DISSEMINATION OF STRONG-MOTION DATA VIA THE INTERNET QUICK REPORT AND THE INTERNET DATA REPORT AT THE CISN ENGINEERING DATA CENTER

Kuo-Wan Lin, Anthony Shakal, and Moh Huang
Strong Motion Instrumentation Program, California Geological Survey

and

Christopher Stephens and Woody Savage
National Strong Motion Program, U.S. Geological Survey

Abstract

The Engineering Data Center (EDC) of the California Integrated Seismic Network (CISN) provides an Internet Quick Report (IQR) to distribute processed strong-motion data and detailed information on instrumented stations immediately after an earthquake. The coverage area of the IQR has been extended to statewide coverage and the Internet Data Report has been introduced. The EDC also has developed search functions to let users quickly access strong-motion data records from certain stations or certain structure types for different earthquakes based on station or structure characteristics.

Introduction

The California Integrated Seismic Network (CISN) is a newly formed consortium of institutions engaged in statewide earthquake monitoring. The five core members of CISN include the California Geological Survey (CGS, formerly the California Division of Mines and Geology), the California Institute of Technology, the Pasadena Office of the U.S. Geological Survey, the Menlo Park Office of the U.S. Geological Survey and the University of California, Berkeley. The California Office of Emergency Services (OES) serves as an ex-officio participant in the CISN.

The CISN has a southern California seismic data center at Pasadena, a northern California seismic data center in the Bay area, and the statewide Engineering Data Center. The CISN Engineering Data Center is operated by the CGS Strong Motion Instrumentation Program (CSMIP) in cooperation with the USGS National Strong Motion Program (NSMP). The EDC is currently at http://www.conservation.ca.gov/cisn-edc/ (Figure 1), but reflecting the dual-agency nature of the EDC, it will be operating in parallel at a USGS address later in 2002. This will provide the critically needed robustness and redundancy for the EDC, in the case of a major earthquake or other event at either location, which is a central goal of the CISN and of OES.

A primary goal of the EDC as well as the other two Data Centers is to provide rapid information products after an earthquake, ranging from the ShakeMap to distribution of the data and calculated parameters. A dedicated high-speed computer network, or Intranet, connecting all CISN partner agencies is currently under construction and standardized, consensus protocols for the exchange of earthquake parametric data and waveforms are being finalized by the CISN Standards Committee. With the completion of the Intranet, the CISN partner networks will routinely exchange strong-motion waveform and parameter data between centers and the EDC will assemble strong-motion data sets for the earthquake engineering community incorporating data from all CISN stations.

The EDC uses the Internet Quick Report (IQR) to rapidly disseminate strong-motion data for engineering applications right after major earthquakes. The IQR is based on the concept of the traditional Quick Report, streamlined for automated generation. A total of six IQRs have been released after the earthquakes of M~4 and larger since August 2001. In addition, a search function has been developed to provide users a simple but versatile tool to locate strong-motion data of specific interest during ongoing searches and studies between earthquakes. The design of the search function effectively reorganizes access to the strong-motion data at the EDC according to the parameters of the instrumented station or structure. This provides two essentially orthogonal paths to request data, by earthquake for all stations or by station/structure type for all earthquakes, which allows users to quickly locate the data of interest for their engineering applications.

The Internet Quick Report

An Internet Quick Report is generally prepared for earthquakes over magnitude 4.0, for which a ShakeMap is also released by CISN. The content of the IQR is dynamic and cumulative after an earthquake, building as new data continues to be recovered. Initial work on the IQR is described in Shakal and Scrivner (2000) and Lin et al. (2001). An example of the current IQR, from a recent earthquake in southern California, is shown in Figure 2. It lists recovered data from the CSMIP and NSMP networks, in order of increasing epicentral distance. At the top of the IQR web page is given the name and date of the earthquake, links to related information about the event at other CISN sites (location, magnitude and ShakeMap), and the time of last modification of the table. The table lists peak acceleration values and station distances for the strong-motion records recovered. Each row of the table represents one record and includes the station name and number, network, epicentral distance, and peak horizontal acceleration, on the ground and the structure. The row also includes buttons for viewing and/or downloading the data once the data itself is available at the EDC. Information regarding the station or instrumented structure is accessible directly using the Internet link under the station name.

The table shown, designed for viewing using Internet browsers, is complemented by a more comprehensive table available as an ASCII text file using a link at the top of the page. This table can easily be imported into a spreadsheet program for analyses by a user. Both the web table and the text table have a date-time stamp to indicate when it was last modified by update or addition of data.

The Internet Data Report for Previous Earthquakes

The discussion above is focused on data in the immediate post-earthquake period. Earthquake data is also important for long-term analysis, beyond the post-earthquake response time frame. In the past, paper-copy Quick Reports (e.g., CSMIP, 1994) were the pre-Internet analog to the Internet Quick Report. But those Quick Reports were followed by a final hard-copy report on the event's strong motion data, usually released in one month after the event (e.g., Porcella et al., 1994; Shakal et al., 1994). In many ways the IQR is as comprehensive as that report, so one could say that, using new technology, a product is being produced in 30 minutes very comparable to what used to be available only after 30 days. To parallel the final hard copy data report, the Internet Quick Report for an event will become the Internet Data Report, to reflect its more final nature, after enough time has gone by for all data (including that from analog instruments) to be included and quality controlled.

The EDC is creating the Internet Data Reports for all significant previous earthquakes to provide users the same access to previous strong-motion data, including structural data, as for new data. An example showing part of the Internet Data Report for the 1994 Northridge earthquake is shown in Figure 3. The Internet Data Reports have the same format as the IQR, though they will be processed manually in part, and placed in the archive section of the EDC, paralleling the way the CISN ShakeMaps are archived.

Searching for Strong-Motion Data at the CISN Engineering Data Center

The above sections considered access to data on a single-earthquake basis. A second path for access to strong-motion data is to use the search function of the EDC. The data contents for the search function are updated immediately following an IQR update operation as part of the EDC process. Contrary to the IQR and IDR, in which data for a single earthquake is listed for all stations, the search function lists data for a single station (or class of stations) for various earthquakes. The user can access the strong-motion data for a structure of interest (a certain building, bridge, or dam) or for a class of structures (e.g., all mid-height steel buildings) by specifying the categorization or type of the structure.

The design goal of the EDC search function is to distribute strong-motion data from stations of the CISN network in a rapid manner and also provide structural data and associated station information. As such, it complements the extensive database at the COSMOS virtual data center, which includes ground-response records from stations around the world and comprehensive search capabilities (Archuleta, 2000). It also complements the newly completed Internet Site for European Strong Motion Data (ISESD), which provides access to records and station information for data recovered in countries of Europe and the Middle East (Ambraseys, 2000).

The layout of the EDC search function is a typical top-down tier approach that guides the user through a series of choices. The user can further confine the search criteria by entering keywords in appropriate fields anytime during the search process. Results of a given search are presented in a table listing all stations that matched the search criteria. Each station has a direct link in the result table that leads the user to a full list of readily accessed strong-motion data for the station.

The initial search page, which includes six predefined station categories (ground response, buildings, bridges, dams, geotechnical arrays, and other structures) is shown in Figure 4. At the first level of the search process, the user starts a search request by selecting a station category. The system responds by displaying second level options for the selected category. For ground response stations, the user can search for strong-motion data based on station name, station number, and site geology. For structural stations, the second level allows search options that are unique to the structure category as well as the same search criteria as for ground response stations. An example of search options for a building station is shown in Figure 5. Similar structure-type specific options are included for bridges and for dam stations. There is also a third level search option for building stations that considers the lateral force resisting system used in the structural design.

A data search request results in a table listing all stations that match the search criteria. Figure 6 shows an example of a search result for high-rise (8-stories and over) steel frame buildings (the building classifications adopted are those of FEMA 310). Within the table, there is a link for each station, which will take the user to a web page with a list or records just for that station (e.g., Figure 7). The station-data page is again a peak acceleration table. Each row of the table represents one record, and includes the name of the earthquake (which incorporates a link to the Internet Data Report for that event), the epicentral distance, and the peak acceleration on the ground and on the structure. The strong-motion data records for the earthquake can be directly viewed or downloaded via the web link buttons.

Continuing Development

As the infrastructure of CISN develops it will include a dedicated high-speed T1 data network ring, or Intranet, for rapid and robust post-earthquake data exchange among the CISN networks. The level of data exchange for strong-motion waveform and parameter data among CISN partner agencies will increase greatly when this network is operational later in 2002. At that time the IQR process of the EDC will serve strong-motion data from all CISN agencies in a fully automatic mode.

To provide users ready access to strong-motion data from previous earthquakes, Internet Data Reports are being created. The completion of this effort for those earthquakes, coupled with the station data pages for all the structures in the USGS and CGS strong motion networks, will make the CISN engineering data center fully effective, supplanting traditional manual means of accessing and providing strong motion data and station information.

Summary

The CISN Engineering Data Center, operated by the federal-state partnership of the CSMIP of the California Geological Survey and the National Strong Motion Program of the US Geological Survey, will greatly accelerate access to data after events and allow users to conveniently obtain data for specific structures and structure types. The development of the EDC is continuing and is summarized below:

- The CISN Engineering Data Center can be accessed at www.conservation.ca.gov/cisn-edc, and will be available, in parallel, at a usgs.gov address in 2002.

- The EDC has developed the Internet Quick Report which will be available automatically within 15 minutes or less after M>4 earthquakes by later in 2002; until then it will be partly manual and available within minutes to hours of significant earthquakes.

- A search function to allow users to conveniently access strong-motion earthquake data and detailed information on instrumented structures and other stations, including location, site geology, structural system, sensor layouts, and other information has been developed.

- The EDC is populating its data archives to include strong-motion data and station/structure information from previous earthquakes, from the CSMIP and NSMP networks and the other partners.

References

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Shakal, A.F. and C.F. Scrivner (2000). TriNet Engineering Strong-Motion Data Center, in Proceedings SMIP2000 Seminar on Utilization of Strong-Motion Data, p. 115-124.

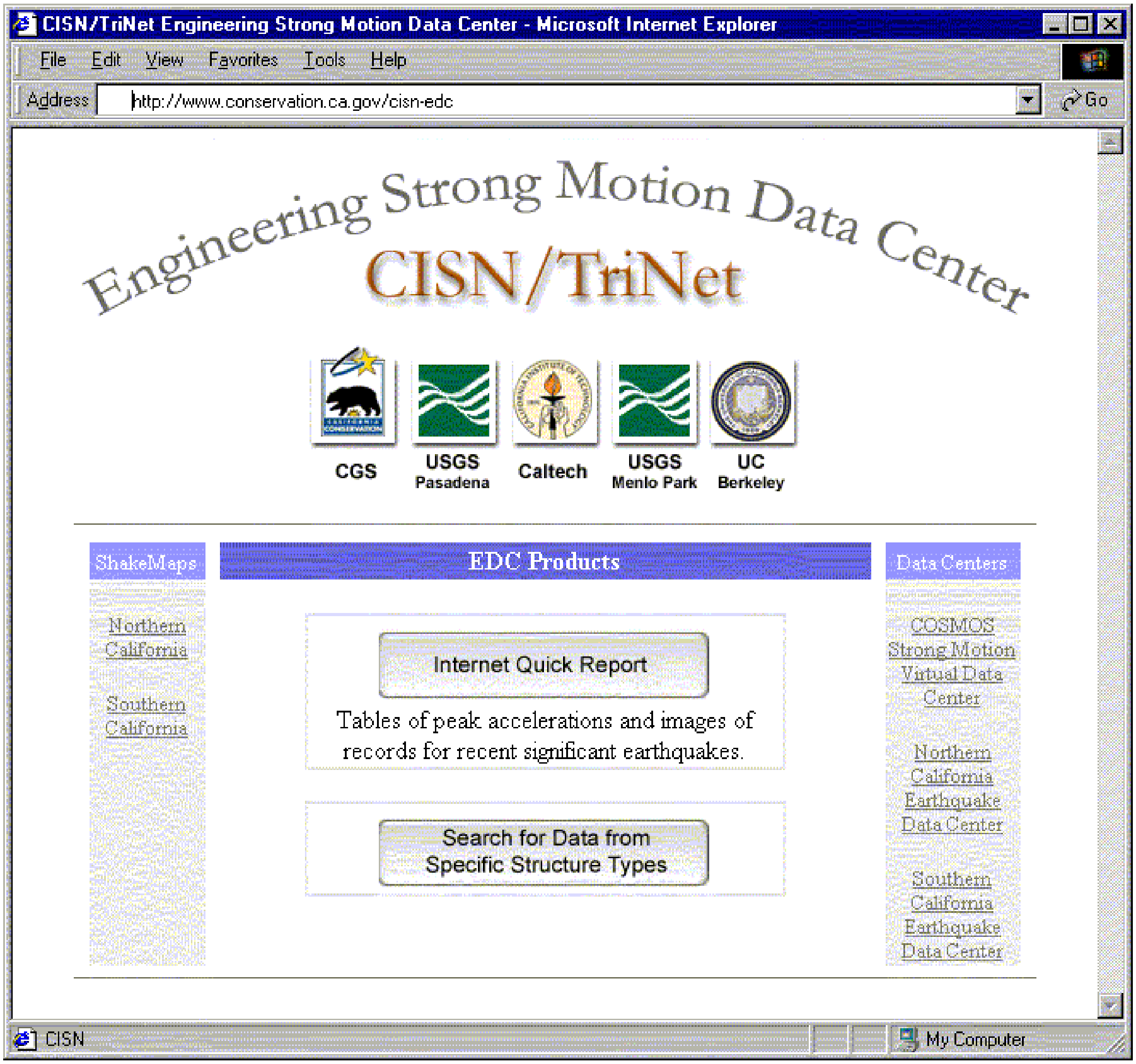
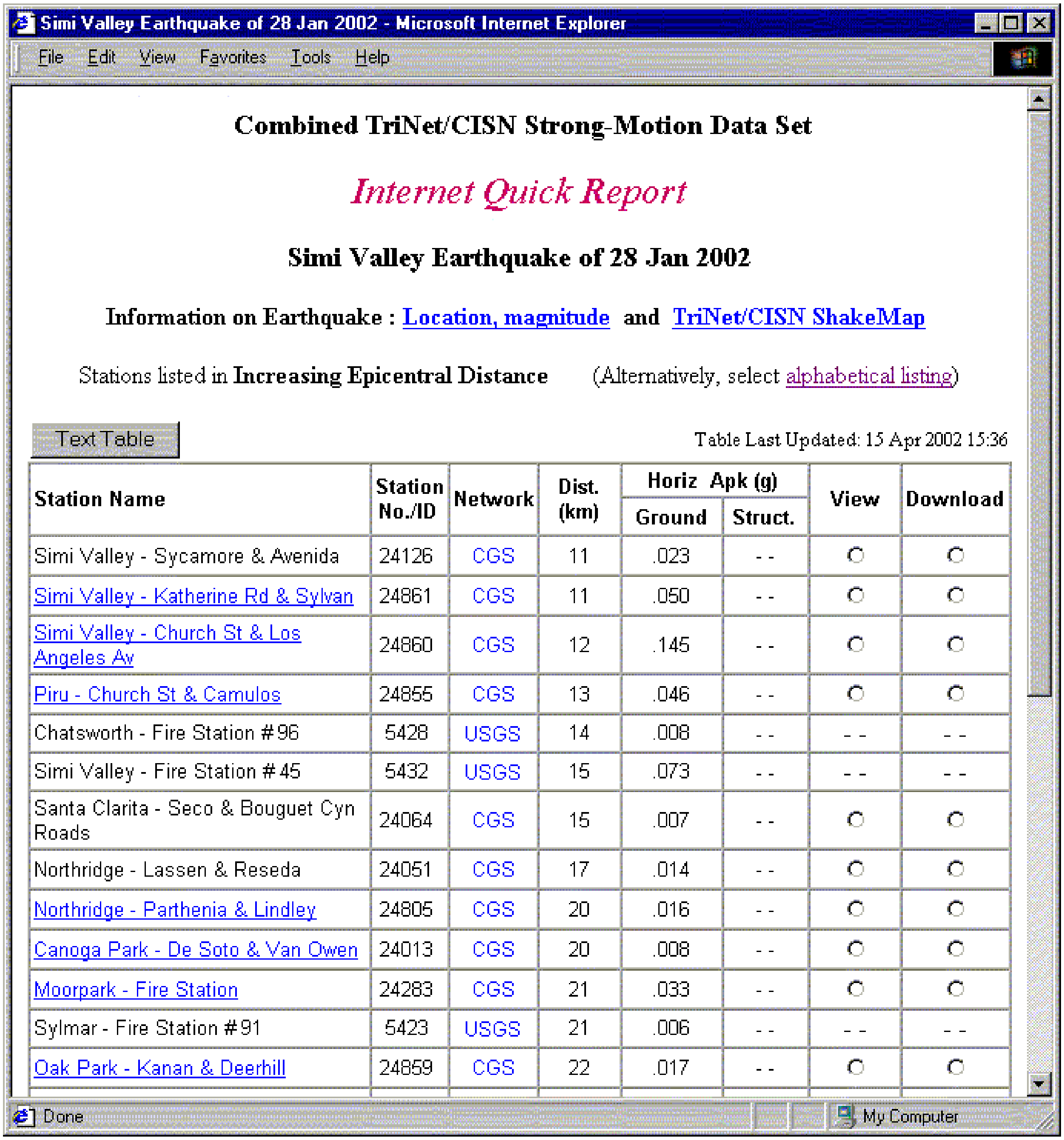


Figure 1. The home page of the CISN Engineering Strong Motion Data Center, with links to Internet Quick Reports, data searches by station/structure type, and links to the other two CISN data centers, the COSMOS data center, and the ShakeMaps for northern and southern California.



Simi Valley Earthquake of 28 Jan 2002 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Combined TriNet/CISN Strong-Motion Data Set

Internet Quick Report

Simi Valley Earthquake of 28 Jan 2002

Information on Earthquake : Location, magnitude and TriNet/CISN ShakeMap

Stations listed in **Increasing Epicentral Distance** (Alternatively, select alphabetical listing)

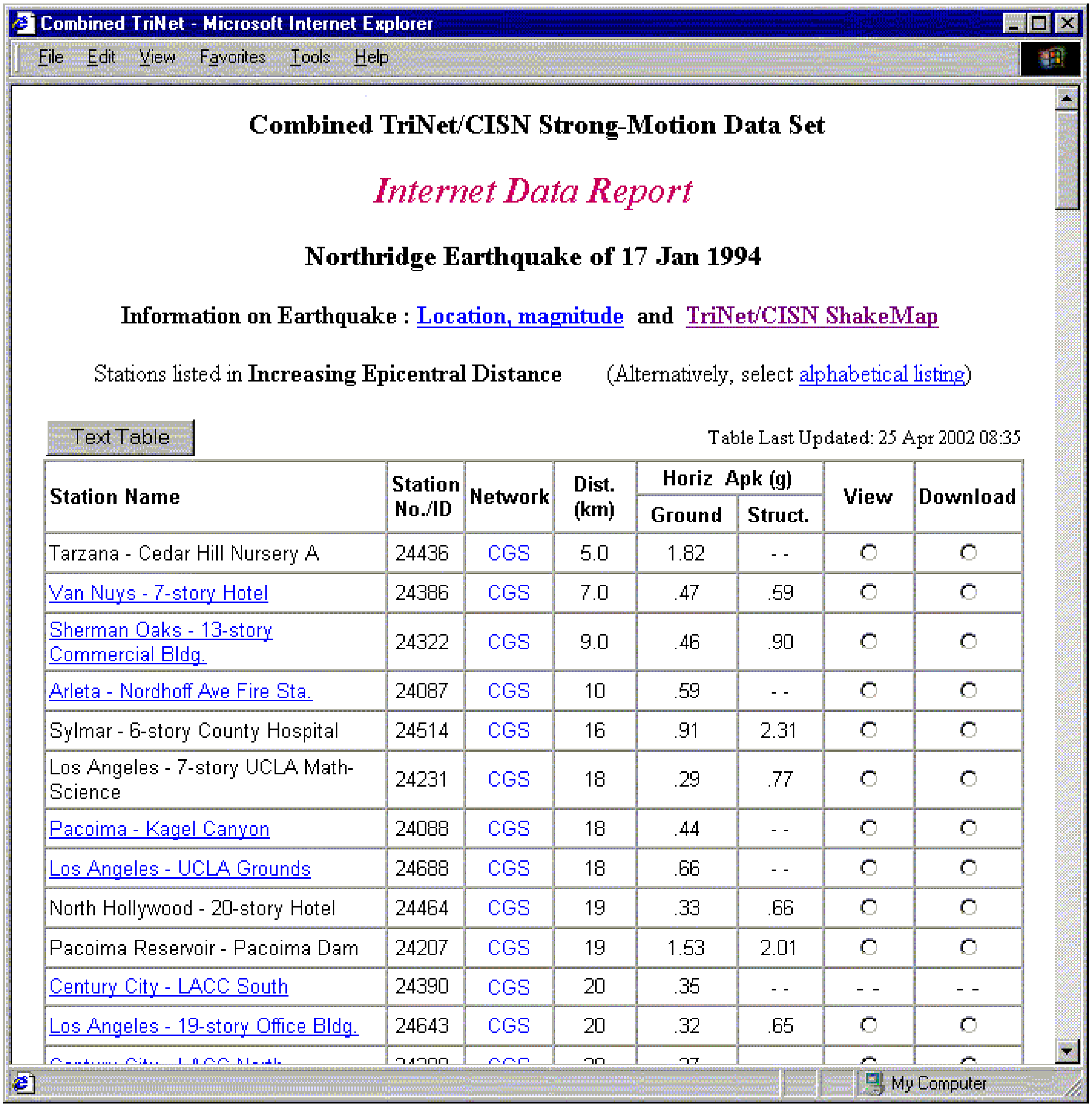
Text Table

Table Last Updated: 15 Apr 2002 15:36

Station Name	Station No./ID	Network	Dist. (km)	Horiz Apk (g)		View	Download
				Ground	Struct.		
Simi Valley - Sycamore & Avenida	24126	CGS	11	.023	- -	○	○
Simi Valley - Katherine Rd & Sylvan	24861	CGS	11	.050	- -	○	○
Simi Valley - Church St & Los Angeles Av	24860	CGS	12	.145	- -	○	○
Piru - Church St & Camulos	24855	CGS	13	.046	- -	○	○
Chatsworth - Fire Station #96	5428	USGS	14	.008	- -	- -	- -
Simi Valley - Fire Station #45	5432	USGS	15	.073	- -	- -	- -
Santa Clarita - Seco & Bouguet Cyn Roads	24064	CGS	15	.007	- -	○	○
Northridge - Lassen & Reseda	24051	CGS	17	.014	- -	○	○
Northridge - Parthenia & Lindley	24805	CGS	20	.016	- -	○	○
Canoga Park - De Soto & Van Owen	24013	CGS	20	.008	- -	○	○
Moorpark - Fire Station	24283	CGS	21	.033	- -	○	○
Sylmar - Fire Station #91	5423	USGS	21	.006	- -	- -	- -
Oak Park - Kanan & Deerhill	24859	CGS	22	.017	- -	○	○

Done · My Computer

Figure 2. An example Internet Quick Report for the M4.2 earthquake that occurred near Simi Valley, CA on Jan. 28, 2002. The table is sorted in epicentral distance order; alphabetical order can be selected at the top, and an ASCII table can be downloaded for spreadsheet or other analysis using the 'Text Table' link. The stations for which strong-motion data is available for viewing and/or downloading are indicated by the presence of push buttons in the right columns. For underlined stations, a linked page may be accessed which contains station photographs and site information.



Combined TriNet - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Combined TriNet/CISN Strong-Motion Data Set

Internet Data Report

Northridge Earthquake of 17 Jan 1994

Information on Earthquake : Location, magnitude and TriNet/CISN ShakeMap

Stations listed in **Increasing Epicentral Distance** (Alternatively, select alphabetical listing)

Text Table

Table Last Updated: 25 Apr 2002 08:35

Station Name	Station No./ID	Network	Dist. (km)	Horiz Apk (g)		View	Download
				Ground	Struct.		
Tarzana - Cedar Hill Nursery A	24436	CGS	5.0	1.82	- -	○	○
Van Nuys - 7-story Hotel	24386	CGS	7.0	.47	.59	○	○
Sherman Oaks - 13-story Commercial Bldg.	24322	CGS	9.0	.46	.90	○	○
Arleta - Nordhoff Ave Fire Sta.	24087	CGS	10	.59	- -	○	○
Sylmar - 6-story County Hospital	24514	CGS	16	.91	2.31	○	○
Los Angeles - 7-story UCLA Math-Science	24231	CGS	18	.29	.77	○	○
Pacoima - Kagel Canyon	24088	CGS	18	.44	- -	○	○
Los Angeles - UCLA Grounds	24688	CGS	18	.66	- -	○	○
North Hollywood - 20-story Hotel	24464	CGS	19	.33	.66	○	○
Pacoima Reservoir - Pacoima Dam	24207	CGS	19	1.53	2.01	○	○
Century City - LACC South	24390	CGS	20	.35	- -	- -	- -
Los Angeles - 19-story Office Bldg.	24643	CGS	20	.32	.65	○	○

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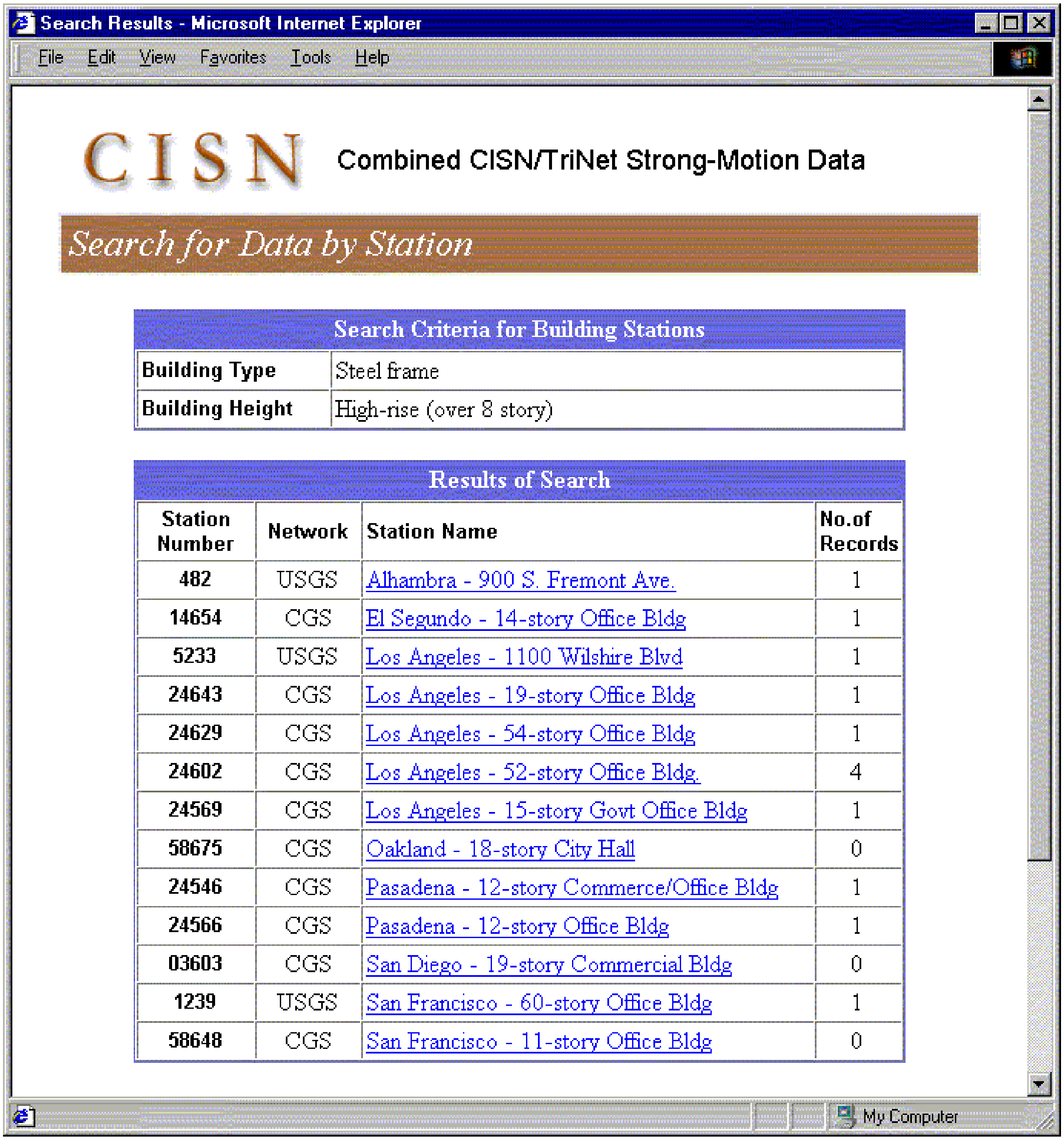
Figure 3. An example of the Internet Data Report table, sorted in epicentral distance order, for the M6.7 Northridge earthquake of Jan. 17, 1994. The table parallels the functionality of the Internet Quick Report, but is permanently available, beyond the time of post-earthquake response, and includes records from analog film stations and other records that may be recovered manually (this is an example and only includes CGS data).

Figure 4. The initial page of the EDC search function. The station data are categorized in six major station types including ground response, buildings, bridges, dams, geotechnical arrays, and other structures.

Figure 5. An example of the second level search options for building stations. Shown in the figure are the pull-down menu choices for building construction material. A following selection menu can be used to establish the desired building height category, and, if desired, the local geology at a structure.



Search Results - Microsoft Internet Explorer

File Edit View Favorites Tools Help

CISN Combined CISN/TriNet Strong-Motion Data

Search for Data by Station

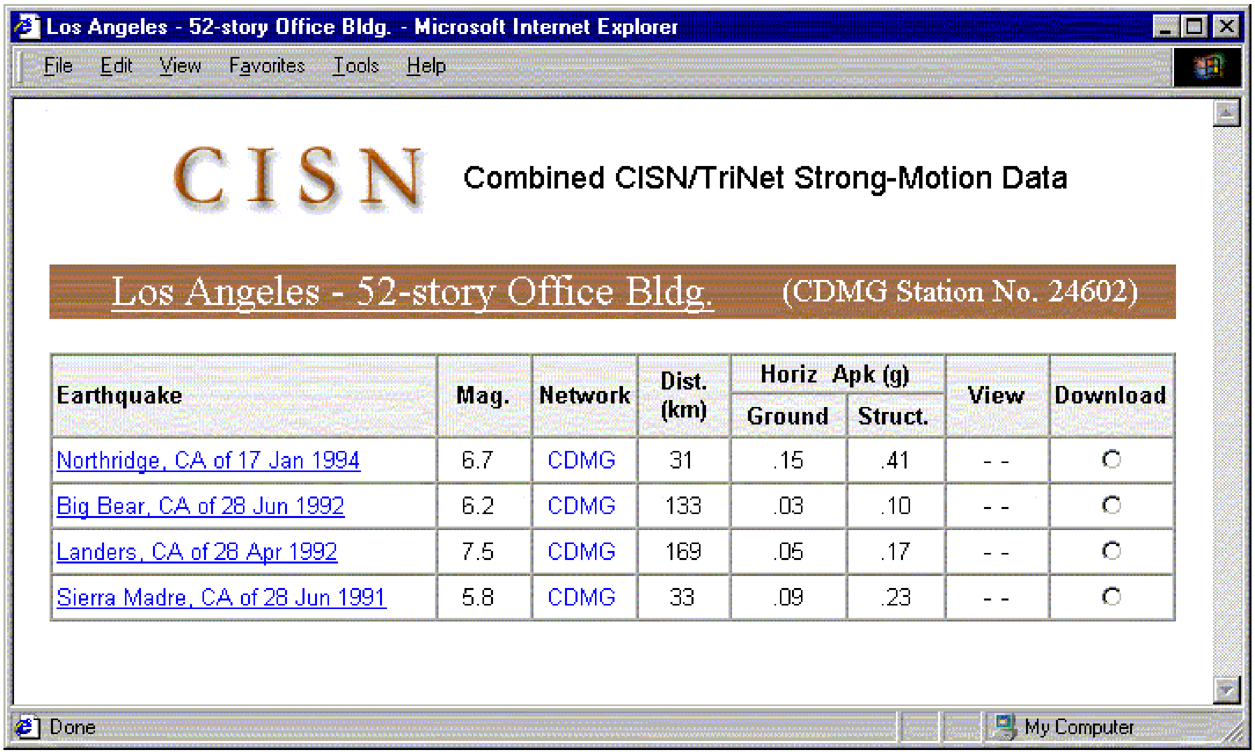
Search Criteria for Building Stations	
Building Type	Steel frame
Building Height	High-rise (over 8 story)

Results of Search

Station Number	Network	Station Name	No.of Records
482	USGS	Alhambra - 900 S. Fremont Ave.	1
14654	CGS	El Segundo - 14-story Office Bldg	1
5233	USGS	Los Angeles - 1100 Wilshire Blvd	1
24643	CGS	Los Angeles - 19-story Office Bldg	1
24629	CGS	Los Angeles - 54-story Office Bldg	1
24602	CGS	Los Angeles - 52-story Office Bldg.	4
24569	CGS	Los Angeles - 15-story Govt Office Bldg	1
58675	CGS	Oakland - 18-story City Hall	0
24546	CGS	Pasadena - 12-story Commerce/Office Bldg	1
24566	CGS	Pasadena - 12-story Office Bldg	1
03603	CGS	San Diego - 19-story Commercial Bldg	0
1239	USGS	San Francisco - 60-story Office Bldg	1
58648	CGS	San Francisco - 11-story Office Bldg	0

My Computer

Figure 6. An example of the result of a search request for data from high-rise (8-stories and over) steel frame buildings. The table indicates the network that responsible for the instrumented building and the number of records available (more records will be added as the existing structural records and information is added to the archive). A user can click on any of listed stations to link to a station-data web page.



Earthquake	Mag.	Network	Dist. (km)	Horiz Apk (g)		View	Download
				Ground	Struct.		
Northridge, CA of 17 Jan 1994	6.7	CDMG	31	.15	.41	- -	○
Big Bear, CA of 28 Jun 1992	6.2	CDMG	133	.03	.10	- -	○
Landers, CA of 28 Apr 1992	7.5	CDMG	169	.05	.17	- -	○
Sierra Madre, CA of 28 Jun 1991	5.8	CDMG	33	.09	.23	- -	○

Figure 7. An example of the station-data web page for a specific station selected in Figure 6. The table shows the collection of strong-motion records for different earthquakes that may be selected from this specific station. A user can click on any of these links to access the IQR or the Internet Data Reports for the earthquakes.