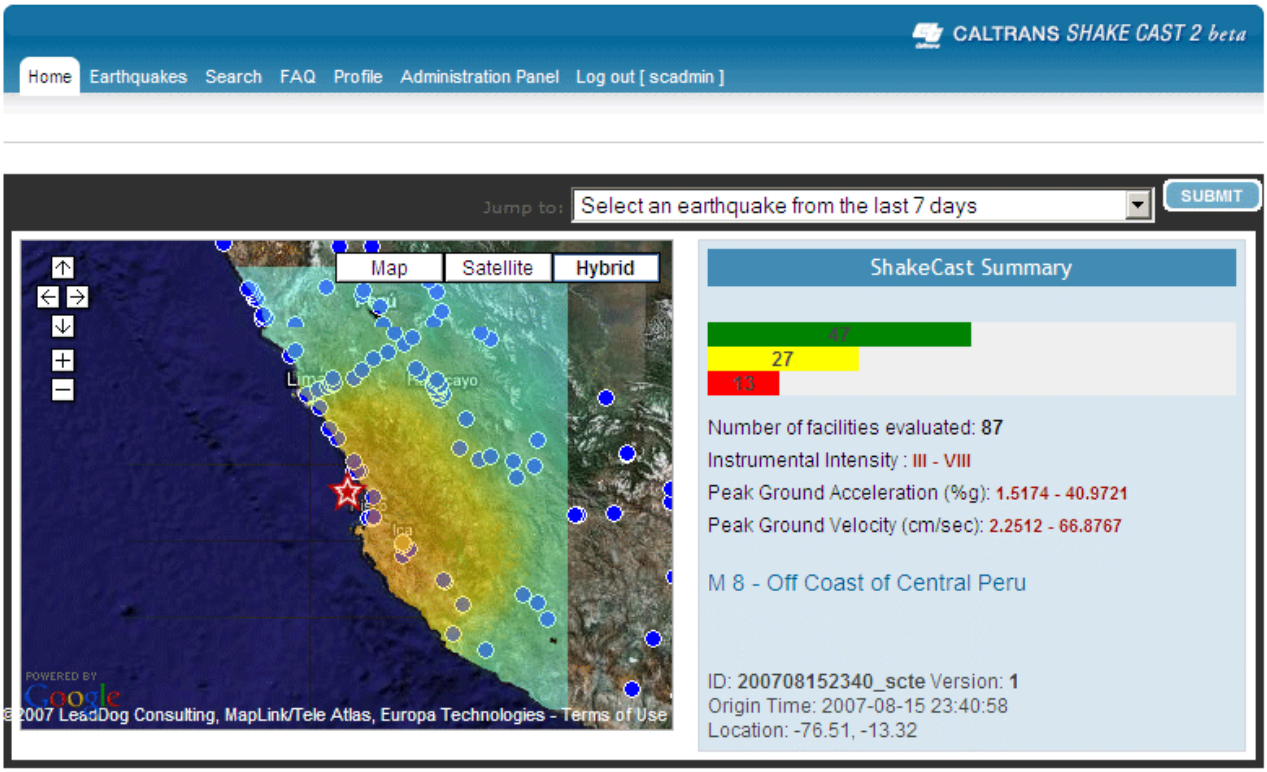
ShakeCast Manual

By Kuo-Wan Lin and David J. Wald



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Contents

Figures

Tables

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1. Introduction

ShakeCast is a freely available, post-earthquake situational awareness application that automatically retrieves earthquake shaking data from ShakeMap, compares intensity measures against users' facilities, and generates potential damage assessment notifications, facility damage maps, and other Web-based products for emergency managers and responders.

1.1 What is ShakeCast?

ShakeCast, short for *ShakeMap Broadcast*, is a fully automated system for delivering specific ShakeMap products to critical users and for triggering established post-earthquake response protocols. *ShakeMap* is a well-established tool used to portray the extent of potentially damaging shaking following an earthquake. It is available and can be found on the Internet at *http://earthquake.usgs.gov/shakemap*. It was developed for and is used primarily for emergency response, loss estimation, and public information. However, for an informed response to a serious earthquake, critical users must go beyond just looking at ShakeMap, and understand the likely extent and severity of impact on the facilities for which they are responsible. To this end the U.S. Geological Survey (USGS) has developed *ShakeCast*.

ShakeCast allows utilities, transportation agencies, businesses, and other large organizations to control and optimize the earthquake information they receive. With ShakeCast, they can automatically determine the shaking value at *their* facilities, set thresholds for notification of damage states for each facility, and then automatically notify (via pager, cell phone, or email) specified operators and inspectors within their organizations who are responsible for those particular facilities so that they can set priorities for response. A schematic diagram showing the ShakeMap/ShakeCast flow of data and information is shown in figure 1.1.

In addition to real-time notification, ShakeCast also can generate and deliver scenario earthquakes for facility response plans (fig. 1.2). This application includes routine testing of the system, earthquake scenario exercises, and evaluating performance and response under potential earthquake conditions. ShakeMap is now used routinely to generate earthquake scenarios for many regions; ShakeCast will further allow planning exercises to be performed using the same notification tools that will be available and in place for responding to a real earthquake.

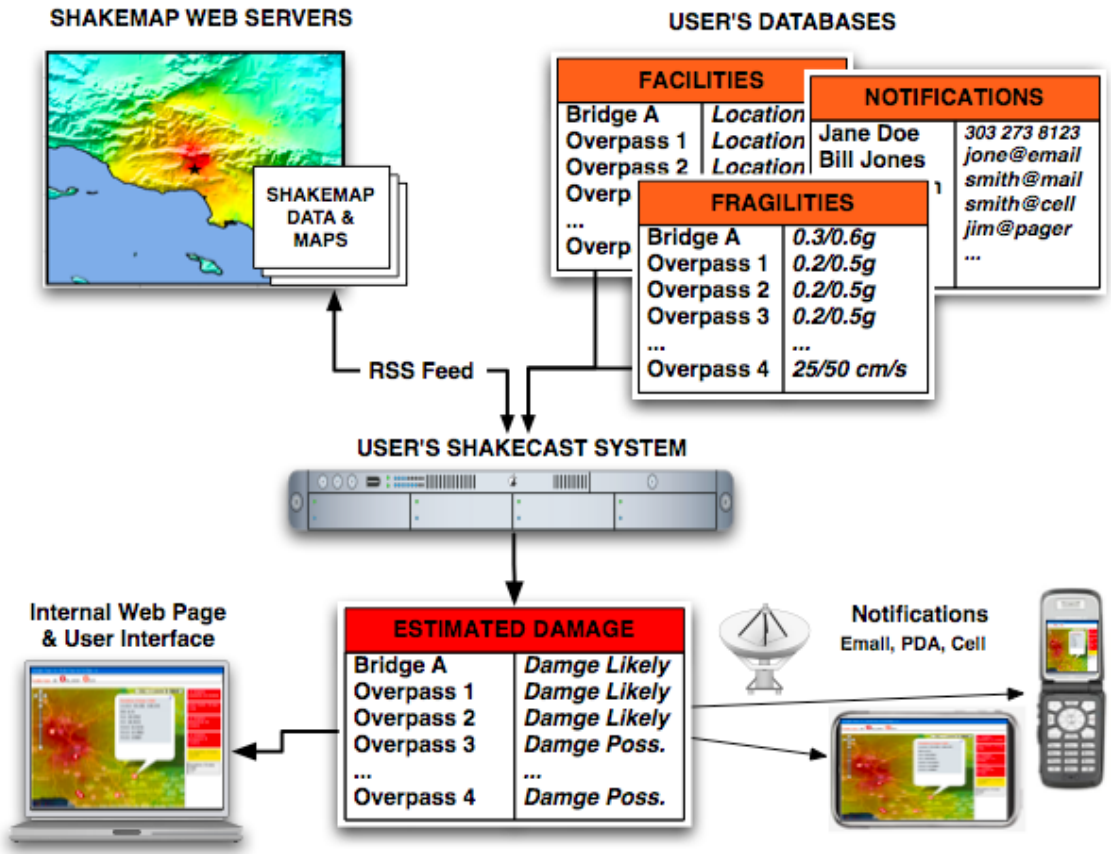


Figure 1.1 ShakeCast flow chart indicating flow of USGS ShakeMap data, users' ShakeCast inventory and user databases, and notifications.

1.2 ShakeCast Technology

Individuals, companies, utilities, and agencies could develop their own strategies and tools for utilization of ShakeMap given their unique facilities and communication paths. However, such efforts are costly and complex. Instead, USGS is facilitating this process with ShakeCast, building a more general-use tool for most of the critical user needs. The ShakeCast software is customizable for facilities, fragilities, and notifications, and we anticipate additional adaptations will be made because the open-source code is provided. Such innovations then can be provided into the tool kit included with updates of the ShakeCast system.

Information Technology (IT) security is a primary concern for users requiring automatic electronic delivery of information. By taking advantage of standard Internet protocols, ShakeCast users avoid most typical corporate and government concerns and firewall limitations. By using Really Simple Syndication (RSS) and interval polling, users initiate all communications with the USGS Web servers that host ShakeMap and retrieve selected products as a request rather than a "push." This RSS approach allows users to update software automatically under conditions of their own choosing.

ShakeCast software is built upon open-source tools, providing standard, freely available software for all users, encouraging user improvements, and simplifying interfacing with existing users' response tools. ShakeCast uses the Apache Web server and PHP (Hypertext Preprocessor) for dynamic Web content, MySQL for facility and notification databases, and is wrapped in

Practical Extraction and Report Language (PERL) scripting. Exchange files are in Extensible Markup Language (XML) for standardized interfacing with Web, geographic information systems (GIS), spreadsheets, databases, and other applications.

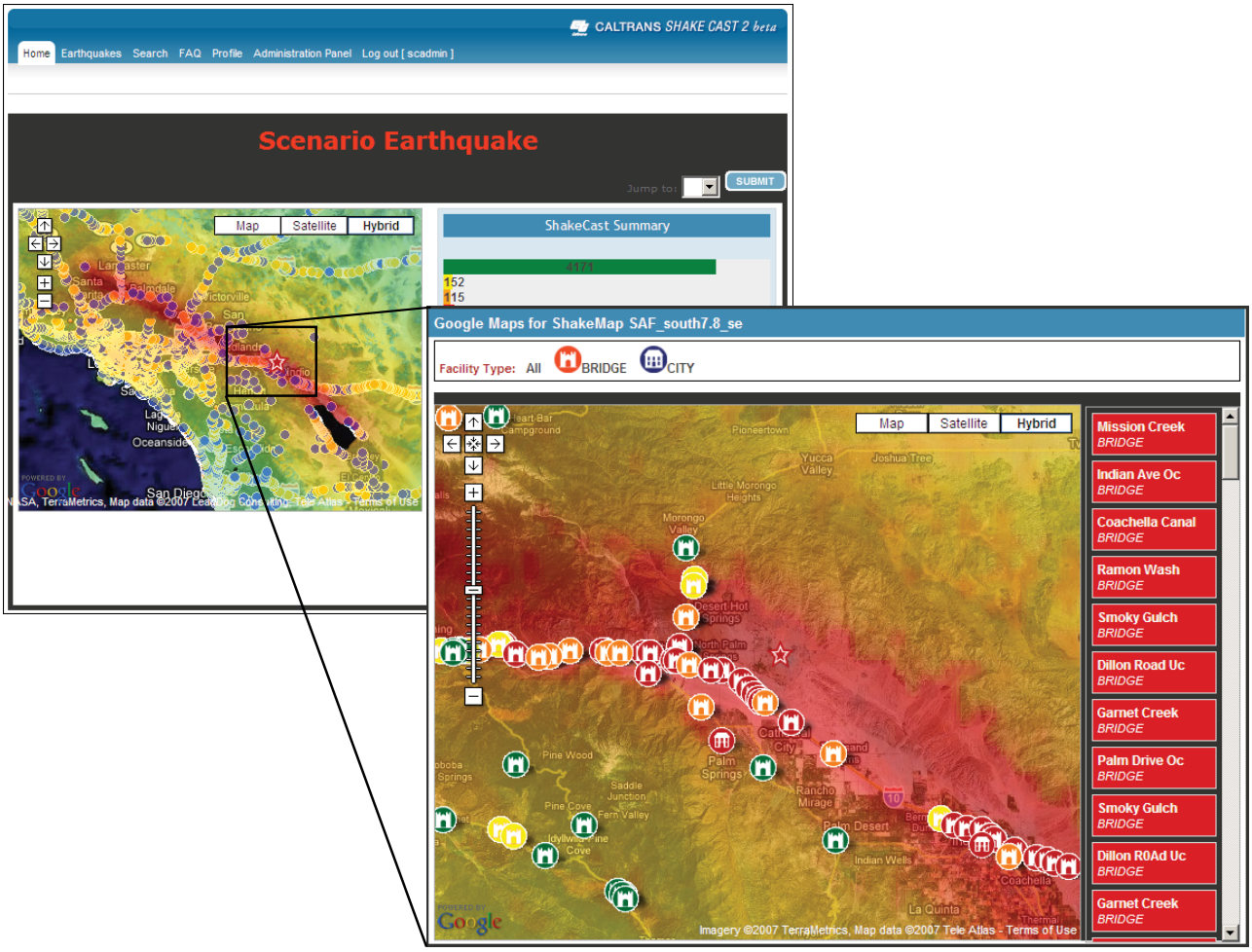


Figure 1.2 The ShakeCast users' interface summary page in mapping mode. The unique features in the mapping mode include variable image size, selectable facility type, customizable facility icons, and color-coding to show possible damage.

1.3 Where Can ShakeCast Be Used?

ShakeMap is now produced for all earthquakes around the globe of magnitude 5.5 or larger. Globally, these ShakeMaps are primarily predictive and thus lack the resolution and certainty of shaking estimates for maps made in regions of dense seismic instrumentation for which it was principally developed. Regions in the United States that have ShakeMap operating with reasonable (but variable) seismic station coverage include major parts of California, Washington, Oregon, Nevada, Utah, Hawaii, and Alaska. Other regions are improving station coverage. Hence, since ShakeMaps are produced for any region of the world, ShakeCast can be deployed for any exposure of facilities worldwide, again with more uncertainty for the results in regions not specifically listed above.

We use the term “facilities” loosely; at the USGS National Earthquake Information Center (NEIC) in Golden, Colo., we assign cities as “facilities” and run ShakeCast to determine shaking levels at cities within the United States and around the globe any time a ShakeMap is produced. The list of cities, their populations, and the intensity estimated at each city becomes a Hypertext Markup Language (HTML) email notification that proves useful for NEIC analysts and for other response purposes. Ultimately, these city-based notifications will be integrated as an option in the USGS Earthquake Notification Service (ENS), but it does not reduce the need for critical users to put their own inventories in an in-house ShakeCast system.

1.4 ShakeCast Availability

ShakeCast is available in two levels, full and “Lite.” We describe in detail the full ShakeCast system that allows users to estimate impact to numerous facilities, each potentially with different vulnerabilities and notification recipients. We expect this system to be deployed by critical users in an earthquake-hardened, operational environment. We have also made available ShakeCast Lite, a subset of the system that allows users to automatically receive ShakeMap products on their laptop or desktop computers, and launch predefined applications using those maps or data. For example, many users employ ShakeCast Lite to automatically open a Web browser showing the latest ShakeMap in their region, launch Google Earth® with the ShakeMap KML file, download ShakeMap grid files and initiate loss-estimation applications, or deliver ShakeMap GIS files to their corporate GIS department for further analyses. ShakeCast Lite is simple to install and use.

1.5 Acknowledgments

USGS contracted with Gatekeeper Systems, Inc., Pasadena, Cali., to help develop the prototype ShakeCast system (Version 1.0). Earlier funding for ShakeCast was provided by the American Lifelines Alliance (ALA), and it is now supported by the U.S. Geological Survey under the Advanced National Seismic System (ANSS). Motivation and support for the development of Version 2 of ShakeCast was provided by the California Department of Transportation (Caltrans) under the coordination efforts of Loren Turner.

2. Installation

An overview of ShakeCast from the users' perspective is provided in figure 2.1. Organizations using ShakeMap/ShakeCast first download and install the ShakeCast (Version 2) software package on a hardened in-house computer system. The software is installed with an interactive installation script. Facility, vulnerability, and notification data are input using import tools and simple, comma separated (CSV) users' files. ShakeCast comes preconfigured, but custom configuration is simplified via ShakeCast tools and the Web interface. The Web interface allows an administrator to access all functions of the local ShakeCast system, and end users are able to manage their own personal information and notification preferences.

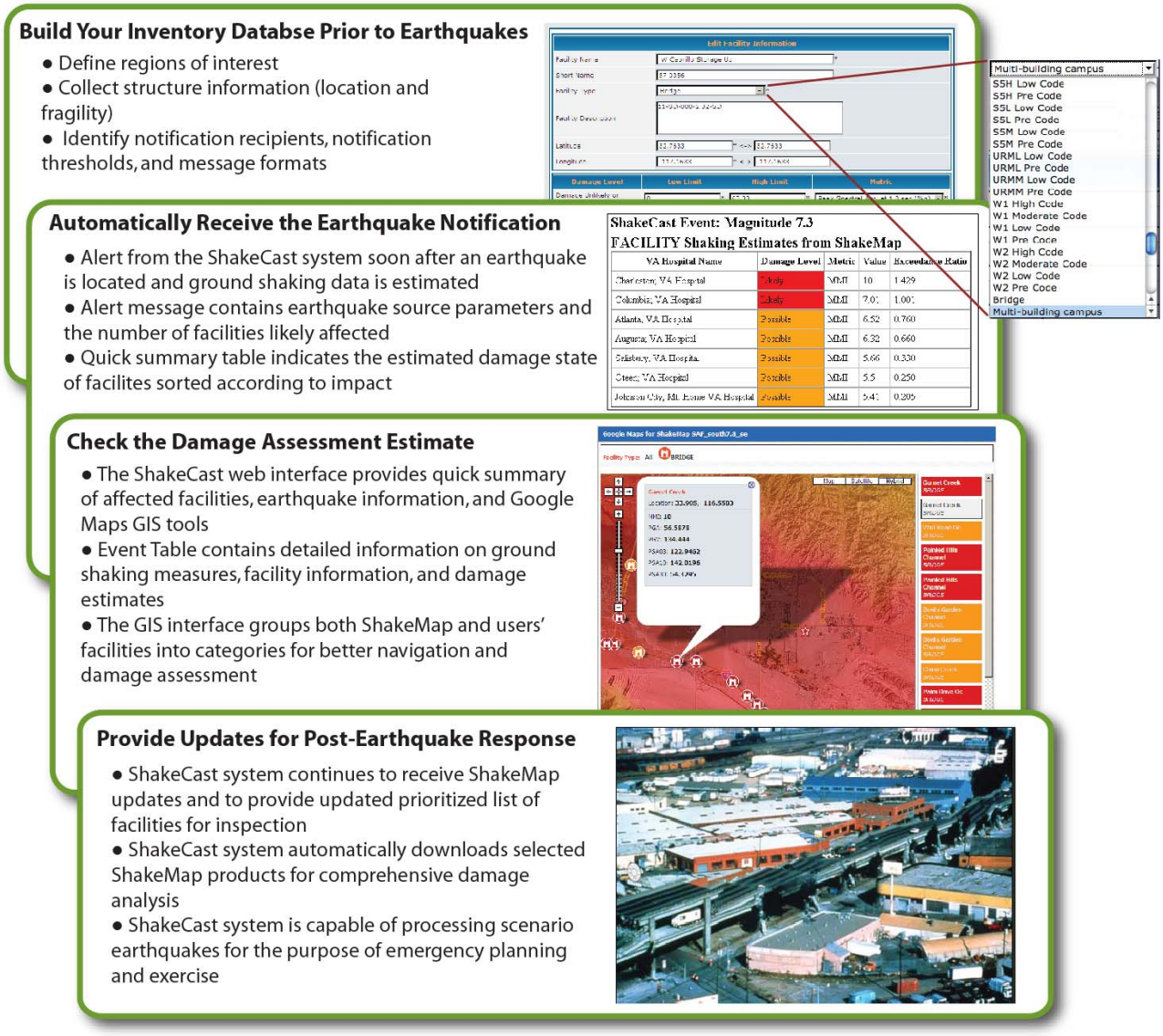


Figure 2.1 ShakeCast overview from the users' perspective.

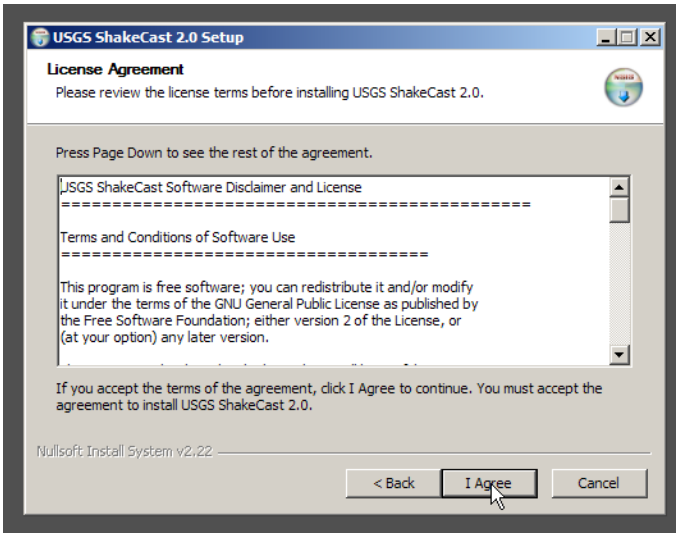
2.1 Hardware/Software Requirements

Version 2 of ShakeCast has been tested on a Microsoft Windows PC computer running the XP Professional operating system. Although the installation package is currently only available for Microsoft Windows, we plan to provide support for UNIX, Mac, and LINUX operating systems in the future.

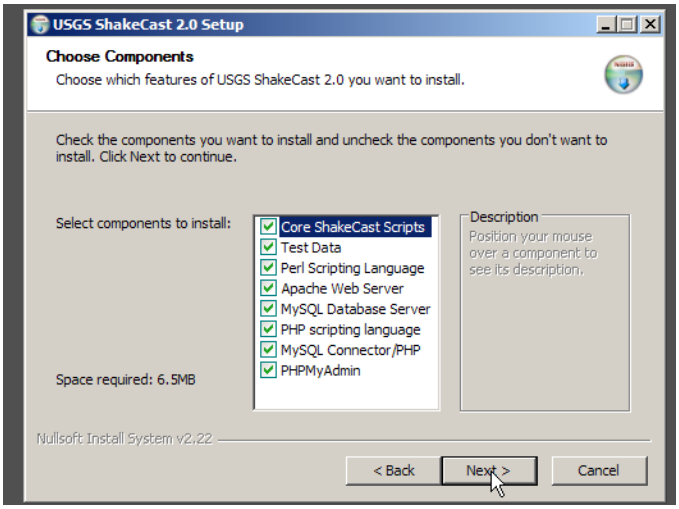
2.2 Initial Installation

To start the ShakeCast installation process:

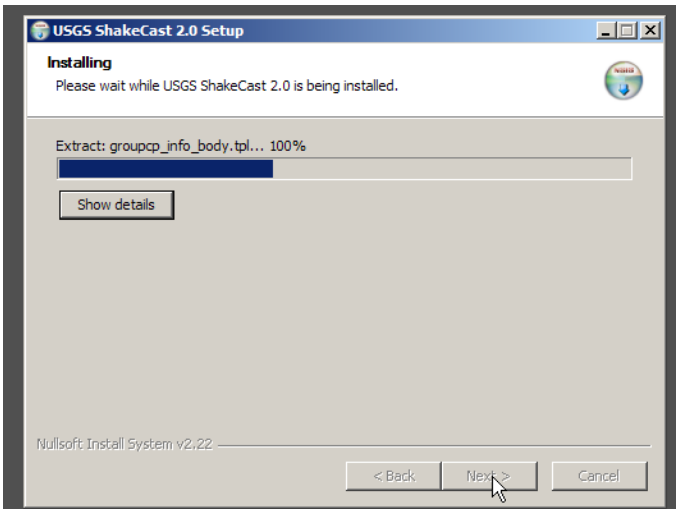
1. The **installer** unpacks the files needed for the installation, which takes less than a minute. After unpacking the installation files, the installer presents an option to view the **license agreement**. You may choose to **Accept** the license agreement and continue the installation process.



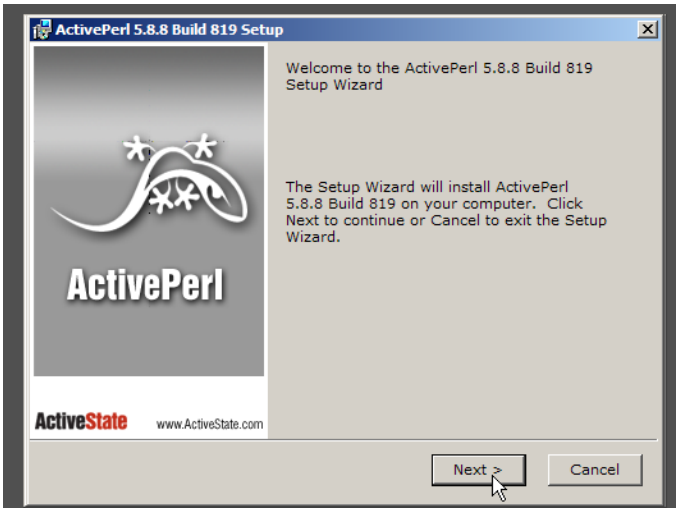
2. The installer displays a **Choose Components** screen that allows you to choose programs to install. We recommend that you keep the default settings, unless you are an advanced user who wants more precise control over the components that will be installed.



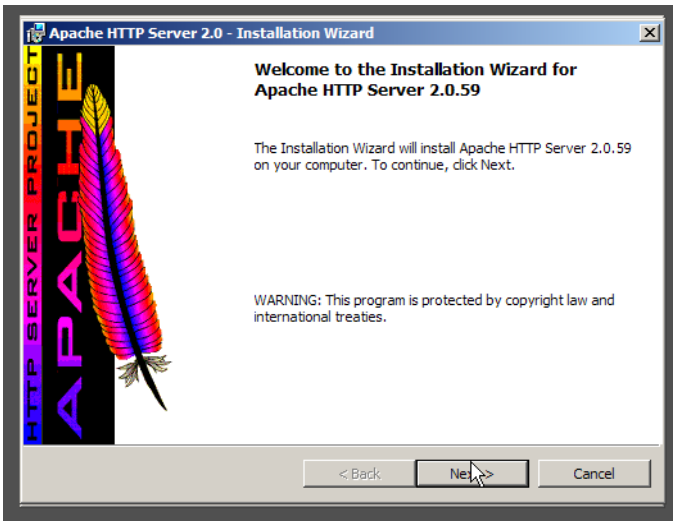
3. After ensuring that the desired program features are selected, click the **Next** button to continue with the installation. Now that you have given the installer all of the information it needs to proceed, progress boxes track the installation process.



After installing the core ShakeCast script, the installer will download and start the ActivePerl setup dialog. Click the **Next** button to continue with the installation.

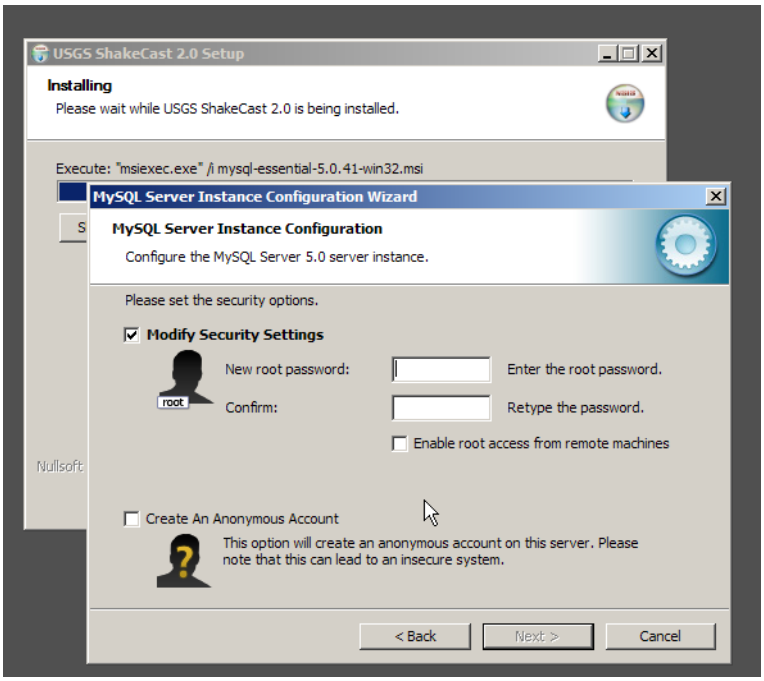


4. After installing the ActivePerl software, the installer will download and start the Apache Web server setup dialog. Click the **Next** button to continue with the installation.



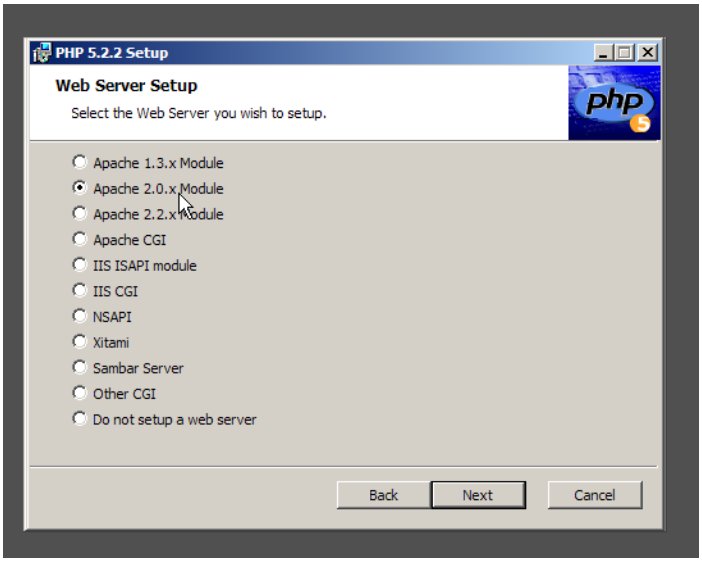
5. After installing the Apache software, the installer will download and start the MySQL database setup dialog. Click the **Next** button to continue with the installation.

6. After installing the MySQL software, configure the database and create a root password.

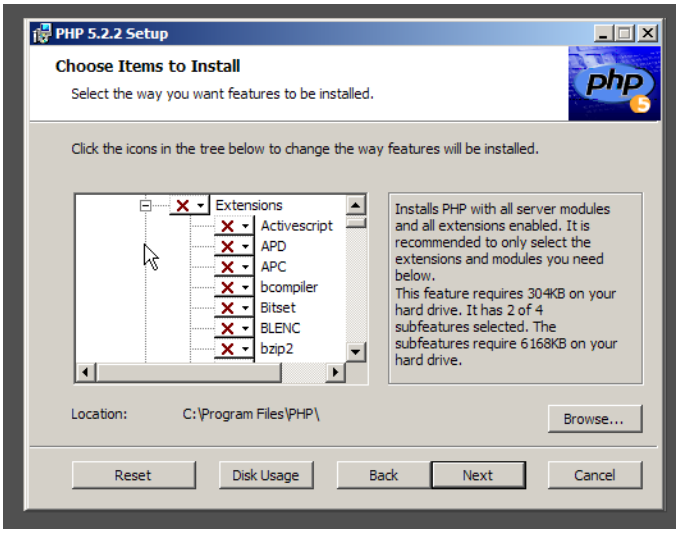


7. After completing the MySQL software configuration, the installer will download and start the PHP setup dialog. Click the **Next** button to continue with the installation.

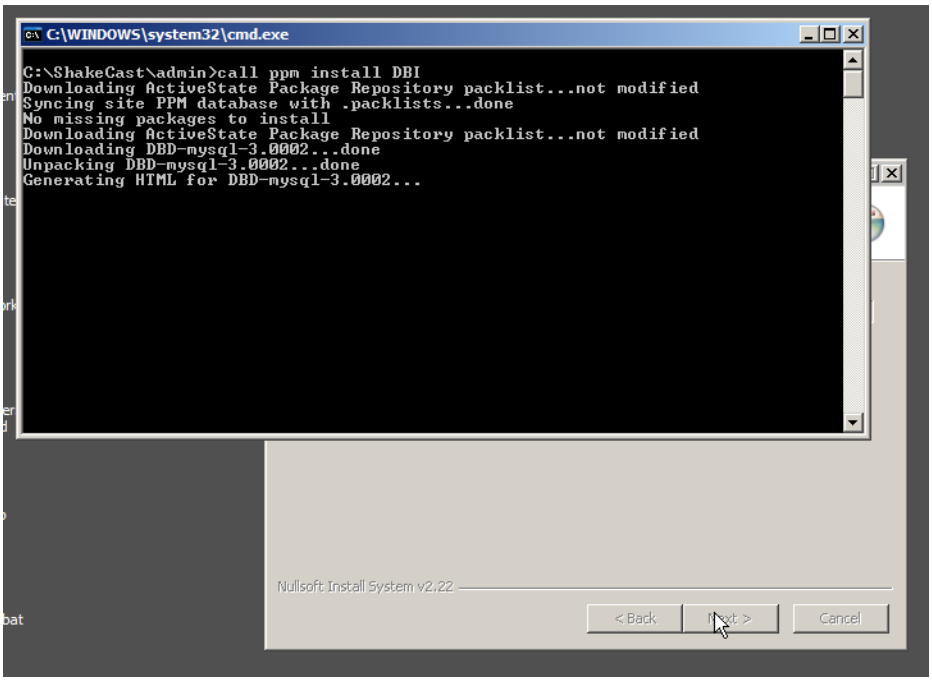
8. After completing the core PHP installation, the installer will start the PHP configuration dialog. Select Apache 2.0.x Module then click the **Next** button to locate the installation directory for Apache Web server.



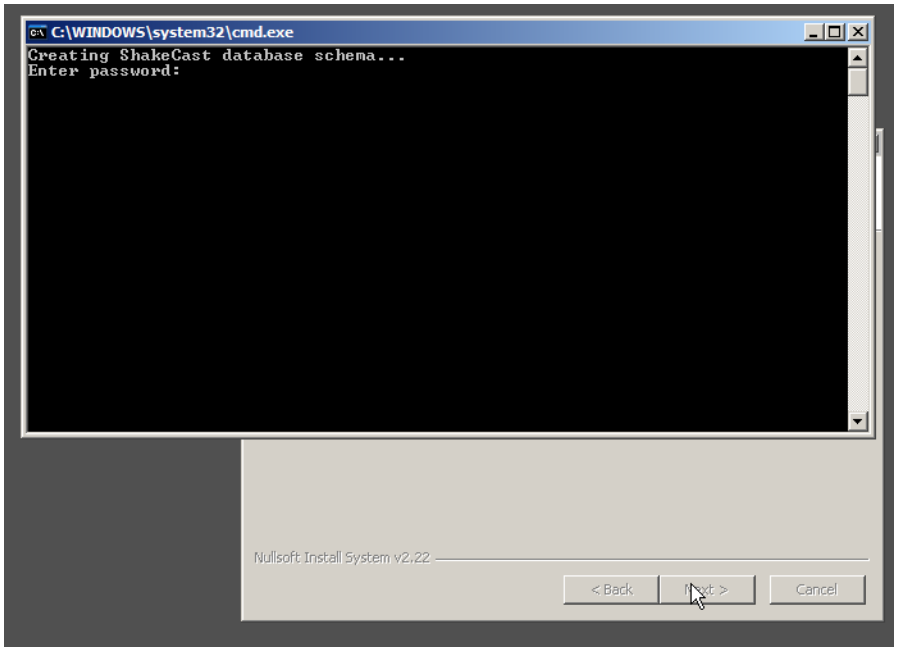
9. In the last step of PHP setup configuration, select to install the Extensions GD2, Multi-byte String, Mcrypt, Mysql, Mysqli, and SMTP. Click the **Next** button to continue with the installation.



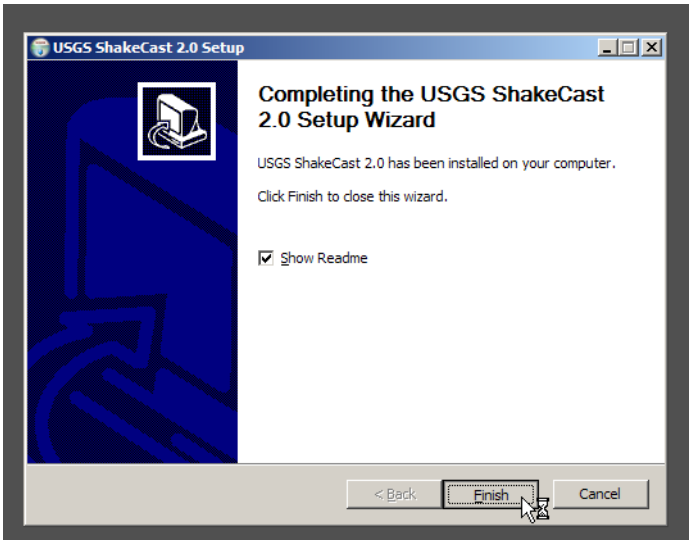
10. After completing the PHP installation, the installer will start the Perl module installation. A DOS Window will appear showing the progress of module installation.



11. After completing the Perl module installation, the installer will start the ShakeCast database configuration. A new DOS Window will appear with a prompt for the password to access the database. Type in the root password entered during the MySQL installation and hit **Enter** to continue with the installation.



12. After completing the ShakeCast database creation and data population, a brief dialog confirms the last steps of the installation process.



2.3 Finalize Installation

A few final configuration steps are required.

1. Notification. The file "c:\shakecast\sc\conf\sc.conf" contains a *Notification* section that looks like:

```
# Notification Configuration
<Notification>
   From         shakemaster@example.com
   EnvelopeFrom     shakemaster@example.com
   SmtpServer      smtp.example.com
   DefaultEmailTemplate     default.txt
   DefaultScriptTemplate     default.pl
   #Username    username
   #Password    password
</Notification>
```

   Modify the *From* (what an email recipient sees), *EnvelopeFrom* (what the SMTP server uses in the protocol) and the *SmtpServer* fields to define how email notifications will be sent. Uncomment and edit the *Username* and *Password* fields if authentication is required for your SMTP server.
2. RSS Daemon. The file “c:\shakecast\sc\conf\sc.conf” contains an *RSS* daemon section that looks like:

```
# RSS Daemon configuration
<rss>
   AUTOSTART    1
   # the LOG & LOGGING setting only applies to messages logged out of
   # GenericDaemon; other messages from polld itself are controlled by the
   # settings of LogLevel and LogFile in the system-wide configuration above
   LOG          c:/shakecast/sc/logs/sc.log
   LOGGING      1
   MSGLEVEL     2
   POLL   60
   PORT   53458
```

```
   PROMPT      rssd>
   SERVICE_NAME rssd
   SERVICE_TITLE ShakeCast RSS Daemon
   SPOLL 10
   REGION SC CI NC NN
   #TIME_WINDOW 30
</rss>
```

Modify the *REGION* (to download ShakeMaps only from selected regions), the *POLL* (polling interval in seconds), and the *TIME_WINDOW* (in days for triggering ShakeCast processing). Available ShakeMap regions are listed in table 2.1.

Table 2.1. ShakeMap region code and description

Region Code	Description
SC	Southern California
CI	Southern California
NC	Northern California
NN	Nevada
UT	Utah
PN	Pacific Northwest
HV	Hawaii
AK	Alaska
GLOBAL	Global and U.S. regions not covered by the above networks (NEIC ShakeMap)
ALL	All the above

3. Restart the ShakeCast Services. To restart the actual services that perform the various ShakeCast functions:

```
cd c:\shakecast\admin
stop_sc_services
start_sc_services
```

4. Customize the ShakeCast server for facilities, profiles, users, and notification templates. Consult ShakeCast documentation and tutorial videos on the ShakeCast download page in configuring ShakeCast server.

2.4 Uninstalling ShakeCast

You may uninstall the ShakeCast Server Software by:

1. Stop and uninstall the services:

```
cd c:\shakecast\admin
stop_sc_services
remove_sc_services
```

2. Remove ShakeCast:

   ```
   c:\shakecast\Uninstall
   ```

   or use **Add/Remove Programs** in the Control Panel.
3. If desired, uninstall Perl, PHP, MySQL, and Apache by using Add/Remove Programs in the Control Panel.

2.5 Setup

Initial setup involves the following steps: (1) populating a database of facility locations and types; (2) assigning fragilities using specific ShakeMap metrics (for example, intensity, peak or spectral acceleration) and the corresponding likely "green," "yellow," and "red" damage states ("damage unlikely," "damage possible," and "damage likely" thresholds, for example); (3) specifying who receives notifications by contact information for facility managers and response personnel (email, cell phone); and (4) selecting under which circumstances the alerts are sent (for example, "damage possible" at specific facilities). In addition, the user can customize the content of the summary report that is delivered internally; for example, a list of facilities based on their likely damage state, and organization-specific links and images.

Example user and earthquake data, tutorials, and documentation are provided with the installation package.

3. ShakeCast User Web Interface

This section describes the User Web Interface of ShakeCast. The User Web Interface is called the "ShakeCast Portal" (fig. 3.1) and is used for all interaction with the ShakeCast system, such as reviewing ShakeCast damage assessment summary for facilities affected by earthquakes, applying for a ShakeCast user account, or signing up for automatic ShakeCast notifications on facilities likely affected after earthquakes.

- The ShakeCast Portal runs on any of the popular Web browsers connected to the Internet,
- Accesses all processed ShakeMaps for both actual and scenario earthquakes,
- Displays all pertinent information associated with facilities including facility parameters, intensity measures, and damage estimates,
- Allows management of automatic ShakeCast notifications for both message formats and facilities of interest, and
- Provides access to ShakeCast Web GIS interface.
- Further, for users with administrative privileges, an additional **Administration Panel** link will also become available.

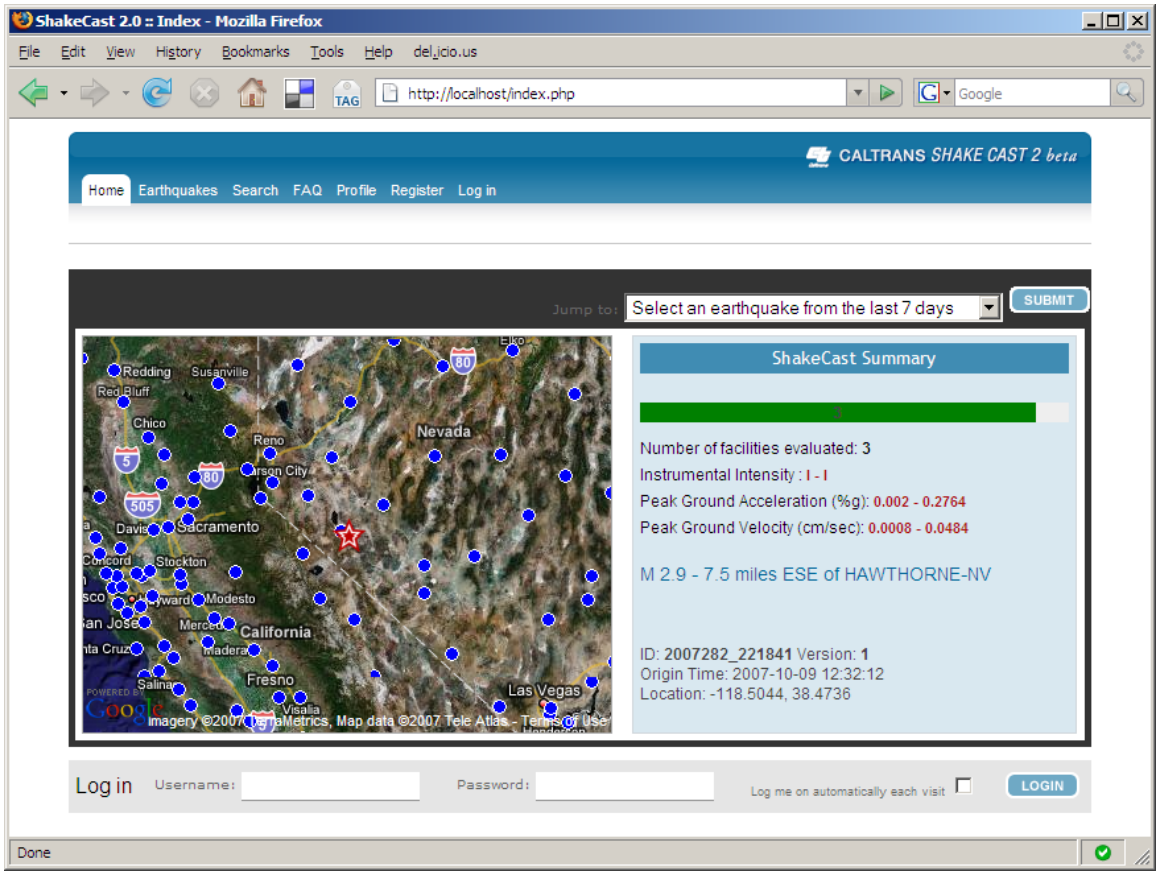


Figure 3.1 Default Web page of the ShakeCast Portal.

3.1 System Requirements

The ShakeCast Portal is implemented with common Web technologies, (PHP, Javascript, and AJAX, etc.), and is compliant with the HTML 4 specifications. The Portal runs on any browser with HTML Strict DTD support, which includes Microsoft's Internet Explorer 7 and up, as well as Firefox. If you do not have one of these browsers, they are available for free download from the Microsoft and Mozilla websites. The ShakeCast Portal is supported for Windows 98, Windows 2000, Windows XP, Mac OS X, Linux, Sun Solaris, and other UNIX-based operating systems.

If operated from behind a firewall or proxy server, the ShakeCast Portal will operate properly only if the firewall allows HTTP requests to Port 80. If the Portal is repeatedly unable to connect to the ShakeCast and Google Map GIS servers, then you should contact your system administrator for assistance. The firewall opening request should specify the source IP addresses (default earthquake.usgs.gov) allowed to connect to the Portal interface.

3.2 Log in Procedure

In order to log in, you must be a registered ShakeCast user. Registering can be accomplished by clicking on the **Register** tab on the ShakeCast Portal front page. See Section 3.11 for further information on registration. Note that only registered users can modify their personal preferences for receiving ShakeCast notifications.

Logging in requires you to provide a user-id and password. Both user-id and password are case sensitive. If you forget your password, click on the "I forgot my password" link and fill in the information requested; your new password will be then be emailed to you.

If the user-id and password are entered correctly, both the **Register** and **Log in** links at the Portal will be replaced with the **Log out** link with the user-id indicated.

3.3 Log out Procedure

To log out of ShakeCast Portal, you must either click on the **Log out** link from the Portal, which will close your active session with the server but leave the Portal browser open, or close the browser window/quit the application, which also will close the active session.

3.4 Front Page of ShakeCast Portal

The ShakeCast Portal front page is shown in figure 3.1. The Portal window is partitioned into a number of components, each serving a different purpose:

- Primary navigation links: a horizontal panel located beneath the organization's logo and ShakeCast banner contains several primary navigation links that allow a user to perform operations or access additional information.
- System message: an area between the primary navigation links and the ShakeCast summary panel that displays event specific information. A typical system message is a banner indicating a scenario earthquake and crucial comments manually entered by an administrator.
- Recently processed earthquake selector: a pull-down menu that allows a user to view the ShakeCast summary for recently processed earthquakes.
- ShakeCast facility/ShakeMap overview: an area in the middle left of the ShakeCast summary panel that displays an overview map with both the ShakeMap and facility layers.

- ShakeCast facility summary: an area in the upper right of the ShakeCast summary panel that displays the number of facilities evaluated, facility potential damage estimates, and the units and the range of ground shaking intensity measures extracted from ShakeMap.
- ShakeCast event summary: an area in the lower right of the ShakeCast summary panel that displays the key source parameters of the earthquake evaluated. The list of parameters includes the event ID, ShakeMap version number, magnitude, location, and origin time.

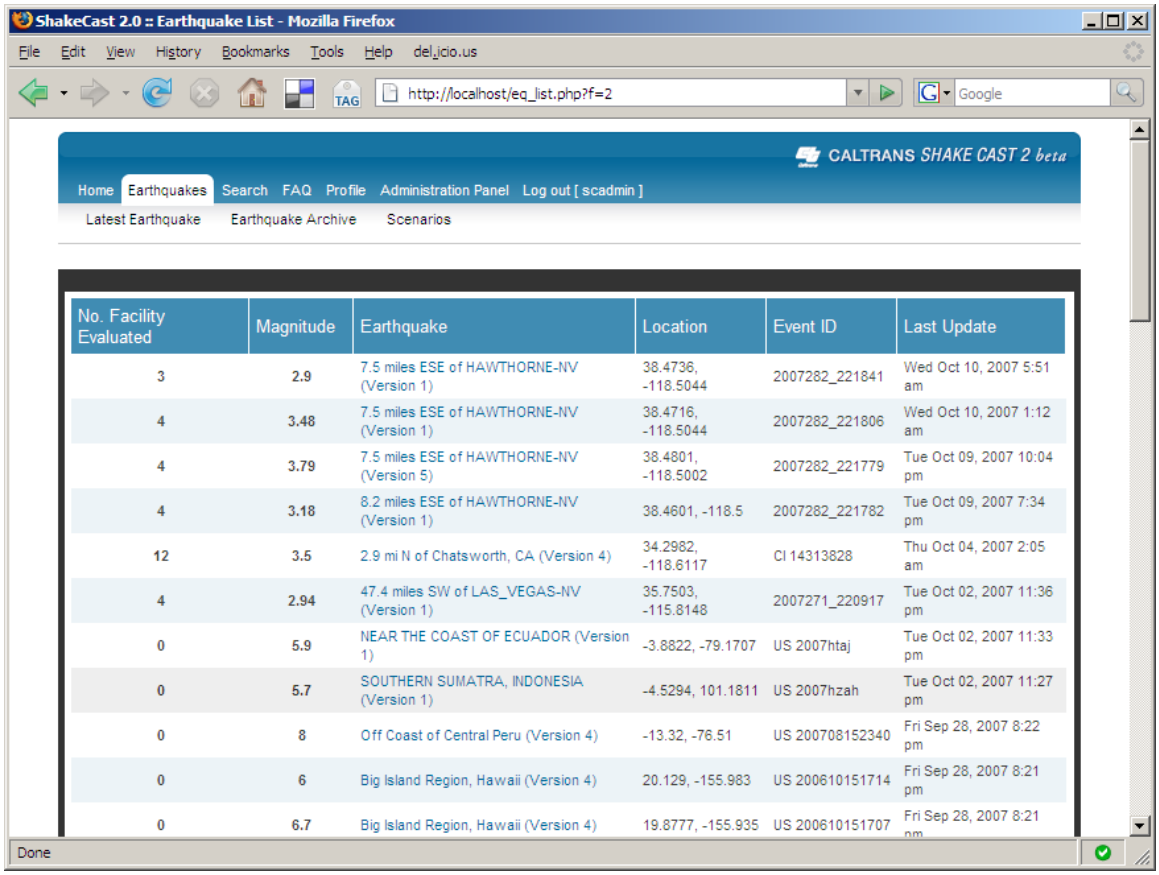
3.5 Primary Navigation Link Tabs

The Primary navigation link tabs currently have the following links in a panel on top of the ShakeCast Portal. Clicking one will invoke the described operation:

- Home: directs the browser window back to the default page of the ShakeCast portal.
- Earthquakes: directs the browser window to the ShakeCast listing of processed ShakeMaps.
- Search: directs the browser window to the ShakeCast search function for information regarding facility inventories and processed ShakeMaps.
- FAQ: directs the browser window to a list of answers to common problems ShakeCast users have encountered.
- Profile: directs the browser window to allow ShakeCast users to manage personal information and notification preferences.
- Register: directs the browser window to the user registration page that allows a non-user to sign-up for an account.
- Administration Panel: directs the browser window to the restricted section for system maintenance and management. This feature is only visible and available to ShakeCast users with administrative privileges.
- Log In/Log Out: the Log In link appears when a user first accesses the page without signing in. It directs the browser window to allow a user to enter information of username and password or to retrieve a lost password. The **Log Out** link terminates the current Log In session and redirects the browser window to the default portal page.

3.6 Listing of the ShakeCast Summary for Earthquakes

The ShakeCast summary of affected facilities for earthquakes is accessed via the Earthquake link (fig. 3.2). This feature allows a ShakeCast user to view facility damage assessment for past earthquakes. The list of processed earthquakes is divided into three categories: (1) Latest Earthquake, (2) Earthquake Archive, and (3) Scenario earthquakes.



No. Facility Evaluated	Magnitude	Earthquake	Location	Event ID	Last Update
3	2.9	7.5 miles ESE of HAWTHORNE-NV (Version 1)	38.4736, -118.5044	2007282_221841	Wed Oct 10, 2007 5:51 am
4	3.48	7.5 miles ESE of HAWTHORNE-NV (Version 1)	38.4716, -118.5044	2007282_221806	Wed Oct 10, 2007 1:12 am
4	3.79	7.5 miles ESE of HAWTHORNE-NV (Version 5)	38.4801, -118.5002	2007282_221779	Tue Oct 09, 2007 10:04 pm
4	3.18	8.2 miles ESE of HAWTHORNE-NV (Version 1)	38.4601, -118.5	2007282_221782	Tue Oct 09, 2007 7:34 pm
12	3.5	2.9 mi N of Chatsworth, CA (Version 4)	34.2982, -118.6117	CI 14313828	Thu Oct 04, 2007 2:05 am
4	2.94	47.4 miles SW of LAS_VEGAS-NV (Version 1)	35.7503, -115.8148	2007271_220917	Tue Oct 02, 2007 11:36 pm
0	5.9	NEAR THE COAST OF ECUADOR (Version 1)	-3.8822, -79.1707	US 2007htaj	Tue Oct 02, 2007 11:33 pm
0	5.7	SOUTHERN SUMATRA, INDONESIA (Version 1)	-4.5294, 101.1811	US 2007hzah	Tue Oct 02, 2007 11:27 pm
0	8	Off Coast of Central Peru (Version 4)	-13.32, -76.51	US 200708152340	Fri Sep 28, 2007 8:22 pm
0	6	Big Island Region, Hawaii (Version 4)	20.129, -155.983	US 200610151714	Fri Sep 28, 2007 8:21 pm
0	6.7	Big Island Region, Hawaii (Version 4)	19.8777, -155.935	US 200610151707	Fri Sep 28, 2007 8:21 pm

Figure 3.2 The Earthquake page listing the events processed by the ShakeCast system and the number of evaluated facilities in reverse chronological order.

- Latest Earthquake: displays a table listing all versions of published ShakeMaps for the most recently processed earthquake. As a common earthquake refining process, the source parameters for a significant earthquake and associated ground motion estimates are constantly updated as more information becomes available. The ShakeCast system tracks version changes of ShakeMap for an earthquake and re-evaluates facility damage assessments accordingly.
- Earthquake Archive: displays a table listing previously processed ShakeMaps for actual earthquakes and their facility damage assessment.
- Scenarios: displays a table listing previously processed scenario ShakeMaps and their facility damage assessment. ShakeCast scenarios also include converted actual ShakeMaps for the purpose of local testing.
- All columns can be sorted by selecting their respective headers.

3.7 ShakeCast Facility Damage Assessment

The ShakeCast facility damage assessment view is the center piece of the Web portal. ShakeCast users interact with the view in either table or map mode.

- Table mode: displays facility damage assessment in a number of paged tables connected with navigation links (fig. 3.3). Each row of the table represents a ShakeCast damage assessment for one facility. It consists of facility information, damage state estimate, and ground motion estimates at the location of the facility. To view the facility on a map, click the facility row to enable the mapping inset. The mapping inset is a floating pane that can be dragged on top of the earthquake table page. To disable the inset, click on the "Close" button on the upper-right corner of the mapping inset.

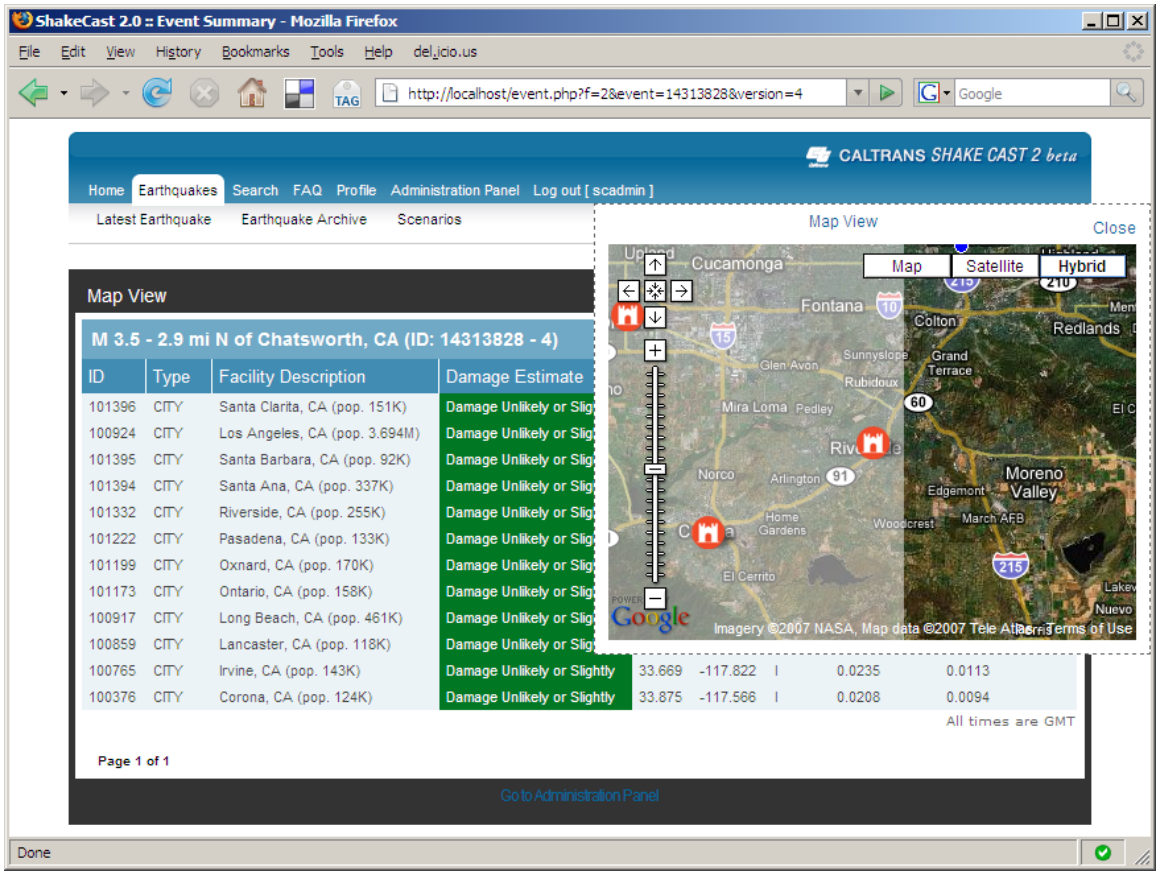


Figure 3.3 The Event page displaying in table mode. Facilities with damage estimates are listed in paged tables with navigation links. Each row of the table represents one facility and contains information regarding facility description, damage estimate, and ground shaking estimates for the site for all available metrics.

- Map mode: displays facility damage assessment via a Web based mapping interface (fig. 3.4), currently the Google Maps interface. Facilities are presented in both images and list items with facility-type filtering. The facility markers within the mapping area become visible at proper zoom level and are color-coded corresponding to damage estimates. To view the ground motion measures of a facility, click the facility marker in the mapping area to display the parametric values.

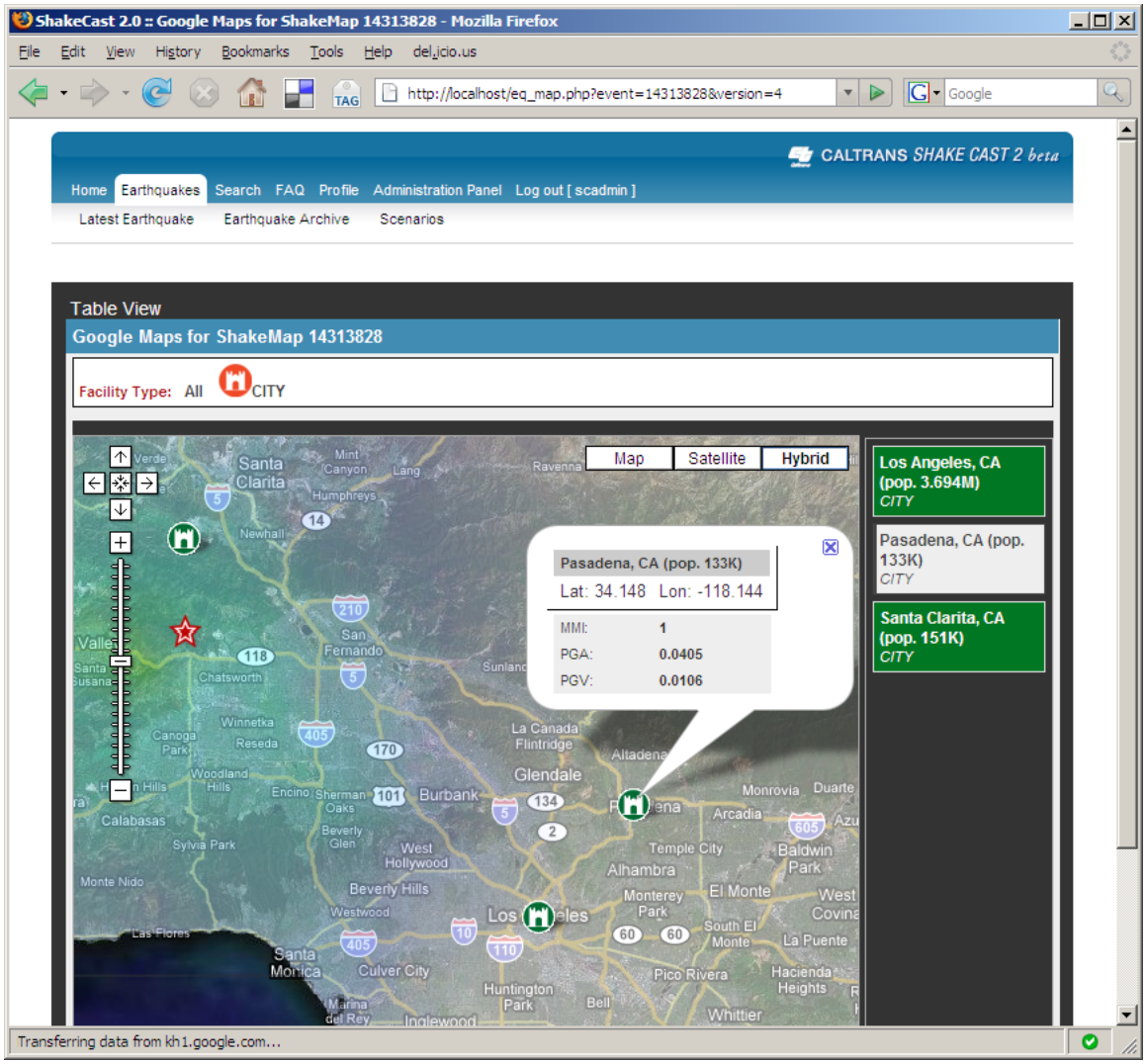


Figure 3.4 The Event page displaying in map mode. The map display is divided into three regions: (1) facility type selector located on top of the display and used to turn on/off facilities of certain type; (2) facility list panel to the right of the display showing a list of facilities located within the mapping area with color-coded damage estimates; and (3) the interactive mapping area displaying the facility locations with the ShakeMap image overlay. The facility markers are in color-coded damage levels and users can pan, zoom, and click on the facilities to reveal shaking parameters.

3.8 Search Facilities

The search function shown in figure 3.5 is designed to retrieve facility information inside the ShakeCast database. The search result contains facility information, fragility settings including metrics and ranges of threshold, and damage estimates from all previously processed ShakeMaps.

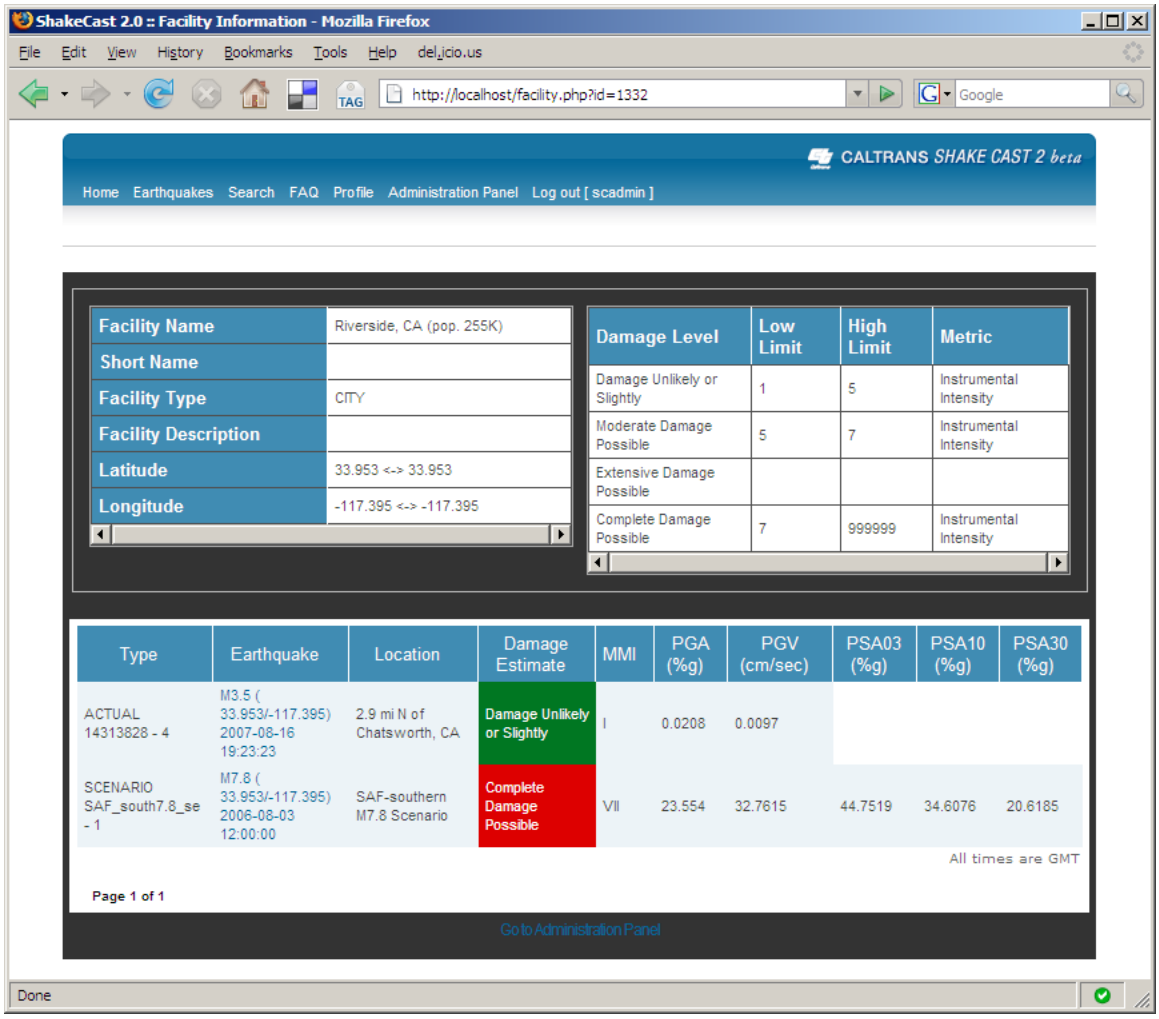


Figure 3.5 The search result of a facility displaying parameters for the facility and the history of damage estimates from previous earthquakes.

3.9 Frequently Asked Questions (FAQ)

The FAQ page is intended to answer some of the more commonly asked questions. Users should contact the ShakeCast administrator for further questions and bug reports.

3.10 User Profile Management

ShakeCast users manage their registered information, delivery methods for notifications, and notification profiles from the Profile page. This page view consists of three editing panels: (1) General Settings; (2) Email List; and (3) Notification Profiles.

- General Settings: displays the password and contact information editable by the user (fig. 3.6). The new password will take effect after the current active session is closed, either by closing the browser window or by logging out of the ShakeCast system.

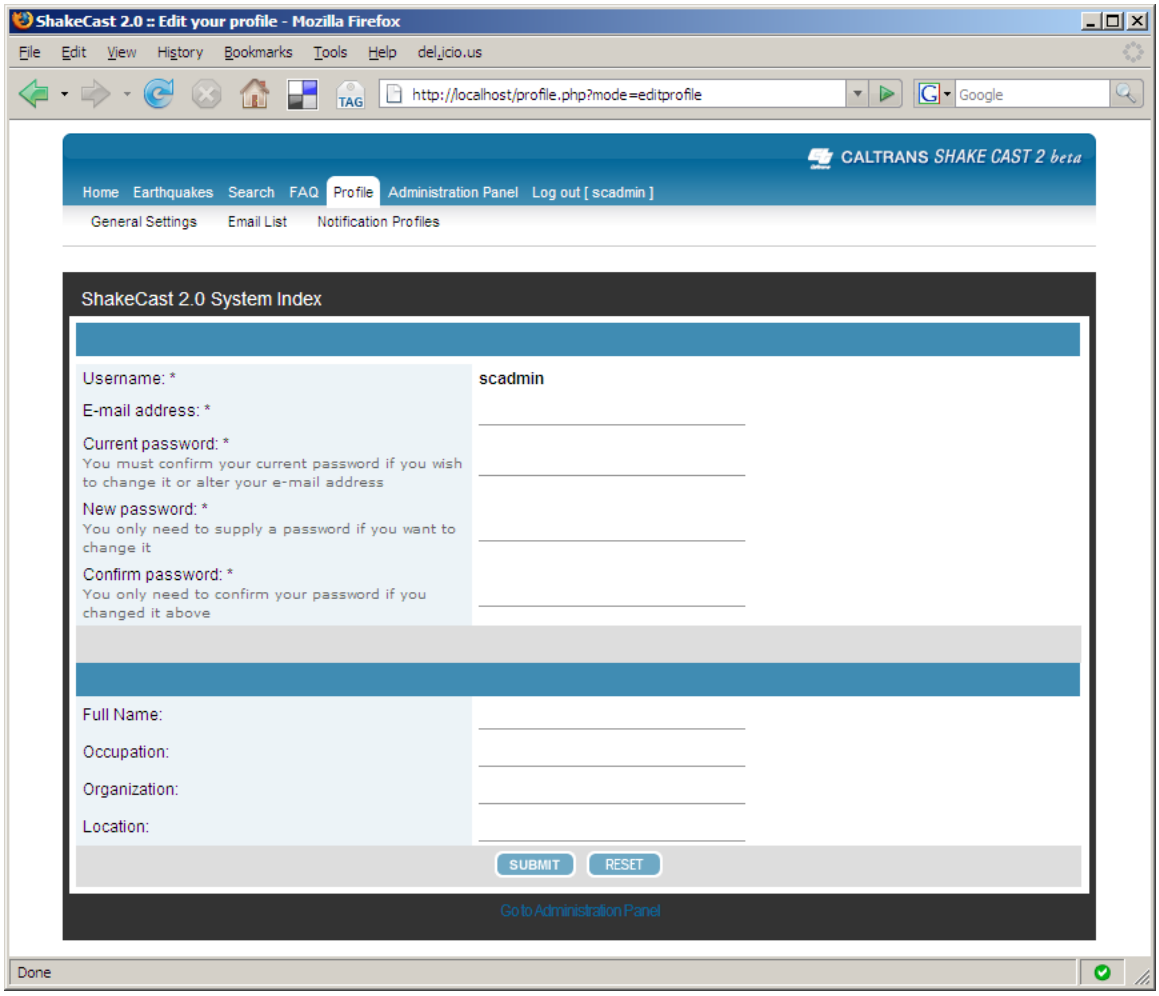


Figure 3.6 The General Settings page displaying editable information for a registered ShakeCast user. The user can use this form to update his/her password and contact information.

- Email List: displays an editable list of addresses that the ShakeCast user registered with the system (fig. 3.7). A user can register up to three different addresses for receiving content-rich HTML notification messages, plain text email notifications, or short text paging messages. The default email address will be used for receiving ShakeCast notifications if no custom addresses are specified in this panel. All newly registered delivery addresses are activated by either the user or system administrator. User activation is completed by clicking on an activation link in the confirmation message sent to the new delivery address. Before a delivery address is activated, a lock symbol will appear in the panel and no ShakeCast notifications will be delivered to that address.

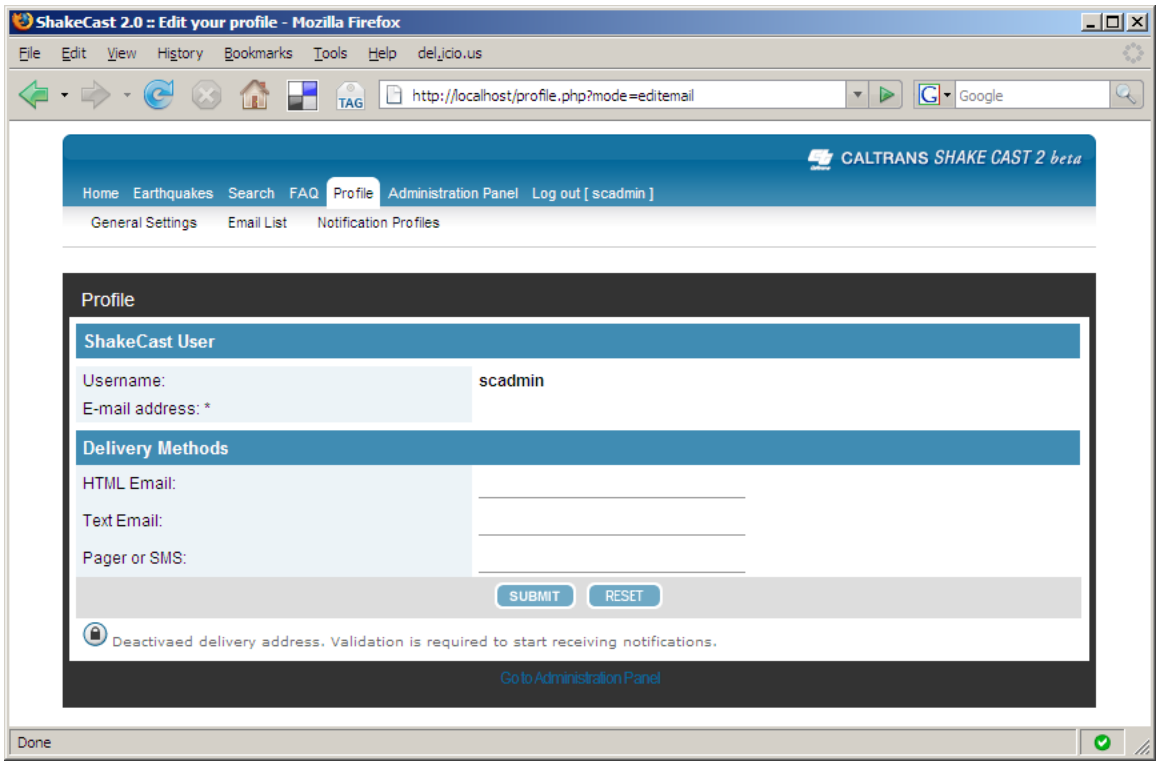


Figure 3.7 The Delivery Methods page displaying user defined email addresses for receiving ShakeCast notification. All new delivery addresses require activation before they can be used to receive notifications.

- Notification Profiles: displays a list of selectable notification profiles that are available to the user (fig. 3.8). To add a profile to a user's notification preference, click on the profile to highlight the selection. The coverage area will be shown in the map area. Uncheck a profile from the list to remove it from a user's preference. At the end of profile selections, the user will need to click on the button "Update Notification Profiles" to submit the changes to the ShakeCast database.

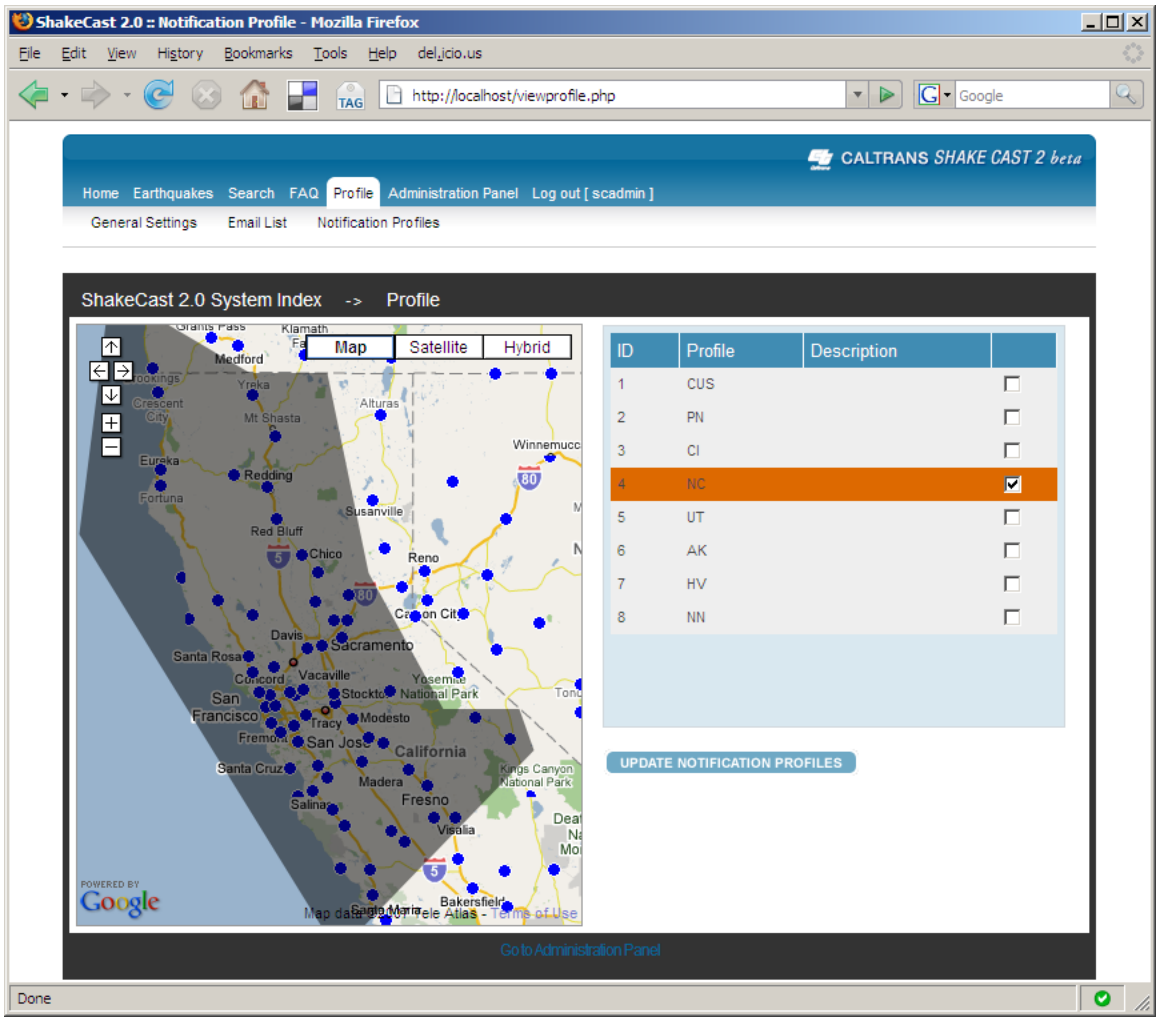


Figure 3.8 The Notification Profiles page displaying a list of predefined notification profiles to the user. A user can subscribe or unsubscribe a profile by checking and unchecking the profile in the table. Changes will take effect after the user submits the form.

3.11 User Registration

By default, a ShakeCast system is preconfigured with restricted access to registered users. The registration process is typically a two step process. In the first step a new user submits contact information to sign up for a new account as shown in figure 3.9 and will receive a confirmation email message for the submitted request. After the ShakeCast administrator receives and approves the request, the user will receive a second approval email message. To activate the account and to log in for the first time, click on the link provided inside the approval message. If a user account is created by an administrator, the new user will simply receive one confirmation email message for account activation.

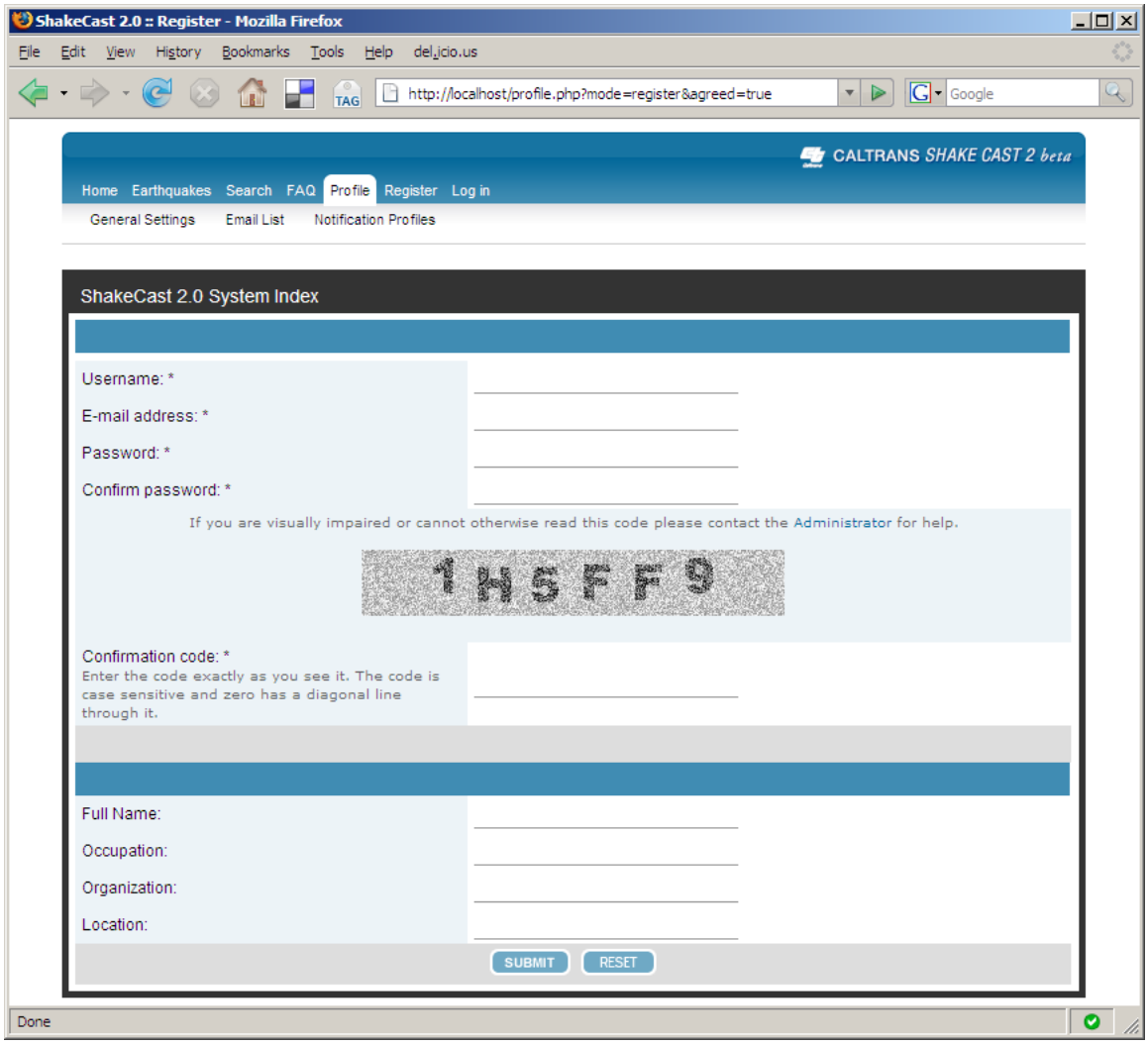


Figure 3.9 The Registration page displaying a form in which the prospective user submits contact information for review. Depending on system configuration, the user will receive one confirmation message for submittal and another for account activation.

4. ShakeCast Administrator Web Interface

This section describes the Administrator Web Interface of ShakeCast. The ShakeCast interface is designed for an administrator to perform common tasks ranging from management of both facility and user inventory to system wide maintenance and configuration. Access to the administrative page is restricted to ShakeCast users with administrative privileges. The range of tasks that can be performed from the interface includes: (1) earthquake/ShakeMap management; (2) system configuration; (3) facility management; (4) notification/profile management; and (5) user account and notification management.

The administrative page view displays a list of system management tasks in the left panel and the work area of the selected task in the right panel. Figure 4.1 shows the default page view when the page is first accessed. The right panel shows the current status of the ShakeCast system: (1) network connection with the upstream USGS server for ShakeMap RSS data feed; (2) system services and summary of process logs; (3) latest processed ShakeMap and notifications; and (4) code version of the current system and available script updates. For each of the first three server system functions, there is a color indicator in either green or red that reflects the status of the function.

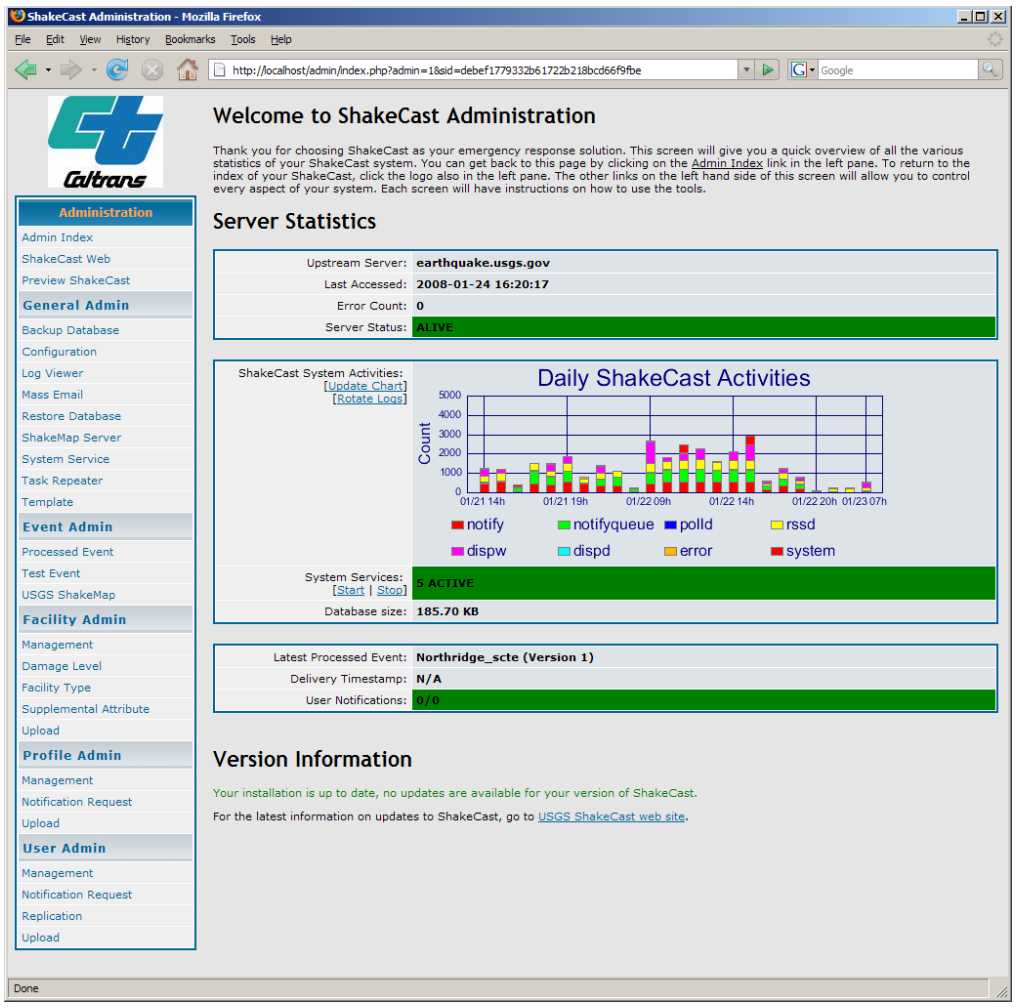


Figure 4.1 Default Web page of the ShakeCast administration interface.

Depending on the level of user privilege the ShakeCast system is configured, the administrator may or may not be able to perform all ShakeCast functions from the administrator Web interface. These limitations apply specifically to ShakeCast functions that require administer privileges on the local operating system. The ShakeCast administrator Web interface does not cover management for system level services and supporting software. There are currently five ShakeCast daemon services (dispatch, polling, RSS, notify queue, notify processes) and their configuration files that require direct access to the operating system. In addition to the ShakeCast system services, the same restriction also applies to supporting software including the Apache Web server and MySQL database applications. An administrator will need to log on to the server system where the ShakeCast system resides to make changes to the configuration files of applications and to start and stop ShakeCast system processes and supporting software.

4.1 General Administration

The general administration section allows a ShakeCast administrator to manage system wide tasks in six different categories: (1) Backup Database; (2) General Configuration; (3) Log Viewer; (4) Mass Email; (5) Restore Database; (6) ShakeMap Server; (7) System Service; (8) Task Repeater; and(9) Template.

4.1.1 Backup Database

This page allows an administrator to perform backup of the ShakeCast database, consisting of 70 tables. The backup options can be a combination of table structure and data as shown in figure 4.2. The output format is a single file in either plain text or compressed format. The backup copy can be used to restore the system database using the 'Restore Database' function described later.

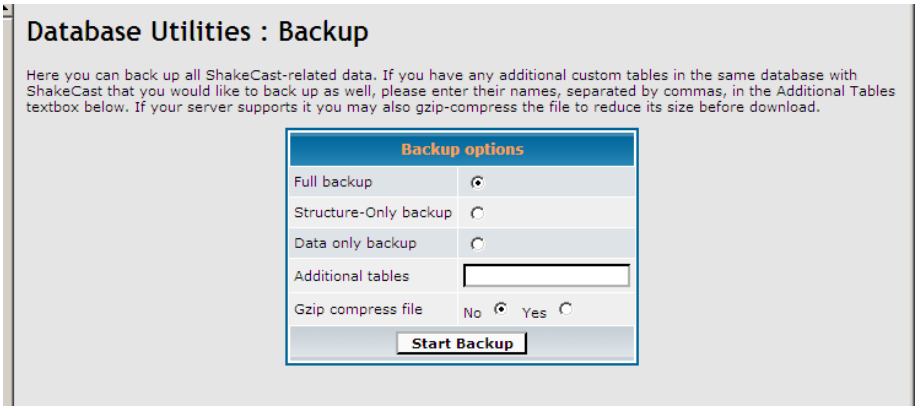


Figure 4.2 The database backup page has three backup options: full, structure-only, or data-only. After submitting the form, the administrator can specify the filename and location of the database backup file.

4.1.2 General Configuration

This page displays a list of configurable options of the system. These options include configurations of system identity and user page, session management, and external SMTP server.

System identity. The hostname and port fields describe the URL that a ShakeCast user will use to access the system (fig. 4.3). Each hostname requires a unique API key from the Google Maps server. User-related settings include account activation, access control, and Web page style.

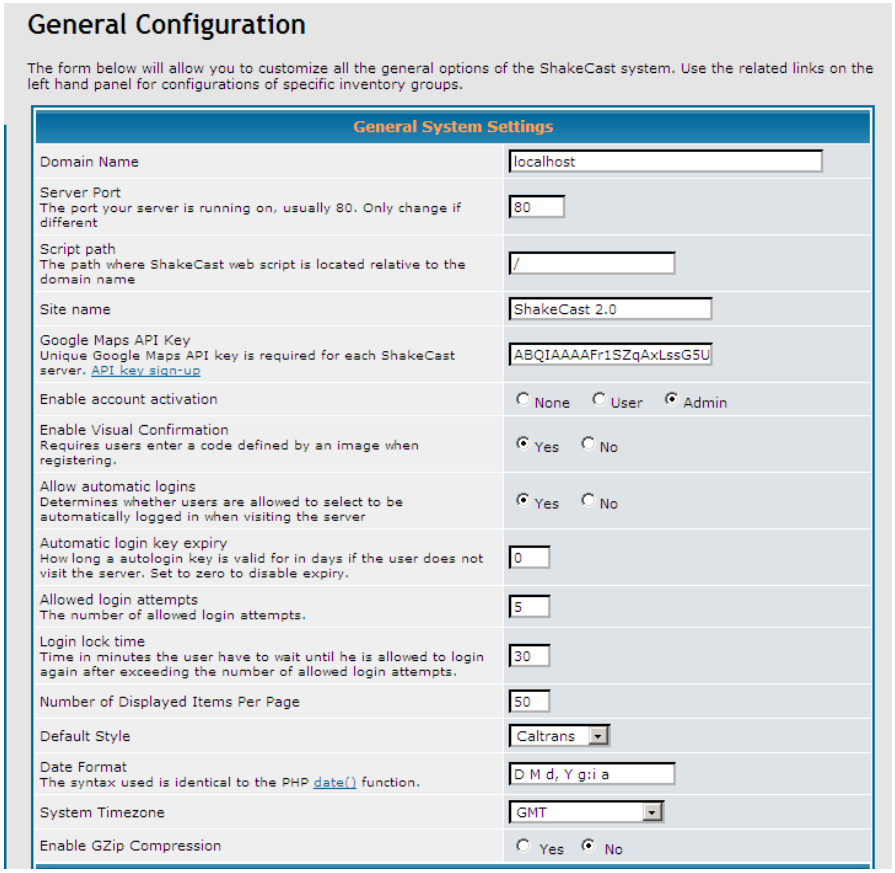


Figure 4.3 The general configuration page handleing system-wide options regarding system identity and policy settings.

Cookie settings. ShakeCast implements session control via a cookie stored on the user's Web browser during log-in. The administrator can use this setting (fig. 4.4) to configure the time period for each successful log-in.

Figure 4.4 The cookie settings determining the time window for persistent log-in and system identification on the remote system.

Email settings. This form contains information on the Email server (fig. 4.5) that the ShakeCast system or administrator uses to send email to the end users. This configuration also updates the settings of SMTP server information in "sc.conf" that the ShakeCast system uses to send email notifications. A utility script "sync_conf.pl" is included for synchronization of configuration settings.

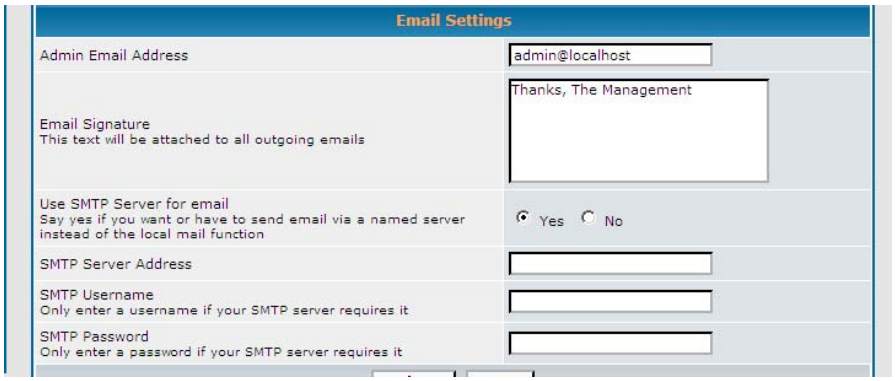


Figure 4.5 The Email Settings Block holding information of the email server for all email messages sent from the administrative interface.

4.1.3 Log Viewer

Figure 4.6 displays a list of log files that are available for viewing inside the ShakeCast log directory. The log directory is configurable under the **System Service** link described later in this section. Each log file row contains information regarding the filename, file size, and other ShakeCast services that are related to the log file. The only available function for a log file is **View**.

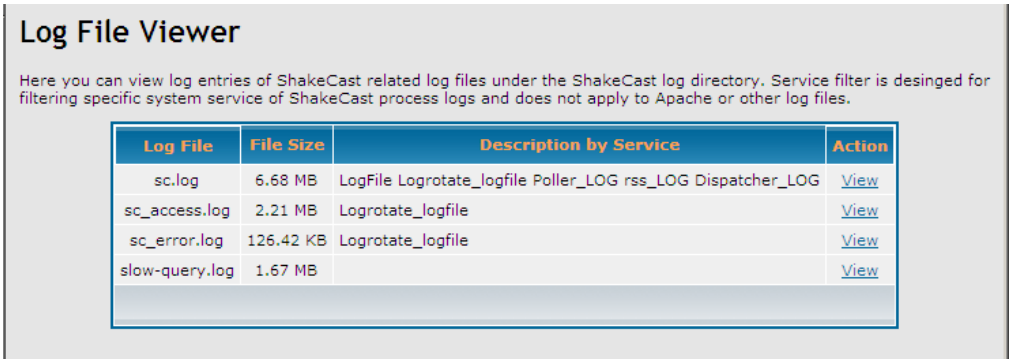


Figure 4.6 The ShakeCast Log File Viewer page listing available log files for viewing.

The administrator can click on the **View** link to review the content of the selected log file (fig. 4.7). By default, up to 500 most recent entries of the selected log file will be displayed in the view pane in ascending order. There are three viewing options on the bottom of the view pane for fine-tuning the listing order of log entries, filtering of ShakeCast services, and changing the number of displayed log entries.

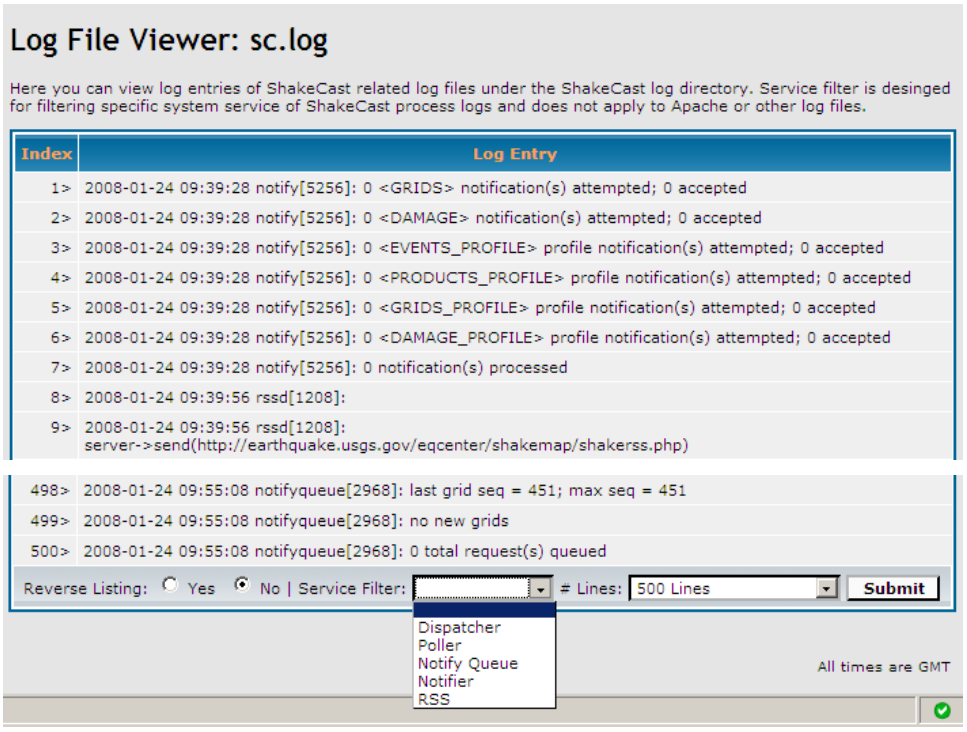


Figure 4.7 The ShakeCast Log File Viewer page for a selected log file. Selectable viewing options are located at the bottom of the view pane and consist of three options: Reverse Listing, Service Filter, and # Lines.

4.1.4 Mass Email

This page displays a form (Figure 4.8) for the administrator to compose an email message for delivery to the registered users.

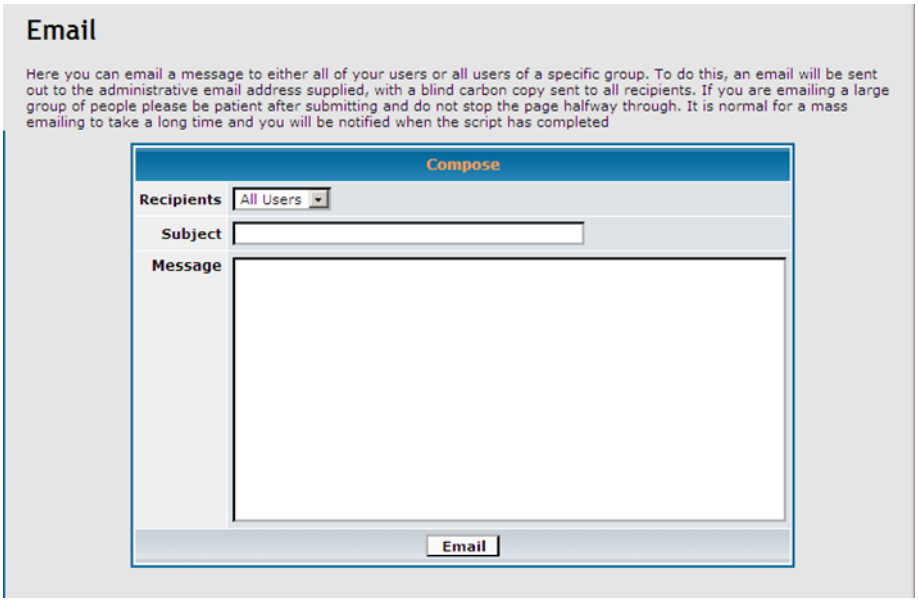


Figure 4.8 The email form page for composing an email message.

4.1.5 Restore Database

This page displays a dialog for the administrator to upload a backup file of the database as shown in figure 4.9. The database backup file can be generated from the ShakeCast backup function or from common database dumping utilities. This process will overwrite any existing data in the current system.

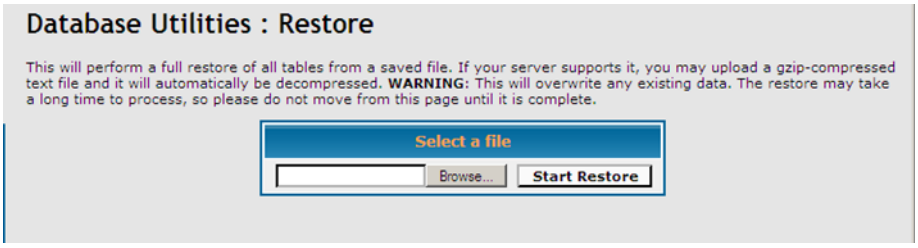


Figure 4.9 The Database Restore page. The source of backup file can be from previous backup operations or in a standard MySQL dump file.

4.1.6 ShakeMap Server

This page displays a list of trusted servers in which ShakeMap products reside (fig. 4.10); this list also includes the ShakeCast system itself. The ShakeCast system comes preconfigured with three default servers that should not be removed:

1. Server ID 1 contains the hostname that is allowed for injecting ShakeMap products into the current ShakeCast system. The default setting is “localhost.” Any changes to this server should also be applied to the “sc.conf” file.

2. Server ID 1000 is the ID of the current ShakeCast system. The default setting is “localhost” and should be changed to the hostname of the system on which the ShakeCast is installed.

3. Server ID 1302 is the upstream USGS Web server that hosts ShakeMap products for real time notifications. The USGS Web server consists of a cluster of servers, and the content of each server is cached by a commercial vender (Alkamai) for the purpose of rapid dissemination of information and robustness.

The new ShakeCast system also supports the server-client configuration of the original ShakeCast system. The administrator can consult documentation of Version 1 for details. Available functions for each server are **Edit**, **Delete**, and **Password**.

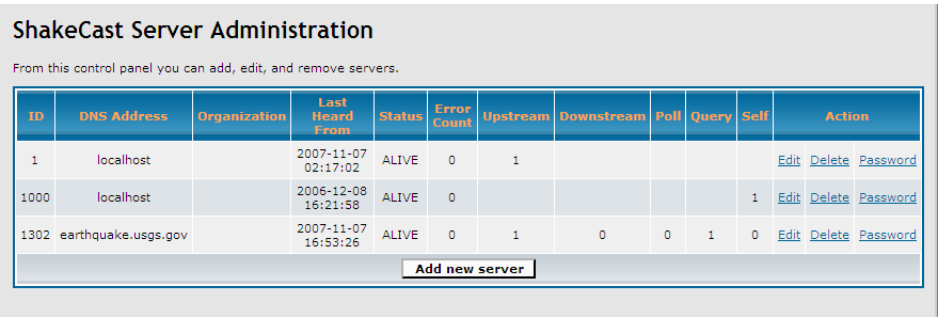


Figure 4.10 The ShakeCast Server Administration page listing available servers and their current status. The system comes with three default server settings and should not be altered.

Edit. The server form (fig. 4.11) contains server related information including identification and permitted functions.

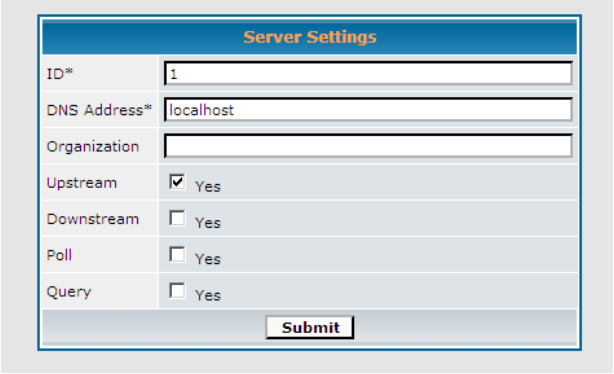


Figure 4.11 The Server Settings page for adding and editing servers to the ShakeCast database.

Delete. Remove information on the server entry from the database.

Password. Configure a password for accessing the designated server as shown in figure 4.12. Neither Server ID 1000 (local system) nor 1302 (USGS Web server) require a password for access. The system has a preconfigured password for incoming password for Server ID 1 (injection system). Any changes to the incoming password for a server will update the password file "sc-servers" for authentication by the Apache Web server.

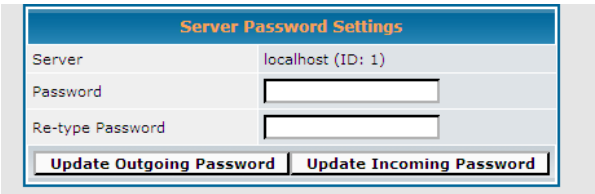


Figure 4.12 The Server Password Configuration page. It is reserved primarily for backward compatibility with the Version 1 ShakeCast system.

4.1.7 System Service

This page displays a list of configurable options for the system that dictates the behaviors of both ShakeCast system services and command line utilities. Changes of system service settings will be carried over to the plain file equivalent "sc.conf" file under the ShakeCast configuration directory. The only exception is the access and authentication information for the ShakeCast database, which is kept solely in the "sc.conf" file. It is recommended to restart ShakeCast services to force reload of configurations on changes specific to the system services.

Warning: Misconfigured system options will result in failed ShakeCast system services and utilities.

General system service settings. Figure 4.13 shows systemwide configurations for the ShakeCast installation. These options include directories for ShakeCast root, data, notification template, log file, etc. Additional run-time information includes logging level, and user and group ID, if applicable. Each hostname requires a unique API key from the Google Maps server. The "Threshold" field is a new option that only applies to system version 2.0.1 and later. It is an option to trigger ShakeCast processes for ShakeMap updates only if changes of ground motion measures exceed the specified threshold in percentage ratio. The "Threshold" option is disabled if the field is left blank.

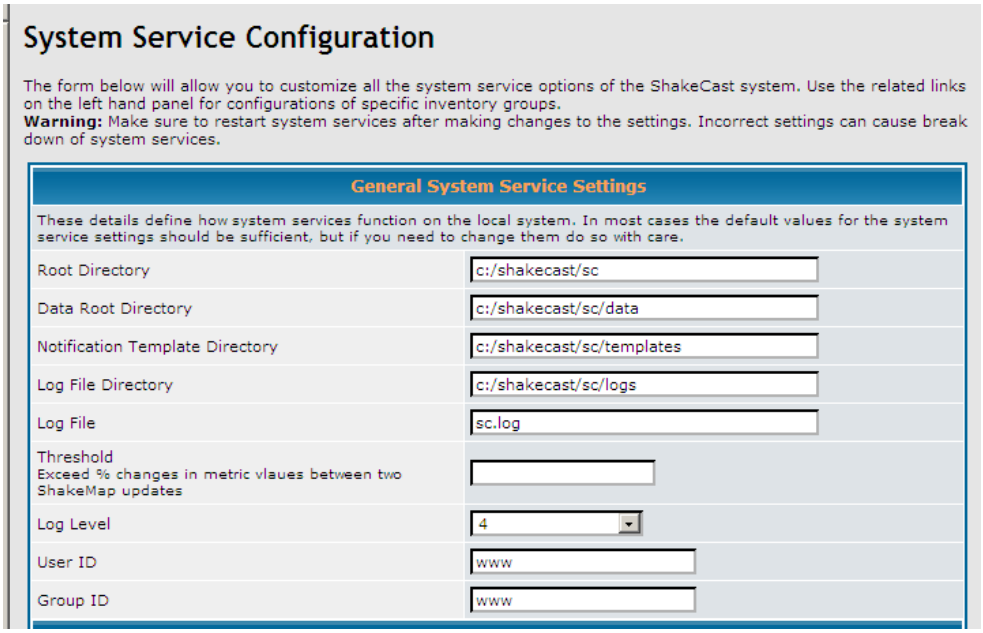


Figure 4.13 The General System Service Settings page handling system-wide options regarding all ShakeCast system services and command line utilities.

Local injection server settings. The form (fig. 4.14) contains information on the local server for injecting ShakeMaps into the database and triggering ShakeCast processes. Changes to the settings of the local injection server are usually not needed.

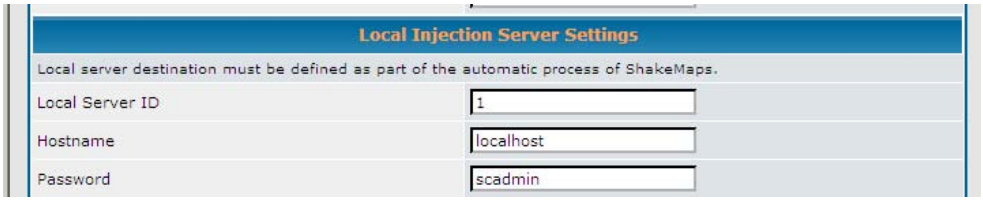


Figure 4.14 The Local Injection Server Settings determining the destination server and authentication information on the remote system.

Web server access control. This form contains information of the Apache Web server (fig. 4.15) which the ShakeCast system or administrator uses to generate password entries for access control. By default, the ShakeCast system is preconfigured with access control for server-to-server communications (including the default local server). User authentication is by default handled by the portal page. To enable or disable the access control settings, the administrator will need to edit the Apache configuration file directly.

Figure 4.15 The Web Server Access Control holding information of the Apache Web server for access control.

Dispatcher service. This form contains information of the ShakeCast Dispatcher Service (fig. 4.16). The Dispatcher Service is a background process that manages worker processes for both incoming and outgoing service requests.

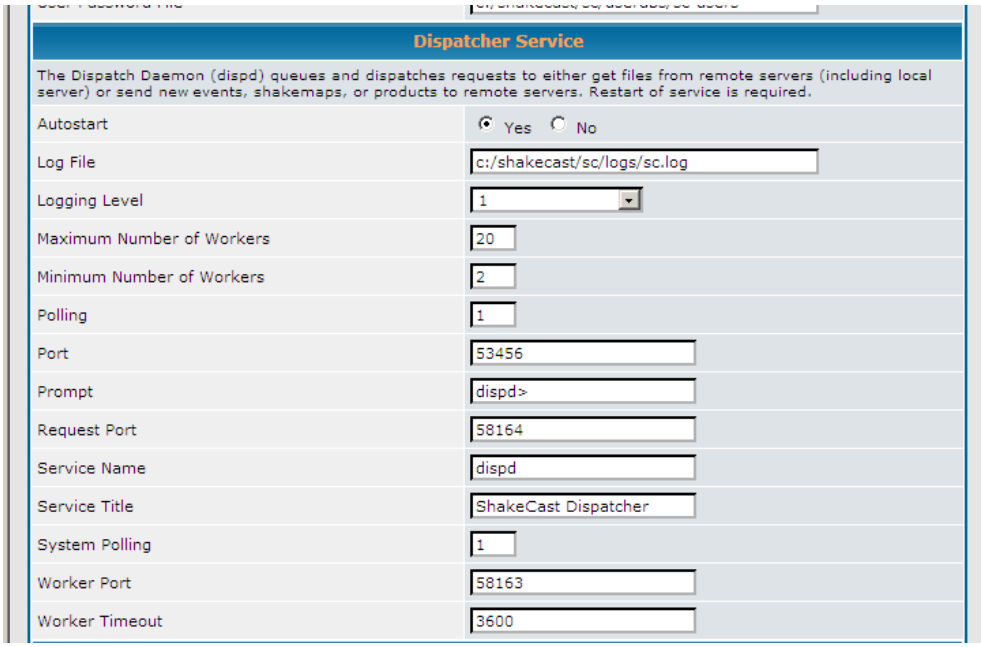


Figure 4.16 The Dispatcher Service holding information of the ShakeCast Dispatcher process.

Polling service. This form contains information of the ShakeCast Polling Service (fig. 4.17). The Polling Service is a background process that routinely polls ShakeMap information from remote ShakeCast servers specified in the "ShakeMap Server" block described earlier in this section.

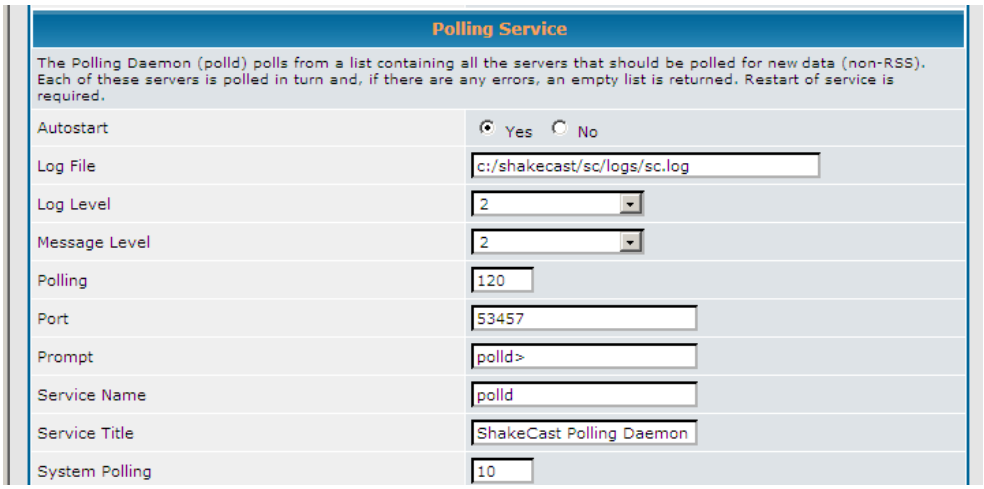


Figure 4.17 The Polling Service holding information of the ShakeCast Polling process.

Notification queuing service. This form contains information of the ShakeCast Notification Queuing Service (fig. 4.18). The Notification Queuing Service is primarily a background process but can be invoked from the command line. The process scans the database at the specified Scan Period (in seconds) for new ShakeMaps and creates notification queues based on the notification requests stored in the database.

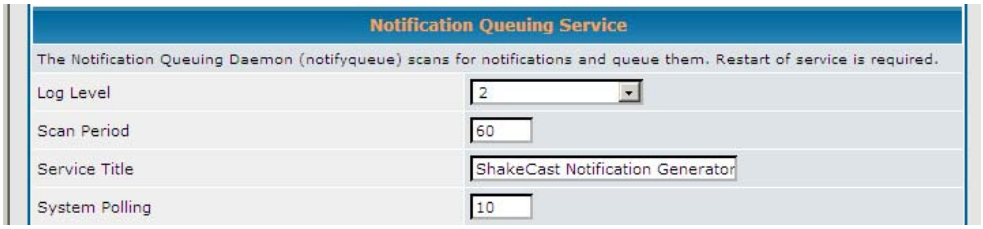


Figure 4.18 The Notification Queuing Service holding information of the ShakeCast Notification Queuing process.

Notification service. This form contains information of the ShakeCast Notification Service (fig. 4.19). Like the Notification Queuing Service, the Notification Service is primarily a background process but can be invoked from the command line. The process scans the database at the specified Scan Period (in seconds) for new notification queues then assembles and delivers notifications to users who subscribe to ShakeCast notifications.

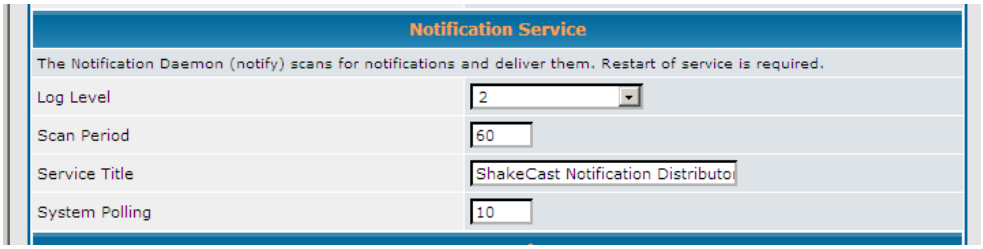


Figure 4.19 The Notification Service holding information of the ShakeCast Notification process.

RSS service. This form contains information of the ShakeCast RSS Service (fig.e 4.20). The RSS Service is a background process that routinely polls ShakeMap information from the USGS Web Server specified in the "ShakeMap Server" block described earlier this section. In addition to daemon specific information, the administrator can configure the service in the field "ShakeMap Originator Region" to retrieve region specific ShakeMaps. Table 2.1 lists available network codes for ShakeMaps. The field "Earthquake Time Window" is an optional filter that excludes ShakeMaps from being processed if the origin time of the event falls outside the active time window (in days).

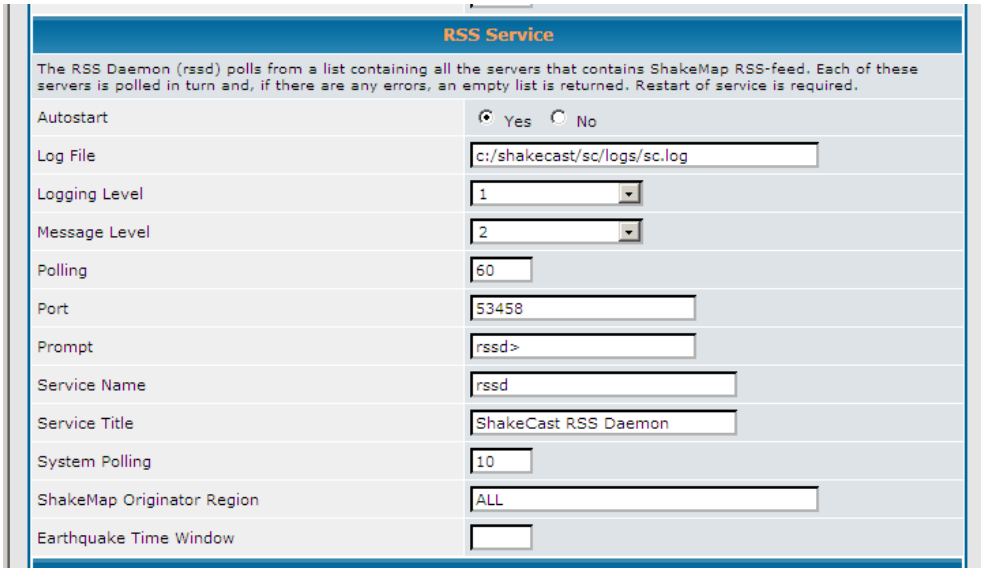


Figure 4.20 The RSS Service holding information of the ShakeCast RSS process.

Notification SMTP settings. This form contains information of the email server (fig. 4.21) that the ShakeCast system services use to send email to the end users. A utility script "sync_conf.pl" is included for synchronization of configuration settings.

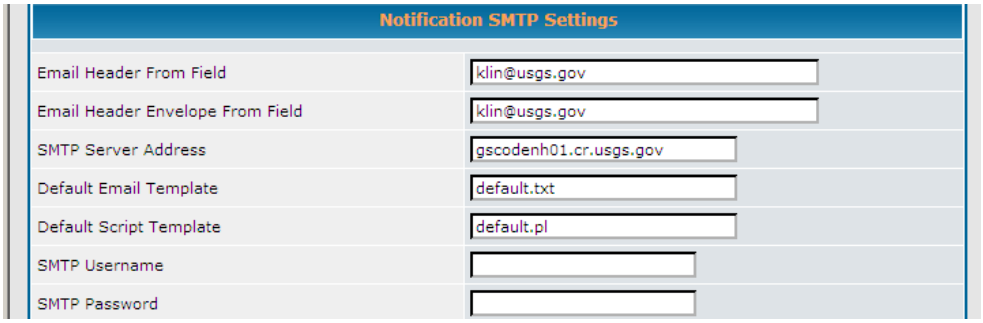


Figure 4.21 The Notification SMTP Settings Service holding information of the email server for all email messages sent by the ShakeCast system services.

Logrotate and logstats settings. This form contains information of both the logrotate and logstats ShakeCast utilities (fig. 4.22). Both command line utilities are ShakeCast add-ons and do not interfere with the core system services. The administrator can invoke the utilities from the DOS Window command line, the ShakeCast administrator default page, or the "Task Repeater" page (described next) as a scheduled task.

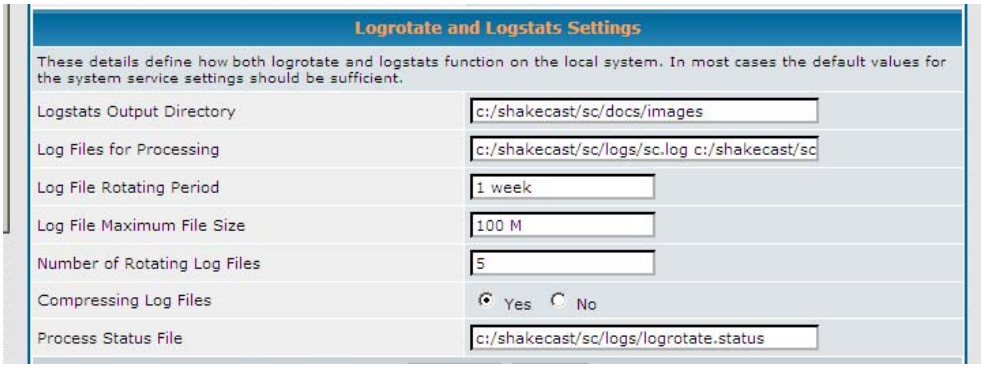


Figure 4.22 The Logrotate and Logstats Settings holding information of both the logrotate and logstats ShakeCast utilities.

4.1.8 Task Repeater

Figure 4.23 displays a list of scheduled tasks on the local ShakeCast system. The Task Repeater page converts a ShakeCast task request into a Windows Scheduled Task via the system function "schtasks." Thus, in order to schedule a ShakeCast task, the administrator will need both the username and password on which the ShakeCast software is installed. The available functions for the page are **Run**, **Delete**, and **Add**.

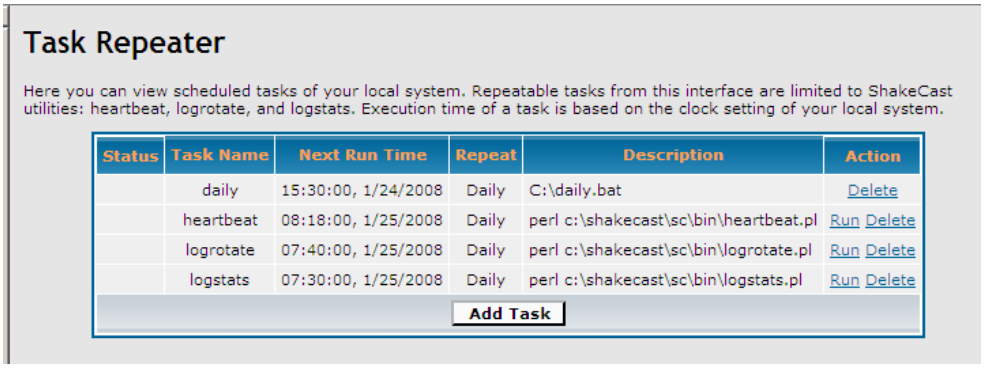


Figure 4.23 The ShakeCast Task Repeater page listing scheduled tasks on the local system and their run-time information.

Run. Execute the selected task immediately.

Delete. Remove the selected task from the local system.

Add. The editable form shown in figure 4.24 allows the ShakeCast administrator to schedule new tasks on the local system. Tasks available to schedule include `heartbeat`, `logrotate`, `logstats`, `shake_fetch`, and `tester`. Only one scheduled task is permitted for a unique task type. Additional command line options are needed for both `shake_fetch` and `tester` tasks. See Section 6.9 on required parameters for `shake_fetch` and Section 6.11 for `tester`.

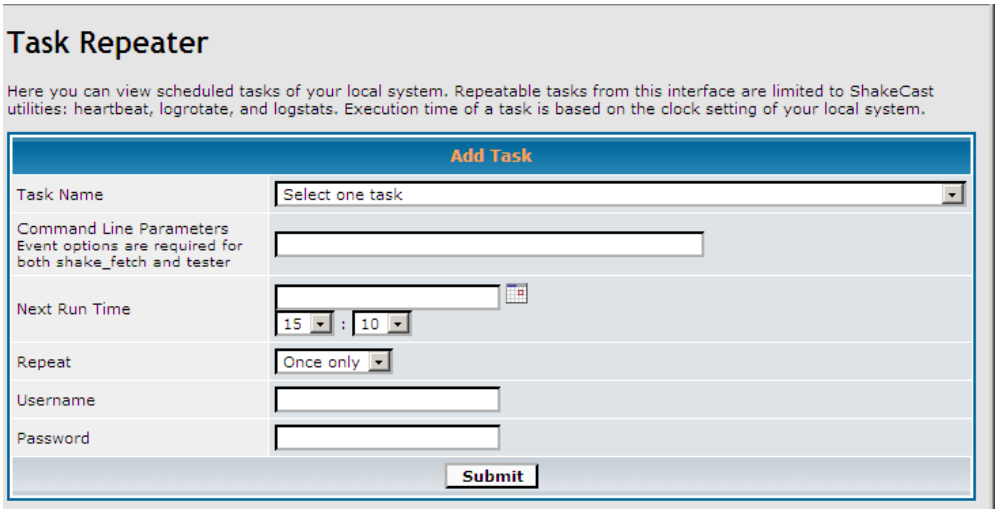


Figure 4.24 The Task Repeater Add page. The administrator can create scheduled tasks from five ShakeCast service utilities: heartbeat, logrotate, logstats, shake_fetch, and tester.

4.1.9 Template

Figure 4.25 displays a list of configurable notification templates that are available for the system. The templates are categorized in six different notification types, and each notification type consists of five different delivery methods—a total of 30 template variations. The six notification types are “Cancel Event,” “New Event,” “Updated Event,” “New Product,” “Facility Shaken,” and

"Facility Damage." The five different delivery methods are "Pager", "HTML Email", "Text Email", "Voice", and "Script." In addition to the default template, the administrator can create custom templates for any template variant. Each defined template is divided into three sections, the header, body, and footer, and files reside in the "templates" directory. This configuration does not apply to the ShakeCast Web pages. The available functions for each defined template are: **View**, **Edit**, and **Delete**.

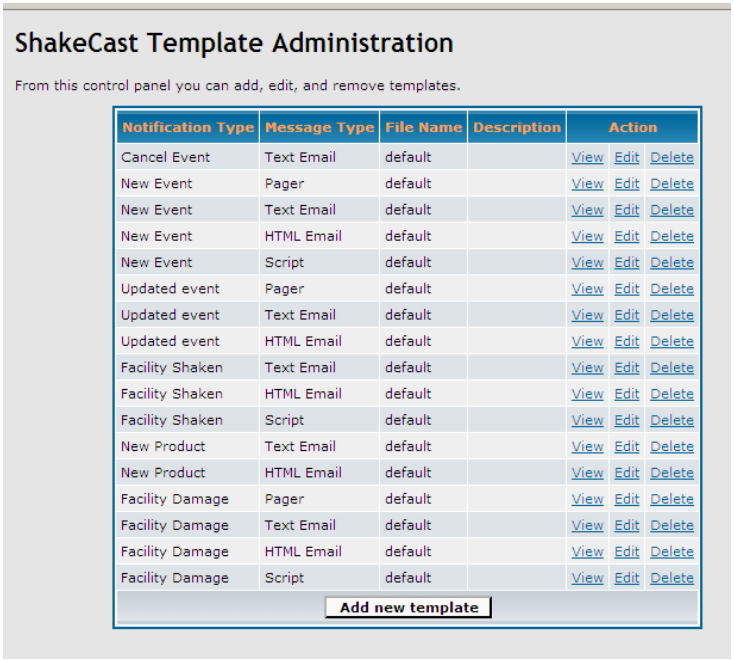


Figure 4.25 The ShakeCast Template Administration page listing available templates for sending notifications.

View. Show the content of the selected template (fig. 4.26).

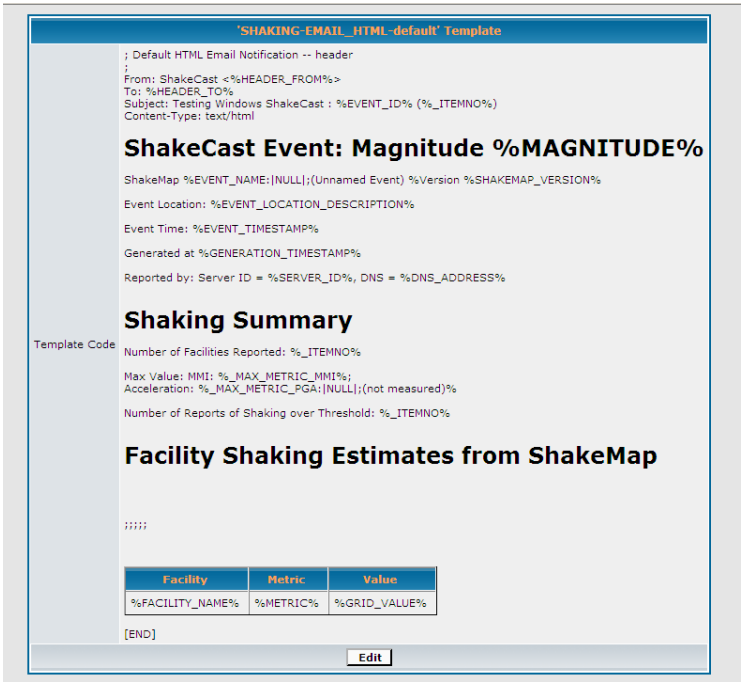


Figure 4.26 The ShakeCast Template Preview page. Each template file consists of three segment files: the header, body, and footer. It displays the layout and keywords embedded in the template file after joining the three individual segments.

Edit. The editable form shown in figure 4.27 allows the ShakeCast administrator to create/edit both existing and new templates. A template variant only allows for one "default" template. Custom templates can be created by giving the template a new template name and filename other than "default."

Delete. Remove information on the template entry from the database and the local file system.

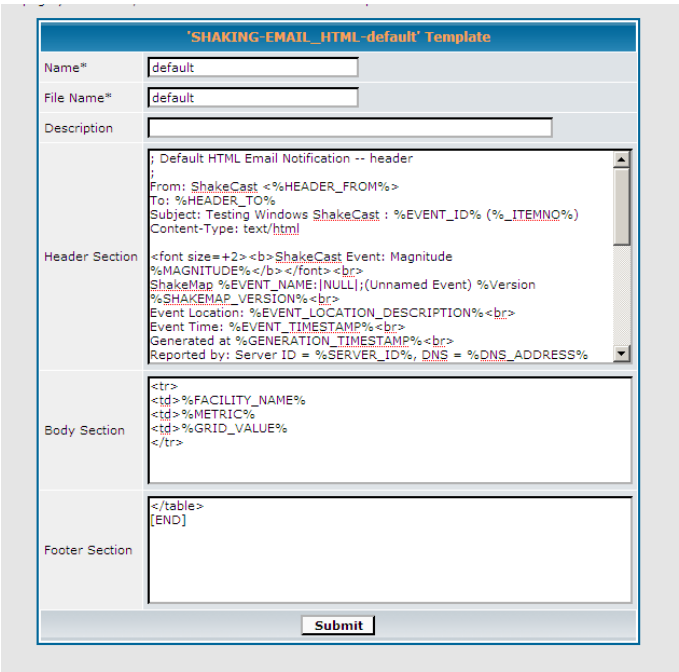


Figure 4.27 The ShakeCast Template Edit page. The administrator can copy and paste a custom design into the editable box for each segment. If given a custom template name other than "default," the system will create custom template files based on the given template name and register them in the database.

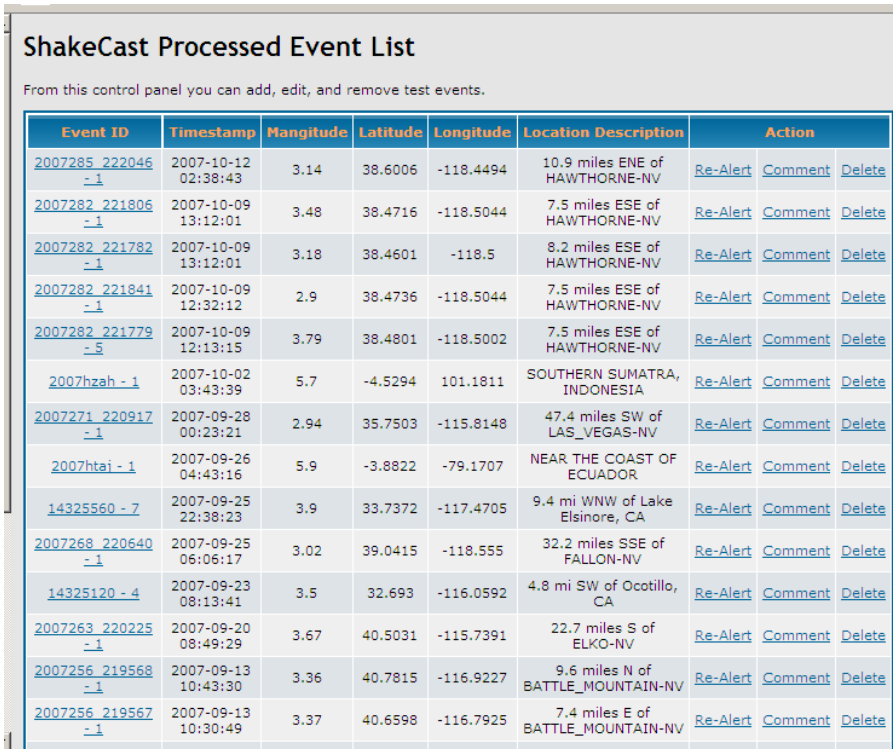
4.2 Event Administration

The **Event Administration** section allows a ShakeCast administrator to manage ShakeMap events in three different categories: (1) processed ShakeMap events; (2) ShakeCast test events; and (3) additional ShakeMap inventory on the USGS Web site.

4.2.1 Processed Event

This page displays a list of both actual and scenario ShakeMaps (fig. 4.28) that have been processed by ShakeCast and are present in the database. Available functions for each processed event are **Re-Alert**, **Comment**, and **Delete**.

Re-Alert. The **Re-Alert** function triggers the ShakeCast notification process to re-send notifications to ShakeCast users who were on the recipient list. The list of recipients and facilities is based on the time the event was processed.



ShakeCast Processed Event List

From this control panel you can add, edit, and remove test events.

Event ID	Timestamp	Mangitude	Latitude	Longitude	Location Description	Action		
2007285_222046 - 1	2007-10-12 02:38:43	3.14	38.6006	-118.4494	10.9 miles ENE of HAWTHORNE-NV	Re-Alert	Comment	Delete
2007282_221806 - 1	2007-10-09 13:12:01	3.48	38.4716	-118.5044	7.5 miles ESE of HAWTHORNE-NV	Re-Alert	Comment	Delete
2007282_221782 - 1	2007-10-09 13:12:01	3.18	38.4601	-118.5	8.2 miles ESE of HAWTHORNE-NV	Re-Alert	Comment	Delete
2007282_221841 - 1	2007-10-09 12:32:12	2.9	38.4736	-118.5044	7.5 miles ESE of HAWTHORNE-NV	Re-Alert	Comment	Delete
2007282_221779 - 5	2007-10-09 12:13:15	3.79	38.4801	-118.5002	7.5 miles ESE of HAWTHORNE-NV	Re-Alert	Comment	Delete
2007hzah - 1	2007-10-02 03:43:39	5.7	-4.5294	101.1811	SOUTHERN SUMATRA, INDONESIA	Re-Alert	Comment	Delete
2007271_220917 - 1	2007-09-28 00:23:21	2.94	35.7503	-115.8148	47.4 miles SW of LAS_VEGAS-NV	Re-Alert	Comment	Delete
2007htaj - 1	2007-09-26 04:43:16	5.9	-3.8822	-79.1707	NEAR THE COAST OF ECUADOR	Re-Alert	Comment	Delete
14325560 - 7	2007-09-25 22:38:23	3.9	33.7372	-117.4705	9.4 mi WNW of Lake Elsinore, CA	Re-Alert	Comment	Delete
2007268_220640 - 1	2007-09-25 06:06:17	3.02	39.0415	-118.555	32.2 miles SSE of FALLON-NV	Re-Alert	Comment	Delete
14325120 - 4	2007-09-23 08:13:41	3.5	32.693	-116.0592	4.8 mi SW of Ocotillo, CA	Re-Alert	Comment	Delete
2007263_220225 - 1	2007-09-20 08:49:29	3.67	40.5031	-115.7391	22.7 miles S of ELKO-NV	Re-Alert	Comment	Delete
2007256_219568 - 1	2007-09-13 10:43:30	3.36	40.7815	-116.9227	9.6 miles N of BATTLE_MOUNTAIN-NV	Re-Alert	Comment	Delete
2007256_219567 - 1	2007-09-13 10:30:49	3.37	40.6598	-116.7925	7.4 miles E of BATTLE_MOUNTAIN-NV	Re-Alert	Comment	Delete

Figure 4.28 The Processed Event List page listing all previously processed ShakeMaps for the local system. From here the administrator can view, re-alert, comment, or delete any processed ShakeMap events.

Comment. The **Comment** function (fig. 4.29) allows a ShakeCast administrator to attach additional information to a processed event, via email notification and (or) Web posting. The target of email comment only applies to the list of recipients who received ShakeCast notifications for the specified event.

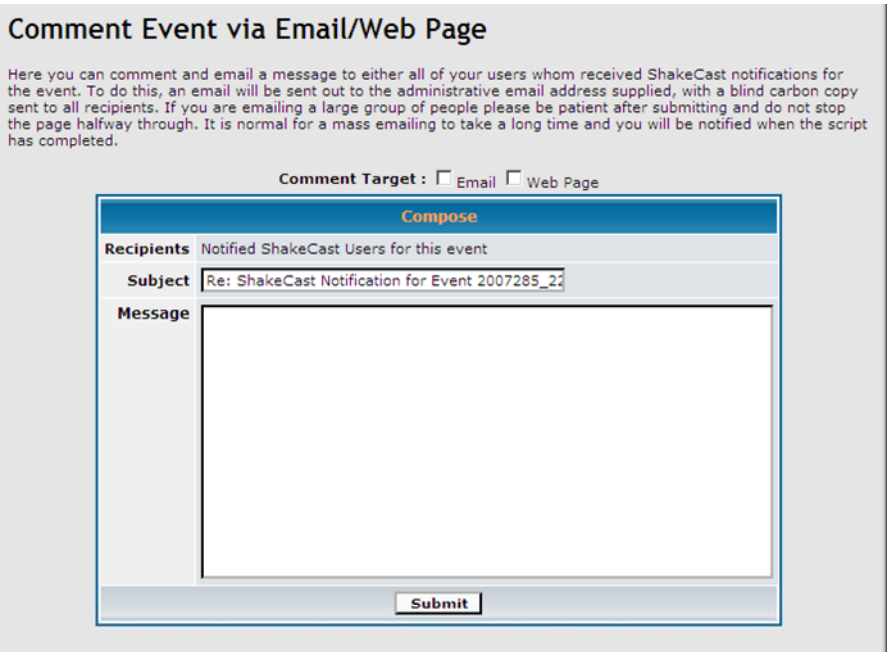


Figure 4.29 The Event Comment page allowing the administrator to add additional information for the specified event for ShakeCast users whom are the recipients of notifications and/or on the ShakeCast portal page for the event.

Delete. The **Delete** function removes all processed information for the specified event including event information, metrics, and notifications from the database. This function is typically used to remove unwanted events from the database and to reprocess selected ShakeCast events. This function does not remove ShakeMap products from the ShakeCast download directory.

4.2.2 Test Event

This page displays a list of processed ShakeMaps that are available for the purpose of local testing (fig. 4.30). To trigger a test event, click on the links in the **Action** column to simulate either a new or an updated event. Notifications generated from test events are sent to ShakeCast users whose notification profiles are configured to also receive test events. To add a processed ShakeCast event to the test event list, click on the "Add new test event" button on the bottom of the page and select an event from a list of processed ShakeCast events. To remove a test event, delete the event from the ShakeCast test event directory on the local file system.

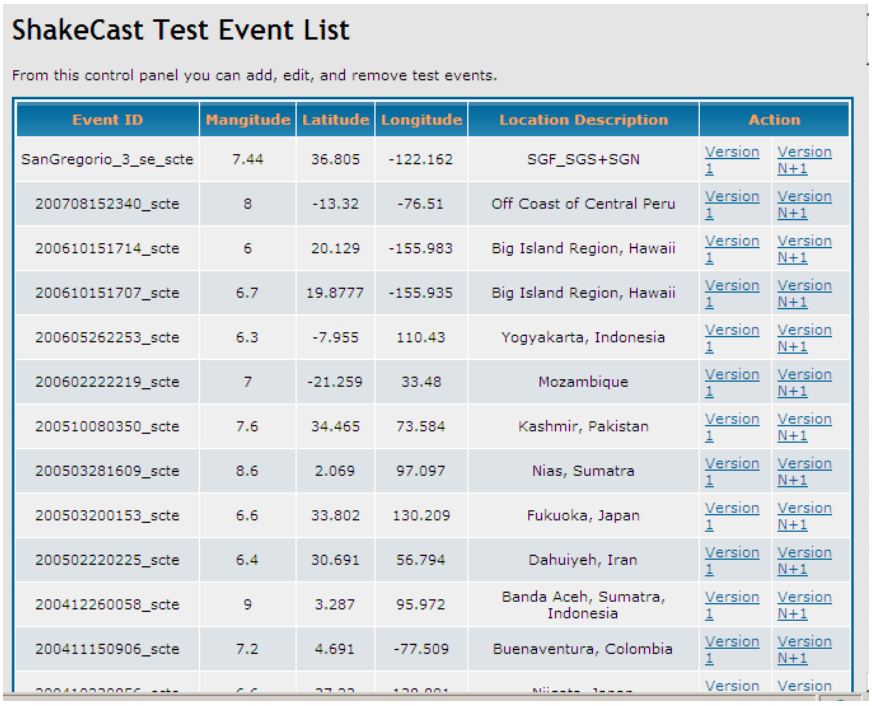


Figure 4.30 The ShakeCast Test Event List page listing available test events residing on the local system. From this interface, an administrator can trigger a local test event or convert a processed ShakeMap into a test event.

4.2.3 USGS ShakeMap

This interface retrieves a list of both actual and scenario ShakeMaps from the USGS Web site that are available for download and process as shown in figure 4.31. The two available options for a ShakeMap event are **Download Only** and **Inject**. The **Download Only** function retrieves all available products for a ShakeMap and stores them in the ShakeCast data directory on the server system. The **Inject** function performs the same **Download Only** function plus an additional ShakeCast process for the ShakeMap event, as for the real-time RSS system process. The **Inject** function is different from the RSS process in that it is not restricted to the ShakeMap region directive of the RSS process and that it can also process scenario ShakeMaps. The ShakeCast administrator should use the **Inject** function with caution since the process treats actual USGS ShakeMaps as real events.

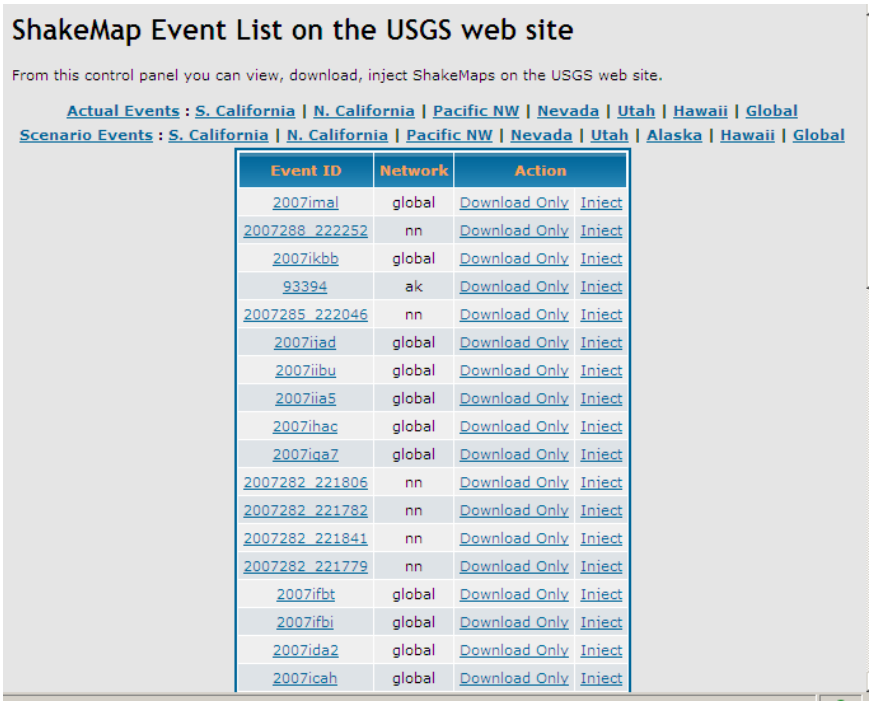


Figure 4.31 The USGS ShakeMap page listing available ShakeMaps on the USGS Web server for both actual and scenario events. From this interface the administrator can download and inject the ShakeMap directly into the local ShakeCast system. This function overwrites the `REGION` directive in the system configuration and will process ShakeMaps for actual events as real events. It will skip events that have already been processed.

4.3 Facility Administration

The **Facility Administration** section handles facility-specific interaction with the ShakeCast system. This management section is divided into five categories: (1) Damage Level; (2) Facility Type; (3) Facility Management; (4) Supplemental Attributes; and (5) Upload. Changes made in the four categories have different scopes of influence. The **Damage Level** settings apply to all facilities in the ShakeCast database. Settings for both **Facility Type** and **Supplemental Attributes** are defined for specific structure types. Finally, **Facility Management** allows management of facility-specific information. It is worth noting that any changes made to **Damage Level** and **Facility Type** will not affect corresponding settings for existing facilities inside the database and will only apply to new facilities. In addition to manual editing of facility settings, the administrator can use the "manage_facility.pl" tool to refresh settings of all facilities via batch processing.

4.3.1 Damage Level

This page displays a list of available damage state descriptions for facilities (fig. 4.32). The ShakeCast system is preconfigured with a four-level damage classification. The number of damage levels is flexible and the ShakeCast administrator can create additional damage states for custom needs. Although defined damage levels are available to all facilities for damage assessment, it is not necessary to specify the range of ground intensity measures for all damage levels for a given

facility. Unspecified damage levels of a facility will simply not be used to measure the damage state for the facility.

Figure 4.32 The Damage Level Administration page listing defined damage levels on the local server. The ShakeCast system has prebuilt four damage level settings that match the HAZUS damage level settings. If custom damage levels are added to the system, the administrator should recheck the integrity of the default fragility settings for existing facilities.

4.3.2 Facility Type

This page displays a list of available definitions for structure types of facilities (fig. 4.33). Each facility type includes a set of optional fields of default fragility settings. The ShakeCast system comes with default fragility settings for 128 choices of HAZUS model building type and code era (see the document "HAZUS Damage Level" for detailed definitions). The database also contains definitions of common geotechnical structures, but includes no fragility settings. ShakeCast users can define custom structure types for their facilities. To define damage states for a given facility type as shown in figure 4.34, the ShakeCast administrator will need to provide the range of high and low values of the described damage level and the metric of ground intensity measure.

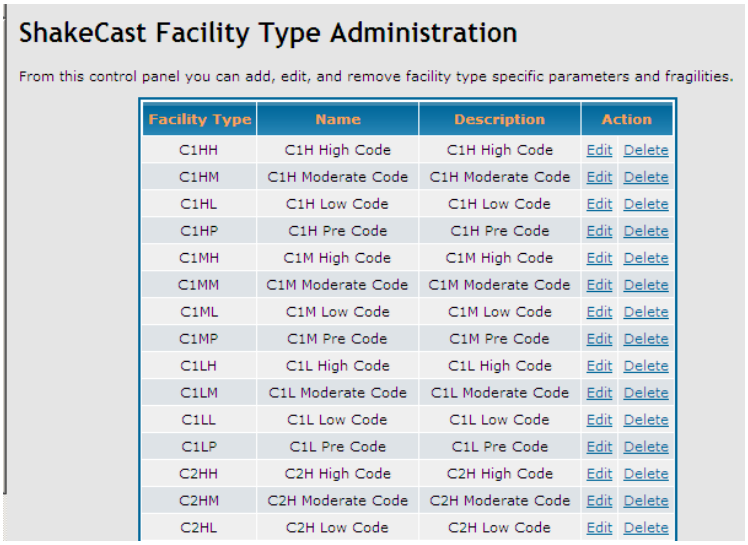


Figure 4.33 The Facility Type Administration page of the ShakeCast administration interface. The ShakeCast comes with more than 150 predefined common facility types. Custom defined facility types can be added from this interface.

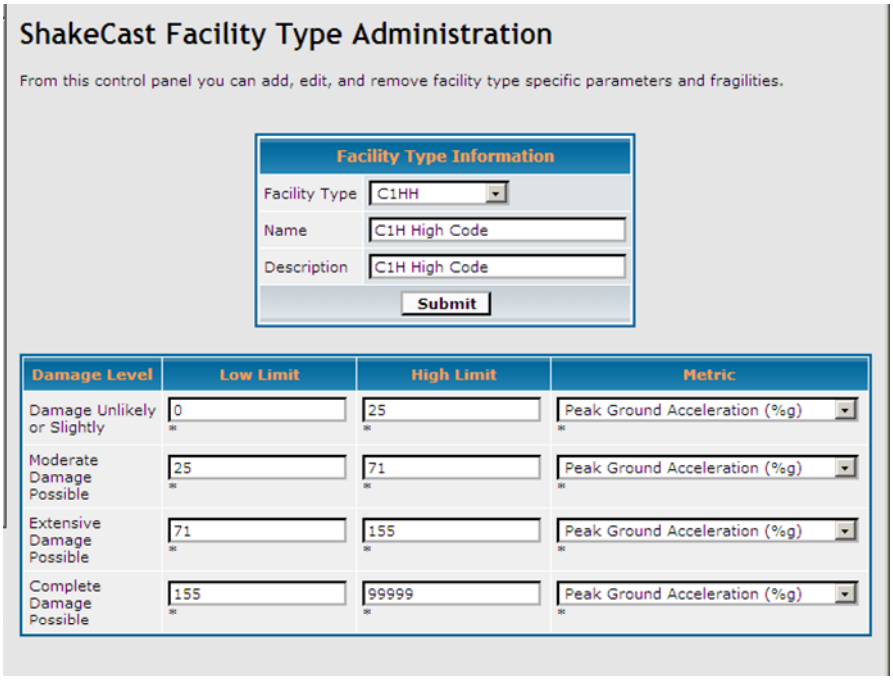


Figure 4.34 The Facility Type Editing page. ShakeCast comes with default fragility settings for common building types, code level, and code era. Custom fragility settings can be added via the facility type editing page.

4.3.3 Management

This page displays a list of user-defined facilities populated in the ShakeCast database (fig. 4.35). From this view the administrator can create new facilities and manage information of

existing ones. When updating the facility inventory, the administrator can also remove the system cache of facility image tiles by checking the "Clear Cache" checkbox. The button **Export Facility** will convert the current facility inventory into a standard CSV formatted text files including fragility settings and facility specific attributes. The format of the file is described in detail in Section 6.5. An exported facility file can be imported back to the ShakeCast database via either the **Upload** function (described later this section) or the command line utility "manage_facility.pl" (see Section 6.5).

Required fields for a user-defined facility include facility name, facility type, and location in latitude and longitude (fig. 4.36). Facility location can be either a point location or a rectangular area. Fragility settings for a facility are needed for damage estimates. Custom fragility settings for a facility, either in values and (or) choices of metric, will override the default settings for the given facility type. For ShakeCast systems with large inventories of facilities, the administrator can use either the **Upload** function or the system utility "manage_facility.pl" to populate new facilities and to update/remove existing ones.

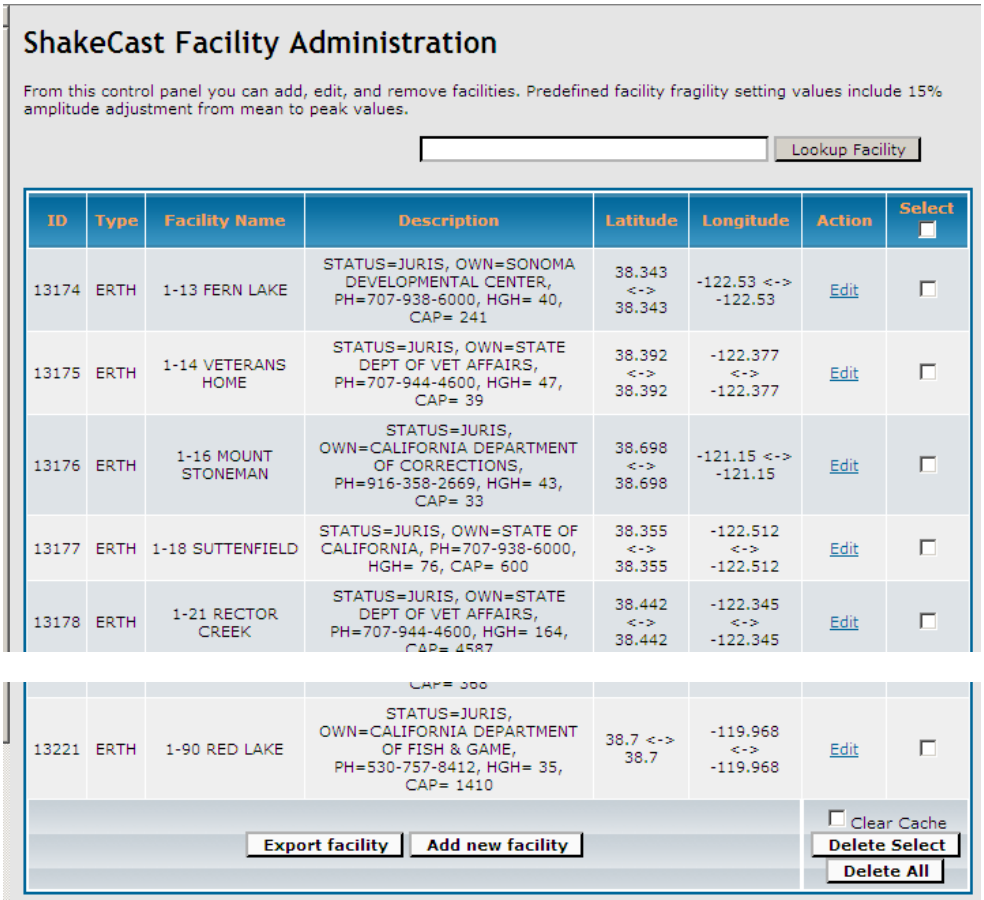


Figure 4.35 The Facility Administration page displaying a list of user-defined facilities on the local system. Available options for facility management are **Add**, **Edit**, or **Delete**.

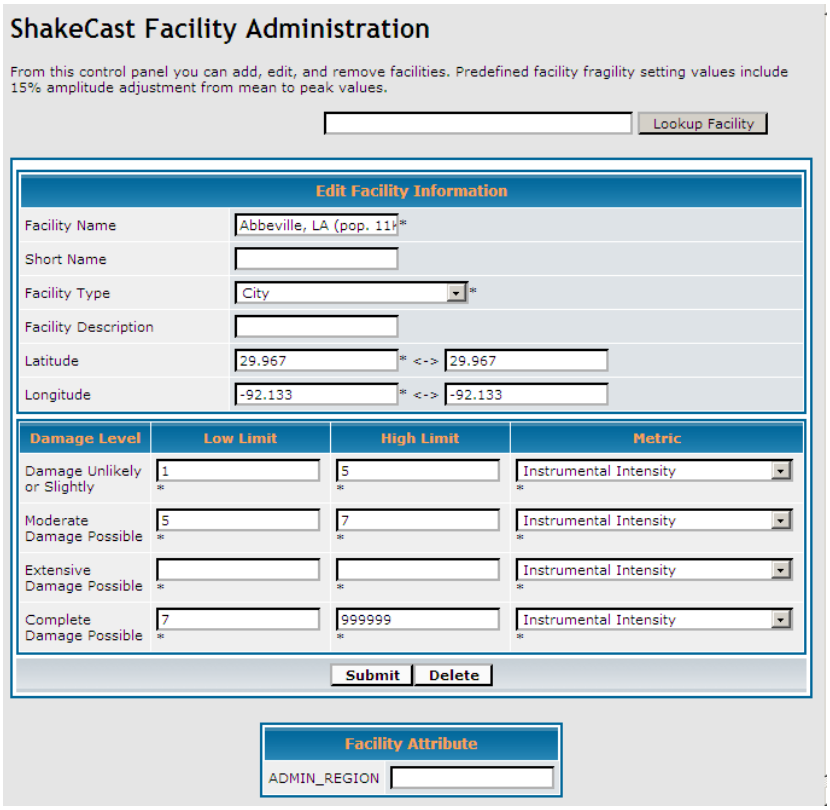


Figure 4.36 The Facility Editing page displaying a form containing facility-specific information and optional fragility-setting information, either default or custom values.

4.3.4 Supplemental Attribute

This page displays a list of defined attributes associated with structure types. The supplemental attribute block is a free-form field and multiple fields are permitted. It is designed to store specific information for facility types that are not commonly shared among facilities.

4.3.5 Upload

This page displays a dialog for the administrator to upload a facility file into the database as shown in figure 4.37. A facility file can be generated from the ShakeCast facility export function or from common spreadsheet applications such as Excel. This interface uses the "manage_facility" utility to process uploaded facility data. Available process options are `Replace`, `Insert`, `Delete`, `Update`, and `Skip`. Detailed descriptions of these options and input file formats are included in Section 6.5.

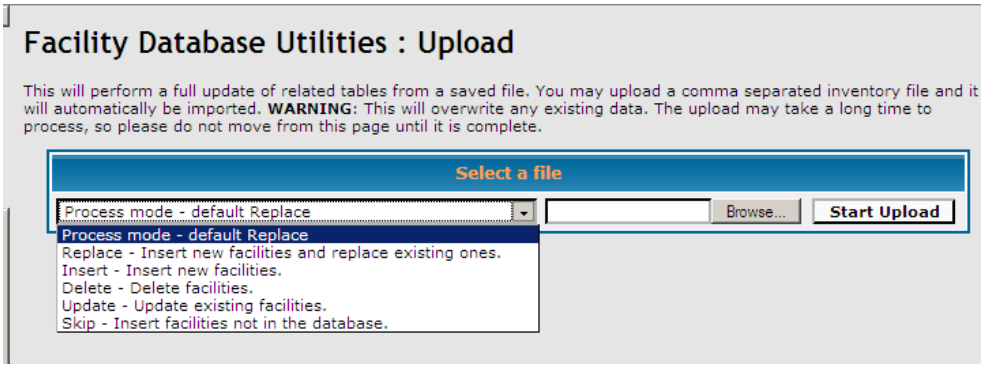


Figure 4.37 The Facility Upload page. The source of facility file can be from a previously exported facility file or in a standard facility CSV file. This interface uses the "manage_facility" utility to process uploaded facility data. Available process options are Replace, Insert, Delete, Update, and Skip.

4.4 Profile Administration

A ShakeCast profile can be viewed as a pseudo user who represents a group of users with shared notification requests but different delivery methods. ShakeCast notification profiles are optional for setting up notification for systems with relatively small facility inventory or with a number of users. For larger systems, notification profiles provide an efficient method to limit the growth of the database and to maintain performance of notification processing by aggregating common notifications.

The profile administration section handles management of profiles with respect to both facilities and notification requests. This management section is divided into three categories: (1) management of profile geometry polygons for facility association; (2) notification request for profile; and (3) upload of profiles. As for facility management, there is a command line counterpart of the Web interface, "manage_profile.pl." For systems with large inventory, the administrator can use the "manage_profile.pl" tool to refresh settings of all profiles via batch processing.

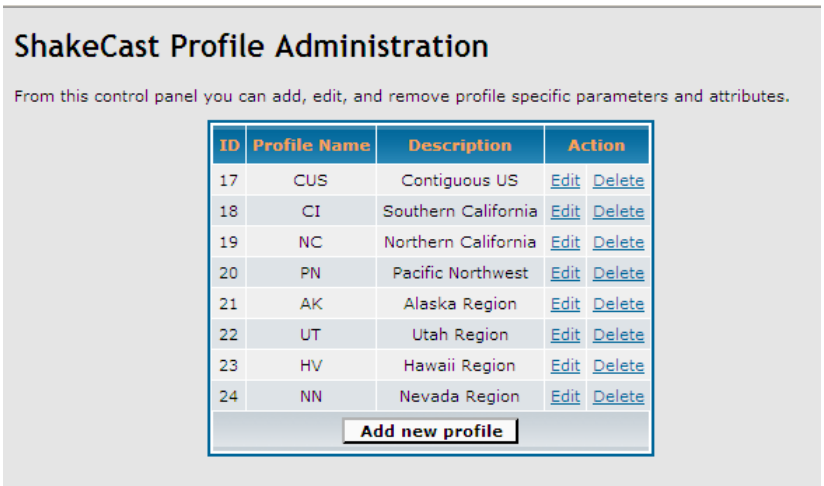


Figure 4.38 The Profile Administration page listing defined profiles on the local system that are available to the ShakeCast users for subscription.

4.4.1 Management

This page displays a list of defined profiles to which a user can subscribe for notification requests (fig. 4.38). Each profile consists of a geometric polygon outlining the region of interest and a set of notification requests for the enclosed facilities. The administrator defines the polygon via the interactive map and with the additional options for selecting rectangular and circular regions (fig. 4.39). Upon submitting the form, a list of facilities enclosed by the geometric boundaries will be assigned to the profile. The list of facilities for a profile is not restricted to the facilities enclosed inside the polygon and can be edited later.

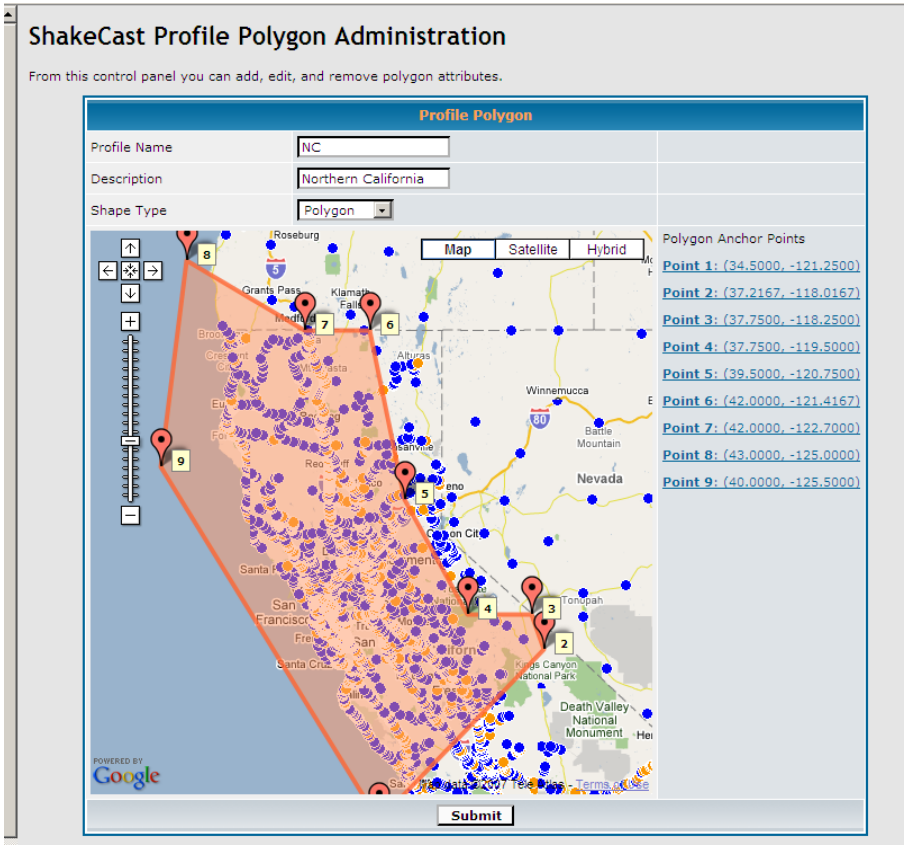


Figure 4.39 The profile polygon page displaying a Google Maps-based GIS interface of a defined polygon for the profile. The administrator can modify the boundaries of the polygon or switch to other geometric forms, including rectangular and circular boundaries.

4.4.2 Notification Request

This page displays a list of available notification requests configured for each profile (fig. 4.40). From this view the administrator can select a profile and edit or remove its notifications.

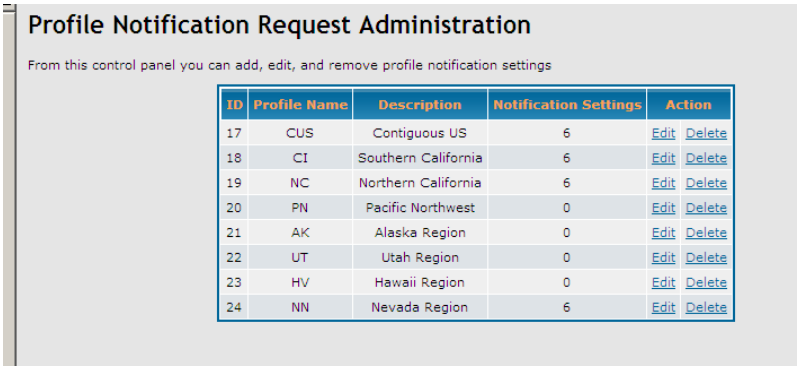


Figure 4.40 The Profile Notification Request Administration summary page listing available profiles and their notification request settings. The administrator can edit or delete notification request settings associated with a profile from this interface.

When creating a notification request, there are six different notification types to choose from as shown in Figure 4.41. The notification types include "New Event," "Cancel Event," "Update Event," "New Product," "Facility Shaken," and "Facility Damage." It is permitted to define more than one notification request of the same type for a profile. Multiple notification requests can be aggregated into groups as a combined message during the dissemination of notifications, based on users' requests.

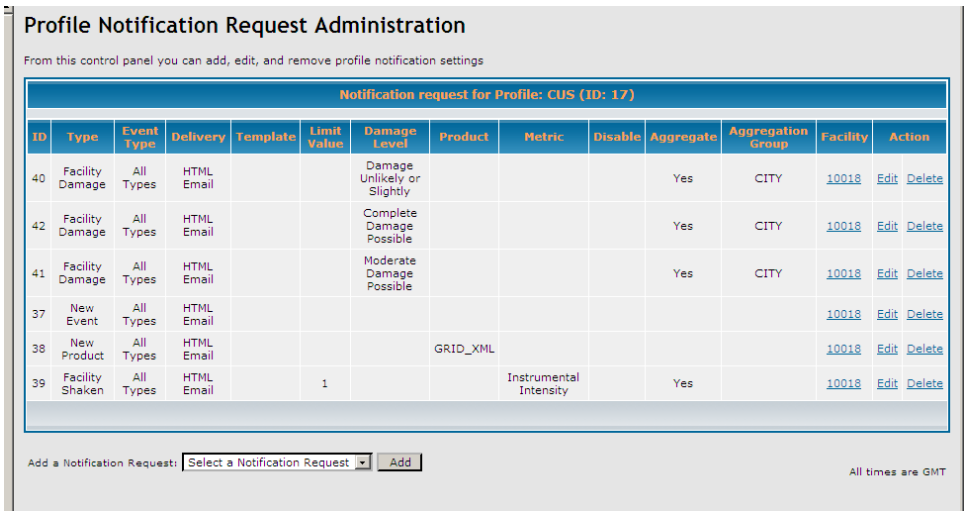


Figure 4.41 The Notification Request summary page listing defined notification request settings for a profile. The administrator can add, edit or delete specific notification request settings. Facility-based notification requests will affect all facilities enclosed by the profile polygon.

Inside the Notification Request summary view, the available functions are **Add**, **Edit**, **Delete**, and **Facility** selection. To add a new request, use the drop-down menu on the lower left corner of the form to create and configure the request (fig. 4.42). The **Delete** function removes the selected notification request from the database.

All notification request types require information of notification type, event type, and delivery method. For "New Product" type, an additional field of product type is needed. For "Facility Damage" type, the additional required field is damage level. For "Facility Shaken" type, the administrator needs to specify both the metric and the limit value of shaking threshold.

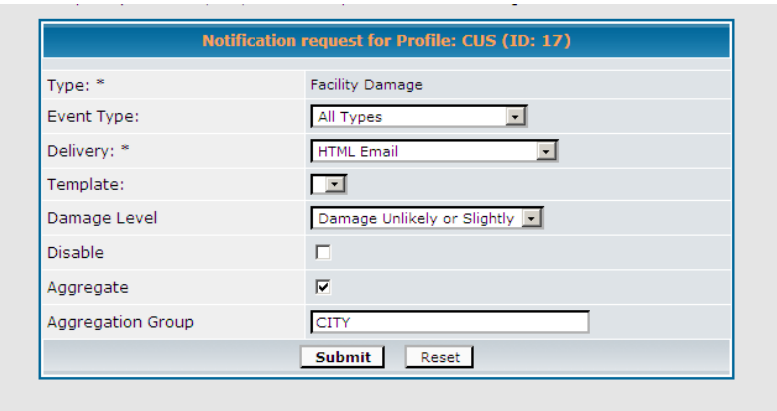


Figure 4.42 The Notification Request editing page displaying a configurable form for the specified request type. Available notification request types are: "New Event," "Cancel Event," "Update Event," "New Product," "Facility Shaken," and "Facility Damage."

To fine tune the list of facilities for a profile, the administrator can click on the facility link inside the **Notification Request** summary page (fig. 4.43). The profile-facility association view is a set of paged tables with included facilities marked by check marks. The administrator can switch between the subscribed list and the full list of facilities to add and remove facilities from the list. The facility inventory is updated for the profile after the administrator submits the changes.

ID	Type	Facility Name	Latitude	Longitude	Select
1	BRIDGE	Minot Creek	41.5536	-124.0547	☑
2	BRIDGE	Hunter Creek	41.5581	-124.0589	☑
3	BRIDGE	High Prairie Creek	41.5683	-124.0689	☑
4	BRIDGE	Wilson Creek	41.6044	-124.1006	☑
5	BRIDGE	Smith River (Hiouchi)	41.8064	-124.0822	☑
6	BRIDGE	Myrtle Creek	41.8017	-124.0556	☑
7	BRIDGE	Hardscrabble Creek	41.8392	-124.0261	☑
8	BRIDGE	Smith River	41.8425	-124.0117	☑
9	BRIDGE	Middle Fork Smith River	41.8578	-123.8853	☑
10	BRIDGE	Patrick Creek	41.8744	-123.8436	☑
11	BRIDGE	Middle Fork Smith River	41.88	-123.8272	☑
12	BRIDGE	Middle Fork Smith River	41.8831	-123.8186	☑
13	BRIDGE	Middle Fork Smith River	41.8608	-123.8719	☑
14	BRIDGE	Smith River	41.8797	-124.1369	☑
15	BRIDGE	Rowdy Creek	41.9283	-124.1417	☑
16	BRIDGE	Gilbert Creek	41.9819	-124.2031	☑
17	BRIDGE	Panther Creek	41.5561	-124.0567	☑
18	BRIDGE	Route 101/169 Separation	41.5228	-124.0342	☑
19	BRIDGE	Hoppow Creek (W169-N101)	41.5231	-124.0333	☑
20	BRIDGE	Hoppow Creek (Off-Ramp)	41.5228	-124.035	☑
21	BRIDGE	Klamath River	41.5181	-124.0314	☑

Figure 4.43 The profile-facility association page displaying a list of facilities included in the profile. The administrator can toggle between the profile and master facility list to fine tune the list by adding or removing facilities from the interface.

4.4.3 Upload

This page displays a dialog for the administrator to upload a profile file into the database as shown in Figure 4.44. This interface uses the "manage_profile" utility to process uploaded profile data. Available process options are `Replace/Update`, `Insert`, and `Delete`. Detailed descriptions of these options and input file formats are included in Section 6.6.

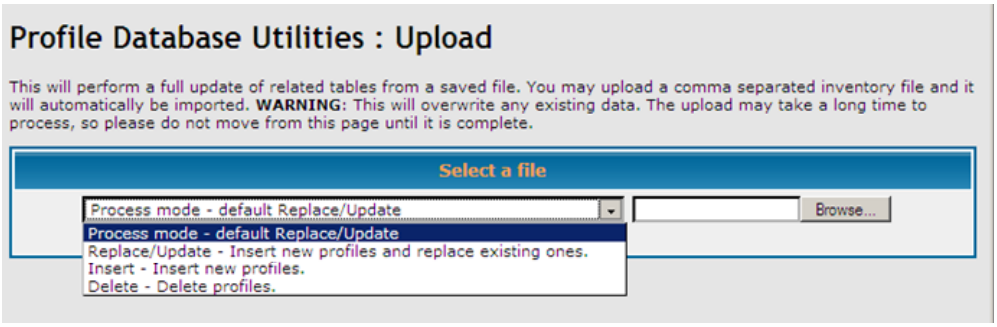


Figure 4.44 The Profile Upload page. This interface uses the "manage_profile" utility to process uploaded profile data. Available process options are Replace/Update, Insert, and Delete.

4.5 User Administration

The user administration section handles tasks of user-specific interactions with the ShakeCast system. Depending on the system configuration, creation of a new user account and notification requests can be initiated by either the end-user or the administrator. Upon a user's request for a new account, the administrator can usually approve or deny the request by responding to the email message sent by the ShakeCast system. This management view allows the administrator to review settings of all user accounts and overwrite any existing settings. The section is divided into four categories: (1) Management; (2) Notification Request; (3) Replication; and (4) Upload. Batch processing for a large number of user accounts and settings of notification requests is available via the ShakeCast utility "manage_user.pl."

4.5.1 Management

This page displays a list of users stored inside the ShakeCast database (fig. 4.45). In addition to the basic user information, the table also shows the user privilege and user status. A "Suspended" user status indicates that the user account exists in the database but the user can neither logon nor receive notifications. To remove a user permanently from the database, the administrator should use the **Delete** function from within this view. There are three available functions for the **Management** view: **Add**, **Edit**, and **Delete**. The **Delete** function removes all information including user data, notification requests, and previous notifications for the selected user from ShakeCast. Both the **Add** and **Edit** functions share the same interface as shown in figure 4.46. The exception is that for **Add** the administrator needs to provide a unique user name for the new user account.

Figure 4.45 The User Administration Summary page displaying a list of ShakeCast users including their privileges and status. The administrator can add, edit, or delete users from this interface.

The user account form consists of four sections regarding information for user log-in, user profile, delivery addresses, and special fields. The user can update information for the first three sections from the user accessible account management page. The administrator-only fields allow both suspension and removal of any user account, including an administrator. The administrator

can also use this form to modify user privileges. It is advisable to limit the number of users with administrative privilege.

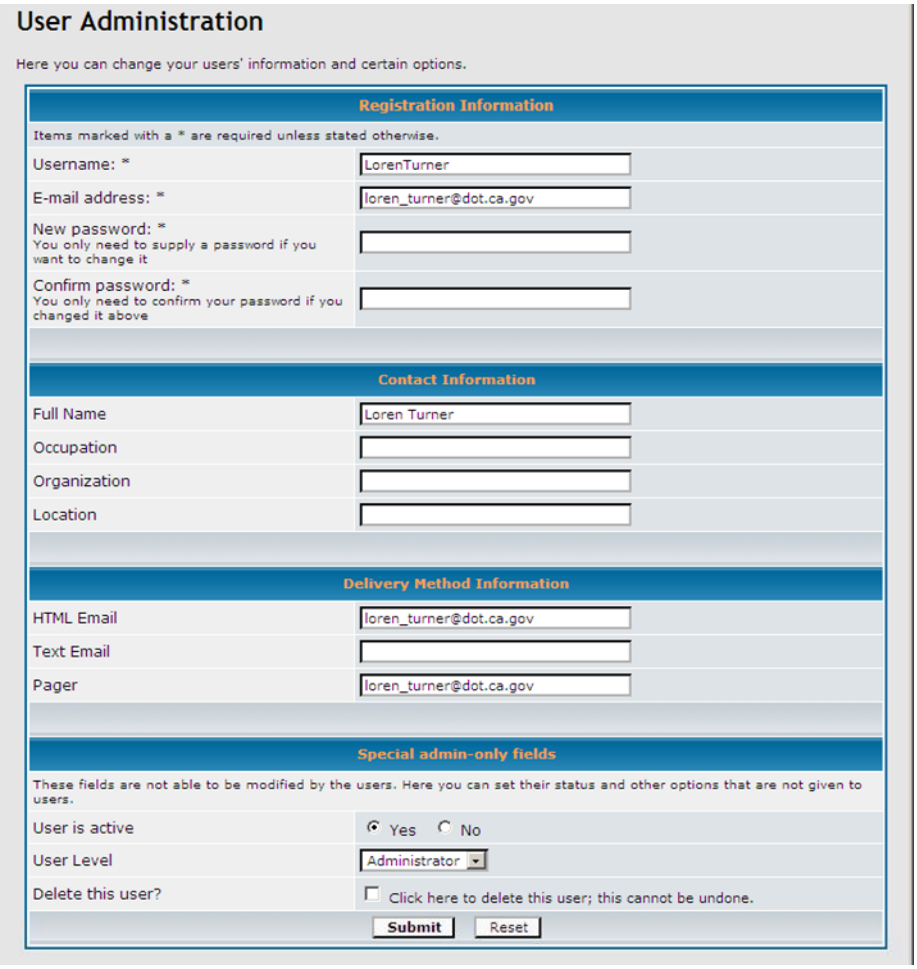


Figure 4.46 The User Administration Data Editing page displaying a form of editable fields containing contact information, notification preferences, and user status for the specified user.

4.5.2 Notification Request

This function works the same as the Notification Request view for profile management (fig. 4.40). Changes of notification request settings only apply to the selected user and any user-profile association will be nullified.

4.5.3 Replication

This page displays a form with two drop-down lists for both the source and destination for the replication process (fig. 4.47). The ShakeCast replication function allows the administrator to duplicate notification requests of a selected profile or user to a group of users. For better performance of system notifications immediately after earthquakes, the administrator can create a profile for users who share common notification requests. By assigning the user group to a single

profile, the administrator can effectively reduces the processing time and the table size of the notification queue. User replication may be used to produce a template of notification requests for particular users for further customization.

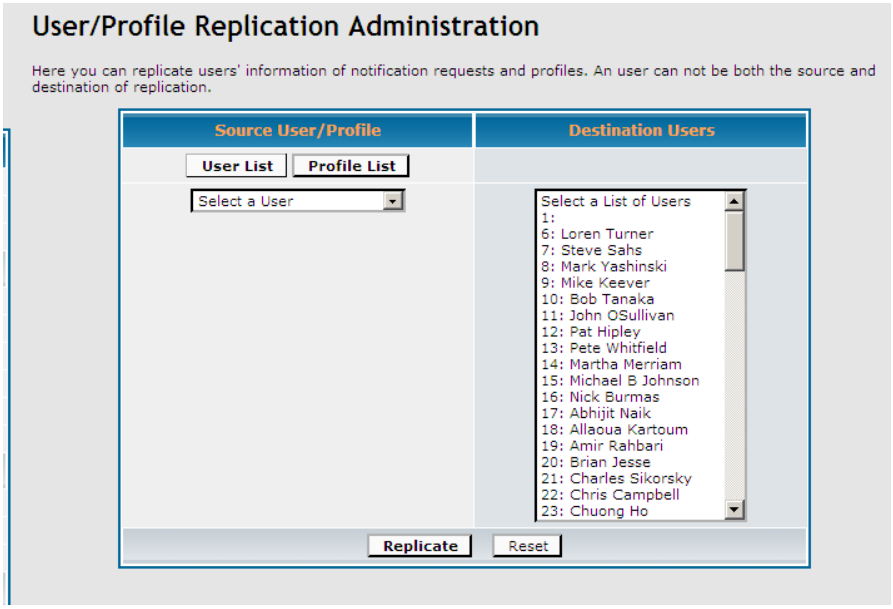


Figure 4.47 The User/Profile Replication Administration page displaying two panels for both source and destination of the replication process. The administrator can toggle between user and profile as the source of replication.

4.5.4 Upload

This page displays a dialog for the administrator to upload a user file into the database as shown in figure 4.48. This interface uses the "manage_user" utility to process uploaded user data. Available process options are `Replace`, `Insert`, `Delete`, `Update`, and `Skip`. Detailed descriptions of these options and input file formats are included in Section 6.7.

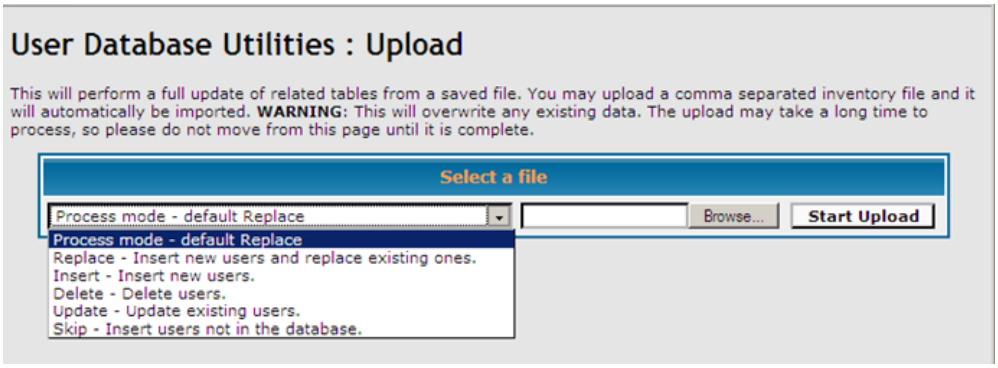


Figure 4.48 The User Upload page. This interface uses the "manage_user" utility to process uploaded user data. Available process options are Replace, Insert, Delete, Update, and Skip.

4.6 Miscellaneous Administration

4.6.1 Web Access to ShakeCast System Version 1

In addition to the standard portal access, the ShakeCast version 2 system also retains the Web directories from the previous version for the purpose of both user and server communications. Access to these pages is restricted and is authenticated through the Apache Web server. The administrator has to edit the files "httpd-sc.conf" and "sc-servers" files to configure user access and password changes. To disable the version 1 Web access, edit the ShakeCast Web configuration file "httpd-sc.conf" under the "conf" directory by commenting out the "scripts/s" and the "scripts/c" sections.

4.6.2 PMA Access

The ShakeCast system has preconfigured an optional installation of **PHPMyAdmin** into the "/pma" directory. The application allows the administrator to interact with the database via the Web interface. To access the interface, the administrator is required to provide the same username and password as for the version 1 Web access and also the username and password to the ShakeCast database. To disable the PMA access, edit the ShakeCast Web configuration file "httpd-sc.conf" under the "conf" directory by commenting out the "pma" section.

4.6.3 Database Configuration

Information regarding access to the ShakeCast database and authentication is stored inside the "sc.conf" configuration file under the "conf" directory. The administrator will also need to update the "sc.conf" file every time access information to the database is changed.

4.6.4 Default Center Location

The default center point for the ShakeCast mapping interface is stored in the file "default-sc.js" under the "docs" directory and is currently set in California. The administrator can edit the content of the file to change the default center location.

5. XML Documents

This Section documents the ShakeCast XML file formats. Extensible Markup Language (XML) is a widely used and easily implemented method of exchanging data between disparate computer systems. The ShakeCast System receives ShakeMap information in XML from the USGS Web server and uses XML to communicate all kinds of information between ShakeCast servers:

- The ShakeCast software itself and data about ShakeCast Servers,
- Data about events (earthquakes) and products (data files) available on the network, and
- Status information that helps the administrators of the ShakeCast servers know if their network is running smoothly.

5.1 ShakeMap RSS Feed XML

RSS, which stands for "Really Simple Syndication" (sometimes called Rich Site Summary), has been adopted by news services, Weblogs, and other online information services to deliver content to subscribers. After subscribing to an RSS feed, you will be notified when new content is available without having to visit the Web site. The USGS ShakeMap RSS data feed contains the following XML:

```
<?xml version="1.0"?>
<?xml-stylesheet href="shake_feed.xsl" type="text/xsl" media="screen"?>
<rss  xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:eq="http://earthquake.usgs.gov/rss/1.0/"  version="2.0">
<channel>
<title>USGS Earthquake ShakeMaps</title>
<description>List of ShakeMaps for events in the last 30
days</description>
<link>http://earthquake.usgs.gov/</link>
<dc:publisher>U.S. Geological Survey</dc:publisher>
<pubDate>Mon, 16 Jul 2007 20:23:29 +0000</pubDate>
<item>
<title>6.7 - NEAR THE WEST COAST OF HONSHU, JAPAN</title>
<description><![CDATA[<img
src="http://earthquake.usgs.gov/eqcenter/images/thumbs/shakemap_global_200
7ewac.jpg" width="100" style="float:left;" />Date: Mon, 16 Jul 2007
01:13:27 GMT<br />Lat/Lon: 37.574/138.44<br />Depth: 49<br
/>]]></description>
<link>http://earthquake.usgs.gov/eqcenter/shakemap/global/shake/2007ewac/<
/link>
<pubDate>Mon, 16 Jul 2007 01:13:27 GMT</pubDate>
<geo:lat>37.574</geo:lat>
<geo:long>138.44</geo:long>
<dc:subject>6</dc:subject>
<eq:seconds>1184598989</eq:seconds>
<eq:depth>49</eq:depth>
<eq:region>global</eq:region>
<eq:shakethumb>http://earthquake.usgs.gov/eqcenter/images/thumbs/shakemap_
global_2007ewac.jpg</eq:shakethumb>
</item>
</channel>
</rss>
```

5.2 Event XML

A ShakeCast Event is described by Event XML. A sample Event XML is provided.

```
<event event_id="SAF_south7.8_se" event_version="1"
event_status="RELEASED" event_type="SCENARIO" event_name=""
event_location_description="SAF-southern M7.8 Scenario"
event_timestamp="2006-08-03 12:00:00" external_event_id="SAF_south7.8_se"
magnitude="7.8" lat="33.922270" lon="-116.469670" />
```

5.3 Product XML

A ShakeCast Product is described by Product XML. A sample Product XML is provided.

```
<product shakemap_id="SAF_south7.8_se" shakemap_version="1"
product_type="HAZUS" product_status="RELEASED" generating_server="1"
generation_timestamp="2007-02-08 16:07:03" lat_min="32.405603"
lat_max="35.455603" lon_min="-114.769670" lon_max="-119.353003" />
```

5.4 ShakeMap XML

A ShakeCast ShakeMap is described by ShakeMap XML. A sample ShakeMap XML is provided.

```
<shakemap shakemap_id="SAF_south7.8_se" shakemap_version="1"
event_id="SAF_south7.8_se" event_version="1" shakemap_status="RELEASED"
generating_server="1" shakemap_region="ci" generation_timestamp="2007-02-
08 16:07:03" begin_timestamp="2007-02-08 16:07:03" end_timestamp="2007-02-
08 16:07:03" lat_min="32.405603" lat_max="35.455603" lon_min="-119.353003"
lon_max="-114.769670">
<metric metric_name="MMI" min_value="9.4900" max_value="10.0000" />
<metric metric_name="PGA" min_value="9.9989" max_value="10.0002" />
<metric metric_name="PGV" min_value="10.0000" max_value="99.9109" />
<metric metric_name="PSA03" min_value="10.0005" max_value="99.9687" />
<metric metric_name="PSA10" min_value="10.0007" max_value="99.9747" />
<metric metric_name="PSA30" min_value="1.7880" max_value="9.9989" />
</shakemap>
```

5.5 Exposure XML

A ShakeCast Exposure is described by Exposure XML. A sample Exposure XML is provided.

```
<?xml version="1.0" encoding="UTF-8"?>
<exposure>
      xmlns:xlink="http://www.w3.org/1999/xlink"

      code_version="Pager 0.2.0"
      event_id="usneb6_06"
      version="1"
      timestamp="2006-10-11T16:07:03Z"
```

```
      source="us"
      status="RELEASED">

      <event
            type="ACTUAL"
            id="urn:earthquake.usgs.gov:origin:usneb6_06:1"
            magnitude="6.3"
            depth="17.1"
            latitude="-7.955000"
            longitude="110.430000"
            timestamp="2006-05-26T22:54:01GMT"
            description="JAVA, INDONESIA" />

      <shakemap
            code_version="3.1.1 GSM"
            id="urn:earthquake.usgs.gov:shakemap:usneb6_06:6"
            version="6"
            timestamp="2006-10-11T16:07:03Z"
            source="us"
            status="RELEASED" />

      <summary type="MMI" units="mmi">
            <bin label="I" value="1" range="[.5,1.5)"
keywords="incomplete">
                  <measure type="population" value="0" units="people"
source="landscan2005" />
            </bin>
            <bin label="II" value="2" range="[1.5,2.5)"
keywords="incomplete">
                  <measure type="population" value="0" units="people" />
            </bin>
            <bin label="III" value="3" range="[2.5,3.5)"
keywords="incomplete">
                  <measure type="population" value="963142" units="people"
/>
            </bin>
      </summary>
</exposure>
```

6. ShakeCast Utilities

This section describes utilities included in the standard ShakeCast distribution. All utilities (even core ShakeCast system services) can be executed directly from the command line and are only available to administrators. Utility such as "tester.pl" can be invoked directly from the Administration Interface for management of ShakeCast test events. As the development of the ShakeCast system continues, more utilities will be added to the existing inventory as part of the update.

In general, the use of utilities is related to one or more of the three objectives: (1) state of the system; (2) system and inventory maintenance; and (3) data input/output. Among utilities described in this section, `heartbeat`, `logrotate`, and `logstate` are state-of-health utilities. The utilities `manage_event`, `manage_facility`, `manage_profile`, and `manage_user` interact directly with the ShakeCast database for the purpose of maintenance. The `scfeed_local`, `shake_fetch`, `tester`, and `template` utilities provide the means for a ShakeCast system to digest special ShakeMaps, conduct local testing/exercise, and generate ShakeCast products that are unique to the local installation.

6.1 heartbeat

6.1.1 Name

heartbeat.pl — ShakeCast Heartbeat Generator

6.1.2 Synopsis

```
heartbeat.pl
```

6.1.3 Description

The **heartbeat.pl** utility is used to generate a ShakeCast event XML with event type as `HEARTBEAT`. The output is injected into the ShakeCast system via **sm_inject.pl**, and a copy is stored in the ShakeMap data directory. This will trigger an event notification to users whom are subscribed to receive heartbeat events.

The script reads no options from the command line. To create a customized heartbeat event, edit the script located inside the ShakeCast bin directory.

6.2 logrotate

6.2.1 Name

logrotate.pl — ShakeCast Log File Rotation Tool

6.2.2 Synopsis

```
logrotate.pl [ --conf config file ]
```

6.2.3 Description

The **logrotate.pl** utility is used to generate rotating backup files of ShakeCast log files ("sc.log," "sc_access.log," and "sc_error.log"). Configurable parameters include `rotate-time`, `max_size`, `keep-files`, `compress`, and `status-file`. The administrator can schedule a routine run of this script for maintenance of ShakeCast log files.

The script reads one optional configuration file from the command line. The default configuration file is "sc.conf."

rotate-time
: Specify the time window for keeping log entries.

max_size
: Specify the size limit of log files.

keep-files
: Specify the number of backup log files to retain.

compress
: Specify the compression option of backup log files.

status-file
: Specify the filename of process status.

6.2.4 Options

--**conf**
: Specify the filename of a custom configuration file to read process parameters for `logrotate.pl`.

6.3 logstats

6.3.1 Name

logstats.pl — ShakeCast Chart Generator for System Statistics

6.3.2 Synopsis

```
logstats.pl [ --conf config file ]
```

6.3.3 Description

The **logstats.pl** utility is used to process ShakeCast log files (“sc.log,” “sc_access.log,” and “sc_error.log”) specified in the system configuration file and to generate a set of image files in both histogram and pie charts. The daily activity chart is the default chart displayed in the default page of the Administration Web Interface. The administrator can schedule a routine run of this script to generate new statistics charts.

The script reads one optional configuration file from the command line. The default configuration file is “sc.conf.”

6.3.4 Options

--**conf**

Specify the filename of a custom configuration file to read process parameters for `logstats.pl`.

6.4 manage_event

6.4.1 Name

manage_event.pl — ShakeCast Event Management Tool

6.4.2 Synopsis

```
manage_event.pl [ mode ] [ option ... ] event_id [event_id2 ... ]
```

6.4.3 Description

The **manage_event.pl** utility is used to re-alert or delete processed ShakeMap events in the ShakeCast database. It reads one or more event IDs from the command line. Mode is one of `--resend` or `--delete`. The `manage_event.pl` utility will return an error message if you do not specify a mode.

--**resend**
: Reprocess notifications for the ShakeMaps and resend notifications to users who are on the recipient list.

--**delete**
: Delete existing events. All information for the processed ShakeMaps will be removed from the ShakeCast database; it does not affect downloaded products in the file system.

6.4.4 Options

--**verbose**
: Display more detailed information about the progress of the import. This option may be repeated to increase detail further.

--**help**
: Print a synopsis of program usage and invocation options.

6.5 manage_facility

6.5.1 Name

manage_facility.pl — ShakeCast Facility Management Tool

6.5.2 Synopsis

```
manage_facility.pl [ mode ] [ option ... ] file.csv [ file2.csv ... ]
```

6.5.3 Description

The **manage_facility.pl** utility is used to insert, update, or delete facility data in the ShakeCast database. It reads data from one or more CSV format files. One or more files must be given on the command line. Multiple files can have different formats. Mode is one of `--insert`, `--replace`, `--delete`, `--update`, or `--skip`. The **manage_facility.pl** utility will operate in replace mode if you do not specify a mode.

--**insert**
: New facility records are inserted. It is an error for the facility to already exist; if it does the input record is skipped.

--**replace**
: New records are inserted. If there is an existing facility it is first deleted, along with any associated attributes and fragility levels. All required facility fields must be supplied.

--**delete**
: Delete existing facilities. All required facility fields must be supplied.

--**skip**
: New facility records are inserted. Records for existing facilities are skipped without generating an error. The summary report will indicate how many records were skipped.

--**update**
: Update existing facilities. If the facility does not already exist an error is issued and the record is skipped.

  In this mode the only required fields are `EXTERNAL_FACILITY_ID` and `FACILITY_TYPE`. Any group values are simply added to the existing set of attributes for the facility, unless the new value matches an existing value, in which case the group value is skipped. For metrics, any metric that appears in the input will be completely replaced.

6.5.4 Options

--**verbose**
: Display more detailed information about the progress of the import. This option may be repeated to increase detail further.

--**help**

Print a synopsis of program usage and invocation options

--**limit=*n***

Terminate the import after ***n*** errors in input records. Set to 0 to allow an unlimited number of errors.

This limit only applies to errors encountered when processing a data record from the input file. More serious errors, such as omitting a required field, will always cause the entire input file to be skipped.

--**quote=*x***

Use x as the quote character in the input file. The default quote character is a double-quote ("). This character is also used as the escape character within a quoted string.

--**separator=*x***

Use x as the field separator character in the input file. The default separator character is a comma (,).

6.5.5 File Format

The **manage_facility.pl** utility reads from one or more CSV-formatted files. By default, fields are separated by commas, and field values that include commas are protected by enclosing them in quotes, but these defaults can be modified; see the `--quote` and `--separator` options above.

The first record in the input file must contain column headers in CSV-format. These headers tell **manage_facility.pl** how to interpret the rest of the records. Each header field must specify a facility field, a facility metric field, or a group field. The header fields are not case sensitive; `facility_name` and `FACILITY_NAME` are equivalent. Fields can appear in any order.

6.5.5.1 Facility Fields

The following facility names are recognized. These fields correspond to tables and columns in the ShakeCast database. Please refer to the ShakeCast Database Description on the USGS Web site for a more detailed description of the structure of the ShakeCast Database.

external_facility_id (**Text(32), required always**)
This field identifies the facility. It must be unique for a facility type but the same `external_facility_id` may be used for different types of facilities.

facility_type (**Text(10), required always**)
This field identifies the type of facility. It must match one of the types in the `facility_type` table. Currently defined types are: BRIDGE, CAMPUS, CITY, COUNTY, DAM, DISTRICT, ENGINEERED, INDUSTRIAL, MULTIFAM, ROAD, SINGLEFAM, STRUCTURE, TANK, TUNNEL, UNKNOWN, and HAZUS building types. Refer the HAZUS Damage Level document (appendix A) for the 128 HAZUS building types and code era.

facility_name (**Text(128), required for insert/replace**)
The value of this field is what the user sees.

short_name (**Text(10), optional**)
The value of this field is used by ShakeCast when a shorter version of the name is needed due to space limitations in the output.

description (**Text(255), optional**)
You can use this field to include a short description of the facility.

lat (**Float, required for insert/replace**)

Specifies the latitude of the facility in degrees and fractional degrees.
lon (**Float, required for insert/replace**)
Specifies the longitude of the facility in degrees and fractional degrees.

6.5.5.2 Fragility Fields

Each field beginning with `METRIC:` is taken to be a facility fragility specifier. The format of a fragility specifier is:

METRIC:*metric-name:damage-level*

where *metric-name* is a valid Shakemap metric (MMI, PGV, PGA, PSA03, PSA10, or PSA30) and damage-level is a valid *damage level* (GREEN, YELLOW, ORANGE, or RED). Examples of Facility Fragility column labels are `METRIC:MMI:RED` and `metric:pga:yellow`.

The metric-name values are defined by the ShakeMap system, and are generally not changed. The above values are current as of spring 2008. The damage level values shown above are the default values shipped with ShakeCast. These values are defined in your local ShakeCast database, and you may use the administration Web interface (Section 4.3) to change those values and the color names that refer to them.

6.5.5.3 Attribute Fields

A facility can have attributes associated with it. These attributes can be used to group and filter facilities.

Each field beginning with `ATTR:` is taken to be a facility attribute specifier. The format of a facility attribute specifier is:

ATTR:*attribute-name*

where *attribute-name* is a string not more than 20 characters in length.

Examples of Facility Attribute column labels are `ATTR:COUNTY` and `ATTR:Construction`. Attribute values can be any string up to 30 characters long.

6.5.6 Example

6.5.6.1 Example 1 — Point Facilities

Assume we have a file named *ca_cities.csv* containing California cities that we want to load into the ShakeCast database. The file is in CSV format and includes the name of each city and the latitude/longitude of its city center or city hall. Records in the file are in the form

```
Rancho Cucamonga,34.1233,-117.5794
Pasadena,34.1561,-118.1318
```

The file is missing two required fields, `facility_type` and `external_facility_id`. Since the city name is unique we can add a new column that is a copy of the name column and use that as the `external_facility_id`. Another column containing the value CITY for each row is added for the `facility_type`. You can either make these changes using an editor, a spreadsheet program, or with a simple script written in a text processing language like Perl.

After making these modifications the records look like

```
CITY,Rancho Cucamonga,Rancho Cucamonga,34.1233,-117.5794
CITY,Pasadena,Pasadena,34.1561,-118.1318
```

The input file also needs a header record; after adding one the input file looks like

```
FACILITY_TYPE,EXTERNAL_FACILITY_ID,FACILITY_NAME,LAT,LON
CITY,Rancho Cucamonga,Rancho Cucamonga,34.1233,-117.5794
CITY,Pasadena,Pasadena,34.1561,-118.1318
...
```

The facilities in this file can now be loaded into ShakeCast using the command

```
manage_facility.pl ca_cities.csv
```

6.5.6.2 Example 2 — Fragility Parameters

It is easy to load fragility parameters for your facilities using **manage_facility.pl**. Building on example 1, assume a simple model where Instrumental Intensity (MMI) above 7 corresponds to likely damage (RED), MMI between 5 and 7 corresponds to possible damage (YELLOW), and MMI below 5 corresponds to little chance of damage (GREEN). The lower threshold of each range (1, 5, 7) is appended to every record in the input file and the header record is changed to reflect the added fields:

```
FACILITY_TYPE,EXTERNAL_FACILITY_ID,FACILITY_NAME,LAT,LON, \
      METRIC:MMI:GREEN,METRIC:MMI:YELLOW,METRIC:MMI:RED
CITY,Rancho Cucamonga,Rancho Cucamonga,34.1233,-117.5794,1,5,7
CITY,Pasadena,Pasadena,34.1561,-118.1318,1,5,7
 ...
```

Import this file as before. New facility data will replace existing ones.

6.5.6.3 Example 3 — Multiple Attributes and Multiple Metrics

You can include multiple attributes, multiple metrics, or multiple attributes and multiple metrics for each row of an import file. For example,

```
FACILITY_TYPE,EXTERNAL_FACILITY_ID,ATTR:COUNTY, ATTR:SIZE,\
      METRIC:MMI:GREEN, METRIC:MMI:YELLOW, METRIC:MMI:RED
CITY,Rancho Cucamonga,San Bernardino,Small,1,2,6
CITY,Pasadena,Los Angeles,Medium,1,2,6
```

This file would be loaded using the command

```
manage_facility.pl --update city_county.csv
```

The above example updates the existing city locations to associate them with a county attribute and a size attribute, and defines the green, yellow, and red shaking thresholds.

6.6 manage_profile

6.6.1 Name

manage_profile.pl — ShakeCast Profile Management Tool

6.6.2 Synopsis

```
manage_profile.pl [ mode ] [ option ... ] [ profile.conf ] [ lat,lon … ]
```

6.6.3 Description

The **manage_profile.pl** utility is used to insert, update, or delete geometry profiles in the ShakeCast database and to associate facilities within the profile boundaries with the profile. It reads data from a profile configuration file or lat/lon pairs of a polygon from the command line. Mode is one of `--insert`, `--delete`, `--update`, or `--poly`. The **manage_profile.pl** utility will operate in replace mode if you do not specify a mode.

--**insert**
: New profiles are inserted. It is an error if the profile already exists; if it does the input record is skipped.

--**delete**
: Delete existing profiles. All required profile fields must be supplied.

--**poly**
: Read polygon data from the command line and output facility data within the polygon boundaries.

6.6.4 Options

--**conf**
: Specify the optional profile configuration file.

--**verbose**
: Display more detailed information about the progress of the import. This option may be repeated to increase detail further.

--**help**
: Print a synopsis of program usage and invocation options.

6.6.5 File Format

The **manage_profile.pl** utility reads data from a file in Apache config format. Lines beginning with '#' and empty lines will be ignored. Spaces at the beginning and the end of a line will also be ignored as well as tabulators. If you need spaces at the end or the beginning of a value you can use double-quote ("). An option line starts with its name followed by a value. An equal sign (=) is optional. Some possible examples:

```
user    max
user  = max
```

```
    user            max
```

If there is more than one statement with the same name, an array will be created instead of a scalar.

Each profile is defined as a **block** of options. A **block** looks much like a block in the well known Apache config format. It starts with **<blockname>** and ends with **</blockname>**. An example:

```
<CI>
    POLY        35.8000 -116.4000       \
                34.0815 -114.4717       \
                32.0000 -114.3333       \
                32.0000 -120.5000       \
                34.5000 -121.2500       \
                37.2167 -118.0167       \
                36.6847 -117.7930       \
                35.8000 -116.4000
    <NOTIFICATION>
                NOTIFICATION_TYPE       NEW_EVENT
                DELIVERY_METHOD         EMAIL_HTML
                EVENT_TYPE              ALL
    </NOTIFICATION>
    <NOTIFICATION>
                NOTIFICATION_TYPE       NEW_PROD
                DELIVERY_METHOD         EMAIL_HTML
                PRODUCT_TYPE            GRID_XML
                EVENT_TYPE              ALL
    </NOTIFICATION>
</CI>
```

6.6.5.1 Profile Tag Names

The following profile tag names are recognized. These fields correspond to tables and columns in the ShakeCast database. Please refer to the ShakeCast Database Description for a more detailed description of the structure of the ShakeCast Database.

poly (**float pairs, required always**)
This field identifies the boundaries of the profile geometry. It must contain at least three anchor points in order to define a polygon. The total number of anchor points should be limited to less than 100, otherwise the administration interface may not be able to display the entire polygon during editing. The **manage_profile.pl** will, however, process the polygon definition.

notification (**Text(32), optional**)
One notification block represents one notification request associated with the profile and applies to all facilities within the profile polygon. Multiple notification blocks for a profile are permitted.

6.6.5.2 Notification Tag Names

Each notification block defines one notification request. Tag names correspond to the field names of the table "profile_notification_request." Required tags for a notification block include `NOTIFICATION_TYPE`, `DELIVERY_METHOD`, and `EVENT_TYPE`. The `EVENT_TYPE` tag is required for notification type `NEW_PROD`, and the `DAMAGE_LEVEL` tag for notification type `DAMAGE`. Valid notification types are `CAN_EVENT`, `NEW_EVENT`, `UPD_EVENT`, `SHAKING`, `NEW_PROD`, and `DAMAGE`.

can_event
This notification request is triggered when an event is cancelled by the seismic network in which the event was located and the ShakeMap is removed from the USGS Web site. Requires `EVENT_TYPE` and `DELIVERY_METHOD` tags.

new_event
This notification request is triggered when an event is located by a seismic network and a ShakeMap becomes available on the USGS Web site. Requires `EVENT_TYPE` and `DELIVERY_METHOD` tags.

upd_event
This notification request is triggered when the source parameters of an event are updated with a new version by the seismic network. New versions of ShakeMaps for the event may or may not coincide with an updated event. Requires `EVENT_TYPE` and `DELIVERY_METHOD` tags.

new_prod
This notification request is triggered when a specified ShakeMap product of an event is available on the USGS Web site. Requires `EVENT_TYPE`, `DELIVERY_METHOD`, and `PRODUCT_TYPE` tags.

shaking
This notification request is triggered when the ground shaking parameter at the location of the facility exceeds the preset value. Requires `EVENT_TYPE`, `DELIVERY_METHOD`, `METRIC`, and `LIMIT_VALUE` tags.

damage
This notification request is triggered when the ground shaking parameter at the location of the facility falls between the high and low values of facility fragility settings. Requires `EVENT_TYPE`, `DELIVERY_METHOD`, and `DAMAGE_LEVEL` tags.

6.7 manage_user

6.7.1 Name

manage_user.pl — ShakeCast User Management Tool

6.7.2 Synopsis

```
manage_user.pl [ mode ] [ option ... ] file.csv [ file2.csv ... ]
```

6.7.3 Description

The **manage_user.pl** utility is used to insert, update, or delete user data in the ShakeCast database. It reads data from one or more CSV format files. One or more files must be given on the command line. Multiple files can have different formats. Mode is one of `--insert`, `--replace`, `--delete`, `--update`, or `--skip`. The **manage_user.pl** utility will operate in replace mode if you do not specify a mode.

--**insert**
: New user records are inserted. It is an error for the user to already exist; if it does the input record is skipped.

--**replace**
: New records are inserted. If there is an existing user it is first deleted, along with any associated delivery addresses, notification requests, and profiles. All required user fields must be supplied.

--**delete**
: Delete existing users. All required user fields must be supplied.

--**skip**
: New user records are inserted. Records for existing users are skipped without generating an error. The summary report will indicate how many records were skipped.

--**update**
: Update existing users. If the user does not already exist an error is issued and the record is skipped.

  In this mode the only required fields are `USERNAME` and `USER_TYPE`. Any delivery methods, profiles and users for cloning that appears in the input will be completely replaced.

6.7.4 Options

--**verbose**
: Display more detailed information about the progress of the import. This option may be repeated to increase detail further.

--**help**
: Print a synopsis of program usage and invocation options

--**limit=*n***

Terminate the import after ***n*** errors in input records. Set to 0 to allow an unlimited number of errors.
This limit only applies to errors encountered when processing a data record from the input file. More serious errors, such as omitting a required field, will always cause the entire input file to be skipped.

--**quote=*x***
Use ***x*** as the quote character in the input file. The default quote character is a double-quote ("). This character is also used as the escape character within a quoted string.

--**separator=*x***
Use ***x*** as the field separator character in the input file. The default separator character is a comma (,).

6.7.5 File Format

The **manage_ user.pl** utility reads from one or more CSV-formatted files. By default, fields are separated by commas, and field values that include commas are protected by enclosing them in quotes, but these defaults can be modified; see the `--quote` and `--separator` options above.

The first record in the input file must contain column headers. These headers tell **manage_user.pl** how to interpret the rest of the records. Each header field must specify a user name field and a user type field. The header fields are not case sensitive; `username` and `USERNAME` are equivalent. Fields can appear in any order.

6.7.5.1 User Fields

The following facility names are recognized. These fields correspond to tables and columns in the ShakeCast database. Please refer to the ShakeCast Database Description for a more detailed description of the structure of the ShakeCast database.

username (**Text(32), required always**)
This field identifies the user. It must be unique for a user type.

user_type (**Text(10), required always**)
This field identifies the type of use. It must match one of the types in the `user_type` table. Currently defined types are: `ADMIN`, `USER`, and `SYSTEM`.

full_name (**Text(32), optional**)
The value of this field is the user's full name.

email_address (**Text(10), optional**)
The value of this field is the user's email address for receiving communication from the ShakeCast system.

password (**Text(10), optional**)
The value of this field is used by ShakeCast to generate a password for accessing the ShakeCast interface and the Web site if password protected.

phone_number (**Text(255), optional**)
You can use this field to include a user's phone numbers.

6.7.5.2 Delivery Method Fields

Each field beginning with `DELIVERY`: is taken to be a delivery method specifier. The format of a delivery method specifier is:

DELIVERY:*delivery-method*

where *delivery-method* is a valid message format (PAGER, EMAIL_HTML, or EMAIL_TEXT). Examples of Delivery Method column labels are `DELIVERY:EMAIL_HTML` and `delivery:email_html`.

The message format values are defined by the ShakeCast system, and are generally not changed. The damage level values shown above are the default values shipped with ShakeCast. These values are defined in your local ShakeCast database, and you may use the administration Web interface to change those values and the color-names that refer to them.

6.7.5.3 Profile Fields

A user can have notification requests replicated from an existing profile. Each field beginning with `PROFILE`: is taken to be a profile specifier. The format of a profile specifier is:

PROFILE:*profile-name*

where *profile-name* is a valid profile name.

6.7.5.4 User Fields

A user can have notification requests replicated from an existing user. Each field beginning with `USER`: is taken to be a user specifier. The format of a user specifier is:

USER: *shakecast-user*

where *shakecast-user* is a valid user ID.

6.8 scfeed_local

6.8.1 Name

scfeed_local.pl — ShakeMap Grid/Product Injection Tool

6.8.2 Synopsis

```
scfeed_local.pl [ --event event_id ] [ option ... ]
```

6.8.3 Description

The **scfeed_local.pl** utility is used to process downloaded ShakeMap products located in the ShakeCast data directory. It reads one event ID from the command line and creates XML messages before feeding them to ShakeCast. The injection process triggers the ShakeCast process in the same manner as for a real earthquake with respect to facility damage assessment and user notifications.

The name of an unprocessed ShakeMap must match the name of an event ID. ShakeMaps can be downloaded via the USGS ShakeMap link from the ShakeCast Administration Panel or manually from other sources. It will be renamed with the version number appended to the end of the directory name after **scfeed_local.pl** has processed the ShakeMap. Outputs of ShakeCast XML files will also be stored in the same directory.

The script will quit gracefully if the ShakeMap has been processed earlier by the ShakeCast system, and as a result no notifications will be delivered. To reprocess a ShakeMap that already exists in the ShakeCast system, the administrator will need to either convert the ShakeMap into a test event or delete the event first. Instead of using the Administration Interface, an administrator can use the **tester.pl** utility to convert a ShakeMap to a test event and the **manage_event.pl** utility to delete a ShakeMap. The ShakeCast data directory for the deleted ShakeMap also needs to be removed from the file system before starting the reprocess procedure described earlier.

6.8.4 Options

--**event**
: Specify ID of the event to process. All information for the processed ShakeMaps will be removed from the ShakeCast database; it does not affect downloaded products in the file system.

--**verbose**
: Display more detailed information about the progress of the import. This option may be repeated to increase detail further.

--**help**
: Print a synopsis of program usage and invocation options

6.9 shake_fetch

6.9.1 Name

shake_fetch.pl — USGS ShakeMap Fetching Tool

6.9.2 Synopsis

```
shake_fetch.pl [ option ... ]
```

6.9.3 Description

The **shake_fetch.pl** utility is used to retrieve ShakeMaps from the USGS Web site then triggers the ShakeCast process for the downloaded event. An event can be either an actual or a scenario ShakeMap. The script is usually invoked as a scheduled task from the administration interface but also can be executed directly from the command line interface. Both `--network` and `--event` options are required. A previously processed event will not re-trigger the ShakeCast process.

6.9.4 Options

--**network**
: Specify network code of the ShakeMap to process.

--**event**
: Specify ID of the ShakeMap to process.

--**help**
: Print a synopsis of program usage and invocation options.

6.10 template

6.10.1 Name

template.pl — ShakeCast General Templating Tool

6.10.2 Synopsis

```
template.pl [ option ... ] --event event_id --template template
```

6.10.3 Description

The **template.pl** utility is used to generate a ShakeCast facility summary for the specified event. The script reads at least one event ID and one template file from the command line. The output file is stored in the ShakeCast data directory for the specified event. By default, if no output filename is specified, the filename of the template file will be used (without ".tt" postfix) instead. The underscore symbol (_) will be interpreted as the file extension separator.

--**event=*s***
: Specify ID of the event to process.

--**template=*s***
: Specify a filename for the template used to generate ShakeCast summary. The template files are located under the ShakeCast "template/xml" directory. The system comes with two default templates. The file "shakecast.tt" is the template for generating "exposure.xml' and the file "kml.tt" for generating Google Earth KML format XML files.

6.10.4 Options

--**version=*n***
: Specify version number of the event to process.

--**output=*s***
: Specify filename of the output of ShakeCast summary. The output directory is the ShakeCast data directory for the specified event.

--**help**
: Print a synopsis of program usage and invocation options.

6.10.5 File Format

The **template.pl** utility is based on the Perl Template Toolkit. Please see the Template Manual manual page on the Comprehensive Perl Archive Network (CPAN) for the complete reference, which goes into much greater detail about the features and use of the Template Toolkit.

This section covers a brief summary of the template directives. ShakeCast specific identifiers include `exposure`, `item`, and `type`. Facility specific identifiers include `name`, `latitude`, `longitude`, `damage_level`, `MMI`, `PGA`, `PGV`, `PSA03`, `PSA10`, and `PSA30`.

6.10.5.1 GET

Evaluate and print a variable or value.

```
[%   GET variable %]
[%       variable %]
[%       hash.key %]
[%         list.n %]
[%     code(args) %]
[% obj.meth(args) %]
[%  "value: $var" %]
```

6.10.5.2 CALL

As per GET but without printing result (for example, call code).

```
[%  CALL variable %]
```

6.10.5.3 SET

Assign a values to variables.

```
[% SET variable = value %]    # 'SET' also optional
[%     variable = other_variable
       variable = 'literal text @ $100'
       variable = "interpolated text: $var"
       list     = [ val, val, val, val, ... ]
       list     = [ val..val ]
       hash     = { var => val, var => val, ... }
%]
```

6.10.5.4 DEFAULT

Like SET above, but variables are only set if currently unset (that is, have no true value).

```
[% DEFAULT variable = value %]
```

6.10.5.5 INSERT

Insert a file without any processing performed on the contents.

```
[% INSERT legalese.txt %]
```

6.10.5.6 INCLUDE

Process another template file or block and include the output. Variables are localised.

```
[% INCLUDE template %]
[% INCLUDE template  var = val, ... %]
```

6.10.5.7 PROCESS

As INCLUDE above, but without localising variables.

```
[% PROCESS template %]
[% PROCESS template  var = val, ... %]
```

6.10.5.8 WRAPPER

Process the enclosed block WRAPPER ... END block then INCLUDE the named template, passing the block output in the 'content' variable.

```
[% WRAPPER template %]
   content...
[% END %]
```

6.10.5.9 BLOCK

Define a named template block for subsequent INCLUDE, PROCESS, etc.

```
[% BLOCK template %]
   content
[% END %]
```

6.10.5.10 FOREACH

Repeat the enclosed FOREACH ... END block for each value in the list.

```
[% FOREACH variable = [ val, val, val ] %]    # either
[% FOREACH variable = list %]                 # or
[% FOREACH list %]                            # or
   content...
   [% variable %]
[% END %]
```

6.10.5.11 WHILE

Enclosed WHILE ... END block is processed while condition is true.

```
[% WHILE condition %]
   content
[% END %]
```

6.10.5.12 IF / UNLESS / ELSIF / ELSE

Enclosed block is processed if the condition is true / false.

```
[% IF condition %]
   content
[% ELSIF condition %]
     content
[% ELSE %]
     content
[% END %]
[% UNLESS condition %]
   content
[% # ELSIF/ELSE as per IF, above %]
   content
[% END %]
```

6.10.5.13 SWITCH / CASE

Multi-way switch/case statement.

```
[% SWITCH variable %]
[% CASE val1 %]
   content
[% CASE [ val2, val3 ] %]
   content
[% CASE %]         # or [% CASE DEFAULT %]
   content
[% END %]
```

6.10.5.14 MACRO

Define a named macro.

```
[% MACRO name <directive> %]
[% MACRO name(arg1, arg2) <directive> %]
```

```
...
[% name %]
[% name(val1, val2) %]
```

6.10.5.15 FILTER

Process enclosed FILTER ... END block then pipe through a filter.

```
[% FILTER name %]                       # either
[% FILTER name( params ) %]             # or
[% FILTER alias = name( params ) %]     # or
   content
[% END %]
```

6.10.5.16 USE

Load a "plugin" module, or any regular Perl module if LOAD_PERL option is set.

```
[% USE name %]                          # either
[% USE name( params ) %]                # or
[% USE var = name( params ) %]          # or
...
[% name.method %]
[% var.method %]
```

6.10.5.17 PERL / RAWPERL

Evaluate enclosed blocks as Perl code (requires EVAL_PERL option to be set).

```
[% PERL %]
     # perl code goes here
     $stash->set('foo', 10);
     print "set 'foo' to ", $stash->get('foo'), "\n";
     print $context->include('footer', { var => $val });
[% END %]
[% RAWPERL %]
   # raw perl code goes here, no magic but fast.
   $output .= 'some output';
[% END %]
```

6.10.5.18 TRY / THROW / CATCH / FINAL

Exception handling.

```
[% TRY %]
     content
   [% THROW type info %]
[% CATCH type %]
     catch content
   [% error.type %] [% error.info %]
[% CATCH %] # or [% CATCH DEFAULT %]
     content
[% FINAL %]
   this block is always processed
[% END %]
```

6.10.5.19 NEXT

Jump straight to the next item in a FOREACH/WHILE loop.

```
[% NEXT %]
```

6.10.5.20 LAST

Break out of FOREACH/WHILE loop.

```
[% LAST %]
```

6.10.5.21 RETURN

Stop processing current template and return to including templates.

```
[% RETURN %]
```

6.10.5.22 STOP

Stop processing all templates and return to caller.

```
[% STOP %]
```

6.10.5.23 TAGS

Define new tag style or characters (default: [% %]).

```
[% TAGS html %]
[% TAGS <!-- --> %]
```

6.10.5.24 COMMENTS

Ignored and deleted.

```
[% # this is a comment to the end of line
   foo = 'bar'
%]
[%# placing the '#' immediately inside the directive
    tag comments out the entire directive
%]
```

6.11 tester

6.11.1 Name

tester.pl – ShakeCast Test Event Tool

6.11.2 Synopsis

```
tester.pl [ option ... ]
```

6.11.3 Description

The **tester.pl** utility is used to handle ShakeCast test events and includes conversion, listing, and triggering of test events. The script is usually invoked from the administration interface but also can be executed directly. It reads one process type from the command line.

6.11.4 Options

--type

Specify the type of action to process. Process type is one of `event_menu`, `new_test`, `create_test`, `inject_next`, or `inject_first`.

event_menu
Output a list of test events available on the system.

new_test
Output a list of actual events on the system that have not been converted into test events.

create_test
Convert the specified event into a test event that can be triggered locally. Require an additional `--key` option. A new data directory for the event will be created under the "`test_data`" directory with the name of event ID and "`_scte`" postfix.

inject_first
Trigger a ShakeCast process for the specified test event as a new event. Require an additional `--key` option.

inject_next
Trigger a ShakeCast process for the specified test event as an updated event. Require an additional `--key` option.

--key

Specify ID of the event to process. All information for the processed ShakeMaps will be removed from the ShakeCast database; it does not affected downloaded products in the file system.

References

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Appendix A. Converting HAZUS Structure Type to Structural Damage Level

A.1 Selecting Model Building Type and Code Era

ShakeCast offers structural damage estimation capability adapted from the HAZUS-MH earthquake module (NIBS and FEMA, 2003). For any site of interest, the user begins by selecting from the available HAZUS model building types, of which there are 36 (table A.1). "Model building type" refers to the materials of construction (wood, steel, reinforced concrete, etc.), the system used to transmit earthquake forces from the ground through the building (referred to as the lateral force-resisting system), and sometimes height category (lowrise, midrise, and highrise, which generally correspond to 1-3, 4-7, and 8+ stories, respectively).

The user must also select for each facility its building code era, of which there are four (high code, moderate code, low code, and pre-code; table A.2 and fig. A.1). Code eras reflect important changes in design forces or detailing requirements that matter to the seismic performance of a building. Sixteen combinations of model building type and code era do not exist (for example, high-code unreinforced masonry bearing wall), so in total there are 128 choices for HAZUS model building type and code era. Note that code era is largely a function of location and year built, so in principal ShakeCast could simplify the user's job of selecting a code era by asking for era of construction (pre-1941, 1941-1975, or post-1975) instead and then looking up the code era via internal GIS database.

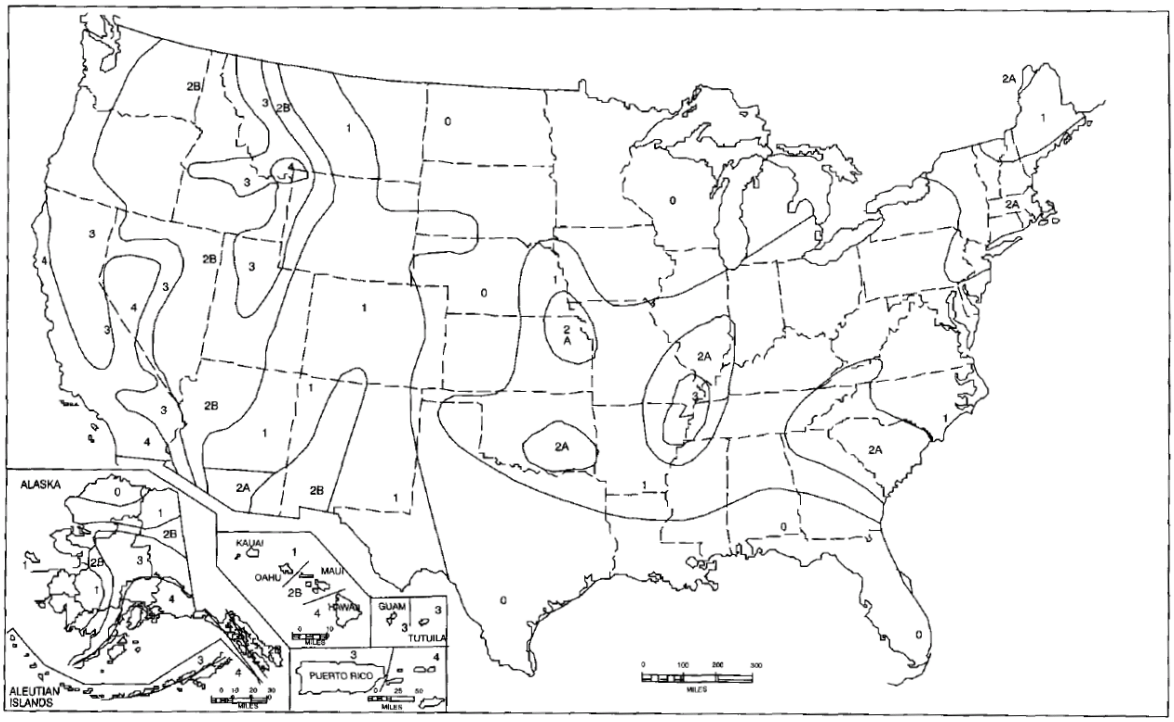

Figure A.1 Seismic zone map of the United States (fig. 16-2, ICBO, 1997).

A.2 Describing Damage

The user selects between 3 and 4 alert levels, meaning that any facility affected by an earthquake is noted either green, yellow, or red (3 levels), or green, yellow, orange, or red (4 levels). These colors index the likely structural damage state of the facility in HAZUS terms: green corresponds to HAZUS' undamaged or slight structural damage states, yellow corresponds to moderate structural damage, orange to extensive structural damage, and red to complete structural damage. These terms (slight, moderate, etc.) are described via likely effects of the earthquake on the structural system. For example, for a small woodframe building (W1, regardless of code era), "green" corresponds to "Undamaged or small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer." These descriptions can be found in the HAZUS-MH technical manual (NIBS and FEMA, 2003) Section 5.3.1.

A.3 Relating Seismic Excitation to Structural Damage

When an earthquake occurs, its shaking intensity at each facility location is estimated in terms of peak horizontal ground acceleration (PGA). Buildings and ground motions are highly variable, even given a model building type and PGA level, so it is uncertain the exact level of PGA that will cause a given facility to experience structural damage of any particular level. The relationship between PGA and damage state is therefore probabilistic, meaning that one can estimate the probability of a given building experiencing a given structural damage state when the building experiences a certain level of PGA. It is more convenient here to estimate the PGA at which there is a given probability of damage exceeding a given structural damage state. In ShakeCast, a facility is indicated as damage level x (that is, green, yellow, orange, or red) when the PGA is such that there is at least a 50% probability of the corresponding HAZUS structural damage state and less than a 50% probability of the next-higher HAZUS structural damage state. These PGA values are taken from the HAZUS-MH Technical Manual Table 5.14a-d.

A.4 Tabular Lookup Data

Two lookup files in CSV format are provided with this manual, one for a three-level damage scheme, the other for a four-level damage scheme. Each has seven columns or fields, listed in table A.3. The fields correspond to data appearing in the ShakeCast Facility Administration screen (see Section 4.3).

Table A.1. HAZUS-MH earthquake model building types (NIBS and FEMA 2003 Table 3.1)

No.	Label	Description	Height			
			Range		Typical	
			Name	Stories	Stories	Feet
1	W1	**Wood, Light Frame (≤ 5,000 sq. ft.)**		1 - 2	1	14
2	W2	**Wood, Commercial and Industrial (>5,000 sq. ft.)**		All	2	24
3	S1L	**Steel Moment Frame**	Low-Rise	1 - 3	2	24
4	S1M		Mid-Rise	4 - 7	5	60
5	S1H		High-Rise	8+	13	156
6	S2L	**Steel Braced Frame**	Low-Rise	1 - 3	2	24
7	S2M		Mid-Rise	4 - 7	5	60
8	S2H		High-Rise	8+	13	156
9	S3	**Steel Light Frame**		All	1	15
10	S4L	**Steel Frame with Cast-in-Place Concrete Shear Walls**	Low-Rise	1 - 3	2	24
11	S4M		Mid-Rise	4 - 7	5	60
12	S4H		High-Rise	8+	13	156
13	S5L	**Steel Frame with Unreinforced Masonry Infill Walls**	Low-Rise	1 - 3	2	24
14	S5M		Mid-Rise	4 - 7	5	60 156
15	S5H		High-Rise	8+	13	
16	C1L	**Concrete Moment Frame**	Low-Rise	1 - 3	2	20
17	C1M		Mid-Rise	4 - 7	5	50
18	C1H		High-Rise	8+	12	120
19	C2L	**Concrete Shear Walls**	Low-Rise	1 - 3	2	20
20	C2M		Mid-Rise	4 - 7	5	50
21	C2H		High-Rise	8+	12	120
22	C3L	**Concrete Frame with Unreinforced Masonry Infill Walls**	Low-Rise	1 - 3	2	20
23	C3M		Mid-Rise	4 - 7	5	50
24	C3H		High-Rise	8+	12	120
25	PC1	**Precast Concrete Tilt-Up Walls**		All	1	15
26	PC2L	**Precast Concrete Frames with Concrete Shear Walls**	Low-Rise	1 - 3	2	20
27	PC2M		Mid-Rise	4 - 7	5	50
28	PC2H		High-Rise	8+	12	120
29	RM1L	**Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms**	Low-Rise	1-3	2	20
30	RM2M		Mid-Rise	4+	5	50
31	RM2L	**Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms**	Low-Rise	1 - 3	2	20
32	RM2M RM2H		Mid-Rise	4 - 7	5	50
33			High-Rise	8+	12	120
34	URML	**Unreinforced Masonry Bearing Walls**	Low-Rise	1 – 2	1	15
35	URMM		Mid-Rise	3+	3	35
36	MH	**Mobile Homes**		All	1	10

Table A.2. HAZUS-MH guidelines for selection of damage functions for typical buildings based on UBC seismic zone and building age (NIBS and FEMA 2003 Table 5.20).

UBC Seismic Zone (NEHRP Map Area)	**Post-1975**	**1941 - 1975**	**Pre-1941**
Zone 4 (Map Area 7)	High-Code	Moderate-Code	Pre-Code (W1 = Moderate-Code)
Zone 3 (Map Area 6)	Moderate-Code	Moderate-Code	Pre-Code (W1 = Moderate-Code)
Zone 2B (Map Area 5)	Moderate-Code	Low-Code	Pre-Code (W1 = Low-Code)
Zone 2A (Map Area 4)	Low-Code	Low-Code	Pre-Code (W1 = Low-Code)
Zone 1 (Map Area 2/3)	Low-Code	Pre-Code (W1 = Low-Code)	Pre-Code (W1 = Low-Code)
Zone 0 (Map Area 1)	Pre-Code (W1 = Low-Code)	Pre-Code (W1 = Low-Code)	Pre-Code (W1 = Low-Code)

Table A.3. Layout of damage lookup tables.

Field name	**Type**	**Description**
ID	Integer	A unique index
Facility Type	String	HAZUS model building type and seismic design level
Color	String	Green, Yellow, Orange, or Red
Damage Level	String	Equivalent HAZUS structural damage level(s)
Low Limit	Integer	Intensity with 50% probability of this damage level occurring
High Limit	Integer	Intensity with 50% probability of next damage level occurring
Metric	String	Intensity metric