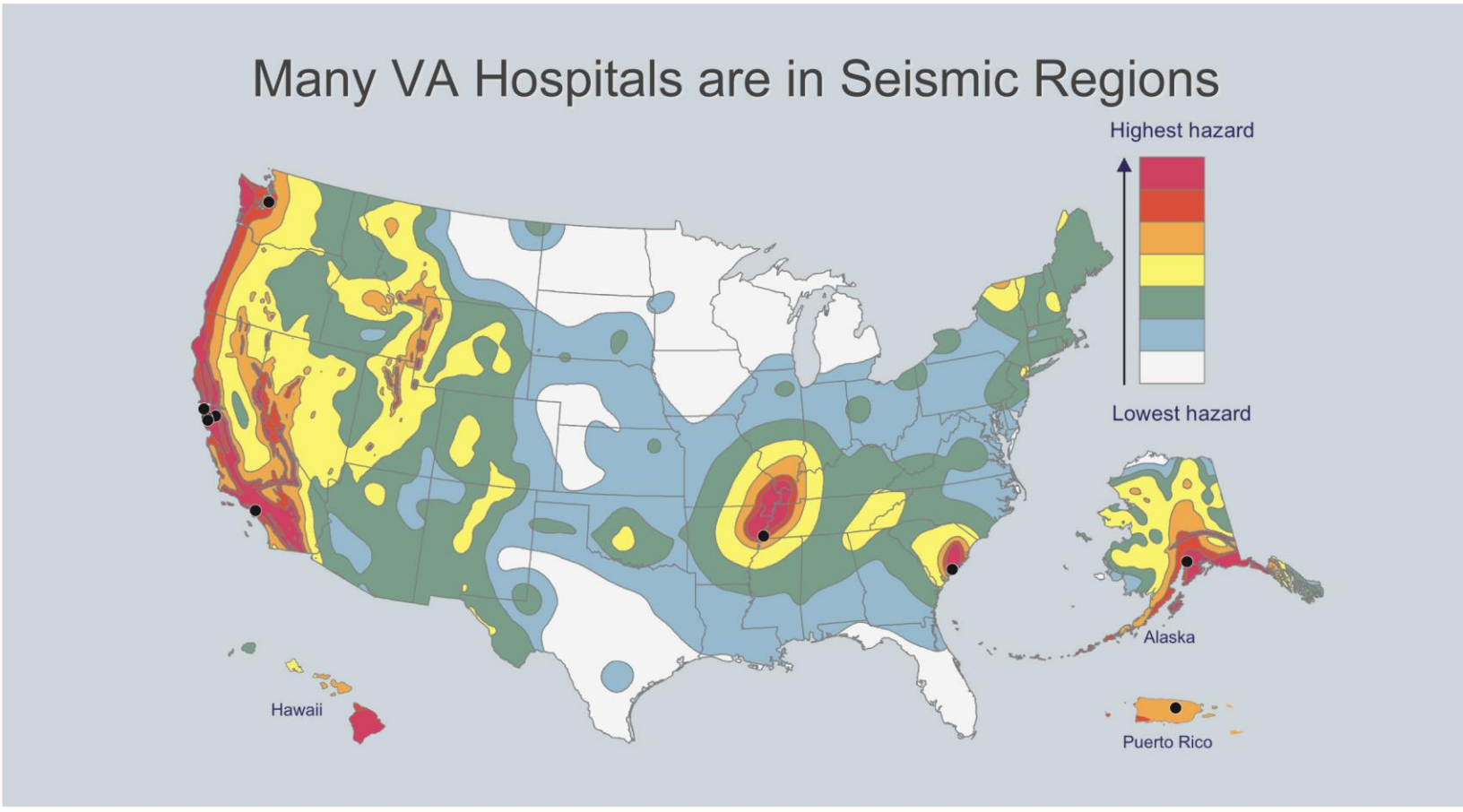
VA

U.S. Department of Veterans Affairs

Office of Construction & Facilities Management



Seismic Design Requirements

AUGUST 2013

H-18-8

FOREWORD

Background

In 1971, after the San Fernando earthquake when two VA buildings collapsed, VA began to undertake a full seismic safety program. Title 38 - United States Code, section 8105 required the Secretary to assure that each medical facility constructed or altered shall be of construction that is resistant to fire, earthquake, and other natural disasters. This initiated the creation of the Secretary's Advisory Committee on Structural Safety of VA Facilities, which formally approved in 1975 the original VA Seismic Design document, H-08-8, Earthquake Resistant Design Requirements for VA Facilities. These requirements were developed with the concept that all VA Essential Facilities must remain in operation after an earthquake and were far in advance of National Codes.

This document is periodically updated and revised. The revision of H-08-8 to H-18-8 in 1995 was a major rewrite to bring VA seismic design requirements more in line with the updated national model codes. Further updates/revisions of minor nature were made in 1997, 1998, 2000, 2002, 2003, 2005, 2006, 2008, 2010, and 2011.

Current Revision Highlights:

- Reference of ASCE 396 changed to FEMA 396
- Modified definition of Ancillary Facilities slightly to define them as non-essential.
- Modified sections 3.7 to preclude exemption of non-structural elements in low seismicity and emphasize following section 4.0.

Note: A vertical bar is placed to the right of the revised sections.

Lloyd H. Siegel
Associate Executive Director
Office of Facilities Planning

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1.0 DEFINITIONS

1.1 ASCE/SEI 41–06: Seismic Rehabilitation of Existing Buildings, American Society of Civil Engineers.

1.2 AISC 341: Seismic Provisions for Structural Steel Buildings, including Supplement No. 1 dated 2006, American Institute of Steel Construction.

1.3 ASCE 7: Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, Latest Edition

1.4 **ASCE 31- 02:** Seismic Evaluation of Existing Buildings, American Society of Civil Engineers.

1.5 **FEMA 396:** Incremental Seismic Rehabilitation of Hospital Buildings, American Society of Civil Engineers.

1.6 Category of Facilities:

a) **Critical Facilities:** Buildings that are required to remain functional after an earthquake or other natural disaster such as hurricane, tornado, etc. These facilities include, but are not limited to, the occupancy categories listed as Critical Facilities in Table 1, and they shall be assigned to IBC Occupancy Category IV.

b) **Essential Facilities:** Buildings that must remain operational with minor repairs after an earthquake or other natural disaster such as hurricane, tornado, etc. These facilities include, but are not limited to occupancy categories listed as Essential Facilities in Table 2, and they shall be assigned to IBC Occupancy Category III.

c) **Ancillary Facilities: These** facilities include, but are not limited to, the occupancy categories listed as Ancillary Facilities in Table 3. All ancillary facilities shall be designated as non-essential facilities and shall be assigned to IBC Occupancy Category II.

1.7 IBC: **International Building Code, Latest Edition.**

1.8 Occupancy Category: A category used to determine earthquake design loads based on the nature of the occupancy.

1.9 OSHPD: Office of Statewide Health Planning & Development, State of California

1.10 Seismic Design Category: A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site (as defined in IBC and ASCE 7).

1.12 Seismicity

Region of Seismicity	S_S	S_1
Very High	≥ 1.250g	≥0.500g
High	< 1.250g ≥0.750g	< 0.500g ≥ 0.300g
Moderate – High	< 0.750g ≥ 0.350g	< 0.300g ≥ 0.140g
Moderate – Low	< 0.350g ≥ 0.250g	< 0.140g ≥ 0.100g
Low	< 0.250g	< 0.100g

Note: Values for S_S and S_1 at all VA sites are given in Table 4

1.13 Soft Story & Extreme Soft Story: As defined in ASCE 7, Table 12.3-2.

1.14 Spectral Response Acceleration: A parameter used to characterize the anticipated earthquake shaking at a given site. (Table 4)

S_s**:** Spectral acceleration parameter at short periods corresponding to the mapped maximum considered earthquake.

S_1**:** Spectral acceleration parameter at a period of 1 sec corresponding to the mapped maximum considered earthquake.

2.0 GENERAL

These requirements cover all VA facilities including those of National Cemetery Administration, Veterans Benefits Administration, and Veterans Health Administration.

2.1 New Critical and Essential Facilities

All new Critical and Essential Facilities shall be designed and constructed in full compliance with the earthquake design and detailing requirements of IBC as modified in these provisions. Critical Facilities shall be assigned IBC Occupancy Category IV and Essential Facilities shall be assigned IBC Occupancy Category III. These buildings are intended to remain operational after an earthquake or other natural disaster such as tornado or hurricane as defined in ASCE 7, Section 1.5.

2.2 New Ancillary Facilities

All new Ancillary Facilities shall be designed and constructed in full compliance with the earthquake design and detailing requirements of IBC with no additional modifications. Ancillary Facilities shall be assigned to Occupancy Category II as defined in ASCE 7, Section 1.5.

2.3 Existing Facilities - Evaluation

a. A seismic evaluation shall be conducted for existing facilities in areas of Moderate High, High, and Very High Seismicity that meet one or more of the following criteria:
   i. Facilities selected for renovation as part of a VA classified Major Project
   ii. Facilities selected for renovation where the area of renovation is greater than 50% of the total area
   iii A project is planned which significantly extends the building's useful life through alterations or repairs which total more than 30% of the replacement value of the facility.
   iv. Facilities under consideration by VA for purchase or lease

b. Existing Critical and Essential Facilities shall be evaluated using the procedures in ASCE 31-02 for the Immediate Occupancy Performance Level.

c. Existing Ancillary Facilities shall be evaluated using the procedures in ASCE 31-02 for the Life Safety Performance Level.

2.4 Existing Facilities – Rehabilitation

a. All Critical and Essential Existing Facilities shall be rehabilitated using nonlinear static procedures described in ASCE 41 to achieve the following rehabilitation objectives.

i. Immediate occupancy performance level at BSE-1 (Basic Safety Earthquake Level 1, Earthquake Hazard Level having a probability of exceedance of 10 percent in 50 years) as defined in ASCE 41.
ii. Collapse Prevention performance level at BSE-2 (Basic Safety Earthquake Level 2, Earthquake Hazard Level having a probability of exceedance of 2 percent in 50 years) as defined in ASCE 41.

b. All Ancillary Facilities shall be rehabilitated using nonlinear static procedures described in ASCE 41 using the requirements to achieve Basic Safety Objectives.

2.5 Existing Facilities Rehabilitation – Alternative Approach

An alternative approach may be permitted on a case-by-case basis upon approval by the Office of Construction & Facilities Management (CFM) for Critical and Essential Facilities to be strengthened according to procedures in ASCE 41.

2.6 Spectral Response Accelerations

The selection of Seismic Design Category for use in the design and analysis of all new and existing facilities shall be based on the spectral response accelerations shown in Table 4 after adjustment for site class effects as specified in ASCE 7. For the design of buildings in Seismic Design Category A, use ASCE 7 section 11.7. For all other Seismic Design Categories (B – F), use ASCE 7Chapter 12: Seismic Design Requirements for Building Structures.

3.0 MODIFICATIONS TO THE REQUIREMENTS OF IBC FOR NEW CRITICAL AND ESSENTIAL FACILITIES ASSIGNED TO HIGH SEISMIC DESIGN CATEGORIES

3.1 Structural Irregularities (ASCE 7, Section 12.3.3)

For structures assigned to Seismic Design Categories D, E, or F, the following types of irregularities as defined by ASCE 7 Table 12.3-1 & 2 are not allowed:

a. Stiffness irregularity – Soft Story
b. Stiffness irregularity – Extreme Soft Story
c. Weight (mass) irregularity
d. Vertical geometric irregularity

3.2 Seismic-force-resisting-systems (ASCE 7, Table 12.2-1)

The following structural systems are permitted for new Critical and Essential Facilities assigned to Seismic Design Categories D, E, or F.

a. Building Frame Systems
   i. Steel eccentrically braced frames (EBF) moment resisting connections at columns away from links
   ii. Special reinforced concrete shear walls (Building Frame)
   iii. Special reinforced masonry shear walls (Building Frame)
   iv. Special steel concentrically braced frames
   v. Light frame walls with shear panels-wood structural panels/sheet steel panels (Building Frame) for structures two stories or less
   vi. Buckling-restrained braced frames, moment-resisting beam-column connections

b. Moment-Resisting Frame Systems, if approved by VA.
   i. Special steel moment-resisting frames (SMRF)
   ii. Special reinforced concrete moment-resisting frames

c. Dual Systems
   i. Special reinforced concrete shear walls with SMRF
   ii. Special reinforced masonry shear walls with SMRF
   iii. Steel EBF with SMRF
   iv. Special steel concentrically braced frame with SMRF
   v. Buckling-restrained braced frame

Other structural systems as permitted by the IBC for Seismic Design Categories D, E or F, including ones that employ seismic isolation and seismic damping systems are permitted subject to written approval by the VA.

3.3 Special Provisions for structures assigned to Seismic Design Categories D, E, or F.

The provisions of this section shall apply to all new Critical and Essential Facilities.

a. Bay spacing essentially shall be equal and uniform throughout.

b. Transfer beams or trusses supporting upper level columns shall not be used unless permitted on a case by case basis by VA.

c. Seismic joints shall be avoided, in so far as possible. When required, they shall be specifically identified in the schematic design phase of the project and approved by VA, subject to the following provisions:

    1. Seismic joints shall be properly detailed on the working drawings;

    2. Seismic joints shall be sized based on the maximum expected displacements, considering the effects of story drift, diaphragm displacements and rotations, and a realistic approximation of element section properties. For materials designed considering the ultimate limit state, such as concrete, the stiffness representative of this state shall be used. Seismic separations shall be 125% of the separation required by ASCE 7; and

    3. Adjacent structures that are not integral with an existing structure shall be separated by not less than 2 inches per story.

3.4 Limitations on Reinforced Concrete Structures

The provisions of this section shall apply to all new Critical and Essential Facilities assigned to Seismic Design Categories D, E, or F.

a. Prestressed concrete structural members, including pre-tensioned and post-tensioned members, and precast elements such as tilt-up wall panels, and precast beam and column elements shall not be used to resist seismic forces.

b. Lightweight concrete shall not be used in structural members resisting earthquake forces, except in concrete floors and roof slabs used as diaphragm elements to distribute earthquake forces to vertical lateral-load resisting elements.

3.5 Limitations on Steel Structures

The provisions of this section shall apply to all new Critical and Essential Facilities assigned to Seismic Design Categories D, E, or F.

a. Special steel moment resisting frame system shall be in compliance with Section 9 of AISC 341.

b. Steel eccentrically braced systems shall be subject to the following special provisions:

    1. Connections of non-structural elements shall not be located in the vicinity of EBF link beams. Non-structural elements include, but are not limited to, pre-cast panel connections, elevator guide rail supports, stairs, and pipe supports, etc.

3.6 Story Drift Limitations

The calculated story drift for the construction of all new Critical and Essential Facilities assigned to Seismic Design Categories D, E, or F shall not exceed 50% of the values allowed by ASCE 7.

3.7 Exemptions

a. No action regarding seismic rehabilitation of the seismic force resisting system of existing buildings need be undertaken in regions of moderate-low and low seismicity
b. Non-structural components shall comply with the requirements of section 4.0.

4.0 ELEMENTS OF STRUCTURES, NONSTRUCTURAL COMPONENTS, AND EQUIPMENT SUPPORTED BY STRUCTURES FOR CRITICAL AND ESSENTIAL FACILITIES

4.1 1In structures assigned to Seismic Design Category C, D, E, or F, permanent equipment and nonstructural components and their attachments, and the structure-supported attachments of permanent equipment shall be designed to resist total design forces prescribed in ASCE 7, Chapter 13 as modified by this document.

Exceptions: Seismic restraint may be omitted for the following installations:

a. Gas and medical piping less than one inch inside diameter;

b. Piping in boiler and mechanical equipment rooms less than 1 ¼ inch inside diameter;

c. All other piping less than 2 ½ inch inside diameter except for automatic fire suppression systems;

d. All electrical conduits, less than 2 ½ inch inside diameter;

e. All rectangular air handling ducts less than six square feet in cross sectional area;

f. All round air handling ducts less than 28 inches in diameter;

g. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger;

h. Equipment weighing less than 400 lbs, supported and attached directly on the floor; and

i. Equipment weighing less than 20 lbs suspended from the roof or floor or hung from the wall.

4.2 In structures assigned to Seismic Design Category C, D, E, or F, permanent equipment and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment and components that are considered rugged as listed in section 2.2 of OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

5.0 SITE DATA FOR CRITICAL AND ESSENTIAL FACILITIES

5.1 New and Existing Facilities

Geologic hazards and site-specific ground-response reports shall be required for all proposed construction of new Critical and Essential Facilities assigned to Seismic Design Category C, D, E, or F and for all proposed seismic rehabilitation of existing Critical and Essential Facilities in areas of Moderate High, High, and Very High Seismicity.

Except in regions of low seismicity, the geotechnical investigation shall use appropriate methods to allow the most accurate evaluation of the site class in accordance with Chapters 20 and 21 of ASCE 7, including field shear wave velocity measurements.

5.2 Geologic Hazards Report

The purpose of the geologic hazards report shall be to identify potential geologic and seismic conditions that require detailed evaluation, and may require mitigation by the project. The report shall contain data that provide an assessment of the nature of the site and potential for earthquake damage based on preliminary investigations of the regional and site geology, subsurface conditions and the potential seismic shaking. The engineering geologic report shall not contain design criteria, but shall contain basic data to be used for a preliminary earthquake engineering evaluation of the project. The basis for seismic assessment in geologic hazards reports must be stated clearly.

The report shall include, but shall not be limited to the following:

a. Geologic investigation;

b. Identification of any known active and potentially active faults, both regional and local, including estimates of the peak ground accelerations that could occur at the site; and

c. Evaluation of any slope stability problems at or near the site, liquefaction potential and settlement potential of the building site.

VA shall approve the engineering geologic hazard report prior to the preparation of the geotechnical report.

5.3 Site-Specific Ground-Response Report

The site-specific ground-response report shall present a detailed characterization of earthquake ground motions for the site. The characteristics of the expected strong ground motion to be used in design shall be determined by site evaluation studies based on geological and seismological characteristics of the site, including data given in the engineering geologic hazards report. The estimates should be derived by accepted methods of seismological practice, including Next Generation Attenuation (NGA) relationships where applicable, and fully documented in the ground response report. The level of ground motions to be developed shall be determined using the procedures in Chapter 21 of ASCE 7.

VA shall approve the site-specific ground response report prior to its adoption for project design.

6.0 COMMENTARY

Section 1.0

Section 1.2: Critical and Essential Facilities are those where most operations and functions must be able to resume immediately, while repair is required to restore some non-essential services due to a limited amount of seismic damage.

Section 2.0

Section 2.1: The seismic design requirements in the previous edition of H-18-8 did not distinguish between the Critical and Essential categories. This has now been separated and has different design requirements.

Section 3.0

Section 3.1: The design engineer shall provide multiple lines of resistance when selecting a lateral force-resisting configuration. Redundancy of frame lines is intended to avoid concentration of seismic force demands in the structure and/or foundation system. Lines of lateral force resistance shall be located at major areas of plan irregularity such as reentrant corners.

Section 3.2

The permitted structural systems listed in Section 3.2 are chosen to provide cost-effective and reliable seismic performance. Proposals to obtain written approval for other structural systems shall demonstrate the value of those systems, relative to the permitted systems, considering (a) initial construction and maintenance costs, (b) requirements for bracing non-structural components and building contents, (c) risk of economic losses and disruption to hospital functions due to earthquakes and (d) other demonstrable benefits."

Section 3.3.c

Because seismic joints have a serious impact on exterior siding, floor joints, and interior construction and utilities, they should be avoided if at all possible.

Section 5.0

Site class is used to determine the values of short-period and 1-second design spectral accelerations, S_{DS} and S_{D1} that define Seismic Design Category in accordance with ASCE-7. Except in regions of low seismicity, an accurate evaluation of site class is to be made in accordance with Chapter 20 and Chapter 21 of ASCE 7 and is to be presented in the geotechnical evaluation report. Field shear wave velocity measurements are typically expected to provide the most reliable basis for an accurate evaluation of site class.

Although site-specific studies exist for most of VA's Critical sites, the intent of this provision is to update those studies (done in mid-seventies) for all proposed construction of new Critical and Essential Facilities assigned to moderate or high seismic design categories and all existing Critical and Essential Facilities selected for full seismic rehabilitation in areas of Moderate High, High, and Very High Seismicity.

New site-specific studies for VA facilities are to consider up-to-date information on the attenuation of earthquake ground motions with distance from the earthquake source, and other relevant seismologic and geologic information. Research sponsored by the Pacific Earthquake Engineering Research Center has led to significantly improved procedures to estimate attenuation of earthquake motions, and culminated with publication in 2008 of so-called Next Generation Attenuation (NGA) relationships for plate-boundary tectonic regimes dominated by crustal faults, such as the Western United States. It is the intent of VA requirements that new site-specific studies for VA facilities take advantage of those improved procedures and other pertinent published information on earthquake ground motion estimation, in accordance with the state of practice for the seismic design of buildings.

The standard practice of preparing a geotechnical report containing foundation recommendations, soil-bearing values, results of any necessary soil borings, etc., is still required for all VA projects.

[VA Facilities Occupancy Categories]

Table 1: Critical Facilities

Occupancy Sub-name
Acute Care
Ambulatory Care/ Outpatient Clinic
Animal Facility
Boiler Plants
Communications Center
Emergency Command Center
Emergency Generator
Fire/Police Station
Hazardous Material Storage
Hospital
Information Technology
Medical Gas Storage
Medical Research/Records
National Continuity of Operation Center
Security & Law Enforcement
Water Tower, Utility Supply Storage Structure

Table 2: Essential Facilities

Occupancy Sub-name
Consolidate Mail-Out Pharmacy
Dietetics
Domiciliary
Drug/Alcohol Rehabilitation
Long Term Care
Medical Equipment Storage
Mental Health - Inpatient
Psychiatric Care Facility
Rehabilitation Medicine

Table 3: Ancillary Facilities

Occupancy Sub-name	
Accessory Non-Building Structure	Maintenance Facility (Shops)
Auditorium	Maintenance Storage (Equipment)
Biomedical Eng. (equip. & wheelchair repair)	Materials Management Storage
Canteen-Cafeteria	Office
Canteen-Retail Store	School
Cemetery Building	Parking Garage
Chapel	Plant Outbuilding
Child Care	Post Office
Clinical Service Administration Office	Recreational
Community-Based Outpatient Clinic	Student Housing
Connecting Corridor-Concourse, and Bridge	Temporary Building
Credit Union	Toilets (Outhouse)
General Administration Office	Training, Education
Greenhouse	Veterans Services
Quarter (Residential)	Warehouse
Laundry	Waste Management (Incinerator & Recycle)
Library/Museum	Waste Storage

Note: The Critical, Essential and Ancillary Facilities Tables are developed to keep in line with three occupancy categories listed in IBC.

Table 4
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Abraham Lincoln	915	IL	0.188	0.068	L
Albany	528A8	NY	0.230	0.069	L
Albuquerque	501	NM	0.561	0.169	MH
Alexandria	502	LA	0.127	0.060	L
Alexandria	825	LA	0.128	0.061	L
Alexandria	826	VA	0.153	0.050	L
Allen Park	553A	MI	0.126	0.045	L
Alton	800	IL	0.484	0.149	MH
Altoona	503	PA	0.144	0.049	L
Amarillo	504	TX	0.175	0.043	L
American Lake	663A4	WA	1.194	0.417	H
Anchorage	463	AK	1.502	0.561	VH
Ann Arbor	506	MI	0.120	0.045	L
Annapolis	801	MD	0.155	0.050	L
Asheville	637	NC	0.388	0.106	MH
Aspinwall	646A4	PA	0.125	0.048	L
Atlanta	508	GA	0.230	0.086	L
Augusta	509	GA	0.372	0.114	MH
Augusta (Lenwood)	509A0	GA	0.378	0.115	MH
Balls Bluff	827	VA	0.160	0.051	L
Baltimore	512	MD	0.170	0.051	L
Baltimore	802	MD	0.170	0.051	L
Baltimore/Loch Raven	512GD	MD	0.170	0.051	L
Barrancas	828	FL	0.099	0.048	L
Batavia	528A4	NY	0.266	0.060	ML
Bath	803	NY	0.165	0.053	L
Bath	528A6	NY	0.165	0.053	L
Baton Rouge	829	LA	0.121	0.053	L
Battle Creek	515	MI	0.112	0.047	L
Bay Pines	516	FL	0.078	0.032	L
Bay Pines	830	FL	0.078	0.032	L
Beaufort	831	SC	0.693	0.183	MH
Beckley	517	WV	0.263	0.076	ML
Bedford	518	MA	0.288	0.070	ML
Beverly	804	NJ	0.273	0.060	ML
Big Spring	519	TX	0.111	0.031	L
Biloxi	520	MS	0.119	0.052	L
Biloxi	832	MS	0.117	0.052	L
Birmingham	521	AL	0.303	0.096	ML
Black Hills	884	SD	0.151	0.042	L

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Boise	531	ID	0.312	0.106	ML
Bonham	549A4	TX	0.161	0.062	L
Boston	523	MA	0.272	0.067	ML
Brevard	673GA	FL	0.083	0.035	L
Brockton	523A5	MA	0.251	0.063	ML
Bronx	526	NY	0.361	0.070	MH
Brooklyn	630A4	NY	0.353	0.069	MH
Buffalo	528	NY	0.282	0.059	ML
Butler	529	PA	0.128	0.048	L
Calverton	805	NY	0.209	0.056	L
Camp Butler	806	IL	0.268	0.105	L
Camp Nelson	833	KY	0.225	0.089	ML
Canandaigua	528A5	NY	0.187	0.057	L
Castle Point	620A4	NY	0.280	0.067	ML
Cave Hill	834	KY	0.247	0.103	ML
Charleston	534	SC	1.443	0.355	VH
Chattanooga	835	TN	0.474	0.116	MH
Cheyenne	442	WY	0.192	0.053	L
Chicago (Lakeside)	537GD	IL	0.161	0.059	L
Chicago (Westside)	537	IL	0.166	0.060	L
Chillicothe	538	OH	0.157	0.064	L
Cincinnati	539	OH	0.176	0.075	L
City Point	836	VA	0.187	0.058	L
Clarksburg	540	WV	0.187	0.068	L
Cleveland/Brecksville	541A0	OH	0.197	0.052	L
Cleveland/Wade Park	541	OH	0.197	0.052	L
Coatesville	542	PA	0.274	0.060	ML
Cold Harbor	837	VA	0.206	0.058	L
Columbia	589A4	MO	0.198	0.088	L
Columbia	544	SC	0.572	0.153	MH
Corinth	838	MS	0.501	0.169	MH
Crown Hill	807	IN	0.190	0.083	L
Culpeper	839	VA	0.193	0.057	L
Cypress Hills	808	NY	0.358	0.069	MH
Dallas	549	TX	0.113	0.049	L
Dallas/Fort Worth	916	TX	0.116	0.050	L
Danville	550	IL	0.224	0.091	L
Danville	809	IL	0.224	0.091	L
Danville	840	KY	0.219	0.092	L
Danville	841	VA	0.196	0.074	L
Dayton	552	OH	0.186	0.069	L
Dayton	810	OH	0.206	0.070	L
Denver	554	CO	0.214	0.056	L

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Des Moines	636A6	IA	0.075	0.043	L
Detroit	553	MI	0.121	0.045	L
Dublin	557	GA	0.215	0.083	L
Durham	558	NC	0.198	0.078	L
Eagle Point	906	OR	0.583	0.255	MH
East Orange	561	NJ	0.363	0.071	MH
El Paso	756	TX	0.333	0.107	ML
Erie	562	PA	0.163	0.049	L
Fargo	437	ND	0.074	0.021	L
Fayetteville	564	AR	0.207	0.091	L
Fayetteville	565	NC	0.297	0.101	ML
Fayetteville	842	AR	0.207	0.091	L
Finn's Point	811	NJ	0.232	0.055	L
Florence	843	SC	0.728	0.198	MH
Florida	911	FL	0.090	0.038	L
Fort Bayard	885	NM	0.272	0.081	ML
Fort Bliss	886	TX	0.336	0.109	MH
Fort Custer	909	MI	0.109	0.047	L
Fort Gibson	844	OK	0.187	0.075	L
Fort Harrison	436	MT	0.746	0.222	MH
Fort Harrison	845	VA	0.225	0.060	L
Fort Howard	512GF	MD	0.167	0.050	L
Fort Leavenworth	887	KS	0.129	0.055	L
Fort Logan	888	CO	0.219	0.057	L
Fort Lyon	567	CO	0.165	0.050	L
Fort Lyon	889	CO	0.165	0.050	L
Fort McPherson	890	NE	0.094	0.033	L
Fort Meade	568	SD	0.206	0.051	L
Fort Meade	891	SD	0.206	0.051	L
Fort Mitchell	908	AL	0.142	0.066	L
Fort Richardson	910	AK	1.502	0.560	VH
Fort Rosecrans	892	CA	1.569	0.614	VH
Fort Sam Houston	846	TX	0.105	0.029	L
Fort Scott	893	KS	0.128	0.066	L
Fort Sill	920	OK	0.373	0.085	MH
Fort Smith	847	AR	0.209	0.088	L
Fort Snelling	894	MN	0.061	0.027	L
Fort Thomas	539A	OH	0.150	0.058	L
Fort Wayne	610A4	IN	0.150	0.059	L
Fresno	570	CA	0.501	0.222	MH
Gainesville	573	FL	0.107	0.048	L
Glendale	848	VA	0.225	0.060	L

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Golden Gate	895	CA	2.218	1.266	VH
Grafton	812	WV	0.139	0.054	L
Grand Island	636A4	NE	0.129	0.039	L
Grand Junction	575	CO	0.287	0.067	ML
Gulfport	520A0	MS	0.119	0.052	L
Hampton	590	VA	0.120	0.048	L
Hampton	849	VA	0.122	0.049	L
Hampton (VAMC)	850	VA	0.122	0.049	L
Hines	578	IL	0.173	0.058	L
Hines VBA	201	IL	0.173	0.058	L
Honolulu**	459	HI	0.613	0.178	MH
Hot Springs	896	SD	0.207	0.049	L
Hot Springs	568A4	SD	0.207	0.049	L
Houston	580	TX	0.087	0.036	L
Houston	851	TX	0.088	0.036	L
Houston VBA	362	TX	0.087	0.036	L
Huntington	581	WV	0.192	0.071	L
Indianapolis	583	IN	0.192	0.083	L
Indianapolis (CS Rd)	583A4	IN	0.192	0.083	L
Indiantown Gap	813	PA	0.219	0.056	L
Iowa City	636A8	IA	0.100	0.052	L
Iron Mountain	585	MI	0.058	0.026	L
Jackson	586	MS	0.194	0.086	L
Jackson VBA	323	MS	0.194	0.086	L
Jefferson Barracks	852	MO	0.580	0.167	MH
Jefferson City	853	MO	0.236	0.100	ML
Kansas City	589	MO	0.127	0.059	L
Keokuk	814	IA	0.148	0.072	L
Kerrville	854	TX	0.074	0.026	L
Kerrville	671A4	TX	0.074	0.026	L
Knoxville	636A7	IA	0.083	0.048	L
Knoxville	855	TN	0.519	0.118	MH
Lake City	573A4	FL	0.122	0.054	L
Las Vegas	593	NV	0.549	0.171	MH
Leavenworth	897	KS	0.129	0.055	L
Leavenworth	589A6	KS	0.129	0.055	L
Lebanon	856	KY	0.225	0.098	L
Lebanon	595	PA	0.228	0.057	L
Lexington	857	KY	0.224	0.088	L
Lexington (CD)	596A4	KY	0.229	0.087	L
Lexington (LD)	596	KY	0.229	0.087	L

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Lincoln	636A5	NE	0.177	0.046	L
Little Rock	598	AR	0.494	0.160	MH
Little Rock	858	AR	0.507	0.164	MH
Livermore	640A4	CA	1.590	0.602	VH
Loma Linda	605	CA	1.761	0.610	VH
Long Beach	600	CA	2.022	0.853	VH
Long Island	815	NY	0.293	0.063	ML
Los Angeles	898	CA	1.656	0.590	VH
Los Angeles	691GE	CA	2.232	0.766	VH
Loudon Park	816	MD	0.170	0.051	L
Louisville	603	KY	0.246	0.102	ML
Lyons	561A4	NJ	0.347	0.069	ML
Madison	607	WI	0.104	0.044	L
Manchester	608	NH	0.351	0.080	MH
Marietta	859	GA	0.251	0.089	ML
Marion	657A5	IL	1.118	0.306	H
Marion	610	IN	0.151	0.067	L
Marion	817	IN	0.151	0.067	L
Marlin	674A5	TX	0.090	0.040	L
Martinez/NCSC	612	CA	1.575	0.600	VH
Martinsburg	613	WV	0.167	0.052	L
Massachusetts	818	MA	0.211	0.056	L
McClellan	612GH	CA	0.487	0.221	MH
Memphis	614	TN	1.289	0.354	VH
Memphis	860	TN	1.289	0.354	VH
Menlo Park	640A0	CA	1.792	0.793	VH
Miami	546	FL	0.051	0.019	L
Miles City	436GJ	MT	0.099	0.034	L
Mill Springs	861	KY	0.234	0.096	L
Milwaukee (Wood)	695	WI	0.108	0.045	L
Minneapolis	618	MN	0.060	0.027	L
Mobile	862	AL	0.117	0.053	L
Montgomery	619	AL	0.154	0.069	L
Montgomery VBA	322	AL	0.154	0.069	L
Montrose	620	NY	0.332	0.070	ML
Mound City	863	IL	3.390	1.313	VH
Mountain Home	621	TN	0.392	0.102	MH
Mountain Home	864	TN	0.392	0.102	MH
Murfreesboro	626A4	TN	0.290	0.116	ML
Muskogee	623	OK	0.185	0.074	L
Nashville	626	TN	0.345	0.133	ML
Nashville	865	TN	0.345	0.133	ML

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Natchez	866	MS	0.141	0.067	L
NCA Operations Support	786	VA	0.189	0.066	L
New Albany	867	IN	0.250	0.103	ML
New Bern	868	NC	0.162	0.065	L
New Orleans	629	LA	0.110	0.048	L
New York	630	NY	0.361	0.070	MH
Newington	689A4	CT	0.240	0.063	L
NMCA	914	AZ	0.178	0.061	L
NMCP**	899	HI	0.613	0.178	MH
North Chicago	556	IL	0.141	0.053	L
North Little Rock	598A0	AR	0.514	0.165	MH
Northampton	631	MA	0.224	0.066	LL
Northport	632	NY	0.286	0.064	ML
Oklahoma City	635	OK	0.336	0.074	ML
Omaha	636	NE	0.123	0.042	L
Orlando	673BY	FL	0.096	0.038	L
Palo Alto	640	CA	1.959	0.827	VH
Perry Point	512A5	MD	0.216	0.054	L
Philadelphia	642	PA	0.271	0.060	ML
Philadelphia	819	PA	0.281	0.062	ML
Phoenix	644	AZ	0.182	0.062	L
Pittsburgh (HD)	646A5	PA	0.125	0.049	L
Pittsburgh (UD)	646	PA	0.125	0.048	L
Poplar Bluff	657A4	MO	1.100	0.303	H
Port Hudson	870	LA	0.123	0.055	L
Portland	648	OR	0.984	0.345	H
Prescott	649	AZ	0.342	0.100	ML
Prescott	900	AZ	0.350	0.102	MH
Providence	650	RI	0.234	0.061	L
Quantico	872	VA	0.162	0.052	L
Quincy	820	IL	0.181	0.082	L
Raleigh	873	NC	0.202	0.079	L
Reno	654	NV	1.500	0.600	VH
Richmond	652	VA	0.225	0.060	L
Richmond	874	VA	0.225	0.060	L
Riverside**	901	CA	1.500	0.600	VH
Rock Island	821	IL	0.131	0.060	L
Roseburg	653	OR	0.830	0.422	VH
Roseburg	902	OR	0.830	0.422	H
Sacramento NCHCS	612A4	CA	0.464	0.214	MH
Saginaw**	655	MI	0.080	0.037	L
Salem	658	VA	0.264	0.076	ML

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Salisbury	659	NC	0.261	0.094	ML
Salisbury	876	NC	0.261	0.094	ML
Salt Lake City	660	UT	1.577	0.625	VH
San Antonio	671	TX	0.105	0.031	L
San Antonio	877	TX	0.105	0.029	L
San Diego	664	CA	1.562	0.602	VH
San Francisco	662	CA	1.761	0.901	VH
San Francisco	903	CA	1.500	0.668	VH
San Joaquin Valley	913	CA	1.825	0.600	VH
San Juan	672	PR	0.898	0.314	H
Santa Fe	904	NM	0.484	0.156	MH
Saratoga	917	NY	0.252	0.074	ML
Seattle	663	WA	1.551	0.534	VH
Sepulveda	691A4	CA	2.042	0.727	VH
Seven Pines	878	VA	0.198	0.057	L
Sheridan**	666	WY	0.271	0.060	ML
Shreveport	667	LA	0.153	0.069	L
Sioux Falls	438	SD	0.111	0.034	L
Sitka	905	AK	0.965	0.497	H
Somerville AMS	796	NJ	0.325	0.067	ML
Spokane	668	WA	0.404	0.114	MH
Springfield	879	MO	0.221	0.096	L
St. Albans	630A5	NY	0.338	0.067	ML
St. Augustine	875	FL	0.126	0.053	L
St. Cloud	656	MN	0.079	0.022	L
St. Louis (JB)	657A0	MO	0.596	0.171	MH
St. Louis (JC)	657	MO	0.596	0.171	MH
St. Petersburg VBA	317	FL	0.078	0.032	L
Staunton	880	VA	0.211	0.063	L
Syracuse	528A7	NY	0.180	0.061	L
Tahoma	919	WA	1.284	0.436	VH
Tampa	673	FL	0.077	0.032	L
Temple	674	TX	0.082	0.037	L
Togus	402	ME	0.292	0.077	ML
Togus	822	ME	0.292	0.077	ML
Tomah	676	WI	0.067	0.034	L
Topeka	589A5	KS	0.157	0.054	L
Tucson	678	AZ	0.287	0.081	ML
Tuscaloosa	679	AL	0.268	0.093	ML
Tuskegee	619A4	AL	0.150	0.068	L
Vancouver	648A4	WA	0.918	0.325	H
Waco	674A4	TX	0.087	0.040	L

Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

Table 4 (continued)
Spectral Response Accelerations at VA Facilities

Site	Med Center Number	State	$S_{s\ (new)}$	$S_{1\ (new)}$	Seismicity
Walla Walla	687	WA	0.460	0.131	MH
Washington, DC	688	DC	0.153	0.050	L
West Haven	689	CT	0.244	0.062	L
West Los Angeles	691	CA	1.867	0.636	VH
West Palm Beach	548	FL	0.060	0.025	L
West Roxbury	523A4	MA	0.265	0.066	ML
West Virginia	912	WV	0.139	0.054	L
White City	692	OR	0.585	0.264	MH
White River Junction	405	VT	0.299	0.081	ML
Wichita	589A7	KS	0.135	0.051	L
Wilkes-Barre	693	PA	0.199	0.057	L
Willamette	907	OR	0.987	0.348	H
Wilmington	460	DE	0.260	0.058	ML
Wilmington	881	NC	0.296	0.098	ML
Winchester	882	VA	0.167	0.054	L
Wood	823	WI	0.107	0.044	L
Woodlawn	824	NY	0.153	0.053	L
Zachary Taylor	883	KY	0.247	0.103	ML

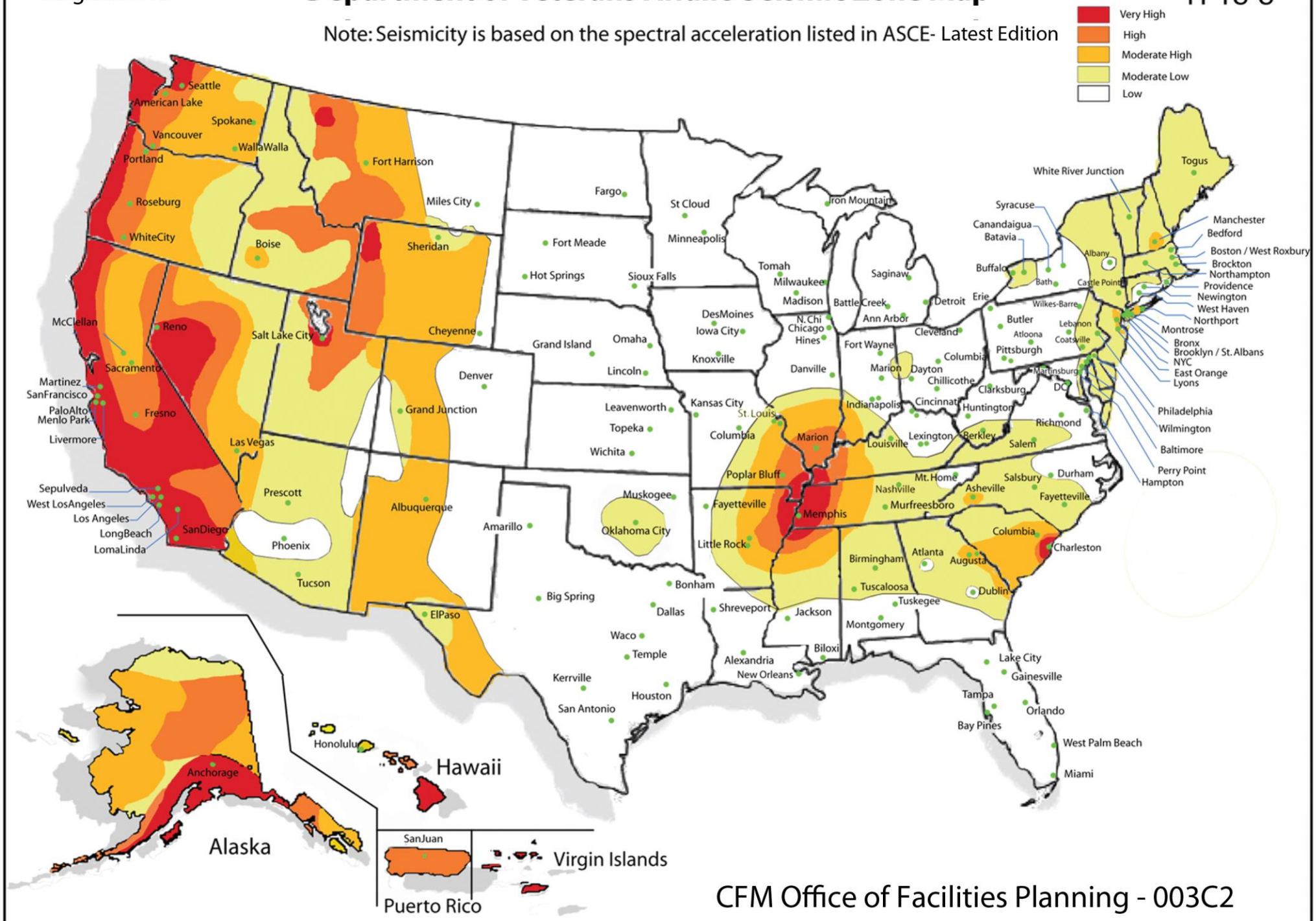
Note: Values of S_s & S_1 have been obtained from the design maps of Chapter 22 of ASCE 7.

August 2013

Department of Veterans Affairs Seismic Zone Map

H-18-8

Note: Seismicity is based on the spectral acceleration listed in ASCE- Latest Edition



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