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APR 10 1995

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SUSQUEHANNA STEAM ELECTRIC STATION
MAIN STEAM ISOLATION VALVE/ALTERNATE
LEAKAGE TREATMENT SYSTEM : FOLLOW-UP RESPONSE
TO REQUEST FOR ADDITIONAL INFORMATION — **Docket Nos. 50-387 and 50-388**
PLA-4303 FILES A17-2/R41-2

References: 1) *PLA-4289, R.G. Byram to USNRC, "Main Steam Isolation Valve/Alternate Leakage Treatment System : Response to Request for Additional Information", dated 3/28/95.*

2) *USNRC to R.G. Byram, "Request for Additional Information Regarding the Pennsylvania Power & Light Company's Request to Amend the Susquehanna Steam Electric Station Unit 1 & 2 Licenses to Reflect Removal of the Main Steam Isolation Valve Leakage Control System" (TAC Nos. M91013 and M91014) dated 3/03/95.*

3) *PLA-4228, R.G. Byram to USNRC, "Proposed Amendment Nos. 178 to License No. NPF-14 and No. 132 to License No. NPF-22 : Increase of MSIV Leakage Rate and Deletion of Leakage Control System," dated 11/21/94.*

The purpose of this letter is to provide the Pennsylvania Power & Light Company response to the remaining questions (7, 9, 10, 11, 12 & 13) from the NRC's Request for Additional Information (RAI) of March 3, 1995 (Reference 2). This RAI resulted from the NRC Staff's evaluation of the structural and seismic analysis portion of the Susquehanna Steam Electric Station (SSES) proposed amendment (Reference 3) to increase Main Steam Isolation Valve (MSIV) leakage rate and delete the MSIV Leakage Control System (LCS). The partial response (Reference 1) was provided to support the timely approval of this proposed license amendment and restated the Staff's specific RAI questions followed by PP&L's response to each. This response to the remaining questions follows the same format and supports the requested (Reference 2) response time.

Questions regarding this supplemental information should be directed to Mr. A. K. Maron at (610) 774-7852.

Very truly yours,

R. G. Byram

Attachment

130059

A001
'11

copy: NRC Region I
Ms. M. Banerjee, NRC Sr. Resident Inspector - SSES
Mr. C. Poslusny, Jr., Sr. Project Manager - OWFN
Mr. W. P. Dornsife, PA DER

QUESTION 7.

The licensee should provide calculations that demonstrate the seismic adequacy of the condenser, by using an acceptable analytical methodology, considering the integrity of pertinent structural members, the seismic demand, and the seismic capability of the condenser support members.

PP&L's RESPONSE

PLA 4228, dated November 21, 1994, provided some information relative to seismic adequacy of the SSES main turbine steam condenser. PP&L Calculation No. EC-012-6007 addresses the issues relative to seismic adequacy of the SSES main turbine steam condenser by establishing the pertinent physical data which is then used for the evaluation of the condenser units and their anchorage system. The structural characteristics are compared to those of similar "database" condensers which have experienced significant earthquakes as addressed in NEDC-31858P, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control System". The anchor system is determined to have the capability of withstanding the seismic loads in combination with operating loads. Each condenser shell is specifically compared to the database condensers from Moss Landing, Units 6 and 7, and Ormond Beach, Units 1 and 2. These condensers have similar physical arrangements and construction details to the SSES condenser and would function similarly in the resistance of seismic forces.

The Unit 1 and Unit 2 condensers are identical for the purposes of this seismic evaluation. The condenser is made up of three shells: high pressure, intermediate pressure, and low pressure units. Although piping interconnects the shell units, each shell is independently supported on the concrete base slab of the turbine pedestal by six embedded plate assemblies. Positive attachment is provided by anchor bolts and welds to the embedded plate assemblies. Rubber expansion joints provide structural isolation of the condenser from the turbine. Forces in the anchor systems of these condenser shells which could occur in the event of a Design Basis Earthquake (DBE) are derived in the calculation. The three shells are considered to function independently in the determination of these DBE loads.

In order for comparison to the database condensers, as well as for evaluation of the anchorage systems, the weights of the three condenser units are required. The operating weight of each condenser unit is determined by summing the dry weight and the weight of the water. The dry weights of the units are derived from the anchor uplift loads provided on the pressure shell anchor detail drawing. The summation of the dry weight anchor tension forces are subtracted from the vacuum uplift force. The difference is the dry weight of the unit. The water weight is approximated by estimating volumes of the units based on the condenser drawings. The following table provides the overall dimensions and calculated weights for each of the three condenser shells:

Unit	Plan Dimension	Height	Dry Weight	Water Weight	Operating Weight
high pressure	29' x 49'	56'	678,200 lbs	1,454,544 lbs	2,132,700 lbs
intermediate pressure	29' x 39'	56'	643,000 lbs	1,341,288 lbs	1,984,300 lbs
low pressure	29' x 29'	56'	567,800 lbs	1,004,890 lbs	1,572,700 lbs

By comparison to the database condensers, it is apparent that most of the physical features of the SSES condenser which would have seismic significance are either enveloped by, or would be less critical than, the database condensers. Two possible exceptions are the greater height of the SSES condenser and the lower anchorage to capacity-demand ratio for the intermediate pressure shell.

The SSES condenser is higher than the database condensers. The larger ratio of height to base width is likely to cause larger overturning forces. This greater height is not considered critically significant for three reasons. First, the operating weight of each shell in comparison to the shell side area is comparable to that of the database condensers. As a result, the shear stresses in the shell plate would not be significantly greater than for the database condensers for the same "g" load. The second reason is that the anchor bolt shear areas compare favorably to that of the database condensers for all shells except the intermediate pressure shell. The fact that the anchors for the SSES condenser are determined to have more than enough capacity to withstand the DBE seismic forces in combination with operating loads provides the third reason that the greater height of the SSES condenser is not considered critically significant.

Although the capacity-demand ratio for the intermediate pressure condenser is lower than the comparable database condensers, calculations have determined that the anchorage has sufficient capacity to resist the seismic loads. Evaluations of the capability of the anchorages to withstand DBE loads are performed for each of the three condenser units. The resulting shear and tension forces are compared to capacities of the anchor bolts and embedded plate weldments with consideration of friction resistance. Welds and anchor bolts are not considered to act concurrently in resisting the shear loads since the bolt holes are oversized. It is reasonable to assume that friction resistance may be considered along with weld capacity or in combination with anchor bolt capacity. The calculation determines that the anchorage system has more than enough capacity to resist the maximum tension and shear forces resulting from the DBE loading for each of the three SSES condenser shell units.

Based on the weights provided in the previous table, the following table shows the calculated anchorage loads relative to the maximum DBE forces for each of the three units:

	condenser units		
(load/forces are kips)	high	intermediate	low
Bolt Tension Capacity	897	359	1890
DBE + Oper. Tension	493	91	905
Friction Resistance	183	171	135
Weld Shear Capacity	445	284	445
Bolt Shear Capacity*	1814	1814	1814
Weld + Friction	628	455	580
Bolt + Friction	1997	1985	1949
DBE Shear Load	448	417	330

* (Shear Capacity of bolts not in tension)

In summary, by comparison of the physical components and general arrangement of the SSES condenser units to those of the indicated database condensers which have successfully withstood significant seismic events, and calculations which determine the sufficient capacity of the anchorage systems, seismic adequacy of the SSES condenser units is substantiated.

QUESTION 9.

For each of the earthquake-facility pairs in the experience database which are being relied upon to demonstrate the seismic adequacy of the ALT system for Susquehanna provide the following information:

a. The name, location (latitude and longitude), and foundation geology (i.e., rock, deep soil, shallow soil) of the facility.

b. The name, date, time, epicenter, magnitude of the earthquake and the distance from the facility to the earthquake rupture.

c. The five percent of critical damping response spectra of the ground motion estimated at the facility from the earthquake.

d. The method used to estimate the ground motion at the facility. If the ground motion is based on actual ground motion recordings, provide the location (latitude and longitude) and foundation geology of the recording station and its distance from the facility and its distance to the closest part of the fault rupture. If the estimation is based on a method other than an actual recording of the earthquake ground motion or if the recording station is not collocated with the facility, describe the method used to estimate the ground motion in detail and provide any ground motion attenuation equations which may have been used to obtain the estimate.

PP&L's RESPONSE

The earthquake-facility pairs in the experience database which are being relied upon to demonstrate the seismic adequacy of the ALT system for Susquehanna are listed in Table 9 - 1 along with the estimated peak ground acceleration. The facility name, location, approximate distance from the facility to the epicenter, the approximate distance from the facility to the seismic instrument, the facility site soils, and the instrument site soils are provided for selected sites in Table 9 - 2. Specific information in regard to latitude and longitude of the database facilities is not available. The facility, earthquake date and time, magnitude of the recorded ground motions, and the method used to estimate the ground motions is provided in Table 9 - 3 for selected sites. Comparison of the recorded earthquake motions for selected database facilities with the Susquehanna design basis earthquake is provided in Figures 9 - 1 to 9 - 3 for north-south, vertical, and east-west directions, respectively. Another comparison is provided in PLA 4228, dated November 21, 1994, for ground motion response spectra. Both comparisons highlight the low SSES seismic demand relative to the recorded database earthquakes.

SSES plant facilities (Category 1) are founded on bedrock, a hard indurated siltstone which is a member of the Devonian Mahantango Formation. Natural slopes adjacent to the plant are relatively flat. Most of the slopes are composed of soil; few rock slopes occur. No old landslides, rock slips, or landslide scars have been noted near the plant structures. The natural slopes have been concluded to present no significant hazards to plant structures. Consideration of all engineering geologic factors at the SSES site concludes that the bedrock is competent and provides satisfactory foundation support for all major structures.

The SSES is situated in a region which has experienced only a minor amount of moderate earthquake activity in historic time. The record of earthquake occurrences in the region dates back to the middle 16th century. Many earthquakes have been reported since that time and minor structural damage has been associated with several of the events. However, none of these earthquakes were considered to be of major or catastrophic proportion. There are no reports from the Berwick area of Pennsylvania which would indicate that ground motions from any historical earthquake in the east have exceeded an intensity as great as Modified Mercalli Intensity Scale IV on the competent rock on which the plant is located.

A DBE of less than Intensity VI is the maximum earthquake consistent with tectonic models and historical evidence presented for the site. However, a DBE generating a horizontal ground acceleration of 10 percent of gravity has been selected in compliance with the minimum design requirement of the regulatory agencies.

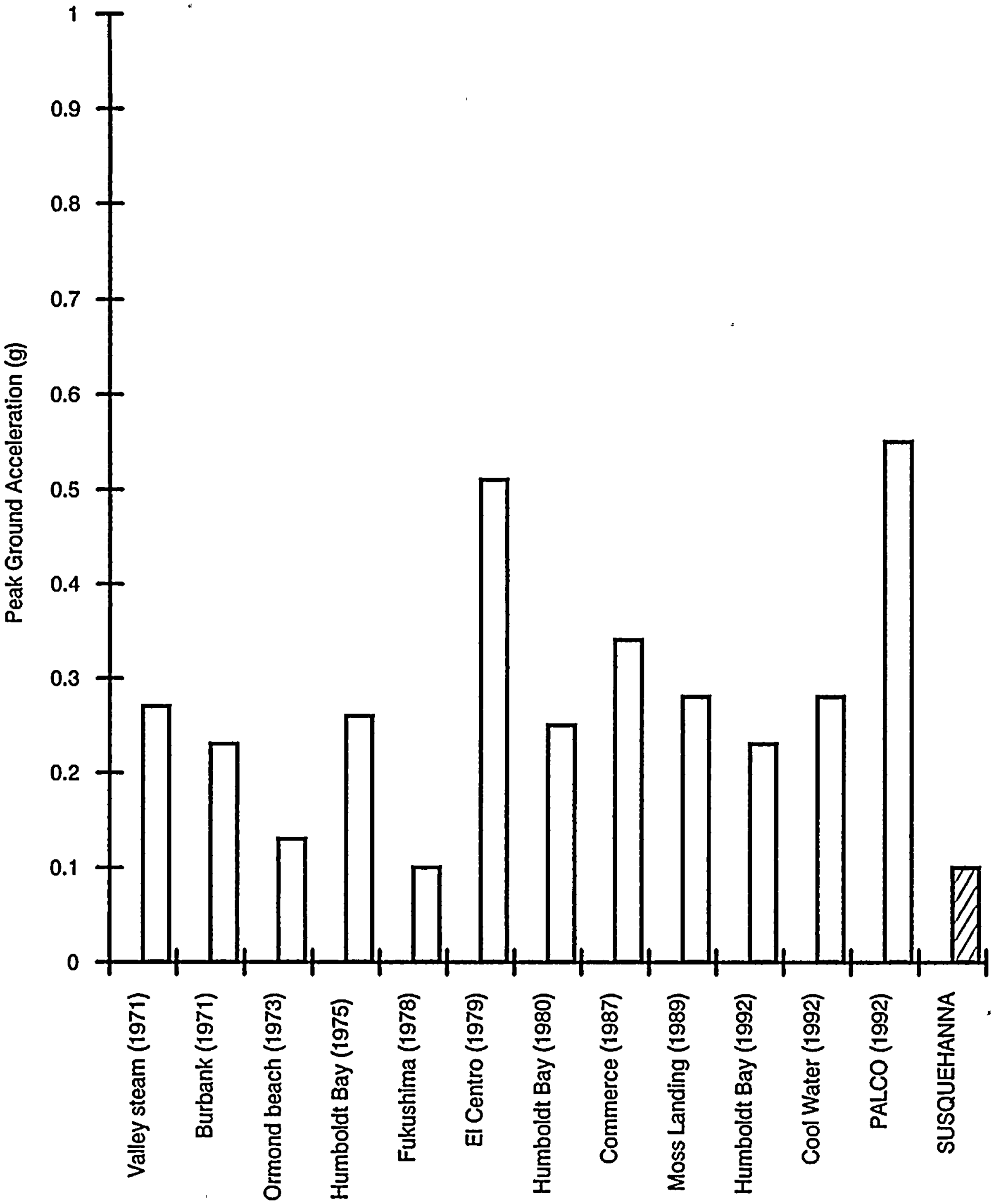
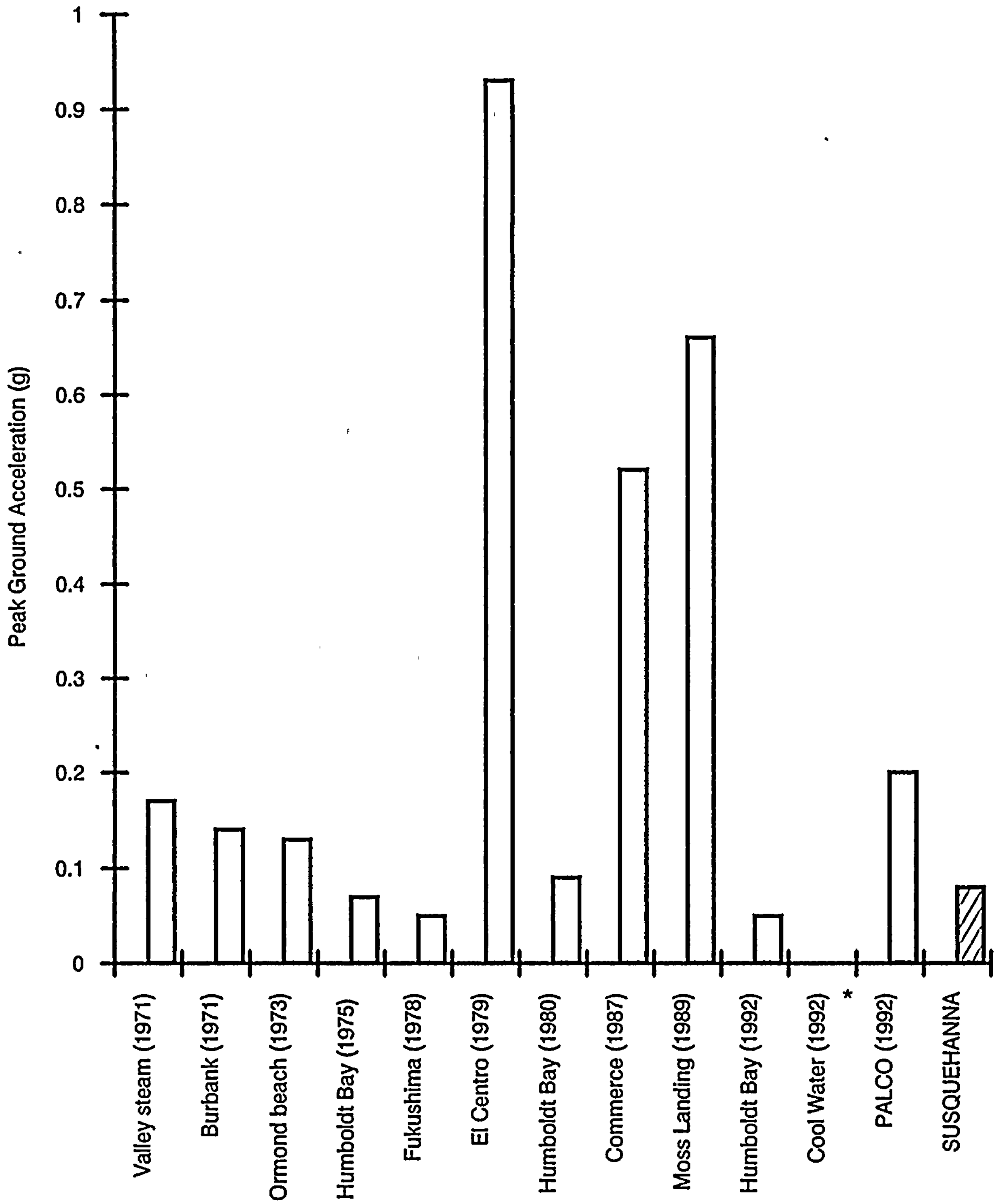


Figure 9 - 1

Comparison Between Recorded Earthquake Motions at Selected Database Facilities and Susquehanna Design Basis Earthquake in North-South Direction (Based on Table 9-3)



* Note: Data is not available for vertical direction.

Figure 9 - 2
Comparison Between Recorded Earthquake Motions at Selected Database Facilities and Susquehanna Design Basis Earthquake in Vertical Direction (Based on Table 9-3)

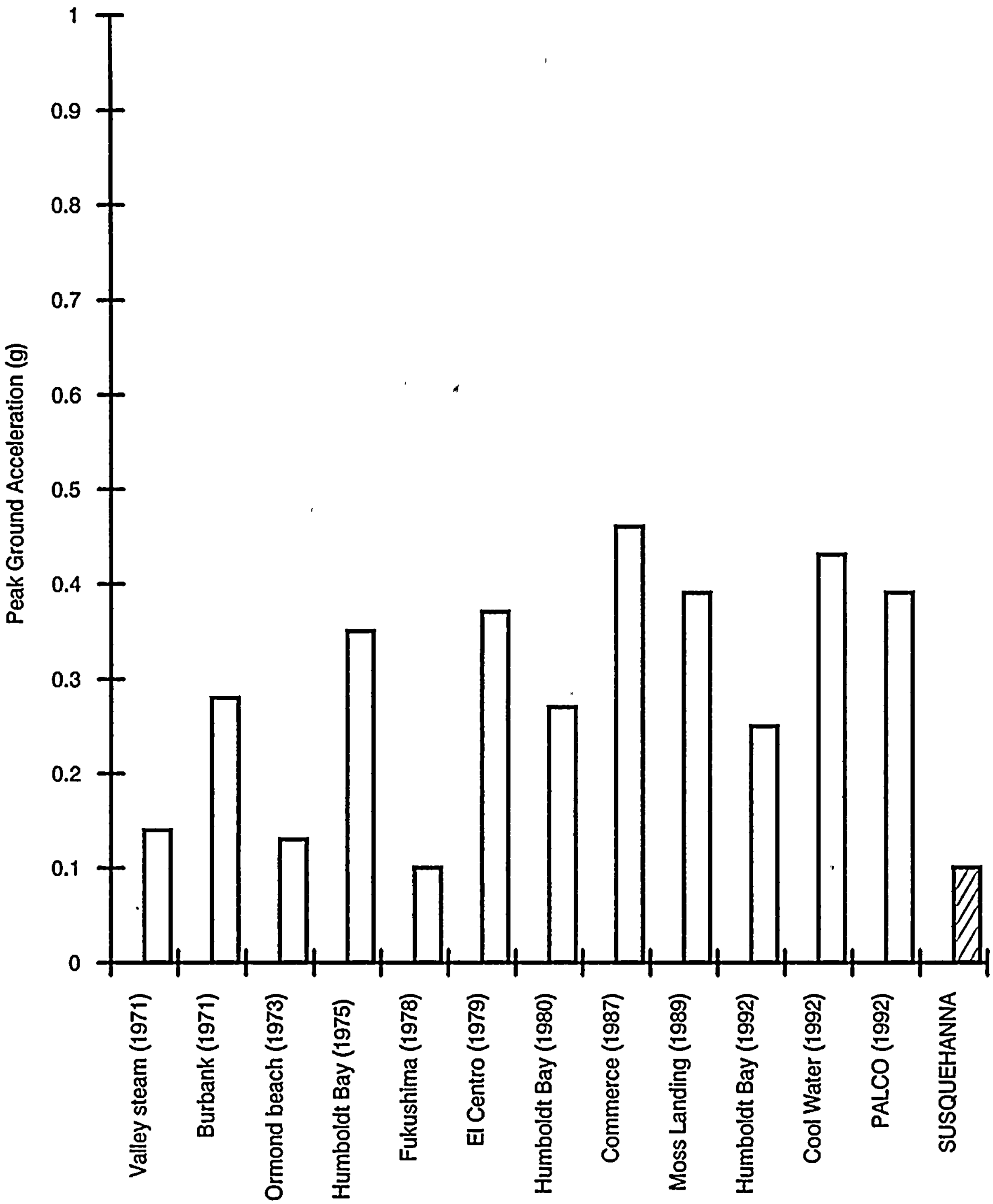


Figure 9 - 3

Comparison Between Recorded Earthquake Motions at Selected Database Facilities and Susquehanna Design Basis Earthquake in East-West Direction (Based on Table 9-3)

Table 9 - 1

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration [1] (g)
San Fernando, CA. Earthquake 1971 (M6.5)	Sylmar Converter Station	Large electrical substation	0.50
	Rinaldi Receiving Station	Large electrical substation	0.50
	Valley Steam Plant	Four-unit gas-fired power plant	0.30
	Burbank Power Plant	Six-unit gas-fired power plant	0.30
	Glendale Power Plant	Five-unit gas-fired power plant	0.25
	Pasadena Power Plant	Five-unit gas-fired power plant	0.20
Point Mugu, CA. Earthquake 1973 (M5.7)	Ormond Beach Power Plant	Large two-unit oil-fired power plant	0.20
Ferndale, CA. Earthquake 1975 (M5.5)	Humboldt Bay Power Plant	Two gas-fired units, one nuclear unit	0.30 [2]
Imperial Valley CA. Earthquake 1979 (M6.6)	El Centro Steam Plant	Four-unit Gas-fired power plant	0.42 [2]
	Drop IV Hydro Plant	Two-unit hydroelectric plant	0.30
Humboldt, CA. Earthquake 1980 (M7.0)	Humboldt Bay Power Plant	Two gas-fired units, one nuclear unit	0.26

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g) [1]
Coalinga, CA. Earthquake 1983 (M6.7)	Main Oil Pumping Plant	Pumping station feeding oil pipeline from Coalinga area	0.60
	Union Oil Butane Plant	Petrochemical facility to extract butane and propane from well waste gas	0.60
	Shell Water Treatment Plant	Petrochemical facility to demineralize water prior to steam injection into oil wells	0.60
	Coalinga Water Treatment Plant	Water purification facility	0.60
	Pleasant Valley Pumping Plant	Pumping station from the San Luis Canal to the Coalinga Canal	0.56 [2]
	San Luis Canal Pumping Station	Agricultural pumping station taking water from the San Luis Canal	0.20-0.60
	Gates Substation	500 KV electrical substation	0.25
	Kettleman Compressor Station	Natural gas pipeline booster station	0.20
Morgan Hill, CA. Earthquake 1984 (M6.2)	IBM/Santa Teresa Facility	Large computer facility for software development	0.37 [2]
	San Martin Winery	Wine fermentation facility and tank farm	0.30
	Metcalf Substation	500 KV electrical substation	0.40
	Mirassou Winery	Wine fermentation facility and tank farm	0.20
Mexico Earthquake 1985 (M8.1)	Infiernillo Dam	Six-unit hydroelectric plant	0.15
	La Villita Power Plant	Four-unit hydroelectric plant	0.14
	SICARTSA Steel Mill	Large steel mill	0.25
	Fertimex Plant	Large fertilizer production plant	0.25

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g) [1]
Chile Earthquake 1985 (M7.8)	Bata Shoe Factory	Tannery and shoe manufacturing facility	0.64
	Llolleo Water Pumping Plant	Water pumping and filtration plant	0.55
	Rapel Hydroelectric Plant	Five-unit hydroelectric plant	0.23 [2]
	Concon Petroleum Refinery	Petrochemical facility producing fuel Oil, asphalt, gasoline, and other petroleum products	0.30
	Oxiquim Chemical Plant	Chemical facility producing various products, including feed stock for paint ingredients	0.30
	Concon Water Pumping Station	Water pumping station	0.30
	Renca Power Plant	Two-unit coal-fired power plant	0.30
	Laguna Verde Power Plant	Two-unit coal-fired peaking plant	0.25
	Las Ventanas Copper Refinery	Copper refinery/foundry/power plant	0.25
	Las Ventanas Power Plant	Two-unit gas-fired power plant	0.25
Adak, Alaska Earthquake 1986 (M7.5)	Adak Naval Base	Diesel-electric power plants, electrical Substations, water treatment plant, steam plants	0.25 [2]
North Palm Spring, CA. Earthquake 1986 (M6.0)	Devers Substation	500 KV electrical substation	0.85 [2]
	Whitewater Hydro Plant	Small hydroelectric power plant	0.50
Chalfant Valley, CA. Earthquake 1986 (M6.0)	Hi-Head Hydro Plant	Small one-unit hydroelectric plant	0.25
San Salvador Earthquake 1986 (M5.4)	Soyapango Substation	115 KV substation	0.50
	San Antonio Substation	115 KV substation	0.30

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration[1] (g)
Whittier, CA. Earthquake 1987 (M5.9)	Olinda Substation	230 KV substation	0.65[2]
	SCE Central Dispatch Headquarters	Data porcessing center	0.56[2]
	SCE Headquarters	Large office complex and data processing center	0.42[2]
	California Federal Bank Facility	Data processing facility	0.40
	Ticor Facility	Data processing facility	0.40
	Meas Substation	230 KV substation	0.35
	Sanwa Bank Facility	Data processing facility	0.40
	Alhambra Station	Telephone switching station	0.40
	Rosemead Station	Telephone switching station	0.40
	Central Station	Telephone switching station	0.15
	Wells Fargo Bank Facility	Data processing facility	0.35
	Center Substation	230 KV Substation	0.35
	Lighthype Substation	230 KV Substation	0.26[2]
	Del Amo Substation	230 KV Substation	0.20
	Commerce Refuse-to-Energy Plant	Trash-burning power plant	0.30
	Pasadena Power Plant	Five-unit gas-fired power plant	0.25
	Glendale Power Plant	Five-unit gas-fired power plant	0.20
	Puente Hills Landfill Gas & Energy Recovery Plant	Methane burning power plant	0.20

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)
Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g) [1]
Bay of Plenty, New Zealand Earthquake 1987 (M6.25)	Edgecumbe Substation	230 KV substation	0.50
	New Zealand Distillery	Liquor distillery	0.50
	Caxton Paper Mill	Paper and pulp mill	0.40
	Kawerau Substation	230 KV substation	0.40
	Whakatane Board Mill	Paper mill producing cardboard	0.25
	Matahina Dam	Two-unit hydroelectric plant	0.26 [2]
Superstition Hill (El Centro), CA. 1987 (M6.3)	Mesquite Lake Resource Recovery Plant	Organic waste burning power plant	0.20
	El Centro Steam Plant	Four-unit gas-fired power plant	0.26 [2]
Loma Prieta Earthquake 1989 (M7.1)	Moss Landing Power Plant	Seven-unit gas-fired power plant	0.34
	Gilroy Energy Cogen Plant	Combined gas turbine and steam plant	0.32
	Cardinal Cogen Plant	Combined gas turbine and steam plant	0.25
	University of California at Santa Cruz	Diesel cogeneration plant and HVAC plants	0.45 [2]
	Hunter's Point Plant	Three-unit gas-fired power plant	0.15
	Portrero Plant	Two-unit gas-fired plant	0.15
	Metcalf Substation	500 KV substation	0.30
	San Mateo Substation	230 KV substation	0.20
	National Refractory	Large brick & magnesia extraction plant	0.30
	Green Giant Foods	Food processing and cold storage plant	0.30

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g)
Loma Prieta Earthquake 1989 (M7.1) (Continued)	Watsonville Wastewater Treatment	Sewage treatment plant	0.40
	Santa Cruz Station	Telephone switching station	0.40
	Watsonville Station	Telephone switching station	0.33 [2]
	Seagate Technology Watsonville	Electronic manufacturing facility	0.40
	Santa Cruz Water Treatment	Water purification facility	0.40
	Soquel Water District	Pumping stations & storage tanks	0.50
	Upton Foods	Food processing and packaging facility	0.30
	Lone Star Cement	Cement factory	0.25
	Watkins-Johnson Instruments	Electronic manufacturing plant	0.35
	Rinconada Water Treatment Plant	Water purification facility	0.30
	IBM/Santa Teresa Facility	Software development laboratory	0.20
	EPRI Headquarters	Office and data processing complex	0.25
Central Luzon, Philippines Earthquake 1990 (M7.7)	Baguio Station	Telephone switching station	3.0
	Cabanatuan Substation	230 KV substation	3.0
	La Trinidad Substation	230 KV substation	3.0
	San Manuel Substation	230 KV substation	3.0
	Moog Manufacturing Plant	Electronic manufacturing plant	3.0

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g)
Valle de Estrella, Costa Rica Earthquake 1991 (M7.4)	Bomba Water Treatment Plant	Water treatment plant	3.0
	Cachi Dam	Large hydroelectric plant	0.12 [2]
	Changuinola Power Plant	Diesel power plant	3.0
	Limon Station	Telephone switching station	3.0
	Moin Power Plant	Diesel and gas turbine power plant	3.0
	RECOPE Refinery	Oil refinery	3.0
Sierra Madre, California Earthquake 1991 (M5.8)	Pasadena Power Plant	Five-unit gas-fired power plant	0.20
	Goodrich Substation	230 KV substation	0.30
Cape Mendocino Earthquake 1992 (M7.0)	Pacific Mill	Lumber mill & Cogen plant	0.47
	Centerville Naval Base	HVAC and diesel power plant	0.40 [2]
	Humboldt Bay Power Plant	Two gas-fired units, one nuclear unit	0.24 [2]
Landers & Big Bear Earthquake 1992 (M7.4)	Cool Water Power Plant	Two gas-fired units, two combined cycle unit	0.35 [2]
	SEGs 1 & 2 Steam Plants	Solar-powered generating plants	0.35
	Newberry Compressor Plant	Piston-driven gas compressors	0.25
	Pfizer Ore Processing	Limestone Production	0.30
	Mitsubishi Cement	Cement Production	0.30

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.

Table 9 - 1 (Continued)

Summary Of Sites Reviewed In Compiling The Seismic Experience Data Base

Earthquake (Magnitude)	Facility	Type of Facility	Estimated Peak Ground Acceleration (g) [1]
Guam Earthquake 1993 (M8.0)	Cabras Power Plant	Two Oil-fired units	0.25 [4]
	Piti Power Plant	Four oil-fired units	0.25 [4]
	Tanguisan Power Plant	Two Oil-fired units	0.25 [4]
	Yigo Gas Turbine	Packaged gas turbine-generator	0.25 [4]
	Dededo Gas Turbine	Turbine-generator and diesel	0.25 [4]
	GPA Diesel Plants	Four units with two diesel each	0.25 [4]
	Uguma Water Treatment Plant	Water treatment facility	0.25 [4]
Northridge Earthquake 1994 (M6.7)	Sylmar Converter Station	Large electrical substation	0.85 [2]
	Olive View Cogen	Two-unit gas turbine plant	0.72
	Placerita Cogen	Two-unit gas turbine plant	0.50
	Great Western Data Center	Data processing facility emergency diesel & UPS plant	0.50
	Castaic Pump-Turbine Plant	Seven-unit hydro plant	0.35

1. Average of two horizontal components of ground motion based on nearest accelerographs or absolute values listed in Table 9-3 when average is not used.
2. Ground acceleration measured by an instrument at the site.
3. There were no strong motion records in the heavily damaged region of the earthquake, therefore accurate estimates of PGA cannot be made.
4. Although there were no strong motion records on the Island of Guan. USGS estimated 0.25g as the average peak ground acceleration for the Island based on effects.

Table 9 - 2
Earthquake Distances and Soil Data
Selected Database power Plant facilities

Facility Name (Earthquake)	Facility Location	Approx. Distance to Epicenter (KM)	Approx. Distance to Seismic Instrument (KM)	Facility Site Soils	Instrument Site Soils
Valley Steam Plant (1971 San Fernando E.Q.)	East San Fernando Valley, CA.	15	8	Deep alluvium	Deep alluvium
Burbank Power Plant (1971 San Fernando E.Q.)	Burbank, CA.	20	8	Compact Alluvium	Compact Alluvium
Ormond Beach Power Plant (1973 Point Mugu E.Q.)	4 km North of Point Mugu, CA.	3	5	Soft Sedimentary Material	(Not available)
Humboldt Bay Power Plant (1975 Ferndale E.Q.)	5 km south of Eureka, CA.	10	0	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m
Fukushima Nuclear Power Plant (1978 Miyagiken-Oki, Japan E.Q.)	South of Namie and 140 SE of Fukushima Japan	140	0	Competent soft mudstone formation with a thickness in excess of 300m	Competent soft mudstone formation with a thickness in excess of 300m
Humboldt Bay Power Plant (1980 Humboldt County E.Q.)	5 km south of Eureka, CA.	50	0	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m
Humboldt Bay Power Plant (1992 Cape Mendocino E.Q.)	5 km south of Eureka, CA.	40	0	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m	Deep soft soil, strata of dense compact fine to medium grained sand mixed with gravel and claystone to about 200m

Table 9 - 2 (Continued)
Earthquake Distances and Soil Data
Selected Database power Plant facilities

Facility Name (Earthquake)	Facility Location	Approx. Distance to Epicenter (KM)	Approx. Distance to Seismic Instrument (KM)	Facility Site Soils	Instrument Site Soils
El Centro Steam Plant (1979 Imperial Valley E.Q.)	El Centro, CA.	25	1	Deep alluvial deposits composed primarily of stiff to hard clay interlain with laminations of silty clay loam and sandy loam	(Similar to Facility Foundation Material)
Commerce Refuse to Energy Plant (1987 Whittier E.Q.)	Commerce, CA.	10	1	(Judged similar to soil at Instrument site)	Interface of soft and compact alluvium
Moss Landing Power Plant (1989 Loma Prieta E.Q.)	Monterey Bay, CA.	20	13	Ancient beach deposits and Santa Cruz coastal terrace deposits	(Somewhat softer conditions than facility)
Cool Water Power Plant (1992 Landers / Big Bear E.Q.)	Degget, CA.	60	0	(Not available)	(On-site instruments, same soil as facility)
PALCO Cogeneration Plant (1992 Cape Mendocino E.Q.)	Scotia, CA.	20	2	Soft recent alluvial deposits	Soft recent alluvial deposits

Table 9 - 3
Earthquake Record Data
Selected Database Power Plant Facilities

Facility Name	Earthquake Date and Time	Recorded Ground Motions	Method Used to Estimate Ground Motions
Valley Steam Plant	February 9, 1971 San Fernando E.Q. 6:01 AM	Holiday Inn Van Nuys, CA Record: N-S 0.27g VERT 0.17g E-W 0.14g	Records slightly scaled up to a peak of 0.30g based on the site's distance to the causative fault. (5km)
Burbank Power Plant	February 9, 1971 San Fernando E.Q. 6:01 AM	City Hall Glendale, CA Record: N-S 0.23g VERT 0.14g E-W 0.28g	Records from Glendale City Hall best represent soil conditions at facility site. Record slightly scaled up to 0.30g because plant is significantly closer to causative fault than the Glendale City Hall Record.
Ormond Beach Power Plant	February 21, 1973 Point Mugu E.Q. 6:46 AM	PGA of 0.13g was recorded at Port Hueneme about 2km further from epicenter	PGA of 0.20g was estimated base on typical California attenuation relationships, and independently based on observation and measurement of pipe displacements.
Humboldt Bay Power Plant	June 7, 1975 Ferndale E.Q. 1:46 AM	Storage Building Slab on site record: N-S 0.26g VERT 0.07g E-W 0.35g	Recorded on site.
Fukushima Nuclear Power Plant	June 12, 1978 Miyagi-ken-Oki E.Q. 17h 14m Japanese Standard Time	On site instrumentation record: Peak 0.125g N-S 0.10g VERT 0.05g	Recorded on site.
Humboldt Bay Power Plant	November 8, 1980 Humboldt County E.Q. 2:27 AM	ZPA recorded by triaxial recorder on operating floor of Unit 3 Refuel Bldg: N-S 0.25g VERT 0.09g E-W 0.27g	Recorded on site.

Table 9 - 3 (Continued)
Earthquake Record Data
Selected Database Power Plant Facilities

Facility Name	Earthquake Date and Time	Recorded Ground Motions	Method Used to Estimate Ground Motions
Humboldt Bay Power Plant	April 25, 1992 (M7.0, M6.0) April 26, 1992 (M6.5) Cape Mendocino E.Q. 11:06 AM (M7.0) 12:41 AM (M6.0) 4:18 AM (M6.5)	Storage Building Slab on Site record for M6.0: N-S 0.23g VERT 0.05g E-W 0.25g	Recorded on site.
El Centro Steam Plant	October 15, 1979 Imperial Valley E.Q.. 4:16 PM	USGS El Centro Differential Instrument Array record: N-S 0.51g VERT 0.93g E-W 0.37g	Motion at USGS instrument location was considered to represent the effective free-field motion for the power plant.
Commerce Refuse to Energy Plant	October 1, 1987 Whittier E.Q. 7:42 AM	Record from USGS Instruments at L.A. Bulk Mail Center: N-S 0.34g VERT 0.52g E-W 0.46g	Bulk Mail Center instrument was considered applicable because of proximity to Commerce Plant and similar soil conditions. PGA estimate reduced to 0.30g due to observed lack of damage.
Moss Landing Power Plant	October 17, 1989 Loma Prieta E.Q. 5:04 PM	Watsonville, CA, record: N-S 0.28g VERT 0.66g E-W 0.39g	Estimated PGA of 0.34g based on studies of available recordings and local soil conditions by PG&E.
Cool Water Power Plant	June 28, 1992 Landers/Big Bear E.Q. 4:58 AM (M7.4) 8:04 AM (M6.5)	Maximum record from free-field instrument located on site: E-W 0.43g N-S 0.28g	Recorded on site.
PALCO Cogeneration Plant	April 25, 1992(M7.0,M6.0) April 26, 1992 (M6.5) Cape Mendocino E.Q. 11:06 AM (M7.0) 12:41 AM (M6.0) 4:18 AM (M6.5)	Record from CSMIP accelograph array in Rio Dell for M7.0: N-S 0.55g VERT 0.20g E-W 0.39g	Facility motion judged to be the same as accelograph location because of the similarity of the facility and recording sites.

QUESTION 10.

Provide the following information related to the seismic analysis of the turbine building referred to in Section 2.3 (on page 7) of Enclosure 2 of Nov. 21, 1994 submittal:

a. The details of seismic analysis performed, and the seismic building model that was used, including the structural and soil properties.

b. A discussion of the procedure used to account for the variabilities associated with the structure frequency, structure damping, and the soil (rock) moduli.

c. Justification for the use of the NUREG/CR-0098 median ground response spectra as the ground motion input for this analysis.

d. The location at which the ground motion was input to the seismic building model.

e. The results of the seismic analysis including the floor response spectra at critical locations of the turbine building.

PP&L's RESPONSE

10a. Response spectrum and time history seismic analyses were performed for the turbine building during the original design of the Susquehanna Steam Electric Station. The north-south, east-west, and vertical models are shown in Figures 10 - 1 to 10 - 3. Two east-west models were used for the analysis and design of the turbine building; one model has pinned boundary conditions at the bottom of the columns while the other model has rotational restraints as the boundary conditions at the bottom of the columns. The forces from each of the east-west models were used to obtain the design forces. The SSES design basis earthquake was used as the seismic input motion for analyses. As an example of the models used for analysis, the masses and element beam properties for the north-south model are presented in Tables 10 - 1 and 10 - 2.

Time history analyses utilizing the north-south, east-west, and vertical models were performed in order to calculate response spectra in the respective direction. The structural damping utilized for DBE and OBE is 5% and 2% of critical damping respectively. Response spectra were calculated at those frequencies specified in Table 5-1 of BC-TOP-4A titled "Seismic Analysis of Structures and Equipment for Nuclear Power Plants".

10b. The floor response spectrum curves were broadened by plus/minus twenty percent to account for the variabilities associated with the structure frequency, structure damping, and the soil moduli.

10c. The NUREG/CR-0098 median ground response spectra was intended to be utilized for the generation of new median centered spectra if required. However, existing floor response spectra were extrapolated to generate the 5% damping response spectra.

10d. The ground motion was input to the turbine building model at the foundation.

10e. See the response to question 11d for the seismic deflections. Floor response spectra are provided in Figures 10-4 to 10-34. These curves show floor spectra at the locations where the ALT piping is structurally supported.

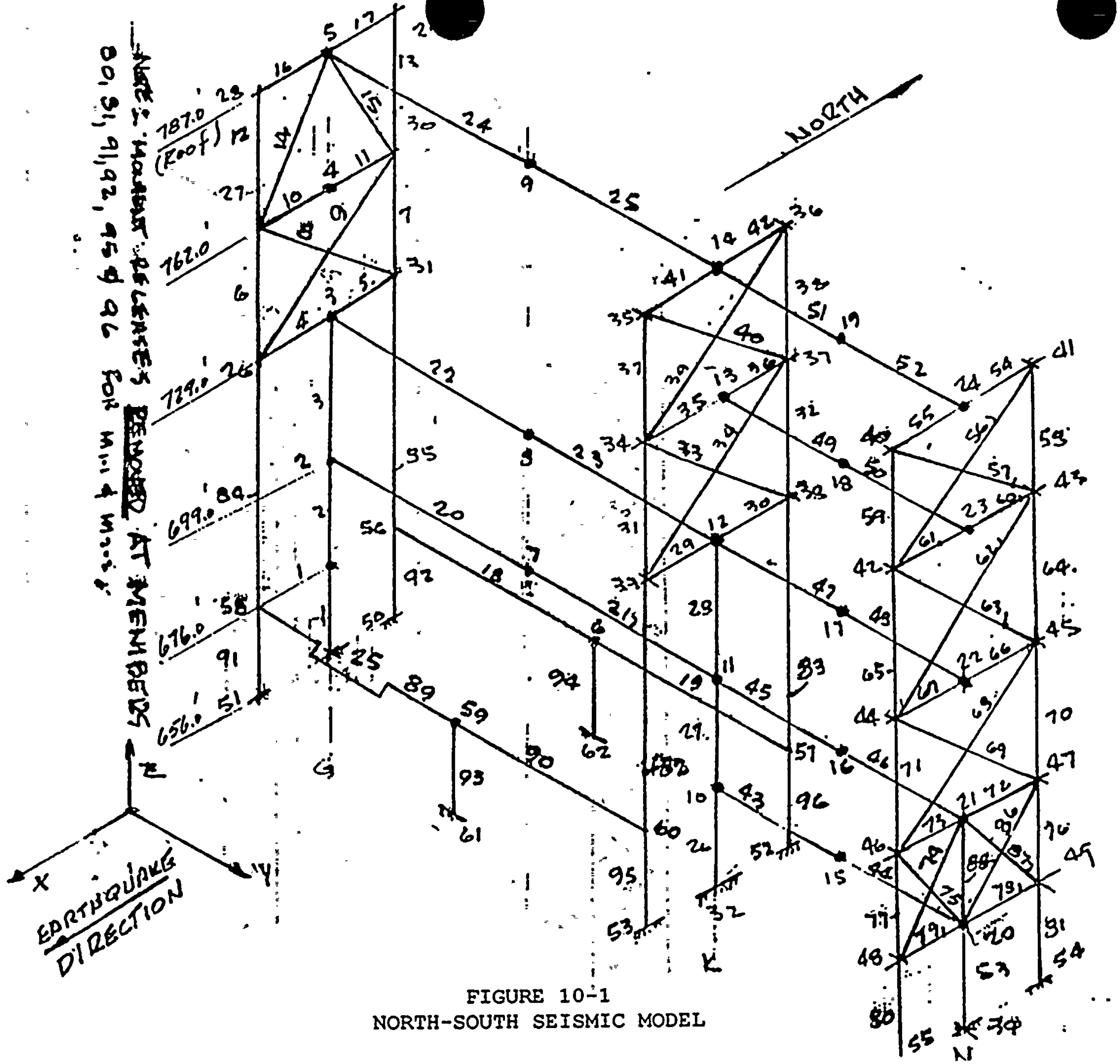


FIGURE 10-1
NORTH-SOUTH SEISMIC MODEL

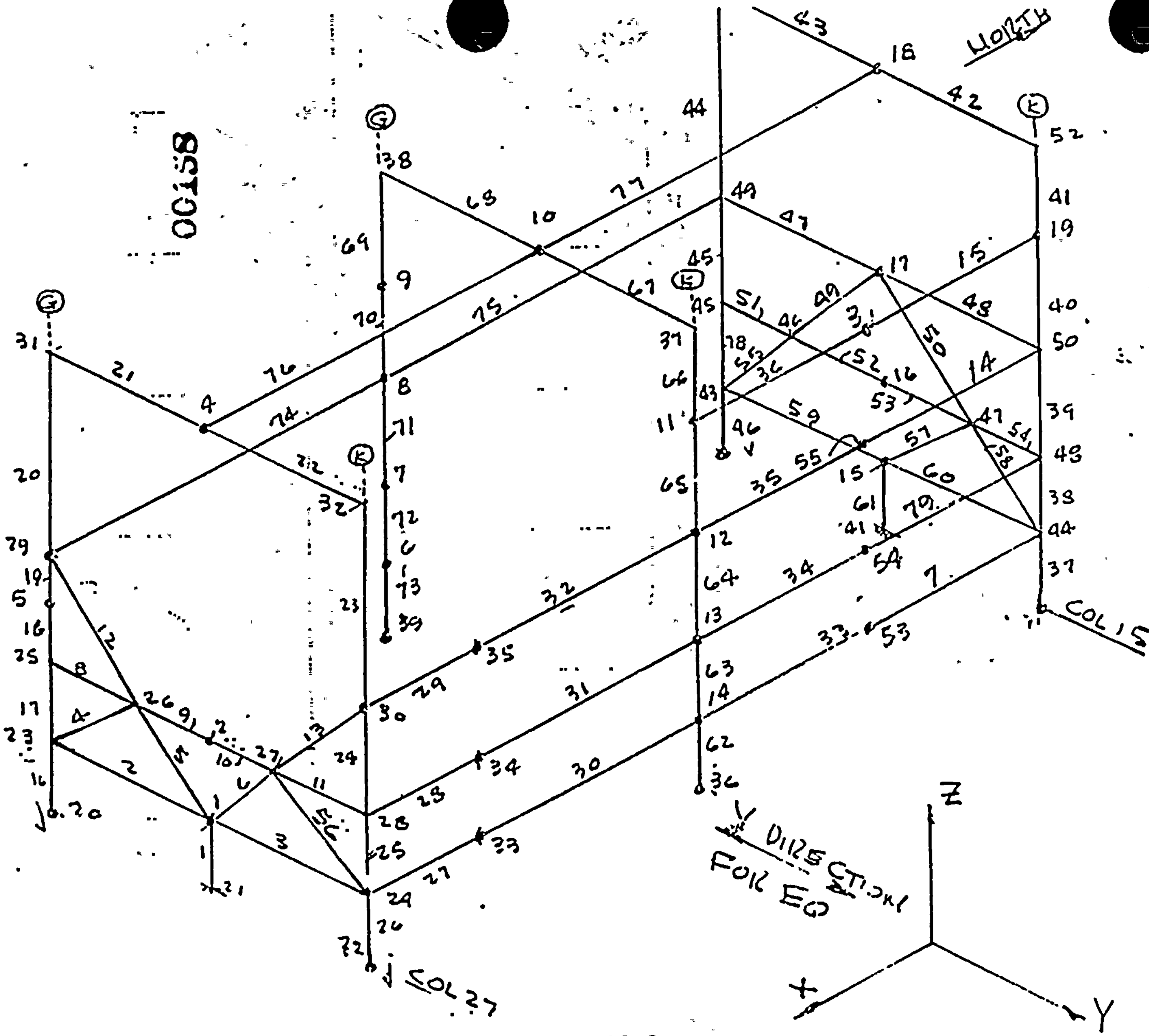


FIGURE 10-2
EAST-WEST SEISMIC MODEL

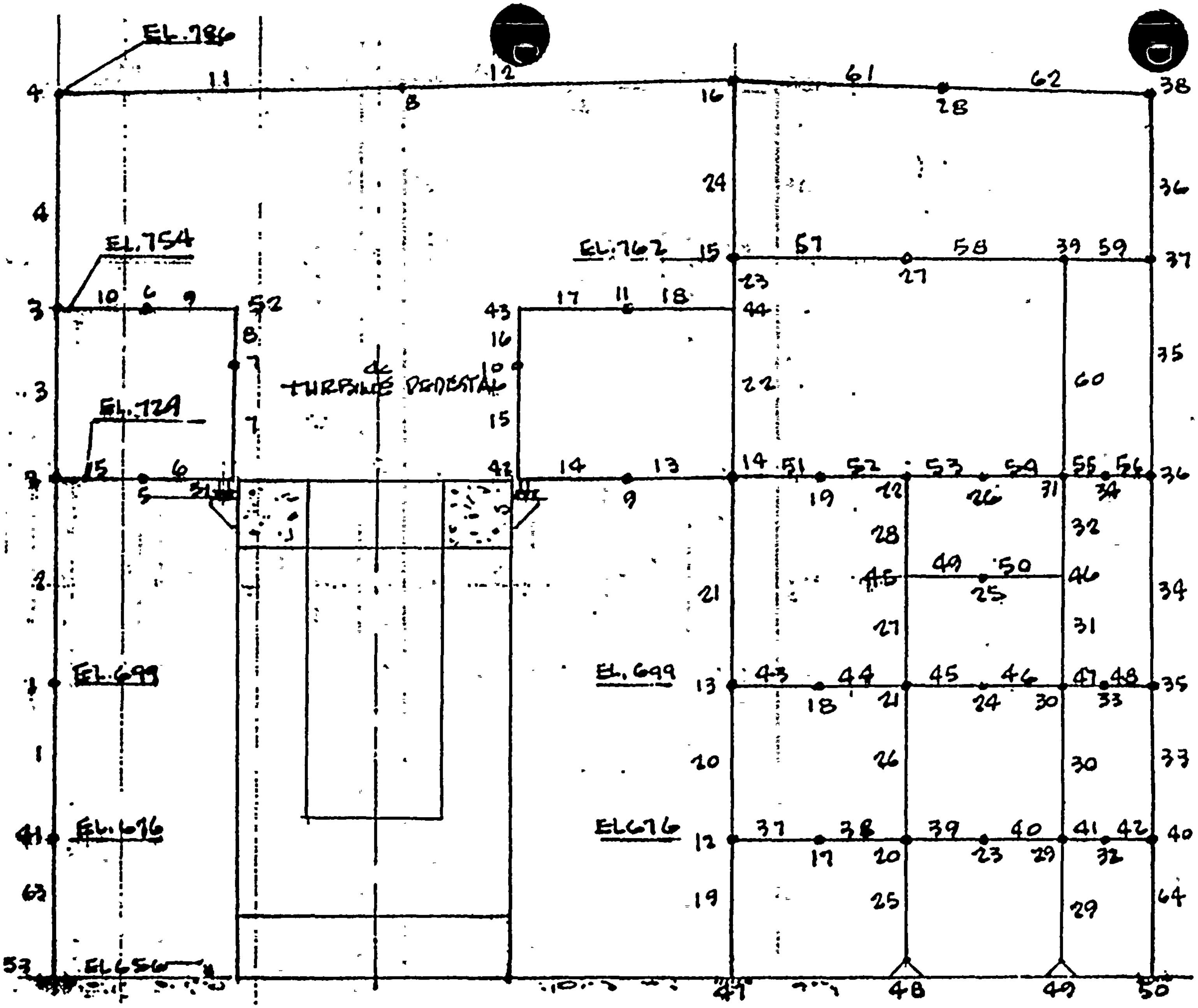


FIGURE 10-3
VERTICAL SEISMIC MODEL

TABLE 10 - 1
MASSES (K-SEC2/FT)

MASS NUMBER	MASS	MASS NUMBER	MASS
1	129	13	104
2	144	14	5
3	121	15	259
4	116	16	429
5	7	17	387
6	148	18	162
7	237	19	13
8	368	20	30
9	55	21	15
10	74	22	17
11	85	23	9
12	74	24	1
		59	290

TABLE 10 - 2
BEAM PROPERTIES

BEAM NO.	AREA A 1-1 (FT^2)	A 2-2 (FT^2)	A 3-3 (FT^2)	MOMENT OF INERTIA I 1-1 (FT^4)	I 2-2 (FT^4)	I 3-3 (FT^4)
1	1.68E+03	1.40E+03	1.40E+03	1.40E+04	3.49E+03	1.56E+07
2	5.58E+02	4.65E+02	4.65E+02	3.12E+03	7.79E+02	3.76E+06
3	3.96E+02	3.30E+02	3.30E+02	1.19E+03	2.97E+02	1.09E+06
4	6.00E+01	5.00E+01	5.00E+01	1.25E+02	3.13E+01	2.88E+03
5	6.00E+01	5.00E+01	5.00E+01	1.25E+02	3.13E+01	2.88E+03
6	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
7	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
8	3.00E-01	2.20E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
9	3.00E-01	2.20E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
10	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
11	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
12	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
13	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
14	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
15	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
16	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
17	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
18	1.08E+02	9.00E+01	9.00E+01	1.44E+02	2.62E+01	3.60E+01
19	1.08E+02	9.00E+01	9.00E+01	1.44E+02	2.62E+01	3.60E+01
20	9.20E+01	7.70E+01	7.70E+01	2.50E+01	5.23E+03	1.00E+02
21	9.20E+01	7.70E+01	7.70E+01	2.50E+01	5.23E+03	1.00E+02
22	1.23E+02	1.03E+02	1.03E+02	2.54E+02	1.77E+04	6.30E+01
23	1.23E+02	1.03E+02	1.03E+02	2.54E+02	1.77E+04	6.30E+01
24	2.48E+00	1.00E+00	1.60E+00	7.00E-01	8.04E+02	6.80E+00
25	2.48E+00	1.00E+00	1.60E+00	7.00E-01	8.04E+02	6.80E+00
26	7.30E+02	6.08E+02	6.08E+02	2.53E+03	6.32E+02	5.18E+06
27	5.94E+02	4.95E+02	4.95E+02	1.78E+03	4.46E+02	1.94E+06
28	5.68E+02	4.73E+02	4.73E+02	2.32E+03	5.80E+02	1.53E+06
29	6.60E+01	5.50E+01	5.50E+01	1.67E+02	4.20E+01	3.17E+03
30	6.60E+01	5.50E+01	5.50E+01	1.67E+02	4.20E+01	3.17E+03
31	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
32	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
33	6.80E-01	5.50E-01	1.40E-01	1.00E-02	2.00E-01	8.00E-02
34	6.80E-01	5.50E-01	1.40E-01	1.00E-02	2.00E-01	8.00E-02
35	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
36	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
37	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02
38	1.24E+00	8.00E-01	5.00E-01	1.00E-02	3.40E+00	9.00E-02

TABLE 10 - 2 (Continued)
BEAM PROPERTIES

BEAM NO.	AREA A 1-1 (FT^2)	A 2-2 (FT^2)	A 3-3 (FT^2)	MOMENT OF INERTIA I 1-1 (FT^4)	I 2-2 (FT^4)	I 3-3 (FT^4)
39	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
40	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
41	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
42	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
43	3.48E+02	2.90E+02	2.90E+02	5.05E+02	1.48E+06	5.50E+01
44	3.48E+02	2.90E+02	2.90E+02	5.05E+02	1.48E+06	5.50E+01
45	5.84E+02	4.87E+02	4.87E+02	1.47E+03	2.18E+06	3.68E+02
46	5.84E+02	4.87E+02	4.87E+02	1.47E+03	2.18E+06	3.68E+02
47	4.89E+02	4.07E+02	4.07E+02	1.43E+03	1.92E+06	3.57E+02
48	4.89E+02	4.07E+02	4.07E+02	1.43E+03	1.92E+06	3.57E+02
49	2.87E+02	2.39E+02	2.39E+02	1.75E+02	1.08E+06	4.40E+01
50	2.87E+02	2.39E+02	2.39E+02	1.75E+02	1.08E+06	4.40E+01
51	8.20E-01	4.20E-01	4.00E-01	1.00E-02	2.66E+02	7.60E-01
52	8.20E-01	4.20E-01	4.00E-01	1.00E-02	2.66E+02	7.60E-01
53	4.68E+02	3.90E+02	3.90E+02	1.40E+03	3.52E+02	9.49E+05
54	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
55	1.80E-01	1.00E-01	8.00E-02	1.00E-02	7.00E-02	1.00E-02
56	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
57	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
58	3.90E-01	3.00E-01	9.00E-02	1.00E-02	1.00E-01	4.00E-02
59	3.90E-01	3.00E-01	9.00E-02	1.00E-02	1.00E-01	4.00E-02
60	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
61	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
62	6.80E-01	5.50E-01	1.40E-01	1.00E-02	2.00E-01	8.00E-02
63	6.80E-01	5.50E-01	1.40E-01	1.00E-02	2.00E-01	8.00E-02
64	3.90E-01	3.00E-01	9.00E-02	1.00E-02	1.00E-01	4.00E-02
65	3.90E-01	3.00E-01	9.00E-02	1.00E-02	1.00E-01	4.00E-02
66	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
67	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
68	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
69	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
70	4.90E-01	3.80E-01	1.10E-01	1.00E-02	1.30E-01	5.00E-02
71	4.90E-01	3.80E-01	1.10E-01	1.00E-02	1.30E-01	5.00E-02
72	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
73	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
74	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
75	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
76	4.90E-01	3.80E-01	1.10E-01	1.00E-02	1.30E-01	5.00E-02

TABLE 10 - 2 (Continued)
BEAM PROPERTIES

BEAM NO.	AREA			MOMENT OF INERTIA		
	A_{1-1} (FT^2)	A_{2-2} (FT^2)	A_{3-3} (FT^2)	I_{1-1} (FT^4)	I_{2-2} (FT^4)	I_{3-3} (FT^4)
77	4.90E-01	3.80E-01	1.10E-01	1.00E-02	1.30E-01	5.00E-02
78	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
79	4.70E-01	3.30E-01	1.40E-01	1.00E-02	2.00E-01	3.00E-02
80	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
81	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
82	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
83	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
84	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
85	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
86	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
87	2.00E-01	1.40E-01	6.00E-02	1.00E-02	5.00E-02	1.00E-02
88	4.90E-01	3.80E-01	1.10E-01	1.00E-02	1.30E-01	5.00E-02
89	1.28E+02	1.07E+02	1.07E+02	1.71E+02	4.37E+04	4.26E+01
90	1.28E+02	1.07E+02	1.07E+02	1.71E+02	4.37E+04	4.26E+01
91	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
92	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
93	4.14E+02	3.45E+02	3.45E+02	3.45E+03	8.63E+02	2.80E+05
94	3.86E+02	3.22E+02	3.22E+02	2.06E+03	5.15E+02	3.00E+05
95	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04
96	3.00E+02	2.55E+02	2.55E+02	1.00E+02	2.50E+01	1.00E+04

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 8

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.175	0.000	0.112	0.000
0.180	0.000	0.119	0.000
0.440	0.365	0.239	0.089
0.522	0.480	0.597	0.214
0.660	1.880	1.200	0.423
0.725	2.540	1.200	0.210
1.380	2.540	1.200	0.210
1.390	3.795	1.359	0.125
1.470	3.795	2.628	1.120
2.403	3.795	2.628	1.120
2.500	4.444	2.628	0.776
2.744	4.444	1.702	0.183
3.500	4.444	1.702	0.183
3.652	3.900	1.702	0.248
4.340	1.920	1.456	0.766
4.820	1.920	1.285	0.506
5.985	1.920	1.285	0.506
6.500	1.920	1.131	0.331
7.800	0.960	0.742	0.408
8.000	0.960	0.682	0.308
14.000	0.960	0.612	0.215
34.520	0.619	0.372	0.114
37.500	0.570	0.372	0.138
50.000	0.570	0.372	0.138

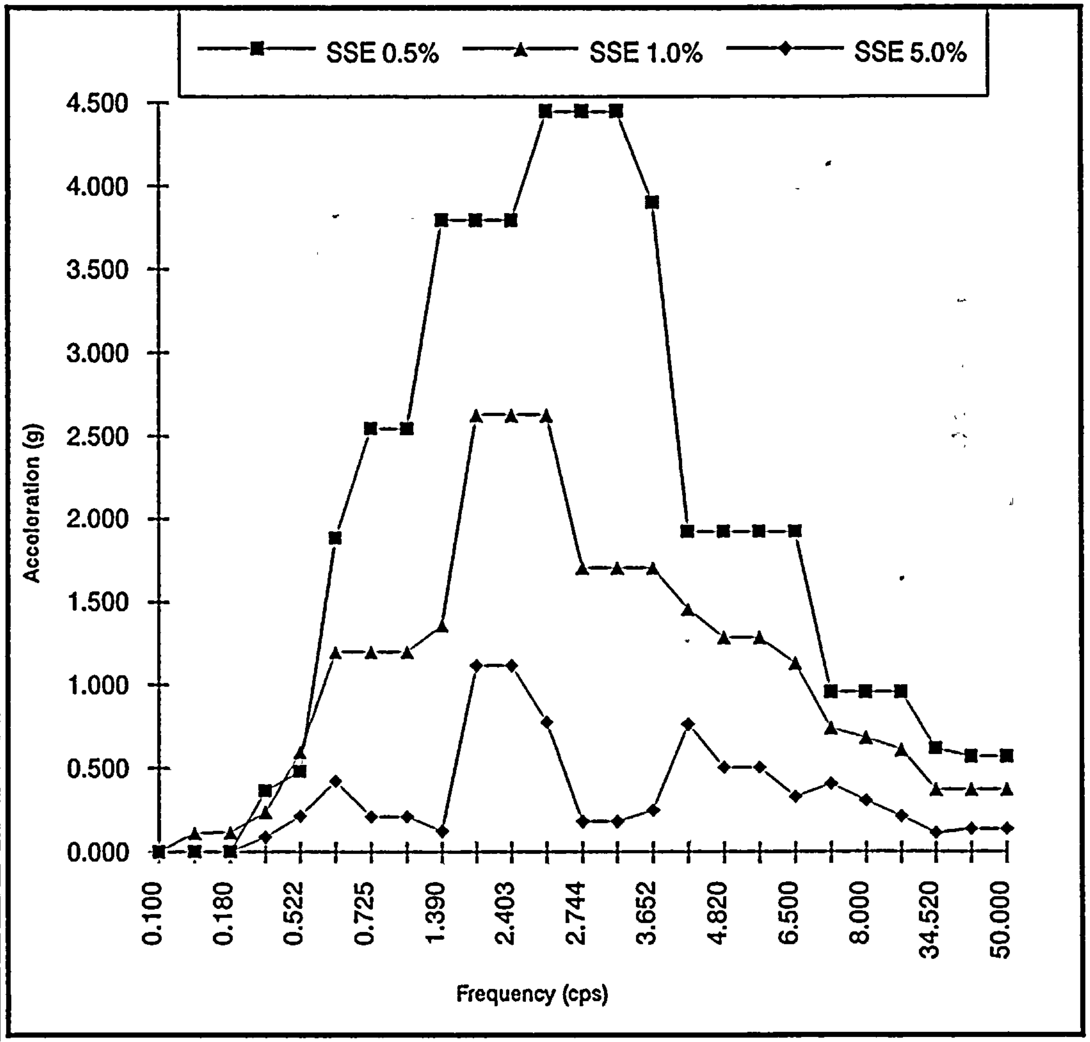


Figure 10 -4

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 12

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.180	0.200	0.089	0.014
0.192	0.220	0.102	0.017
0.585	0.892	0.395	0.060
0.760	1.190	0.516	0.214
1.300	1.190	0.889	0.452
1.325	1.190	1.385	0.436
1.400	7.211	2.871	0.338
1.500	7.211	4.853	1.935
2.400	7.211	4.853	1.935
2.605	6.480	4.853	2.480
2.625	6.000	4.674	2.617
2.840	6.000	2.750	0.449
3.758	6.000	2.750	0.449
4.158	3.014	2.750	0.382
4.342	1.640	2.383	0.350
5.085	1.640	0.902	0.225
7.350	1.640	0.902	0.225
7.650	1.640	0.700	0.097
8.000	1.640	0.700	0.097
11.020	1.130	0.700	0.230
19.000	1.130	0.700	0.230
20.000	1.064	0.700	0.265
22.080	0.928	0.500	0.119
26.500	0.640	0.400	0.134
50.000	0.640	0.400	0.134

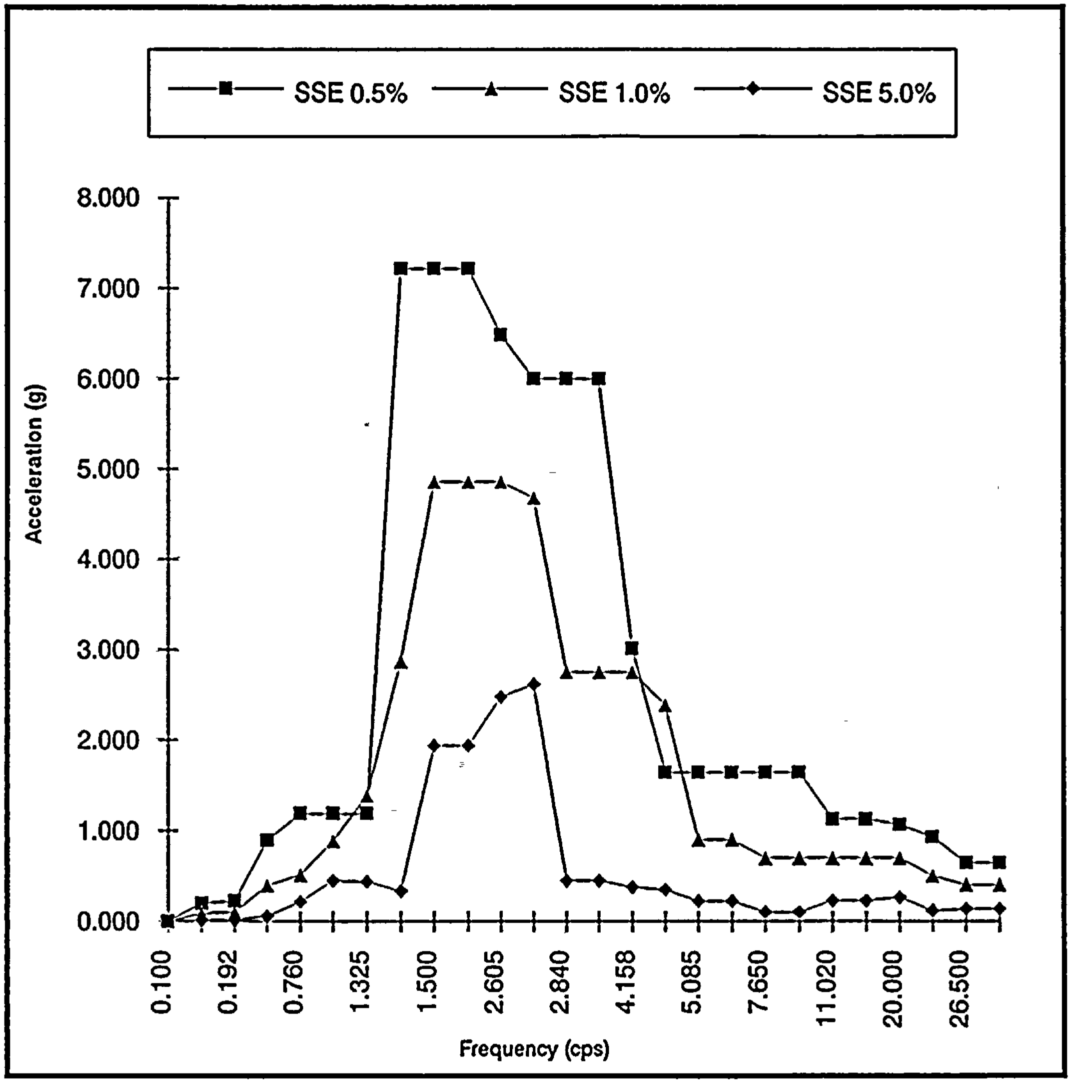


Figure 10- 5

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 13

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.178	0.090	0.081	0.063
0.190	0.100	0.093	0.079
0.619	0.402	0.182	0.029
1.238	0.840	0.572	0.234
1.300	0.884	1.097	0.302
1.450	4.762	2.366	0.466
1.525	4.762	3.000	1.026
2.359	4.762	3.000	1.026
2.495	4.762	2.577	0.619
2.700	4.324	1.940	0.302
2.758	4.324	1.760	0.218
5.456	4.324	1.760	0.218
5.748	4.324	1.582	0.153
7.125	4.324	1.582	0.153
7.250	4.324	1.531	0.137
9.150	0.964	0.759	0.436
9.248	0.964	0.719	0.364
17.000	0.964	0.473	0.091
20.085	0.490	0.375	0.202
22.520	0.490	0.298	0.094
50.000	0.490	0.298	0.094

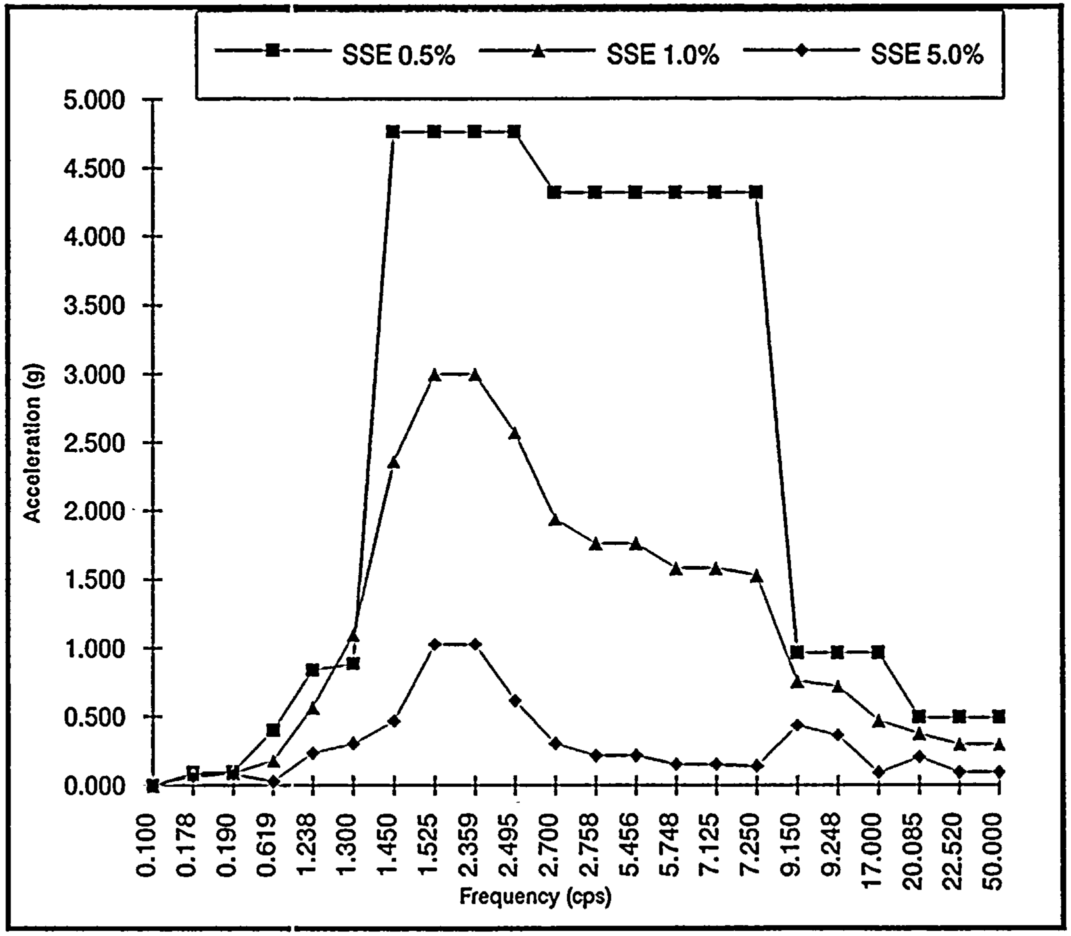


Figure 10 - 6

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 14

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.175	0.080	0.050	0.017
0.628	0.246	0.159	0.058
0.950	0.364	0.317	0.230
1.095	0.440	0.388	0.290
1.302	0.548	0.388	0.174
1.600	0.704	0.739	0.244
1.739	1.500	0.902	0.277
1.800	1.850	0.902	0.170
2.558	1.850	0.902	0.170
2.685	1.850	1.000	0.240
2.980	1.850	1.000	0.240
3.020	1.970	1.000	0.207
4.456	1.970	1.000	0.207
4.955	1.970	0.969	0.187
5.150	1.613	0.969	0.297
7.250	1.613	0.969	0.297
8.100	1.613	0.755	0.130
8.485	1.440	0.658	0.107
8.898	1.440	0.554	0.060
14.354	1.440	0.554	0.060
14.500	1.440	0.542	0.056
18.020	0.330	0.242	0.118
18.958	0.330	0.162	0.031
24.000	0.330	0.162	0.031
26.950	0.240	0.162	0.065
50.000	0.240	0.162	0.065

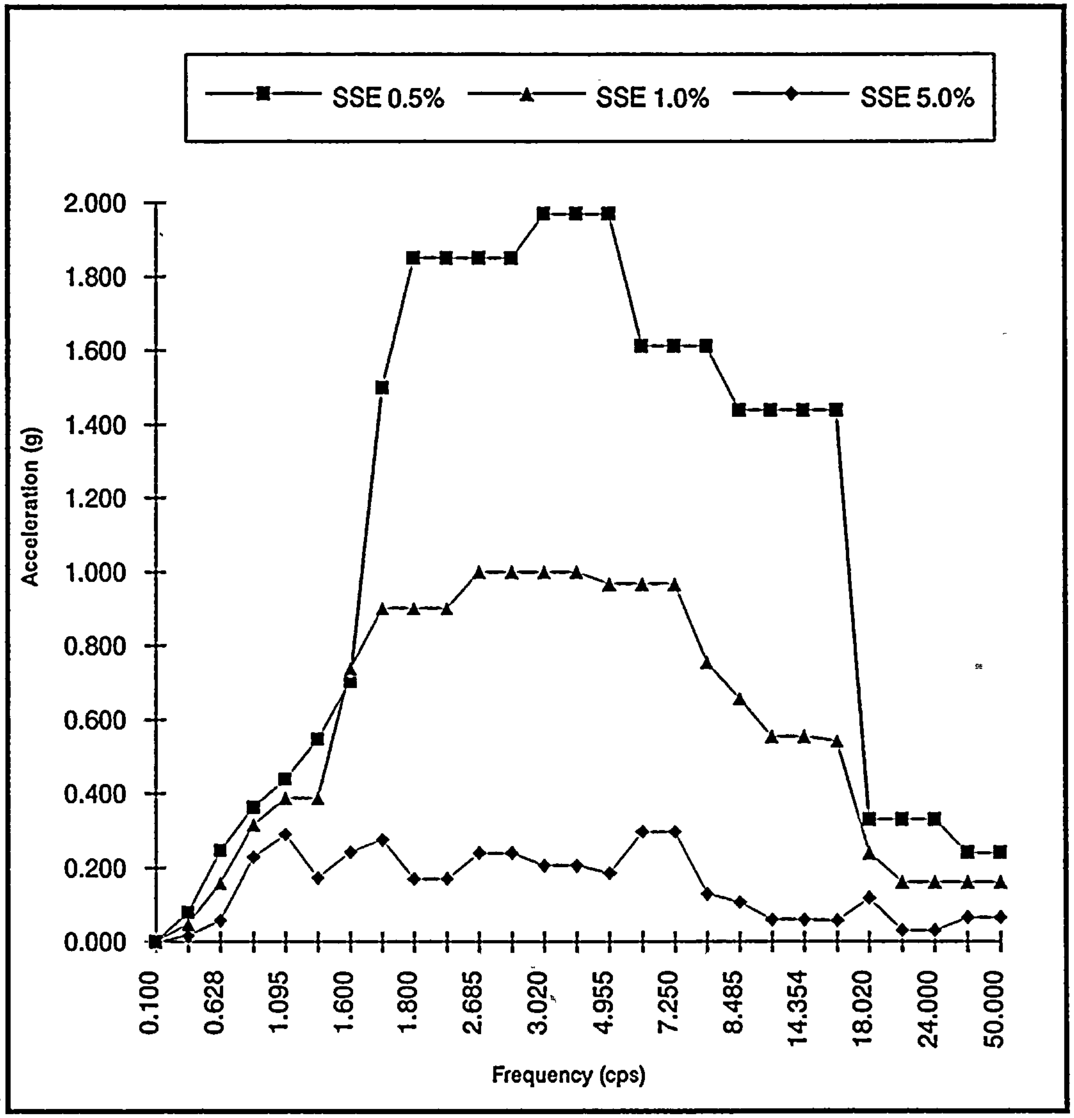


Figure 10 - 7

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 15

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.192	0.029	0.070	0.022
0.700	0.188	0.174	0.145
1.498	0.440	0.411	0.351
1.800	0.718	0.500	0.216
1.845	0.760	0.500	0.189
3.250	0.760	0.500	0.189
3.700	0.760	0.575	0.301
3.752	0.760	0.584	0.317
5.125	1.044	0.584	0.152
15.200	1.044	0.584	0.152
17.000	1.044	0.958	0.350
17.995	1.392	0.958	0.403
27.000	1.392	0.958	0.403
28.450	1.766	0.958	0.232
33.500	0.250	0.358	0.118
35.000	0.250	0.180	0.084
50.000	0.250	0.180	0.084

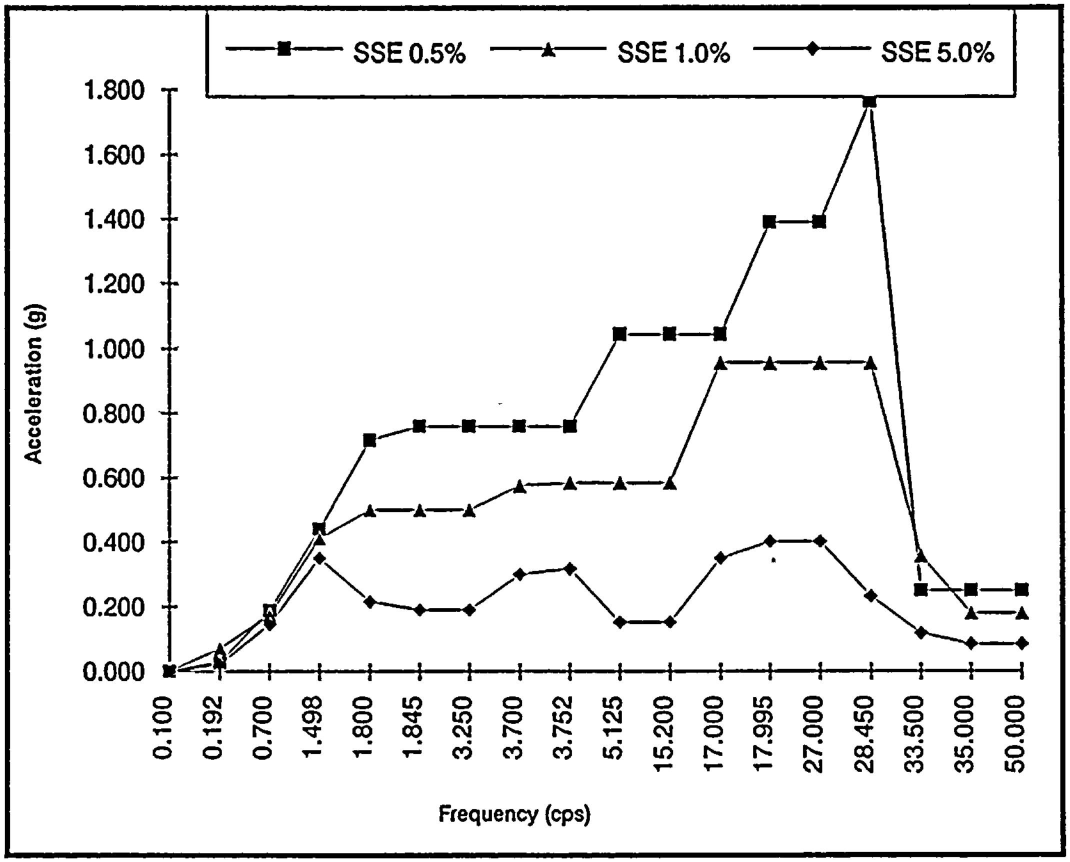


Figure 10 - 8

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 16

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1%	SSE 5%
0.100	0.000	0.000	0.000
0.180	0.048	0.075	0.018
1.100	0.588	0.438	0.221
1.385	0.756	1.953	0.549
1.485	4.383	2.484	0.664
1.582	4.383	3.000	1.244
4.820	4.383	3.000	1.244
5.000	4.383	3.240	1.606
5.200	4.649	3.240	1.401
8.229	4.649	3.240	1.401
8.350	4.649	3.188	1.328
13.650	1.124	0.928	0.595
13.950	1.124	0.800	0.363
19.250	1.124	0.728	0.266
34.000	0.630	0.528	0.350
37.500	0.630	0.480	0.255
50.000	0.630	0.480	0.255

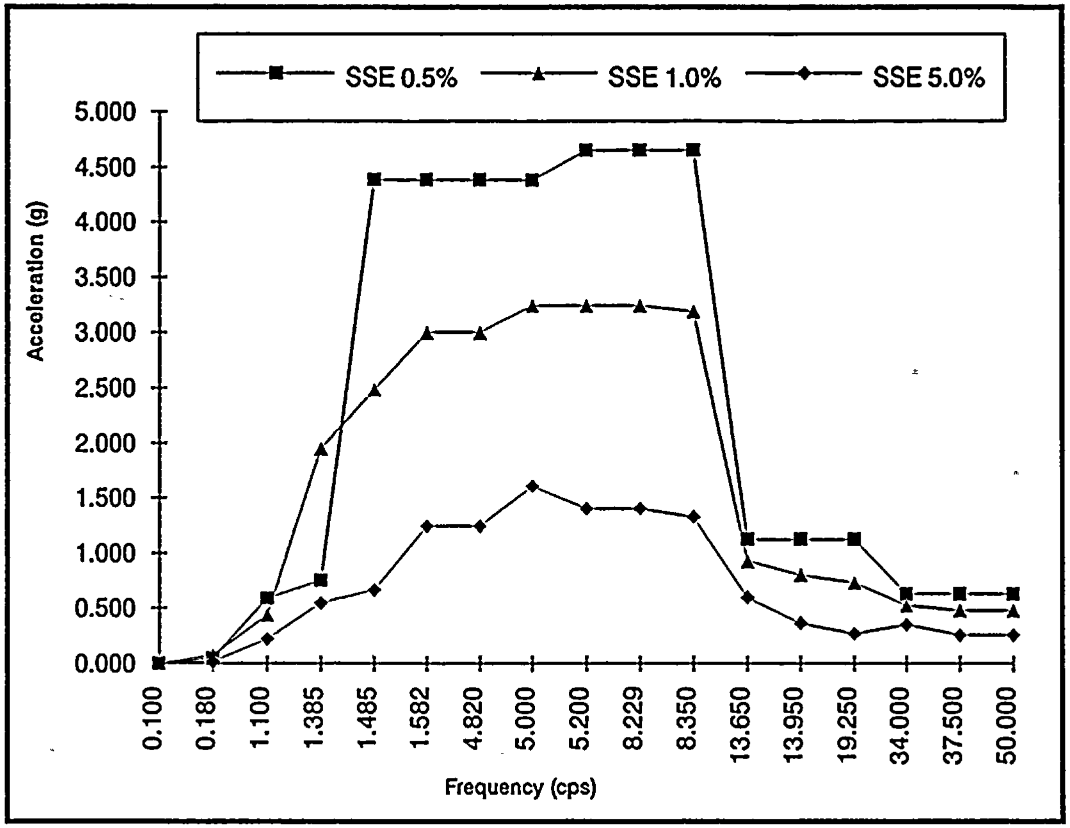


Figure 10 - 9

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 17

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.179	0.070	0.097	0.207
0.198	0.128	0.120	0.103
0.567	1.270	0.465	0.045
0.700	1.680	0.730	0.105
0.760	1.680	0.849	0.174
1.285	1.680	0.849	0.174
1.300	2.786	0.849	0.054
1.452	8.855	4.650	1.042
1.500	8.855	5.850	2.234
2.500	8.855	5.850	2.234
2.600	8.855	4.920	1.257
2.700	13.018	3.990	0.256
2.758	12.450	3.990	0.284
3.355	6.590	3.990	1.244
3.600	6.130	3.990	1.472
5.520	2.530	2.667	0.875
7.650	2.530	1.200	0.212
10.000	2.530	1.162	0.191
14.000	1.398	1.096	0.623
20.020	1.398	0.998	0.456
28.200	1.164	0.865	0.434
36.650	0.924	0.595	0.214
37.500	0.840	0.595	0.267
50.000	0.840	0.595	0.267

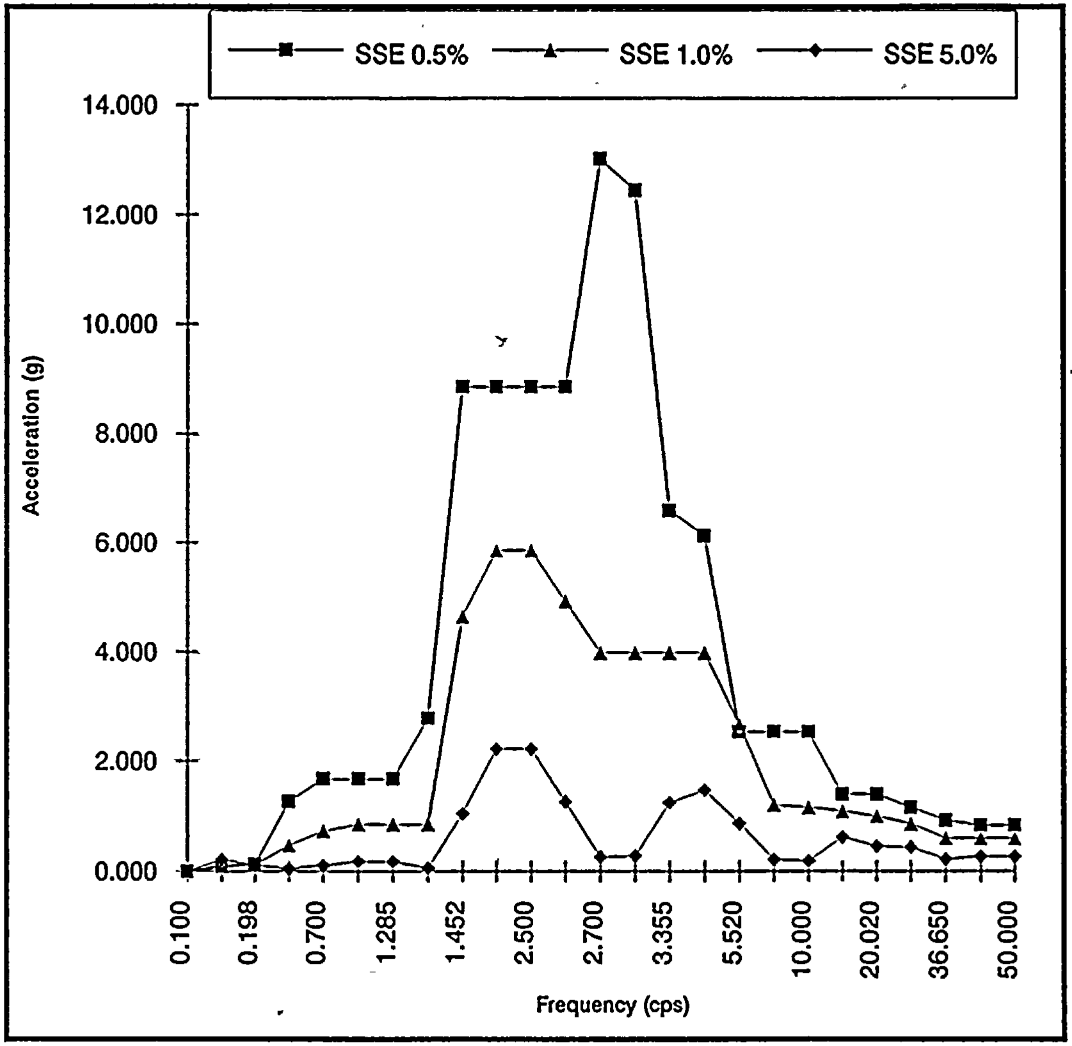


Figure 10 - 10

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 53

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.194	0.120	0.054
0.700	0.214	0.096
1.745	0.768	0.343
4.500	0.875	0.391
5.000	2.060	0.921
8.000	2.060	0.921
11.200	0.359	0.161
32.500	0.192	0.086
50.000	0.192	0.086

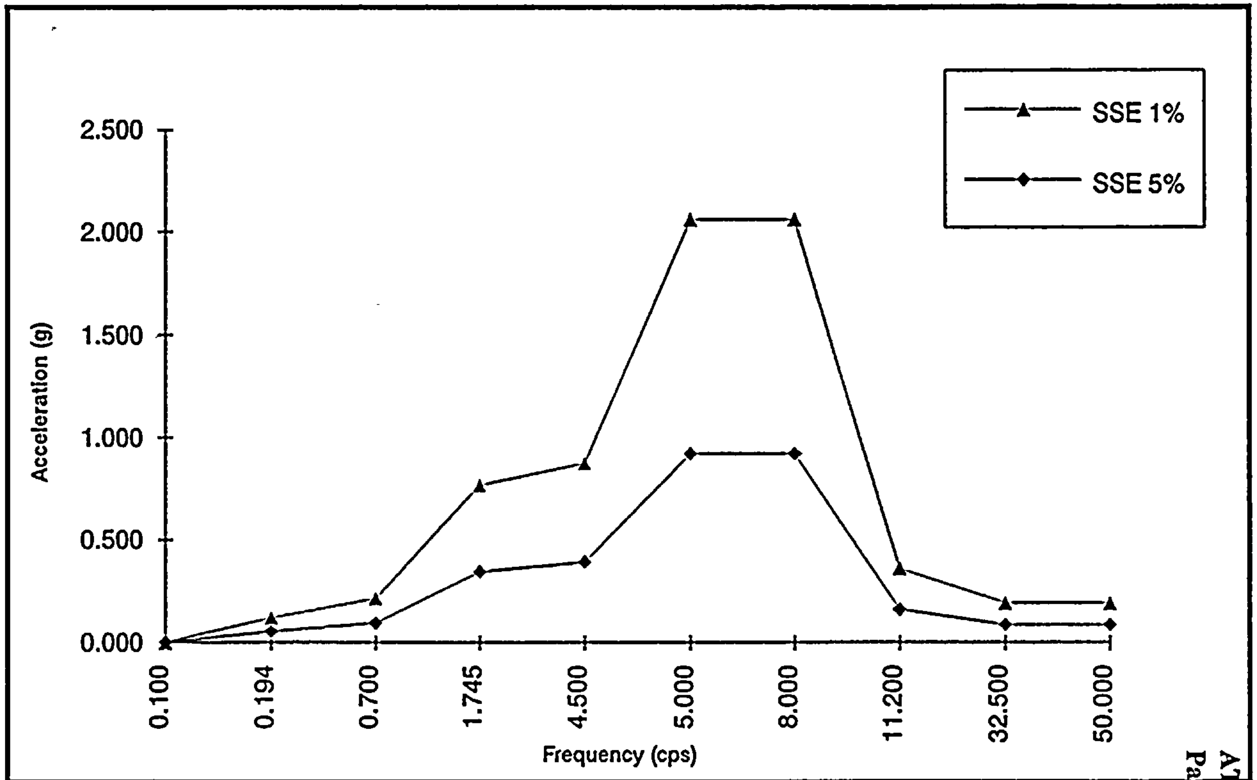


Figure 10 - 11

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 54

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.185	0.085	0.038
1.040	0.330	0.148
1.400	2.578	1.153
2.500	2.578	1.153
2.715	1.450	0.648
4.100	1.450	0.648
4.500	0.982	0.439
7.955	0.982	0.439
9.560	0.480	0.215
40.000	0.240	0.107
50.000	0.240	0.107

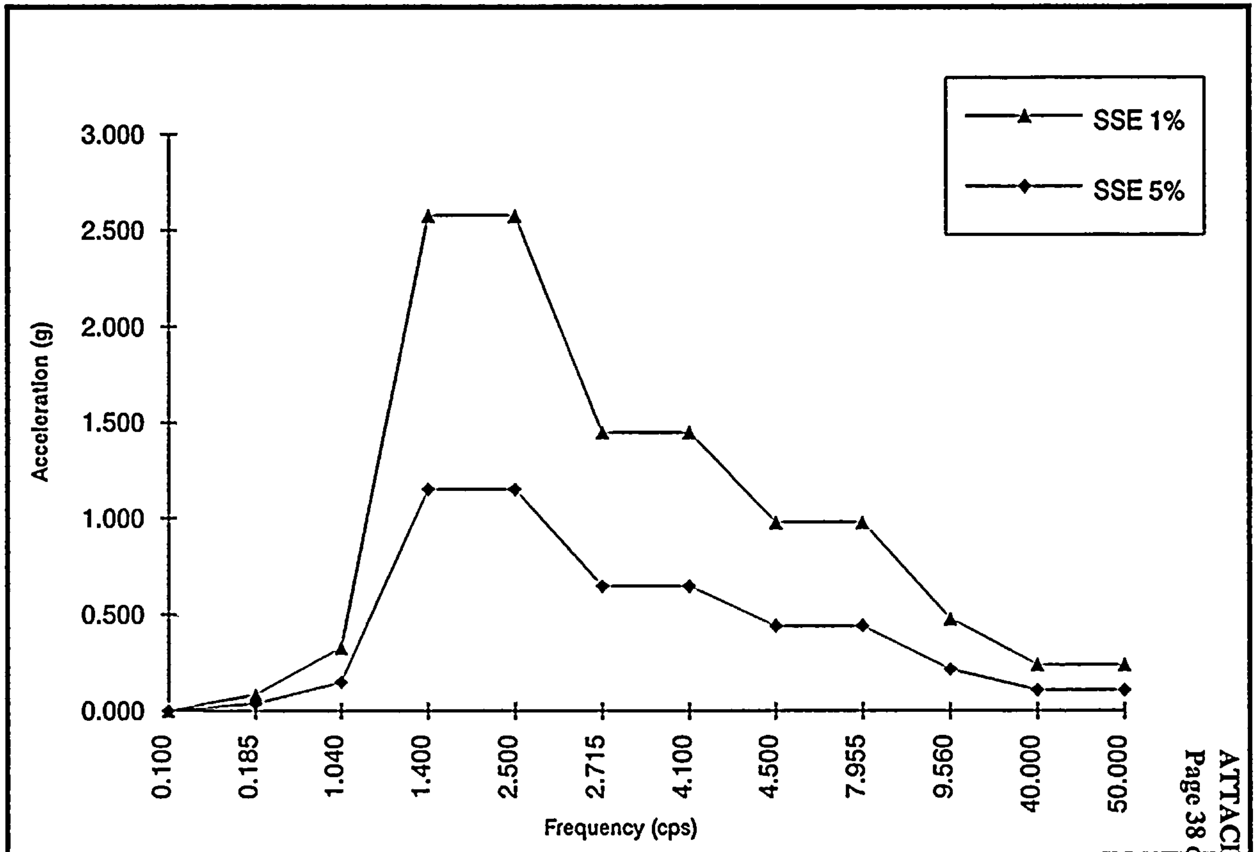


Figure 10 - 12

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
E-W Point 55

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.185	0.180	0.080
0.420	0.180	0.080
0.710	0.560	0.250
1.148	0.560	0.250
1.456	3.965	1.773
2.500	3.965	1.773
2.750	1.538	0.688
3.750	1.538	0.688
3.950	1.125	0.503
7.500	1.125	0.503
8.000	0.582	0.260
22.500	0.582	0.260
23.010	0.395	0.177
50.000	0.395	0.177

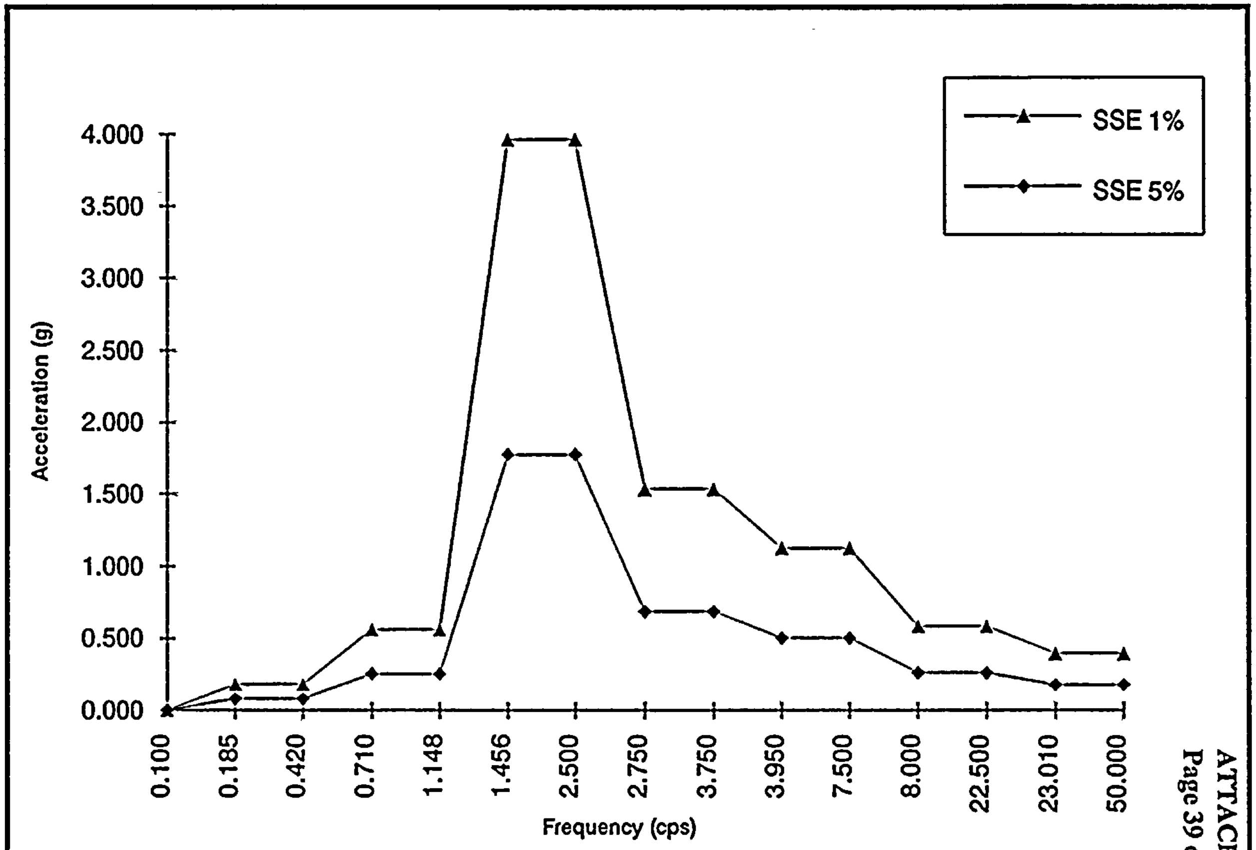


Figure 10 - 13

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PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 1

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.565	0.140	0.063
3.245	0.604	0.270
5.485	0.604	0.270
34.800	0.140	0.063
50.000	0.140	0.063

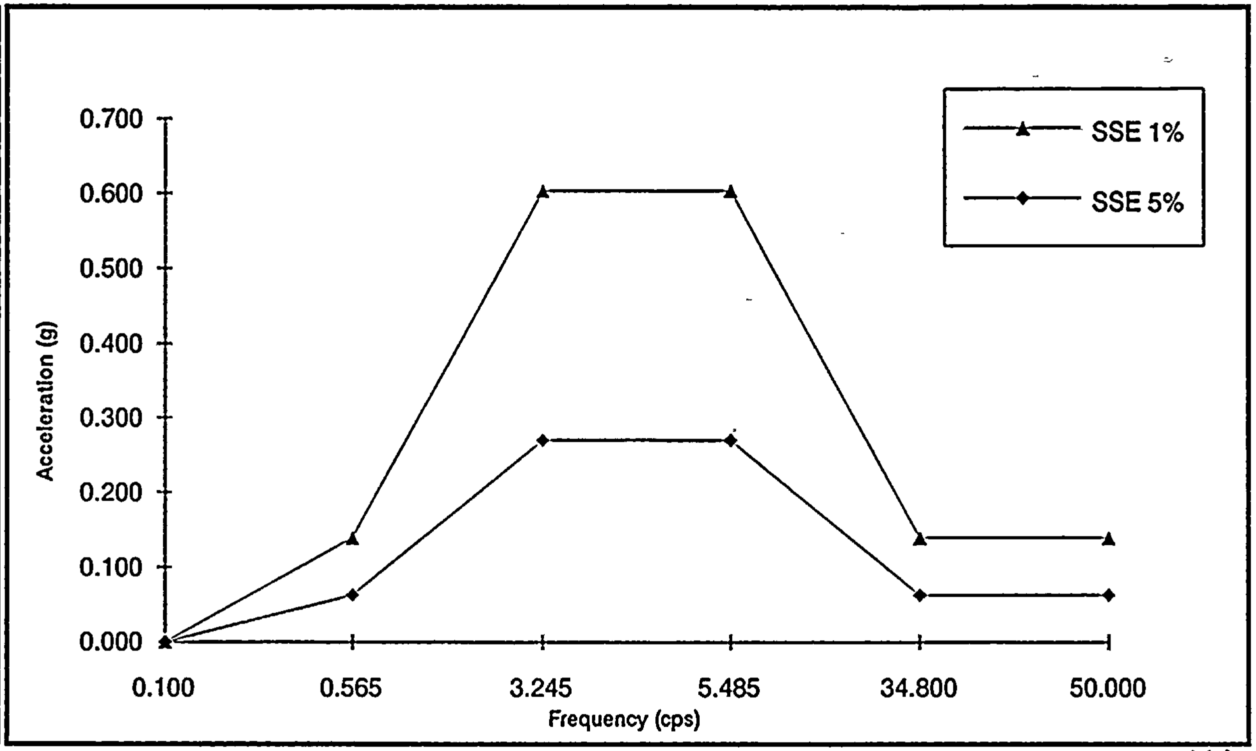

Figure 10 - 14

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 2

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.685	0.162	0.072
3.225	0.669	0.299
5.425	0.669	0.299
5.650	0.635	0.284
23.500	0.635	0.284
35.000	0.122	0.055
50.000	0.122	0.055

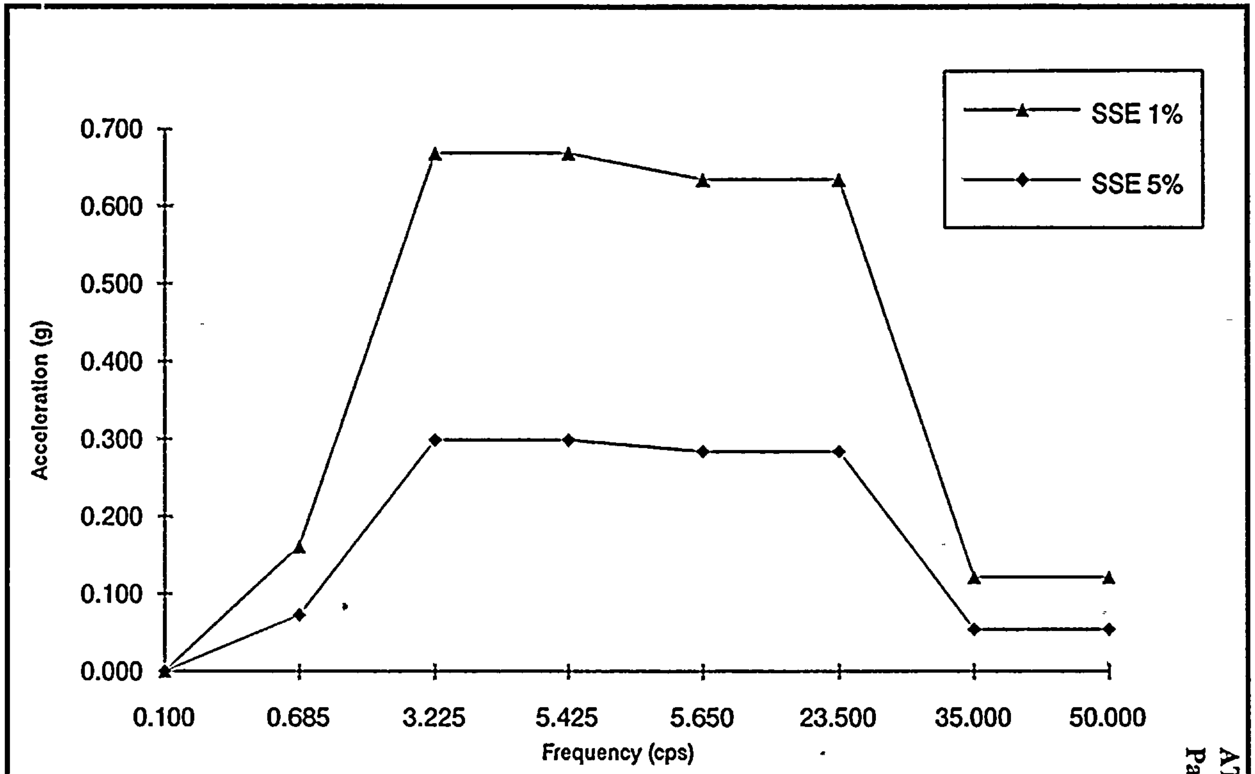

Figure 10 - 15

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 3

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.565	0.148	0.066
3.358	0.682	0.305
11.035	0.682	0.305
13.040	0.940	0.420
23.025	0.940	0.420
30.500	0.162	0.072
50.000	0.162	0.072

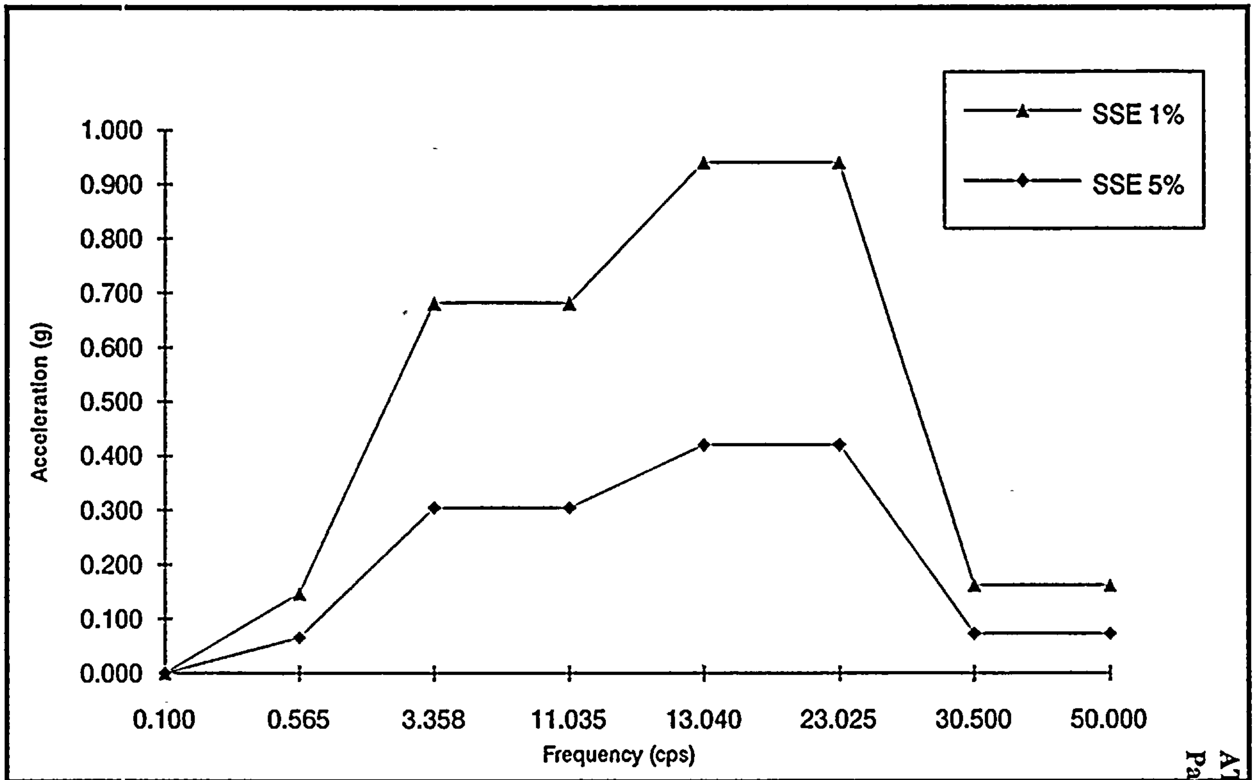

Figure 10 - 16

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 7

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
2.325	0.640	0.286
3.252	3.795	1.697
6.458	3.795	1.697
11.995	0.565	0.253
22.980	0.565	0.253
28.500	0.398	0.178
50.000	0.398	0.178

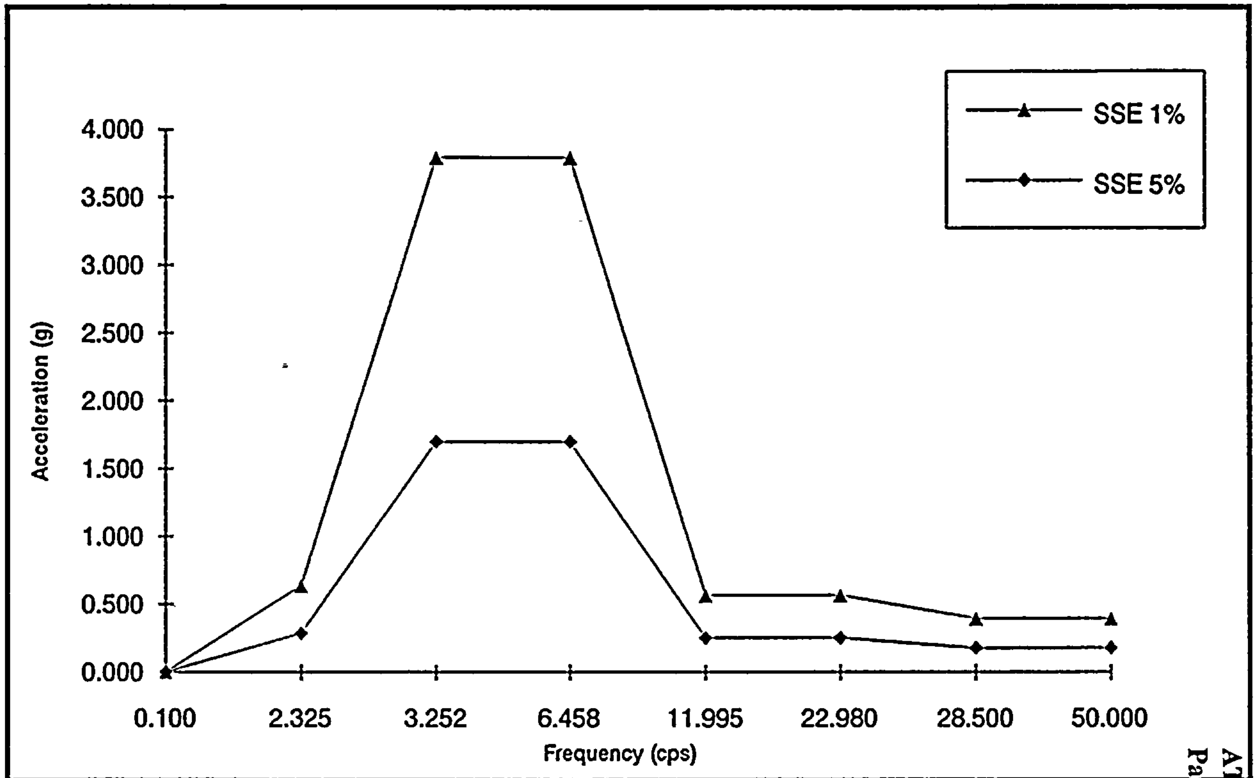

Figure 10 - 17

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 8

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
1.498	0.425	0.190
1.510	1.135	0.508
2.585	1.135	0.508
3.720	4.158	1.860
5.670	4.158	1.860
9.520	0.600	0.268
50.000	0.600	0.268

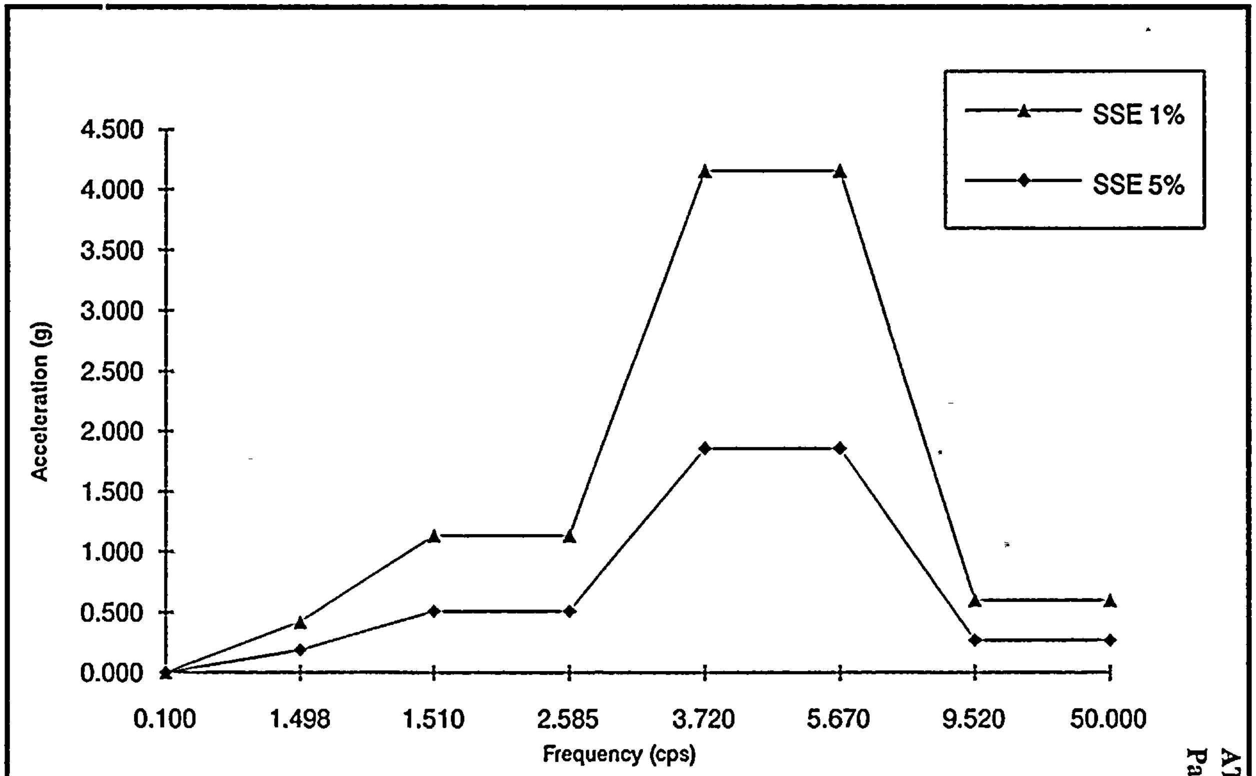

Figure 10 - 18

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 10

Frequency (cps)	Acceleration (g) SSE 1.0%	Acceleration (g) SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.649	0.154	0.069
3.248	0.635	0.284
5.335	0.635	0.284
15.985	0.267	0.119
22.450	0.267	0.119
35.000	0.142	0.064
50.000	0.142	0.064

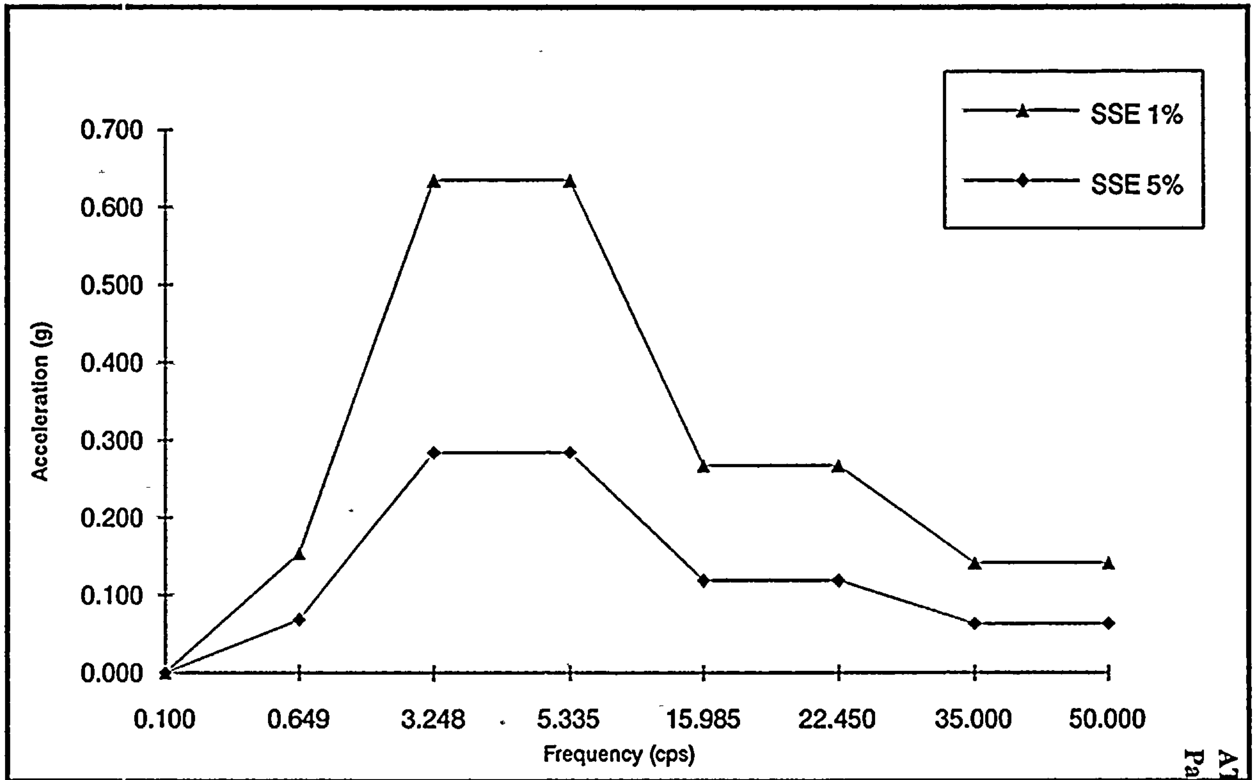

Figure 10 - 19

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 11

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.685	0.162	0.072
3.248	0.690	0.309
5.340	0.690	0.309
7.000	0.424	0.190
17.200	0.249	0.111
30.850	0.249	0.111
35.200	0.142	0.064
50.000	0.142	0.064

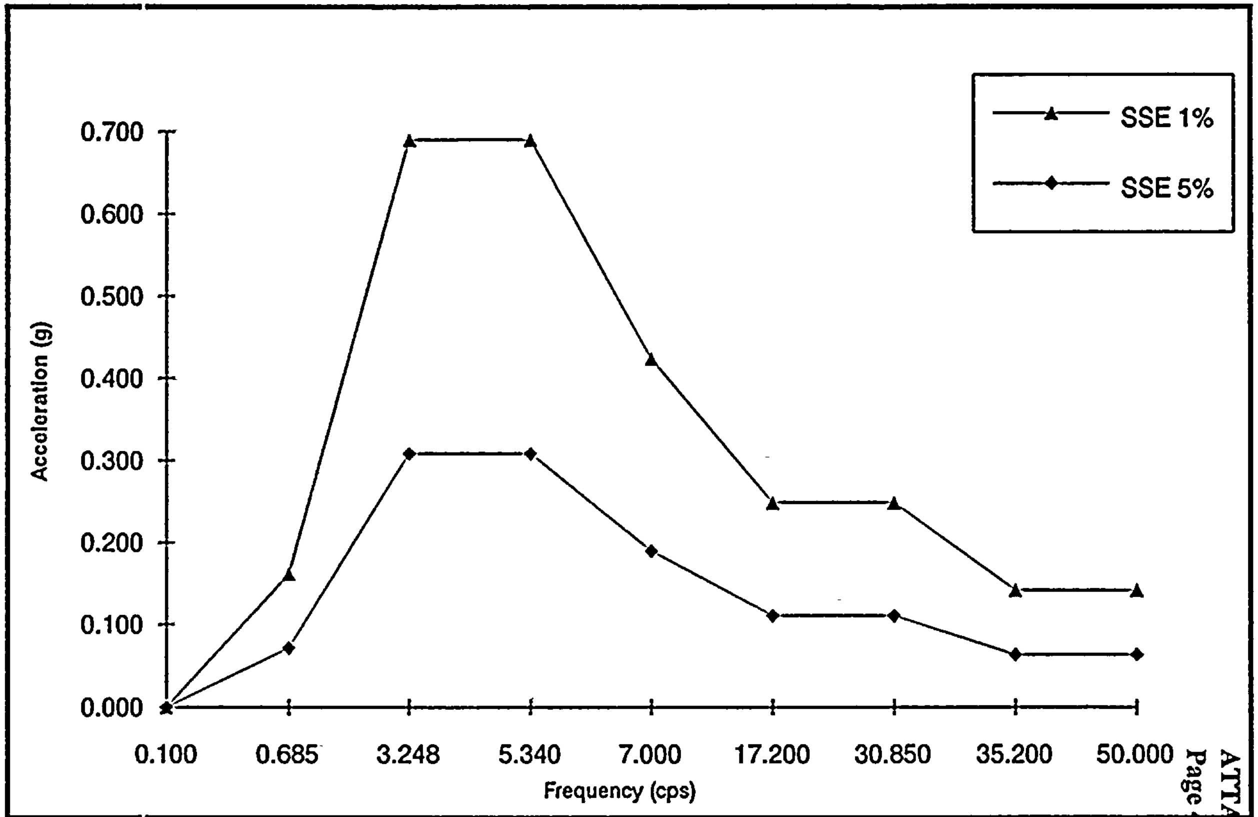

Figure 10 - 20

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 12

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.698	0.160	0.072
2.160	0.528	0.236
3.155	0.732	0.327
5.495	0.732	0.327
6.600	0.380	0.170
14.200	0.285	0.127
28.852	0.285	0.127
34.995	0.142	0.064
50.00	0.142	0.064

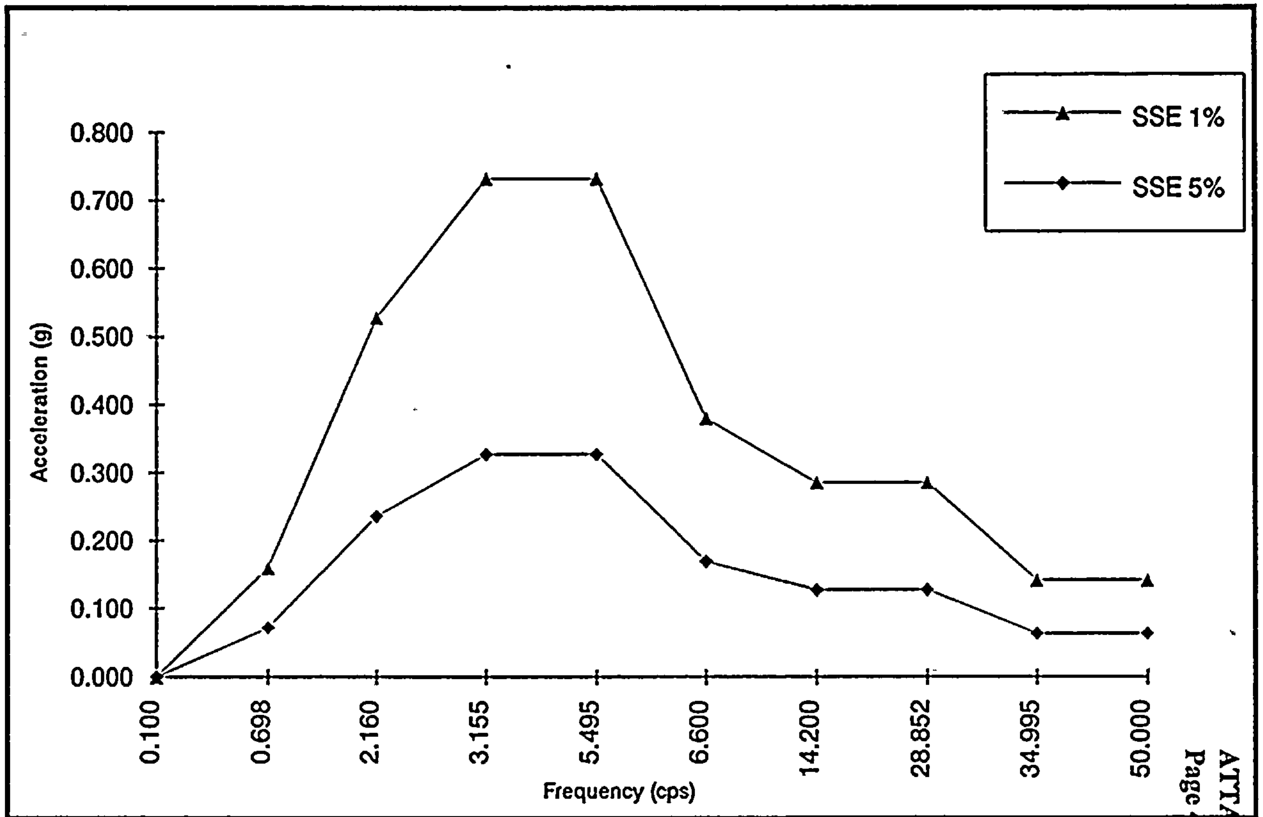

Figure 10 - 21

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 16

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
1.025	0.402	0.180
1.650	1.220	0.546
2.250	1.220	0.546
2.750	4.354	1.947
4.670	4.354	1.947
4.990	3.230	1.444
7.028	3.230	1.444
10.075	0.995	0.445
29.985	0.500	0.224
50.00	0.500	0.224

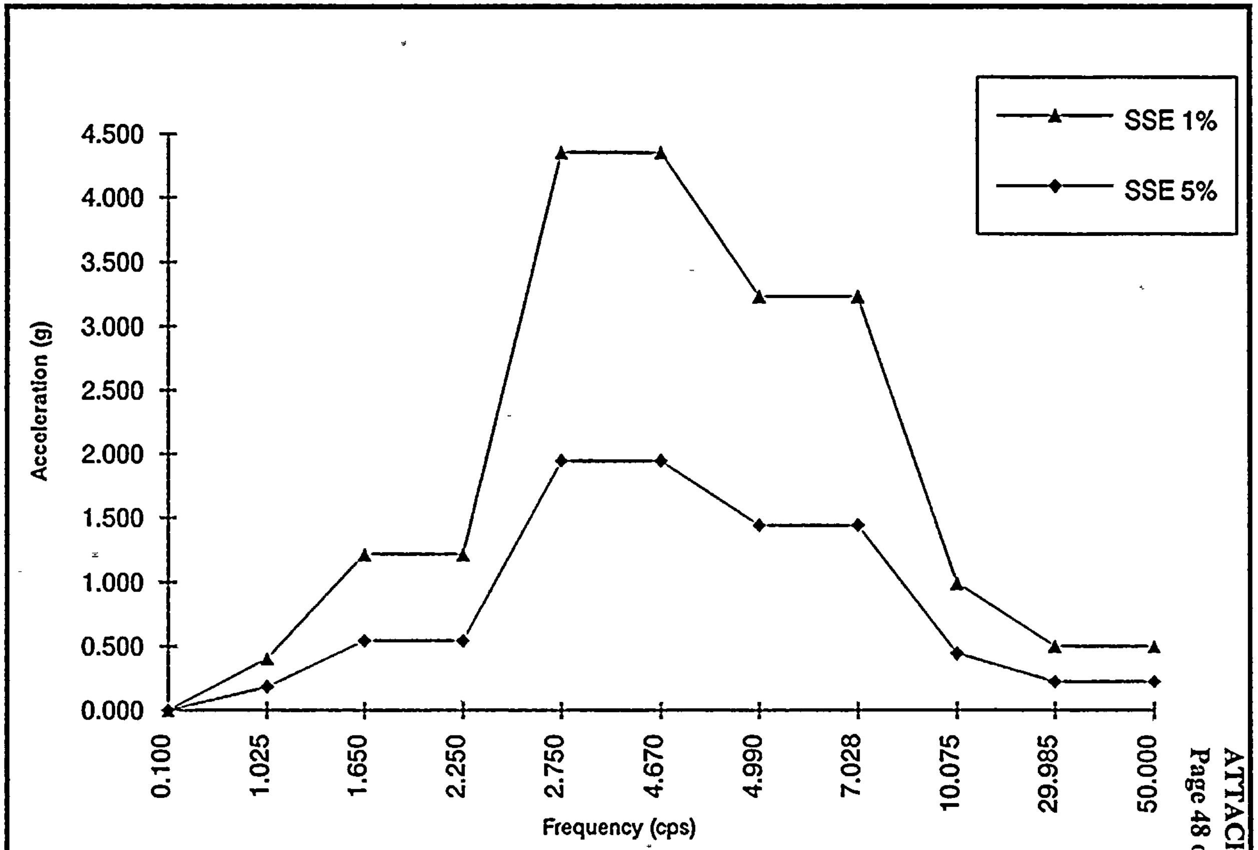

Figure 10 - 22

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 17

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.750	0.325	0.145
1.298	0.765	0.342
1.500	2.742	1.226
3.750	2.742	1.226
4.052	3.330	1.489
7.052	3.330	1.489
11.980	0.885	0.396
20.020	0.885	0.396
28.340	0.560	0.250
50.000	0.560	0.250

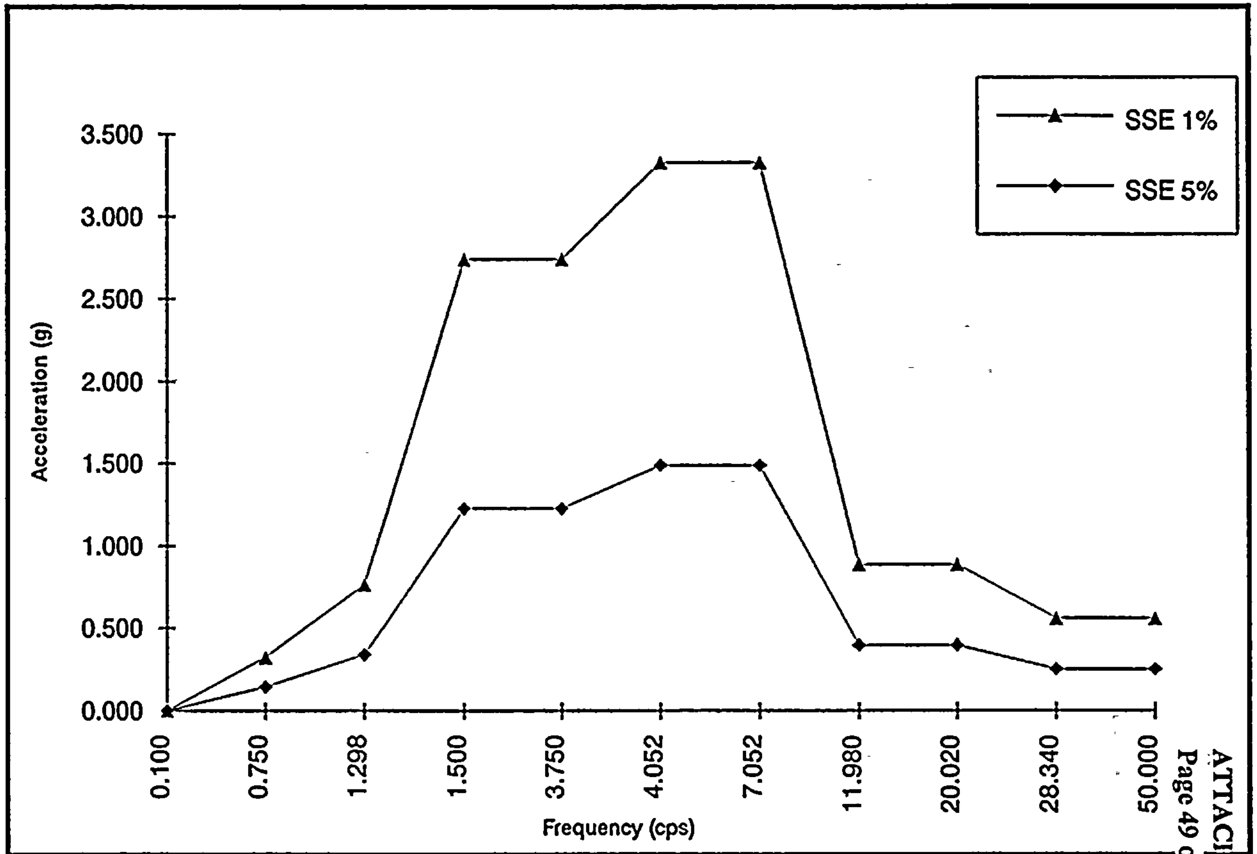

Figure 10 - 23

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
N-S Point 22

Frequency (cps)	Acceleration (g)	
	SSE 1.0%	SSE 5.0% = SSE 1.0%/SQRT of 5
0.100	0.000	0.000
0.650	0.159	0.071
1.652	0.482	0.216
3.000	0.482	0.216
3.245	0.605	0.271
5.600	0.605	0.271
6.400	0.420	0.188
17.800	0.244	0.109
24.500	0.244	0.109
34.250	0.120	0.054
50.000	0.120	0.054

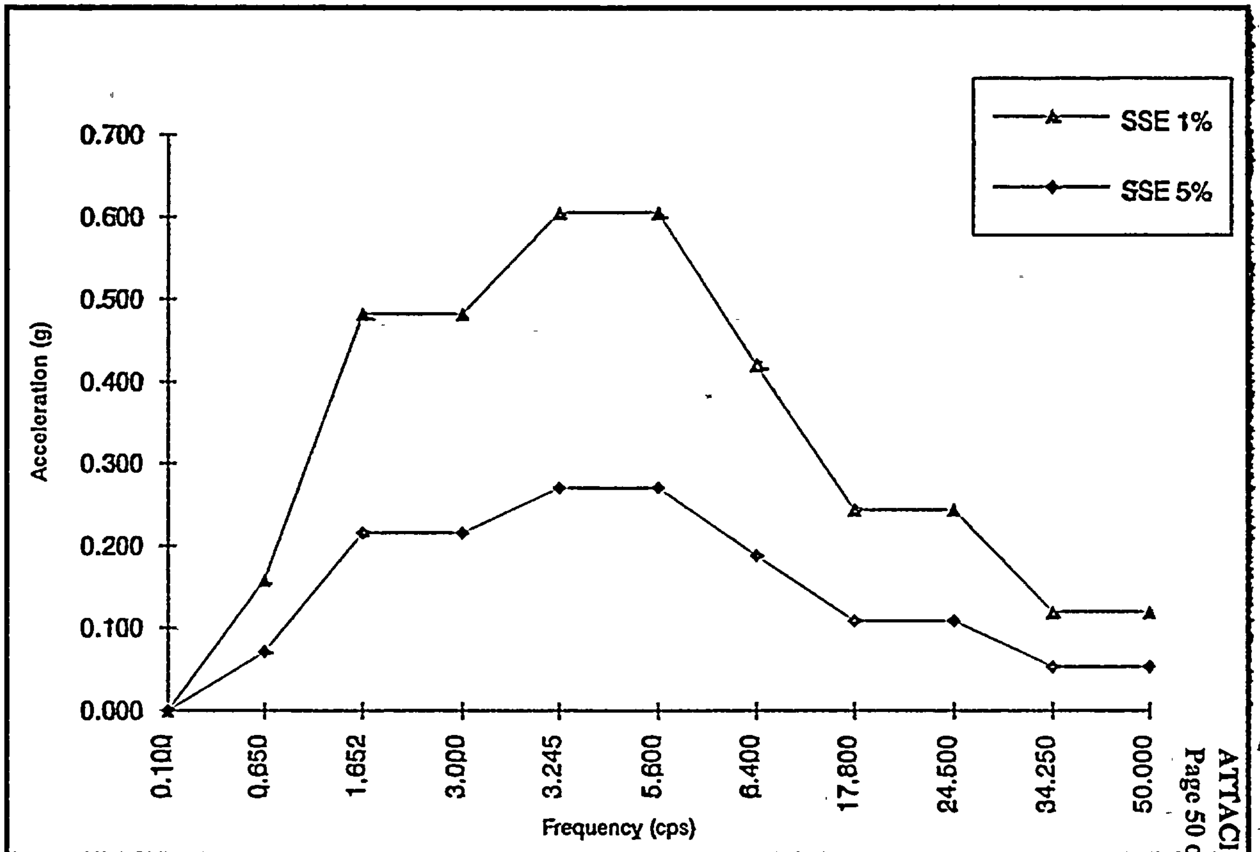

Figure 10 - 24

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PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 5

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.660	0.156	0.138	0.104
1.600	0.420	0.263	0.089
3.600	0.718	0.530	0.262
3.750	0.740	0.637	0.450
5.600	2.577	1.962	1.042
5.670	2.657	1.962	0.971
10.000	2.657	1.962	0.971
11.982	0.600	1.332	0.637
14.980	0.600	0.380	0.132
17.500	0.600	0.355	0.105
24.000	0.360	0.292	0.180
28.300	0.360	0.250	0.107
50.000	0.360	0.250	0.107

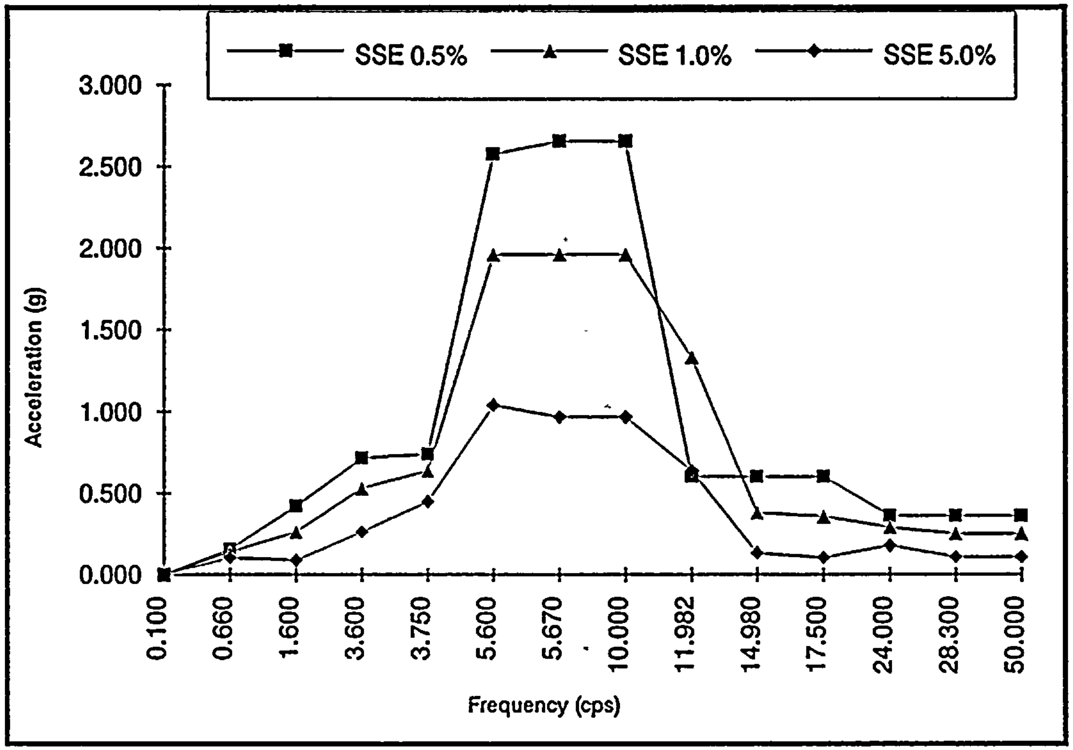


Figure 10 - 25

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 9

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
1.400	0.520	0.300	0.084
2.500	0.960	0.667	0.286
2.600	4.554	0.700	0.009
2.850	4.554	2.700	0.802
4.340	4.554	2.700	0.802
4.400	4.554	2.517	0.635
5.000	1.268	0.685	0.164
8.550	0.480	0.361	0.089
9.600	0.480	0.265	0.067
50.000	0.480	0.265	0.067

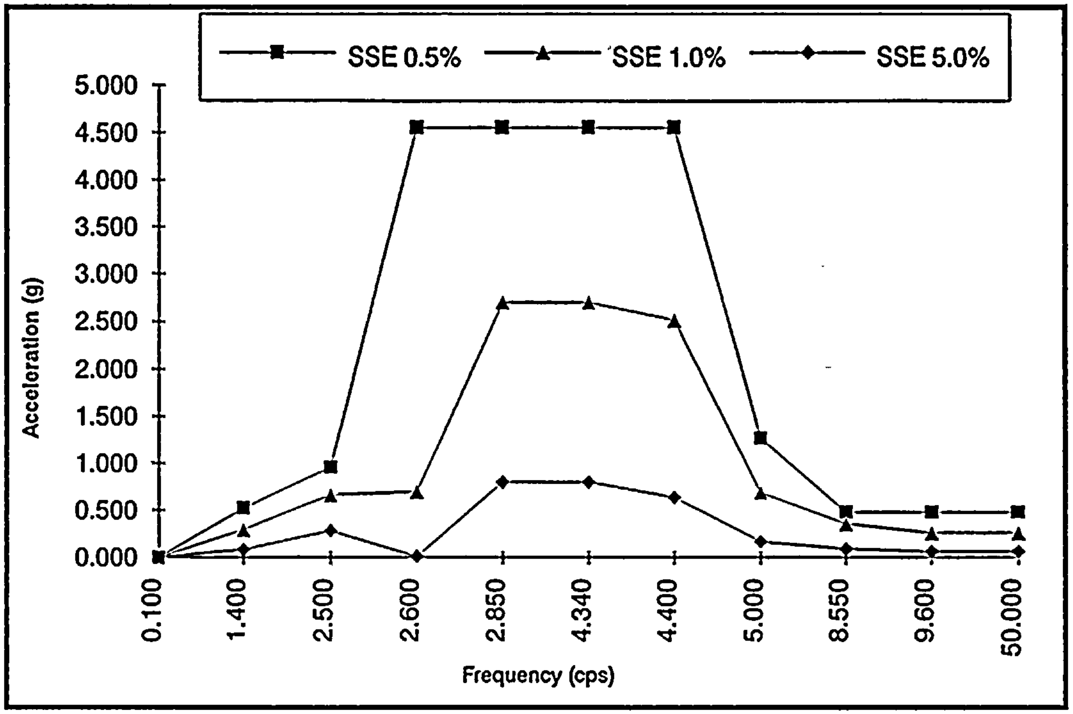


Figure 10 - 26

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 12

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.460	0.110	0.080	0.038
0.610	0.160	0.097	0.030
3.300	0.558	0.398	0.182
3.500	0.558	0.420	0.217
5.670	0.558	0.420	0.217
11.000	0.558	0.300	0.071
12.000	0.483	0.300	0.099
17.650	0.483	0.300	0.099
19.000	0.483	0.271	0.071
19.980	0.280	0.250	0.069
24.000	0.280	0.162	0.045
31.000	0.280	0.162	0.045
32.500	0.280	0.143	0.030
35.000	0.124	0.112	0.088
36.000	0.124	0.100	0.061
50.000	0.124	0.100	0.061

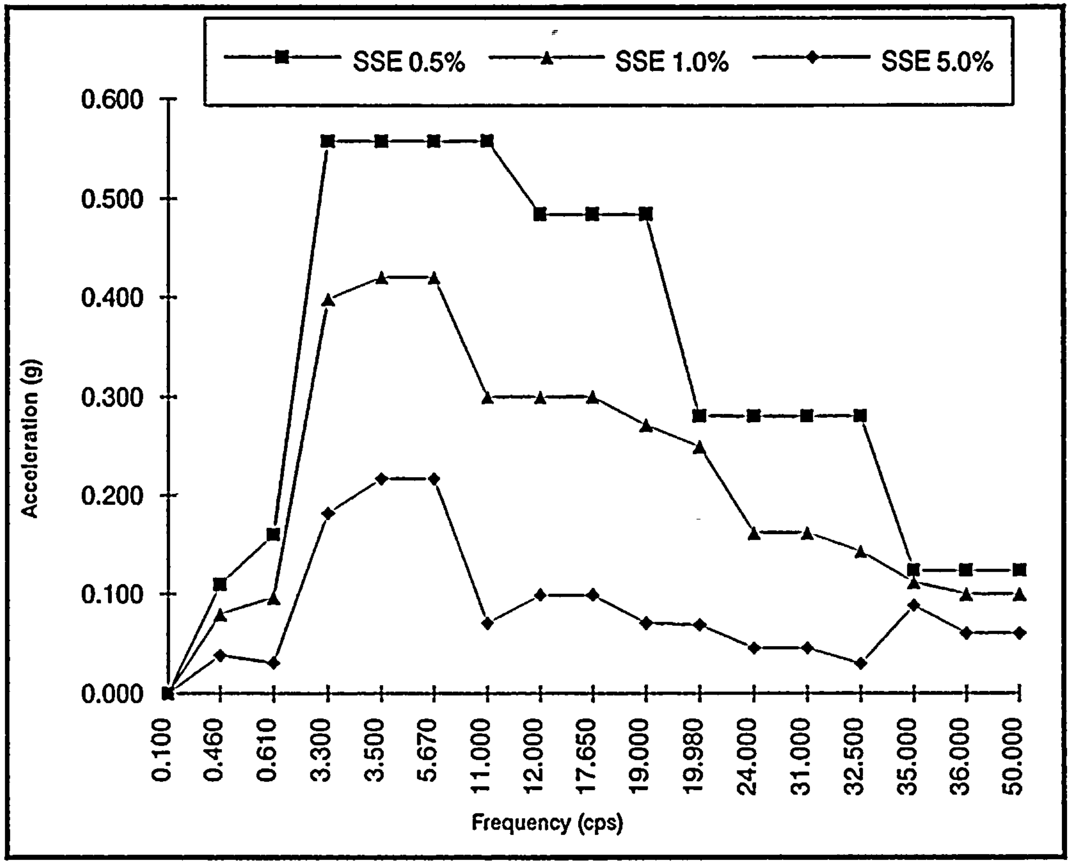


Figure 10 - 27

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 13

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.655	0.130	0.120	0.100
0.698	0.140	0.125	0.096
3.150	0.508	0.428	0.288
3.500	0.560	0.428	0.229
9.100	0.560	0.428	0.229
10.250	0.560	0.452	0.275
12.000	0.848	0.488	0.135
19.000	0.848	0.488	0.135
19.500	0.734	0.488	0.189
21.650	0.388	0.329	0.069
23.500	0.388	0.192	0.037
31.500	0.388	0.192	0.037
34.800	0.388	0.139	0.013
35.000	0.388	0.139	0.013
37.500	0.160	0.139	0.013
50.000	0.160	0.139	0.013

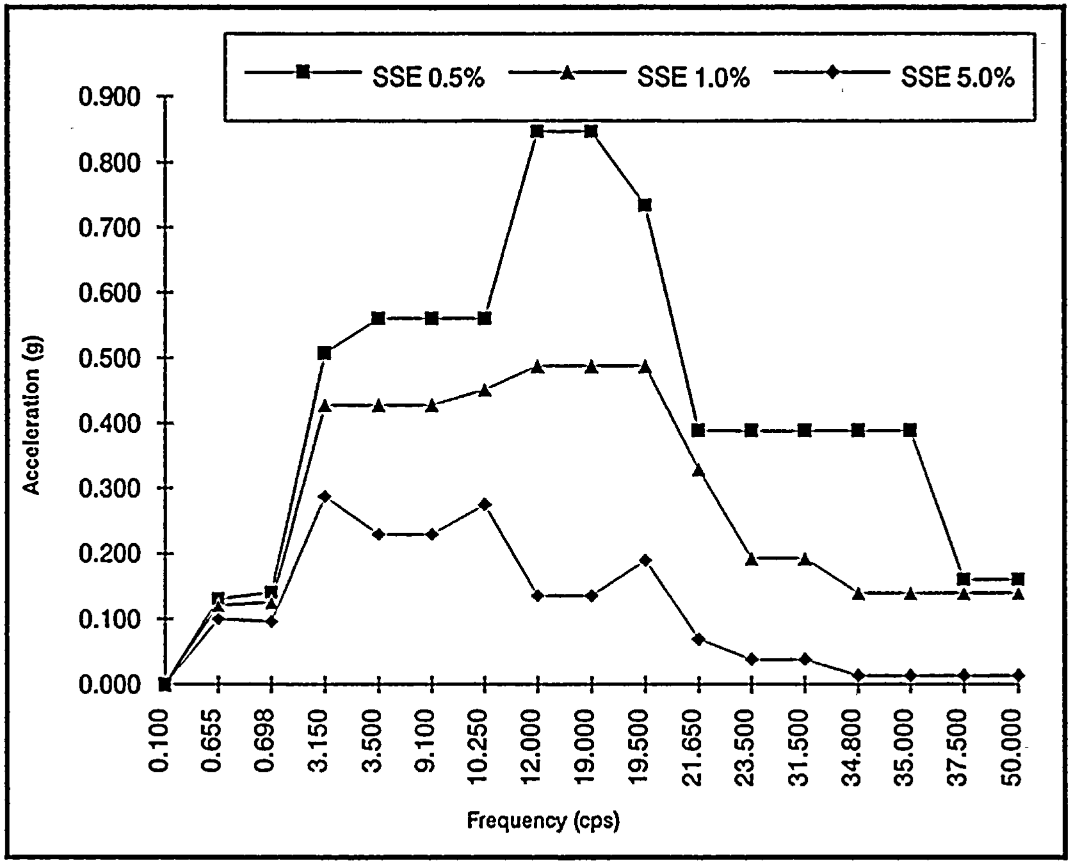


Figure 10 - 28

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 14

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.620	0.136	0.110	0.067
1.500	0.368	0.232	0.079
2.900	0.438	0.425	0.080
11.000	0.840	0.425	0.087
11.600	1.656	0.702	0.096
12.000	1.392	0.702	0.143
19.700	1.392	0.702	0.143
20.000	1.392	0.660	0.117
23.000	0.400	0.237	0.070
23.300	0.400	0.195	0.037
32.000	0.400	0.195	0.037
32.500	0.378	0.195	0.042
35.200	0.254	0.140	0.035
35.500	0.240	0:140	0.040
50.000	0.240	0.140	0.040

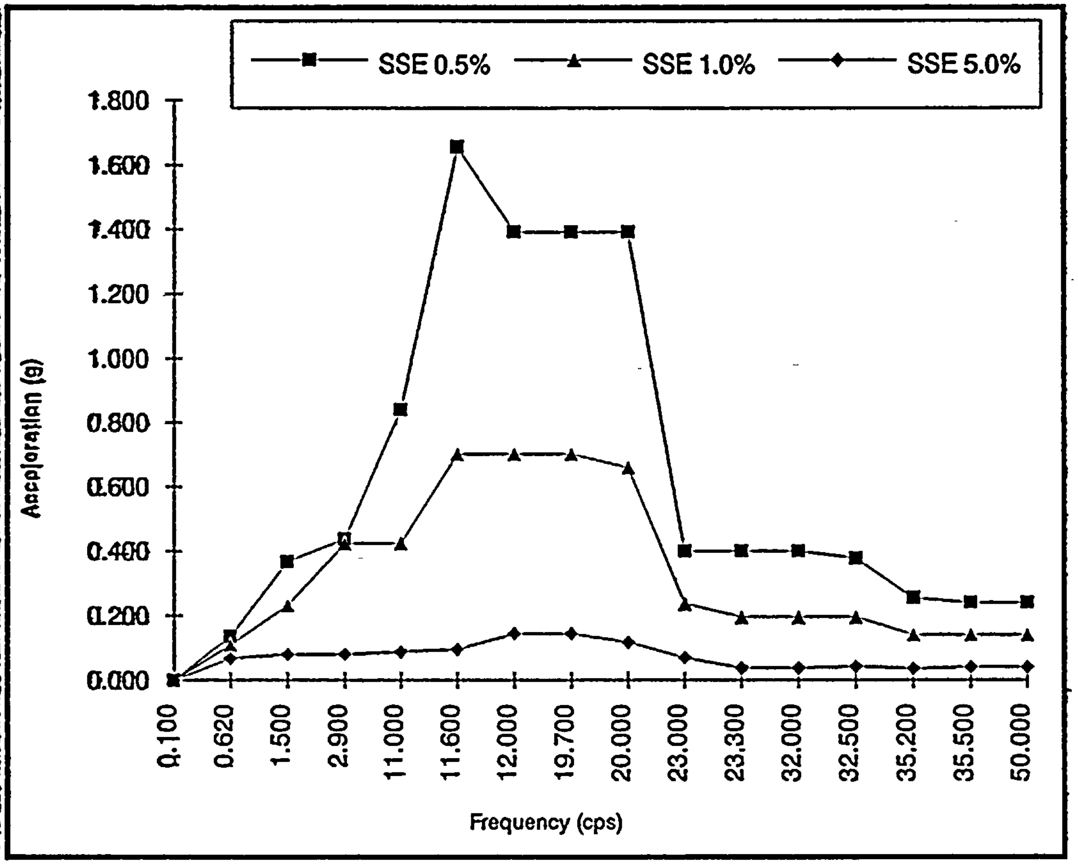


Figure 10 - 29

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 19

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.780	0.168	0.160	0.143
1.698	0.396	0.294	0.147
3.250	0.708	0.520	0.254
3.900	0.838	1.002	0.374
4.600	3.640	1.520	0.503
4.650	2.429	1.520	0.512
7.600	2.429	1.520	0.512
8.600	1.944	0.515	0.024
8.950	1.280	0.515	0.062
13.400	1.280	0.515	0.062
19.000	1.280	0.338	0.015
23.300	0.592	0.202	0.017
25.000	0.320	0.202	0.069
50.000	0.320	0.202	0.069

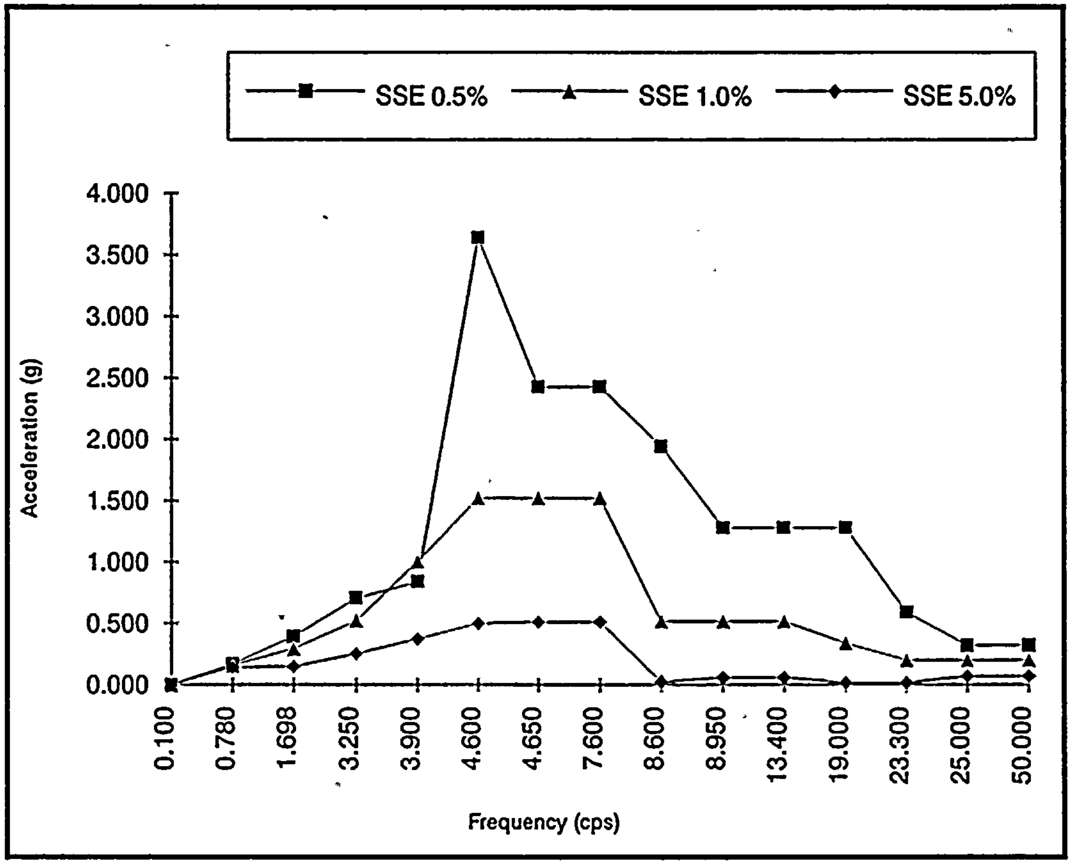


Figure 10 - 30

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 22

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.950	0.246	0.240	0.227
1.925	0.530	0.414	0.233
3.300	0.914	0.660	0.310
3.750	1.040	1.416	0.475
4.450	4.472	2.592	0.731
4.550	4.472	2.760	0.900
7.550	4.472	2.760	0.900
7.600	4.342	2.760	0.964
8.980	1.150	1.859	0.610
11.000	1.150	0.540	0.093
17.250	1.150	0.540	0.093
17.850	1.150	0.533	0.089
27.000	0.640	0.424	0.163
37.500	0.640	0.300	0.052
50.000	0.640	0.300	0.052

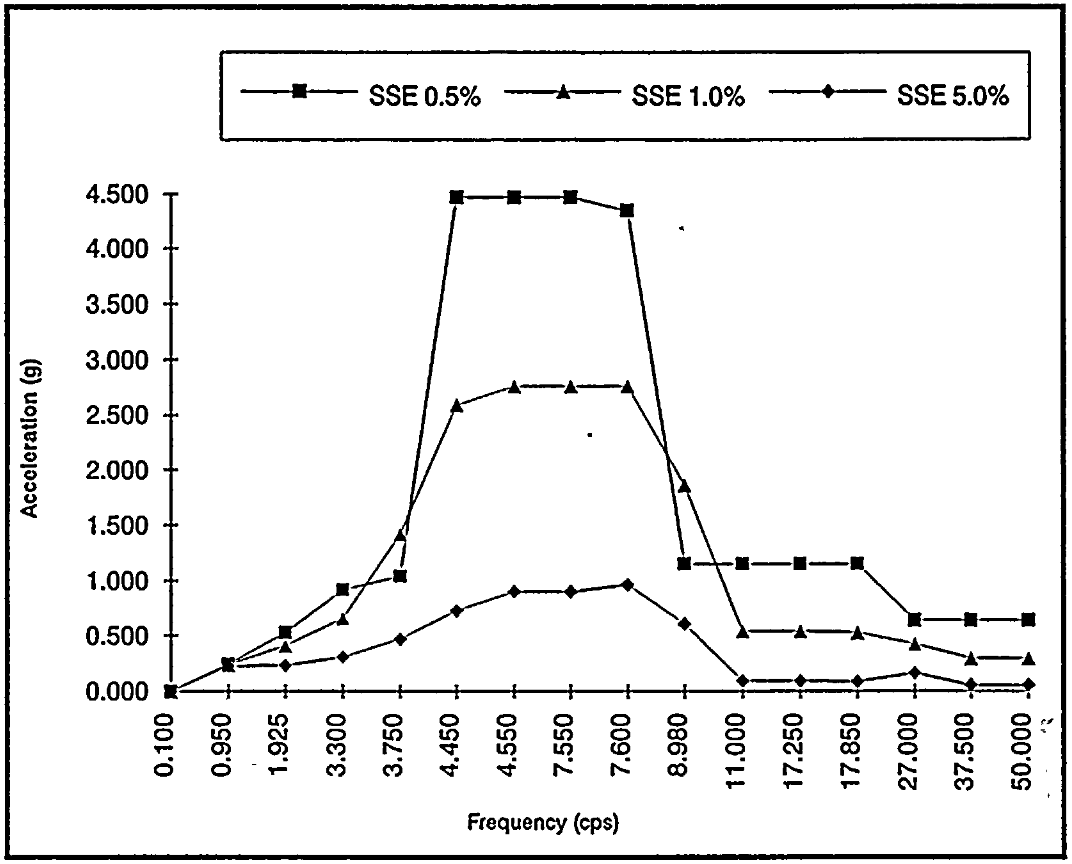


Figure 10 - 31

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 25

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.900	0.250	0.210	0.140
1.900	0.564	0.375	0.145
3.250	0.838	0.598	0.273
3.760	0.940	1.383	0.621
4.550	3.681	2.600	1.160
4.670	4.149	2.600	0.878
7.600	4.149	2.600	0.878
9.020	1.120	1.465	0.448
10.250	1.076	0.482	0.075
24.500	0.556	0.300	0.072
26.500	0.484	0.300	0.099
50.000	0.484	0.300	0.099

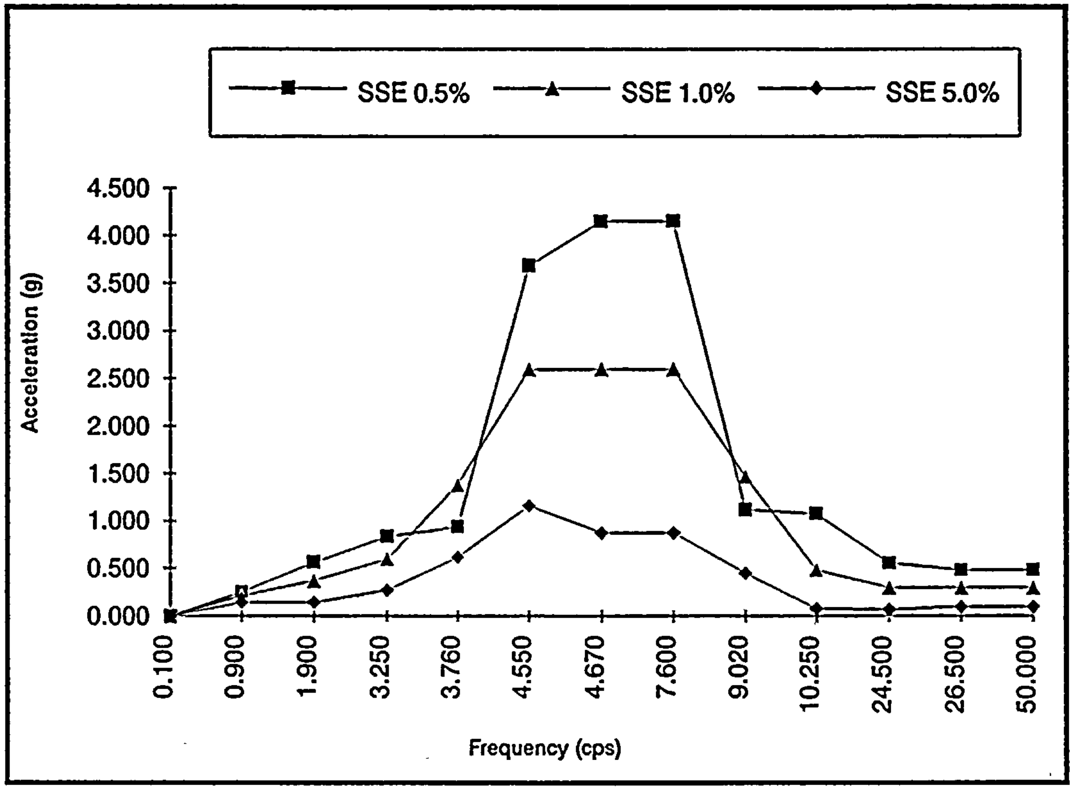


Figure 10 - 32

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 26

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
2.275	0.640	0.247	0.027
3.480	0.984	0.710	0.333
3.750	1.060	1.429	0.378
4.400	7.074	3.160	0.486
4.500	5.060	3.160	1.059
7.500	5.060	3.160	1.059
8.700	1.280	2.037	0.691
10.000	1.280	0.820	0.292
18.000	1.280	0.591	0.098
23.500	0.480	0.434	0.343
27.500	0.480	0.320	0.125
50.000	0.480	0.320	0.125

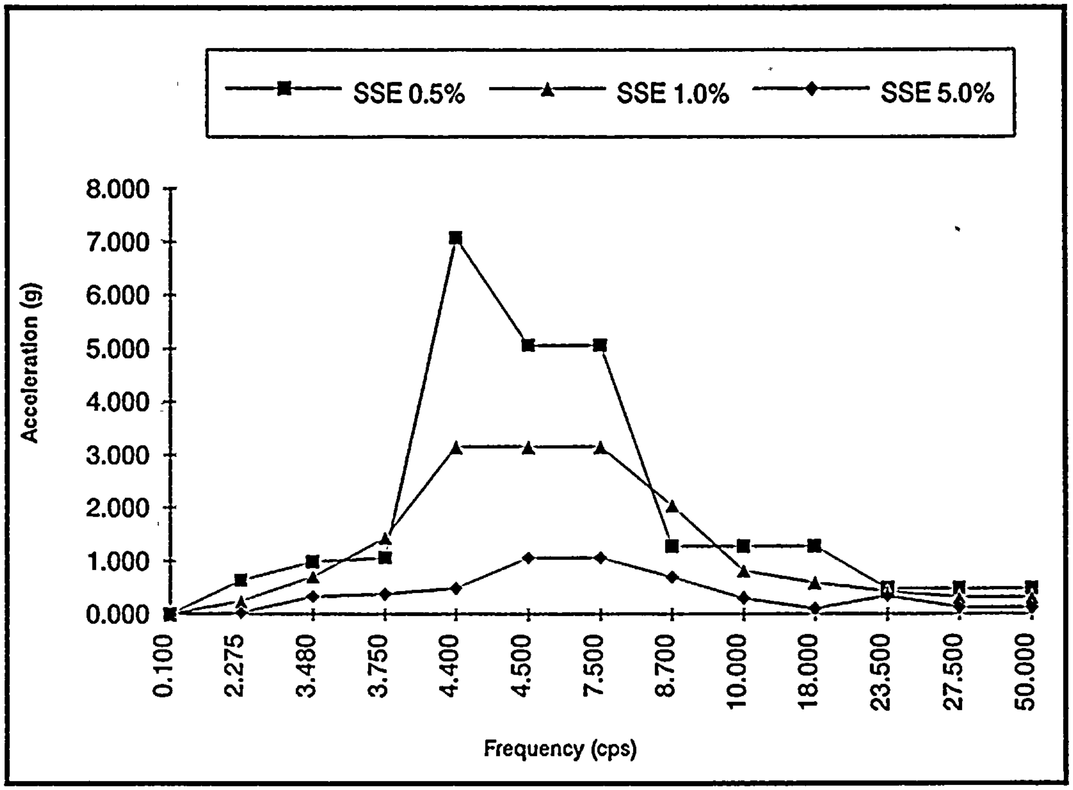


Figure 10 - 33

PP&L - Susquehanna Steam Electric Station
Turbine Building
DBE Response Spectra
Vertical Point 31

Frequency (cps)	Acceleration (g)		
	SSE 0.5%	SSE 1.0%	SSE 5.0%
0.100	0.000	0.000	0.000
0.920	0.192	0.240	0.069
3.550	0.804	0.593	0.292
3.600	1.102	0.600	0.146
4.450	3.890	2.790	1.290
4.600	4.453	2.790	0.942
7.500	4.453	2.790	0.942
7.550	4.331	2.790	1.005
9.000	1.280	1.137	0.864
9.480	1.264	0.590	0.101
28.500	0.640	0.315	0.061
29.500	0.640	0.300	0.052
50.000	0.640	0.300	0.052

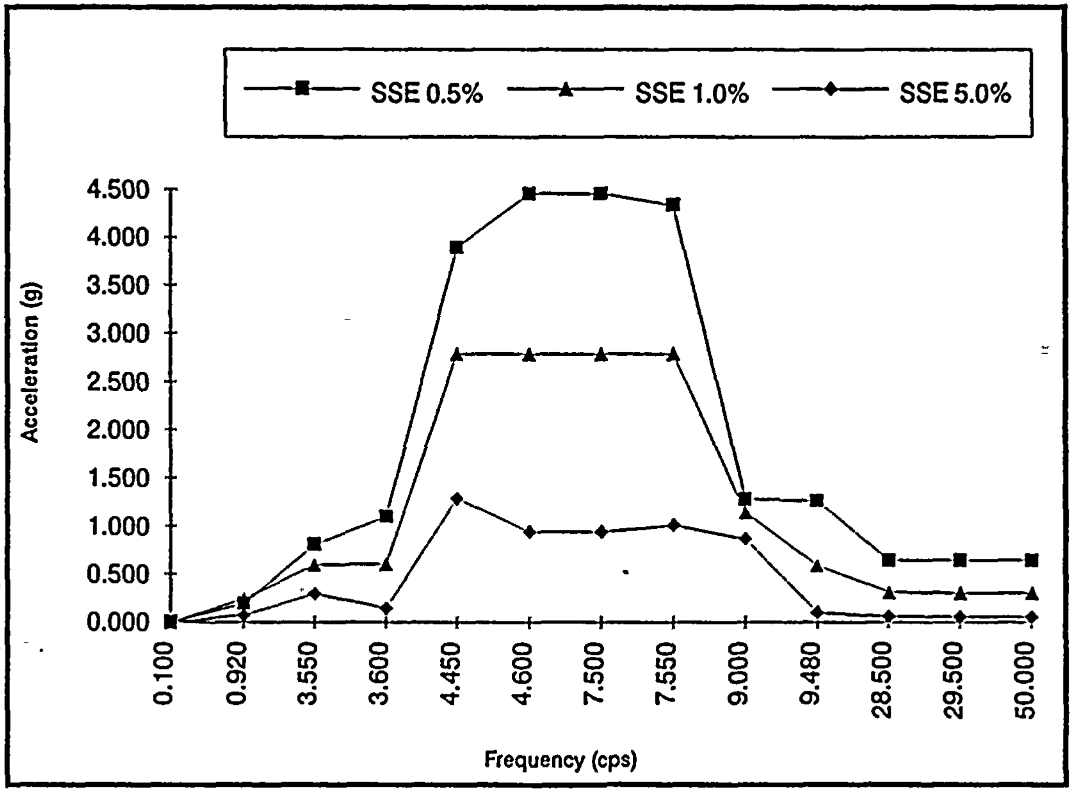


Figure 10 - 34

QUESTION 11.

In Section 2.0 (on page 5) of Enclosure 2 to the November 21, 1994, submittal it is stated that the turbine building was designed to prevent collapse for the DBE condition. On page 7 of Enclosure 2 it is stated that "A seismic analysis of the turbine building was performed for the DBE loading in the north-south, east-west, and vertical directions in order to assure that the building will not collapse. The resulting deflections were also utilized to confirm that there is no interaction with the reactor building." Except for the horizontal shears in both the north-south and east-west directions subjected to the DBE reported in figures 2A and 2B of Enclosure 2, no other analysis results were reported.

a. State whether the reported horizontal shears were obtained from the three directional DBE motion input.

b. The horizontal shears reported in figures 2A and 2B can be considered as seismic demand. Provide the corresponding shear capacity of the turbine building in both horizontal directions.

c. State whether the analysis results conclude that the turbine building would not collapse during the DBE, and provide technical bases to justify such a conclusion.

d. Provide the calculated maximum deflection of the turbine building during the DBE.

e. State whether a time history analysis or a response spectrum analysis was used to calculate the maximum deflection and the stability of the turbine building.

f. State whether the analysis results indicate that the turbine building would respond inelastically during the DBE.

g. Provide the name of the computer code which was used for the analysis of the turbine building, under the DBE loading condition, and state whether the code has the capability of handling inelastic structural behavior.

PP&L's RESPONSE

11a. The horizontal shears resulted from independent response spectrum analyses in the horizontal directions based upon the models described in the response to question 10a.

11b. The horizontal seismic shears provided in figures 2A and 2B of Enclosure 2 of the November 21, 1994 submittal are the total building story shears obtained by summing the column shears and the horizontal force component associated with diagonal bracing in the various frames comprising the turbine building. These story shears are then distributed to the various frames and utilized along with additional loads for design.

For purposes of comparing the seismic demand with the capacity of the structure, it is more appropriate to provide a comparison of the seismic load combination results (DL+LL+Seismic) and the associated interaction ratio for the various components in a typical rigid frame (Figure 11 - 1). Table 11 - 1 summarizes the design forces for rigid frame number 15 along with the acceptance criteria and interaction ratios. This approach is a typical example of the design approach utilized for the turbine building. Based upon the design approach described above, it is concluded that the turbine building design is adequate for the DBE.

11c. Since the structural acceptance criteria for steel structures, described in the response to question 11f, is satisfied for the design of the turbine building, it is concluded that the structure will not collapse during the DBE.

11d. Deflections at selected locations are presented in the table below for both the east-west and north-south directions.

East-West Direction:

Elevation/Node	Deflection (In)
676 Ft, Node 2	0.03125
699 Ft, Node 28	0.34375
729 Ft, Node 30	1.21875
Roof, Node 32	4.5625
676 Ft, Node 44	0.125
699 Ft, Node 48	0.5
729 Ft, Node 50	1.09375
762 Ft, Node 19	4.0
Roof, Node 52	6.03125

North-South Direction:

Elevation/Node	Deflection (In)
676 Ft, Node 10	< 0.03125
699 Ft, Node 11	0.0625
729 Ft, Node 12	0.09375
762 Ft, Node 13	0.75
Roof, Node 14	1.21875
676 Ft, Node 1	Negligible
699 Ft, Node 2	< 0.03125
729 Ft, Node 3	0.03125
762 Ft, Node 4	0.46875
Roof, Node 5	1.125

According to FSAR section 3.7b.2.8: Non-Category I structures that are close to Seismic Category I structures, the turbine building and radwaste buildings, have been designed to withstand an SSE. Dynamic analyses of these structures were done by the response spectrum method. Structural separations have been provided to ensure that interaction between Category I and Non-Category I structures does not occur. The minimum separation at any point is maintained at one and a half times the absolute predicted maximum displacements of the two structures.

11e. Response spectrum analyses were utilized to calculate the deflections listed above. The absolute summation of individual modes of vibration method was utilized to calculate the displacements. Response spectrum analyses were also utilized to determine the turbine building design forces.

11f. The structure responds elastically since the acceptance criteria results in maximum stresses that are less than the material yield stress. The structural acceptance criteria for the load combination utilized to evaluate the turbine building for the DBE condition is stated below. In no case shall the allowable base metal stress exceed $0.90F_y$ in bending, $0.85F_y$ in axial tension or compression, and $0.50F_y$ in shear. Where F_s is governed by requirements of stability (local or lateral buckling), f_s shall not exceed $1.5F_s$.

11g. SAP computer software was utilized to calculate the design forces for the turbine building. The program does not have the capability to include inelastic structural behavior.

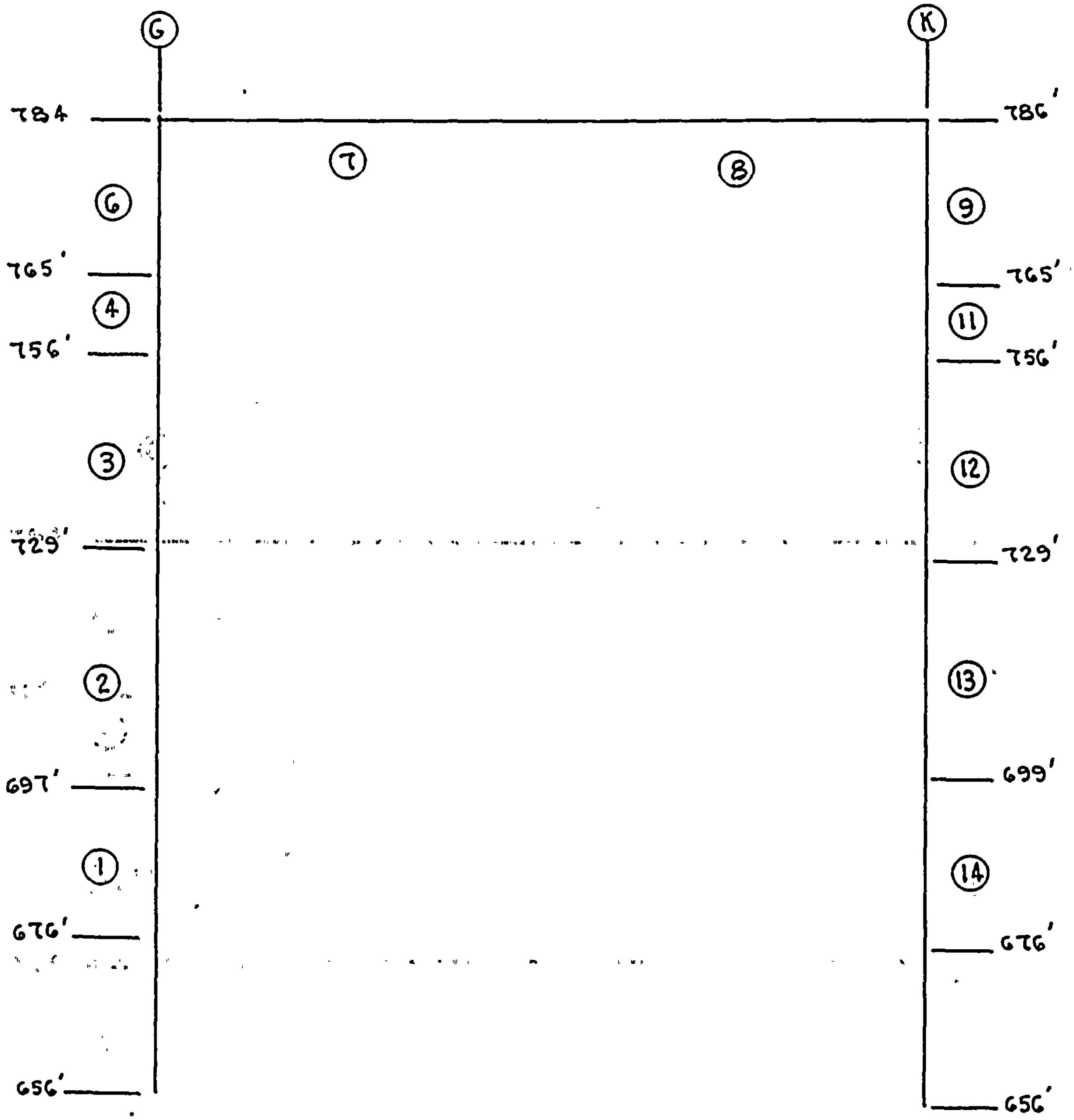


FIGURE 11-1
RIGID FRAME DESIGN MODEL

TABLE 11 - 1
DESIGN FORCES FOR RIGID FRAME 15

MEMBER NUMBER	AXIAL FORCE (K)	MOMENT (K-FT)	SHEAR (K)	AXIAL + MOMENT IA	SHEAR IA
1	1167	2865	416	0.96	0.61
2	587	3753	155	0.989	0.23
3 & 4	588	4040	138	1.449*	0.2
6 & 9	120	3467	114	1.347*	0.16
7	137	3237	86	1.558*	0.12
8	152	806	78	0.78*	0.11
11	668	3845	296	1.458*	0.44
12	468	6440	296	1.355*	0.36
13	1000	2812	252	0.9	0.37
14	1515	2636	331	1.02	0.49

Note 1: Interaction ratios indicated with the asterisk are compared to the 1.5Fs stability acceptance criteria.

QUESTION 12.

With respect to piping anchorage, the submittal only states that "Concrete anchor bolts are evaluated using data from the A46/SQUG criteria, Appendix C." No evaluation results were provided.

a. The submittal did not address how the seismic demand for the pipe anchors was obtained, however, during the January 24, 1995 meeting, the licensee stated that the seismic demand was obtained from piping dynamic analyses. Provide information on the type of analysis performed, the basis of acceptance for the analysis procedure, and the results of the analysis.

b. Provide the evaluation results for piping anchors by comparing the seismic demand to the anchor capacity.

PP&L's RESPONSE

PLA 4274, dated February 21, 1995, provided some information relative to seismic adequacy of the ALT piping anchorage. PP&L Calculation EC-012-6010 provides evaluation of pipe supports for the non-seismic 4-inch main steam drain line. Anchor capacities, as well as stresses in support members, welds, and base plates, were evaluated to determine a margin of safety for each of the selected supports. The evaluation consisted of the analysis of eight representative, enveloping supports, four from each of the two units at SSES. The selection of these supports was based on an overview of the support configurations and original design qualification. The representative selection included both vertical and lateral restraint support types. Since non-safety design practices typically do not include lateral restraints, pipe supports with lateral resisting capacity were natural candidates for inclusion in the representative support population. Some supports were selected based on the indication that minimum remaining component stress or load margins existed between documented and allowable design values. The eight selected supports are shown in Figure 12 - 1.

A computer analysis using ME101 provided pipe support loads resulting from forces due to seismic DBE loads, dead weight, and thermal expansion loads. The anchor bolts were evaluated in accordance with SQUG Appendix C anchorage data. The pipe support drawings indicate HILTI KWIK or equal type bolts and concrete strength of 4000 psi or greater. Table C.2-1 of SQUG Appendix C provides allowable loads for the two anchor bolt sizes used for the selected supports:

	5/8"ϕ	3/4"ϕ
Pullout Capacity	3170 lbs	4690 lbs
Shear Capacity	3790 lbs	5480 lbs
Min. Spacing	6.25"	7.5"
Min. Edge Dist.	6.25"	7.5"

Recent walkdowns have not identified any concrete cracking around the anchor bolts; therefore, no reduction in allowable anchor loads is considered. The following table provides the anchor evaluation data based on the ME101 computer analysis results and the SQUG anchorage criteria shown above. Each evaluated support is identified by its mark number, type, and restraint directions:

Mark Number	Type	Restraint	Anchor Size (ϕ)	P lbs per bolt	P/P_{all}	V lbs per bolt	V/V_{all}	Factor of Safety
EBD-114-H13	Structural	Vertical	5/8"	2311	0.729	318	0.084	1.40
EBD-114-H23	Structural	Lateral	5/8"	223	0.070	–	–	14.2
EBD-114-H25	Structural	Lateral	5/8"	181	0.057	–	–	17.5
EBD-114-H30	Anchor	6-way	3/4"	*	*	*	*	*
EBD-214-H16	Structural	Vertical	5/8"	2879	0.908	330	0.084	1.10
EBD-214-H20	Structural	Vertical	5/8"	2879	0.508	188	0.050	1.97
EBD-214-H22	Structural	Vertical	5/8"	1783	0.702 **	127	0.047**	1.42
EBD-214-H27	Spring & Strut	Vert. & Lat.	5/8"	2822	0.890	558	0.150	1.12

* This is an anchor which is welded to an embedded plate and it has 3/4" HILTI KWIK bolts. Since piping on one side of the anchor was not analyzed, plastic shear and moment capacity of the pipe were utilized for anchor design. Therefore, the anchor bolts have been designed for the worst possible loading and, consequently, they are judged to be adequate for DBE loading.

** Reduced Allowables used due to 3.5" edge distance per SQUG requirements.

Also evaluated are the steel support members, anchor plates, and welds for determination of margin of safety relative to AISC allowable stresses. As for the anchor bolts, the ME101 computer analysis results are used for input to the evaluation of these components. The following table shows a summary of the analysis results, (fb = bending stress and fr = weld shear stress) for each of the supports identified in the previous table:

stress units are ksi	Steel Member(s) (allow. = 0.9*Fy)		Baseplate (allow. = 0.9*Fy)		Welds (allow. = 1.7*0.4*Fy)		Min. Margin
Mark Number	fb	Margin	fb	Margin	fr	Margin	
EBD-114-H13	2.87	11.29	9.54	3.40	2.58	9.49	3.40
EBD-114-H23	6.28	5.16*	8.40	3.86	11.0	2.23	2.23
EBD-114-H25	**	5.16	**	3.86	**	2.23	2.23
EBD-114-H30	***	***	***	***	***	***	***
EBD-214-H16	7.97	4.07	22.5	1.44	6.34	3.86	1.44
EBD-214-H20	3.98	8.14	7.26	4.46	3.17	7.72	4.46
EBD-214-H22	8.00	4.05*	30.7	1.05	6.91	3.54	1.05
EBD-214-H27	12.9	2.51	25.4	1.27	3.35	7.31	1.27

NOTE: Shear stresses in the members and plates are generally insignificant and not included in the table.

* Combined bending and axial stress margin; axial stress is minimal.

** EBD-114-H25 is identical to -H23, net applied forces are less, no evaluation necessary.

*** This is an anchor which is welded to an embedded plate and it has 3/4" HILTI KWIK bolts. Since piping on one side of the anchor was not analyzed, plastic shear and moment capacity of the pipe were utilized for anchor design. Therefore, the anchor bolts have been designed for the worst possible loading and, consequently, they are judged to be adequate for DBE loading.

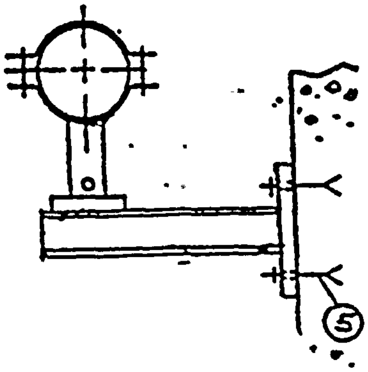
Following is a summary of the safety margins from the previous tables showing the minimum safety margin for the each of the evaluated pipe supports:

Mark Number	Anchor Bolt Factor of Safety	Steel Component Safety Margin	Pipe Support Safety Margin**
EBD-114-H13	1.40	3.40	1.40
EBD-114-H23	14.2	2.23	2.23
EBD-114-H25	17.5	2.23	2.23
EBD-114-H30	*	*	*
EBD-214-H16	1.10	1.44	1.10
EBD-214-H20	1.97	4.46	1.97
EBD-214-H22	1.42	1.05	1.05
EBD-214-H27	1.12	1.27	1.12

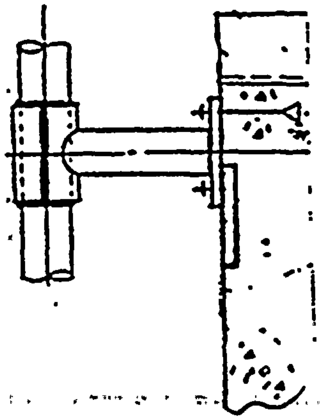
* This is an anchor which is welded to an embedded plate and it has 3/4" HILTI KWIK bolts. Since piping on one side of the anchor was not analyzed, plastic shear and moment capacity of the pipe were utilized for anchor design. Therefore, the anchor bolts have been designed for the worst possible loading and, consequently, they are judged to be adequate for DBE loading.

** Some of the support safety margins are different from the respective margins provided in PLA 4274 as a result of using the higher upset allowables in lieu of the normal allowables and performing more detailed analyses including prying effects. However, the selected 8 pipe supports are still seismically adequate.

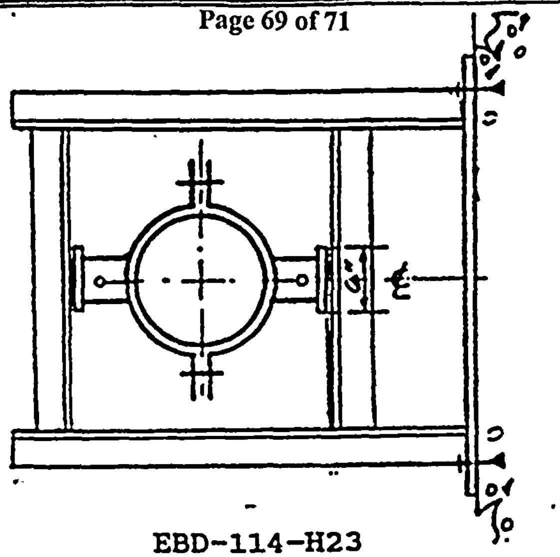
In conclusion, the selected pipe support anchor capacities, as well as stresses in support members, welds, and base plates, have been evaluated to determine a margin of safety for each of the selected supports. These safety margins indicate that each of the analyzed supports would not experience any overstress in the event of a design basis seismic event.



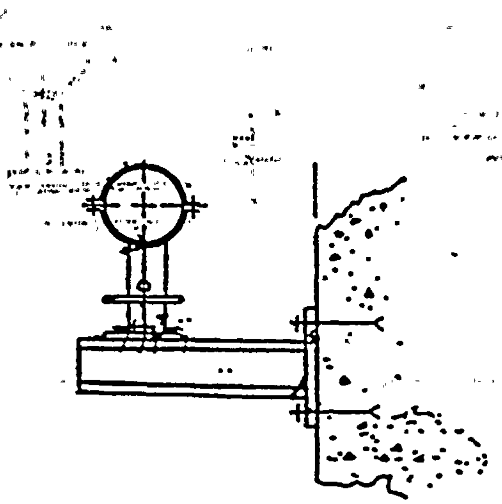
EBD-114-H13



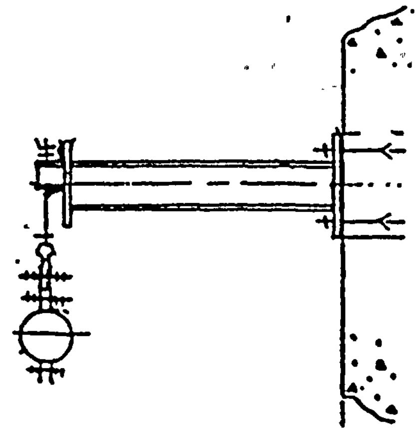
EBD-114-H30



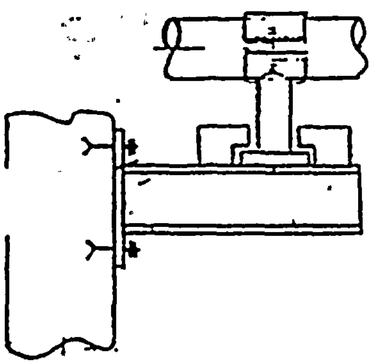
EBD-114-H23
EBD-114-H25



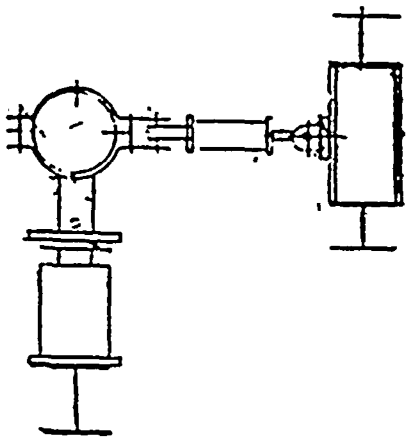
EBD-214-H16



EBD-214-H20



EBD-214-H22



EBD-214-H27

Figure 12 - 1

QUESTION 13.

The submittal states that "The block walls which are of concern for the MSIV LCS Elimination Project are evaluated with seismic loads using the DBE floor spectra. However, no evaluation results were reported and there was no mention of the adequacy of these block walls.

a. Provide the evaluation results for the block walls.

b. Explain the criteria which were used for the evaluation of the capacity of the block walls (e.g., the strength method in the Uniform Building Code).

PP&L's RESPONSE

The block walls identified as having potential safety impact on the new piping path for the MSIV Leakage Control System Elimination Project at the Susquehanna Steam Electric Station (SSES) are evaluated in PP&L Calculation No. EC-012-6006. The evaluations were performed in accordance with Section 3.7b.3.1.5 of the Final Safety Analysis Report (FSAR) and Technical Specification 8856-C-110, "Procedure for the Structural Assessment of Concrete Blockwalls for Susquehanna Steam Electric Station."

The FSAR requires an absolute sum of the vertical seismic response and the larger of the E-W or N-S seismic response. The out-of-plane seismic loading is critical as a "fall-down" condition could have a damaging effect on the piping of concern. Consequently, the walls parallel with the E-W direction are evaluated for the N-S seismic load combined with the vertical seismic load, dead load, and attachment loads. Likewise, walls parallel with the N-S direction are evaluated for E-W seismic loads in combination with the other applicable loads.

Specification 8856-C-110 requires a local and global analysis for assessment of the concrete block walls. The local analysis for the attachment loads is performed using 1.5 times the peak response acceleration. The purpose of the local analysis is to ensure that the attachments would not cause any overstress. The global analysis combines the results of the local analysis for attachment loads with the seismic inertial loads, SRV and LOCA, and story drift. SRV and LOCA inertial loads will not exist in the Turbine Building.

For walls spanning vertically between floors, the maximum bending moments due to story drift will occur near the top and bottom of the wall with a theoretical zero moment at mid-height. As the critical section for these wall evaluations is considered to be mid-height, the story drift moment is taken as zero, with one exception where a particular wall requires analysis at a section other than mid-height and a story drift moment is calculated. It is noted that in order for story drift moments to develop, the connections between the walls and the floor slabs must be capable of developing the applied bending moments. None of the walls in question have reinforcing dowel connection to the slabs.

Per the FSAR and Technical Specifications, the wall frequency is to be computed using the effective moment of inertia given by Equation 9-4 of ACI 318-7:

$$I_{eff} = (M_{cr}/M_a)^3 I_g + (1 - (M_{cr}/M_a)^3) I_{cr}$$

For the out-of-plane loading considered critical for this evaluation, the $(M_{cr}/M_a)^3$ term is neglected and $I_{eff} = I_{cr}$. All of the walls are reinforced in both directions on both faces. Equations from ACI 318-71 Handbook, page 390, are used to determine I_{cr}. With the wall frequency and acceleration values determined, the loads and forces required for the local and global analyses are calculated. Where applicable, for moment and shear determination, the same or similar method as that used for the original design is utilized. The walls are evaluated by the working stress method of reinforced concrete design in accordance with ACI-318-71 using formulas without compressive reinforcing unless compression steel is required to lower the concrete stresses.

There are seven walls which were identified as requiring analysis relative to their potential impact on the MSIV LCS Elimination Project. The following table provides a summary of the analysis results for concrete stress (fm) and reinforcing steel stress (fs). The walls are identified by their drawing number and section:

	fm (psi) [allowable = 835]	fs (psi) [allowable = 40,080]
Blockwall Section A, Drawing C-1258	476	41,275
Blockwall Section L, Drawing C-1258	316	24,740
Blockwall Section A, Drawing C-1263	802	37,971
Blockwall Section C, Drawing C-1263	332	48,260
Blockwall Section F, Drawing C-1259	302	47,213
Blockwall Section H, Drawing C-1259	82	8029
Blockwall Section H, Drawing C-1208	see note *	see note *

* (This wall is in the Reactor Building and is designed for OBE, DBE, SRV, and LOCA loads. As a result, no further evaluation was required.)

The calculation results indicate no concrete overstresses. Three overstresses due to a DBE loading were calculated for reinforcing steel. However, these bars would experience a stress less than 0.9Fy which would not cause failure.

In summary, the Unit 1 and Unit 2 Turbine Building walls identified as having a potential for impact on the new piping for the MSIV Leakage Control System Elimination Project have been evaluated per the SSES FSAR and Technical Specification criteria. Calculation results indicate that these walls will not fall during a design basis seismic event and no further precautions are required for protection of the piping from the concrete block walls in question.