California Integrated Seismic Network

CGS USGS OES Caltech UC Berkeley

Report to the CISN Advisory and Steering Committees from the CISN/PMG 4th Report: 1Q 2003

6 May 2003

Program Management Group
Egill Hauksson, Caltech, (chair)
Lind Gee, UC Berkeley
Doug Given, USGS, Pasadena
David Oppenheimer, USGS, Menlo Park
Tony Shakal, CGS, Sacramento

Table of Contents

Introduction

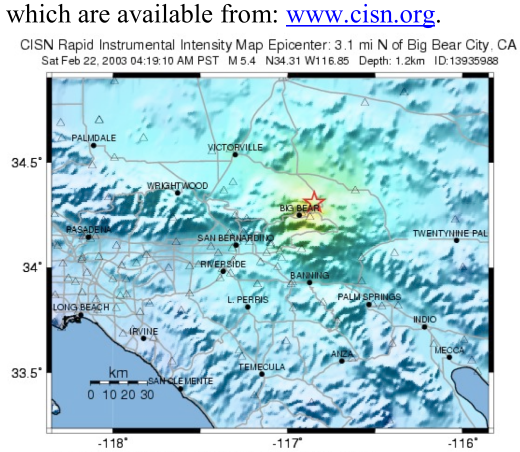
The purpose the PMG report is to provide the CISN Advisory and Steering Committees with an update on current CISN activities. To keep the report short, we do not include routine operation and maintenance work.

Big Bear Earthquake Sequence

A M_L5.4 mainshock occurred at 04:19 am on 22 February 2003, located 2 miles north of Big Bear City in San Bernardino County at a depth of 3.7 miles (Figure 1). It was followed by strong aftershock activity of 116 aftershocks during the first 6 hours.

This sequence is located in a very seismically active area. It is located about 6.2 miles due north of the epicenter of the M6.2 Big Bear aftershock of Landers, which occurred on 28 June 1992. Two M5.3 and M5.4 Landers aftershocks occurred about 3.1 miles to the northwest of the current activity in November and December 1992. In February 2001 a M5.1 event occurred about 5 miles to the west of the current activity.

The mainshock exhibited strike-slip faulting (horizontal movement), sub-parallel to the local strike of the Helendale fault, a more than 40 mile long, late Quaternary faults in the Mojave Desert. Preliminary locations of the aftershocks appear to form a 1 mile long, northwest striking trend, located 2 miles to the west of the main surface trace of the Helendale fault. The Helendale fault forms the western edge of the Eastern California Shear Zone (ECSZ). The CISN published special reports on the seismology and engineering aspects of the event, which are available from: www.cisn.org.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 1. CISN ShakeMap from the February 2003 ML5.4 earthquake near Big Bear.

Communications Backbone

We have installed the CISN data communication backbone to improve the capabilities of the CISN institutions to share data and to back each other up in the case of a major earthquake. The backbone consists of five T1 links that form a ring connecting Pasadena, Menlo Park, UC Berkeley, CGS, OES, and back to Pasadena.

This quarter, all links in the ring became fully operational (Figure 2). The USGS Menlo Park resolved the final problem that limited the Menlo Park-Berkeley link to low volume traffic.

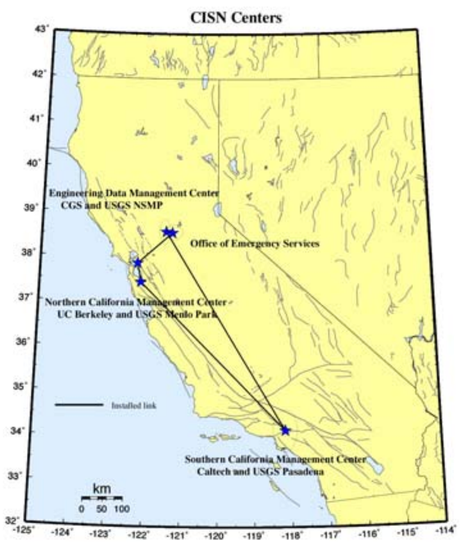


Figure 2. Diagram of the CISN backbone.

During this quarter, we also evaluated several software packages for monitoring the ring. The CISN is currently testing the Multi Router Traffic Grapher (MRTG) package, which collects data for graphical display of traffic on the CISN router interfaces. Several ways of viewing the data are available - by T1 backbone segment, all T1 interfaces, by router, and by the entire CISN backbone network, including all of the Internet backup tunnels between each of the routers. The graphs are presented in Web pages that are available to the CISN partners through the operations Web page.

The CISN Standards Group is also addressing issues related to network security. A working group has been formed, and the charge to the group is "to develop recommended operating practices both for physical security and for issues such as number of connections and recommendations for software configuration such as port closings, wrappers, and router security."

The CISN partners are working to migrate services to the ring. At this point, all traffic between Berkeley and Menlo Park is on the ring. Also, data traffic between Pasadena, Menlo Park, and CGS also flows on the ring. The CISN is waiting for OES to complete the installation of their new computer systems in Sacramento and to configure their routers for access to the CISN backbone.

Seismic Stations Transmitting to Two Data Processing Centers

As part of the TriNet project, CGS and Caltech/USGS Pasadena implemented dual data transmission from several CGS seismic stations in southern California, as a step to increase robustness. One copy of the data is sent to CGS in Sacramento while the second copy was sent to Pasadena. As part of CISN, this mode of data sharing, by having 10 southern California stations send data to both Pasadena and UC Berkeley and 10 northern California stations send data directly to UC Berkeley and Pasadena, will greatly enhance the robustness and backup capabilities of CISN.

The 20 stations, planned for this FY, with dual station feeds are configured and operational (Figure 3). CISN is actively using data from the shared stations to compute magnitudes and ground motions. As an example, use of the Caltech stations allowed the Northern California Management System to calculate a local magnitude of 5.49, instead of 5.62 for the Big Bear mainshock, using only northern California stations. The BSL is currently testing the Caltech stations for computing moment tensors and finite fault parameters.

Product Standardization

A major goal of CISN is product standardization to ensure that products mean the same across the state. In particular, this includes hypocenters, magnitudes, focal mechanisms, and ShakeMaps.

We continue to test statewide configurations for event detection and location. These tests are structured so that both northern and southern California are operating a statewide system in parallel with their current "regional" system. In the most recent set of tests, both statewide systems were missing events - compared with each other and to the regional systems. It appears to be a problem with module that is responsible for event detection. In addition, issues related to the timing of the pick arrival have been noticed (a late arriving pick will produce a different set of detections), which require an improved "pick filter".

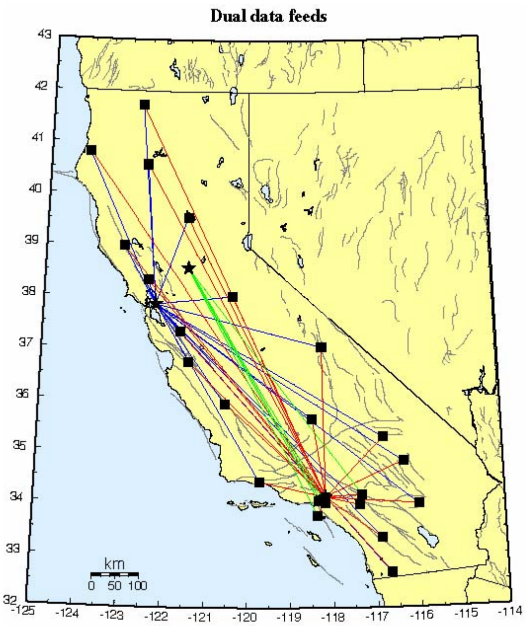


Figure 3. Diagram illustrating dual station data feeds to improve robustness.

However, these tests have been complicated by problems with keeping station metadata synchronized. The Standards Committee requested an inventory of metadata in February and has convened a committee to develop a prototype model for metadata exchange and update. To facilitate future changes the group has established a mechanism for evaluating new proposals for schema modifications.

ShakeMap Enhancements

A high priority of CISN is to improve data availability and to improve the distribution of ShakeMap to ensure that it is available following a major earthquake.

Menlo Park and UCB have established a system of backup ShakeMap machines. For the last 2 months, we have been alternating every 2 weeks the duties of ShakeMap production. In addition, the BSL and MP have started work on a system to help with rapid quality review of ShakeMaps.

In Pasadena we completed the porting of ShakeMap software to the FreeBSD operating system (***on a PC***) to facilitate the distribution of ShakeMap systems and backups. This will greatly reduce cost of and speed up ShakeMap production in the future.

To improve ShakeMap, we implemented a linear ramp between M5.0 and M5.5 for smooth transition between small magnitude and JBF regressions. This weighting option will be flexible and can be applied to weight multiple regressions as commonly done for probabilistic hazard maps.

CISN ShakeMaps were made for 20 earthquakes this quarter, including widely-felt, M5.4 Big Bear, and 5-6 M4.5+ in the same Big Bear sequence.

CISN DISPLAY

The CISN is developing CISN Display to provide statewide real-time earthquake information. The CISN Display is an integrated 24/7 Web-enabled earthquake notification system. The application provides users with real-time seismicity, and following a large earthquake will automatically make available other earthquake hazards information such as ShakeMap.

The CISN Display consists of two modules, CISN Display client and QuakeWatch Server. We developed a draft a 'timeline' of development milestones for working towards a production version of a CISN Display client and QuakeWatch Server running in Pasadena and a second site in northern California.

We installed, ran, and tested the QuakeWatch Server software on a local machine to determine the systems performance and reliability under a simulated test environment. Four CISN Display client software releases: V0.24beta, v0.23beta, v0.22beta and v0.21beta were made available to beta testers.

We implemented a QDM Logic filter to minimize the display of duplicate events from two different networks. 'AUTHOR' (authoritative) network signature in 'Info Panel' for each earthquake event received. Default map-layers and earthquake epicenter color.

We provided several interface updates such as: map scale, maximum zoom-scale limit, option to display audible beeps for events about a magnitude threshold. We also implemented an installation-shield to assist in the downloading and installation of the software by end users. Updated the one-line disclaimer as seen on the bottom of the CISN Display interface. We added a Recent Earthquakes 'legend' and 'color scheme' as the new default interface setting, to match the available real-time earthquake maps available online.

We released the Beta client to the limited external test-users listed below.

OES – Randy Schully, Rich Eisner
Caltrans - Loren Turner, Lallian Mualchin
MWD - Les Fritz, Doug Litchfield
DWP - Ron Tognazinni, Nathan Look

We also responded to questions, comments and suggestion from 'internal' beta testers, CISN members from USGS and UC Berkeley.

Outreach Activities (R. Eisner & J. Goltz)
Outreach continued this quarter with planning and technical assistance provided to the City of Riverside in preparing for and holding a full-scale exercise on April 29, using a ShakeMap/HAZUS scenario for a M7.4 earthquake on the southern San Andreas Fault. This same scenario was used for an exercise on March 19 by the cities of the Coachella Valley with technical assistance provided by the CISN Earthquake Outreach Program. In response to a request by the City of Santa Barbara, a new ShakeMap planning scenario was developed for a M7.4 event, the North Channel Slope Scenario.

As the 1st generation Auto HAZUS (near real-time operation of HAZUS) protocols are finalized, the CISN Outreach Program will work with other OES divisions in developing a procedure for sharing loss estimates with the Operational Areas and other agencies, as appropriate. The program will also explore applications for real-time information from CISN for early recovery operations. These issues were discussed at a meeting with OES Branch Chief for Disaster Assistance Programs, Royce Saunders, on March 13 in Sacramento.

A workshop designed to introduce ShakeMap to the northern California news media was held at the USGS Menlo Park campus on January 23, 2003. Currently, a brief video is being produced based on the scientific presentations on CISN and ShakeMap at the workshop.

Engineering Data Center
Progress occurred on several fronts necessary for the transmission of strong motion data parameter packages and time series waveform files to and from the Engineering Data Center the other centers.

A consensus definition of the packets containing parameters about the ground motion at a station was completed. The new packet allows the ground motion values and times to be defined more precisely, and values for all three components to be separately identified.

The CISN Ground Motion Packet is a major step forward, but since it will require changes at each center, CISN has decided to use the Earthworm II packet as an interim step. The value in this step is that Menlo Park and Berkeley are already using the Earthworm packet in the Northern California Data Center exchanges. The full CISN utilization of this interim packet should occur during the early part of the Second Quarter. This will then be a transitional step to the CISN packet, which will be transmitted on the T1 ring in XML format, a more effective format for computer-to-computer data exchange.

The project to move toward standardized strong motion processing at the Menlo Park NSMP and Sacramento CSMIP programs will take advantage of the effort that has begun in COSMOS and PEER. Workshops are planned for this summer in which comparison of results will be presented and differences discussed. Since the workshop is planned to have International and well as nation-wide participation, the results will represent a consensus well beyond CISN. This is important in use of data from other areas and countries as part of California studies to understand and predict strong motion.

Figure 4. The city hall of Costa Mesa, a nonductile concrete building retrofit with an external steel frame. The city hall is being instrumented under CISN to confirm performance of the retrofit technique, and to provide information on appropriateness for occupancy during response activities after the event.

The set of metadata needed by the Engineering Data Center to process records for use in engineering applications, has been developed by the Strong Motion Working Group. The current effort, though still in draft, will require that the other two centers provide this information with, or as a part of, each record sent to the EDC. Correspondingly, the set of parameters needed by the other two centers for seismological data use is being finalized by other Groups.

The internal network used by CGS to link the computers that monitor field instruments and take the incoming calls during earthquake shaking is being upgraded to a 10baseT communication network.

Seismic Stations, Upgrades and New Deployments – Northern California Management Center

One of the major activities of CISN is to maintain seismic stations in California. The CISN is also involved in upgrades and installation of new stations to improve coverage for ShakeMap and other CISN products.

The BSL has completed the effort to install additional air conditioning and power to its main computer facility in McCone Hall.

The BSL and Caltech are working to improve the real-time amplitude processing software developed in Southern California as part of the TriNet project. In the process of adapting the programs to the Northern California operation environment, a number of issues have been identified and addressed. In addition, the BSL has completed the modifications to add a database to its real-time system.

The USGS Menlo Park continued installation of ANSS sites in urban regions of the San Francisco Bay area. Three new stations were installed in San Francisco (Fire Stations #9, 14, and 43), two in Berkeley (Fire Stations #1 and #3), and one in Mountain View (Fire Station #2). These installations all supply continuous tri-axial acceleration data to the NCSN over its private network. In addition, the NCSN upgraded three analog sites to digital in the North San Francisco Bay region (NBRB, NHM and NAP). These sites improve the ability of the CISN to generate reliable ShakeMaps in the region surrounding the Rogers Creek fault, which could rupture together with the Hayward fault in a M>6.7 quake.

The USGS Menlo Park built custom hardware to convert an existing analog microwave collection node at Williams to satellite telemetry. The site, when completed, will receive analog FM data from 16 seismic stations, discriminate the signals, digitize them and transmit them to Menlo Park via a dedicated satellite link. Installation will be completed by the end of April.

The NCSN continues to work with the staff at the Northern California Data Center to make all its seismic instrument response information available to the user community. This complex task requires meticulous detailing of the hardware path of every channel of digital data recorded since 1984. The effort has taken close to one man-year and the resulting data file is nearly 34,000 lines long. We now have 482 sites and 1476 channels in the database, but we are far from finished.

By far, the most challenging aspect of this quarter was the imposition of firewalls mandated by the Department of Interior. Firewalls affect virtually every aspect of NCSN operations, from seismic data exchange with CISN partners, datacenter updates, response by the Duty Seismologist when away from the office, web updates, and data acquisition via private LAN's and public Internet. The good news is that the worst is behind us, and we are hopefully well protected from hackers.

Seismic Stations, Upgrades and New Deployments – Southern California Management Center

The SC Management Center worked on station upgrades and maintenance. Several vaults in the Salton Sea area have suffered from unusual corrosion. We rebuilt the vaults at Brunts Corner and Salton Sea. The STS-2 sensor at Victorville stations was removed and replaced by a Guralp 3ESP in a new outside vault. Also, worked on repairing the previously flooded vault at Wheeler Ridge.

We tested and implemented several changes to the real-time magnitude software. Changes include longer search windows for peak amps, a new cutoff distance algorithm, and several bug fixes. We also modified the amplitude generator (ampgen) to look for gaps in the amplitude time series and note the presence of gaps in the amplitude records that it writes to the database.

To improve the robustness of the SCSN we are configuring the communication circuits for our remote sites to detour to alternative circuits. We finished configuring the LAN through T1-1 to run in detour mode, and mostly finished configuring the FRAD's to run in detour mode. We also created station configuration files on the

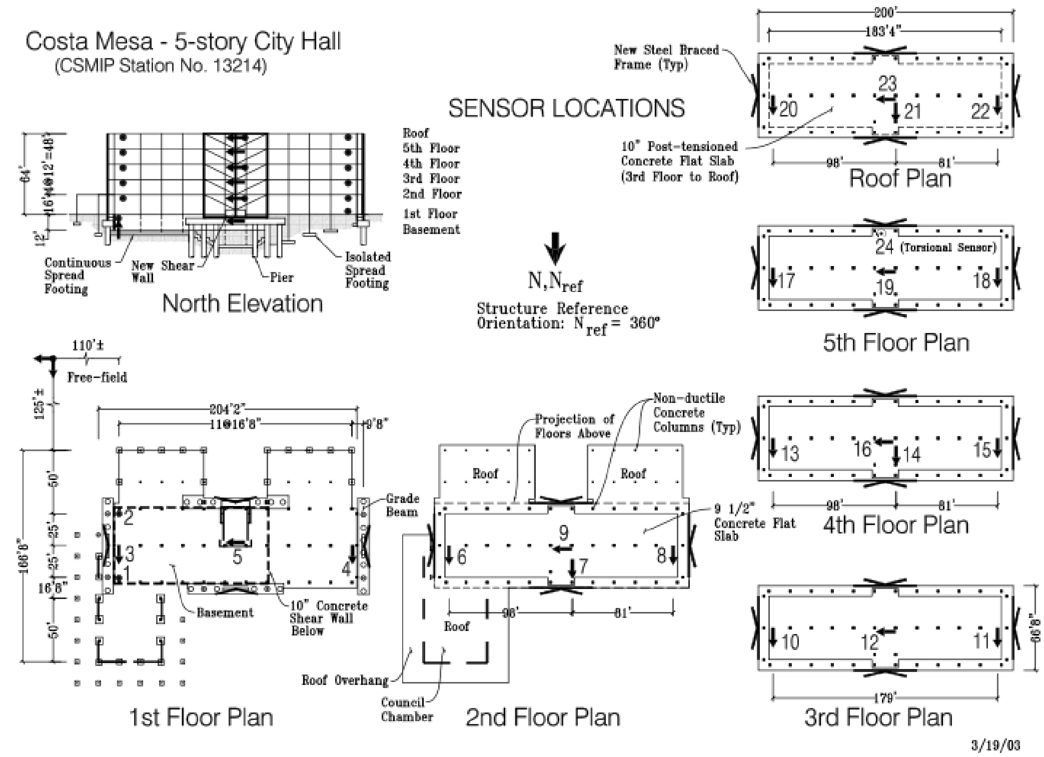


Figure 5. Layout plan for location of strong motion sensors in the Costa Mesa City Hall. An adequate number and configuration of sensors will be used to allow determination of inter-story drift and shear wall rocking.

real-time systems (station.ini files) to acquire data when the system is in detour mode.

As part of deploying the next generation of dataloggers, we worked out Network Address Port Translation for the Qanterra Inc. Q330's to make it possible to use one public IP address for all the Q330's. Using a the same approach, we configured a Cisco router on the T1-3 interface with access lists to allow certain TCP/UDP port access for the remote earthworm hubs.

Because CISN will be producing multiple magnitudes for larger earthquakes, we implemented a test archive database and an associated web page. Currently we have a page that can search for a particular magnitude. http://www.scecdc.scec.org/catalog_search/multmag_index.html. This provides access to user specified magnitudes, like ML or MW. In the past only preferred magnitudes were available.

Seismic Stations, Upgrades and New Deployments – Engineering Management Center

As recommended by the Advisory Committee, one building will be instrumented this year. The Costa Mesa City Hall, shown in Figure 4, was chosen because it is representative of a class of structures, non-ductile concrete buildings, which represent a significant component of California's needed preparation and mitigation for future earthquakes. The building has been retrofitted with an external moment frame and internal shear walls to increase its seismic strength. If the building undergoes damage it will not be possible to direct response and recovery for the building.

The instrumentation will serve to provide confirmation of the retrofit strategy, as well as advise the jurisdiction of the severity of the shaking experienced at the site. In planning the sensor layout more than the usual number of sensors was used, per the recommendations made by the Advisory Committee in January, just as the planning was underway. Enough sensors were included to allow measurement of inter-story drift and of shear wall rocking in the structure. The final sensor layout, after review by Advisory Committee representatives, is shown in Figure 5. The instrumentation, now underway, should be completed by early in Quarter Two. The instrumentation includes a ground station in the parking lot, which will also serve as a reference station for ShakeMap.

The CISN Display

CGS USGS CALTECH OES UCB