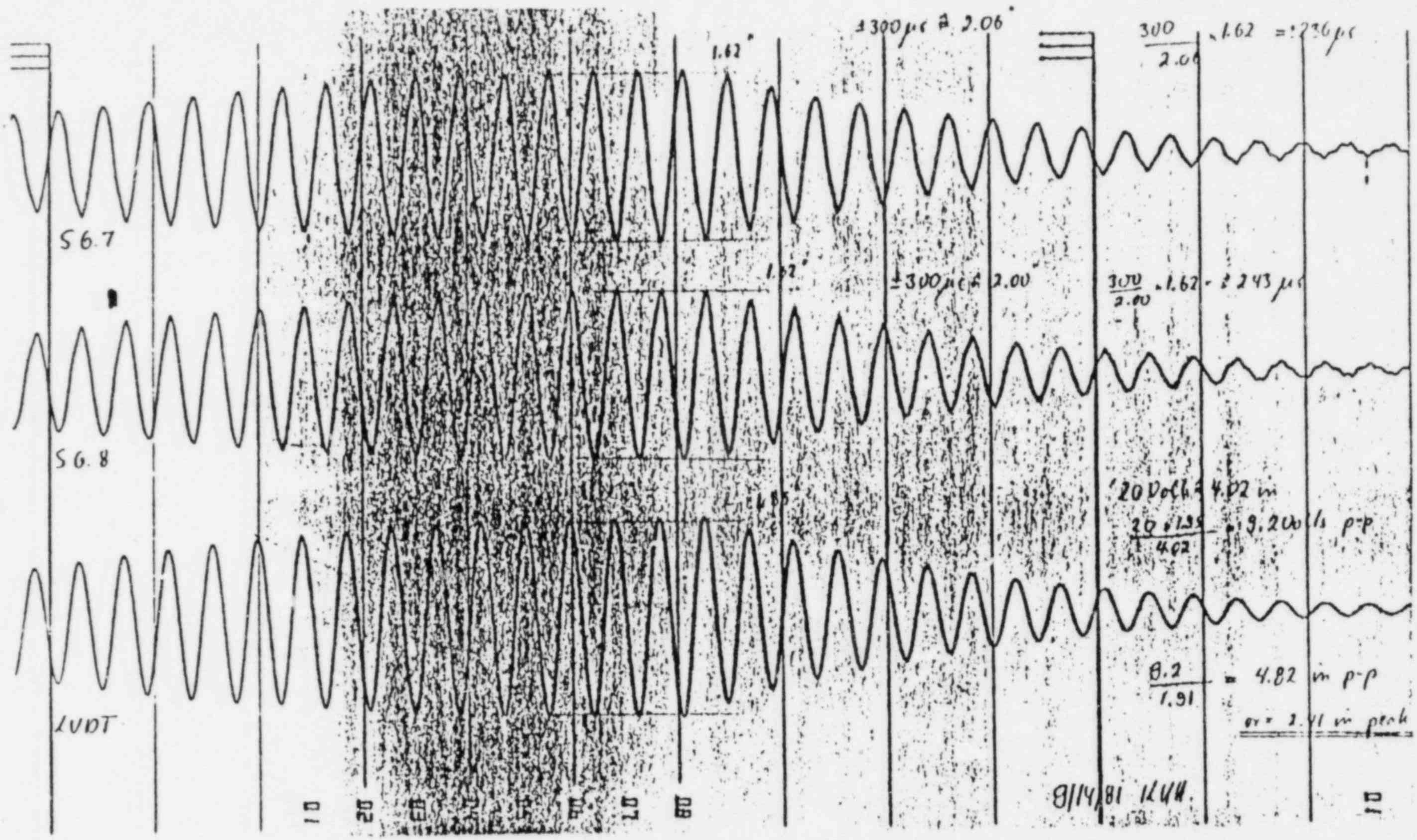
Digital Voltmeter MM200, C-E EL-259, Calibrated 2/10/81.

Strain Read-Out Unit Vishay VE-20A, S/N 25026, Performance Check 9/81.



STATIC DEFLECTION TEST

NOZZLE STRAIN (4" ABOVE BASE PLATE)
VERSUS CEDM TOP DEFLECTION



STRAIN GAUGE AND CEDM TOP DISPLACEMENT TIME HISTORY TRACES

NSSS-ICE

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
9403341 (P.O.) 9270-ICE-0005 Rev.01 (Spec.)	See attachment A1	NSSS-ICE-5 NSSS-ICE-5a thru 5h	Equipment has been qualified according to vendor (Westinghouse). Proprietary reports will be released to LP&L pending resolution of proprietary agreement between Westinghouse and LP&L. (See C-CE-7987 of 10/4/82)	Equipment installed
same P.O. and Spec. as above	See attachment A2	NSSS-ICE-9-1 NSSS-ICE-9-2	Original seismic test (Westingboue # EL991) not approved-_Westinghouse resubmitted with new test report (#EL1348) C-E technical review completed but adminsitrative work not completed. QTR-1010 and QTR-1008 should replace EL991 as the applicable qualification references for the Veri-Trak Recorders. EL1348 is contained in QTR-1010. Retesting by Westinghouse is required. Testing completion is scheduled for May 1, 1983.	Equipment installed.

NSSS-
Plant Engineering (PE)

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
910204 9270-PE 704 Rev 04	BM 307 (CE Tag) Fisher 3" valve	NSSS-PE-36 Rev 1	Oct. 30, 1982	
9102040 9270-PE 704 Rev. 04	CH 210 Y Fisher 1" valve	NSSS-PE-26 Rev 1	Oct. 30, 1982	
9102040 9270-PE 704, Rev. 04	CH 512 Fisher 3" Valve	NSSS-PE-27 Rev 1	Oct. 30, 1982	
9204018 9270-PE 404 Rev. 2	Fuel Pool Pump	NSSS-PE-38	Jan. 1, 1983	
Not Available	3" "Y" Type Strainer	NSSS-PE-16	Oct. 30, 1982	

ATTACHMENT 2
Pg 2 of 2

TAPE DATA LOG SHEET

TEST AKPP RSPT SEIS. QUAL

DATE 7/31/81

RECORDED BY S.K

LOG SHEET NO. 02

HOOKUP SHEET NO.

RECORD SPEED 3 3/4

RECORD BAND WB1

REEL NO.	RUN NO.	FOOTAGE	ATTENUATOR/AMP. SETTING 1	2	3	4	5	6	7	COMMENTS
S-01	~~[illegible]~~	—	H.C	V.C	Acc 9	Acc 7	Acc 5	Acc 3	Trigger	~~OBE 2 2d Run~~ ~~ORT 2~~
	—	—	10V	10V	10V	10V	10V	10V	10V	INPUT ATTEN
	14	298								OBE 2 2d RUN ORT. 2
	15	319								ORT 2 OBE RUN 3
	16	335								ORT 2 OBE RUN 4
	17	354								ORT 2 OBE RUN 5
8/5/81	~~[illegible]~~	INPUTS →	HC	VC	SG 7	SG 8	RSPT 1	RSPT 2	TRGGR	
		ATTEN →	10v	10v	1v	1v	0.2	0.2	10v	
	18	373								F.S. CAL CH 1, 2, 3, 4
	19	390								ORIENTATION 3 OBE 1 NG ABORT
	20	412								ORIENT. 3 OBE 1
	21	431								ORIENT 3 OBE 2 LOOSE CABLE
	22	448								ORIENT 3 OBE 3
	23	466								ORIENT 3 OBE 4

TAPE DATA LOG SHEET

TEST ANPP ESPT SEISMIC QUAL.
DATE 8/5/81
RECORDED BY ETN

LOG SHEET NO. 53
HOOKUP SHEET NO.
RECORD SPEED 3 3/4
RECORD BAND WB I

REEL NO.	RUN NO.	FOOTAGE	ATTENUATOR/AMP. SETTING 1	2	3	4	5	6	7	COMMENTS
8/5/81		—								
		—								~~ORIENT 3 OBE 5~~
S-01	24	484								ORIENT 3 OBE 5
	25	500								ORIENT 3 OBE 6
	26	517								ORIENT 3 SSE
	27	533								ORIENT 4 OBE 1
	28	549								ORIENT 4 OBE 2
	29	567		NG - MISSED DATA.						ORIENT 4 OBE 3
	30	571								ORIENT 4 OBE 4
	31	587								ORIENT 4 OBE 5
	32	604								ORIENT 4 OBE 6
	33	620								ORIENT 4 SSE
	34	637								

Test ID: M01S02 Data Sheet Sine Sweep Test Date: 7/29/81

Test Description: ANPP CEDM 1st Mode Sweeps .02g Observer: KUH. HM

Run No.	DVC System Channel A	B	C	D	Amplifier A	B	C	D	Transducer Sens. A	B	C	D	Comments
1	H.C.	Acc 9 ✓	Acc 7 ✓	Acc 5 ✓	H/C	14	15	16	1.	61.2	70.5	70.5	
2	"	Acc 8 ✓	Acc 6 ✓	Acc 3 ✓	H/C	"	"	"	1.0	69.5	70.5	70.1	
3	"	Acc 1 ✓	Acc 2	Acc 4	H/C	"	"	"	1.0	89.	85.6	70.8	
4													
5													
6													
7													
8													
9													

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17
Full Scale Range Setting	1		300 SG. 1	300 2	300 3	300 5	300 6	100 10	~~4~~	3	3	3	

1/13/78 VCE

Test ID: M01S04 **Data Sheet Sine Sweep Test** Date: 7/29/81

Test Description: ANPP CE011 1st Mode .04g Observer: Skip Kraus / K.H.B.

Run No.	DVC System Channel A	DVC System Channel B	DVC System Channel C	DVC System Channel D	Amplifier A	Amplifier B	Amplifier C	Amplifier D	Transducer Sens. A	Transducer Sens. B	Transducer Sens. C	Transducer Sens. D	Comments
✓1	H.C	Acc 1	Acc 2	Acc 4	H/C	14	15	16	1	89	83	70.0	
✓2	H.C.	Acc 9	Acc 7	Acc 5	"	"	"	"	1	61.2	71.5	70.5	
✓3	H.C.	Acc 8	Acc 6	Acc 3	"	"	"	"	1	69.5	70.5	70.1	
4													
5													
6													
7													
8													
9													

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17	
Full Scale Range in Unig										–				

1/17/78

Test ID: M01506 **Data Sheet Sine Sweep Test** Date: 7/29/81

Test Description: ANPP CERM 1ST MODE .06 g. Observer: S. KRAUSE

Run No.	DVC System Channel A	B	C	D	Amplifier A	B	C	D	Transducer Sens. A	B	C	D	Comments
1	H.C	Acc 8	Acc 6	Acc 3	H/C	14	15	16	1	69.5	70.5	70.1	
2	H.C	Acc 1	Acc 2	Acc 4	H/C	"	"	"	1	89.0	89.6	70.8	
3	H.C	Acc 9	Acc 7	Acc 5	H/C	"	"	"	1	61.2	71.5	70.5	
4													
5													
6													
7													
8													
9													

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17
Full Scale Range Setting	1G		300	←			→	300		3G	3G	3G	

Test ID: M01S0XX Data Sheet Sine Sweep Test Date: 7/29/81

Test Description: ANPP CERM 1ST MODE Observer: S. Krause

Run No.	DVC System Channel A	DVC System Channel B	DVC System Channel C	DVC System Channel D	Amplifier A	Amplifier B	Amplifier C	Amplifier D	Transducer Sens. A	Transducer Sens. B	Transducer Sens. C	Transducer Sens. D	Comments
1✓	H.C	Acc 9	Acc 7	Acc 5	H/C	14	15	16	1	61.2	71.5	70.5	M01S08
2✓		Acc 9	Acc 7	Acc 5		"	"	"		"	"	"	M01S16
3✓		Acc 9	Acc 7	Acc 5									M01S12
4													~~M23S05~~
5													
6													
7													
8													
9													

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17	
Full Scale Range Sr. Unig	1		1000με ←				→	1000 με		10G	10G	10G		

2/13/79 VHF

Test ID: M23S XX **Data Sheet Sine Sweep Test** Date: 7/29/81

Test Description: ANPP CEDM 2ND MODE Observer: ______

Run No.	DVC System Channel A	B	C	D	Amplifier A	B	C	D	Transducer Sens. A	B	C	D	Comments
✓1	H.C.	Acc 9	Acc 7	Acc 5	H/C	14	15	16	1	61.2	71.5	70.5	M23S05.
✓2	H.C.	8	6	3	"	"	"	"					
✓3	H.C	1	2	4	"	"	"	"		89.0	89.6	70.8	
4	H.C	1	2	4	"	"	"	"		89.0	89.6	70.8	M23S10
5	H.C	9	7	5	"	"	"	"		61.2	71.5	70.5	
6	H.C	8	6	3	"	"	"	"		69.5	70.5	70.1	
7	H.C	8	6	3	"	"	"	"		69.5	70.5	70.1	M23S15
8	H.C	1	2	4	"	"	"	"		89.0	89.6	70.8	
9	H.C	9	7	5	"	"	"	"		61.2	71.5	70.5	

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17	
Full Scale Range Gr. Harig										10g	10g	10g		

[illegible]

Test ID: M28SXX   Data Sheet Sine Sweep Test   Date: 7/29/81

Test Description: ANPP CEDM 2+3RD MODE   Observer: ______

Run No.	DUC System Channel A	B	C	D	Amplifier A	B	C	D	Transducer Sens. A	B	C	D	Comments
1	H/C	Acc 9	Acc 7	Acc 3	H/C	14	15	16	1	61.2	71.5	70.1	M23520
2	H/C	↓ 9	↓ 7	↓ 3	H/C	14	15	16	1	61.2	71.5	70.1	M23525
3													
4													
5													
6													
7													
8													
9													

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17
Full Scale Range Setting													

2/23/78 KNE

Test ID: RSSN05 **Data Sheet Sine Sweep Test** Date: 7/28/29/81

Test Description: Sine Sweep .05 g Input. Observer: W.K/M.M KKU

Run No.	DVC System Channel A	B	C	D	Amplifier A	B	C	D	Transducer Sen. A	B	C	D	Comments
1 ✓	H.IC	Acc 5	Acc 7	Acc 9	H.C.	14	15	16	1.0	70.5	71.5	61.2	
2 ✓		Acc 4	Acc 6	Acc 8	H.C.	"	"	"		70.8	70.5	69.5	Abuki 1
3 ✓		"	"	"	H.C	"	"	"					
4 ✓		ACC 1	ACC 2	ACC 3	H.C	"	"	"		89.00	89.63	70.1	
5 ✓		S.G. 1	S.G. 2	S.G. 3	H.C	1	2	3		72.5	72.5	72.5	INCORRECT SENSITIVITY SETTINGS RERUN. ABORT
6 2/3		S.G. 1	S.G. 2	S.G. 3	"	"	"	"		"	"	"	
7		S.G. 4	S.G. 5	S.G. 6	H.C					72.5	72.5	72.5	
8		S.G. 7	S.G. 8	S.G. 9	H.C					72.5	72.5	72.5	
9		Acc 4	Acc 5	Acc 6	H. C	~~70.8~~ 14	~~70.5~~ 15	~~70.5~~ 16		70.8	70.5	70.5	REPLACE ACC CABLE - 4

Amplifier No:	Control Horiz.	Control Vertical	1	2	3	4	5	6	13	14	15	16	17
Full Scale Range Setting	1 G									3G	3G	3G	

7/17/79 VEE

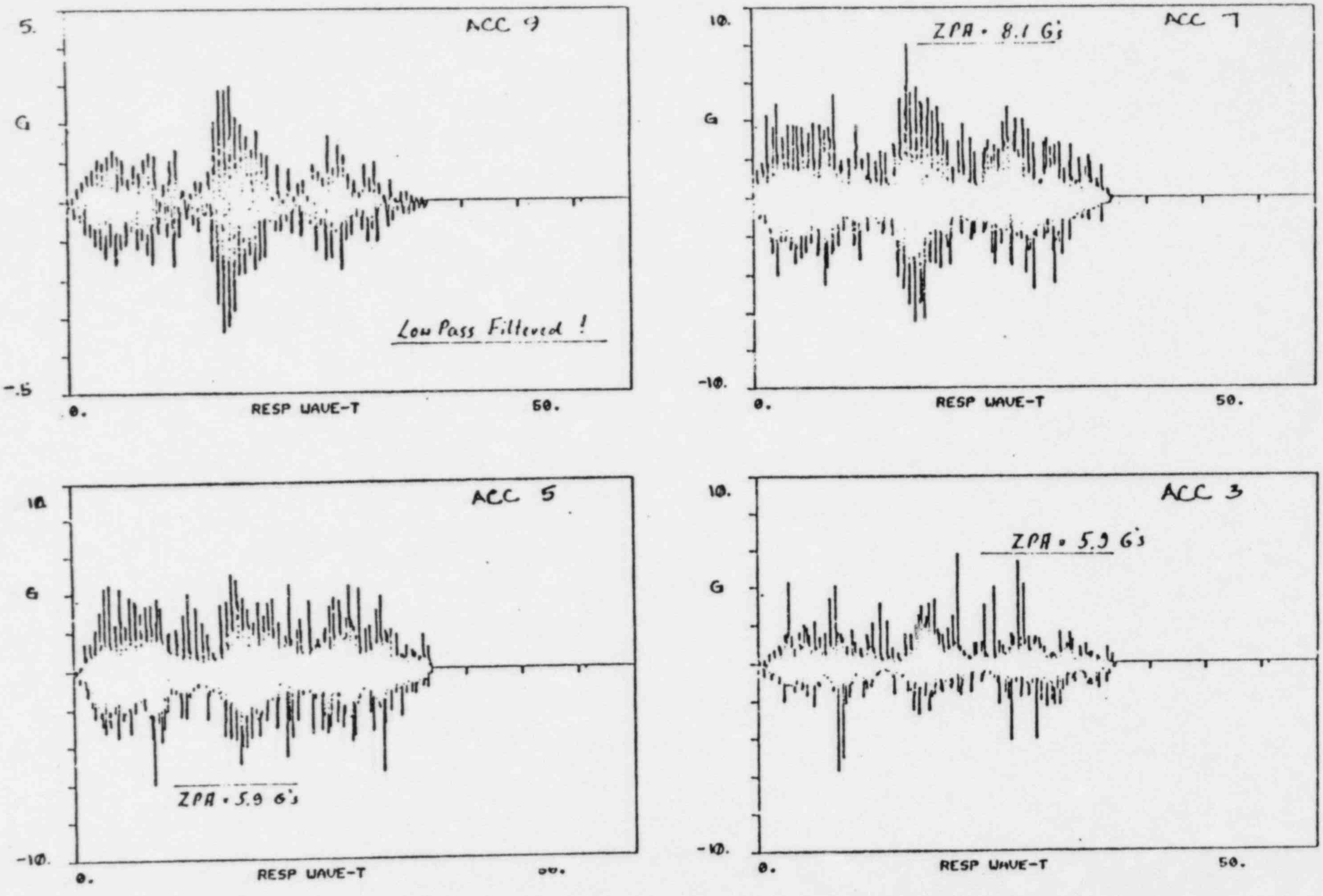


FIGURE 26 ACCELERATION TIME HISTORIES AT DIFFERENT SHROUD ELEVATIONS, SSE EVENT ORIENTATION 1

TABLE 1

SUMMARY OF RESULTS .02g EXCITATION SWEEPS

TEST FILE: RSSN02

MODAL STRAIN AMPLITUDES

		MODES			
		1	2	3	
STRAIN GAUGE (με)		2.3 Hz	~9 Hz	~12 Hz	
S.G. 10		93.51	10.11	48.09	
S.G. 9				36.55	
S.G. 6		141.7			
S.G. 5					
S.G. 4		186.07	9.16	18.89	
S.G. 3		164.31	9.16	18.32	
S.G. 2		171.76	10.31	18.32	
S.G. 1		174.62	10.31	18.89	
MODAL TRANSFER FUNCTIONS (g/g)					FIRST MODE DAMPING (%)
ACC 9		59.39	6.90	6.70	2.7
ACC 8		50.0	4.58	9.06	
ACC 7		39.79	2.19	12.40	2.6
ACC 6		33.87	.95	15.08	
ACC 5		23.38	2.19	15.46	2.4
ACC 4			3.05	13.36	
ACC 3		8.87	3.45	9.77	
ACC 2		6.32	3.07	6.86	
ACC 1		3.54	2.20	3.80	

TABLE 2

SUMMARY OF RESULTS .05g EXCITATION SWEEPS
TEST FILE: RSSN05

MODAL TRANSFER FUNCTION AMPLITUDES

MODE	ACC 1	ACC 2	ACC 3	ACC 4	ACC 5	ACC 6	ACC 7	ACC 8	ACC 9
1	2.8	4.6	7.0	—	17.4	25.5	30.1	38.8	43.3
2	2.9	4.9	5.3	—	4.8	.5	6.3	7.7	18.9
3	2.3	3.9	5.4	—	9.2	9.1	8.8	7.5	6.7

MODAL DAMPING VALUES

MODE	ACC 5	ACC 6	ACC 7	ACC 8	ACC 9	AVG.
1	2.54	2.69	2.54	2.65	2.61	2.61
2	3.86	—	2.76	4.04	3.39	3.51
3	1.95	2.11	2.51	-	-	2.19

MODAL STRAIN AMPLITUDES

MODE	S.G. 1	S.G. 2	S.G. 3	S.G. 4	S.G. 6	S.G. 9
1	360	367	347	377	293	61
2	37	43	37	40	—	—
3	23	23	23	23	—	25

TABLE 3

SUMMARY OF MODAL TRANSFER FUNCTIONS - SINE SWEEP TESTING

MODE	EXCITATION LEVEL (g)	ACC 1	ACC 2	ACC 3	ACC 4	ACC 5	ACC 6	ACC 7	ACC 8	ACC 9
1	.02	2.77	4.43	6.41	10.80	15.77	22.28	27.44	34.13	41.49
	.04	2.42	3.90	5.93	9.56	14.72	20.35	26.10	31.84	38.43
	.06	2.95	5.11	7.40	13.58	20.08	27.15	35.85	45.22	60.61
	.08					20.36		34.23		52.01
	.10					19.60		33.27		46.18
	.12					18.83		31.74		40.15
2	.05	2.87	4.33	5.0	4.04	2.31	1.25	3.81	8.10	11.35
	.10	3.44	5.48	6.53	5.69	3.72	.98	3.97	9.31	13.31
	.15	3.50	5.58	6.50	6.12	4.48	.86	4.52	9.29	15.16
	.20			5.77				3.81		12.88
	.25			5.66				3.37		11.73
3	.05	2.12	3.85	5.75	7.87	8.94	8.35	6.71	4.52	2.69
	.10	1.79	3.13	4.61	6.19	7.16	6.87	6.03	4.32	3.74
	.15	2.29	3.88	5.77	7.60	8.33	8.87	6.63	4.99	5.09
	.20			4.62				5.19		3.75
	.25			3.69				4.25		2.60

Note: The Transfer Functions are defined by the Ratio of Acceleration Levels of the monitored Accelerometer over the Horizontal Control Accelerometer.

TABLE 4

SUMMARY OF MODAL STRAIN LEVELS SINE SWEEP TESTING

MODE	EXCITATION LEVEL (g)	S.G. 1	S.G. 2	S.G. 3	S.G. 5	S.G. 6	S.G. 10
1	.02	132	136.5	127	117	101.7	76
	.04	236	241	228	212	183	149
	.06	472	492	460	427	366	283
	.08	640	660	600	560	480	350
	.10	790	810	740	690	580	420
	.12	910	920	860	790	660	480
2	.05	47	47	43	28	19	26
	.10	93	96	88	55	34	46
	.15	138	144	131	79	41	64
	.20	162	165	150	96	51	90
	.25	207	210	192	120	60	110
3	.05	29	29	26	15	9	69
	.10	42	44	40	27	15	121
	.15	74	75	70	43	21	203
	.20	87	90	81	48	27	240
	.25	96	99	84	51	27	230

Note: Strain values are listed in microinch/inch

TABLE 5

MODAL DAMPING PROPERTIES - SINE SWEEP TESTING

MODE	EXCITATION LEVEL (g)	ACC 1	ACC 2	ACC 3	ACC 4	ACC 5	ACC 6	ACC 7	ACC 8	ACC 9	AVERAGE
1	.02					3.15	3.05	3.10	3.05	3.12	3.09
	.04				2.93	2.80	2.94	2.73	2.72	2.77	2.82
	.06				2.32	2.32	2.38	2.14	2.07	1.97	2.20
	.08					2.43		2.41		2.34	2.39
	.10					2.32		2.48		2.74	2.51
	.12					2.52		2.48		3.14	2.71
2	.05	8.32	6.63	5.17	5.48	4.48			5.04		5.85
	.10										
	.15	4.93	4.82	5.09	4.86	5.05					4.95
	.20			5.96							5.96
	.25			5.65							5.65
3	.05		3.45	3.33	3.08	3.08	3.48				3.28
	.10		3.14	3.19	3.47	3.28	3.19	3.17			3.24
	.15	3.19		2.54	2.61	3.10	3.20	3.58			3.04
	.20			2.19							2.19
	.25			3.12							3.12

Damping values are listed in Percent of Critical

TABLE 6

STRAIN LEVELS AND RSPT ELECTRICAL PERFORMANCE

SEISMIC OBE AND SSE TESTING

			MEASURED STRAIN DATA-VISICORDER				ELECTRICAL PERFORMANCE	
TEST ORIEN.	TEST DESCRIPTION	TAPE RUN NO.	S.G. 1 με	S.G. 3 με	S.G. 5 με	S.G. 10 με	RSPT 1 S/N 604	RSPT 2 S/N 596
1	OBE 1	4	625	600	550	340	OK	OK
1	OBE 2	5	625	600	550	350	OK	OK
1	OBE 3	6	625	605	550	340	OK	OK
1	OBE 4	7	635	605	550	335	OK	OK
1	OBE 5	8	625	605	550	340	OK	OK
1	SSE 1	9	775	745	675	405	OK	OK
2	SSE 1	11	755	745	680	405	OK	OK
2	SSE 2	12	775	745	675	400	OK	OK
2	OBE 1	13	620	600	550	335	OK	OK
2	OBE 2	14	625	600	555	335	OK	OK
2	OBE 3	15	625	600	550	330	OK	OK
2	OBE 4	16	625	600	550	340	OK	OK
3	OBE 5	17	625	605	555	335	OK	OK
			S.G. 7 με	S.G. 8 με				
3	OBE 1	20	600	615			OK	OK
3	OBE 2	21	600	625			LOOSE	CABLE
3	OBE 3	22	610	635			OK	OK
3	OBE 4	23	620	630			OK	OK
3	OBE 5	24	615	630			OK	OK
3	OBE 6	25	615	630			OK	OK
3	SSE	26	755	740			OK	OK
4	OBE 1	27	760	740			OK	OK
4	OBE 2	28	760	750			OK	OK
4	OBE 3	29	765	760			OK	OK
4	OBE 4	30	770	760			OK	OK
4	OBE 5	31	770	750			OK	OK
4	OBE 6	32	770	750			OK	OK
4	SSE	33	765	750			OK	OK

Note: OBE Events for Test Orientation 4 inadvertently were run at SSE Intensity.

TABLE 7

LIST OF EQUIPMENT AND INSTRUMENTATION

Instrument	Manufacturer	Model Number	Serial Number	Calibration Requirements	
Seismic Shaker Table	M/Rad	—		—	
Hydraulic Shaker	MTS	204.63	299	—	
Shaker Controller	MTS	406.11B	1094	—	
Shaker Control Unit	MTS	436.11AB	463	—	
Digital Vibration	—	P/N 2931-973	Unit C-E	QA Verification of software used	
Control System	Time Data Corp.	TDV-25P			
Control Accelerometers	Unholtz Dickie	100-PA	492/493	Per Manufacturer	Check calibrated within last 12 months
Response Accelerometers	Unholtz Dickie	75 D2/PA	156/104-117	Per Manufacturer	
Response Accelerometers	Endevco	7701-100	AA15, AA16	Per Manufacturer	
Signal Conditioners	Unholtz Dickie	2216x	145/146	Performance Check	
Charge Amplifiers	Unholtz Dickie	D-22 H Type	2024-2027	Performance Check	
Charge/Voltage Amps	Unholtz Dickie	D-22 R Type	2048-2053	Performance Check	
Oscilloscope	Tektronix	5000 Series	B117232	Performance Check	
Strain Gauges	Micro Measurement	WK-06-125AD-350	—	—	
Visicorder	Honeywell	1858-07906	1704DH77	Signal Calibration	
Power Supply	Power Mate or equal	QRD15-1	IL-113	—	
Tape Recorder	Racal Store 7D	D7 690/S		Signal Calibration	

APPENDIX A

ELECTRICAL AND FUNCTIONAL INSPECTION SHEETS

Electrical Inspection Sheet

SN 076

ected by: ________ Date: 7/25/81

Ref. Para.	Pins	Measured Resistance (ohms) & Remarks									
7.1.2.1	A-B	3092			After Switch Aging						
		1000	1110	1220	1330	1504	1614	1724	1844	1961	2075
		1010	1120	1230	1340	1514	1625	1735	1855	1965	2085
		1022	1130	1240	1350	1524	1634	1744	1865	1975	2094
		1029	1140	1250	1361	1534	1644	1754	1875	1985	2105
		1040	1149	1260	1370	1544	1656	1764	1885	1996	2114
7.1.2.2	A-C	1050	1160	1270	1380	1554	1664	1775	1895	2006	
		1059	1169	1280	1391	1569	1675	1785	1906	2017	
		1069	1180	1290	1402	1574	1684	1795	1919	2027	
		1079	1189	1300	1411	1584	1694	1805	1925	2044	
		1091	1202	1311	1420	1594	1705	1815	1935	2055	
		1100	1210	1320	1433	1605	178	1825	1945	2014	
		Bottom to Top									
		2114	1996	1885	1764	1656	1534	1361	1240	1130	1021
		2104	1985	1875	1756	1644	1524	1350	1230	1109	1012
		2094	1975	1865	1745	1634	1514	1340	1220	1099	1000
		2084	1965	1855	1735	1625	1504	1330	1210	1090	
		2074	1959	1845	1724	1614	1432	1320	1200	1079	
7.1.2.3	A-C	2064	1945	1825	1715	1604	1420	1310	1190	1069	
		2054	1935	1815	1705	1594	1410	1290	1180	1059	
		2044	1925	1805	1694	1584	1401	1280	1161	1050	
		2027	1916	1795	1684	1574	1390	1270	1149	1042	
		2017	1906	1785	1674	1566	1380	1260	1140	1029	
		2006	1895	1775	1664	1554	1370	1250	1129	1022	
		Top to Bottom									
8.1.2.4	D-E F-H J-K	0.001 0.001 0.001									
8.1.2.5	A thru K	Satisfactory									

Electrical and Functional

Inspection Sheet

is. ted By: *D.A. STORY* *D. A. Story* Date: *8/7/91*

RSPT S/N 596

Ref. Para.	Pins	Measured Resistance (Ohms) & Remarks *After Seismic Testing*									
4.3.1	A-B	3,132 Ω				*			*		
4.3.2	A-C	1000	1110	1221	1331	1543	1654	1764	1884	1985	2103
		1010	1121	1231	1341	1554	1664	1774	1885	2006	2113
		1020	1131	1241	1351	1564	1674	1784	1895	2006	2123
		1030	1141	1251	1361	1574	1684	1795	1905	2016	2133
		1043	1151	1261	1371	1584	1694	1804	1915	2026	2143
		1052	1161	1271	1381	1594	1704	1814	1925	2036	2153
		1060	1171	1281	1391	1604	1714	1824	1935	2046	
		1070	1181	1291	1401	1614	1724	1834	1945	2056	
		1080	1191	1301	1411	1624	1734	1844	1958	2066	
		1090	1202	1311	1421	1634	1744	1855	1965	2083	
		1100	1211	1321	1431	1644	1755	1865	1975	2093	
4.3.3	A-C	2153	2036	1935	1824	1714	1604	1391	1281	1171	1060
		2143	2026	1925	1814	1704	1594	1381	1271	1161	1051
		2133	2016	1915	1804	1694	1584	1371	1261	1151	1042
		2123	2006	1905	1796	1684	1574	1361	1251	1141	1030
		2113	2000	1995	1784	1674	1564	1351	1241	1131	1020
		2103	1996	1885	1774	1664	1554	1341	1231	1122	1010
		2093	1985	1880	1764	1654	1544	1331	1221	1110	1000
		2083	1975	1865	1754	1644	1431	1321	1211	1100	
		2066	1965	1855	1744	1634	1421	1311	1201	1090	
		2056	1956	1845	1734	1624	1411	1301	1191	1080	
		2046	1945	1834	1724	1614	1401	1291	1181	1070	
3.4	D-E	0.9 Ω									
	F-H	1.0 Ω									
	J-K	0.6 Ω									
4.3.5	A thru K	} INFINITY									

Electrical Inspection Sheet

SN 604

Inspected by: W. J. Slater   John Falkowski   Date: 7/24/81

Ref. Para.	Pins	Measured Resistance (ohms) & Remarks									
7.1.2.1	A-B	3018	-			After Switch Aging					
7.1.2.2	A-C	0.997	1108	1219	1328	1428	1538	1648	1758	1868	1977
		1.008	1125	1228	1337	1438	1548	1658	1718	1978	1987
		1018	1129	1240	1342	1448	1559	1669	1779	1888	1997
		1028	1138	1249	1348	1458	1564	1678	1788	1897	2009
		1038	1149	1258	1358	1418	1578	1688	1798	1908	2019
		1048	1158	1318	1369	1478	1609	1694	1808	1918	2028
		1058	1169	1278	1378	1561	1598	1708	1818	1928	2038
		1068	1180	1289	1388	1499	1609	1718	1828	1937	
		1078	1189	1298	1398	1508	1618	1728	1837	1950	
		1088	1198	1309	1408	1518	1628	1739	1848	1959	
		1098	1208	1318	1418	1528	1638	1748	1858	1968	
		Bottom to Top ↑									
7.1.2.3	A-C	2038	1928	1818	1708	1598	1508	1379	1268	1158	1059
		2028	1918	1808	1698	1108	1478	1369	1258	1150	1048
		2019	1908	1798	1688	1578	1418	1358	1240	1139	1039
		2009	1898	1788	1678	1568	1458	1342	1240	1129	1028
		2000	1888	1779	1668	1558	1449	1339	1228	1125	1018
		1988	1878	1768	1658	1548	1438	1328	1219	1122	1008
		1978	1868	1758	1648	1538	1428	1318	1208	1108	1000
		1968	1858	1748	1638	1528	1418	1307	1198	1099	997
		1959	1848	1739	1629	1518	1409	1298	1188	1088	
		1948	1838	1728	1618	1508	1399	1288	1182	1078	
		1938	1828	1718	1609	1499	1388	1278	1169	1018	
		Top to Bottom ↓									
8.1.2.4	D-E F-H J-K	0.000 0.000 0.000									
8.1.2.5	A thru K	satisfactory									

DATA SHEET NO. 1

Electrical and Functional

Inspection Sheet

Tested By: D.A. STORY *D.A. Story* Date: 8/7/81

RSPT S/N 604

After Seismic Testing

Ref. Para.	Pins	Measured Resistance (Ohms) & Remarks									
4.3.1	A-B	3019Ω									
4.3.2	A-C	1000	1109	1219	1329	1439	1547	1659	1768	1879	1988
		1009	1120	1229	1339	1449	1559	1669	1779	1888	2000
		19	1129	1241	1349	1459	1569	1679	1784	1898	2009
		29	1139	1250	1354	1469	1579	1689	1799	1908	2019
		39	1151	1259	1369	1479	1594	1699	1809	1918	2039
		49	1159	1269	1374	1490	1599	1709	1819	1928	
		59	1169	1279	1389	1499	1609	1719	1829	1938	
		69	1183	1284	1399	1509	1619	1729	1839	1949	
		79	1189	1299	1409	1519	1629	1739	1849	1959	
		89	1199	1309	1419	1529	1639	1749	1859	1968	
		99	1209	1319	1429	1539	1649	1754	1868	1978	
4.3.3	A-C	2039	1929	1819	1709	1599	1490	1379	1269	1150	1039
		2029	1917	1809	1699	1589	1479	1370	1259	1139	1029
		2019	1909	1799	1689	1579	1469	1354	1250	1129	1019
		2009	1898	1789	1679	1569	1454	1344	1241	1120	1009
		2000	1888	1779	1669	1559	1449	1339	1230	1109	1000
		1988	1879	1769	1659	1549	1439	1329	1219	1100	
		1978	1869	1754	1649	1539	1429	1319	1209	1089	
		1968	1859	1744	1639	1529	1419	1310	1200	1079	
		1954	1849	1739	1629	1519	1409	1300	1189	1069	
		1947	1839	1729	1619	1509	1400	1289	1181	1059	
		1938	1829	1719	1609	1499	1389	1279	1164	1049	
3.4	D-E	1.1Ω									
	F-H	1.0Ω									
	J-K	0.5Ω									
4.3.5	A thru	INFINITY									

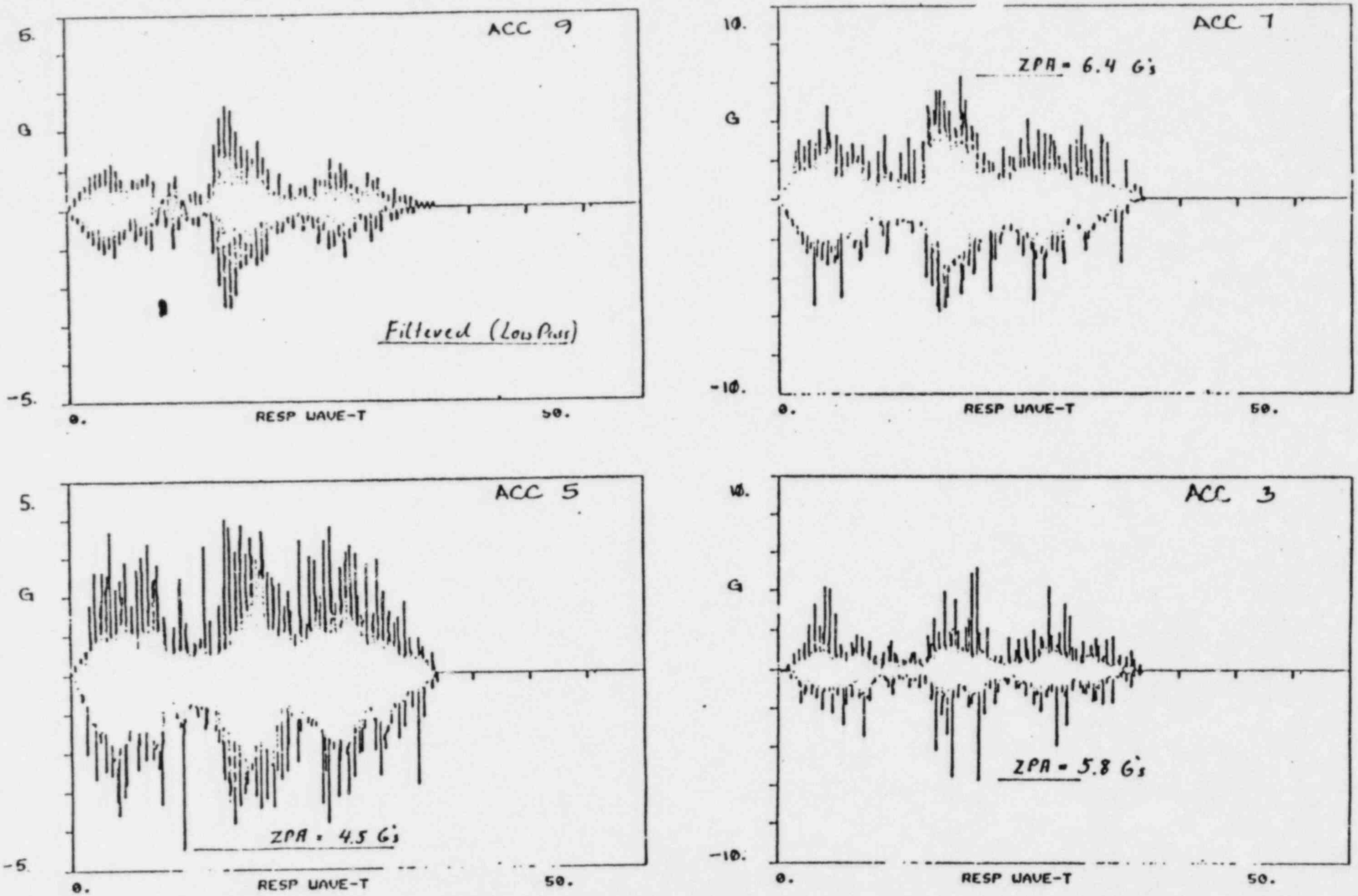


FIGURE 25 ACCELERATION TIME HISTORIES AT DIFFERENT SHROUD ELEVATIONS, OBE EVENT ORIENTATION 1

ENCLOSURE 4

SEISMIC QUALIFICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) Status of PE Confirmatory Items
Attachment (2) Seismic Qualification Completion Schedule
Attachment (3) Seismic Analyses of Muellor 3" Y-Type Strainer
Attachment (4) ME-894 Certified Design Report of Horizontal Pump

November 10, 1982

RESPONSE TO CE/PLANT ENGINEERING CONFIRMATORY ITEMS FROM WATERFORD UNIT #3 SQRT RE-AUDIT

ITEM	COMMENTS/RESPONSE
GENERIC	Comment: It was noticed that during the review of NSS-PE-10 (Deborating Ion Exchanger), NSSS-PE-15 (Purification Filter) and NSSS-PE-33 (Holdup Tank), nozzle loads were negelected in the stress analysis. This seems to be a generic pattern. Response Nozzle loads for this equipment (seismic category tanks, HXS, Filters and Ion Exchangers) were originally simulated in the seismic analyses by increasing the seismic acceleration loading imposed on these components. This simulation was considered to be conservative because the component supports were judged to be more highly loaded than they would be if the appropriate siesmic and nozzle loads were considered. In response to the SQRT audit concern, a follow-on effort has been initiated to confirm that the original approach was conservative. All of the design reports for the applicable CE equipment have been reviewed and nozzle loads have been directly evaluated to determine their effect on component supports. In all cases, the original support loadings were more severe. All nozzle-to-shell juncture stresses were also evaluted and found to be within acceptable levels.
GENERIC	Comments Status of equipment not yet seismically qualified and their qualification schedule should be provided to NRC. This status should be submitted monthly until completion of qualification of all safety related equipment. Response Status is given on Attchment (2)

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-1 SQRT NO. NSSS-PE-14 BA MAKEUP PUMP SPECIFIC ITEM: PUMP B	COMMENT 1. Explain basis for load cases 4 & 5 and show that they are conservative. Response Load Case 4 is "nozzle plus impeller loads in the x-direction". Load Case 5 is "nozzle plus impeller loads in the z-direction". CE has reviewed these loading cases in detail and confirms that these loadings encompass the most severe direction possible for the application of nozzle loads. Comment 2. Explain load combinations used for computing bolting stress and show that they are conservative. Response The load combinations used for computing bolt stresses include those loads from seismic accelerations in both transverse directions (note that a vertical acceleration would have no effect on the bolts), impeller loads, and nozzle loads in the most severe direction. CE has reviewed these loads and confirms that they are conservative.
Item No. NSSS-2 SQRT NO. NSSS-PE-25 BORIC ACID TANK CIRC. VALVE SPECIFIC ITEM: 3CH-F171B	Comment 1. Provide certification that the computer calculation based on Engineering Standard ES100, Rev. B dated 4/8/75 have been verified. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before 11/30/82. Comment 2. Confirm that deflections calculated in Seismic Analysis for Order 1-46610 dated April 3, 1976 for tag number CH-511 will not interfere with valve closure. Response Same as Previous Response.

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-1 SQRT NO. NSSS-PE-14 BA MAKEUP PUMP SPECIFIC ITEM: PUMP B	**COMMENT** 1. Explain basis for load cases 4 & 5 and show that they are conservative. **Response** Load Case 4 is "nozzle plus impeller loads in the x-direction". Load Case 5 is "nozzle plus impeller loads in the z-direction". CE has reviewed these loading cases in detail and confirms that these loadings encompass the most severe direction possible for the application of nozzle loads. **Comment** 2. Explain load combinations used for computing bolting stress and show that they are conservative. **Response** The load combinations used for computing bolt stresses include those loads from seismic accelerations in both transverse directions (note that a vertical acceleration would have no effect on the bolts), impeller loads, and nozzle loads in the most severe direction. CE has reviewed these loads and confirms that they are conservative.
Item No. NSSS-2 SQRT NO. NSSS-PE-25 BORIC ACID TANK CIRC. VALVE SPECIFIC ITEM: 3CH-F171B	**Comment** 1. Provide certification that the computer calculation based on Engineering Standard ES100, Rev. B dated 4/8/75 have been verified. **Response** CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before 11/30/82. **Comment** 2. Confirm that deflections calculated in Seismic Analysis for Order 1-46610 dated April 3, 1976 for tag number CH-511 will not interfere with valve closure. **Response** Same as Previous Response.

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-5 SQRT NO. NSSS-PE-52 FW CONTROL VALVE SPECIFIC ITEM: 5FW-FM834	Comment Verification of computer program ES100, Rev. B (4/8/75) performed for Item NSSS-PE-25. Results will also be applicable here. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before 11/30/82.

ATTACHMENT 2

Pg 1 of 1

NSSS-
Plant Engineering (PE)

SEISMIC QUALIFICATION
COMPLETION SCHEDULE

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
910204 9270-PE 704 Rev 04	BH 307 (CE Tag) Fisher 3" valve	NSSS-PE-36 Rev 1	Janurary 1, 1983	
9102040 9270-PE 704 Rev. 04	CH 210 Y Fisher 1" valve	NSSS-PE-26 Rev 1	Janurary 1, 1983	
9102040 9270-PE 704, Rev. 04	CH 512 Fisher 3" Valve	NSSS-PE-27 Rev 1	Janurary 1, 1983	

ATTACHMENT 3

POWER SYSTEMS
COMBUSTION ENGINEERING, INC.

Contract LOUISIANA P&L - WATERFORD STATION UNIT # 3

Calculation 10 Pages

Appendix 0 Pages

Calculation Number C-PAC-010

Revision 0

Title MUELLER STEAM SPECIALTY 3" Y-TYPE STRAINER SEISMIC ANALYSIS

Author V. TOKARZ

Date 10/22/82

Calculation contains safety related design information: Yes X No ___

The safety related design information contained in this document has been reviewed and satisfies where applicable the items contained on checklist(s) # 2 of the Quality Assurance of Design Manual. This review is certified to have been so accomplished.

Independently Reviewed by E.A. SIEGEL *E a Siegel* Date 10-26-82

Approved by *[signature]* Date 10-26-82

Distribution E A SIEGEL, A PASCENTE, D J. LIEBRO

Summary Purpose:

TO ESTABLISH THE STRUCTURAL ADEQUACY OF THE 3" Y-TYPE STRAINER UNDER SEISMIC ACCELERATIONS OF 3 g's.

Method and Results of Review:

THIS CALCULATION WAS VERIFIED BY THE METHOD OF DESIGN REVIEW AND SATISFIES WHERE APPLICABLE THE ITEMS ON CHECKLIST # 2 OF THE QUALITY ASSURANCE OF DESIGN MANUAL.

1.0 ABSTRACT

1.1 PURPOSE

THE PURPOSE OF THIS CALCULATION IS TO VERIFY THE STRUCTURAL INTEGRITY OF THE MUELLER 3" Y-TYPE STRAINER UNDER 3 g SEISMIC ACCELERATIONS IN THREE ORTHOGONAL DIRECTIONS APPLIED SIMULTANEOUSLY.

1.2 SCOPE

THIS CALCULATION APPLIES TO THE LETDOWN STRAINER, TAG NO. 2CH-S151 A/B FURNISHED TO LOUISIANA POWER AND LIGHT COMPANY FOR THEIR WATERFORD STEAM ELECTRIC STATION UNIT NO. 3.

1.3 REFERENCES

1.3.1 MUESSCO PIPE LINE STRAINERS AND SILENT CHECK VALVES CATALOG No. 7:-R-1

1.3.2 ROARK, FORMULAS FOR STRESS AND STRAIN, 5TH ED.

1.3.3 BLODGETT, DESIGN OF WELDED STRUCTURES, THE LINCOLN ARC WELDING FOUNDATION, 1966.

1.3.4 LESLIE SELF CLEANING STRAINER ANALYSIS, FILE M-193, DTD. 4-24-78.

1.4 METHOD OF ANALYSIS AND ASSUMPTIONS

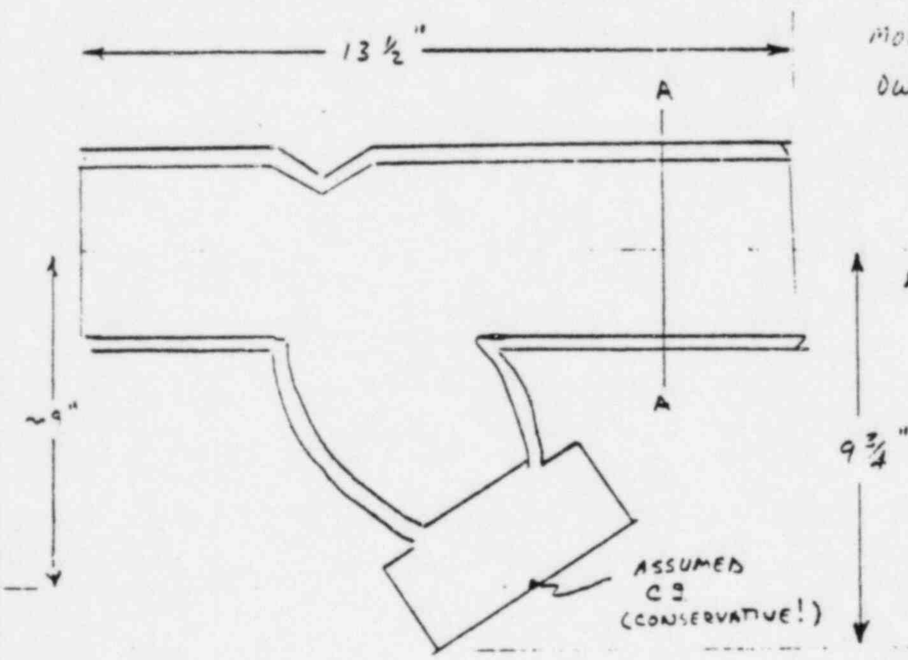
BASIC BEAM THEORY AND VERY CONSERVATIVE ASSUMPTIONS WERE USED IN FINDING THE SEISMIC STRESSES AND NATURAL FREQUENCY OF THE 3" Y-TYPE STRAINER. 3 g LOADS WERE ASSUMED TO ACT SIMULTANEOUSLY IN THREE ORTHOGONAL DIRECTIONS. STRESSES WERE CONSERVATIVELY COMBINED BY USING AN ABSOLUTE SUMMATION.

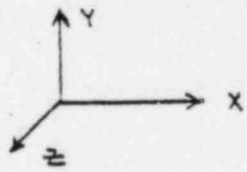
1.5 CONCLUSIONS

THE STRAINER IS STRUCTURALLY ADEQUATE TO WITHSTAND A 3 g SEISMIC ACCELERATION APPLIED SIMULTANEOUSLY IN 3 ORTHOGONAL DIRECTIONS AT THE PIPING CONNECTIONS.

SEISMIC STRESS ANALYSIS
FOR Y-TYPE STRAINER (3")

PO NO. 9402242
ITEM # 1
MFG: MUELLER STM. SPECIALTY
MOD. NO.: 761-SS-WE
DWG. NO.: AN-3.0-761SSWE
Rev 1





BASIC ASSUMPTIONS TO BE USED:

1) ASSUME C.G. @ 9" OFF CL of PIPE (VERY CONSERVATIVE!)

2) STRAINER CROSS-SECTION TO BE EQUAL TO THAT OF SCHEDULE 40S PIPE

O.D. = 3.5"	A = 2.[illegible] in^2
I.D. = 3.[illegible]	I = 3.017 in^4
t = .216"	Z = 1.72[illegible] in^3

POWER SYSTEMS
COMBUSTION ENGINEERING, INC.

SEISMIC LOAD:

- FOR THE LOADING ON THIS STRAINER, A 3 g ACCELERATION IN THREE ORTHOGONAL DIRECTIONS WILL BE USED. THE METHOD OF "ABSOLUTE SUM" WILL BE USED TO COMBINE ALL STRESSES AT SECTION A-A.

STRAINER WEIGHT   REF 1.3.1

STRAINER wt = 43 Lbs
WATER wt ≈ 10 Lbs

TOTAL WEIGHT = 53 Lbs

APPLY LOADS

- SHOCK IN X-DIRECTION

$F_x = 3.0(53) =$ [illegible] #

$M_z = 3.0($[illegible]$)(53) = 1431$ "#

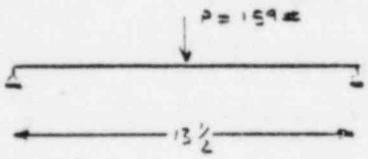
$F_y = \frac{1431}{13.5} =$ [illegible] #

$\sigma_x = \frac{159}{2.228} + \frac{1431}{1.724} = 901.4$ PSI

$\tau_y = \frac{106}{\text{[illegible]}} = 47.$[illegible] PSI

- **SHOCK IN Y-DIRECTION**

ASSUME [illegible] AS FOLLOWS:



$$M_{MAX} = \frac{P\ell}{4} = \frac{53(3+1)(13\tfrac{1}{2})}{4} = 715.5\ \text{"\#}$$

$$F_y = \frac{53(4)}{2} = 106\ \#$$

$$\sigma_x = \frac{715.5}{1.724} = 415.0\ \text{PSI}$$

$$\tau_y = \frac{106}{2.228} = 47.6\ \text{PSI}$$

- **SHOCK IN Z DIRECTION**

$$M_T = 53(3)(9) = 1431\ \text{"\#}$$

$$F_z = 53(3) = 159\ \#$$

$$\tau = \frac{16\, M_T\, d_2}{\pi\,(d_2^{\,4} - d_1^{\,4})}^{*} + \frac{F_z}{2A}$$

* d_2 = O.D.
d_1 = I.D.

$$\tau = \frac{16\,(1431)\,3.5}{\pi\,(3.5^4 - 3.0[illegible]^4)} + \frac{159}{2(2.[illegible])} = 4[illegible].7\ \text{PSI}$$

STRESSES DUE TO [illegible]

σ_1 = LONGITUDINAL STRESS [illegible]

SHEAR [illegible] σ_2 = CIRCUMFERENTIAL STRESS = 300 PSI

σ_3 = RADIAL STRESS

• USE ROARK 5TH ED" TABLE 32 CASE # 1 :

a = OD/2 = 3.5/2 = 1.75"
b = ID/2 = 3.068/2 = 1.534"
q = UNIT PRESS. (LB/IN²)

$$\sigma_{2\,MAX} = q\,\frac{a^2+b^2}{a^2-b^2}$$

$$= 300\,\frac{1.75^2+1.534^2}{1.75^2-1.534^2}$$

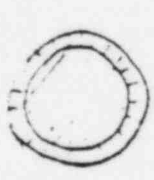
$$= 2290.\ PSI$$

$$\sigma_{3_{MAX}} = -q = -300\ PSI$$

$$\tau_{TOT\,(DUE\,TO\,q)} = \sigma_2 - \sigma_3 = \underline{2590.6}\ PSI$$

• [illegible] LONGITUDINAL STRESS DUE TO [illegible]

[illegible] STRAINER X-SECT. ([illegible] 7.2[illegible] IN²)



[illegible] X-SECT. AREA ([illegible] IN²)

FORCE F_L [illegible]

= [illegible] #

• LONGITUDINAL STRESS (CONT'D)

CONSERVATIVELY ASSUME $\sigma_1 = \frac{P}{A} = \frac{[illegible]}{[illegible]} =$ 995 PSI

COMBINE ALL STRESSES (USE ABSOLUTE SUM)

$\sigma_{x\,TOT} =$ [illegible] $-$ 415.0 $+$ 995 $=$ 2311.4 PSI

$\tau_{TOT} =$ [illegible] $+$ 47.6 $+$ [illegible] $+$ [illegible].6 $=$ [illegible] PSI

SA-351 GR CF8M

• (S_h) PIPING ALLOWABLE STRESS VALUE @ 600°F = 16.8 KSI

LEVEL B SERVICE ALLOWABLE = 1.2 (S_h) = 20.16 KSI
(ASME CODE SECTION III)

• [illegible] STRESS [illegible]

$\sigma_{MAX} = \frac{2311.4}{2} + \sqrt{\left(\frac{2311}{2}\right)^2 + [illegible]^2} =$ 4[illegible] PSI

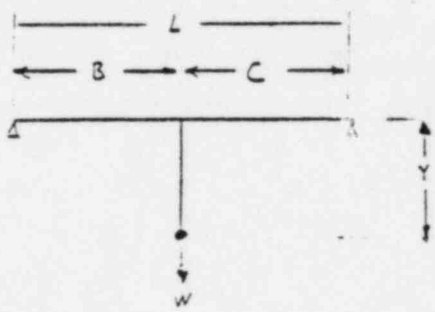
$\tau_{MAX} =$ 3766 PSI

[illegible] → THE [illegible] CLEARLY SHOW [illegible] BETWEEN ACTUAL STRESSES AND ALLOWABLE STRESS

NATURAL FREQUENCY ANALYSIS

• DUE TO VERTICAL ACCELERATION

ASSUME THE FOLLOWING [illegible]



B = C = 6.75 (ASSUMED)

L = 13.5

w = 53 # WT

$r_1 = \frac{I.D.}{2} = 1.534$

$r_2 = \frac{OD}{2} = 1.75$

$$F_V = \frac{1}{2\pi}\sqrt{\frac{386}{Y}}$$

REF. THOMPSON VIBRATION THEORY 9TH PRINTING Pg 5 EQ 1.2-9

$$Y = \frac{W B^2 C^2}{3 E I L}$$

REF. MACH. HDBK 17TH ED. Pg 25[illegible] [illegible]

$$Y = \frac{53\ (6.75)^4}{3\ (30\times10^6)\ ([illegible])\ 13.5}$$

$$Y = 3.0 \times 10^{-5}$$

$$F_V = \frac{1}{2\pi}\sqrt{\frac{386}{.00003}} = \underline{570.\pm\ CPS}$$

NATURAL FREQUENCY

- DUE TO HORIZONTAL ACCELERATION

$W = 53\#$
$Y = 1''$ (ASSUMED ...)

$F_H = \frac{1}{2\pi}\sqrt{\frac{JG}{J_o L}}$ $G = 11.2 \times 10^6$

J = POLAR MOMENT OF INERTIA

$J = 1.57\left(R_2^4 - R_1^4\right)$

REF. MACH. HDBK. 17th ED. ...

$J = 1.57\left(1.75^4 - 1.534^4\right) = 6.0\ldots$

J_o = MASS MOMENT OF INERTIA

$J_o = J_C + m x^2$

REF. BEER/JOHNSTON MECHANICS FOR ENGINEERS 2nd ED. ...

$J_o = \frac{m}{12}\left[3(R_2^2 - R_1^2) + L^2\right] + mY^2$

$m = \frac{W}{g} = \frac{53}{386 \text{ IN/SEC}^2} = .1373$

$J_o = \frac{.1373}{12}\left[3(1.75^2 - 1.534^2) + 13.5^2\right] + .1373(1)^2 = 13.23$

$F_H = \frac{1}{2\pi}\sqrt{\frac{6.03(11.2\times10^6)}{13.23(13.5)}} =$ 98 CPS

ATTACHMENT 4

ME-894

CERTIFIED DESIGN REPORT

OF

HORIZONTAL PUMP

Figure 4066

Size 8x8x12

CUSTOMER: COMBUSTION ENGINEERING COMPANY, INC.

P. O.: 9204018 CRANE-DEMING SHOP ORDER: 03677

SPECIFICATION NOS.: SYS 80-PE-404 REV. #00

SERIAL NOS.: NDC-000566, 567

CERTIFIED BY: C. K MCDONALD, P. E., Ph.D.
ALABAMA REGISTRATION NO. 9586

SIGNED: C K McDonald

DATE: 9/25/81

REVIEWED BY CRANE-DEMING PUMPS:

POSITION: QUALITY ASSURANCE MANAGER

SIGNED: Robert Joff DATE: 10/21/81
ROBERT JOFF

APPROVED BY CRANE-DEMING PUMPS:

POSITION: MANAGER OF ENGINEERIBG

SIGNED: Edward Allis DATE: 10/21/81
EDWARD ALLIS

DEMING DIVISION - CRANE COMPANY

CERTIFICATION STATEMENT

This Crane-Deming Figure 4066 Size 8x8x12 pump has been analyzed in accordance with Combustion Engineering Specification No. SYS 80-PE-404 Rev. #00; ASME Boiler and Pressure Vessel Code, Section III, Class 3, 1974 Edition including Winter '75 Addenda; and accepted good practice in seismic stress analysis.

The analysis shows that the pump is structurally adequate to withstand the specified loads and will perform its intended function during Upset and Faulted loads. Please note the limitation on resultant nozzle loads given in Section 4.6 of the report.

C. K. McDonald, Ph.D., P. E.
Alabama Registration No. 9586
September 25, 1981

TABLE OF CONTENTS

Continued...

TABLE OF CONTENTS(Cont.)

1. INTRODUCTION

This report covers the seismic, stress, and deflection analysis of Crane-Deming Figure 4066 Size 8 x 8 x 12 Pump. The analysis is directed toward proving both the structural integrity and functional capability of the pump.

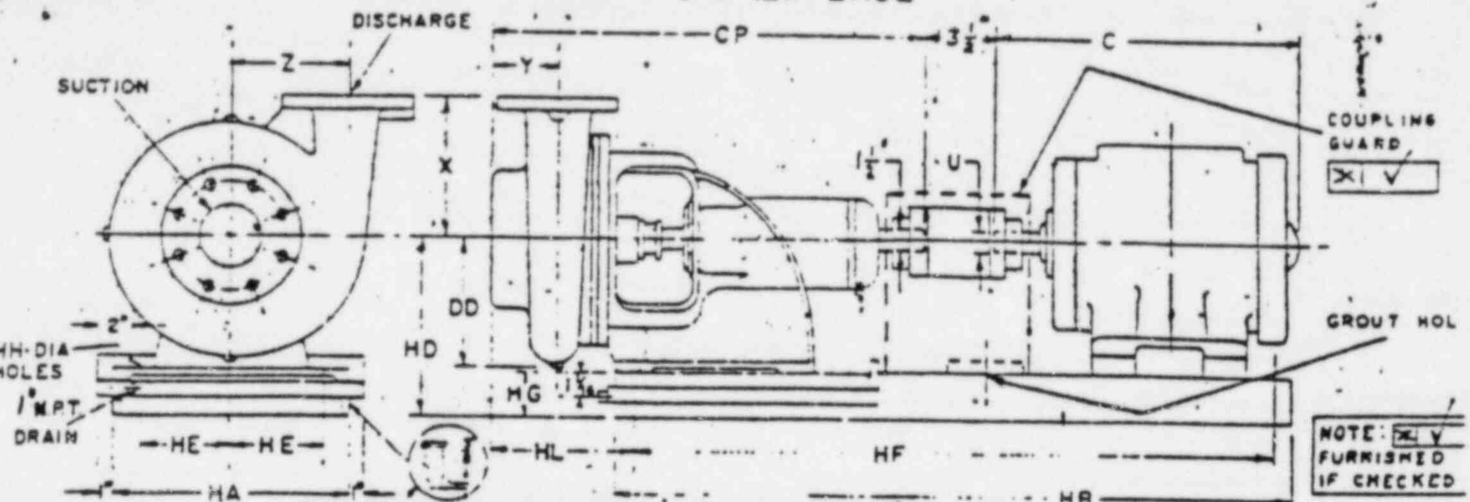
A dynamic model is developed and a computer frequency analysis is made to obtain the frequencies of the assembly, as required by the specification. The pump is shown to be rigid.

The nozzle loads are imposed on the computer model of the assembly and the resulting stresses and deflections are calculated. The stresses are then compared to the allowables given in the ASME Code. The deflections are compared to operating clearances or other limiting criteria.

The nozzles are analyzed for the max. nozzle loads. The loads given in the specification were reduced somewhat, see Section 4.2 of the report.

This pump casing is of complex geometry and has been well verified for normal operation by service experience and hydrostatic tests. The seismic and nozzle loads impose negligible stress in the casing except at nozzle penetrations and flanges which have been analyzed in this report.

This pump has a cast iron frame that cannot withstand nozzle loads. Thus, although the casing will withstand the individual nozzle loads given in Section 4.2, the resultant nozzle loads resolved to the intersection of the discharge/suction centerlines must be zero.



THIS STYLE BASE WITH GROUT HOLE ON 404 FRAME & LARGER

PUMP SIZE	SUCTION (150#) SIZE	DIA FLG	BOLTS	BC	DISCHARGE (150#) SIZE	DIA FLG	BOLTS	BC	X	Y	Z	CP	DD	HL†
4X3X12	4	9	8-3/4	7 1/2	3	7 1/2	4-3/4	6	8 1/2	2 1/2	7 3/8	27 3/8	8 3/4	7 3/8
6X4X12	6	11	8-3/4	9 1/2	4	9	8-3/4	7 1/2	9	2 3/4	7 1/2	28 1/2	9 3/4	7 7/8
6X6X12	5	11	8-3/4	9 1/2	6	11	8-3/4	9 1/2	9	3 1/2	8 3/8	28 7/8	10 1/2	8 3/8
8X6X12	8	13 1/2	8-3/4	11 3/4	6	11	8-3/4	9 1/2	9 1/2	3 1/2	8 7/8	29 1/2	10 7/8	9
→ 8X8X12	8	13 1/2	8-3/4	11 3/4	8	13 1/2	8-3/4	11 3/4	11	4 1/2	10 1/2	30 7/8	13 1/8	10 3/4 ← ②
10X8X12	10	16	12-7/8	14 1/4	8	13 1/2	8-3/4	11 3/4	11	4 1/2	10 1/2	30 7/8	13 1/8	10 1/8
10X10X12	10	16	12-7/8	14 1/4	10	16	12-7/8	14 1/4	11	5 1/2	10 3/8	32 3/8	13 3/8	12 1/8
4X4X12	4	9	8-5/8	7 1/2	4	9	8-5/8	7 1/2	9	2 1/2	7 5/8	27 5/8	10	7 3/8

DIMENSIONS IN INCHES

† FOR 404 FR & LARGER ADD 1/4" TO HL

LOCATION OF DISCHARGE (WHEN FACING SUCTION)

RH PUMP POSITION

WEIGHTS	
PUMP	465
MOTOR	630
BASEPLATE	228
TOTAL	1323

BOTTOM HORIZONTAL & VERTICAL AVAILABLE ONLY WITH SPECIAL FABRICATED BASES

FRAME NO		213T	215T	254T	256T	284TS	284T	286TS	286T	324TS	324T	326TS	326T	364TS	364T	365TS	365T	404TS	404T	405TS	405T
BASE NO		27504	27504	27505	27506	27506	27506	27506	27506	27508	27508	27508	27508	27508	27508	27508	27508	27510	27511	27510	25711
C		17 3/4	19 1/4	22 7/8	24 3/8	24 1/2	25 7/8	26	27 3/8	27 1/2	28 3/4	28 3/4	30 1/4	26 1/2	33 1/4	32	34 1/8	34 1/4	37 1/4	36	38 7/8
HA		15	15	15	15	15	15	15	15	18	18	18	18	18	18	18	18	25	25	25	25
HB		40	40	43	47	47	47	47	47	51	51	51	51	51	51	51	51	50	57	50	57
~~HD~~		~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~12 3/4~~	~~13~~	~~13~~	~~13~~	~~13~~	~~13~~	~~13~~	~~13~~	~~13~~	[illegible]	[illegible]	[illegible]	[illegible]
HD	8X8X12	13 3/8	13 3/8	13 3/8	13 3/8	13 3/8	13 3/8	13 3/8	13 3/8	13 1/2	13 1/2	13 1/2	13 1/2	13 1/2	13 1/2	13 1/2	13 1/2	14 1/2	14 1/2	14 1/2	14 1/2
~~HD 10X10X12~~		~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~13 7/8~~	~~14~~	~~14~~	~~14~~	~~14~~	~~14~~	~~14~~	~~14~~	~~14~~	[illegible]	[illegible]	[illegible]	[illegible]
HE		6	6	6	6	6	6	6	6	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	11 1/2	11 1/2	11 1/2	11 1/2
HF		37 1/2	37 1/2	40 1/2	44 1/2	44 1/2	44 1/2	44 1/2	44 1/2	48 1/2	48 1/2	40 1/2	48 1/2	48 1/2	48 1/2	48 1/2	48 1/2	47	54	47	54
HG		3 3/4	3 3/4	3 3/4	3 3/4	3 3/4	3 3/4	3 3/4	3 3/4	4	4	4	4	4	4	4	4	4 1/2	4 1/2	4 1/2	4 1/2
HH		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	7/8	7/8	7/8	7/8
U		1 3/4	1 3/4	1 3/4	1 7/8	1 7/8	1 7/8	1 7/8	1 7/8	1 7/8	2 1/8	1 7/8	2 1/8	1 7/8	2 3/8	1 7/8	2 3/8	2 3/8	2 7/8	2 1/8	2 7/8

REV. ②

CUSTOMER: COMBUSTION ENGINEERING INC. — CO NO 9204018

PROJECT NAME: LOUISIANA POWER & LIGHT — CONTRACTOR ENGINEER: C.E. CONTRACT # 9270-PE-404

CUSTOMER IDENT. NO.: FUEL POOL PUMPS - QUANT. 2 ① — 31-76-54-4022-00

PUMP DATA	FIG NO.	SIZE	CURVE NO	G.P.M.	HEAD	SP GR	TEMP	ROTATION	~~PACKING~~ / SEAL
	4066	8x8x12	P.C. 2471	2000	76'	.96-1.0	90-200°F	CW	J.C. TYPE 1 $O_{40}F_3$ 1D1

MOTOR DATA	MFGR	H.P.	R.P.M.	PHASE-CYCLE-VOLTAGE	FRAME	ENCLOSURE	INSULATION	FURNISHED BY	MOUNTED BY
	WSTGHS.	60	1800	3 - 60 - 460	364TS	DP	B	DEMING	DEMING

SERIAL No. NDC-000566, 567 — CERTIFIED BY R.D. [signature] — S.O. # 03677 — DATE 3-3-75

① NUCLEAR CLASS 3

REFERENCE PP-03677-2; SEAL GLAND 28009-4

DP-03677-3

2. SUMMARY OF RESULTS

A summary of the stresses, deflections, and loads are given here. The actual values are given and compared to the allowable values.

Components		Actual	Allowable
Motor Hold Down Bolts Stress, PSI	- Shear	4,010	10,000
	- Tensile	7,436	20,000
Pump Hold Down Bolt Stress, PSI	- Tensile	8,021	20,000
	- Shear	2,202	10,000
Anchor Bolt Stress, PSI	- Shear	3,530	10,000
	- Tensile	4,969	20,000
Shaft Stress, PSI		12,272	26,250
Frame Stress, PSI		11,344	21,600
Pump Foot Stress, PSI		8,501	12,500*
Maximum Nozzle Stress, PSI	- Discharge	8,030	19,800
	- Suction	11,667	19,800
Pump Bearing Loads, Lbs.	- Inboard	816	20,253
	- Outboard	5,435	27,000
Flexible Coupling Misalignment, Radians		.001	.017
Impeller Key Stress, PSI	- Shear	2,489	12,000
Impeller Clearance, Inches		.0062	.0065
Nozzle Flange Moment, In-lbs.		75,648	123,212*

* Faulted allowables given here, see detailed calculations for Upset Case. All other allowables are Upset allowables and are compared to Faulted actual values.

3. FREQUENCY ANALYSIS

A dynamic model is prepared and a computer frequency analysis is made to determine the assembly frequencies as required by the specification. A detailed discussion of the dynamic model and computer analysis is given below.

3.1 Dynamic Model

The dynamic model which was developed for the frequency analysis is shown in Figure 2, page 5. The joint numbers (enclosed in circles) and member numbers are included to facilitate the computer input. Several assumptions were made in developing the model. These assumptions were made such that the model would be more flexible than the actual assembly. Thus, the frequencies predicted by the model will be lower than the actual frequencies.

Some of these assumptions are:

1. The bedplate is assumed to be supported only at the foundation bolts. This is true for upward forces but for downward forces the bedplate channel flanges are continuously supported.
2. The motor could help restrain the pump in the direction parallel to the shaft centerline by transmitting forces through the coupling.
   - This is not included in the model since the coupling connection is not positive in that direction. This is also not desirable since this would impose thrust loads on the pump and motor bearings.

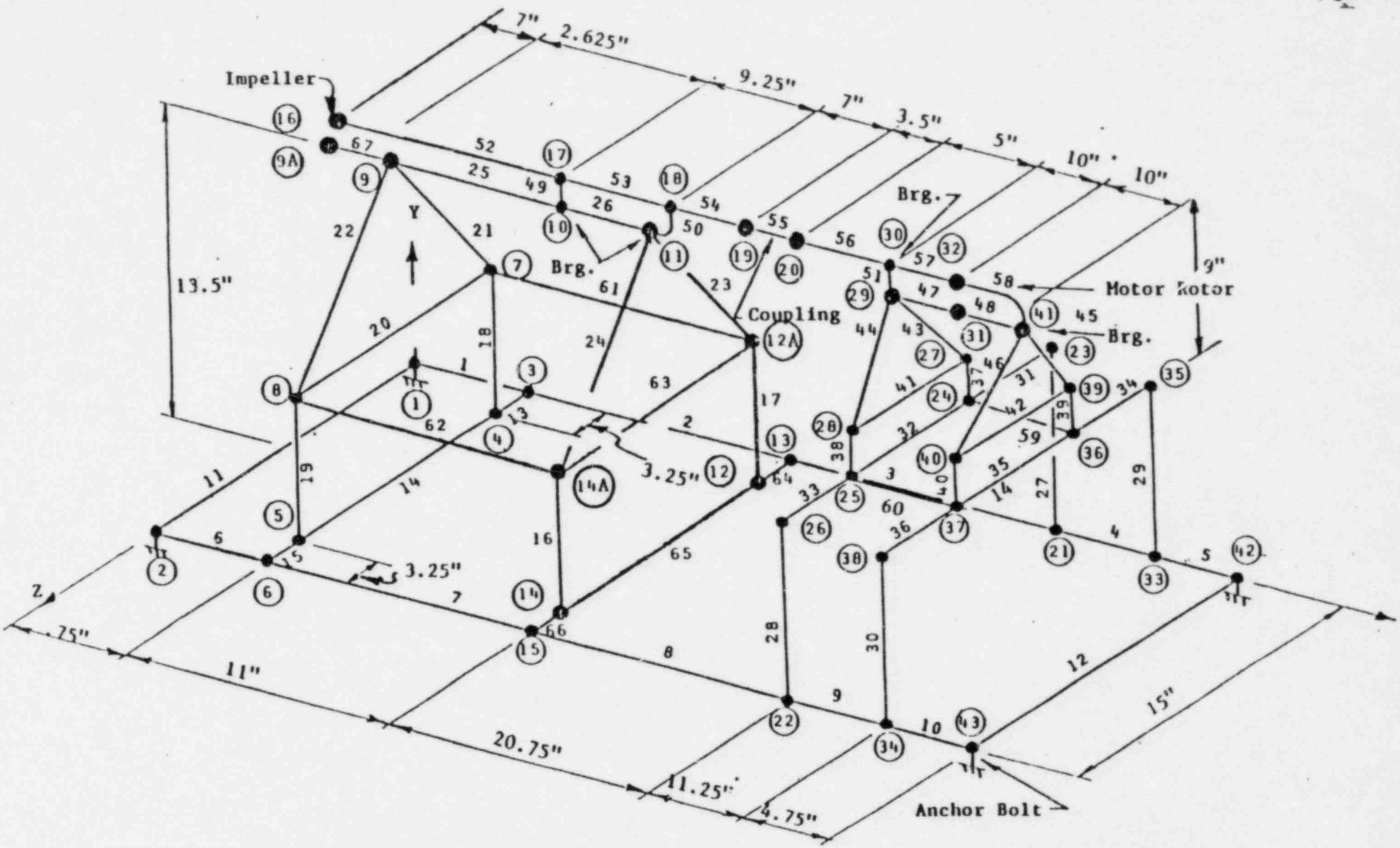


Figure 2 - COMPUTER MODEL FOR FREQUENCY AND STATIC ANALYSIS

3. The bearing stiffness is difficult to determine precisely. Thus, the shaft is assumed to be pinned at the inner pump bearing(Joint 17) and at both motor bearings(Joints 30 and 45).

Masses are lumped at joints in accordance with good practice in seismic analysis. Most of the mass of the pump is lumped at Joints 9A and 11. Joint 9A is the centerline of the nozzles, i.e. where the discharge and suction nozzle centerlines intersect.

The pump and motor casings are modeled by equivalent hollow beam sections. Members 27 through 48 represent the motor casing and Members 20 through 26 and 61, 62, 63, and 67 represent the pump casing.

3.2 Computer Analysis

The computer analysis for the frequencies is performed by use of the ICES-STRUDL computer program operating on an IBM 370/158 computer. Users manuals on the STRUDL program can be obtained from the Massachusetts Institute of Technology. The code has been well verified for frequency calculations. These verification checks will be made available upon request*.

The detailed input data sheets are given on pages 8 through 11. These are believed to be self-explanatory. The motor and pump shaft vary in cross section and are input accordingly.

The analysis is made for the three dimensional frame. Thus, the model is assigned 15 degrees of freedom. However, only the first two frequencies are calculated since the objective is to obtain the frequencies of interest in seismic conditions.

The computer output is shown below. The lowest frequency is seen to be 40 C.P.S. The mode shapes for the two modes are given in Appendix C.

```
JOB ID -  ME-894        JOB TITLE - CRANE DEMING FIGURE 4066 PUMP
ACTIVE UNITS -  LENGTH          FORCE           ANGLE           TEMPERATURE          TIME
                INCH            LB              RAD             DEGF                 SEC
ACTIVE STRUCTURE TYPE - SPACE   FRAME
ACTIVE COORDINATES AXES  X Y Z


    EIGENVALUES
MODE-------EIGENVALUE-------FREQUENCY--------PERIOD----------RADIANS--/
  1      0.632167D 05    0.400162D 02    0.249899D-01    0.251429D 03
  2      0.445553D 06    0.106235D 03    0.941305D-02    0.667497D 03
```

* Notes for Dynamic Seismic Analysis Course, by C. K. McDonald University of Alabama in Birmingham

```
STRUDL 'ME-494' 'CRANE DEMING FIGURE 4066 PUMP'
          ****************************************************
          *                   ICES STRUDL-II                 *
          *          THE STRUCTURAL DESIGN LANGUAGE          *
          *                                                  *
          *        IUG VERSION V3M0,   JUNE 1976             *
          *          SIZE OF POOL   8K BYTES                 *
          *          19:14:23         9/21/81                *
          ****************************************************
TYPE SPACE FRAME
UNITS INCHES POUNDS SECONDS
JOINT COORDINATES
1  0.  0.  0.  SUPPORT
2 0. 0. 15. SUPPORT
3 .75 0. 0.
4 .75 0. 3.25
5 .75 0. 11.75
6 .75 0. 15.
7 .75 .01 3.25
8 .75 .01 11.75
9 .75 13.5 7.5
'9A' -6.25 13.5 7.5
10 3.375 13.5 7.5
11 12.625 13.5 7.5
12 11.75 0. 3.25
'12A' 11.75 .01 3.25
13 11.75 0. 0.
14 11.75 0. 11.75
'14A'  11.75 .01 11.75
15  11.75 0. 15.
16 -6.25 13.51 7.5
17 3.375 13.51 7.5
18 12.625 13.51 7.5
19 19.625 13.51 7.5
20 23.125 13.51 7.5
21 32.5 0. 0.
22 32.5 0. 15.
23 32.5 4.49 0.
24 32.5 4.49 .5
25 32.5 4.49 14.5
26 32.5 4.49 15.
27 32.5 4.5 .5
28 32.5 4.50 14.5
29 28.125 13.5 7.5
```

```
30 28.125 13.51 7.5
31 38.125 13.5 7.5
32 38.125 13.51 7.5
33 43.75 0. 0.
34 43.75 0. 15.
35 43.75 4.49 0.
36 43.75 4.49 .5
37 43.75 4.49 14.5
38 43.75 4.49 15.
39 43.75 4.50 .5
40 43.75 4.50 14.5
41 48.125 13.51 7.5
42 48.5 0. 0. SUPPORT
43 48.5 0. 15. SUPPORT
JOINT RELEASE
1 2 42 43 MOM X Y Z
MEMBER INCIDENCES
1   1   3
2   3   13
3   13   21
4   21   33
5   33   42
6   2   6
7   6   15
8   15   22
9   22   34
10   34   43
11   1   2
12   42   43
13   3   4
14   4   5
15   5   6
16 14 '14A'
17 12 '12A'
18   4   7
19   5   8
20   7   8
21   7   9
22   8   9
23 '12A' 11
24 '14A' 11
25   9   10
26   10   11
27   21   23
```

```
28 22 26
29 33 35
30 34 38
31 23 24
32 24 25
33 26 25
34 35 36
35 36 37
36 38 37
37 24 27
38 25 28
39 36 39
40 37 40
41 27 28
42 39 40
43 27 29
44 28 29
45 39 41
46 40 41
47 29 31
48 31 41
49 10 17
50 11 18
51 29 30
52 16 17
53 17 18
54 18 19
55 19 20
56 20 30
57 30 32
58 32 41
59 24 36
60 25 37
61 7 '12A'
62 8 '14A'
63 '12A' '14A'
64 13 12
65 12 14
66 15 14
67 9 '9A'
MEMBER RELEASE
55 END FORCE X
37 38 39 40 START MOM X Y Z
16 18 19 END MOM X Y Z
```

```
49 51 END MOM X Y Z
58 END MOM Y Z
49    END FORCE Y
56 START MOM Y Z
54 START MOM X
CONSTANTS
E 29000000.0 ALL
MEMBER PROPERTIES
1 TO 10 PRIS AX 6.75 IX .73 IY 289. IZ 7.55 SY 32.15 SZ 2.41
11 12 PRIS AX .875 IX .1 IY .0046 IZ .89 SY .036 SZ .509
13 14 15 31 TO 36 64 65 66 PRIS AX 3. IX .1 IY .0625 IZ 9. SY .25 SZ 3.
16 TO 19 37 TO 40 PRIS AX .226 AY .226 AZ .226  IX 1. IY 1. IZ 1. SY 1. SZ 1.
20 TO 26 61 62 63 67 PRIS AX 9.4 IX 85. IY 42.5 IZ 42.5 SY 13. SZ 13.
27 TO 30 PRIS AX 10. IX 20. IY 10. IZ 10. SY 5. SZ 5.
41 TO 48 59 60 PRIS AX 7. IX 560. IY 280. IZ 280. SY 31. SZ 31.
49 50 51 PRIS AX .1 IX .1 IY .1 IZ .1 SY .1 SZ .1
52 VARIABLE
SEG 1 AX 2.40 IX .96 IY .46 IZ .46 SY .526 SZ .526        L 6.125
SEG 2 AX 3.02 IX 1.44 IY .72 IZ .72 SY . G SZ .370 L 3.5
53 PRIS AX 3.98 IX 2.52 IY 1.26 IZ 1.26 SY 1.12 SZ 1.12
54 PRIS AX 1.76 IX .497 IY .25 IZ .25 SY .331 SZ .331
55 TO 58 PRIS AX 2.76 IX 1.21 IY .60 IZ .60 SY .647 SZ .647
DYNAMIC DEGREES OF FREEDOM
JOINTS '9A' 11 16 19 31 DISP X Y Z
INERTIA  OF JOINTS '9A' LINEAR ALL .78
INERTIA OF JOINTS 11 LINEAR ALL .65
INERTIA OF JOINT 16 LINEAR ALL .078
INERTIA OF JOINTS 19 LINEAR ALL .065
INERTIA OF JOINTS 31 LINEAR ALL 1.93
DYNAMIC ANALYSIS ITERATION EIGENVALUE 2
LIST DYNAMIC EIGENVALUES EIGENVECTORS
```

4. LOADING CRITERIA

4.1 Seismic Loading

The lowest natural frequency of the pump system, including bedplate is 40 cps. The following loads exceed those given by the specification.

	OBE	SSE
Horizontal, X and Z	1.0g	1.5g
Vertical	.7g	1.0g

The loads were applied to the center of mass of each individual pump component. The loads for all three directions are applied, as required by the specification. The stresses are then combined directly for all three directions, which is more conservative than the square-root-of-the-sum-of-the-squares method. The SRSS method is used in some cases.

A computer analysis for the loading condition is made. The computer input is shown on page 14. The analysis is made for the following load cases.

1. 1.5g Lateral X Seismic
2. 1.5g Lateral Z Seismic
3. 1g Vertical Seismic
4. Nozzle plus Impeller Loads

Load case 3 is ratioed by the proper factor to obtain net upward or downward loads, as appropriate.

The computer model shown in Figure 2, page 5, which was used for the frequency analysis is also used for the static seismic and nozzle load analysis. The joint and member input data is the same as for the frequency analysis and is not repeated. The computer output data is given in Appendix A.

4.2 Individual Nozzle Loads

The nozzle loads for the individual nozzles, suction and discharge, are given in Paragraph 4.2.8 of the specification. These loads are listed below. However, it should be noted here that the combined resultant loads at the centerline of the suction/discharge intersection must be limited as shown in Section 4.6 below.

	8" Suction	8" Discharge
Resultant Force, F_R, lbs	2,520	2,520
Resultant Moment, Ft-lbs	6,304	6,304

4.3 Internal Pressure Loading

The internal pressure design conditions are 150 psig at 200°F.

4.4 Shaft Torsional Loading

The motor horsepower is 60 at 1800 R.P.M. Thus, the shaft torque is:

$$T = \frac{63000(60)}{1800} \quad 2,100 \text{ in-lbs}$$

4.5 Other Pump Normal Loads

The pump impeller is subjected to a 300 lbs radial and a 1000 lbs axial load during normal operation.

4.6 Resultant Nozzle Loads

The pump was analyzed for a set of resultant nozzle loads, resolved to the nozzle centerline at Joint 9A on the computer model. However, it was found that the pump foot would be overstressed with these loads. Thus, the resultant nozzle loads at Joint 9A must be zero. Note that the pump foot, Section 5.9, is fully stressed with no resultant nozzle loads.

```
LOADING 1 '1.5 G LATERAL X'
JOINT LOADS
'9A' FORCE X 450.
11 FORCE X 375.
16 FORCE X 45.
19 FORCE X 38.
31 FORCE X 1118.
LOADING 2 '1.5 G LATERAL Z'
JOINT LOADS
'9A' FORCE Z 450.
11 FORCE Z 375.
16 FORCE Z 45.
19 FORCE Z 38.
31 FORCE Z 1118.
LOADING 3 '1 G VERTICAL'
JOINT LOADS
'9A' FORCE Y 300.
11 FORCE Y 250.
16 FORCE Y 30.
19 FORCE Y 25.
31 FORCE Y 745.
LOADING 4 '      NOZZLE + IMPELLER LOADS'
JOINT LOADS
'9A' FORCE Z 5040.
'9A' MOMENT X 35000. Y 35000. Z -35000.
16 FORCE X 1000. Z 300.
LOADING LIST ALL
STIFFNESS ANALYSIS
OUTPUT DECIMAL 5
LIST FORCES DISPLACEMENTS
```

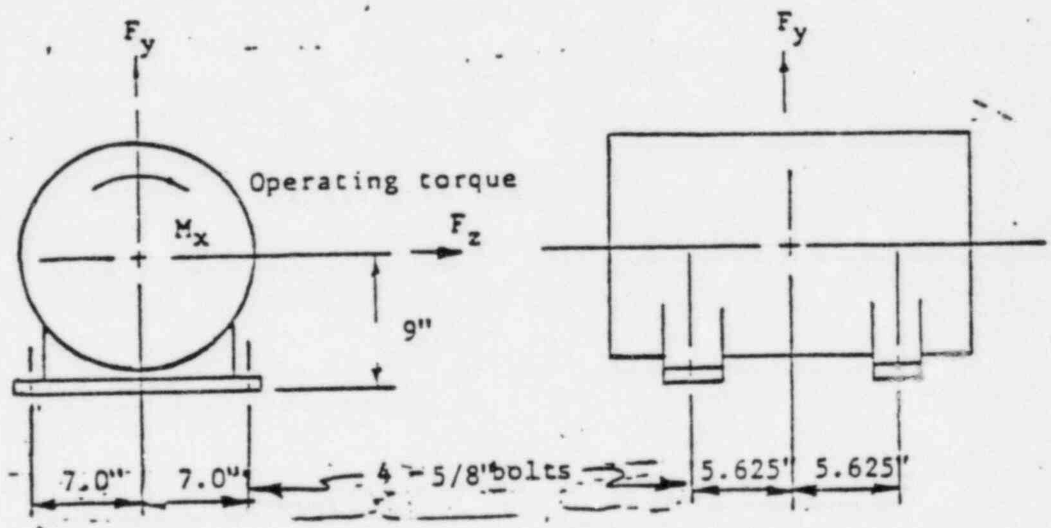
5. STRUCTURAL INTEGRITY ANALYSIS

The detailed stress analysis of the pump, supports, and motor is contained in this section. The stresses are obtained for the two horizontal and the vertical direction and combined directly.

A computer analysis for the pump is contained in App. A. Some of the pertinent stresses are obtained directly from the computer analysis. All of the important stresses could not conveniently be obtained from the computer analysis. Thus, some of the stresses are hand calculated.

5.1 Motor Hold Down Bolts

A sketch of the motor is shown below:



The stress due to operating torque is:

$$S = \frac{2100}{2(14.0)(.226)} = 332 \text{ psi tensile}$$

The total stresses are obtained by adding the stress from the computer output to the stress caused by operating torque. The highest motor bolt stress occurs in the bolt represented by Member 39 (see page A-1). Thus, the total stresses are:

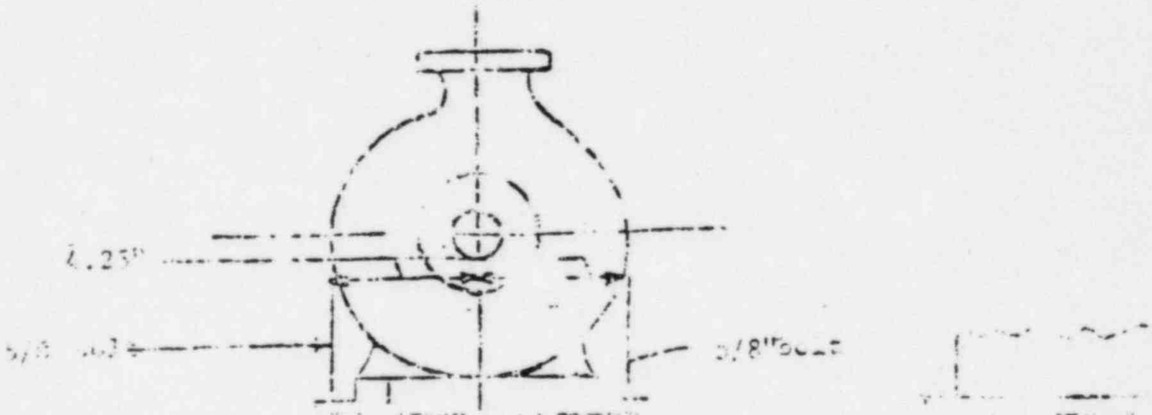
σ = (723 + 394) + 12 ... psi tension

τ = √(1135 + 1340 + 197 ... 2560 + 145 ...)² = 4,010 psi shear

The allowable stresses are 10,000 psi ... 20,000 psi tension for A307 bolts or equivalent, per Subsection NF and Appendix XVII. See Appendix B.

5.2 Pump Housing Hold Down Bolts

A sketch of the pump is shown below:



... stresses ...

= √(291² + 108²) ... = 6,0.. psi tension
= 2/3√(291² + 081² + ...) ... = 5,5.. psi shear
= √(1012 + ...) ... psi ...
= √(677 ...) ... = 4,468 psi shear

The allowable stresses ... 20,000 psi tension ...

... allowable ... stresses are 10,000 psi shear ... 000

... Stresses

The support reactions are ... page A-... The anchor bolts are 5/8 ... The 2 force ... tension load ... shear ...

... maximum ...

$S = (2/3(282 + 841))/.226$ · 3,313 psi tensile Upset

$S = \frac{282 + 841}{.226}$ = 4,969 psi Faulted

$V = \sqrt{(544 + 10\quad)^2 + (98 + \quad)^2}/.226$ = 3,530 psi shear

The allowable stresses are 10,000 ps she r and 20,000 psi tensile for A-307 bolts per Upset.

5.4 Shaft Stresses

The shaft is shown on the comp ter model, page 5, as members 52 through 54. The computer output for stress is given on pages A-4 through A-6. The maximum combined stress occurs in member 52 at the end. (see page 11 for properties).

The shearing stress due to tor is

$= \frac{2100}{2(.370)} = 2,838$ psi

Thus, e maximum stresses are:

V = 2,838 psi shear

S_a = 15 + 1171 + 2(730) + 81 10,881 psi Bending Stress

$S = \sqrt{(2(2838))^2 + (10881)^2}$ 12,272 psi Combined Stress

The allowable stress is 1.5(17500) = 26,250 psi for the Tp 416 S.S. shaft.

5.5 Stresses in Support Frame

maximum stress in the bottom base plate occurs in member 8 (page A-7) and i

S = 1118 + 106 + 2(624) + 887 = 11,3 4 psi

The allowable stress is 21,600 psi for the A-36 steel per Subsection NF.

5.6 Casing/Frame Flange Analysis

The casing/frame flange is a flat face flange with a full face gasket. There is no method given by the ASME Code to evaluate this type flange. However, the flange has been qualified for internal pressure by hydrostatic tests and service experience. Since the resultant nozzle loads must be zero due to the pump foot stress, see Section 5.9 for foot stress with zero nozzle loads, there are negligible loads on this flange other than internal pressure.

5.7 Nozzle Analysis

The 8" discharge and 8" suction nozzles must be checked for their ability to withstand the external loads.

1. Discharge Nozzle

The discharge nozzle-casing intersection is closely approximated as a tee. The methods of ASME Code ND-3652 are used to perform the analysis. The tee is contoured similar to a welding tee but it is not exactly the same as a welding tee. Thus, to be conservative, the stress intensification factor used for this analysis will be the average between a welding tee and a fabricated tee. (The nomenclature used is that of the ASME Code).

For a welding tee:

$$h = \frac{4.4(.625)}{8.5} = .324 \qquad i = \frac{.9}{(.324)^{2/3}} = 1.91$$

For a fabricated tee:

$$h = \frac{.625}{8.5} = .074 \qquad i = \frac{.9}{(.074)^{2/3}} = 5.11$$

Average Stress Intensification Factor

$$i_{avg} = \frac{1.91 + 5.11}{2} = 3.51$$

$$Z = 3.1416(4.31)^2(.625) = 36.4 \text{ in.}^3$$

M_b = 75648 in-lbs. bending moment; M_t = 0 in-lbs. torsional moment

P = 0 lbs. axial V = 2520 lbs. shear

The moment is resolved to the centerline of the tee:

$$M = 75648 + 11(2520) = 103{,}368 \text{ in-lbs.}$$

Equation (8) of ND-3652.1 gives:

$$\frac{150(9.25)}{4(.625)} + \frac{.75(3.51)(103368)}{36.4} = 8{,}030 < 1.5(16500).8 = 19{,}800 \text{ psi}$$

(SA-351 CF8M at 200° F.)

2. Suction Nozzle

The suction nozzle is treated as a nozzle in a flat plate, Cases 10 and 20 of Roark's Formulas for Stress and Strain, 4th Edition, where for this case:

r_o = 6.75" a = 8" t = .625"

The stress coefficients are given on pages 241 and 242 of Roark's Formulas for Stress and Strain, 4th Edition and are:

β_M = .45 β_P = .12

M_b = 75648 in-lbs. M_t = 0 in-lbs.

P = 2,520lbs. V = 0 lbs.

The stresses are:

$$S_R = \frac{.12(2520)}{(.625)^2} + \frac{.45(75648)}{8\ (.625)^2} = 11{,}667 \text{ psi bending}$$

V = 0 psi

The maximum stress by the shear stress theory is:

$$S = \sqrt{(2(\ 0\ ))^2 + (11667)^2} = 11{,}667 \text{ psi}$$

The allowable stress for SA-351 CF8M material is 1.5(16500)(.8) = 19,800 psi

5.8 Nozzle Flange Analysis

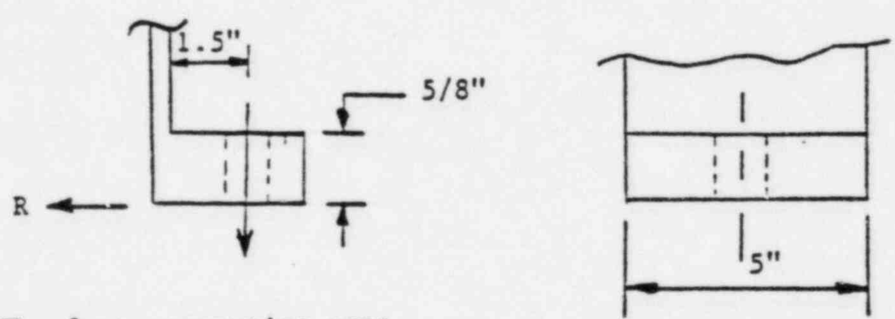
The 8" flanges are ANSI 150# type. Thus, since there are no other known methods of analysis of flanges for external loads, ND-3658.3 (Summer 1978 Addenda) Equation (12) will be used.

The allowable moment on the flange is: M = 6250(25/36)(11.75)(8)(.302) = 123,212 in-lbs

The actual moment is 75,648 in-lbs., thus acceptable. Note that high strength bolts must be used for these connections.

5.9 Pump Foot Stress

The pump foot is as shown below:



The foot properties are:

$$A = .625(5) = 3.125 \text{ in.}^2$$

$$B = \frac{5(.625)^2}{6} = .326 \text{ in.}^3$$

The bolt loads are obtained from Section 5.2 and are:

F = 8021(.226) = 1,813 lbs. Faulted

= 5530(.226) = 1,250 lbs. Upset

R = 2202(.226) = 498 lbs. Faulted

= 1468(.226) = 332 lbs. Upset

$$S = \frac{1813(1.5)}{.326} + \frac{498}{3.125} = 8{,}501 \text{ psi Faulted}$$

$$= \frac{1250(1.5)}{.326} + \frac{332}{3.125} = 5{,}858 \text{ psi Upset}$$

The allowable for Class 25 Cast iron is 6,250 psi Upset and 12,500 psi Faulted.

6. FUNCTIONAL CAPABILITY ANALYSIS

The detailed functional analysis (deflection, rotations, etc.) is contained in this section. The following load conditions is considered: Normal Operating loads + Maximum Nozzle Loads + SSE Loads. The computer analysis is contained in Appendix A.

6.1 Pump Bearing Loads

The pump bearing loads are given on pages A-8 and A-9. The outboard bearing is double row type. Thus, the moment acting on the bearing is converted to an equivalent load by dividing the moment by the centerline distance between rows. Member 49 represents the inboard bearing and member 50 the outboard bearing.

(a) Inboard

Member 49, Joint 17	Total Axial	Total Z
Loading 1	4	0
Loading 2	0	111
Loading 3 (2)	152	0
Loading 4	5	689
Total	161	800
Resultant	816 lbs.	

The inboard bearing is a ND-7610 which has an allowable of 20,253 lbs.

(b) Outboard

Member 50, Joint 18	Total Force Axial	Total Force Z	Total Moment X	Total Moment Z	Total Thrust Y
Loading 1	28	0	0	366	83
Loading 2	0	39	314	0	0
Loading 3(2)	65	0	0	376	0
Loading 4	105	385	742	1204	1000
Totals	198	424	1056	1946	1083

Resultants	468 lbs.	2,214 in-lbs.	1,083 lbs.

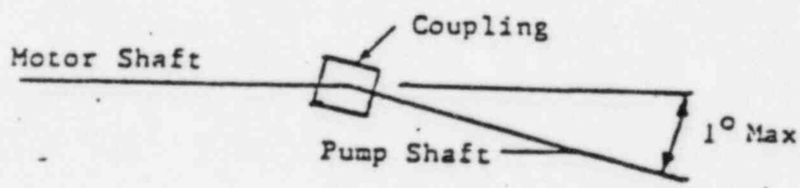
Equivalent loads $= 468 + \frac{2214}{.53} = 4{,}645$ radial + 1083 thrust

The combined loads are: $P = 1.17(4645) = 5{,}435$ lbs.

The outboard bearing is an ND- 5511 which has a specific dynamic capacity of 27,000 lbs., see Appendix D.

6.2 Flexible Coupling Analysis

The coupling is adequate for the normal torsional loads. The seismic and nozzle loads do not impose any additional torsional loads. However, the seismic and nozzle loads do cause bending of the pump and motor shaft, which in turn causes coupling misalignment as shown below:

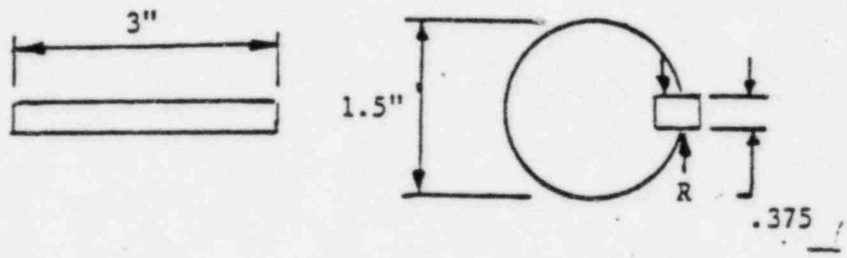


The maximum misalignment must not exceed one degree (.017 radian). This misalignment can be obtained from the computer output as the vector sum of joint 19 (worst case), rotations Y and Z. These rotations are tabulated below, see pages A-10 and A-11.

	Total	
(joint 19)	Y	Z
Loading Case 1	.00000	.00015
Loading 2	.00006	.00000
Loading Case 3(2)	.00000	.00028
Loading Case 4	.00011	.00029
Totals	.00017	.00072
Resultant	.001 radian	

6.3 Impeller Key Analysis

The torque that the impeller key must transmit is practically the same for all loading conditions. This is 2100 in-lbs. operating torque (pg. 13). The forces on the key are shown below:



$$R = \frac{2100\ (2)}{1.5} = 2,800 \text{ lbs.}$$

The shearing stress in the key is:

$$V = \frac{2800}{.375(3)} = 2,489 \text{ psi}$$

The yield stress for the steel key will equal or exceed 40,000 psi. Thus, for shear the allowable stress is: $F_v = .3(40000) = 12,000$ psi.

6.4 Impeller Clearance

The relative deflection between the impeller and pump casing is found by taking the difference of the deflections of joints 9A and 16. The worst case deflections are tabulated below (see pages A-10 & A-11):

Joint 16	Total Y	Total Z
Loading 1	-.00049	.00000
Loading 2	.00000	.00134
Loading 3 (2)	.00016	.00000
Loading 5	-.00679	.01154
Totals	-.00712	.01288

Joint 9A	Total Y	Total Z
Loading 1	-.00054	.00000
Loading 2	.00000	.00044
Loading 3(4)	-.00138	.00000
Loading 5	-.00802	.00692
Totals	-.00994	.00736
Difference (Joint 16 - 9)	.00282	.00552

The total vector deflection is: $D = \sqrt{(.00282)^2 + (.00552)^2} = .0062''$

The clearance on the impeller is .0065". Thus the clearance is adequate.

6.5 Shaft Mechanical Seals

The deflection of the shaft at the mechanical seal is less than .003". Experience indicates that the construction of this seal is such that leakage will not occur when subjected to this small amount of shaft deflection.

MEMBER 39

LOADING - 1 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-1922.72217	-1185.44971	61.54852	-0.00000	0.00000	-1922.72217	-1922.72217

LOADING - 2 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	3942.78442	1339.87427	2540.26416	0.00000	0.00000	3942.78442	3942.78442

LOADING - 3 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	802.73218	142.53601	32.33104	-0.00000	-0.00000	802.73218	802.73218

LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	1238.14966	-397.41113	-145.30745	-0.00000	0.00000	1238.14966	1238.14966

MEMBER 18

* LOADING - 1 — 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
1.000 FR	2391.47876	-1012.98779	218.34358	0.0	0.0	2391.47876	2391.47876

* LOADING - 2 — 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
1.000 FR	7081.07422	-33.86034	1720.06055	0.0	0.0	7081.07422	7081.07422

* LOADING - 3 — 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
1.000 FR	1137.63062	-1.99727	109.85068	0.0	0.0	1137.63062	1137.63062

* LOADING - 4 — UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
1.000 FR	66272.56250	22.59938	26360.15625	0.0	0.0	66272.56250	66272.56250

RESULTS OF LATEST ANALYSES

JOB ID - ME-894 JOB TITLE - CRANE DEMING FIGURE 4066 PUMP

ACTIVE UNITS - LENGTH INCH FORCE LB ANGLE RAD TEMPERATURE DEGF TIME SEC

ACTIVE STRUCTURE TYPE - SPACE FRAME

ACTIVE COORDINATES AXES X Y Z

LOADING - 1 1.5 G LATERAL X

RESULTANT JOINT LOADS - SUPPORTS

JOINT		X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	GLOBAL	-543.81226	-281.97754	-98.10873	-0.00000	-0.00000	0.00000
2	GLOBAL	-543.81226	-281.97754	98.10873	0.00000	0.00000	0.00000
42	GLOBAL	-469.18750	281.97754	14.93389	-0.00000	-0.00000	-0.00000
43	GLOBAL	-469.18750	281.97754	-14.93389	0.00000	-0.00000	0.00000

LOADING - 2 1.5 G LATERAL Z

RESULTANT JOINT LOADS - SUPPORTS

JOINT		X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	GLOBAL	-10.48480	-840.68018	-476.38843	-0.00000	0.00000	-0.00000
2	GLOBAL	10.48480	840.68018	-476.38843	-0.00000	0.00000	-0.00000
42	GLOBAL	419.89697	-982.11490	-536.61133	0.00000	0.00000	0.00000
43	GLOBAL	-419.89697	982.11490	-536.61133	0.00000	-0.00000	0.00000

LOADING - 3 1 G VERTICAL

RESULTANT JOINT LOADS - SUPPORTS

JOINT		X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	GLOBAL	-86.60847	-365.85034	-10.38511	-0.00000	0.00000	-0.00000
2	GLOBAL	-86.60847	-365.85034	10.38511	0.00000	-0.00000	-0.00000
42	GLOBAL	86.60847	-309.14941	-20.91550	0.00000	0.00000	0.00000
43	GLOBAL	86.60847	-309.14941	20.91550	-0.00000	0.00000	0.00000

LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

RESULTANT JOINT LOADS - SUPPORTS

JOINT		X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	GLOBAL	99.19252	-7488.57812	-3450.40161	-0.00000	-0.00000	0.00000
2	GLOBAL	-536.99194	6488.37109	-3162.02856	0.0	-0.00000	0.00000
42	GLOBAL	-284.38403	349.04517	676.93970	-0.00000	-0.00000	0.00000
43	GLOBAL	-277.81641	651.16064	635.49023	0.00000	-0.00000	0.00000

RESULTS OF LATEST ANALYSES

JOB ID - ME-894 JOB TITLE - CRANE DEMING FIGURE 4066 PUMP

ACTIVE UNITS - LENGTH INCH FORCE LB ANGLE RAD TEMPERATURE DEGF TIME SEC

ACTIVE STRUCTURE TYPE - SPACE FRAME

ACTIVE COORDINATES AXES X Y Z

INTERNAL MEMBER RESULTS

MEMBER NORMAL STRESS

MEMBER 52

LOADING - 1 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
6.120	-18.75000	0.0	0.0	0.00000	-0.00000	-18.75000	-18.75000
9.625	-14.90066	0.0	0.0	0.00000	0.00000	-14.90066	-14.90066

LOADING - 2 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
6.120	0.0	0.0	0.0	-523.57397	-0.00000	523.57397	-523.57397
9.625	0.0	0.0	0.0	-1170.60815	-0.00000	1170.60815	-1170.60815

LOADING - 3 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
6.120	0.0	0.0	0.0	0.00000	349.04932	349.04932	-349.04932
9.625	0.0	0.0	0.0	-0.00000	780.40552	780.40552	-780.40552

LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
6.120	-416.66650	0.0	0.0	-3490.49536	-0.00000	3073.82606	-3907.16187
9.625	-331.12573	0.0	0.0	-7804.05078	0.00000	7472.92187	-8135.17578

MEMBER 53

LOADING - 1 — 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-11.30653	0.0	0.0	-0.00000	-0.00000	-11.30653	-11.30653
1.000	-11.30653	0.0	0.0	0.00000	-30.38475	19.07822	-41.69127

LOADING - 2 — 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-0.00000	0.0	0.0	-386.71851	0.00000	386.71851	-386.71851
1.000	-0.00000	0.0	0.0	154.81378	-0.00000	154.81378	-154.81378

LOADING - 3 — 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-0.00000	0.0	0.0	-0.00000	257.81226	257.81226	-257.81226
1.000	-0.00000	0.0	0.0	-0.00000	-120.17957	120.17957	-120.17957

LOADING - 4 — UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-251.25624	0.0	0.0	-2578.12402	0.00001	2326.86768	-2829.38013
1.000	-251.25624	0.0	0.0	631.32471	-44.15070	424.21899	-926.73145

MEMBER 54

LOADING - 1 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
	STRESS						
0.0 FR	21.59091	0.0	0.0	-0.00000	1002.03857	1023.62939	-980.44751
1.000	21.59091	0.0	0.0	-0.00000	334.01294	355.60376	-312.42188

LOADING - 2 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
	STRESS						
0.0 FR	0.00000	0.0	0.0	-425.16235	-0.00001	425.16235	-425.16235
1.000	0.00000	0.0	0.0	126.15424	-0.00000	126.15424	-126.15424

LOADING - 3 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
	STRESS						
0.0 FR	0.00000	0.0	0.0	-0.00000	160.78496	160.78496	-160.78496
1.000	0.00000	0.0	0.0	-0.00000	-122.63863	122.63863	-122.63863

LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
	STRESS						
0.0 FR	-0.00000	0.0	0.0	-104.96806	3486.90503	3591.87305	-3591.87305
1.000	-0.00000	0.0	0.0	-34.98936	1162.30176	1191.29102	-1191.29102

MEMBER 8

LOADING - 1 1.5 G LATERAL X

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	13.30553	0.0	0.0	11.07279	1093.98975	1118.36792	-1091.75684
1.000	13.30553	0.0	0.0	0.03833	-1197.83765	1211.18140	-1184.57031

LOADING - 2 1.5 G LATERAL Z

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	0.30902	0.0	0.0	40.23249	-65.16414	105.72563	-105.10760
1.000	0.30902	0.0	0.0	58.55238	215.98392	274.84497	-274.22105

LOADING - 3 1 G VERTICAL

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	12.83088	0.0	0.0	0.81043	-610.20386	623.84499	-598.20313
1.000	12.83088	0.0	0.0	-4.38170	-1205.57884	1222.79126	-1197.12939

LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

DISTANCE FROM START	AXIAL	Y SHEAR	Z SHEAR	Y BENDING	Z BENDING	MAX NORMAL	MIN NORMAL
0.0 FR	-47.42711	0.0	0.0	-723.34277	8101.47264	8777.38281	-8872.23828
1.000	-47.42711	0.0	0.0	-309.91455	2990.58301	3255.07031	-3347.92456

RESULTS OF LATEST ANALYSES

JOB ID - ME-894 JOB TITLE - CRANE DEMING FIGURE 4066 PUMP

ACTIVE UNITS - LENGTH INCH FORCE LB ANGLE RAD TEMPERATURE DEGF TIME SEC

ACTIVE STRUCTURE TYPE - SPACE FRAME

ACTIVE COORDINATES AXES X Y Z

* LOADING - 1 1.5 G LATERAL X

MEMBER FORCES

MEMBER	JOINT	FORCE AXIAL	FORCE SHEAR Y	FORCE SHEAR Z	MOMENT TORSIONAL	MOMENT BENDING Y	MOMENT BENDING Z
25	9	-3.55019	-403.63208	-0.00000	-0.00001	0.00002	-2427.42432
25	10	3.55019	403.63208	0.00000	0.00001	-0.00001	1367.88965
49	10	-3.67902	0.0	-0.00000	0.0	0.00000	0.0
49	17	3.67902	0.0	0.00000	0.0	0.0	0.0
50	11	-27.90906	82.99998	-0.00000	0.00000	0.00000	-365.87573
50	18	27.90906	-82.99998	0.00000	-0.00000	0.00000	365.70557

* LOADING - 2 1.5 G LATERAL Z

MEMBER FORCES

MEMBER	JOINT	FORCE AXIAL	FORCE SHEAR Y	FORCE SHEAR Z	MOMENT TORSIONAL	MOMENT BENDING Y	MOMENT BENDING Z
25	9	0.00000	-0.00000	-333.45679	75.33842	2498.78979	-0.00000
25	10	0.00000	0.00000	333.45679	-75.33842	-1623.46533	0.00000
49	10	-0.00000	0.0	-110.56934	0.0	1.10561	0.0
49	17	0.00000	0.0	110.56934	0.0	0.0	0.0
50	11	0.00000	-0.00000	39.49992	314.12012	-0.39497	0.00000
50	18	-0.00000	0.00000	-39.49992	-314.12012	0.00000	-0.00000

* LOADING - 3 1 G VERTICAL

MEMBER FORCES

MEMBER	JOINT	FORCE AXIAL	FORCE SHEAR Y	FORCE SHEAR Z	MOMENT TORSIONAL	MOMENT BENDING Y	MOMENT BENDING Z
25	9	68.17297	-168.05408	-0.00000	-0.00000	0.00000	-1046.70068
25	10	-68.17297	168.05408	0.00000	0.00000	-0.00000	605.55859
49	10	-75.16768	0.0	0.00000	0.0	-0.00000	0.0
49	17	75.16768	0.0	-0.00000	0.0	0.0	0.0
50	11	32.36580	0.00000	-0.00000	0.00000	0.00000	-187.82091
50	18	-32.36580	-0.00000	0.00000	-0.00000	-0.00000	187.82091

* LOADING - 4 LPSET NOZZLE + IMPELLER LOADS

MEMBER FORCES

MEMBER	JOINT	FORCE AXIAL	FORCE SHEAR Y	FORCE SHEAR Z	MOMENT TORSIONAL	MOMENT BENDING Y	MOMENT BENDING Z
25	9	553.39136	-2601.28467	-2187.07617	14213.48828	29804.37891	-20633.22266
25	10	-553.39136	2601.28467	2187.07617	-14213.48828	-24063.30078	13804.84766
49	10	-5.34581	0.0	-688.60352	0.0	6.88553	0.0
49	17	5.34581	0.0	688.60352	0.0	0.0	0.0
50	11	-104.57472	959.99976	385.29443	741.82813	-3.85266	-1193.61523
50	18	104.57472	-959.99976	-385.29443	-741.82813	-0.00000	1203.61450

RESULTS OF LATEST ANALYSES

JOB ID - ME-894 JOB TITLE - CRANE DEMING FIGURE 4066 PUMP

ACTIVE UNITS - LENGTH INCH, FORCE LB, ANGLE RAD, TEMPERATURE DEGF, TIME SEC

ACTIVE STRUCTURE TYPE - SPACE FRAME

ACTIVE COORDINATES AXES X Y Z

LOADING - 1 1.5 G LATERAL X

RESULTANT JOINT DISPLACEMENTS - SUPPORTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.

RESULTANT JOINT DISPLACEMENTS - FREE JOINTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.
9A	GLOBAL	0.00191	0.00054	-0.00000	-0.00000	-0.00000	-0.00007
16	GLOBAL	0.00191	0.00049	-0.00000	-0.00000	-0.00000	-0.00006
19	GLOBAL	0.00191	-0.00026	-0.00000	-0.00000	-0.00000	0.00015

LOADING - 2 1.5 G LATERAL Z

RESULTANT JOINT DISPLACEMENTS - SUPPORTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.

RESULTANT JOINT DISPLACEMENTS - FREE JOINTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.
9A	GLOBAL	-0.00000	-0.00000	0.00044	0.00003	0.00001	0.00000
16	GLOBAL	-0.00000	-0.00000	0.00134	0.00003	0.00015	0.00000
19	GLOBAL	-0.00000	0.00000	0.00073	0.00005	-0.00006	-0.00000

* LOADING - 3 1 G VERTICAL

RESULTANT JOINT DISPLACEMENTS - SUPPORTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.

RESULTANT JOINT DISPLACEMENTS - FREE JOINTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.
9A	GLOBAL	-0.00177	-0.00069	-0.00000	-0.00000	-0.00000	0.00012
16	GLOBAL	-0.00177	-0.00008	-0.00000	-0.00000	-0.00000	0.00003
19	GLOBAL	-0.00177	0.00274	-0.00000	-0.00000	-0.00000	0.00014

* LOADING - 4 UPSET NOZZLE + IMPELLER LOADS

RESULTANT JOINT DISPLACEMENTS - SUPPORTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.

RESULTANT JOINT DISPLACEMENTS - FREE JOINTS

JOINT		X DISP.	Y DISP.	Z DISP.	X ROT.	Y ROT.	Z ROT.
9A	GLOBAL	0.01533	0.00802	0.00692	0.00056	0.00062	-0.00129
16	GLOBAL	0.01552	0.00679	0.01134	0.00014	0.00122	-0.00103
19	GLOBAL	0.01531	-0.01693	0.00019	0.00002	0.00011	-0.00029

APPENDIX B - NOMENCLATURE AND FORMULAS

S = Tensile Stress

V = Shearing Stress

S_{max} = The maximum combined stress, combined by the maximum shear stress theory

S_b = A bending stress, usually equal to M/Z; M = moment, Z = Sect. Modulus

R = A shearing force

Y = The vertical direction

X = Direction parallel to the shaft centerline

$V = T/J$, shaft shearing stress where T = torque and $J = 2Z$ = torsional modulus

F_v = Allowable shearing stress for bolts:

> F_v = 10,000 psi for A 307 bolts per the AISC Code and NF-3281 & Appendix XVII of the ASME Section III Code.
>
> F_v = 12,320 psi for A 325 bolts per above references.

F_t = Allowable tensile stress for combined loading per the AISC Code and also per Appendix XVII-2461.3 of the ASME Section III Code.

APPENDIX C - FREQUENCIES AND MODE SHAPES

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******************************
*RESULTS OF LATEST ANALYSES*
******************************

JOB ID -  ME-894        JOB TITLE - CRANE DEMING FIGURE 4066 PUMP
ACTIVE UNITS -  LENGTH       FORCE        ANGLE        TEMPERATURE       TIME
                INCH         LB           RAD          DEGF              SEC

ACTIVE STRUCTURE TYPE - SPACE   FRAME
ACTIVE COORDINATES AXES  X Y Z


     EIGENVALUES
MODE-------EIGENVALUE--------FREQUENCY--------PERIOD------------RADIANS--/
  1      0.6321670 05     0.4001670 02     0.2498990-01     0.2514290 03
  2      0.4455530 06     0.1062350 03     0.9413050-02     0.6674910 03

     EIGENVECTORS

     MODE   1
 JOINT             /-------------------DISPLACEMENT--------------------//--------------------ROTATION--------------------/
                         X DISP.          Y DISP.          Z DISP.            X ROT.           Y ROT.           Z ROT.
  9A      GLOBAL      -0.8474302      -0.3650221       0.0000000
  11      GLOBAL      -0.8462566       0.6892098       0.0000000
  16      GLOBAL      -0.8476846      -0.4011747       0.0000000
  19      GLOBAL      -0.8512921       0.9599991       0.0000000
  31      GLOBAL       0.5551793       0.4323627       0.0000000

     MODE   2
 JOINT             /-------------------DISPLACEMENT--------------------//--------------------ROTATION--------------------/
                         X DISP.          Y DISP.          Z DISP.            X ROT.           Y ROT.           Z ROT.
  9A      GLOBAL       0.9999996       0.2363016       0.0000001
  11      GLOBAL       0.9903573      -0.0512676       0.0000000
  16      GLOBAL       0.9977243       0.8218161       0.0000023
  19      GLOBAL       0.9944583       0.6532454       0.0000000
  31      GLOBAL       0.8439249       0.5941478      -0.0000000
```

APPENDIX D - NEW DEPARTURE BEARING ALLOWABLE LOADS

The allowable loads for Delco New Departure bearings subjected to short term seismic plus nozzle imposed loads are established in accordance with the method outlined below. New Departure Catalog 2C-110, pages 58 to 62, gives:

$$\text{Average Life, } L = 3800\left(\frac{R_R}{R_E}\right)^4$$

R_R = .86(4000) = 3,440 lbs. (ND-5511)
= .86(3000) = 2,580 lbs. (ND-7610)

R_E = Allowable Equivalent Radial Load, Lbs.

Since the maximum duration of an earthquake is no more than one minute, it is conservative to set the life, L, to be equal to one hour. Thus, solving for the maximum allowable seismic load:

$R_E = R_R(3800)^{1/4}$ = 3440(7.85) = 27,000 lbs. (ND-5511)
2580(7.85) = 20,253 lbs. (ND-7610)

Appendix E - Member Properties

Members
1 TO 10

½ of 18" Channel @ 45.8#

members
11 12

¼" x 3½" bars

A = .875 I_y = .0046 in⁴. I_z = .89

S_y = .036 in³. S_z = .509 in⁴.

Members
13 14 15 64, 65, 66 & 31 TO 36

.5" web x 12t = .5 x 6"

A = 3 in².

I_y = .0625 I_z = 9.

S_y = .25 S_z = 3.

Members 16 TO 19, 37 TO 40

Bolts 5/8"φ A = .226

Membs 20 to 26 61 62 63 67

CASING & FRAME

Conservatively $6\frac{1}{2}$" O.D. x $5\frac{1}{2}$" I.D.

$A = 9.4 \quad I_X = 85 \quad I_Y = I_Z = 42.5 \text{ in}^4$

$S_Y = S_Z = 13.1 \text{ in}^3$

NOTE: FRAME PROPERTIES REDUCED TO CONSERVATIVELY ACCOUNT for CAST IRON MODULUS OF ELASTICITY.

27 TO 30

Shim for Motor

Assume RIGID

41 TO 48 MOTOR

18" O.D. x 1/8" Thick

$A = 7. \quad I_X = 560 \quad I_y = I_Z = 280$

$S_Y = S_Z = 31$

49 TO 51

Dummy Members for Bearings

52 SHAFT

Seg 1 D=1.75" L=6.125"

$A = 2.40 \quad I_X = .96 \quad I_Y = I_Z = .46 \text{ in}^4$

$S_Y = S_Z = .526 \text{ in}^3$

SEG 2 D= 1.96" L= 3.25"

A= 3.02 IX = 1.44 IY .72 IZ = .72

Sy = Sz = .370

Memb 53 SHAFT

2.25" Φ A= 3.98 IX = 2.52 Iy = Iz = 1.26

Sy = Sz = 1.12

Memb 54 SHAFT

1.5" Φ

A = 1.76 IX = .497 IY = IZ = .25

Sy = SZ = .331

Membs 55 TO 58 Motor SHAFT & Cplg

1.875" Φ

A = 2.76 IX = 1.21 IY = IZ = .60

Sy = SZ = .647 in^3

ENCLOSURE 5

SEISMIC QUALIFICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) Status of PE Confirmatory Items
Attachment (2) Seismic Qualification Completion Schedule

December 3, 1982

RESPONSE TO CE/PLANT ENGINEERING CONFIRMATORY ITEMS FROM WATERFORD UNIT #3 SQRT RE-AUDIT

ITEM	COMMENTS/RESPONSE
GENERIC	<u>Comment:</u> It was noticed that during the review of NSS-PE-10 (Deborating Ion Exchanger), NSSS-PE-15 (Purification Filter) and NSSS-PE-33 (Holdup Tank), nozzle loads were negelected in the stress analysis. This seems to be a generic pattern. <u>Response</u> Nozzle loads for this equipment (seismic category tanks, HXS, Filters and Ion Exchangers) were originally simulated in the seismic analyses by increasing the seismic acceleration loading imposed on these components. This simulation was considered to be conservative because the component supports were judged to be more highly loaded than they would be if the appropriate siesmic and nozzle loads were considered. In response to the SQRT audit concern, a follow-on effort has been initiated to confirm that the original approach was conservative. All of the design reports for the applicable CE equipment have been reviewed and nozzle loads have been directly evaluated to determine their effect on component supports. In all cases, the original support loadings were more severe. All nozzle-to-shell juncture stresses were also evaluted and found to be within acceptable levels.
GENERIC	<u>Comments</u> Status of equipment not yet seismically qualified and their qualification schedule should be provided to NRC. This status should be submitted monthly until completion of qualification of all safety related equipment. <u>Response</u> Status is given on Attchment (2)

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-1 SQRT NO. NSSS-PE-14 BA MAKEUP PUMP SPECIFIC ITEM: PUMP B	COMMENT 1. Explain basis for load cases 4 & 5 and show that they are conservative. Response Load Case 4 is "nozzle plus impeller loads in the x-direction". Load Case 5 is "nozzle plus impeller loads in the z-direction". CE has reviewed these loading cases in detail and confirms that these loadings encompass the most severe direction possible for the application of nozzle loads. Comment 2. Explain load combinations used for computing bolting stress and show that they are conservative. Response The load combinations used for computing bolt stresses include those loads from seismic accelerations in both transverse directions (note that a vertical acceleration would have no effect on the bolts), impeller loads, and nozzle loads in the most severe direction. CE has reviewed these loads and confirms that they are conservative.
Item No. NSSS-2 SQRT NO. NSSS-PE-25 BORIC ACID TANK CIRC. VALVE SPECIFIC ITEM: 3CH-F171B	Comment 1. Provide certification that the computer calculation based on Engineering Standard ES100, Rev. B dated 4/8/75 have been verified. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before January 1, 1983 Comment 2. Confirm that deflections calculated in Seismic Analysis for Order 1-46610 dated April 3, 1976 for tag number CH-511 will not interfere with valve closure. Response Same as Previous Response.

ITEM	COMMENTS/RESPONSE
ITEM NO. NSSS-5 SQRT NO. NSSS-PE-52 FW CONTROL VALVE SPECIFIC ITEM: 5FW-FM834	Comment Verification of computer program ES100, Rev. B (4/8/75) performed for Item NSSS-PE-25. Results will also be applicable here. Response CE has contacted the vendor on this issue and is currently awaiting a reply. This reply is expected before January 1, 1983

NSSS-
Plant Engineering (PE)

SEISMIC QUALIFICATION COMPLETION SCHEDULE

ATTACHMENT 2

Pg 1 of 1

P.O./SPEC	EQUIPMENT (TAG NOS.)	SQRT FILE NO.	QUALIFICATION SCHEDULE	INSTALLATION SCHEDULE
910204 9270-PE 704 Rev 04	BM 307 (CE Tag) Fisher 3" valve	NSSS-PE-36 Rev 1	*	
9102040 9270-PE 704 Rev. 04	CH 210 Y Fisher 1" valve	NSSS-PE-26 Rev 1	*	
9102040 9270-PE 704, Rev. 04	CH 512 Fisher 3" Valve	NSSS-PE-27 Rev 1	*	

* See CE Letter FJM-553-82 dated Nov. 4, 1982

ENCLOSURE 6

SEISMIC QUALIFICATION REVIEW TEAM

RE-AUDIT FOLLOW UP

Attachment (1) Documentation of Telephone Conversation

January 18, 1983

DOCUMENTATION OF TELEPHONE COMMUNICATIONS

DATE: 1/18/83 **TIME:** 10:00 **A.M., XPXMX**

PARTY CALLING: Jim Wilson (Name) NRC (Company)

PARTY ANSWERING: Sharon Jones (Name) LP&L (Company)

SUBJECT: Seismic Qualification Review Team Second Audit Trip Report **FILE:** 3-A20.18 3-A1.04.02

SUMMARY: (INCLUDING DECISIONS AND OR COMMENTS)

Participating in the conference call were:

Jim Wilson	NRC	Dick Macek	EG&G
Jerry Jackson	NRC	Mark Williams	LP&L
Jag Singh	EG&G	Bob Foley	LP&L
Mark Russell	EG&G	Sharon Jones	LP&L

The purpose of this call is to reach an agreement by all parties to know "where we stand" on generic issues and specific items relating to seismic qualification.

REFERENCE: Second Trip Report for Seismic Criteria Implementation Review Meeting with Louisiana Power & Light Company (LP&L) on Waterford Nuclear Power Station Unit 3: T. Y. Chang to Vincent S. Noonan - December 13, 1982.

The eight (8) specific open items in the referenced document were discussed as follows:

1. Control Components (BOP-E-68) Closed

2. Pressure Switch (NSSS-ICE-16) Closed
   Low Oil Pressure Switch (NSSS-PE-31)

ACTION REQUIRED:

DISTRIBUTION: R. W. Prados, R. M. Foley, M. G. Williams, S. M. Jones, Kanti Gala, H. B. Mulliken (CE), John Hart (Ebasco), John Tompeck (Ebasco), John Zudans (NUS) Jerry Jackson (NRC), Jim Wilson (NRC), Jag Singh (EG&G)

DOCUMENTATION OF
TELEPHONE COMMUNICATIONS

DATE: 1/18/83 TIME: 10:00 A.M., XPXMX

PARTY CALLING: Jim Wilson (Name) NRC (Company)

PARTY ANSWERING: Sharon Jones (Name) LP&L (Company)

SUBJECT: Seismic Qualification Review Team Second Audit Trip Report FILE:

(Cont'd) SUMMARY: (INCLUDING DECISIONS AND OR COMMENTS)

3. Boric Acid Makeup Pump (NSSS-PE-14) Closed

4. Boric Acid Tank Circulating Valve (NSSS-PE-25) Confirmatory
LP&L is awaiting a vendor reponse. Sharon will try to have a telecopy sent to NRC and EG&G this week.

5. Holdup Tank C (NSSS-PE-33) ?
LP&L will confirm that modifications have been made. May/may not be tagged as a confirmatory item.

6. Resister Input Card (NSSS-ICE-5a) EG&G
Under EG&G review. Should be completed by next SER.

7. 1151 Indicator (NSSS-ICE-8-1) ?
LP&L will submit analyses when it is complete. May/may not be tagged as a confirmatory item.

8. CEDM Reed Switch Position Transmitter (NSSS-ICE-15) Closed

ACTION REQUIRED:

DISTRIBUTION:

DOCUMENTATION OF
TELEPHONE COMMUNICATIONS

DATE: 1/18/83 TIME: 10:00 A.M., P.M.

PARTY CALLING: Jim Wilson (Name) NRC (Company)

PARTY ANSWERING: Sharon Jones (Name) LP&L (Company)

SUBJECT: Seismic Qualification Review Team Second Audit Trip Report FILE:

(Cont'd) SUMMARY: (INCLUDING DECISIONS AND OR COMMENTS)

Six generic issues were mentioned in the report discussion:

1. Next status report will be issued 1/21/83. Closed
2. Ebasco is re-verifying. Work should be complete mid-February.
3. In Service Inspection Programs will be submitted to a different branch of NRC.
4. LP&L will respond when review is complete.
5. Closed.
6. Will be followed up by NRC resident inspector.

It is our understanding that there are no "open" items remaining, and that the next SER supplement will reflect this position.

ACTION REQUIRED:

As mentioned in Specific Items 4, 5, 7 and Generic Issues 1, 2, 4.

DISTRIBUTION: