**CE-PA: A User's Manual for Determination of Controlling
Earthquakes and Development of Seismic Hazard
Information Data Base for the Central and
Eastern United States**

C. M. Short

May 31, 1995

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PLC

MASTER

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy, and performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

**CE-PA: A User's Manual for Determination of
Controlling Earthquakes and Development of
Seismic Hazard Information Data Base for the
Central and Eastern United States**

**Prepared by
C. M. Short**

**Prepared for
U.S. Nuclear Regulatory Commission**

FESSP

Fission Energy and Systems Safety Program

Lawrence Livermore National Laboratory

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
DLC

**CE-PA: A User's Manual for Determination of
Controlling Earthquakes and Development of
Seismic Hazard Information Data Base for the
Central and Eastern United States**

Manuscript date: May 31, 1995

**Prepared by:
Cheryl Short**

**Project Managers:
D. L. Bernreuter
A. C. Boissonnade**

**Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, CA 94550**

**Prepared for
U.S. Nuclear Regulatory Commission**

ABSTRACT

The computer program package CE-PA is a research tool developed during a study of existing nuclear power plant sites performed for the U.S. Office of Nuclear Regulatory Research. This program calculates the characteristics of controlling earthquakes, earthquakes that contribute the most to the total seismic hazard, using results of the 1993 LLNL probabilistic seismic hazard analysis for central and eastern U.S. locations. These controlling earthquakes are characterized by mean magnitude and distance values evaluated at two frequency bands, 1-2.5 Hz and 5-10 Hz. CE-PA also provides a seismic hazard information data base, including uniform hazard spectra, seismic hazard results for selected magnitude and distance bands, and magnitude-distance distribution functions.

The package is comprised of a series of programs that are used sequentially. After performing a probabilistic seismic hazard analysis with the 1993 LLNL methodology, total hazard results and de-aggregated hazard results for a matrix of magnitude-distance pairs are obtained. Then, using total hazard results, CE-PA extracts ground motion levels associated with a user-input reference probability of exceedance for spectral accelerations at 1Hz, 2.5Hz, 5Hz, and 10Hz. At these four ground motion levels CE-PA calculates the contribution to the total seismic hazard of earthquakes in a selected set of magnitude and distance bins. Next the package calculates the mean magnitude and distance of the controlling earthquakes for the average of 1 to 2.5 Hz and 5 to 10 Hz.

The program can assess controlling earthquakes for a set of pre-compiled seismic hazard data at existing nuclear power plant sites or new sites.

CE-PA For the Central and Eastern United States

User's Manual (Version 1)

Table of Contents

Abstract	ii
Acknowledgments	v
Introduction	1
I. Methodology to Estimate Controlling Earthquakes	2
II. Overview of CE-PA Software Modules	6
A. Probabilistic Seismic Hazard Analysis	
B. Estimation of Target Ground Motion Levels	
C. De-Aggregation of Seismic Hazard Analysis	
D. Magnitude-Distance Distribution and Determination of Controlling Earthquakes	
III. CE-PA Controller Implementation	19
A. Overview of Options	
B. Example Executions	
1. Case 1-Listing previous sites and Displaying Previous Results	
2. Case 2-Analyzing New site	
3. Case 3-Analyzing Previously Defined Site that needs Binning Analysis	
4. Case 4-Analyzing Previously Defined Site with User Defined Reference Probability Case	
C. Overview of Directory/File Structures	
1. Main Executables.	
2. Fortran Source Codes	
3. Permanent Input Datafiles	
4. Permanent Output Datafiles	
5. Support Libraries	

	D. Technical Support Procedure	
IV.	Perspective	113
	References	114
	Appendix A Benchmarking Data	116
	Appendix B Source Codes and Sample Input/Output Files	117
	Appendix C Installation of CE-PA on SUN OS 4.1.3 with F77-1.4	127
	Tables and Figures	130

ACKNOWLEDGMENTS

Special thanks are extended to two FESSP personnel for their thoughtful reviews of this Manual, Auguste Boissonnade and Don Bernreuter. Besides authoring the concepts and codes, Auguste and Don have been very generous in helping me to understand their purposes and in critiquing the user interface. Their effort, talent and information are appreciated.

The U. S. Nuclear Regulatory Commission (NRC) Division of Research Engineering and Safety Project Manager Richard McMullen provided oversight and resources to make this project possible.

Introduction

The CE-PA, Controlling Earthquake(s) through Probabilistic Analysis¹, software package developed at Lawrence Livermore National Laboratory (LLNL) is a research program used as part of a study performed for the U.S. Office of Nuclear Regulatory Research Division Engineering project on Geosciences Issues in the revision of geological siting criteria². The objectives of this study were to explore ways on how to use results from probabilistic seismic hazard characterization (PSHC) to determine hazard-consistent scenario earthquakes (controlling earthquakes) and to develop design ground motion. The CE-PA software tool evolved to test the concept; it uses the PS HC results of the 1993 Eastern U.S. Update study³ as input.

The purpose of this document is to describe the CE-PA software to users. The software includes two operating system and process controllers plus several fortran routines and input decks. The controllers and codes execute on the NRC's SUN SPARC 10 system, using OS4.1.3. and Fortran77-1.4. The controllers were written to minimize the user's effort when executing the analysis process. The two controllers provide a user-cooperative environment by ordering the execution of the fortran codes, creating several input files, establishing a consistent file naming convention, and assisting in data acquisition, file storage and disk clean up. Some geo-technical expertise is necessary to respond appropriately to the controllers' queries. The fortran routines provide the mathematical analysis using historical seismic data and expert opinions.

This manual gives an overview of the methodology to estimate controlling earthquakes in Section I. A descriptive overview of the procedures and the organization of the program modules used in CE-PA is provided in Section II. Section III contains four example executions with comments and a graphical display of each execution path, plus an overview of the directory/ file structure. Section IV provides some general observations regarding the model.

Benchmark Data is included in Appendix A.

¹ CE-PA are those earthquakes (in terms of magnitude and distance) which most significantly contribute to the hazard at some chosen ground motion level.

² D. Bernreuter, A. C. Boissonnade, C. M. Short, "Investigation of Techniques For The Development of Seismic Design Basis Using the Probabilistic Seismic Hazard Analysis," NUREG/CRxxx, 1996.

³ J.B.Savy, A.C.Boissonnade, R.W.Mensing, C.M. Short, "Eastern U.S. Seismic Hazard Characterization Update," UCLLawrence Livermore National Laboratory, June, 1993, and P. Sobel, "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plants Sites East of the Rocky Mountains," NUREG-1488, October, 1993.

I. Methodology to Estimate Controlling Earthquakes

This section overviews the methodology¹ used to determine the controlling earthquakes using probabilistic seismic hazard analysis. This procedure is based on a de-aggregation of the probabilistic seismic hazard in terms of earthquake magnitudes and distances.

- Step 1. Perform a site-specific probabilistic hazard assessment for central and eastern U.S. (CEUS) sites, for user defined soil conditions. From this analysis, compute median, mean, and 85th percentile hazard curves, that is curves showing annual probability of exceeding various levels of ground motion measures.
- Step 2. Using a reference probability level,² for example the exceedance level for safe shutdown earthquake ground motion (Ref. 1), plus the total seismic hazard generated in Step 1, determine the corresponding ground motion levels for the spectral accelerations at 1Hz, 2.5Hz, 5Hz, and 10 Hz.
- Step 3. De-aggregate the seismic hazard results for each seismic expert and all ground motion experts into a matrix of distance and magnitude bins. Combine the seismic hazard over all the seismic experts in each of the bins.

Steps 4 to 7 below describe the procedure to develop the seismic hazard information base for each ground motion level determined in Step 2. This output information will consist of:

- . Fractional contribution of each magnitude-distance pair to the total median seismic hazard
 - . Magnitudes and distances of the controlling earthquakes.
 - . The ground motion levels for the spectral accelerations at 1Hz, 2.5Hz, 5Hz, and 10Hz corresponding to the reference probability.
- Step 4. Using the de-aggregated median hazard results determined in Step 1, at the target ground motion levels obtained from Step 2, calculate the fractional contribution to the total median hazard of earthquakes in a selected set of magnitude and distance bins for the average of 1 to 2.5Hz and 5 to 10Hz. The median annual probability of exceeding the ground motion levels calculated in Step 1 for each magnitude and distance bin and ground motion measure is denoted by H_{mdf} .

The fractional contribution of each magnitude and distance bin to the total hazard for the average of 1 and 2.5 Hz, $P(m,d)1$, is computed according to:

¹. The methodology is described in detail in Ref. 1

². The Reference Probability level is a probability of exceeding a specific ground motion level.

$$P(m,d)_1 = \frac{\frac{(\sum_{f=1,2} H_{mdf})}{2}}{\sum_m \sum_d \frac{(\sum_{f=1,2} H_{mdf})}{2}}$$

where $f = 1$ and $f = 2$ represent the ground motion measure at 1Hz and 2.5Hz, respectively.

The fractional contribution of each magnitude and distance bin to the total hazard for the average of 5 Hz and 10 Hz, $P(m,d)_2$, is computed according to:

$$P(m,d)_2 = \frac{\frac{(\sum_{f=1,2} H_{mdf})}{2}}{\sum_m \sum_d \frac{(\sum_{f=1,2} H_{mdf})}{2}}$$

where $f = 1$ and $f = 2$ represent the ground motion measure at 5Hz and 10Hz, respectively.

- Step 5. Review the magnitude-distance distribution for the average of 1 Hz and 2.5 Hz to determine if the contribution to the hazard for distances of 100 km or greater is substantial (5% or greater).

If the contribution to the hazard for distances of 100 km or greater exceeds 5%, additional calculations are needed, using the magnitude-distance distribution for distances greater than 100 km - $P_{>100}(m,d)_1$, to determine the controlling earthquake. This distribution is defined by:

$$P_{>100}(m,d)_1 = \frac{P(m,d)_1}{\sum_m \sum_{d>100} P(m,d)_1}$$

The purpose of this calculation is to identify a distant but larger event which may control the low frequency content of a response spectrum. The distance of 100 km is chosen for 69 CEUS plant sites based on previous studies.¹

- Step 6. Calculate the magnitude and distance of the controlling earthquake associated with the ground motions determined in Step 2 for the average of 5 Hz and 10 Hz. The following relation is used to calculate the magnitude (where m is the central magnitude value for each magnitude bin, which are 5.25, 5.75, 6.25, 6.75, 7.3):

$$M_c (5-10 \text{ Hz}) = \sum_m m \sum_d P(m,d)_2$$

This magnitude is determined using results of entire magnitude-distance bins matrix.

The distance of the controlling earthquake is determined according to (where d is the centroid distance value for each distance bin, which are 10, 20.4, 38.9, 77.8, 155.6, 253.3, and 350 km):

$$\ln \{D_c (5-10 \text{ Hz})\} = \sum_d \ln(d) \sum_m P(m,d)_2$$

This distance is determined using results of entire magnitude distance bins matrix.

- Step 7. If the contribution to the hazard calculated in Step 5 for distances of 100 km or greater exceeds 5% for the average of 1 and 2.5 Hz then calculate the magnitude and distance of the controlling earthquakes associated with the ground motions determined in Step 2 for the average of 1 and 2.5 Hz. The following relation is used to calculate the magnitude (where m is the central magnitude value for each magnitude bin):

$$M_c (1-2.5 \text{ Hz}) = \sum_m m \sum_{d>100} P_{>100}(m,d)_1$$

This magnitude is determined using calculations based on magnitude-distance bins greater than distances of 100 km as discussed in Step 4.

The distance of the controlling earthquake is determined according to (where d is the centroid distance value for each distance bin):

$$\ln \{D_c (1-2.5 \text{ Hz})\} = \sum_{d>100} \ln(d) \sum_m P_{>100}(m,d)_2$$

This distance is determined based on magnitude- distance bins greater than distances of 100 km as discussed in Step 4.

¹. See Ref. 1 for details of study.

Step 8. In addition to the calculations performed in the preceding steps, the magnitude and distance values of the controlling earthquakes using mean and 85th percentile seismic hazard results are calculated over all distances for the average of 5-10 Hz and 1-2.5 Hz.

II. Overview of CE-PA Software Modules

The computer program package CE-PA calculates the characteristics or controlling earthquakes, earthquakes that contribute the most to the total seismic hazard, using the results of the 1993 LLNL probabilistic seismic hazard analysis for central and eastern U.S. (CEUS) nuclear plant sites (Ref. 2). These earthquakes are characterized by mean magnitude and distance values evaluated in two frequency bands, 1 to 2.5 Hz and 5 to 10 Hz.

The CE-PA package implements the computational features of the methodology documented in Reference 1. For defining new sites CE-PA needs to access the LLNL PSHC seismic hazard package; it uses previously calculated results for sites already defined and analyzed with PSHC. Guidance on how to use the PSHC package is provided in Reference 4. In addition to the input needed from PSHC, CE-PA requires the input of a reference probability case, that is the probability of exceeding a given ground motion level. Two reference probability levels specified in Ref. 1 are used by default in CE-PA, ALL2 and RG2. Optionally, the user may input his own reference probability level, USER1. These default reference probability values are listed in Table 3.1

Table 1: Reference Probability Values for Example

Reference Probability Cases	50% (Median)	85%	Mean
ALL2	2.4×10^{-5}	1.8×10^{-4}	1.1×10^{-4}
RG2	1.0×10^{-5}	1.0×10^{-4}	7.4×10^{-5}
USER1			

The main products of the CE-PA and PSHC software are:

- Total and de-aggregated seismic hazard results

- Uniform hazard spectra for 1, 2.5, 5 and 10 Hz at given reference probability level.

- Magnitude-distance distribution at selected spectral accelerations averaged over 1 to 2.5 Hz and 5 to 10 Hz.

- Mean magnitude and distance values of controlling earthquakes for average of 1-2.5 Hz and 5-10 Hz. The controlling earthquake for 1-2.5 Hz range will be estimated over all magnitude and distance bins unless the contribution of earthquakes at distances greater than 100 km is 5% or more. In this case the controlling earthquake will be determined for distances greater than 100 km.

A limited number of sensitivity analysis can be performed using this software package including:

Figure 1: General Flow of Information for Calculating Controlling Earthquakes

A user-input reference probability of exceedance can be used to determine the controlling earthquakes.

The magnitude-distance distributions can be assessed using either median, 85th percentile, or mean seismic hazard results.

The controlling earthquakes can be determined using either median, 85th percentile, or mean seismic hazard results.

The controlling earthquakes can be determined for a subset of distances (e.g., less than or greater than 100 km) and magnitudes. This is especially desirable if the contribution of earthquakes at distances greater than 100 km exceeds 5%.

This option is only available using median seismic hazard results.

In the following four sub-sections the flow of information in the assessment of controlling earthquakes is described. Figure 1 illustrates the input of information to CE-PA and its output. First a probabilistic seismic hazard analysis with the 1993 LLNL methodology is performed using the PSHC package. Then, given a reference probability level CE-PA calculates the characteristics of the controlling earthquakes.

Figure 2 is a more detailed flow of information and calculations performed within CE-PA. These steps are summarized in this section and are discussed in more detail in the following pages and demonstrated in the Implementation section.

After a probabilistic seismic hazard analysis with the 1993 LLNL methodology has been performed for the site using the PSHC package, the total seismic hazard results are stored in a condensed file (*xocsp*) using the program XSP.

The second step is to extract ground motion levels (target levels) associated with a user-input reference probability of exceedance for spectral accelerations at 1, 2.5, 5, and 10Hz. This is done by a FNDSVSCR. The total hazard results produced in the previous step are also input. GENFQ is used to create a temporary file indicating the desired ground motion measure.

The third series of programs ALEASBIN93 and COMBIN93 calculate the de-aggregated seismic hazard for a matrix of magnitude-distance pairs¹. CEPA-COMB generates a temporary file which specifies the zonation for the seismicity experts to be combined, the ground motion model, the return periods and percentile values desired. The de-aggregated seismic hazard curves are then stored in a condensed file (*mcocsp#93*) using the program XSP.

In the fourth step, programs GHAZS-SPC and COMBFQ calculate the seismic hazard distribution for the matrix of magnitude-distance bins at the ground motion levels calculated by program FNDSVSCR in Step 3.

The mean magnitude and distance of the earthquakes (controlling earthquakes) contributing the most to the total hazard is calculated. The results are averages in two ranges, 1-2.5 Hz and 5-10 Hz. The magnitude-distance distributions are reviewed to determine if the contribution to hazard for distances of 100 Km or greater is 5% or more. In these cases, further calculation is done to identify distant events which may control the low frequency content of a response spectrum.

¹ See Table 2: Magnitude & Distance Bins

The resulting information is summarized on the screen and printed
 $hcav \begin{Bmatrix} 12 \\ 34 \end{Bmatrix} /k/s\#).$

These calculations can be performed for one or a series of sites. CE-PA offers the possibility to calculate the characteristics of controlling earthquakes for different reference probabilities without having to perform the seismic hazard analysis, if it is already done.

Figure 2 - Overview of steps performed in determination of controlling earthquakes

NOTE: *italics, bold face* = user input
uppercase = executable
 [] = output

A. Probabilistic Seismic Hazard Analysis

A site-specific probabilistic hazard assessment using the 1993 LLNL methodology for central and eastern U.S. sites is performed using the PSHC software package. A detailed explanation on the use of this package is given in Ref.1.

The hazard assessment should be performed, as a minimum, for spectral accelerations at 1, 2.5, 5, 10, and 25 Hz. A lower bound magnitude of 5.0 is recommended and used by default. From this analysis, hazard curves for these ground motion measures are stored, that is curves showing annual probability of exceeding various levels of the ground motion measures.

It is recommended that the total hazard for each ground motion measure be provided, as a minimum, in terms of the median (50th percentile), mean, and 85th percentile hazard curves. This is also a default in PSHC. The output of PSHC is condensed by the program XSP.

Figure 3 Chain of calculation for computing condensed total seismic hazard at a given site using PSHC and XSP

Notes for Figure 3

+	=	nonpermanent file, created only for a specific run
*	=	permanent file of data, is an integral part of the PSHC analysis tool
BE	=	Best estimate
BEHC	=	Best estimate hazard curve
CPHC	=	Constant percentile hazard curve
GMEj	=	Ground motion expert j
PGA	=	Peak ground acceleration
RP	=	Return period
SE	=	Seismicity expert
UHS	=	Uniform hazard spectrum
ZSE	=	Zonation for seismicity expert i

B. Estimation of Target Ground Motion Levels

The output of PSHC is summarized by program XSP (*xocsp*). This information is provided as an input to the program FNDSVSCRIP which extracts the ground motion levels at the 1, 2.5, 5, and 10 Hz associated with each reference probability selected by the user. GENFQ generates an input file (*freq #*) containing the current ground motion measure, e.g., 1 Hz, 2.5 Hz, 5 Hz or 10 Hz. Other variable information required by FNDSVSCRIP includes the site id number, the number of sites (always set to 1), the number of frequencies used in PSHC analysis for site, and a title. The Reference Probability level is at three values, 50th and 85th percentile and mean value. If the user chooses to generate his own Reference Probability level, he will be asked for these three values. If the user chooses the RG2 or ALL2 Reference Probability levels, the three values are input for him. The results are appended to the appropriate on-line file (*svf/k//l*) and stored for use in step 4 by GHAZS-SP.

STEP 2

Figure 4: Determination of target ground motion levels for the spectral acceleration at each Reference Probability and Frequency

C. De-Aggregation of Seismic Hazard Analysis

The diagram in Figure 5 illustrates the information input to the programs ALEASBIN93 and COMBIN93. These programs perform seismic hazard analyses for a series of magnitude and distance bins listed in Table 2. These programs are similar to ALEAS and COMB of PSHC (Figure 3) but the analysis is carried out over a discrete set of distance and magnitude values. The 35 menus for ALEASBIN 93 are permanent files stored on disk (*m#m#93*). The 35 menus for COMBIN 93 are created as needed by CEPACOMB and then destroyed. By default the hazard results are provided for the median (50th percentile), mean, and 85th percentile hazard curves. The output is condensed by the program XSP and stored in the permanent file *mcocsp/i/*. This step takes considerable CPU time and only needs to be repeated if the site definition or bins changes.

Table 2: Magnitude and Distance Bins Used in ALEASBIN93

Distance Range of Bin (km)	Magnitude Range of Bin				
	5 - 5.5	5.5 - 6	6 - 6.5	6.5 - 7	> 7
0 - 15					
15 - 25					
25 - 50					
50 - 100					
100 - 200					
200 - 300					
> 300					

STEP 3

Figure 5: Generation of Condensed **de-aggregated** seismic hazard analysis at 1, 2.5, and 10 Hz for 1 to n seismic experts.

D. Magnitude-Distance Distribution and Determination of Controlling Earthquakes (and Geometric Averaging and Results Display for 1 to 2.5 and/or 5 to 10 Hz)

Using the condensed de-aggregated hazard results, the program GHAZS-SPC calculates the seismic hazard levels for each ground motion measure associated to the target ground motion levels. This calculation is performed for an user-defined number of ground motion levels. However, it is recommended to use either 1 and 2.5 Hz, or 5 and 10 Hz, or the four frequencies all together. By default, controlling earthquakes are calculated using hazard results at both 1 and 2.5 Hz and hazard results at 5 and 10 Hz.

These results are used by the program COMBFQ to calculate the fractional contribution to the total median, mean, and 85th percentile hazard of earthquakes in a selected set of magnitude and distance bins at these ground motion levels. Geometric averaging and results display for 1 to 2.5 and/or 5 to 10 Hz

Program COMBFQ uses the magnitude-distance distribution to calculate the mean magnitude and distance of the controlling earthquakes. These values are calculated over all distances, as well as for distances less than and more than 100 km (using median seismic hazard results), if the contribution for distances greater than 100 km is more than 5%.

STEP 4

Figure 6: Calculation of the fractional contribution of the total seismic hazard of earthquakes in a selected set of magnitude - distance bins and geometrically averaged results for 1-2.5 Hz and 5-10 Hz.

III. CE-PA Controller Implementation

A. Overview of Options

Figure 7: Optional Paths in CE-PA Controller

STEP 1

Figure 8: Input and Output for Codes Used in Step 1

STEP 2

Figure 9: Input and Output for Codes Used in Step 2

STEP 3

The controller concatenates the *xosp/d/m/i* files into a single permanent file, *mcocsp/s/i/93* for each site.

STEP 4

Figure 11: Input and Output for Codes Used in Step 4

Notes for Figures 8 - 11

!	=	variable
+	=	non-permanent file created for a specific run
*	=	permanent file of data saved on disk
/j	=	seismic expert index (1...13)
/i	=	site id index
k	=	ground motion measure code (1= 1Hz, 2 = 2.5Hz, 3 = 5Hz, 4 = 10Hz)
l	=	reference probability level (RG2, ALL2, USER1)
d	=	distance bin (0-15, 15-25, 25-50, 50-100, 100-200, 200-300, > 300)
m	=	magnitude bin (5-5.5, 5.5-6, 6-6.5, 6.5-7, > 7)

B. Example Executions.

1. Case 1: Listing Previous Sites and Displaying Previous Results

EXAMPLE DISPLAYING PREVIOUS SITES AND PREVIOUS RESULTS:

CE-PA.csh your_machine_name_here

CE-PA

CONTROLLED EARTHQUAKES THROUGH PROBABILITY ANALYSIS

Interactive Menu and Batch File Processor

Release Version 1.00

October, 1994

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy, and performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Normally the results of this run are stored in /data1/hazard/results/CE-PA/35BIN_RUN. Please check the variable RESULTS in this file to be sure the output information is being recorded in the location you desire and that desirable previous runs will not be overwritten now. See Manual for further information if necessary.

Would you like to continue execution? [y/n](default yes)

>

start time Wed Nov 9 16:54:27 PST 1994

In order to determine if a site has already been run the user may select 4) View a listing of previously defined sites. This selection will display sites in numeric order including information regarding the site latitude, longitude, soil conditions, and geographic area.

MAIN MENU

Please select one of the following options for determination of controlling earthquakes and development of seismic hazard information base:

- (1) New User Defined Site
- (2) Previously defined NUREG/CR-5250 Sites, or
previously defined User Defined Sites
- (3) User selected reference probability case
(USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

>

Have you set xhost + on your machine? [y/n] default yes

>

Type q at any time to end this listing and return to prompt.

A separate window will appear on your screen labeled "EUS_Update_Study_Sites". It will contain a listing of the sites already studied, including their latitudes and longitudes and site numbers. To progress through the list type a carriage return; to ending the listing at any time, type "q" in the new window. If you had answered "n" to setting the xhost, the listing a sites will appear in this window; use the left mouse button to scroll up and down the listing of previous sites.

Limerick

Site 1

-75.67 40.22 1 1 2
(long.,lat.,icorr2,icorr3,iregsit)

Shearon Harris

Site 2

-79.00 35.58 1 1 2

Braidwood

Site 3

-88.23 41.24 1 1 3

La Crosse Site 4

-91.23 43.56 2 7 3

River Bend Site 5

-91.33 30.76 2 5 4

Wolf Creek Site 6

-95.69 38.24 1 1 4

Watts Bar Site 7

-84.79 35.60 1 1 2

Vogtle Site 8

-81.76 33.14 2 5 2

Millstone Site 9

-72.17 41.31 1 1 1

--More--(7%)

The user wants more data and strikes the carriage return or space bar.

>

Maine Yankee Site 10

-69.70 43.95 1 1 1

Fitzpatrick Site 11

-76.398 43.524 1 1 1

Ginna Site 12

-77.309 43.278 1 1 1

Haddam Neck Site 13

-72.499 41.482 1 1 1

Indian Point Site 14

-73.953 41.271 1 1 1

Nine Mile Point Site 15

-76.410 43.522 1 1 1

Oyster Creek Site 16

-74.206 39.814 2 5 1

Peach Bottom Site 17

-76.269 39.759 1 1 1

Pilgrim Site 18

-70.579 41.944 2 7 1

--More--(17%)

The user wants to quit displaying site data, and types "q" <cr> here.

>

In order to view the results of a previously studied site the user selects 2) Previously defined Sites from the Main Menu, then selects 4) View a listing of controlling earthquakes previously calculated. This will print to the screen a Short Summary of the results for every case (RG2, ALL2, USER1) found in storage.

MAIN MENU

Please select one of the following options for determination of controlling earthquakes and development of seismic hazard information base:

- (1) New User Defined Site
- (2) Previously defined NUREG/CR-5250 Sites, or previously defined User Defined Sites
- (3) User selected reference probability case (USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

>

You have selected PREVIOUSLY developed sites. Please select one of the following options:

- (1) De-aggregate hazard data, generate magnitude-distance distributions, and determine the controlling earthquakes.
- (2) Generate magnitude-distance distributions, and determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data was developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- (3) Determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data and the magnitude-distance distribution were developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- (4) View results of controlling earthquakes previously calculated.
- (5) Return to Main Menu

>

CE-PA must already be completed for the selected sites.

Please choose a site number or a series of site numbers (space delimited) to display.

Sample of a series of site numbers: 1 5 18 <carriage return>

>

Sites selected for display are: 8

If you have not changed the controller during the execution of the selected site(s), the example directory path is the correct

directory path. You may simply copy it to your buffer space then paste it into the response area.

Please enter the directory path for previously stored results of the CE-PA analysis. FOR EXAMPLE:

/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites

> /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites

DISPLAYING A SHORT SUMMARY OF CE-PA ANALYSIS

Current site number: 8

/pubusr/CE-PA/bin/s8

Gathering spectral velocity results.

cp: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s8sp/hazsur_c_geom/hcav12USER1s8: No such file or directory

cp: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s8sp/hazsur_c_geom/hcav34USER1s8: No such file or directory

vogtle

{93},c-GX geom average of 1-2.5hz based on ALL2 ca

freq = 1.0 Hz number of bins used = 35

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
214.81 350.63 459.87

Percent of total hazard for distances .gt. 100km = 48.

For av 1-2.5hz for dist .gt. 100km the controlling

earthquake (Mc & Dc) is 6.65 156.8

For reference the controlling earthquake (Mc & Dc)
calculated for dist .le. 100 km is 5.72 22.4

For reference Mc & Dc based on all magnitude & distance
bins is computed for the median, 85%ile, and mean hazard data.

M av=	6.17	6.27	6.32
D av=	57.07	63.68	71.74

vogtle

{93},c-GX geom average of 1-2.5hz based on RG2 cas
freq = 1.0 Hz number of bins used = 35

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
290.19 464.34 554.10

Percent of total hazard for distances .gt. 100km = 41.
For av 1-2.5hz for dist .gt. 100km the controlling
earthquake (Mc & Dc) is 6.68 156.4

For reference the controlling earthquake (Mc & Dc)
calculated for dist .13. 100 km is 5.71 18.8

For reference Mc & Dc based on all magnitude and distance
bins in computed for the median, 85%ile, and mean hazard data.

M av=	6.11	6.26	6.35
D av=	45.00	54.65	67.57

vogtle

{93},c-GX geom average of 5.-10.hz based on ALL2 c
freq = 5.0 Hz number of bins used = 35

Average 5.0- 10.0 Hz Spectral acceleration (cm/s/s)
316.2 423.80 519.46

Controlling earthquake for av5-10Hz based on all magnitude
and distance bins

Mc & Dc = 5.68 20.4

WARNING percentage of hazard for mag & dist bins gt 100 is = 8
Mc & Dc based on dist 15 100km = 5.60 17.2
Mc & Dc based on dist gt 100km = 6.68 155.7

For reference Mc & Dc based on all magnitude and distance
bins in computed for the median, 85%ile, and mean hazard data.

M av=	5.68	6.15	6.28
D av=	20.45	47.80	61.12

vogtle

{93},c-GX geom average of 5.-10.hz based on RG2 ca
freq = 5.0 Hz number of bins used = 35

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)
434.80 558.42 627.69

Controlling earthquake for av5-10Hz based on all magnitude
and distance bins

Mc & Dc = 5.64 15.7

For reference Mc & Dc based on all mag & dist bins is
computed for the median, 85%ile, and mean hazard data.

M av=	5.64	6.13	6.31
C av=	15.73	40.21	56.89

Complete results are in the directory:

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s8sp/hazsur_c_geom

MAIN MENU

Please select one of the following options for determination of
controlling earthquakes and development of seismic hazard
information base:

- (1) New User Defined Site
- (2) Previously defined NUREG/CR-5250 Sites, or previously
defined User Defined Sites
- 3) User selected reference probability case (USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

>

No match.

CE-PA FINI.

The results are located in

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s#sp/hazsur_c_geom/

in the files beginning hcav*

and in

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom

in the files ending with the site number.

end time Wed Nov 9 16:55:16 PST 1994

2. Case 2: Analyzing New Site

EXAMPLE USER NEW SITE CASE

CE-PA.csh your_machine_name_here

CE-PA

CONTROLLED EARTHQUAKES THROUGH PROBABILITY ANALYSIS

Interactive menu and Batch File Processor

Release Version 1.00

October, 1994

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy, and performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Normally the results of this run are stored in /data1/hazard/results/CE-PA/35BIN_RUN .Please check the variable RESULTS in this file to be sure the output information is being recorded in the location you desire and that desirable previous runs will not be overwritten now. See Manual for further information if necessary.

Would you like to continue execution? [y/n](default yes)

>

start time Wed Nov 2 19:40:20 PST 1994

MAIN MENU

Please select one of the following options for determination of controlling earthquakes and development of seismic hazard information base:

- (1) New User Defined Site
- (2) Previously defined NUREG/CR-5250 Sites, or previously defined User Defined Sites
- (3) User selected reference probability case (USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

> 1

Executing PSHC to generate the distance information.

Be sure to select the New User defined Sites option.

The default values for PSHC queries are acceptable.

Selecting NEW SITE means that you have never completed a PSHC run for the desired site. The PSHC codes (prds, comap, al930621, cb941025) are executed now to obtain a probabilistic seismic hazard analysis with the 1993 LLNL methodology. The seismic hazard results are stored in a cryptic file using the program xsp. See the PSHC Users' Manual for comments on the following prompts and selections.

Welcome to PSHC,
the
Interactive Menu and Batch File Preprocessor
for the Probabilistic Seismic Hazard Codes

To EXIT at any time type Control C

after a slight pause the PSHC routine will then display the following:

Please choose a type of site to analyze. Possibilities are:

- 1: NUREG/CR-5250 Sites 1 through 69 re-combine only (SSE, seismic Experts, percentile bounds, return periods and/or graphics options
- 2: New User Defined Site
- 3: Previous Site (NUREG OR User Defined) for which you want to redefine the site conditions and/or sensitivities
 - 1: List the NUREG/CR-5250 sites
 - 2: List the current User Defined sites
 - 0: You have finished defining the desired sites. Run codes. or EXIT. (default)

Select New User Defined Site.

shc>

Please choose a site to analyze. Possible options are:

107: Site number available for definition now.

Type the assigned number to begin site definition.

-1: List the NUREG/CR-5250 sites

-2: List the current User Defined Sites

-3: Ignore these values and restart site selection

The system gives you the next site number available for definition. This number will be used to refer to the location you are going to define during this execution of PSHC. The executive routine also provides a list of sites involved in previous studies: NUREG/CR-5250 is the original study(Ref.2) and the second listing contains any sites you may have created in the past using this executive routine. If the user is defining a new site (i.e., site not defined in the EUS PSHC study performed by LLNL), then the user must input the site number the executive routine indicates is available for definition, in this case the new site number is 107.

shc>

Currently Inputting Information to Define Site Number: 107

Please Type in a Title for Site (<=15 characters)

.....|.....|.....|

The system wants some identifying title to use for the site you are defining now, e.g. Santa Fe PSV. I used "new bin site PSV". This is followed by prompts for the longitude and latitude.

shc>

Input Site Longitude:

The longitude can be input in negative convention (for North America). If not, the executive routine will correct automatically. After the longitude is input, the executive routine will prompt the user for the site latitude.

Input Site Latitude:

After the latitude has been input (positive convention for North America), the executive routine will prompt the user for the site class category. The site categories are discussed in detail in Refs. 1 and 2.

Site Class Categories:

- 1) class r, rock sites
- 2) class t1, 25-80 ft. till-like soil sites
- 3) class t2, 80-180 ft. till-like soil sites
- 4) class t3, 180-300 ft. till-like soil sites

- 5) class s, thick soil sites
- 6) class s1, 25-80 ft. sand-like soil sites
- 7) class s2, 80-180 ft. sand-like soil sites
- 8) class s3, 180-300 ft. sand-like soil sites

Select an appropriate soil class.

Please choose a site class [1-8] (no default):

5

After the site class category has been defined, the executive routine will prompt the user for the host region in which the site lies.

- Host Region of Site:
- 1) Northeastern US
 - 2) Southeastern US
 - 3) North Central US
 - 4) South Central US

Refer to the map at the front of this manual if you are uncertain about the host region to select for this site.

Please choose a region number [1-4] (no default):

2

Once the site host region index has been input to the executive routine, the routine will echo back the site information the user has input.

Current Definition of Site 107 has title: new site bin site PSV

Longitude: -81.76, Latitude: 33.14

Soil Class: s, thick soil sites

Host Region of Site: Southeastern US

- You may
- (1) accept this site definition,
 - (2) change any portion of the definition,
 - (3) ignore these values and restart site selection

The user must answer with either a 1, 2, or 3. A carriage return will cause the routine to repeat the original display asking for a choice of site to analyze. Once the site definition has been accepted, a user defined site identification file is created, and that site number will be assigned to that site until the System Administrator removes the file from the system. The file will be named PSITESID and all future user defined sites will be added to that file.

Please enter [1,2,3] (no default):

1

The executive routine will then give a standard default design spectra.

The default site specific Safe Shutdown Earthquake(SSE) spectrum is defined as follows:

- (1) Number of spectral points = 4
- (2) Design pga. = 147.1 cm/sec/sec
- (3) Freq. Velocity (cm/sec)

0.55	31.50
2.00	31.50
10.00	6.35
33.00	0.71

Would you like to change the default site specific SSE spectrum for this site?

- (0) No(default)
- (1) Yes

Feel free to change the SSE in any appropriate manner. It will not impair the CE-PA code.

User selects to input new spectra with a 1.

shc>

You selected yes. Is this correct?

- (0): Yes (default)
- (1): No

The user is given an opportunity to change his response to the previous question regarding SSE spectra. User selects the default with a carriage return.

shc>

How many points comprise the SSE spectrum (<=9)

shc>

What is the design pga value?

shc>

Spectral Frequency #1:

Spectral Velocity #1:

Number	Frequency	Spectral Velocity
1	0.250	58.750

Spectral Frequency #2:

Spectral Velocity #2:

Number	Frequency	Spectral Velocity
1	0.250	58.750
2	2.500	39.100

Spectral Frequency #3:

Spectral Velocity #3:

Number	Frequency	Spectral Velocity
1	0.250	58.750
2	2.500	39.100
3	9.000	9.010

Spectral Frequency #4:

Spectral Frequency #4:

Would you like to change any of the following parameters:

- (1) Number of spectral points = 4
- (2) Design pga. = 196.200
- (3) Frequency Velocity

0.250	58.750
2.500	39.100
9.000	9.010
33.300	0.950

Enter number from 1 to 3 to change, 0 to continue.

shc>

There is a slight pause at this point while the executive routine works.

Files produced for site 107 will be stored on the computer in the directory:

/data1/hazard/results/941102.02/001

You may wish to copy the following directory information into your computer buffer space. It will be requested during the later execution phases of CE-PA's new site analysis.

The executive routine sets the code to run all 11 seismic experts because this is the first time the site has been executed.

Using all 11 seismic experts.

The 93 EUS Update sites were analyzed with PGAs of 1.0 g max. For an explanation of this choice see the Executive section of the User Manual.

For which PGA do you wish to analyze this site?

(1) 1 g max(default)

[50. 75. 150. 250. 300. 400. 500. 650. 800. 1000.]

(2) 2 g max

[49. 74. 123. 245. 392. 550. 750. 981. 1400. 1962.]

Please enter 1 or 2. Default is 1.

shc>

For PGA the results are plotted as Probability of Exceedance (Per Year) versus Acceleration (cm/sec**2). For PSV the results are plotted per return period as Velocity (cm/sec) versus Period (sec). PSHC asks the user to define a value of 1G or 2G for the calculation. The answer to this question defines the pga or pgv values for which the hazard is calculated.

If 1) 1g is chosen then the 50 pgv (in cm/sec) values [10 pgv values for 5 frequencies 1.0, 2.5, 5.0, 10.0, 25.0] for which the hazard is calculated are:

1g	1.0	5.	15	25.	40.	50.	60.	70.	80.	200.
	1.0	6.	11.	16.	21.	26.	31.	36.	41.0	200.
	.5	5.5	10.5	15.5	20.5	25.5	30.5	35.5	40.5	200.
	.5	2.5	4.5	6.5	8.5	10.5	12.5	14.5	16.5	185.
	.2	2.2	4.2	6.2	8.2	10.2	12.2	14.2	16.2	182.

If 2) 2g is chosen then the 50 pgv (in cm/sec) values [10 pgv values for 5 frequencies 1.0, 2.5, 5.0, 10.0, 25.0] for which the hazard is calculated are:

2g	.01	0.1	1.	7.	40.	50.	60.	70.	80.	200.
	.01	0.1	1.	5.	21.	26.	31.	36.	41.	200.
	.01	0.1	1.0	5.	20.5	25.5	30.5	35.5	40.5	200.
	.01	0.1	1.0	3.	8.5	10.5	12.5	14.5	16.5	185.
	.01	0.1	1.0	3.	8.2	10.2	12.2	14.2	16.2	182.

The choice of which scale to use is determined on how close the site is to a source zone which high seismicity. For a site which lies next to a source a scaling of 2g must be chosen to capture the probability of exceedance (per year) desired [10 to the -6] or

the velocity desired [1 cm/sec]. For most sites scaling of 1g is adequate to capture the probability of exceedance and velocity desired.

The executive routine will then prompt for a unique plot label that will appear on all slots. The label must be 50 characters or less in length.

Please Input a Unique Plot Label Line (it will appear on ALL Plots).

Label must be <= 50 Characters.

.....|.....|.....|.....|.....|.....|.....|.....|.....|.....|

shc>

Once the user has input his plot label, the executive routine will echo back that label and ask the user if they desire to change it. If the user chooses to change the label the executive routine will cycle through the request for unique plot label again.

The User Defined Plot Label for ALL plots is:

new bin site PSV

Do you wish to change it?

(0) No (default)

(1) Yes

The user selects the default by using the carriage return.

shc>

The executive routine will then request the types of plots the user wishes generated. Several questions are asked in relation to graphical output. Default values are offered and can be implemented by hitting the carriage return at each prompt.

Would you like to plot arith. averages for all return periods on a separate frame?

(0) Yes (default)

(1) No

shc>

Would you like to plot geom. averages for all return periods on a separate frame?

(0) Yes (default)

(1) No

shc>

Plot best est. with percentile curves on a sep. frame for all return periods?

(0) Yes (default)

(1) No

shc>

Plot all the best estimate haz. curves for the individual experts on one?

(0) Yes (default)

(1) No

shc>

The executive routine then requests that the user specify the seed to be used in the hazard calculation.

Please specify random seed:

0.0) The computer will generate a random seed
(default)

1.0) Use "fixed" program supplied seed

large num) Input own random seed (must be <2147483645)

For a standard analysis the computer should generate the random seed from the real time clock value (0.0 option).

The user may choose to supply the seed. He should select a large positive number in the range 10^{12} but less than 2147483645. This option is useful when benchmarking an installation of the codes or when replicating a previously run site. The program supplied fixed seed (1.0 option) is similar in function; it's value is 975234961. The user inputs his own random seed in this example.

shc>

123456789

The executive routine then requests that the user specify the type of graphical output desired. It should be noted that the screen graphics option is valid only for the SUN console. If you are running on a remote machine be sure that your environment is set to display locally (setenv DISPLAY machinename:0.0). The user should be warned that the screen graphics option should only be chosen for attended runs as the program will pause after each graphical output until the user hits the carriage return to signal continuation of the analysis. The graphical output prompt is as follows:

Specify type of graphics output desired:

(1) Screen graphics

(2) Plotter graphics.(use with unattended runs)

(3) Both (default)

For Screen graphics, you MUST be at a Sun console.

The program will pause between graphs and wait for user input before continuing. For unattended runs, use option 2.

The user selects plotter graphics in this example.

shc>

2

The executive routine then requests that the user specify the number of simulations to be performed per attenuation expert. For the Eastern U.S. Update 100 simulations were used for PGA and 50

simulations for PSV. For single site runs (non-production environment) 100 simulations are recommended.
Enter the number of simulations per attenuation expert (max=100 and default=50)

shc>

The executive routine then will prompt the user for the magnitude and intensity bounds to be used in the analysis. The default values are given and the user can either accept the defaults or change the values.

The analysis magnitude and intensity parameters must be set.

Number	Description	Default	Current Value
(1)	Lower Earthquake Magnitude Bound	(5.00)	5.00
(2)	Lower MMI Intensity Bound	(6.50)	6.50
(3)	Upper Bound Earthquake Magnitude	(9.00)	9.00
(4)	Upper Bound MMI Intensity	(12.00)	12.00

The 1989 EUS study used a Lower Earthquake Magnitude Bound of 3.75 and a lower MMI Intensity Bound of 4.0

Enter 0 (default) to accept current values, [1-4] to change a value.

The user accepts the default bounds.

shc>

Once the analysis magnitude and intensity bounds have been set, the executive routine will prompt the user for the number of return periods to be calculated in the analysis. The maximum number of return periods the executive routine can handle is 5. Please enter the number of return periods (max is 5, default is 3)
The user selects the default of 3 return periods by hitting the carriage return.

ALWAYS SELECT THE DEFAULT VALUES WHEN PREPARING A NEW SITE FOR BINNING ANALYSIS.

shc>

Current values for the return periods are:

Number	Value
(1)	1000.
(2)	10000.
(3)	100000.

Enter number of value to change, 0 (default) to accept all values. Values do not have to be in order. (default = 0)

The user selects the default by hitting the carriage return.

shc>

Enter the number of percentiles at which to plot hazard (max is 5 (default is 3))

The user selects the default by hitting the carriage return.

shc>

Current values for the percentile bounds are:

Number	Value
(1)	0.15
(2)	0.50
(3)	0.85

Enter number of value to change, 0 to accept all values.

Values do not have to be in order. (default = 0)

The user selects the default by hitting carriage return.

shc>

Enter the number of percentiles at which to plot combined hazard (max is 5 (default is 3))

ALWAYS SELECT THE DEFAULT VALUES WHEN PREPARING A NEW SITE FOR BINNING ANALYSIS.

The user selects the 3 percentiles for the combined plots. Always choose 3 if CE-PA is being run.

shc>

Current values for the percentile bounds are:

Number	Value
(1)	0.15
(2)	0.50
(3)	0.85

Enter number of value to change, 0 (default) to accept all values.

Values do not have to be in order. (default = 0)

The user selects the default by hitting carriage return.

shc>

The PSHC always does a composite analysis. This is the type of analysis used in the Eastern U.S. Update study. See Ref. 3 for a discussion of ground motion experts and ground motion models. Using COMPOSITE ground motion experts.

Would you prefer the spectra horizontal axes of the combined plots to be: (default is frequency)

- (1) frequency(1993 EUS Update)
- (2) periods

The user selects the default by hitting carriage return.

shc>

The executive routine will prompt you for another site and thus start the whole process over again, or to execute analysis . Choose to execute the PSHC site analysis now. CE-PA needs these results as input information to the fndsvscrp code.

Please choose a type of site to analyze. Possibilities are:

- 1: NUREG/CR-5250 Sites 1 through 69
re-combine only (SSE, seismic Experts, percentile bounds, return periods and/or graphics options
- 2: New User Defined Site
- 3: Previous Site (NUREG OR User Defined)
for which you want to redefine the site conditions and/or sensitivities
- 1: List the NUREG/CR-5250 sites
- 2: List the current User Defined sites
- 0: You have finished defining the desired sites. Run codes.
or EXIT. (default).

The user selects the default exit by hitting carriage return.

shc>

"PSHC" has prepared 1 sites for analysis.

Reminder: files created by this run are stored on the computer in:
/data1/hazard/results/941102.02/001

Do you want to execute this analysis now or later?

- (0) Now (default)
- (1) Later

shc>

PSHC will execute PRDs, COMAP, and ALEAS for expert selected then execute COMBINE. Some of the repetitive information displayed to the screen during the ALEAS runs has been eliminated from this document for brevity's sake.

Executing requested sites now.

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

warning - bem consistency check: please check p(existence) for
zone 20

(This warning can be safely ignored.)

warning - bem consistency check: please check p(existence) for
zone 21

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1989 PRDs

Executing 1989 COMAP

all done, sans problems, relax

Executing 1993 Composite ALEAS

aleas working on : fls107
 seus921
 atcb0127
 gmxcomb
 smenu

output files are : osp1s107
 tsp1s107

opening diglib plot file named dig.ps

time in seconds

cpu	0.21401E+03
usr	0.20787E+03
sys	0.61400E+01

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

1

dig.ps converted to Exp_1.ps

Executing 1993 Composite ALEAS

aleas working on : f2s107
 seus922
 atcb0127

gmxcomb

smenu

output files are : osp2s107

tsp2s107

opening diglib plot file named dig.ps

time in seconds

cpu 0.17249E+03

usr 0.16761E+03

sys 0.48800E+01

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

2

dig.ps converted to Exp_2.ps

...xperts 3, 4, 5, 6, 7, 10, 11, and 12, execute here...

Executing 1993 Composite ALEAS

aleas working on : f13s107

seus9213

atcb0127

gmxcomb

smenu

output files are : osp13s10

tsp13s10

opening diglib plot file named dig.ps

time in seconds

cpu	0.20118E+03
usr	0.19384E+03
sys	0.73400E+01

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

13

dig.ps converted to Exp_13.ps

Executing 1994 Composite COMBINE

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

comb working on: combin

output file is : ocsp107

sse values read from menu file : combin

opening diglib plot file named dig.ps

time in seconds

cpu	33.64
sys	2.93
usr	30.71

ALL

dig.ps converted to Exp_ALL.ps

Extracting from the output of PSHC.

This section (often referred to as phase 1.5) is unique to analyzing new sites and to defining new reference probabilities of exceedance. It will extract ground motion levels associated to a

user-input reference probability of exceedance for spectral accelerations at 1, 2.5, 5, and 10 Hz using the total hazard results produced by PSHC. The program *genfq* creates an input file to the primary code *fndsvscrp*.

Be sure to enter the site number assigned by *PSHC* when you selected the NEW SITE option above.

Please enter the NEW site number (or a series of NEW site numbers) assigned to the desired location by the PSHC program.

Sample of a series of site numbers: 98 105 <carriage return>

> 107

Number of sites to be processed: 1

Collecting PSHC pseudo velocity spectra information.

If you copied this directory information into your buffer earlier, hit paste now. Otherwise, type in the storage location for the PSHC analysis that was printed to your screen before execution.

Please enter the directory path for previously stored results of the PSHC analysis. This path was printed to the screen during execution of PSHC. FOR EXAMPLE: /data1/hazard/results/date.##/001

> /data1/hazard/results/941102.02/001

Extracting Spectra information.

Using path: /data1/hazard/results/941102.02/001

The following clean up process will only be need if you've run this site number more than once. You can ignore any notations about "No match." or "No such file or directory."

Clean up from previous runs:

No match.

rm: xocsp107: No such file or directory

rm: new1sp: No such file or directory

rm: new2sp: No such file or directory

rm: psvhead: No such file or directory

rm: new2sp: No such file or directory

If you failed to include the 50 and 85th percentiles while running PSHC, type "Control C" now and start CE-PA over again.

CE-PA uses the 50th and the 85th percentiles. These should have been included in your SHC/PSHC selections.

Is the number of frequencies used in SHC/PSHC run 4 or 5?(PSHC and CE-PA default is 5)

>

rm: temp: No such file or directory

If you want a description of the reference probability cases offered below, refer to the Overview of CE-PA section of this manual. If you wish to specify your own reference probability level (the USER1 case) consult the Overview of CE-PA section of this manual for a general description or consult Reference 1, "Investigation of Techniques for the Development of Seismic Design Basis Using the Probabilistic Seismic Hazard Analysis" by Bernreuter, et al.

Enter the reference probability (RG2, ALL2, USER1) for the spectral velocity sites. (default RG2, ALL2)>

>

The reference probability case(s) used in this analysis is RG2
ALL2

The ground motion measure used in the CE-PA analysis are:

Frequency (Code)	Frequency (Hz)
[1]	1.0
[2]	2.5
[3]	5.0
[4]	10.0

Please select one of the following options. (default = 3)

- (1) 1 Hz and 2.5 Hz
- (2) 5 Hz and 10 Hz
- (3) Both 1 Hz and 2.5 Hz AND 5 Hz and 10 Hz

>

The Frequency values to run are 1 2 3 4

At this point the controller will execute the *findpgan* and/or *genfq* and *fndsvscrp* routines and store the results appropriately for you.

genfq complete.

Fndsvscrp DONE for Running RG2 frequency 1.

genfq complete.

Fndsvscrp DONE for RG2 frequency 2.

genfq complete.

Fndsvscrp DONE for RG2 frequency 3.

genfq complete.

Fndsvscrp DONE for RG2 frequency 4.

genfq complete.

Fndsvscrp DONE for ALL2 frequency 1.

genfq complete.

Fndsvscrp DONE for ALL2 frequency 2.

genfq complete.

Fndsvscrp DONE for ALL2 frequency 3.

genfq complete.

Fndsvscrp DONE for ALL2 frequency 4.

No match.

No match.

rm: findpgan: No such file or directory

rm: xextac: No such file or directory

FINISHED extracting information from the PSHC analysis for site(s) 107.

Returning to the main controller to de-aggregate hazard data and to generate magnitude-distance distributions, and determine the controlling earthquakes.

The third series of programs (often referred to as phasel) begins here. Since the data has never been de-aggregated, de-aggregate it now by selecting 1). If you select 1) as shown in the example below the controller executes *aleasbin93* and *combin93* to calculate the de-aggregated seismic hazard for a matrix of magnitude-distance pairs. The de-aggregated seismic hazard curves are then stored in a cryptic file using the program *xsp* or *xextac*.

Use the same NEW SITE number(s) assigned by *PSHC* earlier; in this case site 107.

Please choose a site number or a series of site numbers (space delimited) to analyze.

Sample of a series of site numbers: 1 5 18 <carriage return>

> 107

The following directories may already exist on your system as a result of previous executions of CE-PA.

mkdir: /data1/hazard/results/CE-PA/: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites: File exists

The following table shows the default distance and magnitude bins.

The default Distance intervals used in the analysis are:

Distance

Distance

Code	in Km
[1]	0-15
[2]	15-25
[3]	25-50
[4]	50-100
[5]	100-200
[6]	200-300
[7]	>300

The default Magnitude intervals used in the analysis are:

Magnitude Code	Magnitude
[1]	5-5.5
[2]	5.5-6
[3]	6-6.5
[4]	6.5-7
[5]	>7

Distance intervals to be processed:

0-15 15-25 25-50 50-100 100-200 200-300 >300

Magnitude intervals to be processed:

5-5.5 5.5-6 6-6.5 6.5-7 >7

The following information is a quick summary of the information being used during this analysis.

This package uses LLNL 1993 seismic hazard methodology.

Sites to be processed are: 107

Number of sites to be processed: 1

Seismic Experts to be processed: 1 2 3 4 5 6 7 10 11 12 13

Number of Seismic Experts to be processed: 11

The LLNL 1993 COMPOSITE ground motion model is being used.

The total number of magnitude-distance pairs is 35

Printing then removing the hazard surface plots.

The execution of *aleasbin93* and *combin93* begin here. This can be a VERY lengthy process depending upon the number of magnitude-distance pairs you selected above. You may wish to check on the progress of the analysis every couple hours or simply come back another day when this section should be completed. The next prompt will be appear with a > as usual.

Executing ALEASBIN for spectral velocity to generate deaggregated hazard data

Using input files from /data1/hazard/eusupd/datadir and /data1/hazard/comapdir.

Using menus from
/data1/hazard/gdmotiondir/aleas_menus/35bins/93_menus in form
m#m#s{93}

cp: ./aleasbin93
rm: dig.ps: No such file or directory

ln: ./seus92x1: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcomb: File exists

ln: ./m0m1s93: File exists

Running aleasbin{93} on site 107 bin m0m1s93

aleas working on : f1s107
 seus92x1
 atcb0127
 gmxcomb
 m0m1s93

output files are : osp011
 tsp011

Note: this program was linked with -fast or -fnonstd
and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in

the Numerical Computation Guide.

rm: clsis: No such file or directory

rm: osp011: No such file or directory

rm: dig.ps: No such file or directory

ln: ./fls107: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcmb: File exists

Running aleasbin{93} on site 107 bin mlmls93

aleas working on : fls107

seus92x1

atcb0127

gmxcmb

mlmls93

output files are : osp111

tsp111

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

... Repeats aleasbin93 for each expert and bin selected ...

rm: cl3sis: No such file or directory

rm: osp5513: No such file or directory

rm: dig.ps: No such file or directory

ln: ./f13s107: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcmb: File exists

Running aleasbin(93) on site 107 bin m6m5s93

aleas working on : f13s107
 seus92x1
 atcb0127
 gmxcmb
 m6m5s93

output files are : osp6513
 tsp6513

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

rm: c13sis: No such file or directory

rm: osp6513: No such file or directory

rm: atnfb: No such file or directory

rm: gmxfb: No such file or directory

rm: dig.ps: No such file or directory

cp: ./combin93

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp: File exists

rm: dig.ps: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom01 o=ocsp01107 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mccom01

output file is : ocsp0110

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 40.62

sys 2.94

usr 37.68

Extracting from output of combining using xsp

rm: dig.ps: No such file or directory

rm: 1st: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom11 o=ocsp11107 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mcom11

output file is : ocsp1110

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 39.87

sys 2.56

usr 37.31

Extracting from output of combining using xsp

....Repeats Executing *combin93* for each of the selected magnitude and distance bins

rm: dig.ps: No such file or directory

rm: 1st: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: *combin93* i=mccom65 o=ocsp65107 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

comb working on: mcom65

output file is : ocsp6510

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 40.22

sys 2.72

usr 37.50

Extracting from output of combining using xsp

No match.

The fourth series of programs (often referred to as phase2) begins here. In this section the controller executes the program *ghazs-spc* (*ghazs-acc*) which calculates the seismic hazard levels for the matrix of magnitude-distance bins at the ground motion levels calculated by the previous program *fndsvscrp*. Next the program *combfq* using geometric averaging calculates the mean magnitude and distance of the earthquakes (controlling earthquakes) contributing the most to the total hazard. The results are stored on disk and also sent to the printer.

The following lines of information confirm what site(s) and ground motion model and cases are being analyzed.

Sites selected for calculation of magnitude-distance distribution are: 107

The LLNL 93 c ground motion model(s) is being used.

The probability of exceedance levels are discussed in Sections 3 to 5 of Appendix C. Currently, RG2, and ALL2 are implemented. If the user wishes to develop his own reference probability case, it

can be entered as USER1. Please enter the desired input reference probability cases.(default RG2 ALL2):

>

The reference probability case(s) used in this analysis is RG2 ALL2

In order to complete the geometric averaging you must run at least two ground motion measures: 1.0 and 2.5 Hz AND/OR 5.0 and 10.0

The ground motion measures used in the analysis are:

Frequency (Code)	Frequency (Hz)
[1]	1.0
[2]	2.5
[3]	5.0
[4]	10.0

Please select one of the following options. (default = 3)

- (1) 1 Hz and 2.5 Hz
- (2) 5 Hz and 10 Hz
- (3) Both 1 Hz and 2.5 Hz AND 5 Hz and 10 Hz

>

The Frequency values to run are 1 2 3 4

Executing with geom averaging method.

Using path: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites

The following directories may already exist on your system as a result of previous executions of CE-PA.

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom

```
cp /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/cbspcs107/mcocsp10793 mcocsp107
```

GHAZS-SPC takes the hazard data from the condensed de-aggregated seismic hazard and the target levels for ground motion calculated by FNDVSCRCP above then calculates the seismic hazard levels for the matrix of magnitude-distance bins for a given reference probability level and a given ground motion level. This code makes it easier to pick out which bins contribute the most to the hazard and also computes a characteristic earthquake magnitude and distance.

```
ghazs-spc mcocsp107 hcf1RG2s107 svf1RG2 p3df112s107 sitids107
```

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

57.0000

17.0000

22.0000

```
mv hcf1RG2s107 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp107 hcf2RG2s107 svf2RG2 p3df212s107 sitids107
```

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

27.0000

14.0000

21.0000

```
mv hcf2RG2s107 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

ghazs-spc mcocsp107 hcf3RG2s107 svf3RG2 p3df312s107 sitids107

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

22.0000

15.0000

17.0000

mv hcf3RG2s107 /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.

ghazs-spc mcocsp107 hcf4RG2s107 svf4RG2 p3df412s107 sitids107

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

33.0000

12.0000

16.0000

mv hcf4RG2s107 /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.

The generation of magnitude-distance distribution for the selected velocities is complete. (site 107 level RG2)

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom: File exists

```
cp /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/cbspcs107/mcocsp10793 mcocsp107
```

```
ghazs-spc mcocsp107 hcf1ALL2s107 svf1ALL2 p3df112s107 sitids107
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

```
20.8280      15.7480
```

```
52.0000
```

```
18.0000
```

```
22.0000
```

```
mv hcf1ALL2s107 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp107 hcf2ALL2s107 svf2ALL2 p3df212s107 sitids107
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

```
20.8280      15.7480
```

```
26.0000
```

```
14.0000
```

```
22.0000
```

```
mv hcf2ALL2s107 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp107 hcf3ALL2s107 svf3ALL2 p3df312s107 sitids107
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

20.8280 15.7480

18.0000

14.0000

19.0000

```
mv hcf3ALL2s107 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp107 hcf4ALL2s107 svf4ALL2 p3df412s107 sitids107
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

20.8280 15.7480

27.0000

13.0000

18.0000

```
mv hcf4ALL2s107 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom/.
```

The generation of magnitude-distance distribution for the selected velocities is complete. (site 107 level ALL2)

The following directories may already exist on your system as a result of previous executions of CE-PA.

```
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss:
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur
mkdir: /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom
```

Finally the program COMBFQ calculates the mean, media, and 85%ile magnitude and distance of the controlling earthquakes, i.e. those earthquakes contributing the most to the total hazard. A short

summary of results is printed to the screen while the complete results file(s) are sent to the printer.

site 107

geom averaging with range 1-2.5 for RG2 case with c ground motion experts.

rm: nbins: No such file or directory

Combining results for frequencies 1 Hz and 2.5 Hz .

opening diglib plot file named dig.ps

Average 1.0-2.5 Hz Spectral acceleration (cm/s/s)

290.19 464.34 554.10

Percent of total hazard for distances .gt. 100km =41.

For av 1-2.5hz for dist .gt. 100km the controlling

earthquake (Mc & Dc) is 6.68 156.4

cp pf12*s107 /data1/hazard/results/CE-

PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

site 107

geom averaging with range 5.-10. for RG2 case with c ground motion experts.

Combining results for frequencies 5 Hz and 10 Hz.

opening diglib plot file named dig.ps

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)

434.80 558.42 627.69

Controlling earthquake for av5-10Hz based on all magnitude
and distance bins
Mc & Dc = 5.64 15.7

WARNING percentage of hazard for mag & dist bins gt 100 is = 9.
Mc & Dc based on dist lt 100km = 5.64NaN
Mc & Dc based on dist gt 100km = 6.65 155.8

cp pf34*s107 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss:
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur
mkdir: /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom

site 107

geom averaging with range 1-2.5 for ALL2 case with c ground
motion experts.

Combining results for frequencies 1 Hz and 2.5 Hz .

opening diglib plot file named dig.ps

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)

214.81 350.63 459.87

Percent of total hazard for distances .gt. 100km = 59.
For av 1-2.5hz for dist .gt. 100km the controlling
earthquake (Mc & Dc) is 6.65 156.8

cp pf12*s107 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

site 107

geom averaging with range 5.-10. for ALL2 case with c ground motion experts.

Combining results for frequencies 5 Hz and 10 Hz.

opening diglib plot file named dig.ps

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)

316.20 423.80 519.46

Controlling earthquake for av5-10Hz based on all magnitude and distance bins

Mc & Dc = 5.68 20.4

WARNING percentage of hazard for mag & dist bins gt 100 is = 8.

Mc & Dc based on dist lt 100km = 5.60 17.2

Mc & Dc based on dist gt 100km = 6.68 155.7

cp pf34*s107 /data1/hazard/results/CE-

PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

ALL DONE running binning for c ground motion experts.

ALL DONE NRC spectral averaging.

No match.

No match.

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/comment: No such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/combin: No such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/cepacomb: No such file or directory

CE-PA FINI.

Printing results located in

/data1/hazard/results/CE-

PA/35BIN_RUN/93_cgx_sites/s#sp/hazsur_c_geom/

in the files beginning hcav*

and in

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom
in the files ending with the site number.

end time Thu Nov 3 14:56:18 1994

3. Case 3: Analyzing Previously Defined Site That Needs Binning Analysis

EXAMPLE PREVIOUSLY DEFINED SITE

CE-PA.csh your_machine_name_here

CE-PA

CONTROLLED EARTHQUAKES THROUGH PROBABILITY ANALYSIS

Interactive Menu and Batch File Processor

Release Version 1.00

October, 1994

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy, and performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Normally the results of this run are stored in /data1/hazard/results/CE-PA/35BIN_RUN .Please check the variable RESULTS in this file to be sure the output information is being recorded in the location you desire and that desirable previous runs will not be overwritten now. See Manual for further information if necessary.

Would you like to continue execution? [y/n](default yes)

>

start time Wed Nov 9 16:06:51 PST 1994

MAIN MENU

Please select one of the following options for determination of controlling earthquakes and development of seismic hazard information base:

- (1) New User Defined Site
- (2) Previously defined NUREG/CR-5250 Sites, or previously defined User Defined Sites
- (3) User selected reference probability case (USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

> 2

Selecting Previously Defined Site(s) means that you have completed a *PSHC* run for the desired site at some time in the past. When the *PSHC* codes (*prds*, *comap*, *al930621*, *cb941025*) were executed the seismic hazard results were stored on disk. You need to know the directory path to these results.

The third series of programs (often referred to as *phasel*) begins here. Since the data has never been de-aggregated, de-aggregate it now by selecting 1). If you select 1) as shown in the example below the controller executes *aleasbin93* and *combin93* to calculate the de-aggregated seismic hazard for a matrix of magnitude-distance pairs. The de-aggregated seismic hazard curves are then stored in a cryptic file using the program *xsp* or *xextac*.

You have selected PREVIOUSLY developed sites. Please select one of the following options:

- (1) De-aggregate hazard data, generate magnitude-distance distributions, and determine the controlling earthquakes.
- (2) Generate magnitude-distance distributions, and determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data was developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- (3) Determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data and the magnitude-distance distribution were developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- 4) View a listing of controlling earthquakes previously calculated for this site.
- 5) Return to Main Menu

>

Please choose a site number or a series of site numbers (space delimited) to analyze.

Sample of a series of site numbers: 1 5 18 <carriage return>

>

Some of these directories may already exist due to previous executions of CE-PA.

```
mkdir: /data1/hazard/results/CE-PA/: File exists
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN: File exists
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites: File exists
```

The following table shows the default distance and magnitude bins.

The default Distance intervals used in the analysis are:

Distance Code	Distance in Km
[1]	0-15
[2]	15-25
[3]	25-50

[4]	50-100
[5]	100-200
[6]	200-300
[7]	>300

The default Magnitude intervals used in the analysis are:

Magnitude Code	Magnitude
[1]	5-5.5
[2]	5.5-6
[3]	6-6.5
[4]	6.5-7
[5]	>7

Distance intervals to be processed:

0-15 15-025 25-50 50-100 100-200 200-300 >300

Magnitude intervals to be processed:

5-5.5 5.5-6 6-6.5 6.5-7 >7

The following information is a quick summary of the information being used during this analysis.

This package uses LLNL 93 seismic hazard methodology.

Sites to be processed are: 103

Number of sites to be processed: 1

Seismic Experts to be processed: 1 2 3 4 5 6 7 10 11 12 13

Number of Seismic Experts to be processed: 11

The LLNL 1993 COMPOSITE ground motion model is being used.

The total number of magnitude-distance pairs is 35

Printing then removing the hazard surface plots.

The execution of *aleasbin93* and *combin93* begin here. This can be a VERY lengthy process depending upon the number of magnitude-distance pairs you selected above. You may wish to check on the progress of the analysis every couple hours or simply come back another day when this section should be completed. The next prompt will be appear with a > as usual.

Executing ALEASBIN for spectral velocity to generate deaggregated hazard data

Using input files from /data1/hazard/eusupd/datadir and
/data1/hazard/comapdir.

Using menus from
/data1/hazard/gdmotiondir/aleas_menus/35bins/93_menus in form
m#m#s{93}

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/xpert1: File
exists

rm: dig.ps: No such file or directory

ln: ./fls103: File exists

ln: ./seus92x1: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcomb: File exists

Running aleasbin{93} on site 103 bin m1m1s93

aleas working on : fls103
 seus92x1
 atcb0127
 gmxcomb
 m0m1s93

output files are : osp011
 tsp011

Note: this program was linked with -fast or -fnonstd and so may
have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in
the Numerical Computation Guide.

rm: clsis: No such file or directory

rm: osp011: No such file or directory

rm: dig.ps: No such file or directory

ln: ./fls103: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcomb: File exists

Running aleasbin{93} on site 103 bin mlmls93

aleas working on : fls103
 seus92x1
 atcb0127
 gmxcomb
 mlmls93

output files are : osp111
 tsp111

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

... Repeats aleasbin{93} for each expert selected ...

rm: cl3sis: No such file or directory

rm: osp5513: No such file or directory

rm: dig.ps: No such file or directory

ln: ./f13s103: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcomb: File exists

Running aleasbin{93} on site 103 bin m6m5s93

aleas working on : f13s103

seus92x1

atcb0127

gmxcmb

m6m5s93

output files are : osp6513

tsp6513

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the Numerical Computation Guide.

rm: cl3sis: No such file or directory

rm: osp6513: No such file or directory

rm: atnfb: No such file or directory

rm: gmxfb: No such file or directory

rm: dig.ps: No such file or directory

cp: ./combin93

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists

rm: dig.ps: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom01 o=ocsp01103 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mccom01

output file is : ocsp0110

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 40.62

sys 2.94

usr 37.68

Extracting from output of combining using xsp

rm: dig.ps: No such file or directory

rm: lst: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom11 o=ocsp11103 < lst

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mccom11

output file is : ocsp1110

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 39.87

sys 2.56

usr 37.31

Extracting from output of combining using xsp

....Repeats Executing combin93 for each of the selected magnitude and distance bins

rm: dig.ps: No such file or directory

rm: 1st: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom65 o=ocsp65103 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

comb working on: mccom65

output file is : ocsp6510

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 40.22

sys 2.72

usr 37.50

Extracting from output of combining using xsp

No match.

The fourth series of programs (often referred to as phase2) begins here. In this section the controller executes the program *ghazs-spc* (*ghazs-acc*) which calculates the seismic hazard levels for the matrix of magnitude-distance bins at the ground motion levels calculated by the previous program *fndsvscrp*. Next the program *combfq* using geometric averaging calculates the mean magnitude and distance of the earthquakes (controlling earthquakes) contributing the most to the total hazard. The results are stored on disk and also sent to the printer.

If you want a description of the reference probability cases offered below, refer to the Overview of CE-PA section of this manual. If you wish to specify your own reference probability level (the USER1 case) consult the Overview of CE-PA section of this manual for a general description or consult Reference 1, "Investigation of Techniques for the Development of Seismic Design Basis Using the Probabilistic Seismic Hazard Analysis" by Bernreuter, et al.

The probability of exceedance levels are discussed in Sections 3 to 5 of Appendix C. Currently, RG2, and ALL2 are implemented. If the user has developed his own reference probability case, it can be entered as USER1.

Please enter the desired input reference probability cases.(default RG2 ALL2):

>

The reference probability case(s) used in this analysis is RG2 ALL2

In order to complete the geometric averaging you must run at least two ground motion measures: 1.0 and 2.5 Hz AND/OR 5.0

The ground motion measure used in the analysis are:

Frequency (Code)	Frequency (Hz)
[1]	1.0
[2]	2.5
[3]	5.0
[4]	10.0

Please select one of the following options. (default = 3)

- (1) 1 Hz and 2.5 Hz
- (2) 5 Hz and 10 Hz
- (3) Both 1 Hz and 2.5 Hz AND 5 Hz and 10 Hz

>

The Frequency values to run are 1 2 3 4

Executing with geom averaging method.

The total number of magnitude-distance pairs is 35

Please enter the directory path for previously stored results of the de-aggregated hazard analysis. FOR EXAMPLE:

`/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites`

> `/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites`

Using path: `/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites`

The following directories may already exist on your system as a result of previous executions of CE-PA.

`mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists`

`mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom: File exists`

`cp /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/cbspcs103/mcocsp10393 mcocsp103`

`cp: ./ghazs-spc`

GHAZS-SPC takes the hazard data from the condensed de-aggregated seismic hazard and the target levels for ground motion calculated by FNDVSCRCP above then calculates the seismic hazard levels for the matrix of magnitude-distance bins for a given reference probability level and a given ground motion level. This code makes it easier to pick out which bins contribute the most to the hazard and also computes a characteristic earthquake magnitude and distance.

`ghazs-spc mcocsp103 hcf1RG2s103 svf1RG2 p3df112s103 sitids103`

`ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10`

`opening diglib plot file named dig.ps`

20.8280 15.7480

44.0000

18.0000

22.0000


```
mv hcf1RG2s103 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp103 hcf2RG2s103 svf2RG2 p3df212s103 sitids103
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

```
20.8280    15.7480
```

```
29.0000
```

```
20.0000
```

```
21.0000
```

```
mv hcf2RG2s103 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp103 hcf3RG2s103 svf3RG2 p3df312s103 sitids103
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

```
20.8280    15.7480
```

```
22.0000
```

```
18.0000
```

```
18.0000
```

```
mv hcf3RG2s103 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp103 hcf4RG2s103 svf4RG2 p3df412s103 sitids103
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

20.8280 15.7480

22.0000

18.0000

17.0000

```
mv hcf4RG2s103 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

The generation of magnitude-distance distribution for the selected velocities is complete. (site 103 level RG2)

```
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists
```

```
mkdir: /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom: File exists
```

```
cp /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/cbspcs103/mcocsp10393 mcocsp103
```

```
cp: ./ghazs-spc: Permission denied
```

```
ghazs-spc mcocsp103 hcf1ALL2s103 svf1ALL2 p3df112s103 sitids103
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

20.8280 15.7480

41.0000

17.0000

21.0000

```
mv hcf1ALL2s103 /data1/hazard/results/CE-  
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp103 hcf2ALL2s103 svf2ALL2 p3df212s103 sitids103
```

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

25.0000

20.0000

19.0000

mv hcf2ALL2s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.

ghazs-spc mcocsp103 hcf3ALL2s103 svf3ALL2 p3df312s103 sitids103

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

22.0000

19.0000

17.0000

mv hcf3ALL2s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.

ghazs-spc mcocsp103 hcf4ALL2s103 svf4ALL2 p3df412s103 sitids103

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

17.0000

18.0000

18.0000

```
mv hcf4ALL2s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

The generation of magnitude-distance distribution for the selected velocities is complete. (site 103 level ALL2)

The following directories may already exist on your system as a result of previous executions of CE-PA.

```
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss:
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur
mkdir: /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom
```

Finally the program COMBFQ calculates the mean, media, and 85%ile magnitude and distance of the controlling earthquakes, i.e. those earthquakes contributing the most to the total hazard. A short summary of results is printed to the screen while the complete results file(s) are sent to the printer.

site 103

geom averaging with range 1-2.5 for RG2 case with c ground motion experts.

rm: nbins: No such file or directory

Combining results for frequencies 1 Hz and 2.5 Hz .

opening diglib plot file named dig.ps

Average 1.0-2.5 Hz Spectral acceleration (cm/s/s)

290.19	464.34	554.10
--------	--------	--------

Percent of total hazard for distances .gt. 100km =41.

For av 1-2.5hz for dist .gt. 100km the controlling

earthquake (Mc & Dc) is 6.68 156.4

cp pf12*s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

site 103

geom averaging with range 5.-10. for RG2 case with c ground motion experts.

Combining results for frequencies 5 Hz and 10 Hz.
opening diglib plot file named dig.ps

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)
434.80 558.42 627.69

Controlling earthquake for av5-10Hz based on all magnitude and distance bins
Mc & Dc = 5.64 15.7

WARNING percentage of hazard for mag & dist bins gt 100 is = 9.
Mc & Dc based on dist lt 100km = 5.64NaN
Mc & Dc based on dist gt 100km = 6.65 155.8

cp pf34*s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s107sp/hazsur_c_geom
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss:
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur
mkdir: /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom

site 103

geom averaging with range 1-2.5 for ALL2 case with c ground motion experts.

Combining results for frequencies 1 Hz and 2.5 Hz .

opening diglib plot file named dig.ps

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)

214.81 350.63 459.87

Percent of total hazard for distances .gt. 100km = 59.

For av 1-2.5hz for dist .gt. 100km the controlling earthquake (Mc & Dc) is 6.65 156.8

cp pf12*s103 /data1/hazard/results/CE-

PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

site 103

geom averaging with range 5.-10. for ALL2 case with c ground motion experts.

Combining results for frequencies 5 Hz and 10 Hz.

opening diglib plot file named dig.ps

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)

316.20 423.80 519.46

Controlling earthquake for av5-10Hz based on all magnitude and distance bins

Mc & Dc = 5.68 20.4

WARNING percentage of hazard for mag & dist bins gt 100 is = 8.

Mc & Dc based on dist lt 100km = 5.60 17.2

Mc & Dc based on dist gt 100km = 6.68 155.7

cp pf34*s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

ALL DONE running binning for c ground motion experts.

ALL DONE NRC spectral averaging.

No match.

No match.

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/comment: No
such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/combin: No
such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/cepacomb: No
such file or directory

CE-PA FINI.

Printing results located in

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s#sp/hazsur_c_geom/
in the files beginning hcav*

and in

/data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom
in the files ending with the site number.

end time Wed Nov 9 16:28:34 PST 1994

4. Case 4: Analyzing Previously Defined Site with User
Defined Reference Probability Case

EXAMPLE USER SELECTED REFERENCE PROBABILITY CASE

CE-PA.csh your_machine_name_here

CE-PA

CONTROLLED EARTHQUAKES THROUGH PROBABILITY ANALYSIS

Interactive Menu and Batch File Processor

Release Version 1.00

October, 1994

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy, and performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Normally the results of this run are stored in /data1/hazard/results/CE-PA/35BIN_RUN. Please check the variable RESULTS in this file to be sure the output information is being recorded in the location you desire and that desirable previous runs will not be overwritten now. See Manual for further information if necessary.

Would you like to continue execution? [y/n] (default yes)

> ☒ y

start time Mon Nov 7 08:24:19 PST 1994

MAIN MENU

Please select one of the following options for determination of controlling earthquakes and development of seismic hazard information base:

(1) New User Defined Site

- (2) Previously defined NUREG/CR-5250 Sites, or previously defined User Defined Sites
- (3) User selected reference probability case (USER1)
- (4) View a listing of previously defined sites?
- (5) Exit

>

This run assumes that the PSHC codes (*prds*, *comap*, *a1930621*, *cb941025*) were run to obtain a probabilistic seismic hazard analysis with the 1993 LLNL methodology at some earlier time by using PSHC. You will need to know the storage location of that run as it will be requested during the execution of CE-PA's analysis.

Has PSHC been run for this site? [y/n] (default no)

>

This section (often referred to as phase 1.5) is unique to analyzing new sites and to defining new reference probabilities of exceedance. It will extract ground motion levels associated to a user-input reference probability of exceedance for spectral accelerations at 1, 2.5, 5, and 10 Hz using the total hazard results produced by PSHC. The program *genfq* creates an input file to the primary code *fndsvscrp*.

Extracting from the output of PSHC.

Please enter the NEW site number (or a series of NEW site numbers) assigned to the desired location by the PSHC program.

Sample of a series of site numbers: 98 105 <carriage return>

>

Number of sites to be processed: 1

Type in the storage location for the PSHC analysis.

Collecting PSHC pseudo velocity spectra information.

Please enter the directory path for previously stored results of the PSHC analysis. This path was printed to the screen during execution of PSHC. FOR EXAMPLE: /data1/hazard/results/date.##/001

> /data1/hazard/results/941023.01/001

Extracting Spectra information.

Using path: /data1/hazard/results/941023.01/001

The following clean up process will only be need if you've run this site number more than once. You can ignore any notations about "No match." or "No such file or directory."

Clean up from previous runs:

No match.

rm: xocsp103: No such file or directory

rm: new1sp: No such file or directory

rm: new2sp: No such file or directory

rm: psvhead: No such file or directory

rm: new2sp: No such file or directory

If you failed to include the 50 and 85th percentiles while running PSHC, type "Control C" now and start CE-PA over again as a NEW site.

CE-PA uses the 50th and the 85th percentiles. These should have been included in your SHC/PSHC selections.

Is the number of frequencies used in SHC/PSHC run 4 or 5?(PSHC and CE-PA default is 5)

>

rm: temp: No such file or directory

Since you are specifying your own reference probability level (the USER1 case) consult "Appendix C" or Reference 1, "Investigation of Techniques for the Development of Seismic Design Basis Using the Probabilistic Seismic Hazard Analysis" by Bernreuter, et al.

Enter the reference probability (RG2, ALL2, USER1) for the spectral velocity sites. (default RG2, ALL2)>

>

The three reference probability values you calculate and enter here define your case, USER1.

Please enter the reference probabilities at the 50th, 85th percentile and mean values in the format: 1.81900E-05
4.97600E-04 5.63700E-04

>

Using 1.819E-5 4.976E-4 5.637E-4 for case USER1.

The reference probability case(s) used in this analysis is USER1

The ground motion measure used in the CE-PA analysis are:

Frequency (Code)	Frequency (Hz)
[1]	1.0
[2]	2.5
[3]	5.0
[4]	10.0

Please select one of the following options. (default = 3)

- (1) 1 Hz and 2.5 Hz
- (2) 5 Hz and 10 Hz
- (3) Both 1 Hz and 2.5 Hz AND 5 Hz and 10 Hz

>

The Frequency values to run are 1 2 3 4

At this point the controller will execute the *findpgan* and/or *genfq* and *fndsvscrp* routines and store the results appropriately for you.

genfq complete.

Fndsvscrp DONE for USER1 frequency 1.

genfq complete.

Fndsvscrp DONE for USER1 frequency 2.

genfq complete.

Fndsvscrp DONE for USER1 frequency 3.

genfq complete.

Fndsvscrp DONE for USER1 frequency 4.

No match.

No match.

rm: *findpgan*: No such file or directory

rm: *xextac*: No such file or directory

FINISHED extracting information from the PSHC analysis for site(s) 103.

Returning to the main controller to de-aggregate hazard data and to generate magnitude-distance distributions, and determine the controlling earthquakes.

The third series of programs (often referred to as phase1) begins here. You have several options at this point. If you have already de-aggregated the hazard data, for instance when doing cases RG2 or ALL2 for this site, you can skip the first choice and select 2). If the data has never been de-aggregated, de-aggregate it now by selecting 1). If you select 1) as shown in the example below the controller executes *aleasbin93* and *combin93* to calculate the de-aggregated seismic hazard for a matrix of magnitude-distance pairs. The de-aggregated seismic hazard curves are then stored in a cryptic file using the program *xsp* or *xextac*.

Use the same site number(s) in this case site 103.

You have selected PREVIOUSLY developed sites. Please select one of the following options:

- (1) De-aggregate hazard data, generate magnitude-distance distributions, and determine the controlling earthquakes.

- (2) Generate magnitude-distance distributions, and determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data was developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- (3) Determine the controlling earthquakes.

This selection requires that the de-aggregated hazard data and the magnitude-distance distribution were developed sometime previously and can be located on the disk.

You will need to know the location (directory path) of the results.

- (4) View a listing of controlling earthquakes previously calculated.

- (5) Return to Main Menu

>

Please choose a site number or a series of site numbers (space delimited) to analyze.

Sample of a series of site numbers: 1 5 18 <carriage return>

>

The following directories may already exist on your system as a result of previous executions of CE-PA.

mkdir: /data1/hazard/results/CE-PA/: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites: File exists

The following table shows the available distance and magnitude bins. You may select any combination of them you desire provided there is at least one distance and one magnitude bin. Here the example selects all 7 distance and 5 magnitude bins.

The default Distance intervals used in the analysis are:

Distance Code	Distance in Km
[1]	0-15
[2]	15-25
[3]	25-50
[4]	50-100
[5]	100-200
[6]	200-300
[7]	>300

The default Magnitude intervals used in the analysis are:

Magnitude	Magnitude Code
[1]	5-5.5
[2]	5.5-6
[3]	6-6.5
[4]	6.5-7
[5]	>7

Distance intervals to be processed:

0-15 15-25 25-50 50-100 100-200 200-300 >300

Magnitude intervals to be processed:

5-5.5 5.5-6 6-6.5 6.5-7 >7

The following information is a quick summary of the information being used during this analysis.

This package uses LLNL 93 seismic hazard methodology.

Sites to be processed are: 103

Number of sites to be processed: 1

Seismic Experts to be processed: 1 2 3 4 5 6 7 10 11 12 13

Number of Seismic Experts to be processed: 11

Ground motion Experts to be processed: c

The LLNL \${study} COMPOSITE ground motion model is being used.
The total number of magnitude-distance pairs is 35

The execution of aleasbin93 and combin93 begin here. This can be a VERY lengthy process depending upon the number of magnitude-distance pairs you selected above. You may wish to check on the progress of the analysis every couple hours or simply come back another day when this section should be completed. The next prompt will be appear with a > as usual.

Executing ALEASBIN for spectral velocity to generate de-aggregated hazard data

Using input files from /data1/hazard/eusupd/datadir and /data1/hazard/comapdir.

Using menus from
/data1/hazard/gdmotiondir/aleas_menus/35bins/93_menus in form m#m#s(93)

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/xpert1
rm: dig.ps: No such file or directory

ln: ./fls103: File exists

ln: ./seus92x1: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcomb: File exists

ln: ./m0m1s93: File exists

Running aleasbin{93} on site 103 bin m0m1s93

aleas working on : fls103

seus92x1

atcb0127

gmxcomb

m0m1s93

output files are : osp011

 tsp011

Note: this program was linked with -fast or -fnonstd
and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in the
Numerical Computation Guide.

rm: clsis: No such file or directory

rm: osp011: No such file or directory

rm: dig.ps: No such file or directory

ln: ./fls103: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcmb: File exists

Running aleasbin{93} on site 103 bin mlmls93

aleas working on: fls103

 seus92x1

 atcb0127

 gmxcmb

 mlmls93

output files are : osp111

 tsp111

Note: this program was linked with -fast or -fnonstd
and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in
the Numerical Computation Guide.

... Repeats aleasbin{93} for each expert selected ...

rm: cl3sis: No such file or directory

rm: osp5513: No such file or directory

rm: dig.ps: No such file or directory

ln: ./f13s103: File exists

ln: ./atcb0127: File exists

ln: sitecor: File exists

ln: ./gmxcmb: File exists

Running aleasbin(93) on site 103 bin m6m5s93

aleas working on: f13s103
 seus92x1
 atcb0127
 gmxcmb
 m6m5s93

output files are : osp6513
 tsp6513

Note: this program was linked with -fast or -fnonstd and so may have produced nonstandard floating-point results.

Sun's implementation of IEEE arithmetic is discussed in
the Numerical Computation Guide.

rm: c13sis: No such file or directory

rm: osp6513: No such file or directory

rm: atnfb: No such file or directory

rm: gmxfb: No such file or directory

^/rm: dig.ps: No such file or directory

cp: ./combin93

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/cbspca103:
File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/dcpsca103:
File exists

rm: dig.ps: No such file or directory

rm: lst: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom01 o=ocsp01103 < lst

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mcom01

output file is : ocsp0110

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 39.59

sys 2.54

usr 37.05

Extracting from output of combining using xsp

rm: dig.ps: No such file or directory

rm: 1st: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

....Repeats Executing combin93 for each of the selected magnitude
and distance bins

Extracting from output of combining using xsp

rm: dig.ps: No such file or directory

rm: 1st: No such file or directory

rm: lnk: No such file or directory

rm: ulnk: No such file or directory

COMBINE xpert: 1 2 3 4 5 6 7 10 11 12 13

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

No match.

Executing combine: combin93 i=mccom65 o=ocsp65103 < 1st

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10

comb working on: mcom65

output file is : ocsp6510

the input sse spectrum was read from the t-file

opening diglib plot file named dig.ps

time in seconds

cpu 39.57

sys 2.38

usr 37.19

Extracting from output of combining using xsp

No match.

The fourth series of programs (often referred to as phase2) begins here. In this section the controller executes the program *ghazs-spc* (*ghazs-acc*) which calculates the seismic hazard levels for the matrix of magnitude-distance bins at the ground motion levels calculated by the previous program *fndsvscrp*. Next the program *combfq* using geometric averaging calculates the mean magnitude and distance of the earthquakes (controlling earthquakes) contributing the most to the total hazard. The results are stored on disk and also sent to the printer.

The following lines of information confirm what site(s) and ground motion model and cases are being analyzed.

Sites selected for calculation of magnitude-distance distribution are: 103

The LLNL 93 c ground motion model(s) is being used.

Be sure to enter USER1 here.

The probability of exceedance levels are discussed in Sections 3 to 5 of Appendix C. Currently, RG2, and ALL2 are implemented. If the user wishes to develop his own reference probability case, it can be entered as USER1. Please enter the desired input reference probability cases.(default RG2 ALL2):

> USER1

The reference probability case(s) used in this analysis is USER1

In order to complete the geometric averaging you must run at least two ground motion measures: 1.0 and 2.5 Hz AND/OR 5.0

The ground motion measure used in the analysis are:

Frequency
(Code)

Frequency
(Hz)

[1]	1.0
[2]	2.5
[3]	5.0
[4]	10.0

Please select one of the following options. (default = 3)

- (1) 1 Hz and 2.5 Hz
- (2) 5 Hz and 10 Hz
- (3) Both 1 Hz and 2.5 Hz AND 5 Hz and 10 Hz

>

The Frequency values to run are 1 2 3 4

Executing with geom averaging method.

The total number of magnitude-distance pairs is 35

Using path: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites

The following directories may already exist on your system as a result of previous executions of CE-PA.

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp: File exists

mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom: File exists

cp /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/cbspcs103/mcocsp10393 mcocsp103

GHAZS-SPC takes the hazard data from the condensed de-aggregated seismic hazard and the target levels for ground motion calculated by FNDVSCRP above then calculates the seismic hazard levels for the matrix of magnitude-distance bins for a given reference probability level and a given ground motion level. This code makes it easier to pick out which bins contribute the most to the hazard and also computes a characteristic earthquake magnitude and distance.

ghazs-spc mcocsp103 hcf1USER1s103 svf1USER1 p3df111s103 sitids103

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

43.0000

17.0000

23.0000

mv hcf1USER1s103 /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.

ghazs-spc mcocsp103 hcf2USER1s103 svf2USER1 p3df211s103 sitids103

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

26.0000

18.0000

22.0000

mv hcf2USER1s103 /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.

ghazs-spc mcocsp103 hcf3USER1s103 svf3USER1 p3df311s103 sitids103

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older revision than expected 10

opening diglib plot file named dig.ps

20.8280 15.7480

22.0000

18.0000

19.0000

```
mv hcf3USER1s103 /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom/.
```

```
ghazs-spc mcocsp103 hcf4USER1s103 svf4USER1 p3df411s103 sitids103
```

```
ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older  
revision than expected 10
```

```
opening diglib plot file named dig.ps
```

```
20.8280    15.7480
```

```
18.0000
```

```
14.0000
```

```
19.0000
```

```
mv hcf4USER1s103 /data1/hazard/results/CE-PA/35BIN_RUN/  
93_cgx_sites/s103sp/hazsur_c_geom/.
```

The generation of magnitude-distance distribution for the selected velocities is complete. (site 103 level USER1)

The following directories may already exist on your system as a result of previous executions of CE-PA.

```
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/: File exists  
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s103sp/hazsur_c_geom: File exists  
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss: File exists  
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur: File exists  
mkdir: /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom: File exists
```

Finally the program COMBFQ calculates the mean, media, and 85%ile magnitude and distance of the controlling earthquakes, i.e. those earthquakes contributing the most to the total hazard. A short summary of results is printed to the screen while the complete results file(s) are sent to the printer.

site 103

geom averaging with range 1-2.5 for USER1 case with c ground motion experts.

Combining results for frequencies 1 Hz and 2.5 Hz .

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10
opening diglib plot file named dig.ps
Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
214.81 350.63 459.87

Percent of total hazard for distances .gt. 100km = 9.
For av 1-2.5hz for dist .gt. 100km the controlling
earthquake (Mc & Dc) is 6.66 155.6

cp pf12*s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

site 103

geom averaging with range 5.-10. for USER1 case with c ground
motion experts.
Combining results for frequencies 5 Hz and 10 Hz.

ld.so: warning: /pubusr/openwin3/lib/libX11.so.4.3 has older
revision than expected 10
opening diglib plot file named dig.ps
Average 5.-10. Hz Spectral acceleration (cm/s/s)
214.81 350.63 459.87

Controlling earthquake for av5-10Hz based on all magnitude
and distance bins
Mc & Dc = 6.03 26.1

cp pf34*s103 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom/.

ALL DONE generating CE-PA for c ground motion experts.
ALL DONE NRC spectral averaging.

No match.

No match.

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/comment: No
such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/combin: No
such file or directory

rm:/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/cepacomb: No
such file or directory

CE-PA FINI.

Printing results located in

 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/s#sp/hazsur_c_geom/
 in the files beginning hcav*

and in

 /data1/hazard/results/CE-
PA/35BIN_RUN/93_cgx_sites/spss/hazsur/93_cgx_geom
 in the files ending with the site number.

end time Mon Nov 7 08:56:39 PST 1994

C. Overview of Directory Structure

1. Main Executables and Source Codes.

- (a) `/pubusr/CE-PA/bin/CE-PA.csh` is the primary controller. This C-script queries the user for information, locates all the needed files, controls executions, stores the output files, and prints the results.
- (b) `/pubusr/CE-PA/bin//bin-1.5_93.csh` is the second C-script controller. It uses the reference probability level(s) plus the seismic hazard results from PSHC to determine the corresponding ground motion levels for the spectral accelerations at 1, 2.5, 5, and 10 Hz. It appends the results to the appropriate permanent files.
- (c) `/pubusr/CE-PA/bin/[all the FORTRAN and C executables]` - the functions of these FORTRAN codes are described in Section II of this manual.
- (d) `/pubusr/CE-PA/sources/[all of the FORTRAN sources]`
- (e) `/pubusr/PSHC/pshc`. This FORTRAN code is executed to define any NEW site and is the first step to any CE-PA analysis. A full description of the PSHC executive routine is available in the PSHC Software and Data Base Manual, September 1994. This is the code used for the 1993 Eastern U.S. Update study.

2. Permanent Input Datafiles.

- (a) `/data1/hazard/gdmotiondir/accd_svf` - files of probability of exceedance for each site organized by reference probability case and frequency.
- (b) `/data1/hazard/gdmotiondir/aleas_menus/` - control menus used by `aleasbin93` /one for each of the 35 magnitude-distance bins

3. Permanent Output Datafiles.

- (a) `/data1/hazard/comapdir/f*s#` - distance files generated by PSHC (`prds/comap`) and used by both `aleas` and `aleasbin93`.
- (b) `/data1/hazard/results/currentdate.##/###` - Hazard Results of PSHC executions of ALEAS/COMBIN and XSP `xocsp` files.

- (c) /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/ - The directory where all results for a site will be stored. You can change this variable{RESULTS} in the CE-PA.csh controller if necessary when doing sensitivity runs.
 - (d) /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s#sp/cbspes/i//mcocspes#93 - Condensed de-aggregated seismic hazard results.
 - (e) /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/s#sp/hazur_c_geom/hcav* - Files summarizing the CE-PA analysis. This is automatically sent to the printer.
 - (f) /data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/spss /hazur/93_cgx_sites/pf*-
4. Support Libraries
- (a) /usr/libf77/ims1.a
 - (b) /usr/libf77/diglib/sources.x/diglib.a
 - (c) /usr/libf77/tv80.a
 - (d) /pubusr/X11R5/

D. Technical Support Procedure

1. Theory Contact

Don Bernreuter(dlbern@llnl.gov)
L-631, LLNL
P.O. Box 808
Livermore, CA, 94550

A.Boissonnade(abois@llnl.gov)
L-631, LLNL
P.O. Box 808
Livermore, CA, 94550

2. Installation and Execution Contact

Cheryl Short (short1@llnl.gov)
L-632, LLNL
P.O. Box 808
Livermore, CA, 94550

IV. Perspective

The CE-PA software described in this document is the result of on-going research. This state-of-the-art methodology for assessing controlling earthquakes at particular sites is performed by de-aggregating seismic hazard over a set of magnitudes and distances for several frequency ranges. The most important limitation of the current procedure is the restriction of earthquake characteristics to magnitude and distance. Future enhancements will include other parameters including the level of confidence with which ground motion models are used in the seismic hazard analysis.

REFERENCES

1. D. Bernreuter, A. C. Boissonnade, C. M. Short, "Investigation of Techniques for the Development of Seismic Design Basis Using the Probabilistic Seismic Hazard Analysis," NUREG/CR- XXX, 1996.
2. J. B. Savy, A. C. Boissonnade, R. W. Mensing, C. M. Short, "Eastern U.S. Seismic Hazard Characterization Update," UCRL- ID-115111, Lawrence Livermore National Laboratory, June 1993.
3. P. Sobel, "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plants Sites East of the Rocky Mountains," NUREG-1488, October 1993.
4. C. M. Short, B. C. Davis, "PSHC Software and Data Base: A description for Users, along with the Executive and Command Routine Written for the NRC's SUN OS 4.1.3 Systems," UCRL- MA-118706, Lawrence Livermore National Laboratory, September 1994.

Appendices

Appendix A

BENCHMARKING CE-PA/PSHC

All LLNL benchmark run data is located on your system in:

/data1/hazard/results/CE-PA/35BIN_RUN/93_cgx_sites/BENCHMARK/

When doing your own benchmark use the following information:

CE-PA input values:

Select **(1) NEW USER DEFINED SITE**

PSHC input values:

After selecting **(2) New User Defined Site**, define the site like VOGTLE in the EUS Update Study:

Longitude: **-81.76**
Latitude: **33.14**
Soil type: **5** (class s, thick soil)
Host Region: **2**

Use SSE(Safe Shutdown Earthquake) values:

Number of points comprising the SSE spectrum: **4**

Design pga value: **196.2**

Spectral Velocities: **58.75 39.10 9.01 0.95**

Spectral Frequencies: **0.25 2.50 9.00 33.3**

Select PSV plus the DEFAULT SHC choices.

The random seed should be fixed: **123456789**

Use the reference probability cases **RG2** and **ALL2**.

Request prints of the output and compare the results to the results printed here.

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. accross experts
S-XPRT:1,2,3,4,5,6,7,10,11,12,13 G-XPRT:1

vogtle

data files used for this run:

i = 4bcombsp	
o = 4bocsp8	
t1 = 4btsp1s8	t7 = 4btsp7s8
t2 = 4btsp2s8	t10 = 4btsp10s8
t3 = 4btsp3s8	t11 = 4btsp11s8
t4 = 4btsp4s8	t12 = 4btsp12s8
t5 = 4btsp5s8	t13 = 4btsp13s8
t6 = 4btsp6s8	

number of percentile values	=	3
number of return periods	=	5
number of frequencie(s)	=	5
number of simulations per attenuation expert	=	50
number of attenuation experts	=	1
number of seismicity experts	=	11

PROGRAM COMB VER1.10 COMPILED 04/28/93 12:21:40 EXECUTED 07/07/93 15:24:07

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

PROGRAM COMB VER1.10 COMPILED 04/28/93 12:21:40 EXECUTED 07/07/93 15:24:07
NSIM-59, NGM-1, NSEX-11

500., 1000., 2000., 5000., 10000. years return period
best estimate spectra combined over S & G experts

vogtle

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. accross experts

PROGRAM COMB VER1.10 COMPILED 04/28/93 12:21:40 EXECUTED 07/07/93 15:24:07
NSIM-50, NGM-1, NSEX-11

500., 1000., 2000., 5000., 10000. years return period
arithmetic average spectra for S & G experts

vogtle

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. accross experts

PROGRAM COMB VER1.10 COMPILED 04/28/93 12:21:40 EXECUTED 07/07/93 15:24:07
NSIM= 50, NGM= 1, NSEX=11

500., 1000., 2000., 5000., 10000. years return period
geometric average spectra for S & G experts

vogtle

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. accross experts

best estimate spectra by seismic expert for
 500. years return period

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. across experts

best estimate spectra by seismic expert for 1000. years return period

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. across experts

best estimate spectra by seismic expert for
 2000. years return period

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

best estimate spectra by seismic expert for
 5000. years return period

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. across experts

best estimate spectra by seismic expert for
 10000. years return period

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. across experts

500.-year return period constant percentile spectra:
 percentiles = 15., 50. and 85.

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. across experts

1000.-year return period constant percentile spectra:
 percentiles = 15., 50. and 85.

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. across experts

2000.-year return period constant percentile spectra:
 percentiles = 15., 50. and 85.

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

5000.-year return period constant percentile spectra:
percentiles = 15., 50. and 85.

vogtle

EUS update, 1992 Seismicity, PSV
1992 Composite g.m. accross experts

10000.-year return period constant percentile spectra:
 percentiles = 15., 50. and 85.

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

50-th percentile spectra for all return periods

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

50-th percentile spectra for all return periods

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

probability of exceedance of sse vs. frequency

vogtle

EUS update, 1992 Seismicity, PSV
 1992 Composite g.m. accross experts

{93}, c-GX geom average of 1-2.5hz based on ALL2 ca
 freq = 1.0 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on ALL2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 20.00 37.01 44.43

freq = 2.5 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on ALL2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 19.35 29.84 40.78

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
 214.81 350.63 459.87

Percent of total hazard for distances .gt. 100km = 48.
 For av 1-2.5hz for dist .gt. 100km the controlling
 earthquake (Mc & Dc) is 6.65 156.8

For reference the controlling earthquake (Mc & Dc)
 calculated for dist .le. 100 km is 5.72 22.4

For reference Mc & Dc based on all magnitude & distance
 bins is computed for the median, 85%ile, and mean hazard data.
 M av= 6.17 6.27 6.32
 D av= 57.07 63.68 71.74

% contribution to hazard for M & D bins
 based on the median hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	9.2	12.4	0.7	0.0	0.0
20.0	2.5	5.7	0.3	0.0	0.0
39.0	1.4	7.2	2.1	0.0	0.0
78.0	0.2	3.9	4.8	1.4	0.0
155.0	0.0	0.6	8.2	38.5	0.0
253.0	0.0	0.0	0.1	0.6	0.0
350.0	0.0	0.0	0.0	0.0	0.0

% contribution to hazard for M & D bins
 based on the mean hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	3.4	2.3	0.9	0.3	0.1
20.0	2.7	2.3	1.1	0.3	0.1
39.0	4.1	5.4	3.5	1.7	0.5
78.0	3.1	8.3	12.1	10.4	2.2
155.0	0.4	2.0	6.8	14.3	9.6
253.0	0.0	0.0	0.1	0.6	1.3
350.0	0.0	0.0	0.0	0.0	0.1

estimator used =median
{93},c-GX geom average of 1-2.5hz based on ALL2 ca
average of 1-2.5hz
case2 vogtle

Contribution to haza

estimator used = median of 1-2.5hz based on RG2 cas
 {93}, c-GX geom average of 1-2.5hz Contribution to haza
 average of 1-2.5hz vogtle
 case2

estimator used =mean
 (93),c-GX geom average of 1-2.5hz based on RG2 cas
 average of 1-2.5hz
 case2 vogtle

Contribution to haza

{93},c-GX geom average of 5.-10.hz based on RG2 ca
 freq = 5.0 Hz number of bins used = 35
 {93},c-GX prob. of exceed. based on RG2 case2
 vogtle

Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 13.64 20.39 24.24

freq =10.0 Hz number of bins used = 35
 {93},c-GX prob. of exceed. based on RG2 case2
 vogtle

Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 7.02 7.58 7.86

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)
 434.80 558.42 627.69

Controlling earthquake for av5-10Hz based on all magnitude
 and distance bins

Mc & Dc = 5.64 15.7

For reference Mc & Dc based on all mag & dist bins is
 computed for the median, 85%ile, and mean hazard data.

M av= 5.64 6.13 6.31
 D av= 15.73 40.21 56.89

% contribution to hazard for M & D bins
 based on the median hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	30.0	32.3	2.0	0.0	0.0
20.0	5.3	11.0	0.5	0.0	0.0
39.0	1.3	8.2	2.1	0.0	0.0
78.0	0.0	1.0	1.9	0.4	0.0
155.0	0.0	0.0	0.4	3.5	0.0
253.0	0.0	0.0	0.0	0.0	0.0
350.0	0.0	0.0	0.0	0.0	0.0

% contribution to hazard for M & D bins
 based on the mean hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	5.0	4.3	1.7	0.4	0.1
20.0	3.1	3.6	1.8	0.6	0.2
39.0	3.4	6.4	4.8	2.6	0.8
78.0	1.6	6.2	12.0	13.6	2.9
155.0	0.1	0.9	4.1	10.8	8.3
253.0	0.0	0.0	0.0	0.1	0.4
350.0	0.0	0.0	0.0	0.0	0.0

estimator used = median
(93), c-GX geom average of 5.-10.hz based on RG2 ca
average of 5-10hz
case2 vogtle

Contribution to haza

{93}, c-GX geom average of 5.-10.hz based on ALL2 c
 freq = 5.0 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on ALL2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 10.09 15.30 20.15

freq =10.0 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on ALL2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 5.02 5.84 6.46

Average 5.0-10.0 Hz Spectral acceleration (cm/s/s)
 316.20 423.80 519.46

Controlling earthquake for av5-10Hz based on all magnitude
 and distance bins
 Mc & Dc = 5.68 20.4

WARNING percentage of hazard for mag & dist bins gt 100 is = 8.
 Mc & Dc based on dist lt 100km = 5.60 17.2
 Mc & Dc based on dist gt 100km = 6.68 155.7

For reference Mc & Dc based on all mag & dist bins is
 computed for the median, 85%ile, and mean hazard data.
 M av= 5.68 6.15 6.28
 D av= 20.45 47.80 61.12

% contribution to hazard for M & D bins
 based on the median hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	27.1	21.3	1.3	0.0	0.0
20.0	7.6	10.6	0.6	0.0	0.0
39.0	2.9	11.4	2.9	0.0	0.0
78.0	0.1	2.3	3.4	0.8	0.0
155.0	0.0	0.1	1.0	6.6	0.0
253.0	0.0	0.0	0.0	0.0	0.0
350.0	0.0	0.0	0.0	0.0	0.0

% contribution to hazard for M & D bins
 based on the mean hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	4.6	3.5	1.3	0.3	0.1
20.0	3.2	3.2	1.5	0.4	0.2
39.0	4.0	6.4	4.3	2.1	0.6
78.0	2.2	7.5	12.4	12.2	2.3
155.0	0.2	1.3	5.3	12.1	8.1
253.0	0.0	0.0	0.0	0.2	0.5
350.0	0.0	0.0	0.0	0.0	0.0

estimator used =median
{93},c-GX geom average of 5.-10.hz based on ALL2 c
average of 5-10hz
case2 vogtle

Contribution to haza

estimator used = 85%
 (93), c-GX geom average of 5.-10.hz based on RG2 ca
 average of 5-10hz
 case22 vogtle

Contribution to haza

estimator used = mean
{93}, c-GX geom average of 5.-10.hz based on RG2 ca
average of 5-10hz
case2 vogtle

Contribution to haza

{93}, c-GX geom average of 1-2.5hz based on RG2 cas
 freq = 1.0 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on RG2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 27.87 49.08 54.70

freq = 2.5 Hz number of bins used = 35
 {93}, c-GX prob. of exceed. based on RG2 case2
 vogtle
 Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 25.80 39.49 48.67

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
 290.19 464.34 554.10

Percent of total hazard for distances .gt. 100km = 41.
 For av 1-2.5hz for dist .gt. 100km the controlling
 earthquake (Mc & Dc) is 6.68 156.4

For reference the controlling earthquake (Mc & Dc)
 calculated for dist .le. 100 km is 5.71 18.8

For reference Mc & Dc based on all magnitude & distance
 bins is computed for the median, 85%ile, and mean hazard data.
 M av= 6.11 6.26 6.35
 D av= 45.00 54.65 67.57

% contribution to hazard for M & D bins
 based on the median hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	10.5	19.3	1.2	0.0	0.0
20.0	2.1	7.0	0.2	0.0	0.0
39.0	1.1	7.4	2.0	0.0	0.0
78.0	0.1	2.7	3.9	1.1	0.0
155.0	0.0	0.3	5.3	35.2	0.0
253.0	0.0	0.0	0.0	0.4	0.0
350.0	0.0	0.0	0.0	0.0	0.0

% contribution to hazard for M & D bins
 based on the mean hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	3.8	2.8	1.1	0.3	0.1
20.0	2.8	2.6	1.3	0.4	0.2
39.0	3.7	5.5	4.0	2.1	0.7
78.0	2.4	7.2	11.9	11.5	2.7
155.0	0.3	1.6	5.7	13.2	10.1
253.0	0.0	0.0	0.1	0.5	1.2
350.0	0.0	0.0	0.0	0.0	0.1

estimator used =85%
{93},c-GX geom average of 1-2.5hz based on RG2 cas
average of 1-2.5hz
case2 vogtle

Contribution to haza

estimator used =85%
 {93}, c-GX geom average of 1-2.5hz based on ALL2 ca
 average of 1-2.5hz
 case2
 vogtle

Contribution to haza

estimator used = mean
 {93}, c-GX geom average of 1-2.5hz based on ALL2 ca
 average of 1-2.5hz
 case2

vogtle
 Contribution to haza

estimator used = mean
 {93}, c-GX geom average of 5.-10.hz based on ALL2 c
 average of 5-10hz
 case2

vogtle

Contribution to haza

estimator used =85%
{93},c-GX geom average of 5.-10.hz based on ALL2 c
average of 5-10hz
case2

vogtle

Contribution to haza

Appendix B

Source Codes and Sample Input/Output Files

The nine sources are too long to print here. See the directory `/pubusr/CE-PA/sources` for a full listing. Fortran and C codes include:

ALEASBIN93
CEPACOMB
CEPAVALS
COMBFQ
COMBIN93
FNDSVSCR
GENFQ
GHAZS-SPC
XSP
WAIT

The three controllers (CE-PA.csh and bin-1.5_93.csh plus display.csh) are in `/pubusr/CE-PA/bin`. They are also too lengthy to print here but you may print them locally.

Sample condensed total seismic hazard file - xocsp

spectral hazard curves for cgm
cepa new vogtle
velocity best est. arith. mean geo. mean
frequency 1.00
0.1000E+01 0.2224E+00 0.1962E+00 0.1649E+00
0.1000E+00 0.7958E-01 0.7687E-01 0.5621E-01
0.1000E+01 0.8851E-02 0.1258E-01 0.5527E-02
0.7000E+01 0.5113E-03 0.1421E-02 0.2121E-03
0.4000E+02 0.7924E-05 0.8734E-04 0.1229E-05
0.5000E+02 0.4216E-05 0.5638E-04 0.5004E-06
0.6000E+02 0.2550E-05 0.3884E-04 0.2339E-06
0.7000E+02 0.1689E-05 0.2802E-04 0.1190E-06
0.8000E+02 0.1194E-05 0.2094E-04 0.6369E-07
0.2000E+03 0.1213E-06 0.2251E-05 0.5963E-09
frequency 2.50
0.1000E+01 0.1815E+00 0.1644E+00 0.1373E+00
0.1000E+00 0.6615E-01 0.6228E-01 0.4446E-01
0.1000E+01 0.8843E-02 0.1244E-01 0.5025E-02
0.5000E+01 0.7832E-03 0.2187E-02 0.3903E-03
0.2100E+02 0.2863E-04 0.2550E-03 0.1103E-04
0.2600E+02 0.1572E-04 0.1741E-03 0.5567E-05
0.3100E+02 0.9511E-05 0.1255E-03 0.3060E-05
0.3600E+02 0.6187E-05 0.9414E-04 0.1791E-05

0.4100E+02	0.4258E-05	0.7275E-04	0.1101E-05
0.2000E+03	0.4390E-07	0.1654E-05	0.7465E-09
frequency	5.00		
0.1000E-01	0.1278E+00	0.1282E+00	0.1039E+00
0.1000E+00	0.5007E-01	0.4910E-01	0.3140E-01
0.1000E+01	0.4727E-02	0.8480E-02	0.2734E-02
0.5000E+01	0.2642E-03	0.9897E-03	0.1282E-03
0.2050E+02	0.6327E-05	0.7050E-04	0.1593E-05
0.2550E+02	0.3395E-05	0.4322E-04	0.6484E-06
0.3050E+02	0.2033E-05	0.2834E-04	0.2928E-06
0.3550E+02	0.1313E-05	0.1951E-04	0.1427E-06
0.4050E+02	0.8950E-06	0.1393E-04	0.7382E-07
0.2000E+03	0.3850E-08	0.1185E-06	0.1209E-10
frequency	10.00		
0.1000E-01	0.7339E-01	0.7568E-01	0.5672E-01
0.1000E+00	0.2599E-01	0.2938E-01	0.1476E-01
0.1000E+01	0.1403E-02	0.2664E-02	0.7105E-03
0.3000E+01	0.1714E-03	0.4167E-03	0.7041E-04
0.8500E+01	0.1402E-04	0.4530E-04	0.3191E-05
0.1050E+02	0.7994E-05	0.2712E-04	0.1455E-05
0.1250E+02	0.4966E-05	0.1745E-04	0.7243E-06
0.1450E+02	0.3282E-05	0.1184E-04	0.3903E-06
0.1650E+02	0.2272E-05	0.8365E-05	0.2191E-06
0.1850E+03	0.2777E-09	0.6471E-08	0.1657E-11
frequency	25.00		
0.1000E-01	0.5170E-01	0.5145E-01	0.3287E-01
0.1000E+00	0.1027E-01	0.1364E-01	0.5998E-02
0.1000E+01	0.2850E-03	0.5918E-03	0.1266E-03
0.3000E+01	0.2886E-04	0.6414E-04	0.4193E-05
0.8200E+01	0.1358E-05	0.4636E-05	0.1226E-07
0.1020E+02	0.6443E-06	0.2405E-05	0.2361E-08
0.1220E+02	0.3483E-06	0.1379E-05	0.6987E-09
0.1420E+02	0.2045E-06	0.8521E-06	0.2086E-09
0.1620E+02	0.1266E-06	0.5584E-06	0.7970E-10
0.1820E+03	0.5163E-16	0.3943E-10	0.1022E-11
accel/velo	0.150**	0.500**	0.850**
frequency	1.00		
0.1000E-01	0.8720E-01	0.1700E+00	0.3160E+00
0.1000E+00	0.2310E-01	0.6070E-01	0.1310E+00
0.1000E+01	0.1250E-02	0.6170E-02	0.2100E-01
0.7000E+01	0.1920E-04	0.2640E-03	0.2200E-02
0.4000E+02	0.1880E-07	0.1860E-05	0.9580E-04
0.5000E+02	0.4500E-08	0.7320E-06	0.5390E-04
0.6000E+02	0.1400E-08	0.3330E-06	0.3620E-04
0.7000E+02	0.5040E-09	0.1720E-06	0.2500E-04
0.8000E+02	0.2200E-09	0.9970E-07	0.1760E-04
0.2000E+03	0.1380E-12	0.1190E-08	0.9610E-06
frequency	2.50		
0.1000E-01	0.7090E-01	0.1390E+00	0.2580E+00
0.1000E+00	0.1860E-01	0.4450E-01	0.1070E+00
0.1000E+01	0.1040E-02	0.5820E-02	0.2160E-01
0.5000E+01	0.4340E-04	0.4450E-03	0.3530E-02
0.2100E+02	0.5910E-06	0.1350E-04	0.2780E-03
0.2600E+02	0.2350E-06	0.7070E-05	0.1780E-03
0.3100E+02	0.1050E-06	0.4070E-05	0.1250E-03

0.3600E+02	0.5260E-07	0.2570E-05	0.8610E-04	0.0000E+00	0.0000E+00
0.4100E+02	0.2690E-07	0.1690E-05	0.6480E-04	0.0000E+00	0.0000E+00
0.2000E+03	0.3240E-12	0.1280E-08	0.6680E-06	0.0000E+00	0.0000E+00
frequency	5.00				
0.1000E-01	0.4920E-01	0.1070E+00	0.2130E+00	0.0000E+00	0.0000E+00
0.1000E+00	0.1130E-01	0.2950E-01	0.8600E-01	0.0000E+00	0.0000E+00
0.1000E+01	0.4460E-03	0.2770E-02	0.1470E-01	0.0000E+00	0.0000E+00
0.5000E+01	0.1170E-04	0.1200E-03	0.1370E-02	0.0000E+00	0.0000E+00
0.2050E+02	0.4410E-07	0.1910E-05	0.6470E-04	0.0000E+00	0.0000E+00
0.2550E+02	0.1340E-07	0.8860E-06	0.3560E-04	0.0000E+00	0.0000E+00
0.3050E+02	0.4700E-08	0.4490E-06	0.2170E-04	0.0000E+00	0.0000E+00
0.3550E+02	0.1770E-08	0.2380E-06	0.1350E-04	0.0000E+00	0.0000E+00
0.4050E+02	0.6570E-09	0.1310E-06	0.9360E-05	0.0000E+00	0.0000E+00
0.2000E+03	0.1110E-15	0.4610E-11	0.1340E-07	0.0000E+00	0.0000E+00
frequency	10.00				
0.1000E-01	0.2590E-01	0.5530E-01	0.1300E+00	0.0000E+00	0.0000E+00
0.1000E+00	0.4000E-02	0.1460E-01	0.5300E-01	0.0000E+00	0.0000E+00
0.1000E+01	0.1250E-03	0.6870E-03	0.4400E-02	0.0000E+00	0.0000E+00
0.3000E+01	0.9110E-05	0.7110E-04	0.6290E-03	0.0000E+00	0.0000E+00
0.8500E+01	0.1860E-06	0.3910E-05	0.5650E-04	0.0000E+00	0.0000E+00
0.1050E+02	0.7070E-07	0.1930E-05	0.3040E-04	0.0000E+00	0.0000E+00
0.1250E+02	0.2400E-07	0.1070E-05	0.1820E-04	0.0000E+00	0.0000E+00
0.1450E+02	0.9920E-08	0.6240E-06	0.1130E-04	0.0000E+00	0.0000E+00
0.1650E+02	0.4400E-08	0.3780E-06	0.7400E-05	0.0000E+00	0.0000E+00
0.1850E+03	0.1000E-19	0.2700E-13	0.8010E-10	0.0000E+00	0.0000E+00
frequency	25.00				
0.1000E-01	0.1190E-01	0.3020E-01	0.9270E-01	0.0000E+00	0.0000E+00
0.1000E+00	0.1520E-02	0.6060E-02	0.2480E-01	0.0000E+00	0.0000E+00
0.1000E+01	0.2670E-04	0.1240E-03	0.7770E-03	0.0000E+00	0.0000E+00
0.3000E+01	0.2820E-06	0.7940E-05	0.6800E-04	0.0000E+00	0.0000E+00
0.8200E+01	0.6810E-11	0.5140E-07	0.3300E-05	0.0000E+00	0.0000E+00
0.1020E+02	0.2440E-12	0.8620E-08	0.1430E-05	0.0000E+00	0.0000E+00
0.1220E+02	0.1080E-13	0.1360E-08	0.6580E-06	0.0000E+00	0.0000E+00
0.1420E+02	0.7410E-15	0.2300E-09	0.3180E-06	0.0000E+00	0.0000E+00
0.1620E+02	0.7490E-16	0.4070E-10	0.1480E-06	0.0000E+00	0.0000E+00
0.1820E+03	0.1000E-19	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00

Sample Reference Probability File (Probability of Exceedance values) - svf*

PE for av5-10.hz exceeding PE lev1 for case 94RG21

ifq= 2probil. of excd used 1.00000E-05 1.00000E-04 7.40000E-05

1 limerick	13.83	21.52	21.11
2 shearon harris	10.57	16.05	13.12
3 braidwood	8.52	11.72	10.77
4 la crosse	10.76	12.86	14.26
5 river bend	8.87	11.08	12.99
6 wolf creek	6.50	8.34	8.07
7 watts bar	15.25	24.38	21.45
8 vogtle	25.80	39.49	48.67
9 millstone	13.47	18.58	20.98
10 maine yankee	14.64	19.18	20.00

11	fitzpatrick	9.35	14.77	15.38
12	ginna	9.07	17.99	18.18
13	haddam neck	13.68	20.54	21.85
14	indian point	14.80	26.13	22.12
15	nine mile point	9.30	14.72	15.35
16	oyster creek	16.64	26.35	28.18
17	peach bottom	13.48	23.55	21.67
18	pilgrim	28.58	37.72	41.28
19	salem	17.46	27.32	27.62
20	seabrook	16.77	22.69	25.76
21	shoreham	19.28	34.28	33.72
22	susquehanna	10.94	14.19	16.21
23	three mi. island	13.81	23.71	22.65
24	vermont yankee	13.82	24.38	21.23
25	yankee rowe	25.90	44.51	45.85
26	browns ferry	15.48	19.70	17.71
27	brunswick	15.74	22.41	22.61
28	calvert cliffs	15.36	24.25	24.61
29	catawba	12.81	20.24	20.01
30	farley	6.67	7.48	7.13
31	hatch	15.76	21.45	20.25
32	hope creek	17.92	26.90	27.34
33	mcguire	12.03	19.40	18.15
34	north anna	11.60	21.48	18.67
35	oconee	14.49	22.11	20.04
36	robinson	27.03	45.04	63.61
37	sequoyah	15.37	25.60	21.41
38	summer	14.26	26.86	31.87
39	surry	14.22	20.92	21.58
40	beaver vally	8.26	10.28	13.04
41	big rock point	6.29	8.05	8.10
42	byron 1 & 2	8.33	10.98	13.20
43	clinton	23.73	33.12	35.28
44	cook 1 & 2	12.94	16.67	19.16
45	davis besse 1	9.61	13.62	19.53
46	dresden 2&3	9.22	12.80	11.56
47	fermi 2	8.29	11.03	13.85
48	kewaunee	6.92	8.48	7.44
49	lasalle	17.48	25.26	26.31
50	palisades 1	11.21	15.63	16.45
51	perry	7.65	10.59	12.21
52	point beach	7.06	8.33	7.39
53	prairie island	8.83	13.10	10.22
54	zion	13.91	17.82	18.24

55 arkansas	16.89	18.86	21.95
56 bellefonte	16.03	24.08	20.24
57 callaway	13.57	17.67	16.68
58 comanche peak	6.16	6.48	5.55
59 cooper	11.59	19.80	19.56
60 crystal river	4.94	5.05	5.73
61 duane arnold	5.79	6.52	6.15
62 fort calhoun	9.75	14.24	26.00
63 grand gulf	12.03	17.45	24.55
64 monticello	7.34	10.02	8.21
65 quad cities	6.87	10.14	10.91
66 south texas	6.35	8.54	8.97
67 st. lucie	6.42	8.43	8.15
68 turkey point	4.03	5.14	4.34
69 waterford	8.17	10.89	14.73

Sample aleasbin93 Menu - m0m193

***** menu file for running program aleasbin93 ***** (this line not used)pga hazard over dist & mag bins
mag 5 to 5.5
dist 0 to 15

2
1 01 000 0001 1.2345678900000e+08 2 ia1,ia2,ig1,ig2,xseed - (4i5,e20.13)

dist 0 to 15

mag 5 to 5.5

-1 4 3 50 1 0 0 1 (iyvar=-1,0,1 for acc,vel,spec),nfre,nrp,nsim,iprint

1. 2.5 5.0 10.0

1 2 3 4 indices of frequency gm models from gm file

1 3

old ***old f-file format ***

0. 0. 0 0 0. 0. 0.

5.00 6.5 lower mb & mmi values for calc. (default=5.00 & 6.5

5.37 7.24 upper mb & mmi values for calc. (default=no upper bound)

10 1 3 4 number of gmp values, number of lines skipped by gmp var

0 1

1000. 10000. 100000. return periods

.15 .50 .85 the 3 percentile values

array of pga values for which the hazard is calculated (cm/s/s) (10f8.0)

50. 75. 150. 250. 300. 400. 500. 650. 850. 1000.

array of pgv values for which the hazard is calculated (cm/s) (10f8.0)

same as above for psv, for 5 frequencies.

.01 0.1 1.0 7. 40.0 50.0 60.0 70.0 80.0 200.

.01 0.1 1.0 5. 21.0 26.0 31.0 36.0 41.0 200.

.01 0.1 1.0 5. 20.5 25.5 30.5 35.5 40.5 200.

.01 0.1 1.0 3. 8.5 10.5 12.5 14.5 16.5 185.

Sample combin93 Menu - m1com0193

menu for combining aleasbin93 over seismicity experts (input file combin)

11 5 1 1

1 2 3 4 5 6 7 10 11 12 13 s-experts list

2 0.5 .85

500. 1000. 2000. 5000. 10000. return periods

2

distance bin 1, magnitude bin 2
Hazard Estimates for: 93 Pseudo Velocity Spectra
S-XPRT:1,2,3,4,5,6,7,10,11,12,13 G-XPRT:Composite=
***** next 2 lines for titles on plots (this line not used)
distance bin 1, magnitude bin 2
S-XPRT:1,2,3,4,5,6,7,10,11,12,13 G-XPRT:Composite=
*****next line are the flags for plotting the averages (this line not used)) format 5a10/5a10
1 1 0 0 1 0 1 1 0 1 (ia1,ia2,ig1,ig2,issep,notfile,ib1,ib2,nmag,mfper)

Sample condensed de-aggregated seismic hazard file - mcocsps#93

vogtle

	velocity	best est.	arith. mean	geo. mean
frequency	1.00			
0.1000E+01	0.3964E-04	0.3236E-04	0.1817E-04	
0.6000E+01	0.6738E-05	0.1222E-04	0.2776E-05	
0.1100E+02	0.1630E-05	0.8106E-05	0.6744E-06	
0.1600E+02	0.5202E-06	0.6288E-05	0.2156E-06	
0.2100E+02	0.1977E-06	0.5155E-05	0.8174E-07	
0.2600E+02	0.8478E-07	0.4333E-05	0.3489E-07	
0.3100E+02	0.3980E-07	0.3692E-05	0.1696E-07	
0.4100E+02	0.1068E-07	0.2753E-05	0.4838E-08	
0.5500E+02	0.2297E-08	0.1901E-05	0.1319E-08	
0.7500E+02	0.3802E-09	0.1189E-05	0.3274E-09	
frequency	2.50			
0.5000E+00	0.4426E-04	0.3835E-04	0.2222E-04	
0.5500E+01	0.1789E-04	0.1901E-04	0.7487E-05	
0.1050E+02	0.5996E-05	0.1134E-04	0.2478E-05	
0.1550E+02	0.2344E-05	0.8102E-05	0.9670E-06	
0.2050E+02	0.1037E-05	0.6301E-05	0.4259E-06	
0.2550E+02	0.5035E-06	0.5114E-05	0.2052E-06	
0.3050E+02	0.2626E-06	0.4253E-05	0.1059E-06	
0.4100E+02	0.7959E-07	0.3019E-05	0.3191E-07	
0.5500E+02	0.2092E-07	0.2023E-05	0.8902E-08	
0.7500E+02	0.4316E-08	0.1225E-05	0.2069E-08	
frequency	5.00			
0.2000E+00	0.4433E-04	0.3870E-04	0.2252E-04	
0.2500E+01	0.3541E-04	0.2890E-04	0.1494E-04	
0.4500E+01	0.2076E-04	0.1977E-04	0.7857E-05	
0.8500E+01	0.6331E-05	0.1069E-04	0.2137E-05	
0.1250E+02	0.2128E-05	0.6773E-05	0.6701E-06	
0.2000E+02	0.3704E-06	0.3540E-05	0.1009E-06	
0.2500E+02	0.1360E-06	0.2475E-05	0.3458E-07	
0.3000E+02	0.5501E-07	0.1792E-05	0.1363E-07	
0.4500E+02	0.5508E-08	0.7718E-06	0.1473E-08	
0.6500E+02	0.4782E-09	0.2995E-06	0.1884E-09	
frequency	10.00			
0.2000E+00	0.4433E-04	0.3866E-04	0.2250E-04	
0.2500E+01	0.2668E-04	0.2204E-04	0.1011E-04	
0.4500E+01	0.1107E-04	0.1167E-04	0.3490E-05	
0.8500E+01	0.2049E-05	0.4106E-05	0.4848E-06	
0.1250E+02	0.4837E-06	0.1787E-05	0.9188E-07	
0.2000E+02	0.5227E-07	0.5227E-06	0.7653E-08	
0.2500E+02	0.1506E-07	0.2674E-06	0.2183E-08	
0.3000E+02	0.4966E-08	0.1484E-06	0.6685E-09	

```

0.4500E+02 0.3096E-09 0.3533E-07 0.5230E-10
0.6500E+02 0.1715E-10 0.8429E-08 0.6543E-11
accel/velo 0.500** 0.850**
frequency 1.00
0.1000E+01 0.1910E-04 0.4850E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.6000E+01 0.3520E-05 0.2250E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.1100E+02 0.1020E-05 0.1470E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.1600E+02 0.3510E-06 0.1150E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2100E+02 0.1360E-06 0.8810E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.2600E+02 0.5860E-07 0.7110E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.3100E+02 0.2860E-07 0.5440E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.4100E+02 0.8000E-08 0.3530E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.5500E+02 0.1700E-08 0.2210E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.7500E+02 0.3660E-09 0.1210E-05 0.0000E+00 0.0000E+00 0.0000E+00
frequency 2.50
0.5000E+00 0.2290E-04 0.5600E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.5500E+01 0.8590E-05 0.3050E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.1050E+02 0.3540E-05 0.2060E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.1550E+02 0.1510E-05 0.1420E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2050E+02 0.6910E-06 0.1040E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2550E+02 0.3740E-06 0.7390E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.3050E+02 0.1940E-06 0.5870E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.4100E+02 0.6170E-07 0.3320E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.5500E+02 0.1860E-07 0.1780E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.7500E+02 0.4510E-08 0.8670E-06 0.0000E+00 0.0000E+00 0.0000E+00
frequency 5.00
0.2000E+00 0.2330E-04 0.5670E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2500E+01 0.1590E-04 0.4300E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.4500E+01 0.9780E-05 0.3070E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.8500E+01 0.3360E-05 0.1830E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.1250E+02 0.1120E-05 0.1240E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2000E+02 0.2140E-06 0.5380E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.2500E+02 0.7630E-07 0.3200E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.3000E+02 0.3150E-07 0.2080E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.4500E+02 0.3450E-08 0.5570E-06 0.0000E+00 0.0000E+00 0.0000E+00
0.6500E+02 0.3010E-09 0.1340E-06 0.0000E+00 0.0000E+00 0.0000E+00
frequency 10.00
0.2000E+00 0.2330E-04 0.5660E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.2500E+01 0.1120E-04 0.3420E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.4500E+01 0.4540E-05 0.2010E-04 0.0000E+00 0.0000E+00 0.0000E+00
0.8500E+01 0.9110E-06 0.6760E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.1250E+02 0.2110E-06 0.2670E-05 0.0000E+00 0.0000E+00 0.0000E+00
0.2000E+02 0.2140E-07 0.5210E-06 0.0000E+00 0.0000E+00 0.0000E+00
0.2500E+02 0.6330E-08 0.2130E-06 0.0000E+00 0.0000E+00 0.0000E+00
0.3000E+02 0.1990E-08 0.9890E-07 0.0000E+00 0.0000E+00 0.0000E+00
0.4500E+02 0.1090E-09 0.1530E-07 0.0000E+00 0.0000E+00 0.0000E+00
0.6500E+02 0.4760E-11 0.1940E-08 0.0000E+00 0.0000E+00 0.0000E+00

```

...These results are repeated, once for each magnitude-distance bin selected...

```

vogtle
velocity best est. arith. mean geo. mean
frequency 1.00
0.1000E+01 0.8060E-03 0.8695E-03 0.1737E-04
0.6000E+01 0.9660E-05 0.8335E-04 0.1744E-06

```


0.1100E+02	0.5907E-06	0.2147E-04	0.1514E-07
0.1600E+02	0.7755E-07	0.7917E-05	0.2402E-08
0.2100E+02	0.1593E-07	0.3493E-05	0.6632E-09
0.2600E+02	0.4359E-08	0.1728E-05	0.2417E-09
0.3100E+02	0.1449E-08	0.9271E-06	0.1080E-09
0.4100E+02	0.2342E-09	0.3175E-06	0.3056E-10
0.5500E+02	0.3075E-10	0.9236E-07	0.1071E-10
0.7500E+02	0.3094E-11	0.2228E-07	0.4172E-11
frequency	2.50		
0.5000E+00	0.3777E-03	0.4461E-03	0.4253E-05
0.5500E+01	0.9042E-07	0.2495E-05	0.7513E-09
0.1050E+02	0.5201E-08	0.3356E-06	0.4733E-10
0.1550E+02	0.6559E-09	0.8776E-07	0.1094E-10
0.2050E+02	0.1213E-09	0.3191E-07	0.4926E-11
0.2550E+02	0.2872E-10	0.1426E-07	0.2995E-11
0.3050E+02	0.8106E-11	0.7349E-08	0.2121E-11
0.4100E+02	0.8487E-12	0.2480E-08	0.1414E-11
0.5500E+02	0.7322E-13	0.8483E-09	0.1114E-11
0.7500E+02	0.4365E-14	0.2675E-09	0.1017E-11
frequency	5.00		
0.2000E+00	0.2931E-03	0.3881E-03	0.2199E-05
0.2500E+01	0.6075E-07	0.5408E-06	0.5277E-10
0.4500E+01	0.3594E-08	0.5222E-07	0.7522E-11
0.8500E+01	0.5552E-10	0.3620E-08	0.2140E-11
0.1250E+02	0.2438E-11	0.6107E-09	0.1308E-11
0.2000E+02	0.2870E-13	0.5394E-10	0.1000E-11
0.2500E+02	0.2713E-14	0.1509E-10	0.1000E-11
0.3000E+02	0.3436E-15	0.5000E-11	0.1000E-11
0.4500E+02	0.1000E-19	0.3485E-12	0.1000E-11
0.6500E+02	0.1000E-19	0.2476E-13	0.1000E-11
frequency	10.00		
0.2000E+00	0.1433E-05	0.7499E-05	0.4104E-08
0.2500E+01	0.1188E-09	0.3581E-07	0.2200E-11
0.4500E+01	0.1246E-11	0.5716E-08	0.1383E-11
0.8500E+01	0.2831E-14	0.5811E-09	0.1108E-11
0.1250E+02	0.3598E-16	0.1096E-09	0.1048E-11
0.2000E+02	0.1000E-19	0.1041E-10	0.1014E-11
0.2500E+02	0.1000E-19	0.3001E-11	0.1000E-11
0.3000E+02	0.1000E-19	0.1021E-11	0.1000E-11
0.4500E+02	0.1000E-19	0.7594E-13	0.1000E-11
0.6500E+02	0.1000E-19	0.5628E-14	0.1000E-11
accel/velo	0.500**	0.850**	
frequency	1.00		
0.1000E+01	0.2270E-03	0.2020E-02	0.0000E+00
0.6000E+01	0.1990E-05	0.9070E-04	0.0000E+00
0.1100E+02	0.1050E-06	0.1310E-04	0.0000E+00
0.1600E+02	0.8610E-08	0.3360E-05	0.0000E+00
0.2100E+02	0.1320E-08	0.1070E-05	0.0000E+00
0.2600E+02	0.2500E-09	0.4410E-06	0.0000E+00
0.3100E+02	0.5550E-10	0.1700E-06	0.0000E+00
0.4100E+02	0.5170E-11	0.4120E-07	0.0000E+00
0.5500E+02	0.2220E-12	0.8030E-08	0.0000E+00
0.7500E+02	0.8950E-14	0.1070E-08	0.0000E+00
frequency	2.50		
0.5000E+00	0.6670E-04	0.9980E-03	0.0000E+00

0.5500E+01	0.2200E-08	0.9270E-06	0.0000E+00	0.0000E+00	0.0000E+00
0.1050E+02	0.1440E-10	0.4420E-07	0.0000E+00	0.0000E+00	0.0000E+00
0.1550E+02	0.3420E-12	0.5560E-08	0.0000E+00	0.0000E+00	0.0000E+00
0.2050E+02	0.2130E-13	0.1100E-08	0.0000E+00	0.0000E+00	0.0000E+00
0.2550E+02	0.1190E-14	0.2070E-09	0.0000E+00	0.0000E+00	0.0000E+00
0.3050E+02	0.1110E-15	0.5910E-10	0.0000E+00	0.0000E+00	0.0000E+00
0.4100E+02	0.1000E-19	0.7440E-11	0.0000E+00	0.0000E+00	0.0000E+00
0.5500E+02	0.1000E-19	0.7070E-12	0.0000E+00	0.0000E+00	0.0000E+00
0.7500E+02	0.1000E-19	0.4520E-13	0.0000E+00	0.0000E+00	0.0000E+00
frequency	5.00				
0.2000E+00	0.3440E-04	0.7540E-03	0.0000E+00	0.0000E+00	0.0000E+00
0.2500E+01	0.5570E-11	0.1760E-06	0.0000E+00	0.0000E+00	0.0000E+00
0.4500E+01	0.5760E-14	0.5560E-08	0.0000E+00	0.0000E+00	0.0000E+00
0.8500E+01	0.1000E-19	0.4030E-10	0.0000E+00	0.0000E+00	0.0000E+00
0.1250E+02	0.1000E-19	0.1260E-11	0.0000E+00	0.0000E+00	0.0000E+00
0.2000E+02	0.1000E-19	0.6830E-14	0.0000E+00	0.0000E+00	0.0000E+00
0.2500E+02	0.1000E-19	0.5010E-15	0.0000E+00	0.0000E+00	0.0000E+00
0.3000E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.4500E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.6500E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
frequency	10.00				
0.2000E+00	0.1830E-07	0.5760E-05	0.0000E+00	0.0000E+00	0.0000E+00
0.2500E+01	0.1000E-19	0.3090E-11	0.0000E+00	0.0000E+00	0.0000E+00
0.4500E+01	0.1000E-19	0.1150E-13	0.0000E+00	0.0000E+00	0.0000E+00
0.8500E+01	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.1250E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.2000E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.2500E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.3000E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.4500E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00
0.6500E+02	0.1000E-19	0.1000E-19	0.0000E+00	0.0000E+00	0.0000E+00

Sample final file showing controlling earthquakes for specific ground motion level (5-10Hz) and specific reference probability (ALL2) - $hcav \begin{Bmatrix} 34 \\ 12 \end{Bmatrix} //s//$

{93},c-GX geom average of 1-2.5hz based on RG2 cas
 freq = 1.0 Hz number of bins used = 35
 {93},c-GX prob. of exceed. based on RG2 case2
 vogtle

Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 27.87 49.08 54.70

freq = 2.5 Hz number of bins used = 35
 {93},c-GX prob. of exceed. based on RG2 case2
 vogtle

Contribution to hazard for Spectral Velocity
 target level (cm/s) (50%ile 85%ile mean)
 25.80 39.49 48.67

Average 1.0- 2.5 Hz Spectral acceleration (cm/s/s)
 290.19 464.34 554.10

Percent of total hazard for distances .gt. 100km = 41.
For av 1-2.5hz for dist .gt. 100km the controlling
earthquake (Mc & Dc) is 6.68 156.4

For reference the controlling earthquake (Mc & Dc)
calculated for dist .le. 100 km is 5.71 18.8

For reference Mc & Dc based on all magnitude & distance
bins is computed for the median, 85%ile, and mean hazard data.

M av= 6.11 6.26 6.35
D av= 45.00 54.65 67.57

% contribution to hazard for M & D bins
based on the median hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	10.5	19.3	1.2	0.0	0.0
20.0	2.1	7.0	0.2	0.0	0.0
39.0	1.1	7.4	2.0	0.0	0.0
78.0	0.1	2.7	3.9	1.1	0.0
155.0	0.0	0.3	5.3	35.2	0.0
253.0	0.0	0.0	0.0	0.4	0.0
350.0	0.0	0.0	0.0	0.0	0.0

% contribution to hazard for M & D bins
based on the mean hazard

dist	5.25	5.75	6.25	6.75	7.50
10.0	3.8	2.8	1.1	0.3	0.1
20.0	2.8	2.6	1.3	0.4	0.2
39.0	3.7	5.5	4.0	2.1	0.7
78.0	2.4	7.2	11.9	11.5	2.7
155.0	0.3	1.6	5.7	13.2	10.1
253.0	0.0	0.0	0.1	0.5	1.2
350.0	0.0	0.0	0.0	0.0	0.1

Appendix C

Installation of CE-PA on SUN OS 4.1.3

OPERATING SYSTEM/SUPPORT LIBRARIES/GROUP REQUIREMENTS

Unix System with OS 4.1.3
X11R5(X11R4 (openwindows) may be acceptable)
F77-1.4 compiler (non-ansi standard compiler)
C compiler
old "CRAY" version IMSL
DIGLIB
TV80LIB
A user group, e.g. shc, with 775 create file permissions
should exist on the system.
Two "top level" directories are build; the extract utility
will create these directories for you if you don't already
have them.
/pubusr
/data1

INSTALLATION PROCESS

CE-PA uses PSHC (1993 EUS Update version) and several utility libraries. There are three controllers located on the first tar file of the distribution tape to help with the extraction and installation of these codes:

cepa_install.csh
cepa_compile.csh
cepa_permissions.csh
pshc_permissions.csh

To extract these installation files from the exabyte tape, cd into a directory where you can create files. Type:

```
tar xvf /dev/rsmt0
cd distribution
ls
more README (this file)
```

Before you begin extracting the codes from the tapes there are several things you may want to do. Make sure you have sufficient space on your disk(s). Establish a group of users being permitted access. Set some environmental variables in your .cshrc; these variables can be removed after successful installation.

SPACE REQUIREMENTS

1089792	/data1/hazard	(this is the current space consumption; it will grow as new studies are executed)
32621	/pubusr/PSHC	(This size does not change - codes)
23616	/pubusr/CE-PA	(This size does not change - codes)
4100	/usr/libf77	(this size does not change - support utilities, usually already installed on system from previous versions)

The extract utility will create these directories if you don't already have them.

A group should be established before execution of the `cepa_install.csh` script. It should contain a list of users permitted access to these codes and the members should have 775 permissions when creating files.

We used the group name `egg`, if you want to use another groupname be sure to edit the following files

`/pubusr/PSHC/pshc_permissions.csh` and
`/pubusr/CE-PA/cepa_permissions.csh`

accordingly.

Installation is done by "root". File ownerships and permissions are set by root. In your `.cshrc` three environmental variables need to be set:

1. The location of the utility libraries LIBS tv80 diglib
imsl: e.g. `/usr/libf77/tv80lib.a`
`/usr/libf77/diglib/sources.x/diglib` `/usr/libf77/imsl.a`
setenv LIBS '/usr/libf77/imsl.a
/usr/libf77/tv80lib.a
usr/libf77/diglib.a'
2. The X WINDOWS library desired: e.g. `/pubur/X11R5/lib (IX11)`
setenv WINDOWS '/usr/openwin/lib'
3. The location of the fortran compiler must be in your PATH:
e.g. `/pubusr/lang/f77-1.4`
setenv PATH \${PATH}:/pubusr/lang:/usr/openwin/bin
4. The location of the C compiler must be in your PAQTH: e.g.
`/usr/ucb/cc`
setenv PATH \${PATH}:/usr/ucb

The installation script asks if the utility libraries are already installed; it will install and compile the utility libraries if necessary. The utility libraries diglib, tv80lib and IMSL are on the tape in case you need them. The windows (X11R5 preferred) and fortran compiler (F77-1.4 preferred) and C compiler are assumed to be on your system already.

To begin extracting the rest of the codes from tape, compiling them and setting the appropriate ownerships and permissions, type:

cepa_install.csh

INSTALLATION TESTING

To benchmark the installation run

/pubusr/CE-PA/bin/CE-PA.csh *your_machine_name*

for a NEW SITE where the site is defined similarly to VOGTLE (id #8), i.e.

Latitude **33.14**

Longitude **-81.76**

Soil Type: **5** (class s, thick soil sites)

Host Region: **2**

Set four SSE spectrum values:

Design pga. **196.2**

Spectral Freq. 1: **0.25**

Spectral Velocity 1: **58.75**

Spectral Freq. 2: **2.50**

Spectral Velocity 2: **39.10**

Spectral Freq. 3: **9.00**

Spectral Velocity 3: **9.01**

Spectral Freq. 4: **33.3**

Spectral Velocity 4: **0.95**

Set the seed to:

123456789

Use the reference probability cases RG2 and ALL2.

Request prints of the output and compare the results to the results in the Benchmark section of the User's Manual.

List of Tables

Table	1	Reference Probability Values
Table	2	Magnitude and Distance Bins Used in ALEASBIN93

List of Figures

Figure 1	General Flow of Information for Calculating Controlling Earthquakes
Figure 2	Overview of Steps Performed in Determination of Controlling Earthquakes
Figure 3	Chain of Calculation for Computing Condensed Total Seismic Hazard at a Given Site Using PSHC and XSP
Figure 4	Determination of Target Ground Motion Levels for the Spectral Acceleration at each Reference Probability and Frequency
Figure 5	Generation of Condensed De-aggregated Seismic Hazard Analysis at 1, 2.5, and 10 Hz for 1 to n Seismic Experts
Figure 6	Calculation of the Fractional Contribution of the Total Seismic Hazard of Earthquakes in a selected set of Magnitude-Distance Bins and Geometrically Averaged Results for 1-2.5 Hz and 5-10 Hz
Figure 7	Optional Paths in CE-PA Controller
Figure 8	Input and Output for Codes Used in Step 1
Figure 9	Input and Output for Codes Used in Step 2
Figure 10	Input and Output for Codes Used in Step 3
Figure 11	Input and Output for Codes Used in Step 4