

OSHPD/CSMIP
HOSPITAL INSTRUMENTATION
Annual Report
July 1, 2014 through June 30, 2015

OSHPD Agreement No. 13-4097
(DOC No. 1013-960R)

California Strong Motion Instrumentation Program
California Department of Conservation
California Geological Survey

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Sacramento, California 95814-3531

October 1, 2015

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I. INTRODUCTION

The California Strong Motion Instrumentation Program (CSMIP) of the California Geological Survey, Department of Conservation, performs installation, maintenance and data recovery for strong motion instrumentation in hospitals through an interagency agreement with the Office of Statewide Health Planning and Development (OSHPD). Funding strong motion instrumentation of hospitals through the interagency agreement is in lieu of normal building-permit fee funding referenced in Chapter 8 of the Public Resource Code.

Hospital buildings have been instrumented under eight previous Interagency Agreements: 89-0046 (DOC 1089-025R), 92-3187 (DOC 1092-541R), 95-6011 (DOC 1095-570R), 98-9034 (DOC 1098-701R), 01-2069 (DOC 1001-753R), 04-5072 (DOC 1004-790R), 07-7071 (DOC 1007-911R), and 10-1266 (DOC 1010-930R). These agreements extend from July 1989 through June 2013, each covering a period of three fiscal years. The ninth and current interagency agreement 13-4097 (DOC 1013-960R) is also for a period of three years, from July 1, 2013 through June 30, 2016. This Annual Report covers activities performed during the second fiscal year of the Agreement, July 1, 2014 through June 30, 2015.

Since the last report, the new hospital building at the Oakland Kaiser Permanente Medical Center was instrumented. In addition, the building reference free-field stations at the San Francisco General Hospital and the Ventura County Hospital were installed. SMIP also developed the instrumentation system design and plans for the new Lucile Packard Children's Hospital at Stanford, which is currently under construction. Similarly, the instrumentation system design was developed for the Voluntary Seismic Improvement (VSI) seismic strengthening projects at the Community Hospital in Riverside and the Regional Medical Center in Downey. CSMIP worked with the hospital staff, the structural engineer and OSHPD to develop the instrumentation plan and the technical specifications document for the owner-paid instrumentation of these four hospitals. Developing the instrumentation plan and the Technical Specifications Letter (TSL) for these hospitals, working closely with the hospital owner, structural engineer, and OSHPD, is a significant activity for SMIP staff.

Hospital buildings recently instrumented or underway are listed in Tables 1, 2, and 3. Like most other hospitals recently instrumented by CSMIP, the new stations will have near-real-time data communication capability to allow the recorded motion to be automatically transmitted to

Sacramento after an earthquake to be processed and made available for use in post-earthquake response by OSHPD and the hospital owners.

1) OSHPD-Funded Regular Instrumentation of Hospitals

CSMIP has been working on the instrumentation of three regular hospital building projects funded by OSHPD during the last fiscal year, listed in Table 1. The instrumentation of Santa Clara Valley Hospital's Replacement Bed Building 1 in San Jose has been significantly affected by construction delays. The initial marking of the sensor locations in the building was performed by CSMIP in July 2012. The sensor marking was repeated, due to construction delays, in March 2014 at the request of the owner. The current projection is that actual instrument installation will be delayed until 2016, due to the ongoing delays in construction.

Preparation and planning for the instrumentation of the new UCSF Mission Bay Hospital began in early 2014. The sensor locations and instrumentation plan were developed in February 2014 and the field marking of the sensor locations was performed in September 2014. However, the owner requested that the field installation be delayed until after the hospital opened in February 2015.

Preparation and planning for instrumenting the new Oakland Kaiser Permanente Medical Center began in September 2013, while the hospital was under construction. However, the construction project manager requested that the actual field installation be delayed until after the hospital opened in July 2014. Sensor locations and instrumentation plans were finalized in February 2015 and the field marking of the sensor locations was performed in March. Many issues and questions on the sensor installations and cable runs were raised by the hospital facility engineers before CSMIP staff was able to proceed with the field installation. With assistance from OSHPD engineers, compliance officers and field inspectors, the installation of the instrumentation was completed on August 7.

2) Owner-Funded Instrumentation of Hospitals with SMIP Guidance and Assistance

In addition to the hospital instrumentation funded under the OSHPD/CSMIP contract, a significant component of CSMIP hospital instrumentation work involves detailed technical guidance and assistance for hospital instrumentation projects for which the owner absorbs the capital cost of instrumentation under OSHPD regulations.

A total of 15 CSMIP-assisted hospital instrumentation projects are currently underway or have been completed since July 1, 2013. Eight are new hospital buildings (see Table 2) that are base-isolated and/or have energy dissipation devices, or they use an Alternate Means of Compliance (AMOC) in the design. These are required to have owner-paid instrumentation installed during construction per the California Building Code and OSHPD regulations. Another seven are existing hospital buildings (see Table 3) that have been or will be retrofitted under the Voluntary Seismic Improvement (VSI) regulations. These VSI buildings use an Alternate Means of Compliance in their retrofit design and are required to be instrumented at owner expense.

CSMIP Guidance and Assistance CSMIP guidance and assistance in the instrumentation of hospitals includes, first, determining effective candidate sensor locations after study of the structural plans, done in conjunction with the structural engineer, architect of record, and OSHPD. Second is the development of an instrumentation plan that reflects consensus among the parties. Third is the development by CSMIP technical staff of a detailed design for the system, called the Technical Specification Letter or TSL. This TSL is provided to the owner, their contractors and OSHPD, and included in the plans. It specifies acceptable instruments as well as approved installation practices, and provides details for the locations and interconnection of the components. The next step is a field visit by CSMIP staff and representatives of the owner, construction contractor and OSHPD, during which actual sensor locations are approved and physically marked on the structural members. During the subsequent work by the contractor, CSMIP staff assists with issues as they arise. The final step, some months or years later, is field testing by CSMIP and the acceptance, when warranted, of the completed instrumentation system, which may need to be repeated if problems are found in the installation. With acceptance of the installed system, CSMIP takes on long-term maintenance of the instrumentation as well as data recovery and processing, supported by OSHPD.

A total of 12 owner-funded hospital projects are underway, listed in Tables 2 and 3. During FY14-15, CSMIP performed significant work on the four specific projects listed below:

Ventura – Community Memorial Hospital This 6-story steel structure is founded on improved ground. It will be instrumented with 24 sensors in the building and at depth in the underlying improved ground. A geotechnical array will be located outside the building. Marking of the sensor locations was performed by CSMIP on March 10, 2015. Due to technical difficulties a second field visit by CSMIP staff was necessary, which occurred on May 28, 2015. The installation is expected to be completed in late 2015 or early 2016. The TSL had been completed in October 2011.

Stanford – Lucile Packard Children’s Hospital This 6-story steel structure is designed using Alternate Means of Compliance. CSMIP staff studied the building plans to help develop the sensor locations. The instrumentation planning meeting was held on December 17, 2014. The building will be instrumented with 21 sensors. CSMIP completed the Technical Specifications Letter on March 5, 2015.

Riverside – Community Hospital (VSI) Building B is a 6-story concrete structure, built in 1965, which will be seismically strengthened. CSMIP reviewed and commented on the sensor locations proposed by the structural engineer. The instrumentation planning meeting was held on September 26, 2014. The building will be instrumented with 12 sensors plus 3 sensors at a free-field site. CSMIP completed the Technical Specifications Letter on December 1, 2014.

Downey – Regional Medical Center (VSI). The Nursing Tower is a 4-story concrete structure, built in 1967, which will be seismically strengthened. CSMIP reviewed the sensor locations proposed by the structural engineer. The instrumentation planning meeting was held on February. 20, 2015. The building will be instrumented with 12 sensors plus 3 sensors at a free-field site in the parking lot. CSMIP completed the Technical Specifications Letter on April 21, 2015.

3. Summary of Instrumented Hospitals

A total of 65 hospital buildings have been instrumented in the OSHPD/CSMIP project up through this report. One of the buildings (Eden Hospital in Castro Valley) was demolished. The locations of the 65 hospital buildings are shown on a probabilistic seismic hazard map in Appendix D. The hospital buildings and their structural systems are listed in the table in Appendix E.

The instrumentation of the new Oakland Kaiser Hospital and the installation of two reference free-field stations are described in Section II. Ongoing maintenance was performed during FY14-15 on the 63 previously instrumented hospital buildings listed in Section III. Strong-motion records were obtained from several of these buildings and their reference free-field sites during FY14-15, but most were of low level, as listed and highlighted in Section IV. The exception is the M6.0 South Napa earthquake of August 24, 2014, which was recorded at eight hospital buildings. All recordings can be viewed online and downloaded at www.strongmotioncenter.org.

Table 1

Regular Hospital Buildings

Instrumented under OSHPD/CSMIP Hospital Building Instrumentation Project (OSHPD Funded – HBSB Instrum. Comm. Recommended)

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Built	No. of Stories	No. of Sensors	Installation Date
<u>Instrumentation Completed Since July 1, 2013</u>						
1. Oakland – Kaiser Permanente Medical Center (New Replacement Hospital)	58590	IS 080551-01	2014	12/1	18	8/7/2015
Steel buckling-restrained braced frames						
<u>Instrumentation Underway</u>						
2. San Francisco – UCSF Medical Center at Mission Bay (New Hospital)	58572	IS 080619-38	2015	6/0	18+FF	FY 15-16 est.
Steel buckling-restrained braced frames (Includes reference free-field station: San Francisco – UCSF Mission Bay Hospital Grounds, CSMIP Sta. 58579)						
3. San Jose – Santa Clara Valley Hospital (Replacement Bed Bldg. 1)	57537	IS 080219-43	ca. 2016	7/1	20+FF	FY16-17 est.
Steel moment frames, with SidePlate connections (Includes reference free-field station: San Jose – Santa Clara Valley Hospital Grounds, CSMIP Sta. 57xxx)						

Table 2

New Hospital Buildings – Assisted Instrumentation Base-Isolated or Alternate Means of Compliance

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Built	No. of Stories	No. of Sensors	Installation Date
<u>Instrumentation Completed Since July 1, 2013</u>						
1. San Francisco – General Hospital						
	58574	IS 071795	2015	7/2	24+FF	07/25/14
Steel moment frames isolated with friction pendulum bearings (includes 4 relative displacement sensors)						
(Reference free-field station: San Francisco – Marian & Palisade , CSMIP Sta. 58575)						
<u>Instrumentation Underway</u>						
2. La Jolla – UCSD Jacobs Medical Center Bed Tower						
	03593	IL 092778-37	ca. 2016	10/2	24	FY 15-16 est.
Steel moment frames above ground level and concrete shear walls below ground level (AMOC)						
(Reference free-field: Existing sta.: La Jolla – UCSD Hospital Grounds A , CSMIP Sta. 03521)						
3. Ventura – Community Memorial Hospital						
	25594	IS 082255-56	ca. 2016	6/1	24+Geotech Array	FY 15-16
Steel concentrically-braced frames on CDSM improved ground						
(To include 3 downholes under building and a geotech array outside building, CSMIP Sta. 25596)						
4. Stanford – New Stanford Hospital						
	58nnn	IS 081923-43	ca. 2017	7/1	36+FF	FY 16-17 est.
Steel moment frames isolated with friction pendulum bearings at the base						
(To include a reference free-field station)						
5. Stanford – Lucile Packard Children’s Hospital						
	58nnn	IS 091547-43	ca. 2017	6/2	21	FY 16-17 est.
Steel moment frames in the EW direction and steel BRB braced frames in the NS direction above First Level; Concrete shear walls below First Level (AMOC)						
(Reference free-field: Existing station: Stanford – Quarry & Welch , CSMIP Sta. 58086)						
6. Fremont – Washington Hospital						
	57nnn	HS 051385-01	ca. 2016	3/1	24+FF	tbd
Steel moment frames isolated with friction pendulum bearings and viscous dampers						
(To include a reference free-field station)						
7. San Francisco – CPMC Cathedral Hill Hospital						
	58nnn	IS 080885-38	ca. 2019	12/2	24	tbd
Steel moment frames with viscous wall dampers						
(No reference free-field station feasible)						
8. Loma Linda – University Medical Center Replacement Hospital						
	23nnn				tbd	tbd
Base-isolated structure						

Table 3

**Existing Hospital Buildings – Assisted Instrumentation
Voluntary Seismic Improvement (VSI) Projects**

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Design	No. of Stories	No. of Sensors	Installation Date
<u>Instrumentation Completed Since July 1, 2013</u>						
1. San Diego – Sharp Memorial Hospital (South Tower)						
	03546	HL 100694-37	1952	8/1	15+FF	07/22/2013
Concrete shear walls (retrofit: add concrete shear walls and wrap columns) (Reference free-field station: San Diego – I805 & Mesa College , CSMIP Sta. 03544)						
2. Redlands – Community Hospital (Radiology Addition/Bldg. #7)						
	23548	HL 101386-36	1971	2/1	9+FF	07/17/2013
Concrete shear walls (retrofit: add concrete shear walls) (Reference free-field station: Redlands – Terracina & W Fern , CSMIP Sta. 23547)						
<u>Instrumentation Underway</u>						
3. Riverside – Community Hospital (Building B)						
	13nnn		1965	6/1	12+FF	tbd
Concrete shear walls (retrofit: add concrete shear walls and FRP wrap columns) (To include a reference free-field station)						
4. Downey – Regional Medical Center						
	14nnn	IL082802-19A	1967	4/1	12+FF	tbd
Concrete shear walls and moment frames (retrofit: add concrete shear walls) (To include a reference free-field station)						
5. Santa Ana – Western Medical Center (Admin Bldg)						
	13nnn	HL 101526-30	1971	1/0	6+FF	tbd
Steel x-braced frame (retrofit: replace steel x-braces) (To include a reference free-field station)						
6. Los Angeles - Hollywood Presbyterian Medical Center (South Wing)						
	24nnn		1957	4/1	12+FF	tbd
Concrete shear walls (retrofit: add concrete shear walls and wrap columns) (To include a reference free-field station)						
7. Los Angeles - Hollywood Presbyterian Medical Center (Doctor's Tower)						
	24nnn		1971	10/2	15	tbd
Concrete shear walls (retrofit: add concrete shear walls and wrap columns) (Reference free field station will be same as above.)						

II. HOSPITAL INSTRUMENTATION DURING FY14-15

Hospital buildings recently instrumented include the Kaiser Hospital in Oakland and the General Hospital in San Francisco. Instrumentation at the latter was reported in the last year's report. However, the reference free-field station at the General Hospital was installed later than the building. In addition, installation of the reference free-field at the Ventura County Hospital was completed on August 27, 2014. Details of the instrumentation of the Oakland Kaiser Hospital and the reference free-field stations at the San Francisco General Hospital and Ventura County Hospitals are included below:

Kaiser Hospital, Oakland – Appendix A

The new hospital at the Kaiser Permanente Oakland Medical Center includes a 12-story tower and a 4-story podium plus a one-story basement. The building is a steel buckling-restrained braced frame structure. It was designed according to the 2007 California Building Code. The building was opened in July 2014. CSMIP obtained the permission from the owner in September 2013, when it was under construction. However, the construction project manager requested that the instrumentation be performed after the hospital was opened. CSMIP staff studied the plans and developed the 18-sensor instrumentation plan in early February 2015. The proposed sensor locations were approved by OSHPD (R. Lobo) on February 10. CSMIP engineers visited the building to discuss the proposed instrumentation with the facility engineers on February 12. No suitable reference free-field site could be found. CSMIP performed the pre-installation field sensor marking on March 4. However, many issues and questions on the sensor installations and cable runs were raised by the facility engineers. With assistance from OSHPD (R. Lobo) field installation was approved to proceed on April 15. A second pre-installation site visit was needed, with the Inspector of Record, performed April 23. After shop preparations, CSMIP staff started the field installation in June and completed it on August 7, 2015.

It is of interest that the instrumentation in the hospital recorded the M4.0 Piedmont earthquake of August 17, 2015, only 10 days after the system installation was completed. The hospital was only 3 kilometers from the earthquake epicenter. The recorded peak accelerations were 6% g at the building base and 9% g at the roof. The record can be seen at www.strongmotioncenter.org.

A photo of the instrumented building, the sensor locations drawing, and the building description are included in Appendix A.

Reference Free-field at General Hospital, San Francisco – Appendix B

As reported in the last year's report, the instrumentation of the new base-isolated Trauma Center at San Francisco General Hospital was commissioned and accepted by CSMIP on July 25, 2014. At that time, the reference free-field station was not installed, but was installed later and accepted by CSMIP on July 22, 2015. The photo of the building free-field station is included in Appendix B.

Reference Free-field at County Hospital, Ventura – Appendix C

The original free-field station for the Ventura County Hospital (CSMIP Sta. 25747) was installed in 1996, when the building was instrumented. At the request of the hospital owner, the station was removed on November 5, 2007 to allow hospital expansion. After several years of working with the owner to establish an acceptable new location, a new site on the campus was finally selected and approved by the owner. CSMIP staff installed the new station on August 27, 2014. The photo of the reference free-field stations is included in Appendix C.

III. HOSPITAL INSTRUMENTATION MAINTENANCE

During the period covered by this report, CSMIP technical staff performed periodic maintenance of the strong-motion instrumentation installed in the 63 previously-instrumented hospital buildings, 48 of which have an associated free-field instrument. With the addition of the newly instrumented Oakland Kaiser Hospital, a total of 64 hospital buildings are being maintained at the start of FY15-16.

The 63 hospital buildings instrumented as of the beginning of FY14-15 (Eden Hospital, demolished, is not included) are listed alphabetically by city. (An asterisk indicates that the instrumentation at the facility includes a reference free-field station):

1. Alameda - Alameda Hospital *
2. Bakersfield - Kern County Hospital *
3. Berkeley - Alta Bates Hospital
4. Burlingame - Mills Peninsula Hospital *
5. Castro Valley - Sutter Eden Medical Center *
6. Colton - Arrowhead Regional Medical Center (base-isolated) *
7. Crescent City - Sutter Coast Hospital *
8. El Centro - El Centro Regional Medical Center *
9. Escondido - Palomar West Medical Center, Main Tower *
10. Escondido - Palomar West Medical Center, Central Plant
11. Eureka - St. Joseph Hospital *
12. Fairfield - North Bay Medical Center *
13. Fremont - Kaiser Hospital *
14. Gilroy - St. Louise Hospital *
15. Hemet - Hemet Valley Medical Center
16. Indio - JFK Memorial Hospital *
17. Irvine - Kaiser Sand Canyon Hospital *
18. King City - Mee Hospital *
19. La Jolla - Scripps Memorial Hospital *
20. La Jolla - UCSD Hospital *
21. Lancaster - Antelope Valley Hospital *
22. Los Angeles - Childrens Hospital
23. Los Angeles - Good Samaritan Hospital
24. Los Angeles - LAC+USC Hospital (D&T, base-isolated) *
25. Los Angeles - LAC+USC Hospital (Inpatient)
26. Los Angeles - MLK Hospital (base-isolated) *

- | | | |
|-----|----------------|--|
| 27. | Los Angeles | - USC Hospital (base-isolated) |
| 28. | Los Angeles | - USC Hospital Addition |
| 29. | Mammoth Lakes | - Mammoth Hospital * |
| 30. | Moreno Valley | - Riverside County Hospital * |
| 31. | Newport Beach | - Hoag Hospital (West Tower) * |
| 32. | Newport Beach | - Hoag Hospital East Tower (base-isolated) |
| 33. | Novato | - Community Hospital * |
| 34. | Ontario | - Kaiser Hospital * |
| 35. | Oxnard | - St. John's Medical Center * |
| 36. | Palm Springs | - Desert Hospital |
| 37. | Palmdale | - Palmdale Regional Medical Center * |
| 38. | Redlands | - Community Hospital * |
| 39. | Salinas | - Natividad Medical Center * |
| 40. | San Bernardino | - San Bernardino Community Hospital |
| 41. | San Diego | - Sharp Memorial Hospital * |
| 42. | San Diego | - UCSD Medical Center * |
| 43. | San Francisco | - General Hospital * |
| 44. | San Francisco | - Kaiser Hospital |
| 45. | San Francisco | - UCSF Hospital * |
| 46. | San Jose | - O'Connor Hospital * |
| 47. | San Jose | - Santa Clara Valley Hospital (Bldg K) |
| 48. | San Pedro | - Providence Little Company of Lady Medical Center (Bldg. 1T)* |
| 49. | San Pedro | - Providence Little Company of Lady Medical Center (Bldg. 2) |
| 50. | San Rafael | - Marin General Hospital * |
| 51. | Santa Barbara | - Cottage Hospital * |
| 52. | Santa Clara | - Kaiser Hospital * |
| 53. | Santa Maria | - Marian Hospital * |
| 54. | Santa Monica | - St. John's Hospital (base-isolated) * |
| 55. | Santa Rosa | - Kaiser Hospital * |
| 56. | Simi Valley | - Simi Valley Hospital * |
| 57. | Stanford | - University Hospital * |
| 58. | Sylmar | - Olive View Hospital * |
| 59. | Templeton | - Twin Cities Hospital * |
| 60. | Torrance | - Providence Little Company of Lady Medical Center * |
| 61. | Valencia | - Mayo Hospital * |
| 62. | Ventura | - Ventura County Hospital * |
| 63. | Walnut Creek | - Kaiser Hospital |

In addition, CSMIP staff performed monitoring and data recovery for the code-type instrumentation systems (3 triaxial instruments) in the following four hospitals at CSMIP expense:

1. Los Angeles – White Memorial Hospital (7-story)
2. Pasadena – Huntington Memorial Hospital (7-story)
3. Downey – Kaiser Hospital (6-story)
4. Los Angeles – Kaiser LAMC Sunset Hospital (7-story)

IV. STRONG-MOTION RECORDS FROM HOSPITALS

During the period from July 1, 2014 to June 30, 2015 a total of eleven earthquakes with magnitude 3.5 or larger were recorded at instrumented hospitals. The hospitals and the maximum accelerations recorded in the hospital building (the base and superstructure) and at its reference free-field station (ground) if it exists, are listed below for these earthquakes.

M4.6 Big Bear Lake Earthquake of July 5, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Redlands – Community Hospital	2-story concrete shear wall (VSI)	31.7	0.018	0.018	0.027

M6.0 South Napa Earthquake of August 24, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Fairfield – North Bay Medical Center	3-story steel EBF and moment frames	24.2	0.041	0.042	0.172
Novato – Community Hospital	2-story steel CBF frames	24.8	0.043	0.036	0.055
Walnut Creek – Kaiser Hospital	3-story steel moment frames	42.5	No FF	0.028	0.112
Santa Rosa – Kaiser Hospital	4-story steel moment frames	45.7	0.030	0.036	0.091
Alameda – Alameda Hospital	3-story steel moment frames	50.5	0.016	0.013	0.112
Burlingame - Mills Peninsula Hospital	6-story steel CBF frames with base isolation (FPS)	69.4	0.029	0.022	0.082
Fremont – Kaiser Hospital	2-story steel moment frames	79.4	0.008	0.012	0.035
Stanford – University Hospital	3-story steel moment frames	87.5	0.013	0.013	0.050

M3.6 Hemet Earthquake of September 2, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Hemet – Hemet Valley Medical Center	4-story concrete shear wall	5.5	No FF	0.079	0.153

M3.5 Mammoth Lakes Earthquake of September 25, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital	1-story steel CBF frame	9.9	---	0.008	0.050

M3.6 San Juan Bautista Earthquake of November 19, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Salinas – Natividad Medical Center	3-story steel CBF frames	15.3	---	0.011	0.029

M4.2 San Juan Bautista Earthquake of November 19, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Salinas – Natividad Medical Center	3-story steel CBF frames	15.2	0.035	0.034	0.108

M3.9 San Juan Bautista Earthquake of December 5, 2014

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Salinas – Natividad Medical Center	3-story steel CBF frames	15.5	0.053	0.042	0.117

M4.4 Greenfield Earthquake of January 20, 2015

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
King City – Mee Hospital	2-story steel EBF frames	29.2	---	0.028	0.058

M3.6 San Ramon Earthquake of April 2, 2015

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Walnut Creek – Kaiser Hospital	3-story steel moment frames	12.8	No FF	0.010	0.037

M3.6 Concord Earthquake of May 3, 2015

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Walnut Creek – Kaiser Hospital	3-story steel moment frames	8.8	No FF	0.017	0.046
Alameda – Alameda Hospital	3-story steel moment frames	30.1	---	0.011	0.138

M3.7 San Jacinto Earthquake of May 6, 2015

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Hemet – Hemet Valley Medical Center	4-story concrete shear wall	7.1	No FF	0.017	0.028
Moreno Valley – Riverside County Hospital	3-story steel moment frames	22.9	0.008	0.010	0.019

The strong-motion records are available rapidly after an earthquake as part of the Internet Quick Reports at the web site of the Center for Engineering Strong Motion Data (CESMD) at <http://www.strongmotioncenter.org>.

The most significant earthquake is the M6.0 South Napa earthquake of August 24, 2014, which was recorded at a total of eight hospital buildings. The hospital closest to the earthquake is the North Bay Medical Center in Fairfield. The peak accelerations were 4% g at the reference free-

field, and 4% g at the base of the building and 17% g at the roof, respectively. The interactive CESMD map that shows the locations of the earthquake epicenter, the fault, and the stations that recorded the earthquake is shown in Figure 1. The acceleration record from the 3-story North Bay Medical Center building is shown in Figure 2. The acceleration, velocity and displacement records from its reference free-field are shown in Figure 3.

V. FISCAL REPORT

Expenditures and Department of Conservation billings to OSHPD are summarized in the following:

Total amount of Interagency Agreement (July 1, 2013 - June 30, 2016)	\$798,900.00
1) Budgeted for Year 1 (July 2013 - June 2014, FY 13/14)	\$266,300.00
Expended and billed for Year 1	<u>\$189,500.00</u>
Remaining amount to be billed from Year 1	\$76,800.00
2) Budgeted for Year 2 (July 2014 – June 2015, FY 14/15)	\$266,300.00
Expended and billed for Year 2	<u>\$306,300.00</u>
Remaining amount to be billed from Year 1 and Year 2	\$36,800.00
3) Available for Expenditure in Year 3 (July 2015 – June 2016, FY 15/16)	\$266,300.00
	<u>\$36,800.00</u>
	\$303,100.00

The remaining amount for Year 2 is included in the Year 3 budget to cover part of the instrumentation of Oakland Kaiser Hospital, completed on August 7, 2015, and other hospitals.

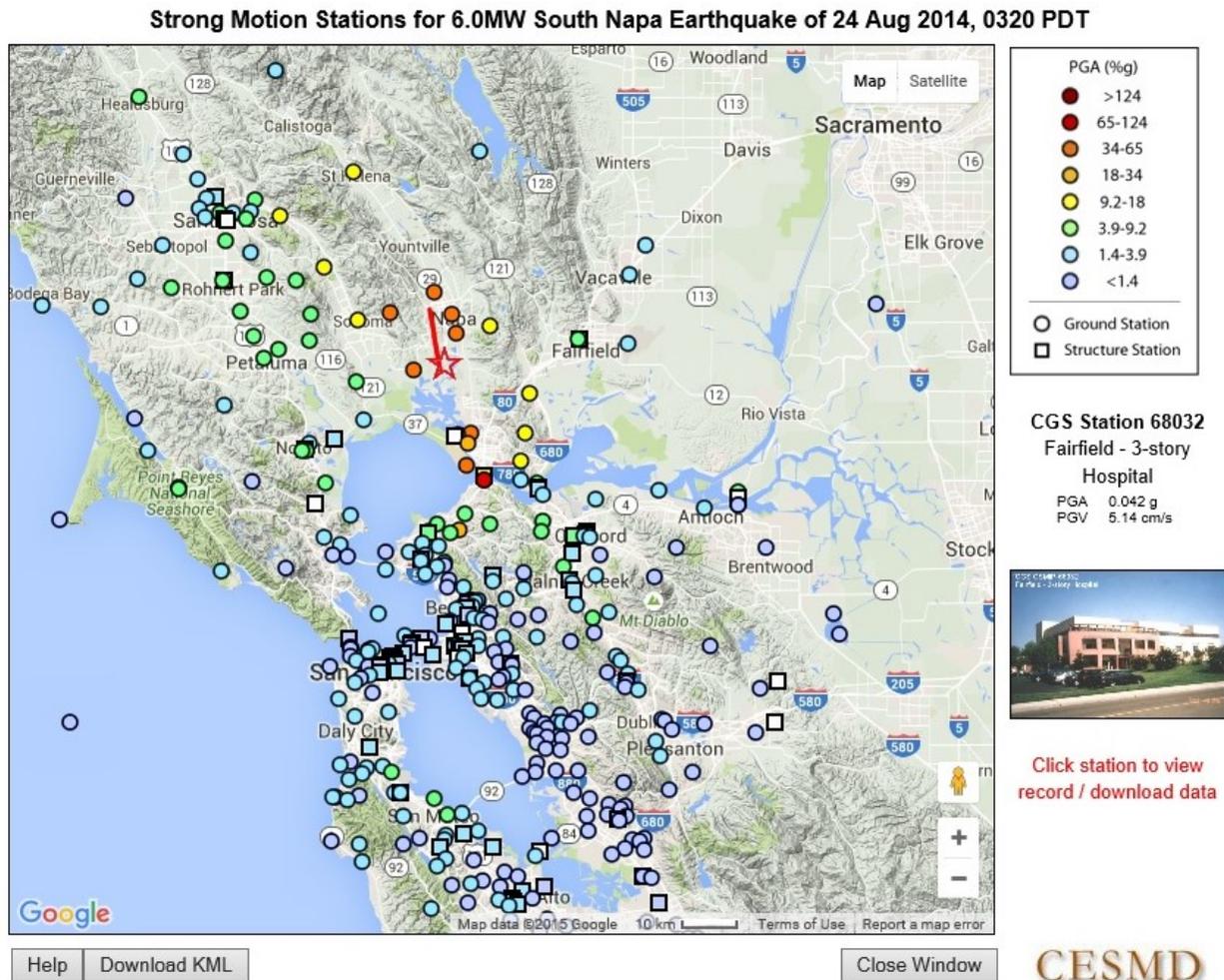


Figure 1. The interactive map at the CESMD, at www.strongmotioncenter.org, showing the locations of the epicenter, the fault and of the strong-motion stations that recorded the M6.0 South Napa earthquake of August 24, 2014. The colors of the dots and squares indicate the level of peak ground accelerations. The photo of the building and the recorded PGA and PGV at the closest hospital, in Fairfield, are shown on the right side of the map by moving the mouse cursor over the square for the Hospital on the map.

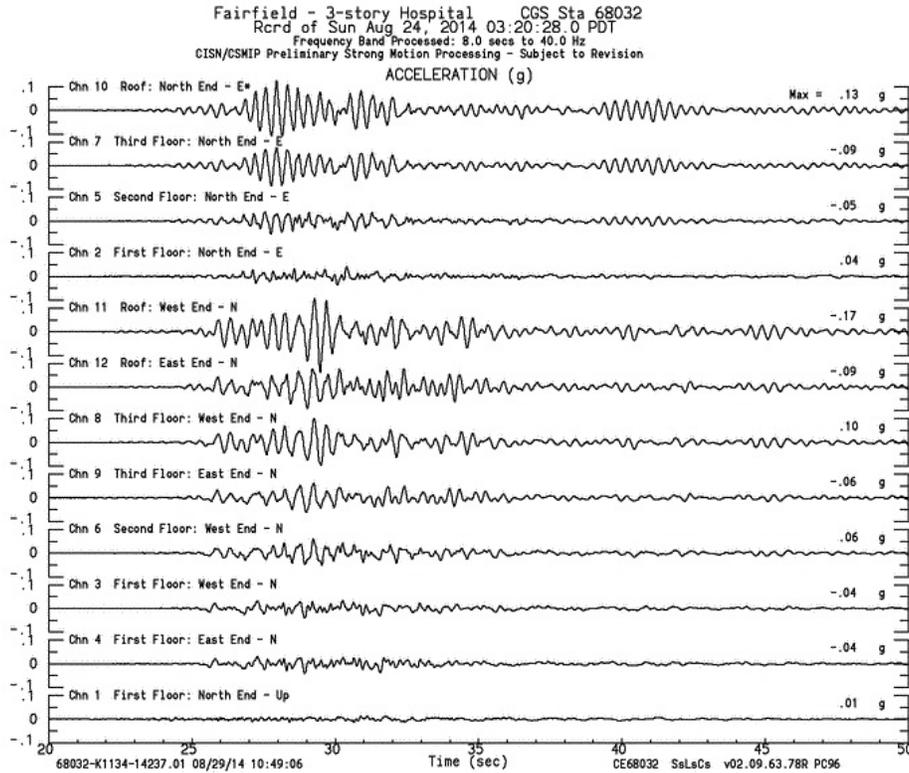


Figure 2. Acceleration records from the North Bay Medical Center in Fairfield during the 6.0 South Napa earthquake of August 24, 2014.

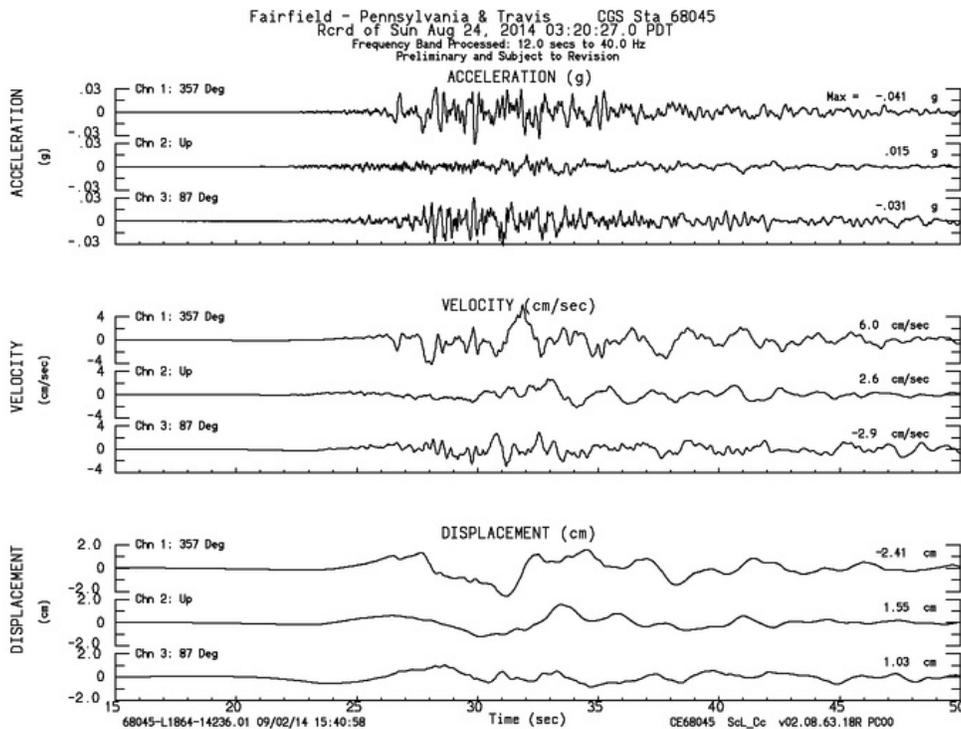


Figure 3. Record obtained at the reference free-field station at the North Bay Medical Center in Fairfield from the M6.0 South Napa earthquake of August 24, 2014.

Appendix A

**Instrumentation
of
Kaiser Hospital
in
Oakland**

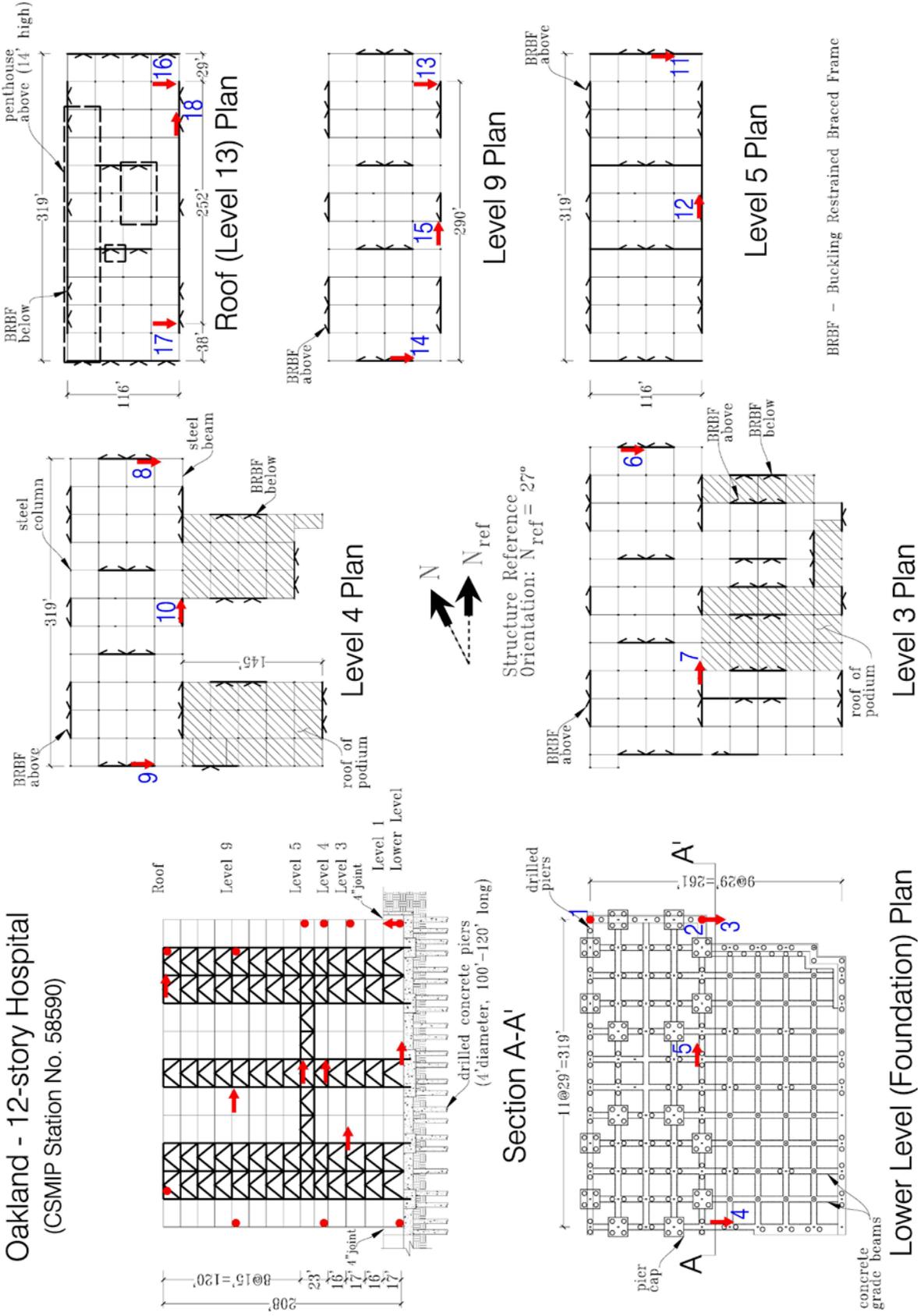
CSMIP Station No. 58590

Oakland – Kaiser Hospital
(CSMIP Station No. 58590)



View of the instrumented building at Oakland Kaiser Hospital.

Oakland - 12-story Hospital (CSMIP Station No. 58590)



Installed: 8/7/2015
Diagram: 8/19/2015

**CSMIP
INSTRUMENTED BUILDING DESCRIPTION**

Station Name: Oakland – Kaiser Hospital **Station No:** 58590
Building : 275 W. MacArthur Blvd. **Building Category (7/85):** I3b/28
Address : Oakland, CA 94611 **Material Category:** Steel

Coordinates: 37.8234 °N, 122.2581°W **No. of stories above/below ground:** 12/1

Base plan shape: Square **Dimensions:** 319' x 261'

Typical floor shape: Rectangular **Dimensions:** 319' x 116'

Vertical load carrying system: Concrete fill over metal deck floors and roof supported by steel (include floor decking system) beams and columns. Level 1 through Level 5 consist of 5" thick normal weight concrete fill over 3" metal deck, while Level 6 through the Roof consist of 4" thick light weight concrete fill over 3" metal deck.

Lateral force resisting system: Steel buckling-restrained braced frames (with moment resisting beam-column connections at select locations) in each direction. Steel braced frames are located at the perimeter and interior.

Foundation Type: Concrete pier caps with 4' diameter (60' – 120' long) drilled concrete piers. Pier caps are tied together with concrete grade beams.

Unusual architectural features: The building is separated from adjacent buildings by seismic joints. Mechanical equipment is located on Level 4 which is 23' tall. There is a large setback that occurs at Level 4 (termination of podium portion of structure). Electrical penthouse, PV racks, and air handling units on the roof.

Design date: 2010 (OSHPD IS-080551-01) **Construction date:** 2010-2014

Design Engineer: Degenkolb Engineers **Architect:** NBBJ
(Name and Address) 1300 Clay Street, Ste. 900 **(Name and Address)** 130 Sutter Street, 2nd Floor
Oakland, CA 94612 San Francisco, CA 94104

Geotechnical Engineer: URS Corporation **Site Class:** D (2007 CBC)
(Name and Address) 1333 Broadway, Suite 800
Oakland, CA 94612

Remarks: The building was designed in accordance with the 2007 California Building Code. This hospital building is instrumented as part of OSHPD/CSMIP agreement to instrument hospitals in California. It was recommended for instrumentation by the Instrumentation Committee of the Hospital Building Safety Board.

AFS, Rev. 4/88

Appendix B

Reference Free-Field at San Francisco General Hospital

San Francisco – General Hospital Grnds
(CSMIP Station No. 58575)



View of the reference free-field station toward the instrumented building (CSMIP Sta. 58574).at San Francisco General Hospital.

Appendix C

Reference Free-Field at Ventura County Hospital

Ventura – County Hospital Grounds A
(CSMIP Station No. 25573)



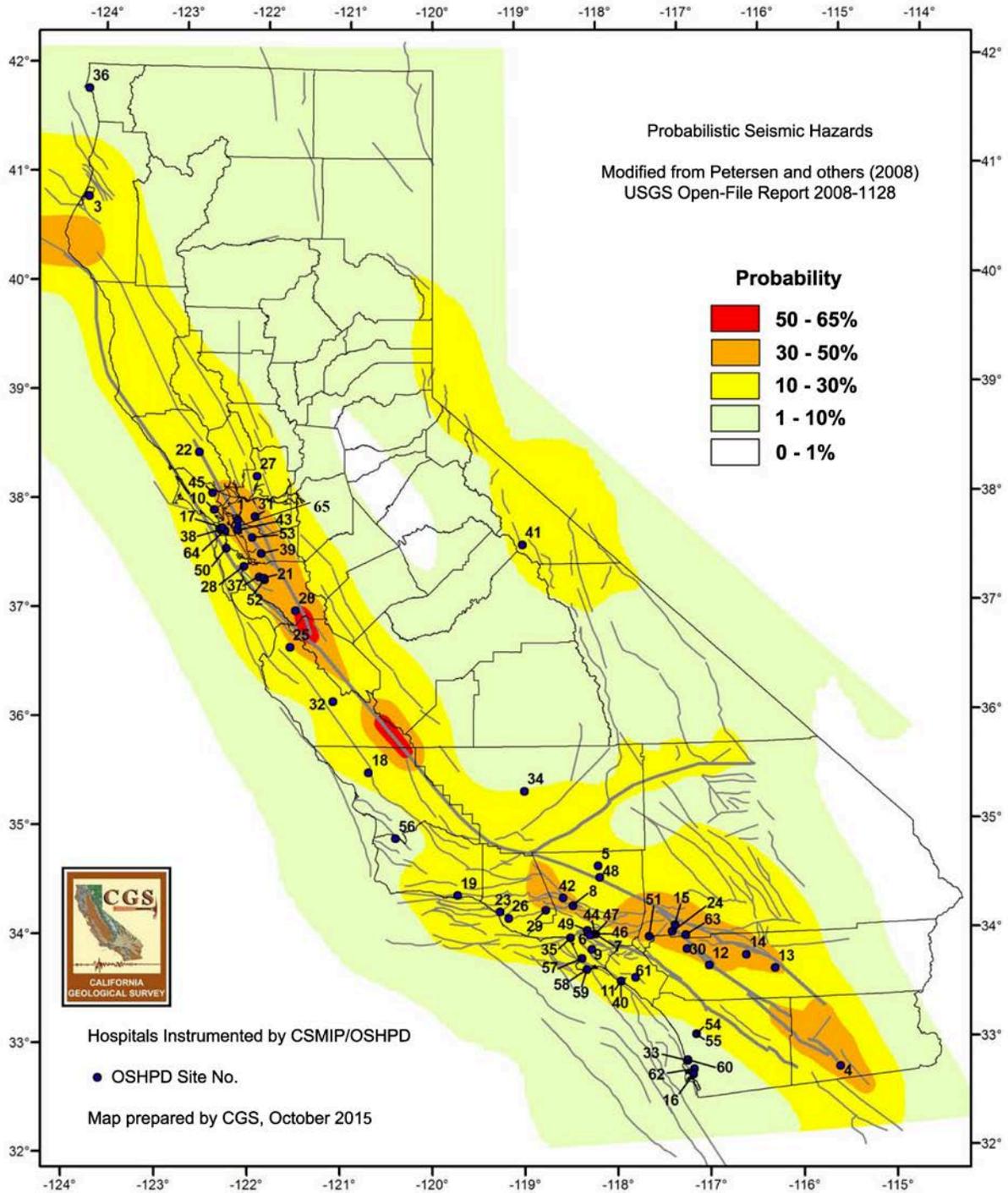
View of the newly-installed reference free-field station at Ventura County Hospital which replaces the old free-field station (CSMIP Sta. 25747).

Appendix D

Hospitals Instrumented by CSMIP/OSHPD

Probability of $A_{pk} > 0.2$ g in 20 years

Alluvial Soil Conditions



Appendix E

HOSPITAL BUILDINGS INSTRUMENTED BY CSMIP/OSHPD

10/1/15

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	310 Bldg Type	SMIAC Bldg Type	No. of Sensors
43	58396	Alameda - Alameda Hospital	3/0	S1L	K1	12+FF
34	34234	Bakersfield - Kern County Hospital	4/1	C2M	H2b	12+FF
1	58496	Berkeley - Alta Bates Hospital	2/1	S2L	I1c	12
50	58390	Burlingame - Mills Peninsula Hospital	6/0	IM	Q2	27+FF
2	58661	Castro Valley - Eden Hospital (demolished Mar. 2013)	2/1	S1L	K1	11
53	58494	Castro Valley - Sutter Eden Medical Center	6/1	S2M	I2a	19+FF
24	23788	Colton - San Bernardino Co. Med. Center	6/0,4/0,2/0	IM	Q2	27+FF
36	99261	Crescent City - Sutter Hospital	1/0	S2L	I1c	10+FF
4	01699	El Centro - Community Hospital	1/0	S2L	I1b	12+FF
54	13473	Escondido - PMC West Hospital (Main Tower)	11/1	S1H	K3a	12+FF
55	13476	Escondido - PMC West Hospital Central Plant	2/0	C2L	H1f	6
3	89770	Eureka - St. Joseph Hospital	4/1	C2M	G2d	11+FF
27	68032	Fairfield - NorthBay Medical Center	3/0	S2L	I1d	12+FF
39	57301	Fremont - Kaiser Hospital	2/0	S1L	K1	15+FF
20	57200	Gilroy - St. Louise Hospital	2/0	S1L	K1	10+FF
12	12267	Hemet - Valley Hospital	4/1	C2M	G2d	10
13	12759	Indio - JFK Hospital	1/0	W1	A1	8+FF
61	13439	Irvine - Kaiser Sand Canyon Hospital	6/partial	S2M	I2b	15+FF
32	47231	King City - Mee Hospital	2/0	S2L	I1c	10+FF
60	03538	La Jolla - Scripps Memorial Hospital (VSI)	7/1	S1M	J2b	12+FF
33	03233	La Jolla - UCSD Hospital	2/0	S1L	J1b	16+FF
5	24609	Lancaster - Antelope Valley Hospital	5/0	S1M	K2	12+FF
49	24397	Los Angeles - Childrens Hospital	7/1	S1M	K2	12
6	24713	Los Angeles - Good Samaritan Hospital	8/1	S2H	I3b	15
44	24250	Los Angeles - LAC+USC Hospital D&T Bldg	6/0	IM	Q2	20+FF
47	24248	Los Angeles - LAC+USC Hospital IP Bldg	9/0	S2H	I3b	12
9	14724	Los Angeles - MLK Hospital	5/1	IM	Q2	21+FF
7	24605	Los Angeles - USC Hospital	7/1	IH	Q3	24
46	24260	Los Angeles - USC Hospital Addition	9/1	S2H	I3b	12
41	54331	Mammoth Lakes - Mammoth Hospital	1/0	S2L	I1b	10+FF
30	13213	Moreno Valley - Riverside County Hospital	3/1	S1L	K1	12+FF
40	13291	Newport Beach - Hoag Hospital East Tower	7/1	IM	Q3	27+FF
11	13589	Newport Beach - Hoag Hospital West Tower	11/0	C2H	H3a	18+FF
45	68430	Novato - Community Hospital	2/0	S2L	I1b	12+FF
65	58590	Oakland - Kaiser Hospital	12/1	S2H	I3b	18
51	23416	Ontario - Kaiser Hospital	5/partial	S2M	I2b	18+FF
26	25949	Oxnard - St. Johns Hospital	4/1	S1M	K2	18+FF
14	12299	Palm Springs - Desert Hospital	4/1	S1M	K2	13
48	24457	Palmdale - Palmdale Regional Hospital	5/0	C2M	H2d	16+FF
63	23548	Redlands - Community Hospital (VSI)	2/1	C2L	H1c	9+FF
25	47796	Salinas - Natividad Medical Center	3/0	S2L	I1b	15+FF
15	23634	San Bernardino - Community Hospital	5/0	S1M	K2	12
62	03546	San Diego - Sharp Memorial Hospital (VSI)	8/1	C2H	H3b	15+FF
16	03743	San Diego - UCSD Hospital	11/1	C1H	M3	12+FF
64	58574	San Francisco - General Hospital	7/2	IM	Q2	24+FF
17	58718	San Francisco - Kaiser Hospital	6/0	C2M	H2d	18
38	58257	San Francisco - UCSF Hospital	15/1	U	U	16+FF
21	57594	San Jose - O'Connor Hospital	5/0	S2M	I2c	16+FF

HOSPITAL BUILDINGS INSTRUMENTED BY CSMIP/OSHPD

10/1/15

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	310 Bldg Type	SMIAC Bldg Type	No. of Sensors
52	57495	San Jose - Santa Clara Valley Hospital (Bldg K)	4/1	S1M	K2	15
59	14536	San Pedro - PLCOM MC (Bldg 02, VSI)	4/1	C2M	H2d	12
58	14535	San Pedro - PLCOM MC (Bldg 1T, VSI)	5/partial	S2M	I2d	12+FF
10	58755	San Rafael - Marin General Hospital	5/1	S1M	J2b	12+FF
19	25777	Santa Barbara - Cottage Hospital	3/1	C2L	H1e	9+FF
37	57251	Santa Clara - Kaiser Hospital	3/1	S2L	I1b	18+FF
56	26470	Santa Maria - Marian Hospital	4/partial	S2M	I2c	12+FF
35	24202	Santa Monica - St. John's Hospital	5/1	IM	Q2	18+FF
22	68669	Santa Rosa - Kaiser Hospital	4/1	S1M	K2	13+FF
29	24104	Simi Valley - Simi Valley Hospital	2/1	S1L	K1	12+FF
28	58055	Stanford - University Hospital	3/1	S1L	K1	12+FF
8	24514	Sylmar - Olive View Medical Center	6/0	UM	R	13+FF
18	36695	Templeton - Twin Cities Hospital	1/0	W1	A1	9+FF
57	14529	Torrance - Prov. Little Company of Mary MC(VSI)	4/2	C2M	H2d	21+FF
42	24344	Valencia - Mayo Hospital	2/partial	S1L	K1	12+FF
23	25744	Ventura - County Hospital	4/1	C2M	H2b	12+FF
31	58199	Walnut Creek - Kaiser Hospital	3/1	S1L	K1	16