SOFTWARE RELEASE NOTICE

1. SRN Number: 327

2. Project Title: GENERAL GLGD | Project No.

3. SRN Title: EZ-FRISK (VERSION 6.1)

4. Originator/Requestor: SARAH GONZALEZ | Date: 08/26/04

5. Summary of Actions

- ☑ Release of new software
- ☐ Change of access software
- ☐ Release of modified software:
- ☐ Software Retirement
  - ☐ Enhancements made
  - ☐ Corrections made

6. Validation Status

- ☑ Validated
- ☐ Limited Validation
- ☐ Not Validated Explain: _____

7. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
SARAH GONZALEZ	R-W	A
JOHN STAMATAKOS	R-W	A
		A

8. Element Manager Approval: A Laurence McKenzie Date: 9/7/04

9. Remarks:

CNWRA Form TOP-6 (09/01)

SOFTWARE SUMMARY FORM

01. Summary Date: 08/26/04	02. Summary prepared by (Name and phone) SARAH GONZALEZ (522-5263)	03. Summary Action: NEW
04. Software Date:	05. Short Title: EZ-FRISK	
06. Software Title: EZ-FRISK (VERSION 6.1)		07. Internal Software ID: NA

08. Software Type:	09. Processing Mode:	10. Application Area NA
☐ Automated Data System ☑ Computer Program ☐ Subroutine/Module	☐ Interactive ☐ Batch ☑ Combination	a. General: ☑ Scientific/Engineering ☐ Auxiliary Analyses ☐ Total System PA ☐ Subsystem PA ☐ Other b. Specific:

11. Submitting Organization and Address:	12. Technical Contact(s) and Phone:
CNWRA/SwRI 6220 Culebra Road San Antonio, TX 78228	RISK ENGINEERING, INC. (303) 499-3000

13. Software Application:
PROBABILISTIC SEISMIC HAZARD CALCULATION

14. Computer Platform	15. Computer Operating System: MS WINDOWS (98/NT/2000/XP)	16. Programming Language(s): NA	17. Number of Source Program Statements: NA
PC			
18. Computer Memory Requirements: 128 Mb	19. Tape Drives: NA	20. Disk Units: NA	21. Graphics: NA

22. Other Operational Requirements
NA

23. Software Availability:	24. Documentation Availability:
☑ Available ☐ Limited ☐ In-House ONLY	☑ Available ☐ Preliminary ☐ In-House ONLY

25.
Software ~~Developer~~ User: S Gonzalez Date: 09/09/04

CNWRA Form TOP-4-1 (05/98)

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

Software Title/Name: EZ-FRISK

Version: 6.10

Demonstration workstation: PC

Operating System: MS Windows (98/NT/2000/XP)

User: S. GONZALEZ

NOTE: Acquired software may or may not meet all requirements and will be evaluated on a case-by-case basis.

Installation Testing [TOP-018, Section 5.6]

Has *installation testing* been conducted for each intended computer platform and operating system?

Yes: ☐ No: ☑ N/A: ☐

Computer Platforms: PC Operating Systems: XP

Location of ~~Acceptance~~ New Test Results: SVTR

Comments:. 7/3/02

Software Output [TOP-018, Section 5.5.4]

Is software designed so that individual runs are uniquely identified by date, time, name of software and version?

Yes: ☑ No: ☐ N/A: ☐

Date and Time Displayed: ✓

Name/Version Displayed: ✓

Comments:

NOTE: Output identification content and format is typically taken as is.

Medium Documentation [TOP-018, Section 5.5.6]

The physical labeling of software medium (tapes, disks, etc.) contains: Program Name, Module/Name/Title, Module Revision, File type (ASCII, OBJ, EXE), Recording Date, and Operating System(s)?

Yes: ☐ No: ☐ N/A: ☐

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

User Documentation [TOP-018, Section 5.5.7]

Is there a Users' Manual for the software and is it up-to-date?

Yes: ☑ No: ☐ N/A: ☐

User's Manual Version and Date: In the HELP function of the software

Comments:

Are there basic instructions for the *installation* and *use* of the software?

Yes: ☑ No: ☐ N/A: ☐

Location of Instructions: In HELP function

Comments:

Configuration Control [TOP-018, Section 5.7, 5.9.3]

Is the Software Summary Form (Form TOP-4-1) completed and signed?

Yes: ☑ No: ☐ N/A: ☐

Date of Approval: 9/9/04

Is the list of files attached to the Software Summary Form complete and accurate?

Yes: ☐ No: ☐ N/A: ☑

Comments:

Is the source code available or, is the executable code available in the case of (acquired/commercial codes)?

Yes: ☑ No: ☐ N/A: ☐

Location of Source Code: QA Records - CD

Comments:

.

Have all the script/make files and executable files been submitted to the Software Custodian?

Only the executable files are being submitted.

Yes: ☑ No: ☐ N/A: ☐

Location of executable files: QA Records CD

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

Software Release [TOP-018, Section 5.9]

Upon acceptance of the software as verified above, has a Software Release Notice (SRN), Form TOP-6 been issued and does the version number of the software match the documentation?

Yes: ☑ No: ☐ N/A: ☐

SRN Number: 327

Comments:

Software Validation [TOP-018, Section 5.10]

Has a Software Validation Test Plan (SVTP) been prepared for the ***range of application*** of the software?

Yes: ☑ No: ☐ N/A: ☐

Version and Date of SVTP: 2.0, 8/13/04

Date Reviewed and Approved via QAP-002: 8/12/04

Comments: Combined SVTP/SVTR

Has a Software Validation Test Report (SVTR) been prepared that documents the results of the validation cases, interpretation of the results, and determination if the software has been validated?

Yes: ☑ No: ☐ N/A: ☐

Version and Date of SVTR: 8/13/04

Date Reviewed and Approved via QAP-002: 8/12/04

Comments.:

Additional Comments:

Gonzales 09/09/04
Software Evaluator/User/Date

[signature] 9/5/04
Software Custodian/Date

SOFTWARE VALIDATION TEST PLAN AND REPORT
EZ-FRISK, Version 6.10

Prepared by

Sarah Gonzalez

Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas

August 2004

Approved by:

H. Lawrence McKague, Element Manager
Geology and Geophysics

08/13/04
Date

CONTENTS

FIGURES

TABLES

1 SCOPE OF VALIDATION

The software EZ-FRISK Version 6.10 was developed by Risk Engineering, Inc. EZ-FRISK calculates the probabilistic earthquake hazard at a site based on user-defined inputs. The user must specify the location and characteristics of seismic sources in the region and select one or more ground motion attenuation models applicable to the region. Seismic sources and attenuation models can either be selected from the EZ-FRISK database or defined by the user. The results of the program's probabilistic calculations are annual frequencies of exceedance of various ground motion levels at the site of interest.

The seismic hazard for a firm rock site in San Diego will be calculated in EZ-FRISK. This calculation will require the input of the relevant seismic sources and attenuation models from the EZ-FRISK database. The results will then be compared to those obtained from the U.S. Geological Survey (USGS) and the California Geological Survey (CGS) websites for the same location. In performing the above calculation, the full capabilities of EZ-FRISK will be tested.

2 REFERENCES

1) Bender, B. and D. Perkins. "SEISRISK III: A Computer Program for Seismic Hazard Estimation". US Geological Survey BULLETIN 1772. 1987.
2) California Geological Survey (http://gmw.consrv.ca.gov/shmp/).
3) Risk Engineering, Inc. EZ-FRISK. Version 6.1. Golden, Colorado. 2003.
4) U.S. Geological Survey hazard mapping website (http://eqhazmaps.usgs.gov/).

3 ENVIRONMENT

3.1 Software

EZ-FRISK was built to operate within the MS Windows™ (98/NT/2000/XP) family of operating systems

3.2 Hardware

The following is a list of minimum requirements needed to run the application:

- PC with Pentium processor (or compatible)
- 64 MB of memory (128 MB recommended)
- 300 MB of free disk space
- A VGA monitor is required (a SVGA monitor is recommended)
- An available internet connection

4 PREREQUISITES

Not applicable.

5 ASSUMPTIONS AND CONSTRAINTS

Assumptions of this validation are presented in Section 6.1.4.

6 TEST CASES

6.1 Seismic Hazard Calculation

6.1.1 Objective

Demonstrate that EZ-FRISK can correctly calculate the seismic hazard at a specified site.

6.1.2 Test Input

A probabilistic seismic hazard analysis (PSHA) for San Diego (latitude 32.712°, longitude -117.16°) will be calculated in EZ-FRISK assuming a firm rock site. For this validation, a shear wave velocity of 1000 m/s will be used. In addition, all seismic sources and attenuation equations will be selected from the EZ-FRISK database. The results from this calculation will then be compared to those obtained from both the U.S. Geological Survey (USGS) and California Geological Survey (CGS) hazard mapping websites for the same location.

6.1.3 Test Procedure

1) Start EZ-FRISK

2) From the horizontal menu bar select "File", then "New". Fill in the "Site Parameters" window as shown in Figure 1. Then, from the horizontal menu bar select "Save As", and save the file as *San Diego PSHA.inp* in the *test* directory.

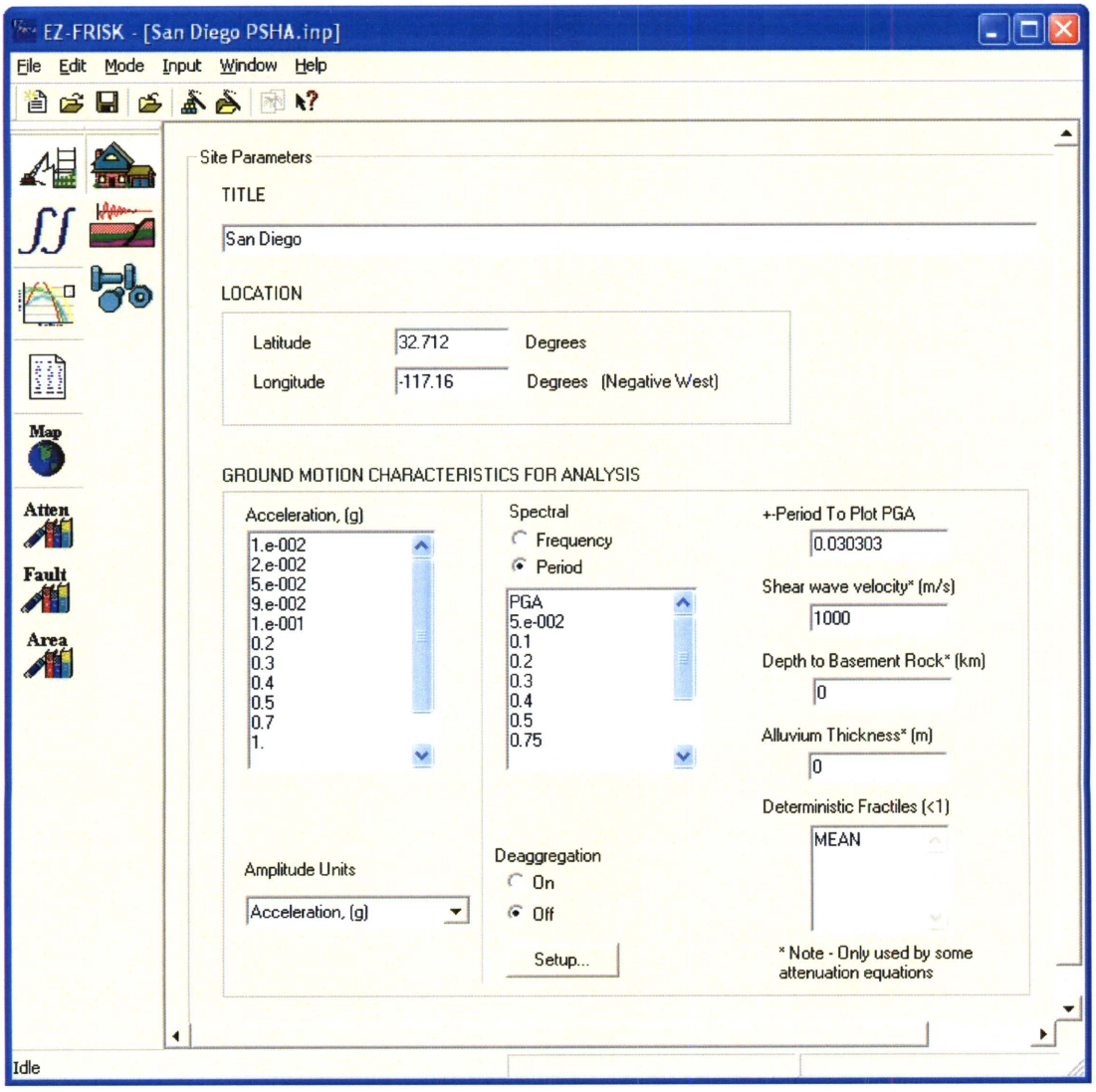


Figure 1. Site Parameters Window

3) Click on the "Source and Attenuation Equations" button in the vertical menu bar. A window entitled "Select Seismic Sources" will appear as shown in Figure 2. Under "Seismic Source Type" option select "Fault", then under Region, select "California USGS02". Then click on the button "Add Within". Another window will appear (see Figure 3) entitled "Add Within Option". Be sure to check the "from region 'CaliforniaUSGS02'" checkbox. Also, set the fault sources from this region to be within 200 km from the site as shown in Figure 3. Then click "OK".

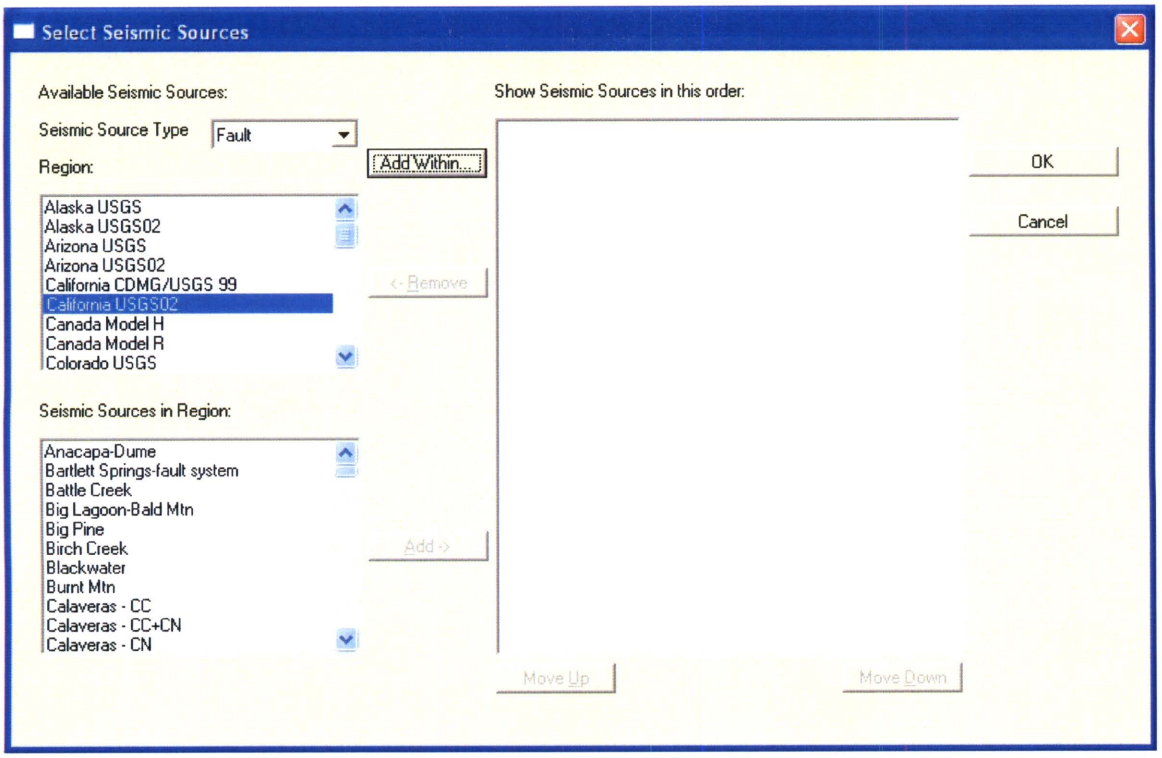


Figure 2. Seismic Sources Window (a)

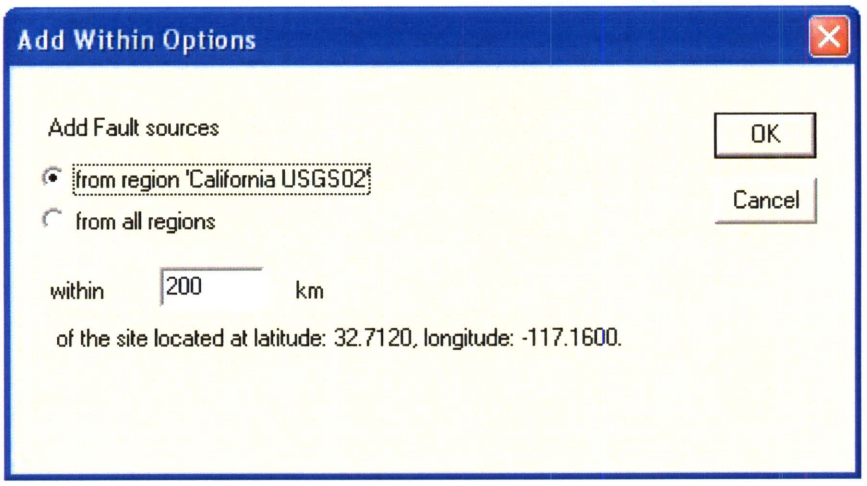


Figure 3. Seismic Sources Window (b)

4) Next, select “Seismic Source Type” as background and select “Background Seismicity 2002”. Add CA Gridded, CA Gridded deep, and WUS Gridded as shown in Figure 4. Then click “OK”.

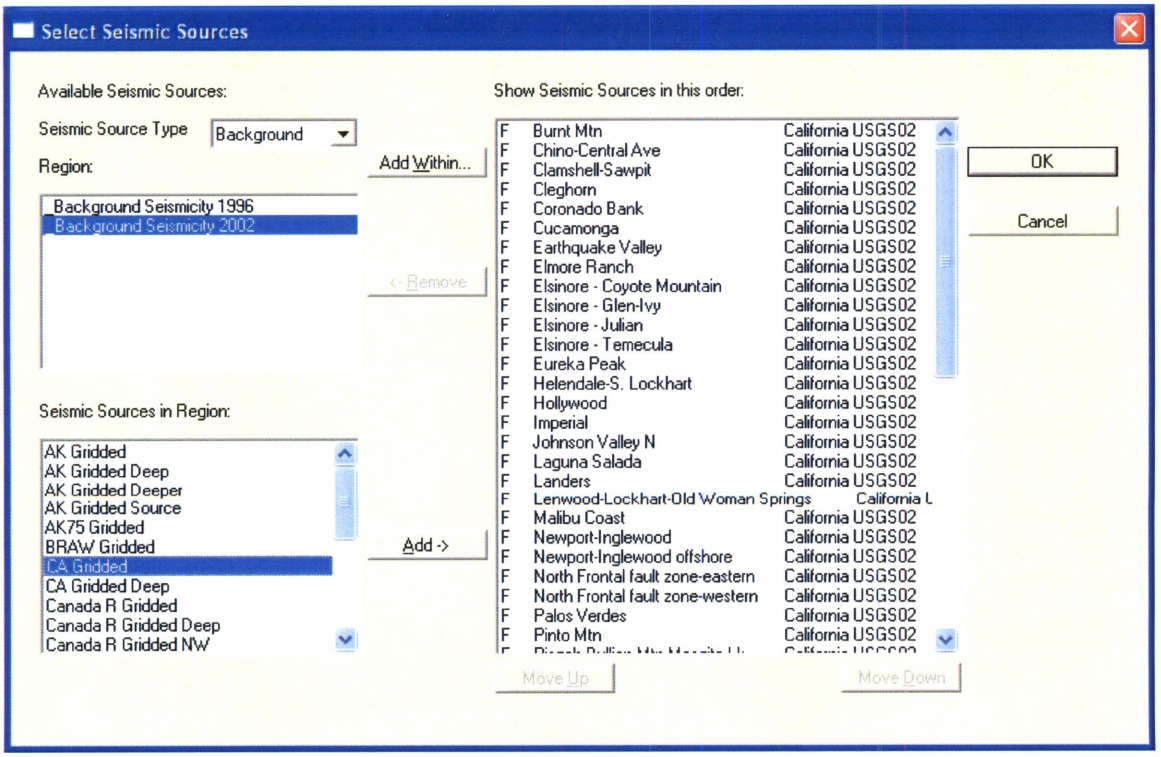


Figure 4. Seismic Sources Window (c)

5) Another window entitled “Select Attenuation Equations” will appear after Steps 3 and 4 have been completed. Select the attenuation equations Boore-Joyner-Fumal (1997) USGS 2002, Sadigh (1997) USGS 2002, Abra.-Silva (1997) Rock USGS 2002, Campbell-Bozorgnia (2003) USGS 2002, then click “OK” (refer to Figure 5). A new window will appear listing all seismic sources and attenuation equations (refer to Figure 6).

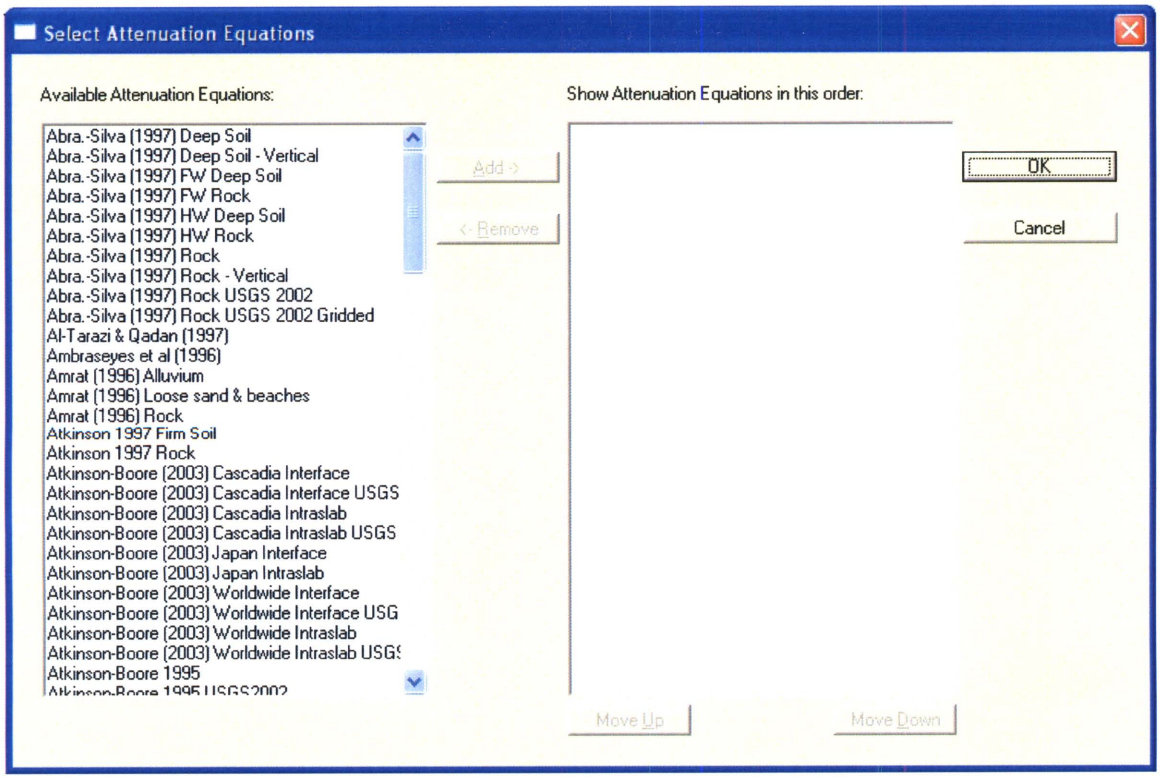
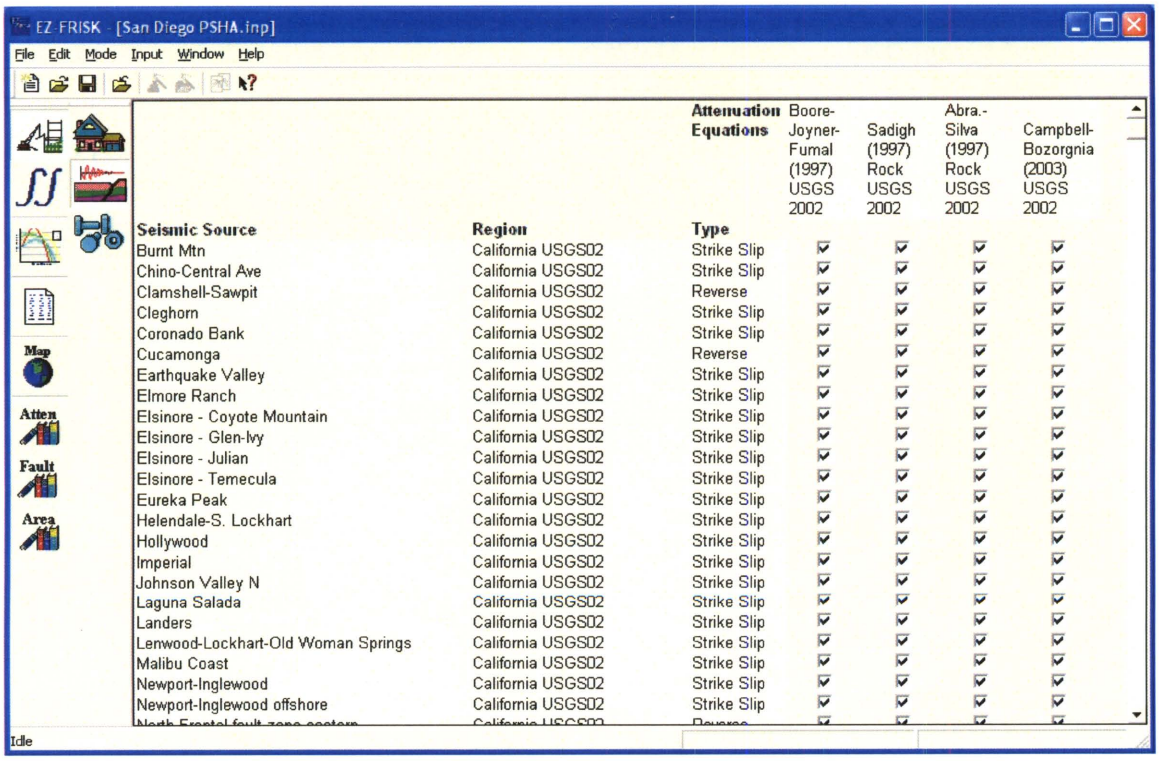


Figure 5. Attenuation Equations Window (a)

6) Check all boxes under each attenuation equation as shown in Figure 6.



Seismic Source	Region	Type	Attenuation Equations: Boore-Joyner-Fumal (1997) USGS 2002	Sadigh (1997) Rock USGS 2002	Abra.-Silva (1997) Rock USGS 2002	Campbell-Bozorgnia (2003) USGS 2002
Burnt Mtn	California USGS02	Strike Slip	☑	☑	☑	☑
Chino-Central Ave	California USGS02	Strike Slip	☑	☑	☑	☑
Clamshell-Sawpit	California USGS02	Reverse	☑	☑	☑	☑
Cleghorn	California USGS02	Strike Slip	☑	☑	☑	☑
Coronado Bank	California USGS02	Strike Slip	☑	☑	☑	☑
Cucamonga	California USGS02	Reverse	☑	☑	☑	☑
Earthquake Valley	California USGS02	Strike Slip	☑	☑	☑	☑
Elmore Ranch	California USGS02	Strike Slip	☑	☑	☑	☑
Elsinore - Coyote Mountain	California USGS02	Strike Slip	☑	☑	☑	☑
Elsinore - Glen-Ivy	California USGS02	Strike Slip	☑	☑	☑	☑
Elsinore - Julian	California USGS02	Strike Slip	☑	☑	☑	☑
Elsinore - Temecula	California USGS02	Strike Slip	☑	☑	☑	☑
Eureka Peak	California USGS02	Strike Slip	☑	☑	☑	☑
Helendale-S. Lockhart	California USGS02	Strike Slip	☑	☑	☑	☑
Hollywood	California USGS02	Strike Slip	☑	☑	☑	☑
Imperial	California USGS02	Strike Slip	☑	☑	☑	☑
Johnson Valley N	California USGS02	Strike Slip	☑	☑	☑	☑
Laguna Salada	California USGS02	Strike Slip	☑	☑	☑	☑
Landers	California USGS02	Strike Slip	☑	☑	☑	☑
Lenwood-Lockhart-Old Woman Springs	California USGS02	Strike Slip	☑	☑	☑	☑
Malibu Coast	California USGS02	Strike Slip	☑	☑	☑	☑
Newport-Inglewood	California USGS02	Strike Slip	☑	☑	☑	☑
Newport-Inglewood offshore	California USGS02	Strike Slip	☑	☑	☑	☑
North Frontal fault zone eastern	California USGS02	Reverse	☑	☑	☑	☑

Figure 6. Attenuation Equations Window (b)

7) Click on the “Calculation Parameters” button from the vertical menu bar. Leave all calculation parameters at their default values as shown in Figure 7.

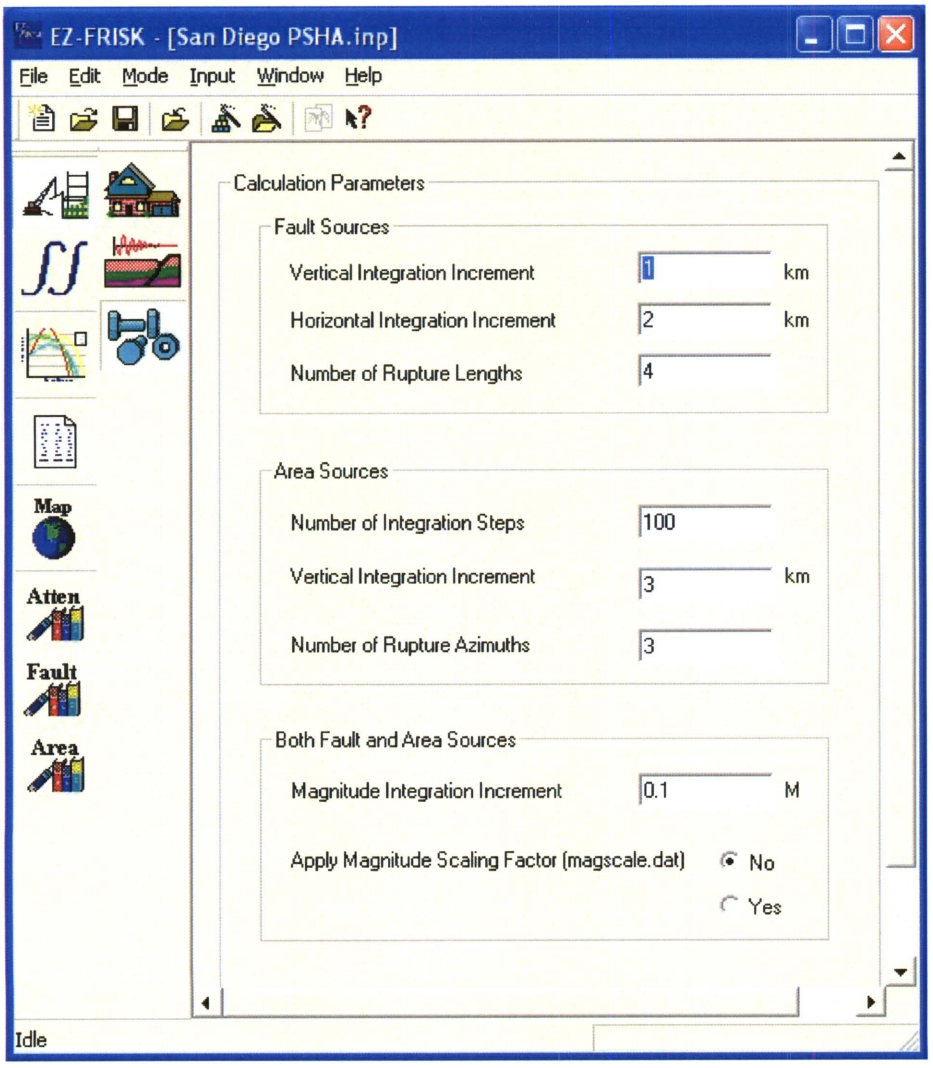


Figure 7. Calculation Parameters Window

8) Click on the execute button in the vertical menu bar. A new window will appear as shown in Figure 8. Click on the "Run Seismic Hazard Analysis" button.

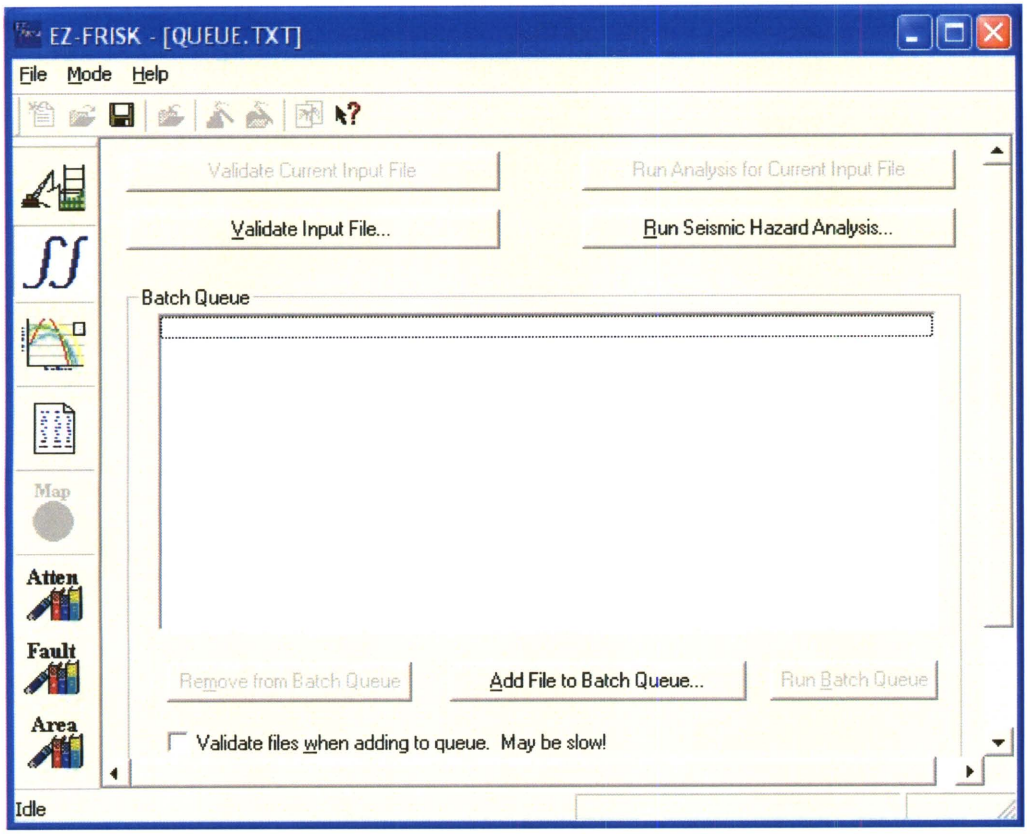


Figure 8. Execute Window

9) After the calculations have been completed, a window will appear such as the one in Figure 9. Go to the horizontal menu bar and under "Mode" select "View Plots". Click on "Total Hazard" plot option button in the vertical toolbar and a window as in Figure 10 will appear.

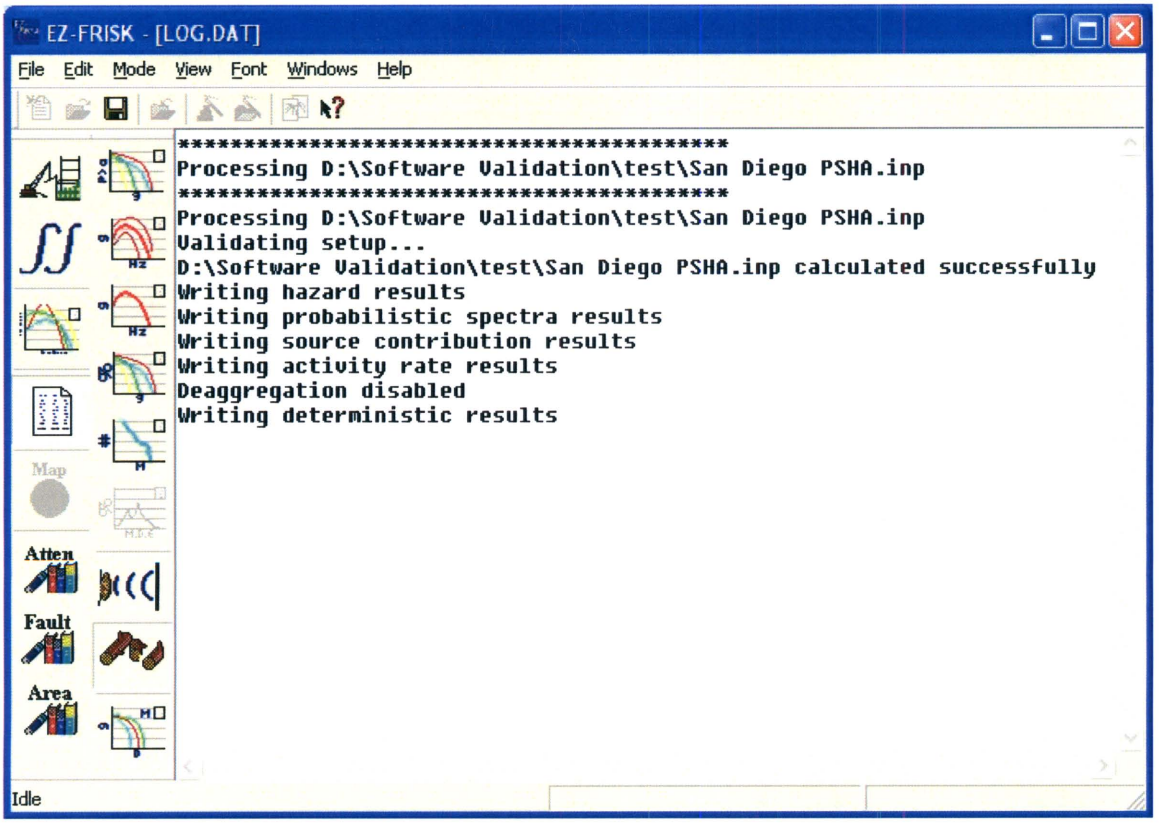


Figure 9. EZ-FRISK Output

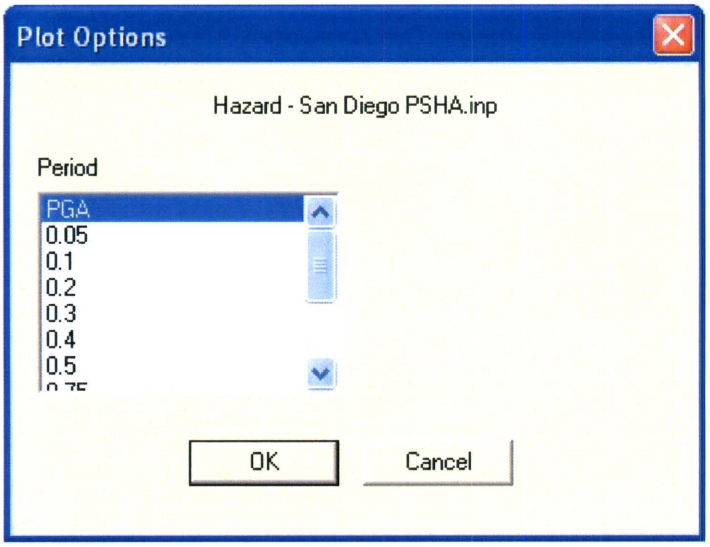


Figure 10. Plot Options Window

10) Select PGA for the period option. The resulting plot is shown in Figure 11.

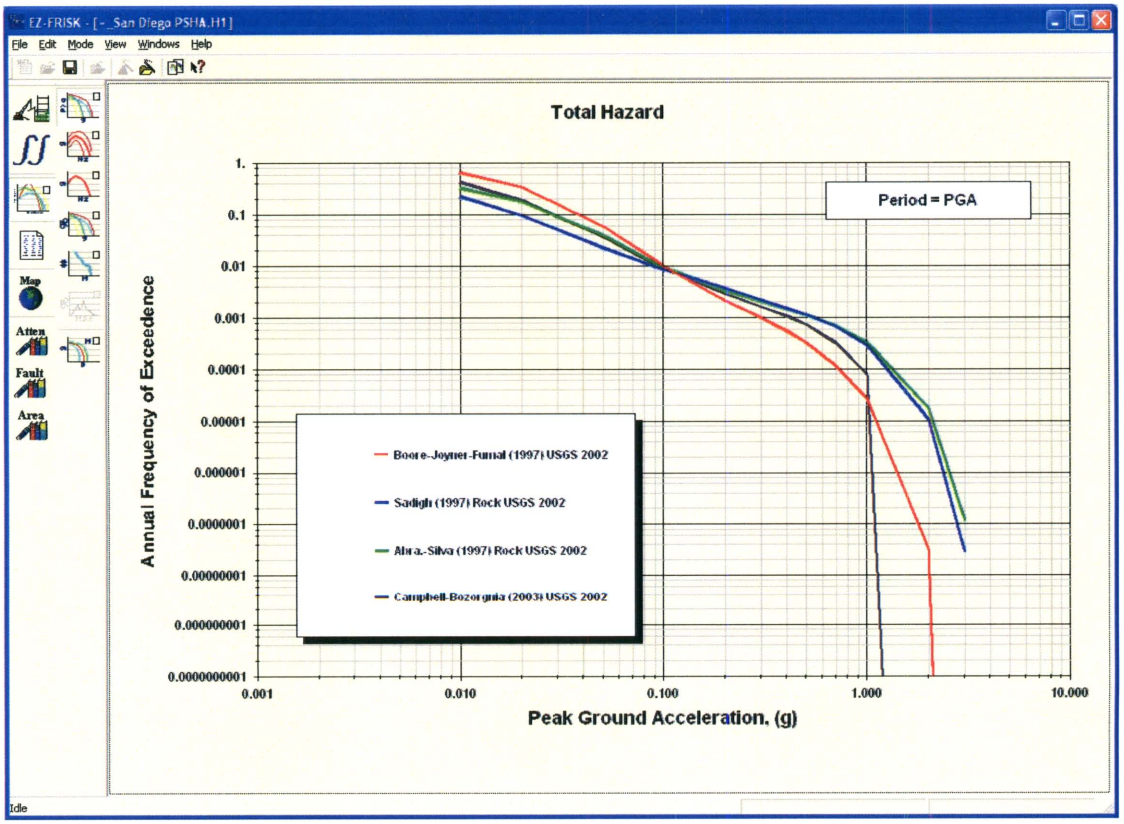


Figure 11. Results for Period = PGA

11) Select "View" from the horizontal menu bar (shown in Figure 11), and then select "Plot Options". The same "Plot options" window will appear as in Figure 10. This time select period 0.2. Repeat again for period 1. The resultant plots are shown in Figures 12 and 13, respectively.

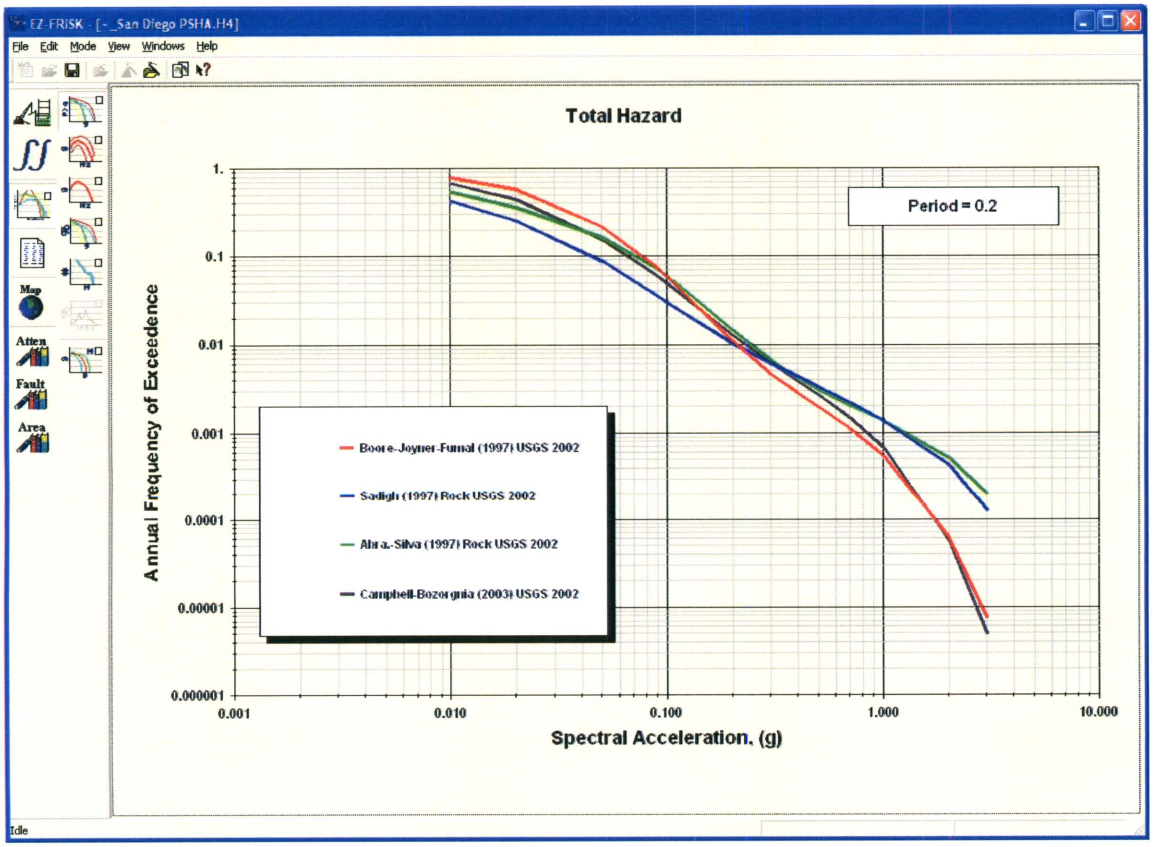


Figure 12. Results for Period = 0.2 Seconds

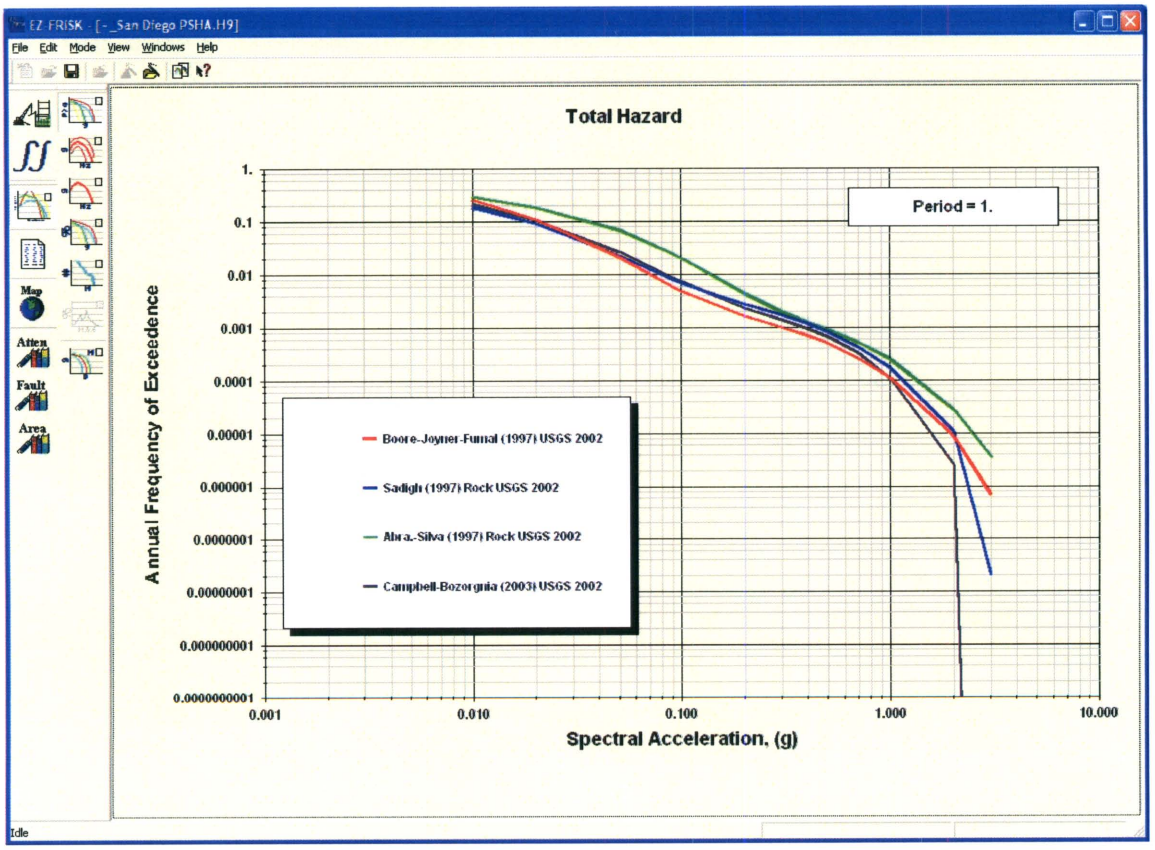


Figure 13. Results for Period = 1 Second

6.1.4 Test Results

Figures 14 and 15 show the results obtained from the CGS and USGS websites, respectively. The USGS website used the seismic hazard software SEISRISK, developed by Bender and Perkins (1987), to calculate the hazard. No reference to the hazard software used was found on the CGS website. Results are provided for ground motions having a 10 percent probability of being exceeded in 50 years, which corresponds to a return period of 475 years, or an annual frequency of exceedance of 0.0021. The USGS website also provides results for ground motions having a 2 percent probability of being exceeded in 50 years, which corresponds to a return period of 2,475 years, or an annual frequency of exceedance of 0.00040. The respective ground motion values for the 475-year return period are identical when rounded to 2 decimal places. Tables 1 and 2 compare results obtained in EZ-FRISK with those obtained from the USGS and CGS websites. Ground motion values from the EZ-FRISK calculation are very close to those obtained from the USGS and CGS websites. Based on this comparison this validation test was successful.

The observed difference between the values from EZ-FRISK and from the USGS and CGS websites is primarily related to the type of attenuation equation used. Tables 1 and 2 only provide EZ-FRISK ground motion values from the Sadigh (1997) USGS 2002

attenuation equation. Mean ground motion values from all attenuation equations are also shown. Ground motion values from the other attenuation equations used in the validation are plotted in Figures 11, 12, and 13. Figures 11, 12, and 13 illustrate that ground motion levels are sensitive to the type of attenuation equation used. The USGS and CGS likely calculated the total hazard using several different attenuation equations and then averaged the results. Other factors which may result in differences between the calculated ground motion values include different numerical integration methods to calculate the total seismic hazard, different calculation parameters (e.g., integration step size), differences in maximum radius of seismic source zone selection, as well as small differences between seismic source geometries and seismic source characteristics. Finally, ground motion values from both the USGS and CGS websites were interpolated from a grid of calculated values. For example, the CGS grid had 0.05° spacing. These interpolated values may not equal values calculated for a specific site.

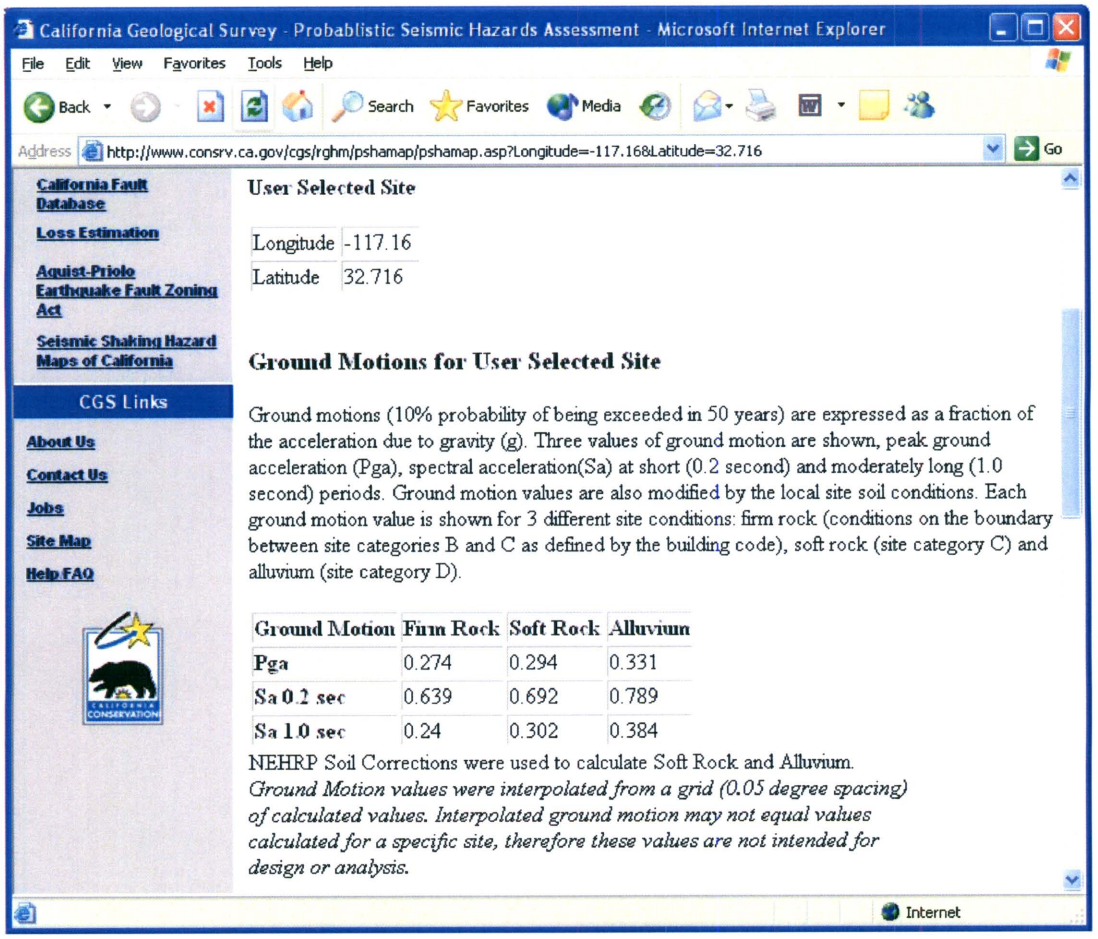


Figure 14. Ground Motion Values from the CGS Website

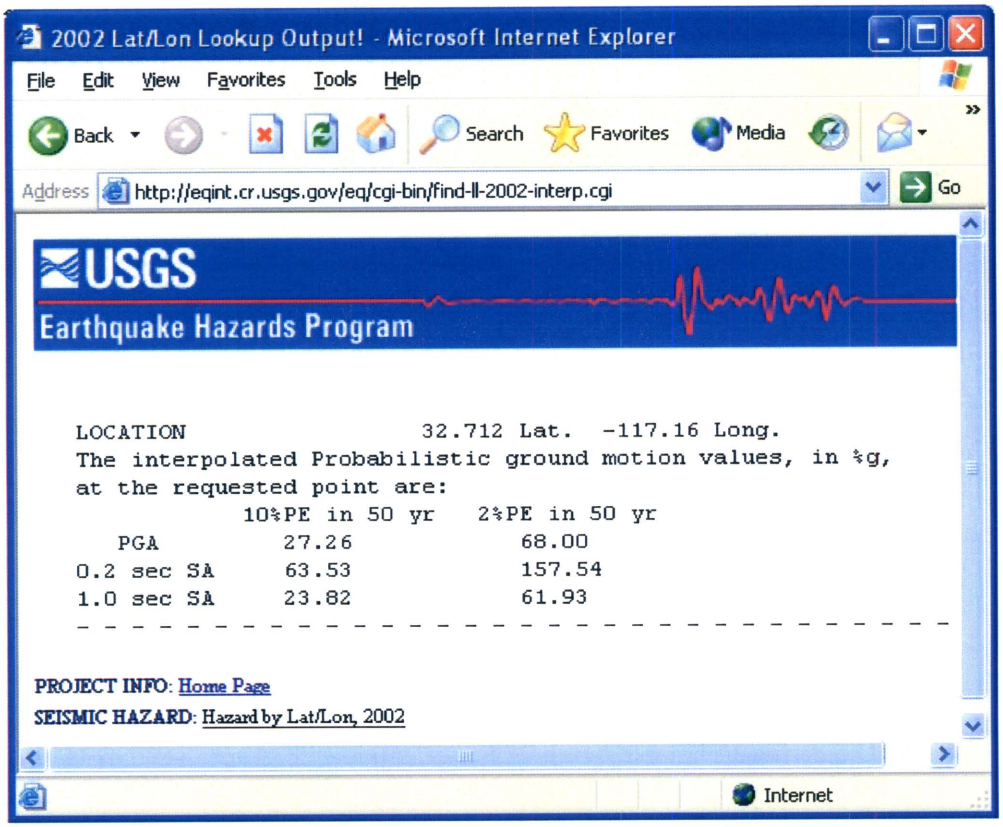


Figure 15. Ground Motion Values from the USGS Website

Table 1. Comparison of Probabilistic Ground Motion Values for an Annual Frequency of Exceedance of 0.0021

Model	PGA (g)	0.2 sec SA	1.0 sec SA
EZ-FRISK (Sadigh, 1997)	0.25	0.57	0.22
EZ-FRISK (Mean)	0.25	0.60	0.24
CGS Website	0.274	0.639	0.240
USGS Website	0.2726	0.6353	0.2382

Table 2. Comparison of Probabilistic Ground Motion Values for an Annual Frequency of Exceedance of 0.00040

Model	PGA (g)	0.2 sec SA	1.0 sec SA
EZ-FRISK (Sadigh, 1997)	0.64	1.2	0.62
EZ-FRISK (Mean)	0.73	1.6	0.68
CGS Website	N/A	N/A	N/A
USGS Website	0.6800	1.5754	0.6193