JUNE 10, 1987

SEISMIC EVENT REPORT

CLINTON POWER STATION

ILLINOS POWER COMPANY

PROJECT NO. 7685-22

DATE: JUNE 12, 1987

Sargent & Lundy
Chicago, Illinois

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1.0 Introduction

This report presents the recorded data and the effects of the June 10, 1987, southeastern Illinois earthquake on the Clinton Power Station.

2.0 Event Description

An earthquake was felt at the Clinton Power Station at approximately 6:50 p.m., June 10, 1987. According to the National Earthquake Information Center in Golden, Colorado, the earthquake registered 5.0 on the Richter scale and was centered in Lawrenceville in southeastern Illinois. Lawrenceville is approximately 120 miles from the Clinton site.

Following evaluation of site seismic data, an Unusual Event was declared at 3:55 a.m. on June 11, 1987, in accordance with site procedures. The event was terminated ten minutes later following notification of State and Federal agencies.

3.0 Plant Operation

The plant was operating at approximately 20% power when the earthquake occurred. The plant continued to operate during and after the earthquake. None of the equipment, including the turbine-generator, malfunctioned or tripped on protective signals during or after the event. This leads us to believe that the vibratory levels at the Clinton station were small and did not affect the integrity of the plant equipment.

Note that during the January 31, 1986, Perry earthquake (also a magnitude 5.0 earthquake occurring approximately 20 miles from the Perry Nuclear Plant) two pieces of non-safety equipment tripped due to protective signals. (Reference: Letter from M. E. Edelman to H. R. Denton dated February 5, 1986, Letter No. PY-CEI/NRR-0433L).

4.0 Plant Walkdown

Shortly after the event, the Shift Supervisor initiated a plant walkdown by equipment operators to evaluate for potential damage. Approximately five hours after the event, the plant was again inspected for any indication of unusual happenings or damage. This second walkdown was performed by joint teams of Illinois Power and Sargent & Lundy personnel; the walkdown inspection attributes for various plant locations are presented in Table 1.

The walkdowns did not identify any visual indication of cracks, spalls, pipe or valve leaks, distortion of steel beams, cable trays or cantilever supports, equipment dislocation or any other damage.

The walkdowns indicate that the plant structures and systems were not affected by the low level of earthquake vibratory motions.

The low level of vibratory motions at the site is also confirmed by the lack of any damage or dislocation of contents of numerous non-seismic temporary office buildings at the site (books falling off the shelves, dislocation of cabinets and desk, etc.).

5.0 Clinton Plant Seismic Instrumentation

Section 3.7.4 of the Clinton FSAR outlines the seismic instrumentation at the Clinton power plant. The time history system (FSAR Section 3.7.4.2.1) and related response spectrum generation instrument were not operating at the time of the earthquake event. The inoperable status of this instrumentation was reported to the NRC per Illinois Power letter No. U-600941, dated May 21, 1987. The inoperable status of the instrumentation was the result of a lightening strike affecting the free field instrumentation a few weeks prior to the earthquake. Thus, no earthquake data was recorded by any of the active seismic instrumentation located at the plant during this period.

The passive instrumentation consisting of the Triaxial Response Spectrum Recorder at elevation 699' in the Circulating Water Screen House and the three Triaxial Peak Accelerographs located within the main plant did record the event.

6.0 Response Spectra Data

A passive response spectrum recorder is located at elevation 699' in the Circulating Water Screen House. This instrument consists of 12 reeds in each of three orthogonal directions tuned to different frequencies encompassing a significant portion of the seismic response spectra. The peak response of each of the reeds is recorded on scratch plates. The recorded data was received by S&L on June 11 and transmitted formally on June 12, 1987, per FPR 201,600 (Attachment A).

Figure 1, 2 and 3 present a comparison of the recorded response data points in the vertical, north-south and the east-west direction with the corresponding design OBE and SSE spectra. All spectra are for a 2% damping.

It can be observed that the vertical and the N-S recorded spectra are enveloped by the corresponding OBE spectra. The recorded E-W spectra is also enveloped by the corresponding OBE response spectra except at 20 Hz and 25 Hz.

All recorded responses are lower than the corresponding SSE spectra.

In our opinion, these comparisons show that the recorded event at Clinton was well below the OBE event for the following reasons:

A. At 34 of the 36 response frequencies, the recorded acceleration is substantially below the OBE spectra. The OBE spectra is an 84 percentile spectra. Thus, there is a 16% chance that at some frequencies the spectra may be exceeded for a given event. The recorded data exceeds the OBE spectra at only 2 of the 36 points.

B. The exceedance at two of the frequencies (20 Hz and 25 Hz) is indicative of high frequency contents of the ground motion and thus, is not significant (see NUREG-0887, Safety Evaluation Report, Supplement No. 9, Perry Nuclear Power Plant, March 1986). It is not unusual for lower magnitude earthquakes to have high amplitude, high frequency peak accelerations of limited durations. These high frequency peak accelerations are usually of short duration and little energy and do not cause damage.

C. The response spectrum recorder is passive equipment. If prior to the earthquake the instrument was bumped, imparting a shock, the recorded reading may be indicative of the magnitude of this shock and not the earthquake motion. This is more likely to affect the high frequency recording.

7.0 <u>Triaxial Peak Accelerograph Data</u>

Three triaxial peak accelerographs, each measuring the absolute peak acceleration in three orthogonal directions are located as follows:

A. IVR-EM012 located in Auxiliary Building, Elevation 718' on shutdown service water piping.

B. IVR-EM013 located in the Diesel Generator Building, Elevation 729' on top of diesel oil storage tank.

C. IVR-EM011 located in the Containment Building Elevation 791' on top of the Stand-by Liquid Control tank.

The recorded data was received by S&L on June 11 and transmitted formally on June 12, 1987, per FPR 201,600 (Attachment A).

The recorded data for the three instruments is presented in Table 2. The table also presents the OBE and SSE response at these locations. The recorded responses are higher than the OBE and SSE design responses by an order of magnitude. This can only be attributed to erroneous recorded data for the following reasons:

A. The diesel oil storage tank is supported on the base mat and is rigid in the N-S direction and fairly rigid (>10 Hz) in the vertical and E-W direction. The high peak acceleration values recorded (0.79g to 3.9g) are inconsistent with the response spectra recorded at the circulating water screen house, with the plant walkdown data showing no visible adverse effects of the earthquake and the fact that no equipment tripped during the event.

B. The high peak acceleration values for the shutdown service water pipe and the tank, both located near the base mat, are totally inconsistent with a 5.0 magnitude earthquake occurring 120 miles from the site.

C. The +ve and -ve acceleration values during an earthquake are likely to be the same. The recording shows large differences between the +ve and -ve magnitudes of the recorded data. This leads us to conclude that the data is inaccurate and is not the result of the seismic event.

D. The three accelerographs are passive recorders. It is possible that the instruments may have been bumped or the recording strip scratched during installation or removal. The calibration of 0.1" per 5.0g acceleration also makes the recording very susceptible to error. For a 1.0g response, the length of the recorded scratch mark will only be 0.02" long.

Based on the above, we believe that the triaxial accelerograph data is in error and not representative of the earthquake motions in the plant.

8.0 Summary and Conclusion

On June 10, 1987, the Clinton Power Plant structures and systems experienced low level vibratory motions due to an earthquake centered at Lawrenceville in southeastern Illinois. The earthquake measured 5.0 on the Richter scale. Lawrenceville is approximately 120 miles from Clinton.

The plant was operating at about 20% power at the time of the earthquake. It continued to operate during and after the earthquake without incidence. The walkdown of the plant by Illinois Power personnel and Sargent & Lundy engineers did not detect any cracks in walls, leaks at flanges, dislocation of equipment or any other adverse effect on plant structures or systems. Similarly, the earthquake did not cause any damage to the temporary office buildings or their contents (books falling off the shelf, dislocation of cabinets or desks, etc.).

These observations indicate a very low level of vibratory motion at the site.

The response spectra record shows that the vibratory motions were well below the OBE design levels except for two isolated high frequency points in the E-W direction. Based on the low magnitude of response, its high frequency and past evaluation showing lack of damage due to short duration, high frequency motions due to a low magnitude earthquake, it is concluded that the isolated exceedance at two high frequency points is not indicative of vibratory motions larger than the OBE design basis.

The triaxial accelerograph data show extremely high (up to 5.6g) acceleration values. The data is judged to be erroneous as such high g levels are inconsistent with the lack of damage at the plant or the surrounding area and the fact that equipment trips did not occur. The data is also not zero mean data, expected during an earthquake event. The triaxial recorded data should be discounted.

In conclusion, the vibratory motions at the Clinton site were well below the plant design OBE level and the plant structures and systems were unaffected by the earthquake.

TABLE 1

PARAMETERS TO EXAMINE

Location: General Area Parameters

Obvious spalling of concrete

Obvious damage to concrete walls

Leakage of flanges/nozzles

Expansion anchors pulled out

Embeds pulled out; spalling of concrete on edge

Distortion of cable trays/HVAC ducts

Distortion of end brackets on hangers/snubbers

Location: Control Building Elevation 800'

Check masonry block walls all around/near attachments for cracks, spalling of paint/mortar.

Check any expansion anchors for obvious damage; particularly any with cantilever members.

Check any accessible cable trays for any unusual displacement or buckling.

Check any accessible HVAC duct for any unusual displacement or buckling.

Location: Containment- Outside Drywell (All Elevations)

Check connections on radial beams for any indication of movement or damage.

Check accessible equipment for leakage at nozzles.

Check mirror insulation for crushing, gaps, movement.

Check any expansion anchors for obvious damage, particularly any with cantilever members.

Check any visible embed connections for spalled concrete at embed edge.

Check any snubber end brackets for any obvious distortion (possible locked snubber).

Check "shake space" for any obstructions, concrete crushing.

TABLE 1 (CON'T)

Location: Main dam

Check strip chart and remove, document any drop in lake level.

Look at overflow discharge; document any excessive flow (document depth of water at discharge).

Location: Screen House

Look for water seepage in pipe chase for SX piping (access was unavailable).

Look for enlarging of cracks.

Look for any expansion anchors with visible damage.

Look at bolted pipe flanges for damage.

Look at spalling at embeds and anchored penetrations.

Locations: RHR Bay

Look at lateral restraints for any distortion, embed damage.

Look at RHR nozzles for any obvious leakage.

Look at any concrete expansion anchors for obvious distortion, damage, pulled anchors.

SARGENT & LUNDY
ENGINEERS

TABLE 2

FG112

COMPARISON OF TRIAXIAL ACCELEROGRAPH RECORDED OBE AND SSE DATA (gs)

LOCATION		E - W +	E - W -	VERTICAL +	VERTICAL -	N - S +	N - S -
1. Diesel Oil Storage Tank DG Bldg.EL.729'	Recorded	>3.9	.78	2.2	.98	.78	.39
	OBE } *design*	.11	.11	.11	.11	.11	.11
	SSE } *spectra*	.25	.25	.25	.25	.25	.25
		~ 50 Hz					
2. Shutdown Service Water Pipe, Aux. Bldg. EL.718'	Recorded	1.4	1.37	1.6	.78	1.8	1.56
	OBE	.175	.175	.162	.162	.297	.297
	SSE	.237	.237	.273	.273	.396	.396
		14 - 25 Hz					
3. Standby Liquid Control Tank, Cont. Bldg. EL.791'	Recorded	>5.5	2.9	2.4	1.18	>1.8	0
	OBE	.18	.18	.23	.23	.18	.18
	SSE	.34	.34	.53	.53	.34	.34

NOTE: The positive reading report is the larger of the two measurements taken at each accelerograph.

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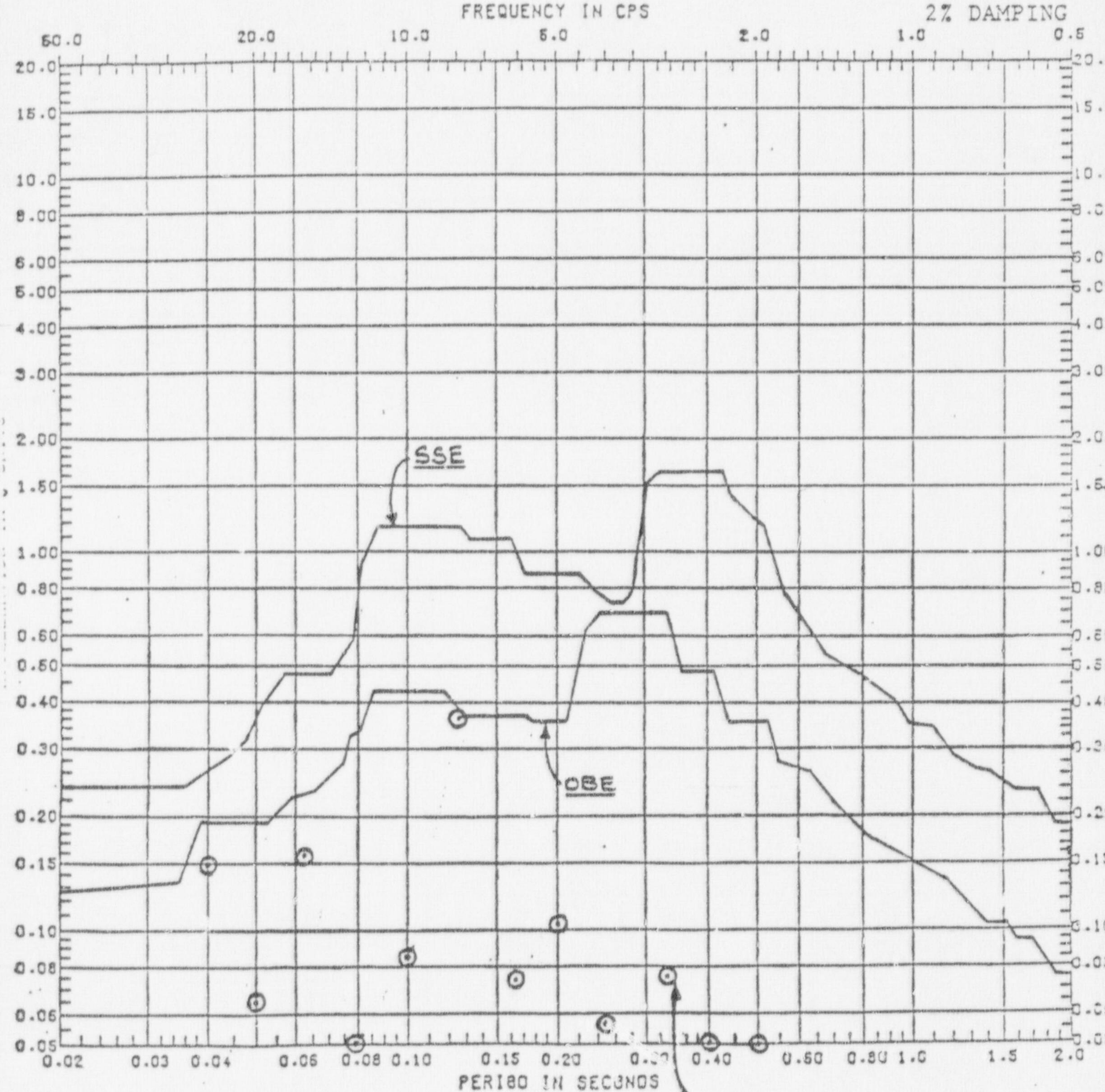
JUNE 10, 1987 SEISMIC RESPONSE



SPECTRA VERTICAL

CLINTON UNIT-1
CIRCULATING WATER SCREEN HOUSE
ELEVATION 699'-0"

LOCATION MAIN FLOOR

FIGURE-1

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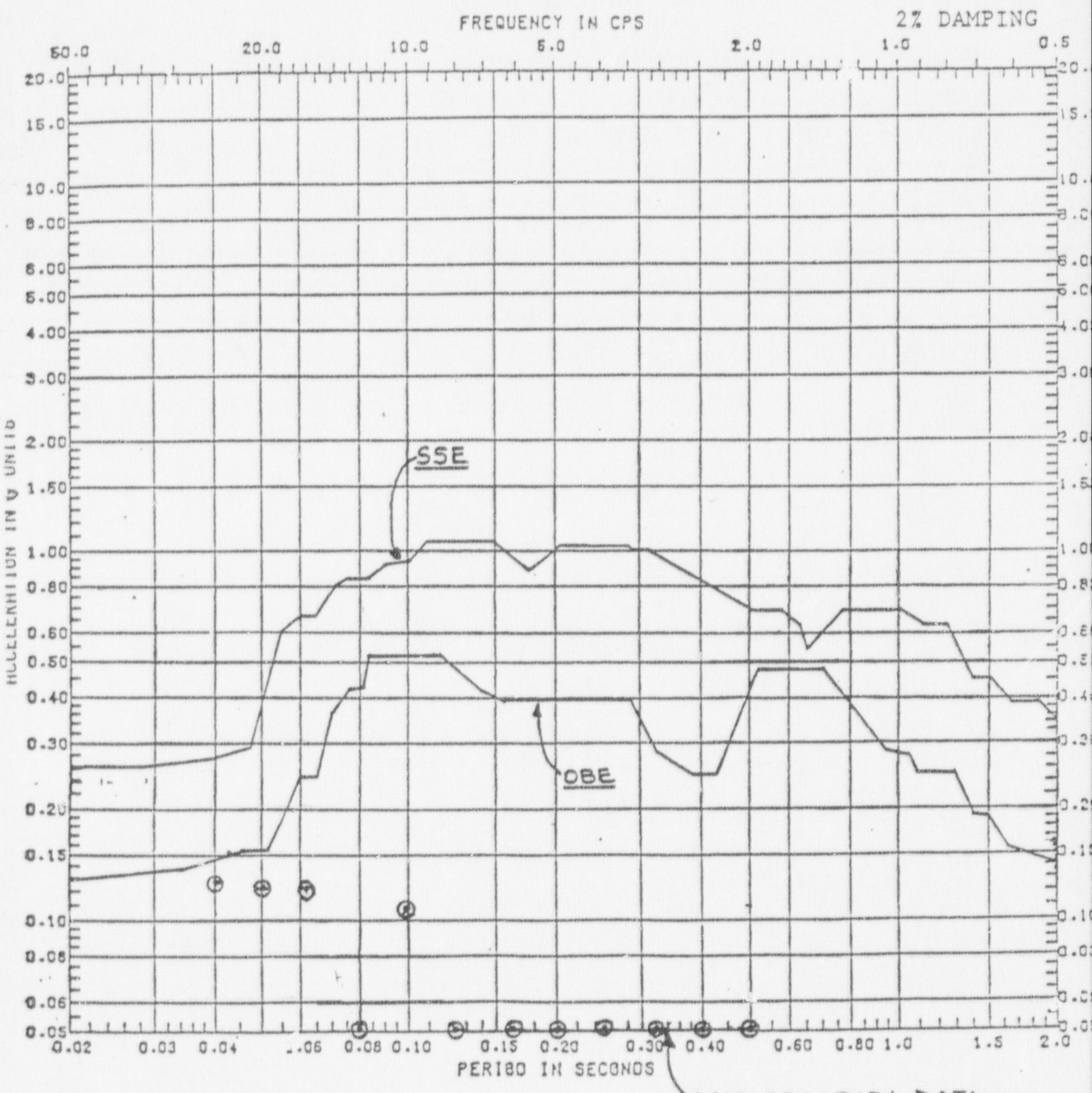
ENGINEERS

JUNE 10, 1987 SEISMIC RESPONSE



SPECTRA HORIZONTAL - NS

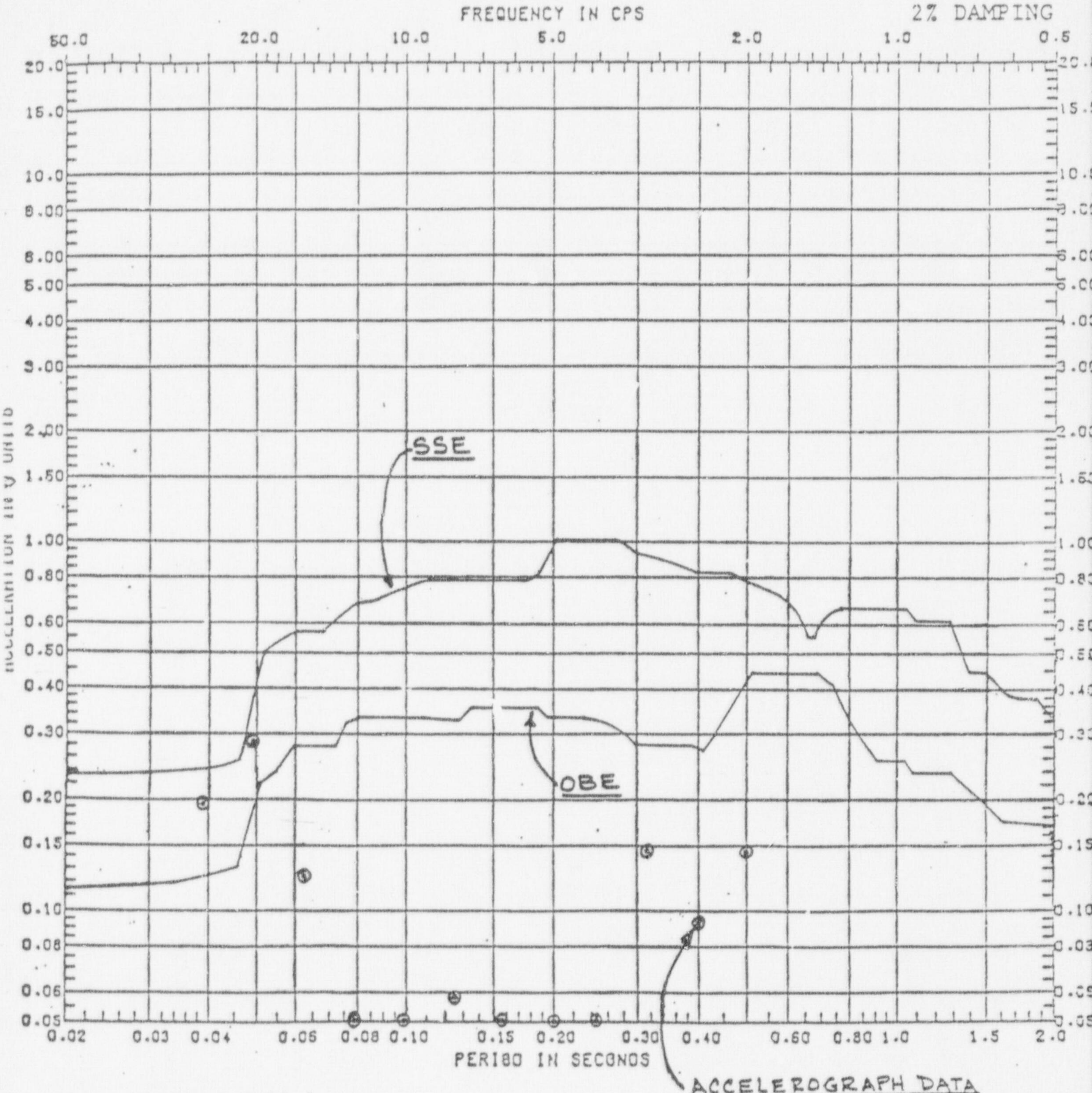
CLINTON UNIT-1
CIRCULATING WATER SCREEN HOUSE
ELEVATION 699'-0"

LOCATION MAIN FLOOR

FIGURE-2

SARGENT & LUNDY
ENGINEERS

JUNE 10, 1987 SEISMIC RESPONSE



CLINTON UNIT-1
CIRCULATING WATER SCREEN HOUSE
ELEVATION 699'-0"
LOCATION MAIN FLOOR

SPECTRA HORIZONTAL - EW

FIGURE-3

PRIORITY 2

JUN 12 A.M.

PMSO-016
Attachment 1
Rev. 1
Page 1 of 1

CLINTON POWER STATION
PLANT STAFF
FIELD PROBLEM REPORT

Originator (Print) M. Stookey ext. 3614 FPR No. 201,600

Mail Code T-31 Department Technical

Originator's Dept. Hd. RW Morquist 6-12-87 System Design. EM
Signature / Date

Question/Problem:
Analyze the attached data taken ~~falling~~ following the earthquake on 6/10/87. The data was taken from 1VR-EM010, 1VR-EM011, 1VR-EM012, 1VR-EM013

Recommended Resolution:
None

References: ~~K28~~ K2931-0002 CPS No. 1337.01

MILESTONE ______ PUNCHLIST No. ______

TECHNICAL DEPARTMENT ONLY

System Engineer M.R. Stookey, 6/12/87 NSED Disposition Required Y
Date
Stookey / Kyle T-31

ENGINEERING DISPOSITION:

June 10, 1987
Seismic Event Report
Attachment A

Preparer/Date ______ / ______ Organization ______

Department Head Approval: ______
Signature / Date

CLASS CODE: NNNN2
CPS No. 1337.05D001
(Rev. 0)

EVENT DATE 10/06/87 (DAY/MONTH/YEAR) EVENT TIME 18:50 (8.5.1.2) NAME M. Stookey (Print)

INSTRUMENT: 1VR-EM013

"T" DEFLECTION	>2 (.41) (8.5.1.3)	(mm) x .51 G/mm	"T" ACCELERATION	>1.02 [3.94] (8.5.1.13) (G)
"V" DEFLECTION	1.1 (.5) (8.5.1.4)	(mm) x .51 G/mm	"V" ACCELERATION	.561 [2.167] (8.5.1.15) (G)
"L" DEFLECTION	.4 (.2) (8.5.1.5)	(mm) x .51 G/mm	"L" ACCELERATION	.204 [.788] (8.5.1.17) (G)

INSTRUMENT: 1VR-EM012

"T" DEFLECTION	.7 (.7) (8.5.1.6)	(mm) x .51 G/mm	"T" ACCELERATION	.357 [~~.701~~ 1.379] (8.5.1.19) (G)
"V" DEFLECTION	.8 (.4) (8.5.1.7)	(mm) x .51 G/mm	"V" ACCELERATION	.408 [1.576] (8.5.1.21) (G)
"L" DEFLECTION	.9 (.8) (8.5.1.8)	(mm) x .51 G/mm	"L" ACCELERATION	.459 [1.773] (8.5.1.23) (G)

INSTRUMENT: 1VR-EM011

"T" DEFLECTION	>2.8 (1.5) (8.5.1.9)	(mm) x .51 G/mm	"T" ACCELERATION	>1.428 [5.52] (8.5.1.25) (G)
"V" DEFLECTION	1.2 (.6) (8.5.1.10)	(mm) x .51 G/mm	"V" ACCELERATION	.612 [2.364] (8.5.1.27) (G)
"L" DEFLECTION	>.9 (0) (8.5.1.11)	(mm) x .51 G/mm	"L" ACCELERATION	>.459 [1.773] (8.5.1.29) (G)

SIGNATURE M. R. Stookey DATE 6/11/87
(8.5.1.30)

(#) = shortest displacement from center

.51 is incorrect conversion factor

.5g = 2.54 mm (1mm = 1.97) conversion factor used

[*] = actual value per K2931-0002 PRA-123 section 7 for a 5g full scale accelerometer

CLASS CODE: NNNN2
CPS No. 1337.05D005
(Rev. 0)

Response Spectrum
SCRIBER ~~ACCELEROGRAPH~~ DATA 1VR-EM010 (Screen House)

EVENT DATE 10 JUN 87 (8.2.1.1) TIME 1845 (8.2.1.2)

VERTICAL ~~VERITCAL~~ CODE LETTER A (8.2.1.1) S/N 1072 (8.2.1.1)

PLATE #	FREQUENCY (HZ)	DEFLECTION DISTANCE P-TO-P (mm)		CALIBRATION DATA (G/mm)	ACCELERATION (G's)
1V	2.00	.8	(REED 1)	.0120	.009
2V	2.52	1.5	(REED 2)	.0188	.028
3V	3.17	2.4	(REED 3)	.0313	.075
4V	4.00	2.3	(REED 4)	.0497	~~.114~~ .057 (11 JUN 87)
5V	5.04	2.7	(REED 5)	.0753	~~.203~~ .102 (11 JUN 87)
6V	6.35	1.2	(REED 6)	.122	~~.146~~ .073 (11 JUN 87)
7V	8.00	3.8	(REED 7)	.194	.368
8V	10.1	.6	(REED 8)	.286	.085
9V	12.7	.3	(REED 9)	.232	.034
10V	16.0	.9	(REED 10)	.347	.156
11V	20.2	.2	(REED 11)	.645	~~.129~~ .0645 (11 JUN 87)
12V	25.4	.3	(REED 12)	.984	~~.295~~ .147 (11 JUN 87)

Signature [signature] (8.5.2.114) Date 11 JUN 87

NOTE: This calculation is not applicable to reeds 1,2,3 on this page

$$ACC = \frac{\text{DEFLECTION DISTANCE} \times \text{CALIBRATION DATA}}{2}$$

CLASS CODE: NNNN2
CPS No. 1337.05D005
(Rev. 0)

TRANSVERSE CODE LETTER A
(8.2.1.1)

S/N 1071
(8.2.1.1)

PLATE #	FREQUENCY (HZ)	DEFLECTION DISTANCE P-TO-P (mm)		CALIBRATION DATA (G/mm)	ACCELERATION (G's)
1T	2.00	10.5	(REED 1)	.0137	.143
2T	2.52	4.2	(REED 2)	.0220	.092
3T	3.17	4.5	(REED 3)	.0332	.149
4T	4.00	.6	(REED 4)	.0524	~~.031~~ .015 (11JUN87)
5T	5.04	.2	(REED 5)	.0718	~~.014~~ .007 (11JUN87)
6T	6.35	.4	(REED 6)	.120	~~.048~~ .024 (11JUN87)
7T	8.00	.6	(REED 7)	.193	~~.116~~ .058 (11JUN87)
8T	10.1	.3	(REED 8)	.295	~~.088~~ .044 (11JUN87)
9T	12.7	.4	(REED 9)	.242	~~.096~~ .048 (11JUN87)
10T	16.0	.7	(REED 10)	.350	~~.245~~ .123 (11JUN87)
11T	20.2	.9	(REED 11)	.630	~~.567~~ .284 (11JUN87)
12T	25.4	.4	(REED 12)	.972	~~.389~~ .194 (11JUN87)

Signature [signature]
(8.5.2.114)

Date 11 JUN 87

$$ACC = \frac{\text{DEFLECTION DISTANCE} \times \text{CALIBRATION DATA}}{2}$$

CMCCSL0328Q

CAL DUE
6/4/88

LAST
6/4/86

CLASS CODE: NNNN2
CPS No. 1337.05D005
(Rev. 0)

LONGITUDINAL CODE LETTER A (8.2.1.1)

S/N 1066 (8.2.1.1)

PLATE #	FREQUENCY (HZ)	DEFLECTION DISTANCE P-TO-P (mm)		CALIBRATION DATA (G/mm)	ACCELERATION (G's)
1L	2.00	.8	(REED 1)	.0144	.011
2L	2.52	.3	(REED 2)	.0214	.006
3L	3.17	.3	(REED 3)	.0341	.010
4L	4.00	.2	(REED 4)	.0502	~~.010~~ .005 (11 JUN 87)
5L	5.04	.5	(REED 5)	.0787	.019
6L	6.35	.3	(REED 6)	.121	.018
7L	8.00	.5	(REED 7)	.184	.046
8L	10.1	.8 *	(REED 8)	.292	.116
9L	12.7	.4	(REED 9)	.236	.047
10L	16.0	.7	(REED 10)	.345	.120
11L	20.2	.4	(REED 11)	~~.633~~ .606 (11 JUN 87)	.121
12L	25.4	.3	(REED 12)	.905	.136

Signature L D Hay (8.5.2.114) Date 11 JUN 87

$$ACC = \frac{\text{DEFLECTION DISTANCE} \times \text{CALIBRATION DATA}}{2}$$

* T TRACE WAS SKEWED FROM 90° READING WAS TAKEN AT 90°