

RAS 13643



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USNRC

May 16, 2007 (4:05pm)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

North Anna ESP Proceeding – Mandatory Hearing

Docket No. 52-008-ESP; ASLBP No. 04-822-02-ESP

Dominion's Presentation on Seismic Safety

Dr. William R. Lettis
Dr. Robin K. McGuire
Dr. John Davie

U.S. NUCLEAR REGULATORY COMMISSION
In the Matter of Dominion Nuclear North Anna LLC (ESP)
Docket No. 52-008-ESP Official Exhibit No. Dominion 16
OFFERED by: Applicant/Licensee Intervenor Dominion Nuclear LLC
NRC Staff Other _____
IDENTIFIED on 4/26/07 Witness/Panel Seismic Safety
Action Taken: ADMITTED REJECTED WITHDRAWN
Reporter/Clerk MC

Template=SECY-028

SECY-02

Overview

**Dr. Lettis – Geology, Seismic Source
Characterization, Surface Fault
Rupture Hazard**

Dr. McGuire – Vibratory Ground Motion

Summary of Geological and Seismological Activities

Regulatory Guidance

Geological and seismological information was developed in accordance with Section 2.5 of RG 1.70 and following guidance in RG 1.165.

Investigations Performed

Review of previous reports prepared for NAPS

Review of published and unpublished geologic maps and literature

Analysis of aerial photography

Geologic field and aerial reconnaissance

Contacted current researchers

Section 2.5.1 Regional and Site Geology

Characterized the physiography, geologic history, stratigraphy, and tectonic setting within a 200-mile radius

Prepared four geologic maps based on data developed:

Two regional geologic maps, 200- and 25-mile radius

Two local geologic maps, 5- and 0.6-mile radius

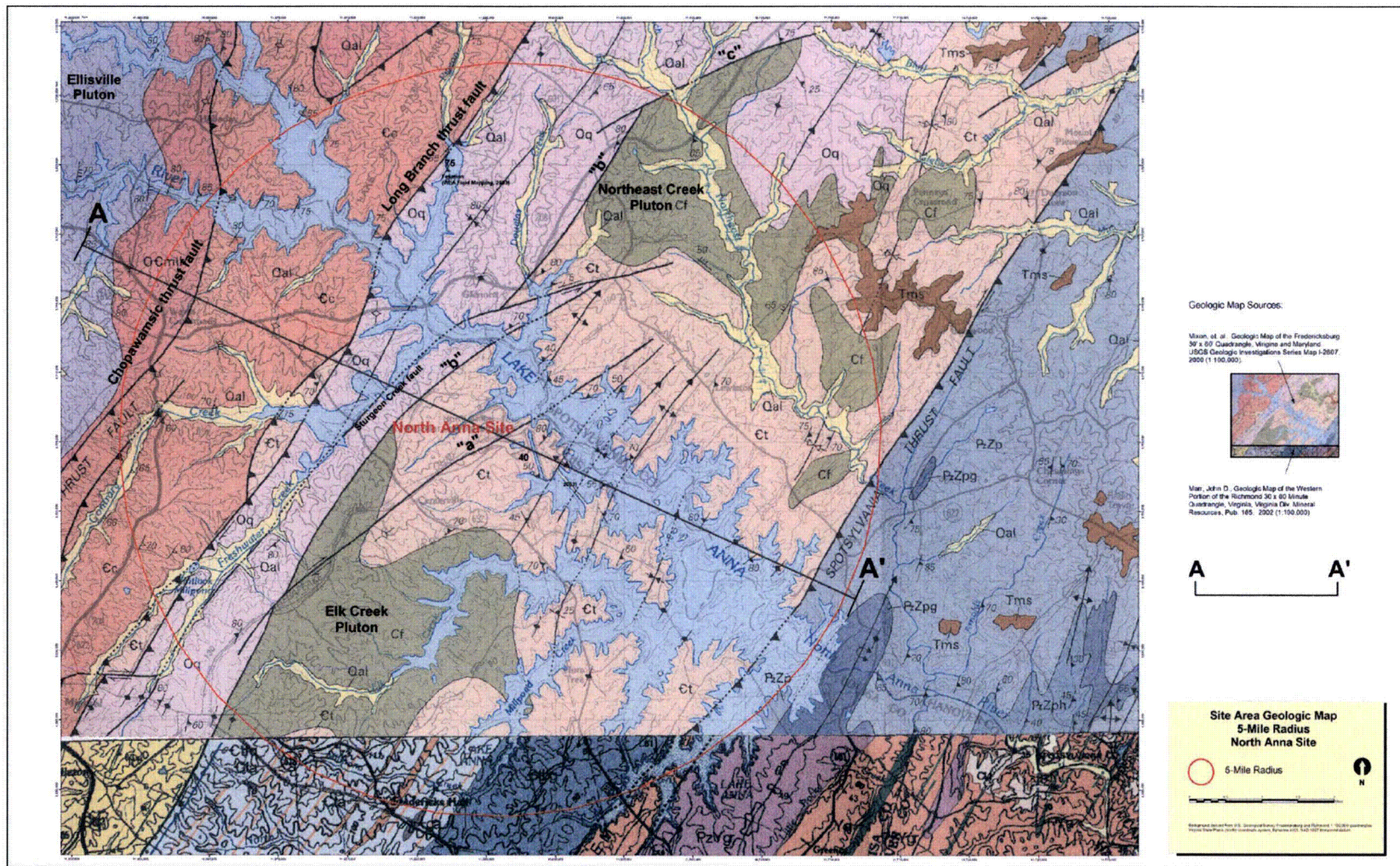


Figure 2.5-11 Site Area Geologic Map (5-Mile Radius) (Sheet 1 of 2)

Summary of Geological and Seismological Review

Section 2.5.3 - Surface Fault Rupture Hazard

No potential for tectonic surface faulting

**No potential for other forms of non-tectonic
permanent ground deformation**

**No indication of strong ground shaking:
no fissuring, liquefaction, landsliding,
lurching, or caving of banks at the site**

Section 2.5.2 – Seismic Source Characterization

**Reviewed EPRI 1986 seismic source model
and sources that contribute 99% hazard at site**

**Evaluated post-EPRI data, including updated
seismicity catalog**

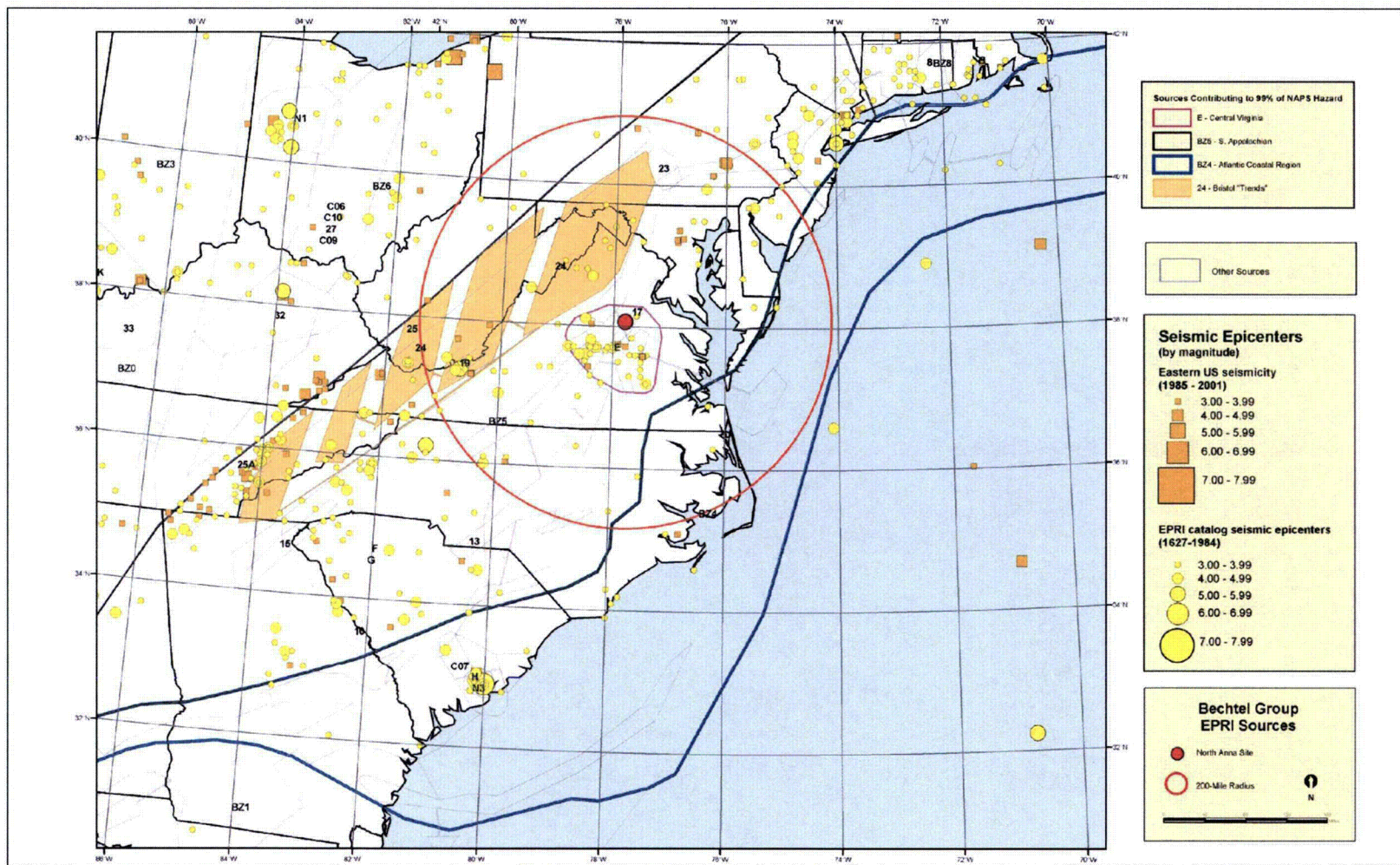


Figure 2.5-19 Bechtel Group EPRI Sources

Section 2.5.2 – Seismic Source Characterization

Conducted Sensitivity Analyses:

- **New Charleston seismic source parameters (Mmax 6.8-7.5, RI 550 yrs, ECFS-s)**
- **East Coast Fault System – Northern Segment**

Updated EPRI Seismic Source Model

- **Added new Charleston source representation**

Safe Shutdown Earthquake (SSE) Ground Motion

Section 2.5.2.6

RG 1.165 Regulatory Position 2 and Appendix E specify how to develop an SSE ground motion.

- **“Reference probability” is the annual probability level such that 50% of a set of currently operating plants has an annual median probability of exceeding the SSE that is below this level.**
- **“Reference probability” calculation updated to accurately reflect current knowledge.**

Safe Shutdown Earthquake (SSE) Ground Motion

- **SSE for the ESP Site was determined from the updated seismic hazard results using a 5×10^{-5} mean probability of exceeding the SSE.**
- **NRC Staff independently determined this reference probability to be conservative, by comparison to the SSE design levels at 29 existing nuclear plants in the central and eastern United States.**

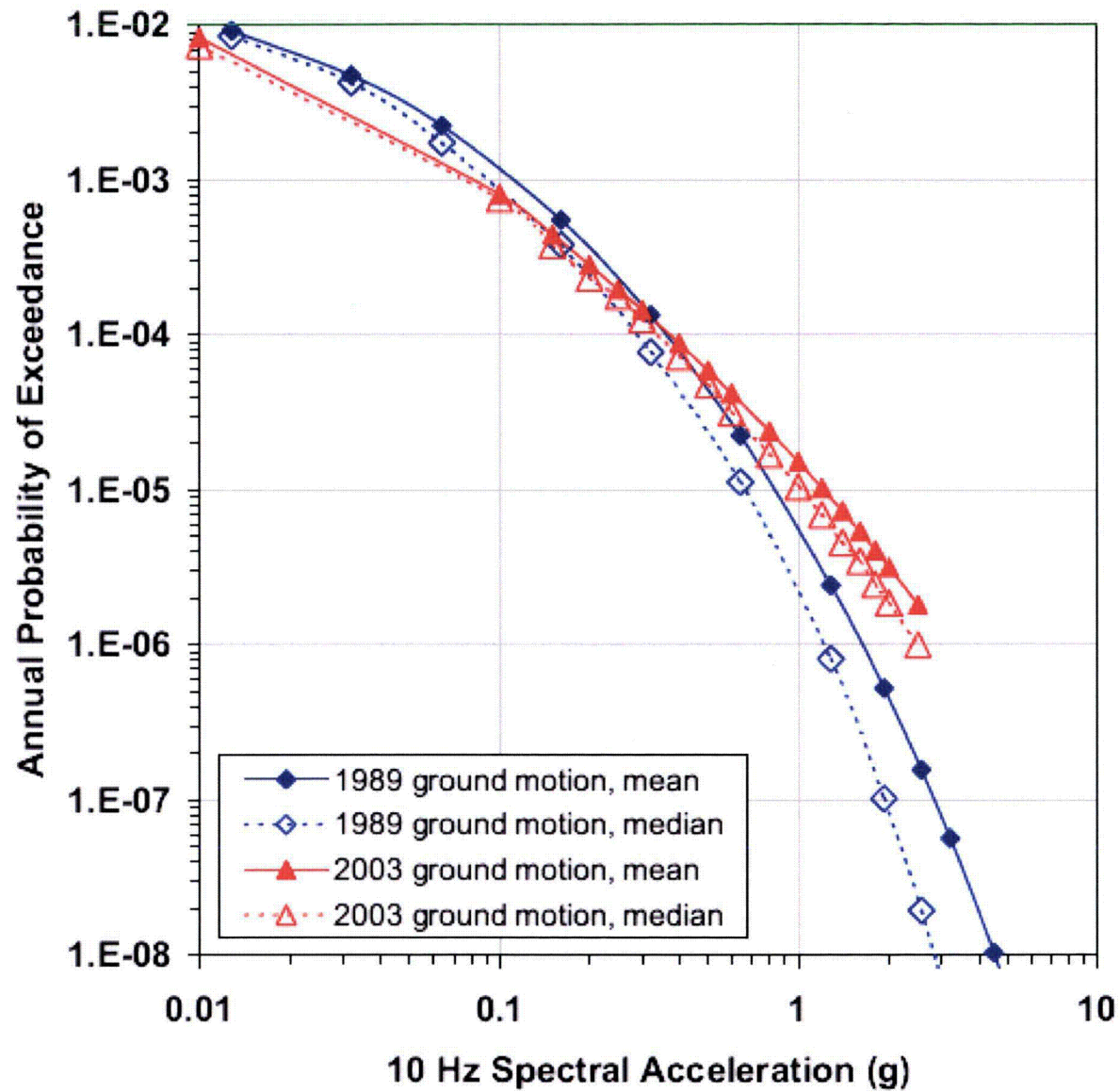


Figure 2.5-44. Sensitivity of 10 Hz Seismic Hazard to 1989 and 2003 Ground Motion Models

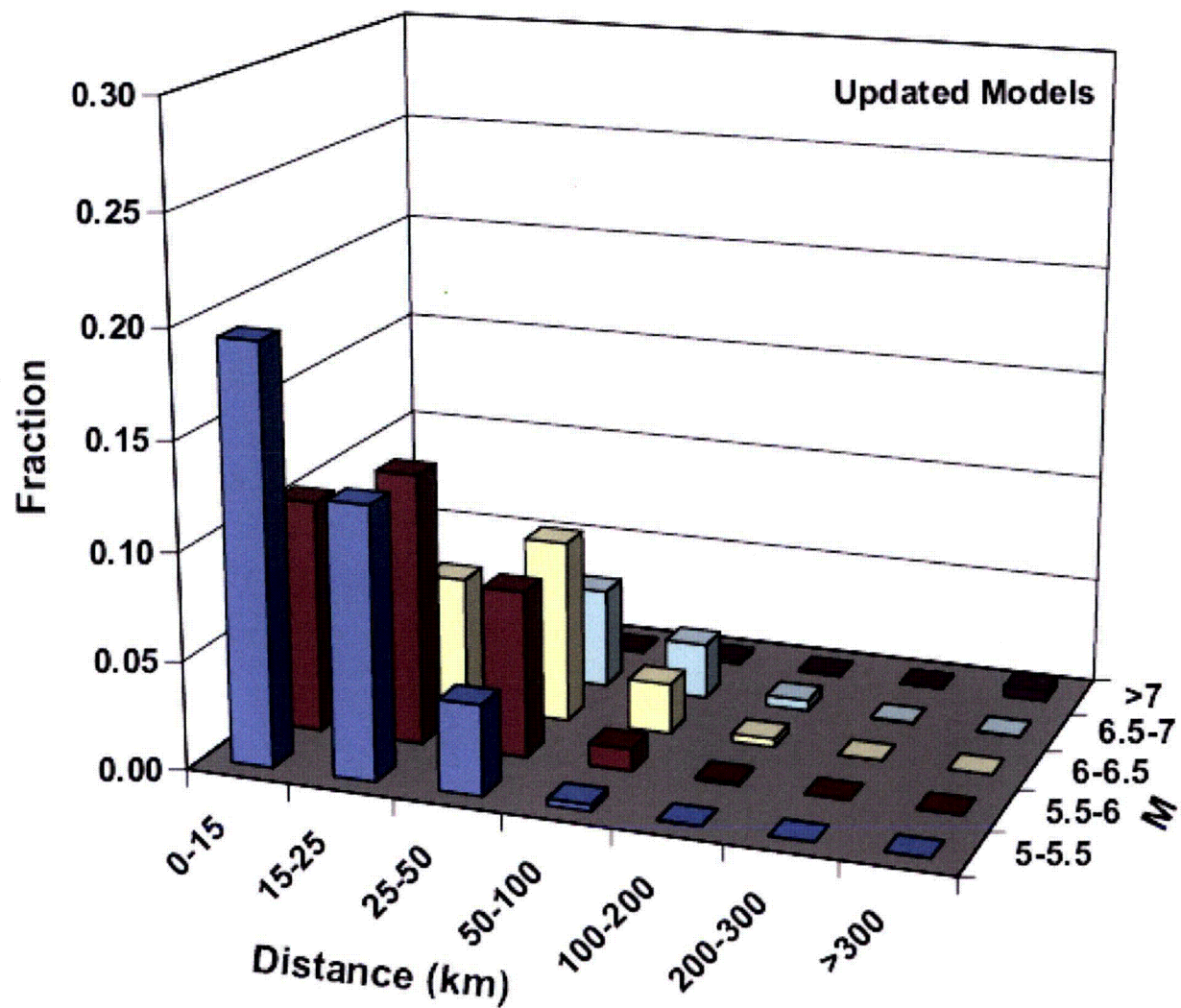


Figure 2.5-50. Magnitude-Distance Deaggregation for High-Frequencies (5 and 10 Hz) at a Mean Annual Frequency of 5×10^{-5} Using Updated Source and Ground Motion Models.

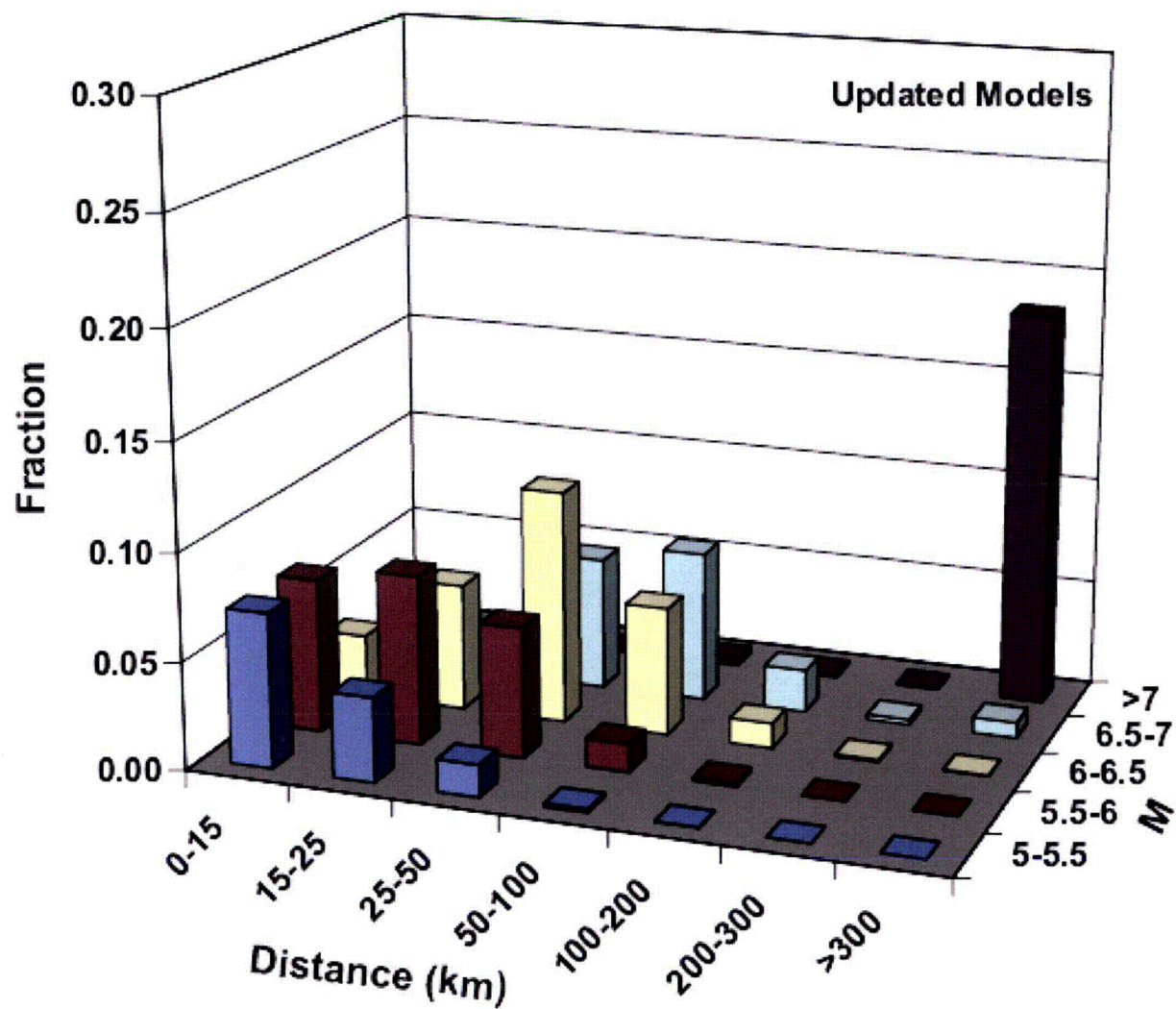


Figure 2.5-49. Magnitude-Distance Deaggregation for Low-Frequencies (1 and 2.5 Hz) at a Mean Annual Frequency of 5×10^{-5} Using Updated Source and Ground Motion Models

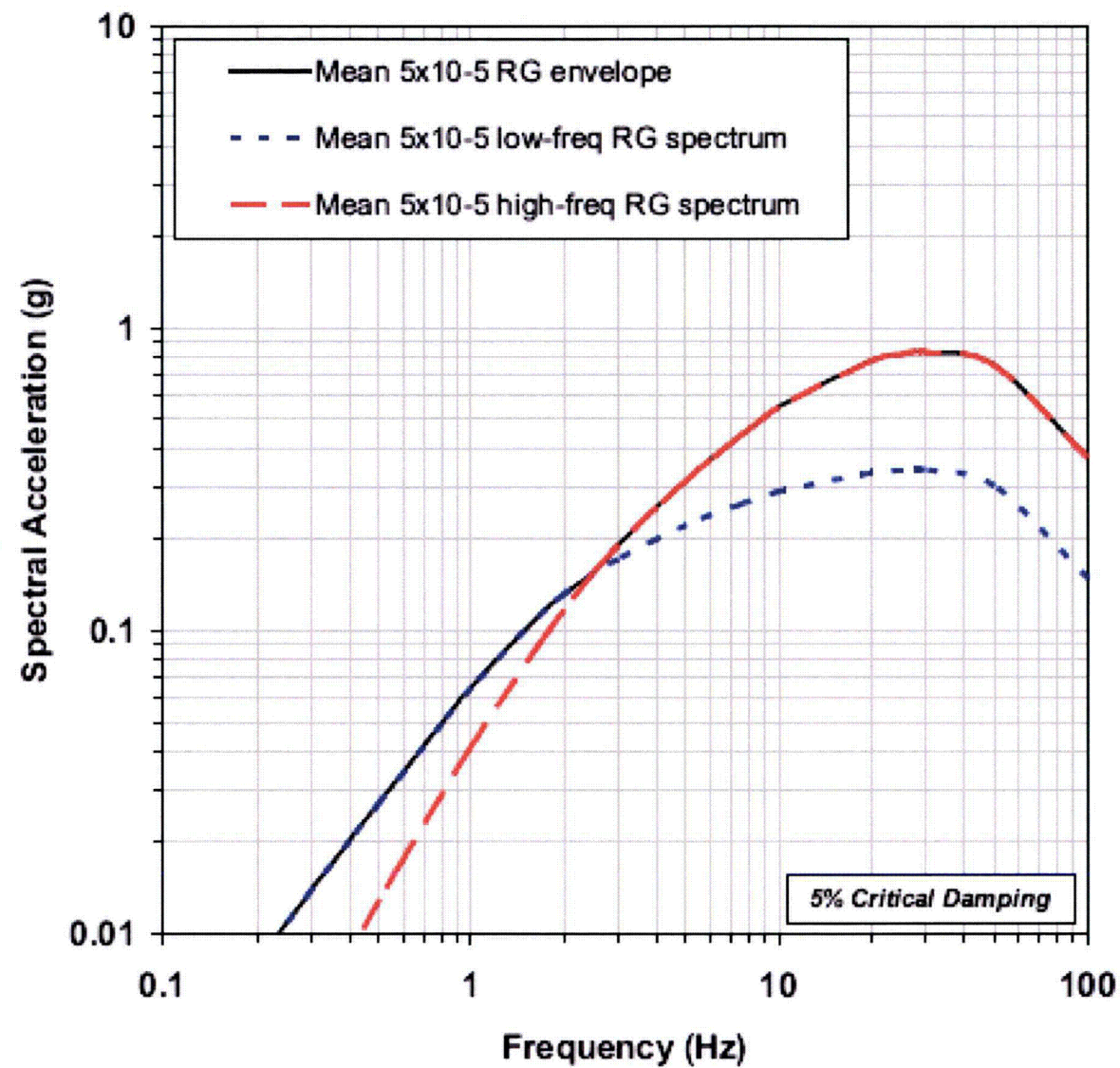


Figure 2.5-51. Low-Frequency, High-Frequency, and Envelope Horizontal Hard Rock SSE Spectra for RG 1.165 Reference Probability Approach Using 5×10^{-5} .

Safe Shutdown Earthquake (SSE) Ground Motion

- **Dominion determined the site response for two controlling earthquakes: a high-frequency earthquake and a low-frequency earthquake.**
- **SSE horizontal spectrum was an envelope of the mean 5×10^{-5} spectrum and the performance-based spectrum.**
- **SSE vertical spectrum was determined using appropriate V/H ratios and the horizontal SSE spectrum.**
- **The Operating Basis Earthquake Ground Motion spectrum was selected as one-third of the SSE spectrum (10 C.F.R. Part 50, Appendix S).**

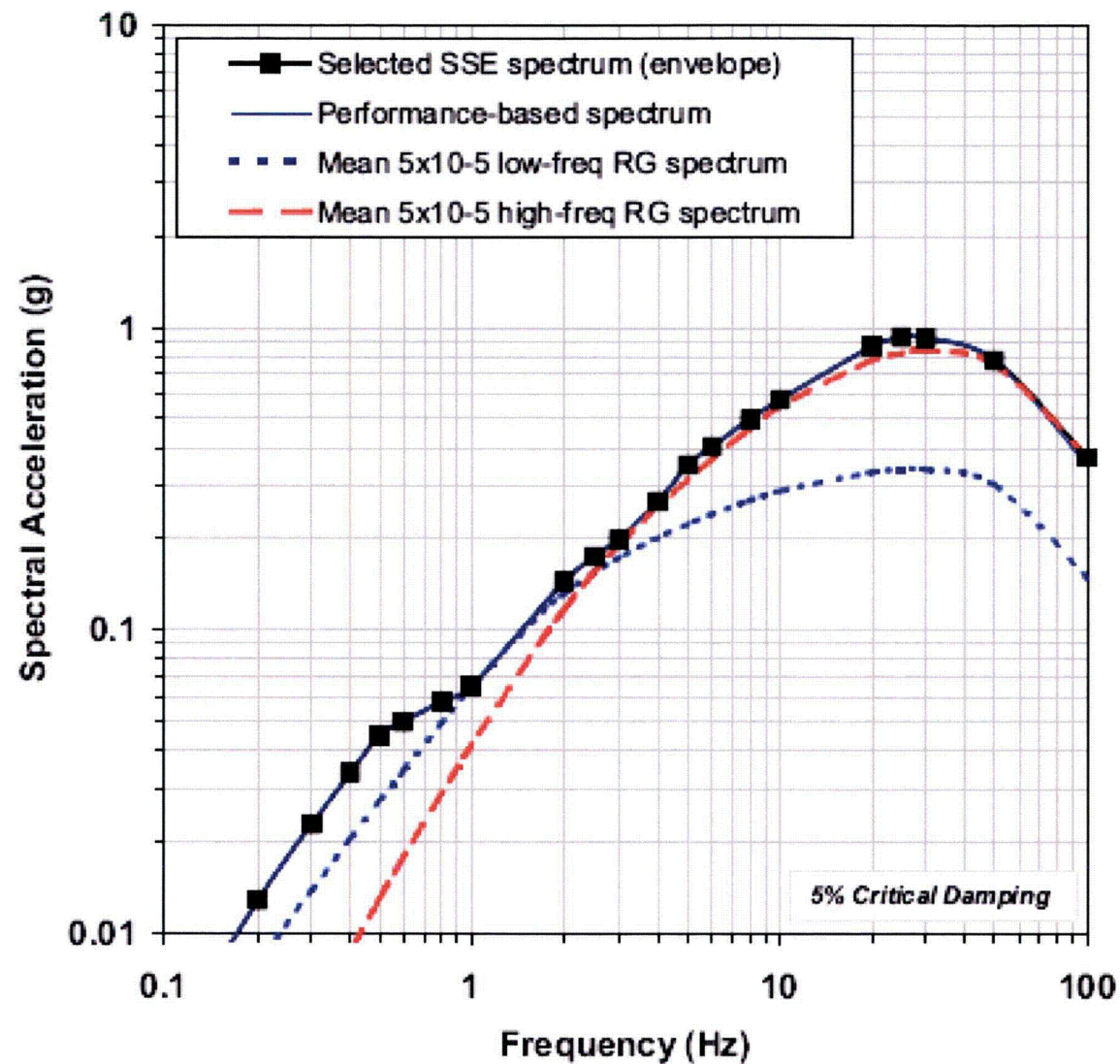


Figure 2.5-54A. Comparison of Performance-Based Spectrum, Mean 5×10^{-5} Scaled Spectra, and Selected Hard Rock SSE Spectrum (Which Envelops the Other Three)

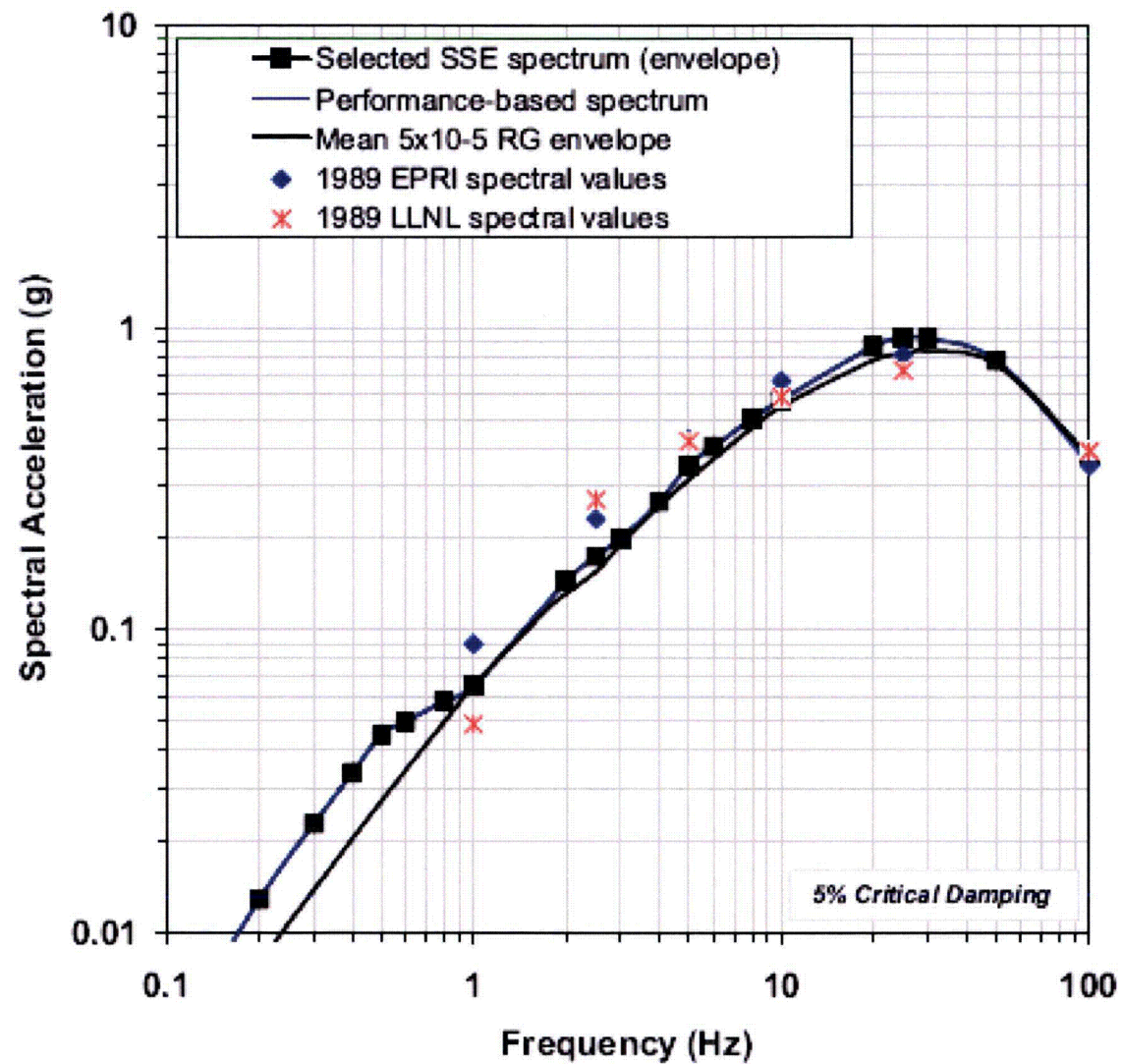


Figure 2.5-54B. Comparison of Mean 5×10^{-5} RG 1.165 Envelope, 1989 EPRI, 1989 LLNL, and Selected Hard Rock SSE Spectra

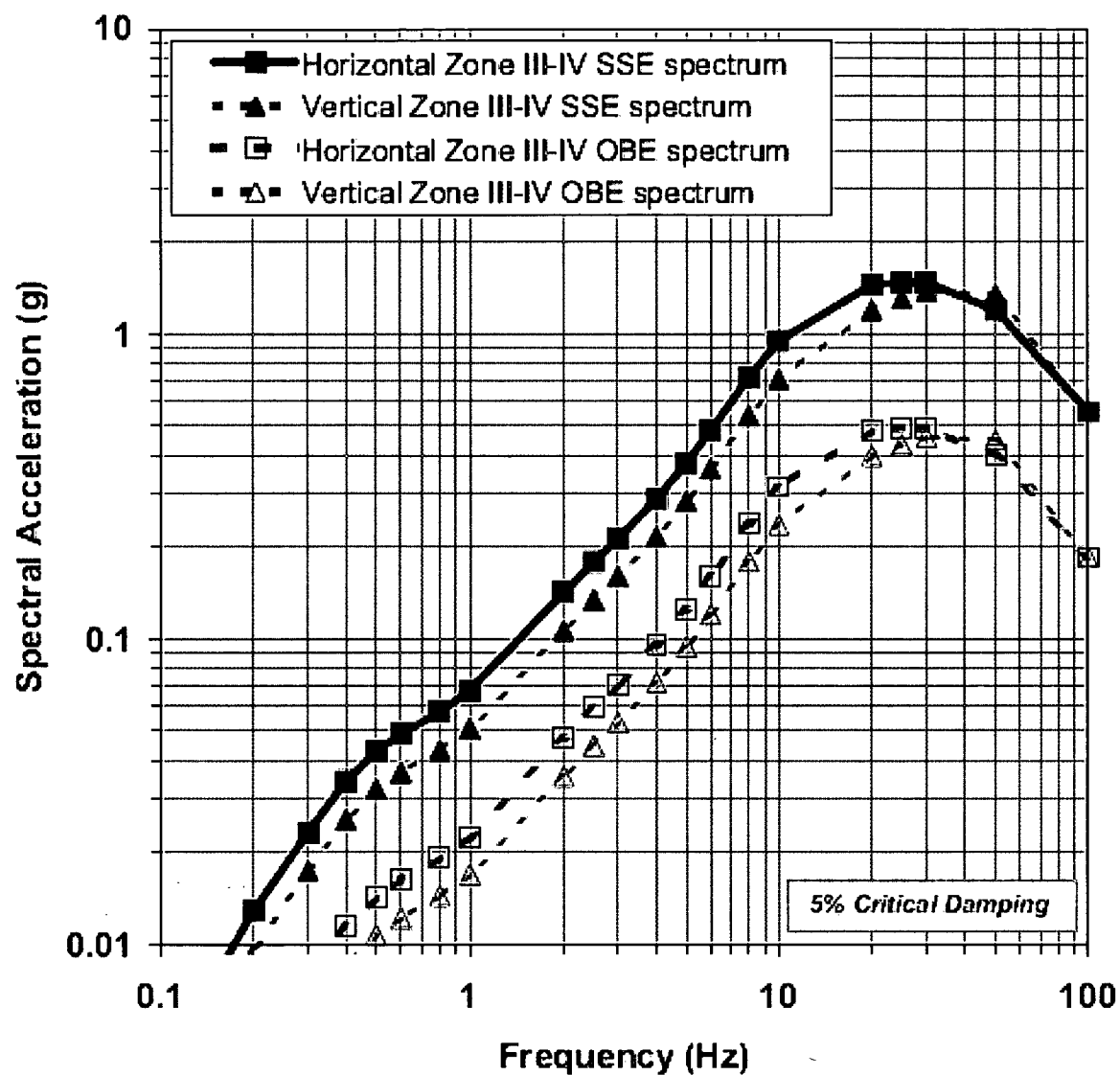
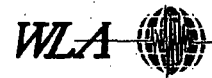


Figure 2.5-55A. Selected Horizontal and Vertical OBE and SSE Spectra for the hypothetical Rock Outcrop Control Point at the Top of Zone III-IV Material (3300 ft/sec Shear Wave Velocity)



WILLIAM R. LETTIS, Ph.D., C.E.G.
President, Principal Geologist

*Seismic Hazard Assessment
Neotectonics
Engineering Geology*

EDUCATION

University of California, Berkeley, CA: *Ph.D., Geology, 1982*
University of California, Berkeley, CA: *M.S., Geology, 1979*
Humboldt State University, Arcata, CA: *B.S., Forestry, 1977; B.S., Geology, 1977*

REGISTRATION

Certified Engineering Geologist, California, No. 1296, 1986
Professional Geologist, California, No. 4079, 1986

PROFESSIONAL HISTORY

William Lettis & Associates, Inc., Walnut Creek, CA, Senior Principal Geologist, 1990-date
Geomatrix Consultants, Inc., San Francisco, CA, Senior Geologist, 1985-1990
Bechtel Civil and Minerals, Inc., San Francisco, CA, Geologist, 1982-1985
U.S. Geological Survey, Menlo Park, CA, Geologist, 1979-1982

AFFILIATIONS AND AWARDS

American Association for the Advancement of Science
American Geophysical Union
Association of Engineering Geologists
Geological Society of America
Earthquake Engineering Research Institute
Seismological Society of America
Humboldt State University, 1998 Alumni of the Year Award
Geological Society of America, Penrose Grant, 1979
University of California Regents Fellowship, 1977-1978

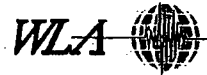
REPRESENTATIVE EXPERIENCE

Dr. Lettis has over 20 years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and LNG terminals. These investigations typically involve detailed site characterization to assess deterministic and probabilistic ground motions, liquefaction potential, surface fault rupture, and static and dynamic slope stability. With over 100 publications, Dr. Lettis is a recognized authority on the assessment of seismic hazards, both in California and throughout the world. He currently is serving on the California Earthquake Prediction Evaluation Council (CEPEC), an advisory committee to the Governor and Office of Emergency Services (OES) and was an invited speaker at the DSOD-sponsored seminar on earthquake engineering for the Association of State Dam Safety Officials on methods for assessing fault activity.

REPRESENTATIVE PROJECTS

Geologic and Seismic Studies for Early Site Permit Application – Vogtle Electric Generating Plant, Georgia

Dr. Lettis currently is Project Manager for geologic and seismic studies in support of an Early Site Permit for the siting of a new nuclear reactor at the existing Vogtle Electric Generating Plant in Georgia. Studies of the Coastal Plain site include a comprehensive update of existing geologic, seismic, and geophysical data bases



for the site region, detailed geologic mapping, and characterization of earthquake sources to update the Electric Power Research Institute (EPRI) seismic source model. Geologic and geomorphic mapping include analysis of aerial photography, field reconnaissance, and aerial reconnaissance in order to identify the presence of any potential capable tectonic sources or seismogenic sources that were not identified in the EPRI studies. Updating of the seismic source model for the PSHA included the development of a new model for the Charleston earthquake source, which is the most significant earthquake source in the region.

Early Site Permit, North Anna, Virginia

Dr. Lettis currently is Project Manager for characterization of seismic sources for the Dominion North Anna Early Site Permit. The source model developed for North Anna involved a thorough evaluation and update of the Electric Power Research Institute (EPRI) seismic source model developed in the late 1980's. Dr. Lettis prepared sections 2.5.1, 2.5.2, and 2.5.3 of the SSAR related to the source model, including updated source parameters for the Charleston and Central Virginia source zones, and newly identified potential fault sources that extend the entire length of the Appalachian front and Coastal Plain. Dr. Lettis documented and defended the new seismic source model with NRC staff.

Early Site Permit, Grand Gulf, Mississippi

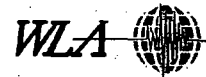
Dr. Lettis currently is Project Manager for the Entergy Grand Gulf Early Site Permit. His responsibilities included completing all sections of 2.5.1 through 2.5.6 of the SSAR, including seismic source characterization and probabilistic seismic hazard analysis to develop the SSE design ground motion in compliance with Regulatory Guide 1.165, and geotechnical characterization of the site in partial compliance with Regulatory Guides 1.31 and 1.32. The seismic source model involved a comprehensive review and update of the Electric Power Research Institute (EPRI) source model developed in the late 1980's, including updated source parameters for the New Madrid source zone and the newly recognized Saline River source zone in the southern United States. Dr. Lettis documented and defended the new source model with NRC staff.

Diablo Canyon NPP, Long-Term Seismic Program

Dr. Lettis was Project Manager for a comprehensive 7-year investigation of seismic sources in central coastal California as part of the Pacific Gas and Electric Company's Long-Term Seismic Program for the Diablo Canyon NPP. The seismic source model was developed to provide an updated ground motion evaluation at the site, including both deterministic and probabilistic seismic hazard analyses. Over 20 capable and potentially capable faults were identified and characterized over a 3-year period through a comprehensive program of detailed mapping, paleoseismic trenching, and onshore and offshore geophysics. Each seismic source was characterized through the use of logic trees for input to the hazard analysis, including the Hosgri, San Simeon and Los Osos faults. Dr. Lettis documented and defended results of the seismic source characterization to NRC staff through numerous meetings and written responses over a subsequent 4-year period. Dr. Lettis is continuing to provide assistance to PG&E on the NRC-mandated Diablo Canyon Long-Term Seismic Program.

Shivta-Rogem Nuclear Power Plant, Israel

Dr. Lettis currently is Project Manager for the Shivta-Rogem Nuclear Power Plant Project in the northern Negev Desert, Israel. He is directing a team of WLA and Israeli geologists, seismologists, and geophysicists to assess seismic hazards, perform probabilistic and deterministic ground motion analyses, and prepare a Preliminary Safety Analysis Report for submittal to the Israeli Atomic Energy Commission. Dr. Lettis documented and defended the PSAR source characterization and ground motion results to the IAEC Licensing Division staff.



U.S. Bureau of Reclamation and Army Corps of Engineers, western U.S.

Dr. Lettis has conducted numerous seismic hazard evaluations for dams and water conveyance systems throughout the western United States. He was Project Manager for seismotectonic evaluations of 48 U.S. Bureau of Reclamation dams in the western United States and for two Army Corps of Engineer dams in the Sierra Nevada of California. These projects involved the geologic and seismologic characterization of known and potential earthquake sources in specific geologic provinces of the western United States, deterministic and probabilistic assessment of ground motions and assessment of liquefaction potential of alluvial foundation materials at specific dam sites.

Seismic Hazard Characterization, Conceptual Engineering for Calaveras Dam, Alameda County, CA

Dr. Lettis provided Senior Technical Peer Review for the SFPUC Calaveras Dam project. He reviewed and provided technical advise on the Calaveras Fault for evaluation of design ground motions and for potential surface fault rupture on secondary fault strands through the existing dam and potential footprints for a new dam. Dr. Lettis provided guidance for the detailed bedrock and Quaternary geologic mapping and paleoseismic trench program, in compliance with DSOD guidelines and criteria for identifying and characterizing active, conditionally active, and inactive faults.

Vulnerability Study Marin Municipal Water Agency, Marin County, California

Dr. Lettis was Project Manager for a seismic and geologic vulnerability assessment of the Marin Municipal Water District's backbone water supply system. Hazards assessed include liquefaction, earthquake-induced slope failure, surface fault rupture, and strong ground motions from three scenario earthquakes. The hazard information was used to identify, prioritize and mitigate hazard vulnerability to the MMWD system for their seismic improvement program.

EBMUD, Seneca Reservoir

As Project Manager, Dr. Lettis completed an investigation of East Bay Municipal Utility District's Seneca Reservoir to evaluate leakage along the reservoir's margins. Suspected causes included aseismic creep along secondary structures associated with the Hayward fault, complex bedrock fractures, and regions of slope instability along the western margin of the reservoir. The project included geologic mapping, placement of geotechnical boreholes and monitoring wells, and excavation of test pits in the liner system of the reservoir. Dr. Lettis worked closely with members of EBMUD and with DSOD staff during all stages of the investigation to assure compliance with existing regulations and to facilitate regulatory review.

EBMUD South Reservoir

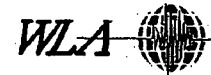
As Project Manager, Dr. Lettis directed an investigation of potential for surface fault rupture through South Reservoir along the West Chabot fault. Based on detailed mapping, trenching, and evaluation of borehole data, the "Carlos B" strand of the West Chabot fault was determined to underlie the reservoir but was shown to be inactive in compliance with DSOD criteria. Based on review, DSOD concurred with the conclusion of fault inactivity.

New Carquinez Bridge, California (2000)

Technical Advisory Board for development of seismic design criteria for large span bridge in the San Francisco Bay Area. Reviewed seismic source characterization, ground motion analysis, selection of time histories, and geotechnical evaluation of bridge pier and abutment foundation.

Caltrans District V Historic Concrete and Steel Arch Bridges Seismic Retrofit, Highway 1, California (1995-1999)

Technical Advisor for geologic and geotechnical site characterization and foundation retrofit studies for eight historic, large-span concrete and steel arch bridges on California Highway 1, including the Bixby Creek,



Rocky Creek, Big Creek, and Cold Springs Canyon arches. The scope of work included site subsurface characterization, laboratory testing, development of seismic design/analyses criteria, foundation evaluation (spread footings, pier, and pile foundations), liquefaction and slope stability analyses, rock mass stability and response analysis, and development of retrofit foundation design. Retrofit design consisted of construction of CIDH pile-supported abutment blocks, and installation of high capacity rock anchors for overturning/uplift resistance (up to 1200 kip capacity).

Oromieh Bridge Earthquake Response Technical Review, Iran

Performed 3rd party review of probabilistic seismic hazard analysis and design spectra for a proposed new viaduct and bridge across Lake Oromieh in northern Iran that will be supported by driven or large diameter CIDH piles in layered soft to stiff lake sediments. Reviewed seismic reflection data for evaluation of potential for surface fault rupture. Prepared evaluation of regional and local seismic sources for input to revised PSHA source model.

New Tacoma Narrows Suspension Bridge technical review and advisory committee, Washington

Performed 3rd party review of probabilistic seismic hazard analysis and for proposed new large span suspension bridge. Review included evaluation of seismic source model, attenuation model, and identification of controlling earthquakes for design, with emphasis on the Cascadia subduction zone and Seattle fault system.

Chacau Bridge, Chile

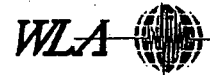
Provided 3rd party peer review of seismic design and geotechnical characterization of proposed new large span suspension bridge. Reviewed seismic source model, attenuation relationships and time histories. Proposed bridge is within area of significant subduction zone tectonic subsidence from 1960 Chilean earthquake. Potential for secondary fault rupture and future tectonic subsidence was evaluated.

Pacific Gas and Electric Company Seismic Hazard Evaluations, San Francisco, CA

Dr. Lettis has conducted seismic hazard evaluations for numerous Pacific Gas and Electric Company (PG&E) facilities throughout California. He investigated the earthquake vulnerability of PG&E's entire gas supply and distribution system, including pipelines, compressor stations, terminals, and pressure-limiting stations. The project involved preparing liquefaction and slope stability hazard maps covering all of northern and central California, site assessments of above ground facilities, and assessments of fault activity at pipeline crossings, including 4 pipeline crossings of the Hayward fault. Dr. Lettis also was Project Manager for a comprehensive fault evaluation for PG&E's Lake Almanor and Butt Valley Dams in the Northern Sierra Nevada. The study involved detailed fault mapping and trenching to assess fault location, recency of activity, MCE and displacement per event. Dr. Lettis also managed a comprehensive, seven-year investigation of Quaternary faulting in central coastal California as part of PG&E's Long-Term Seismic Program for the Diablo Canyon Power Plant. For this study, Dr. Lettis directed a program of mapping, drilling, trenching and age dating to evaluate the capability and behavior of over 20 potentially capable faults including the San Simeon, Hosgri, and Los Osos faults.

Research Investigations

Dr. Lettis has been the Principal Investigator on 28 research projects sponsored by the U.S. Geological Survey, National Science Foundation and U.S. Nuclear Regulatory Commission to assess earthquake hazards in the United States. These studies have included paleoseismic investigations of the San Andreas, Calaveras, San Gregorio, Hayward, Green Valley, and Shannon-Monte Vista faults in the San Francisco Bay region, geomorphic analyses of the 1989 Loma Prieta, 1987 Whittier Narrows, 1992 Landers, and 1994 Northridge earthquakes, and liquefaction mapping of the Napa, San Francisco, and Stockton 1:100,000 scale quadrangles. For the U.S. Nuclear Regulatory Commission, Dr. Lettis performed an investigation of the late Quaternary history and seismotectonic setting of the Meers fault, Oklahoma, and prepared NUREG reports on



Methods for Dating the Age of Active Faults and Methods for Differentiating between Tectonic and Non-tectonic Faults. Dr. Lettis recently conducted post-earthquake investigations of the 1999 Kocaeli and Duzce earthquakes in Turkey, the 1999 Chi Chi earthquake in Taiwan, and was the U.S. Team Leader for the 2002 Buhj earthquake in India, all sponsored by the NSF and Earthquake Engineering Research Institute.

Technical Peer Review

Dr. Lettis provides technical advice and peer review for geological seismic hazard investigations throughout the United States and abroad. For PG&E, he has reviewed several seismic and geotechnical investigations to assess hazards to their hydroelectric facilities in the northern and central Sierra Nevada, many of which were performed in compliance with DSOD requests. He has provided technical review for geologic and seismic hazard assessments of the Los Alamos National Laboratory and Sandia National Laboratory in the Rio Grande Rift, New Mexico, for nuclear facilities in Korea, LNG terminals in Trinidad and Tobago, Peru, and Mare Island in the San Francisco Bay Area, and for various USBR and ACOE dams in California and Colorado.

Expert Witness

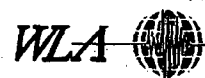
Dr. Lettis provides expert witness services related to the identification and characterization of geologic hazards. He provided expert testimony on the cause, timing, and failure mechanism of a large debris flow for the Yuba County Water Agency, and on the geologic setting of the San Joaquin Valley for the Westlands Water District.

COMMITTEES AND EXPERT PANELS

Member, California Earthquake Prediction Evaluation Council (CEPEC), scientific advisory board to the Governor and Office of Emergency Services (OES), 2003 to 2007
Member, California Geological Survey Geologic Mapping Advisory Committee, 2000 to present
Co-Chairman, American Nuclear Society (ANS) Working Group Committee 2.27 to develop evaluation criteria for assessing seismic hazards for nuclear materials facility, 1996 to present
Member, Ethics Committee of the Earthquake Engineering Research Institute
Member, Board of Directors, Cooperating Organizations of Northern California for Earthquake Research and Technology (CONCERT) 1993 to 1996
Member, Expert panel to assess earthquake hazards in the southeastern United States, Lawrence Livermore National Laboratory/Department of Energy, 1990 to 1996
Member, California Division of Mines and Geology Advisory Committee on Liquefaction Hazards, 1991 to present
Member, California Seismic Safety Commission, Geology/Seismology Subcommittee, 1988 to 1990
Member, NASA Science Committee, 1985

LECTURES

Dr. Lettis was an invited lecturer on Evaluation and Mitigation of Seismic Hazards, sponsored by California Division of Mines and Geology, Southern California Earthquake Center, and University of California, Berkeley. He has been an invited lecturer on Quaternary Geology, regional tectonics, and remote sensing at Stanford University, 1982; University of California, Berkeley, 1982, 1984, 1985, and 1986; the Women Geoscientists of America, San Francisco Conference, 1985, and numerous professional meetings. He was invited Symposium Moderator, Earthquake Risk and Hazard Mitigation Symposium, Association of Geologists 38th Annual Meeting, 1995.



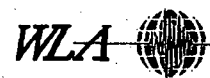
REFERENCES

Books

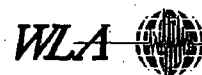
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- Jain, S.K., Lettis, W.R., Murty, C.V.R., and Bardet, J.P., eds., 2002, Bhuj, India Earthquake of January 26, 2001 Reconnaissance Report: Earthquake Spectra, Supplement A to Vol. 18.
- Sowers, J.M., Noller, J.S., and Lettis, W.R., eds., 1998, Dating and Earthquakes: Review of Quaternary Geochronology and its Application to Paleoseismology, NUREG/CR 5562, U.S. Nuclear Regulatory Commission, 6 chapters + apps.

Papers

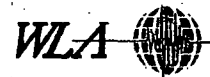
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- Bardet, J.P., Seed, R.B., Lettis, W.R., and others, R., 2000, Ground Failure and Geotechnical Effects – Soil Liquefaction, Landslides, and Subsidence: Earthquake Spectra, 1999 Kocaeli, Turkey, Earthquake Reconnaissance Report, Supplement A to Vol. 16, pp. 141-162.
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- Bullard, T.F., and Lettis, W.R., 1993, Quaternary fold deformation associated with blind thrust faulting, Los Angeles Basin, California: Journal of Geophysical Research, v. 98, pp. 8,349-8,369.
- Hall, N.T., Angell, M., De Wit, M.W., and Lettis, W.R., 1994, Late Quaternary deformation of the southern Santa Cruz Mountains, California, in Alterman, I. B., McMullen, R.B., Cluff, L.S., and Slemmons, D.B., eds., Seismotectonics of the Central California Coast Ranges, Geological Society of America Special Paper p. 292.
- Hanson, K.L., and Lettis, W.R., 1999, Correlation, ages, and uplift rates of Quaternary marine terraces: south-central coastal California: Society of Economic Paleontologists and Mineralogists: Quaternary Coastal Systems of the United States, in press.
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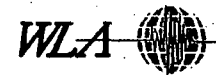
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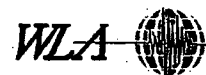
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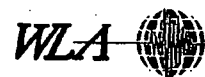
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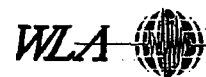
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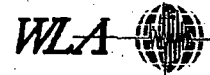
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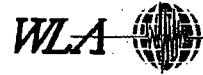
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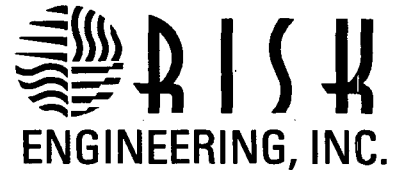
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Curriculum Vitae



ROBIN K. MCGUIRE

EDUCATION: **Ph.D Degree** - Structural Engineering, Massachusetts Institute of Technology
 M.S. Degree - Structural Engineering University of California, Berkeley
 S.B. - Civil Engineering, Massachusetts Institute of Technology

QUALIFICATIONS: Seismic hazard and risk analyses
 Numerical methods and analyses
 Statistical analyses

PRESENT POSITION: President and Principal, Risk Engineering, Inc., Boulder, Colorado

RELEVANT EXPERIENCE

- Technical Director of seismic hazard projects for North Anna, Vogtle, Summer, Lee, Bellefonte, South Texas, Comanche, and Calvert Cliffs nuclear plant sites, to support ESP and COL applications for new generation nuclear facilities at those sites. Geologic and tectonic information developed by other consultants is integrated into the calculations. Work is performed under Quality Assurance procedures. 2002-present.
- Technical Director of project for the Electric Power Research Institute to examine seismic design levels at 28 nuclear plant sites in the eastern US, apply the ASCE 43-05 performance-based procedure. Results were compared to existing seismic design levels and to results from published seismic plant PRAs. 2004-2005.
- Technical Director of project for the US Nuclear Regulatory Commission to revise seismic ground motion design requirements, to achieve levels of seismic safety consistent with risk-based performance goals (balancing seismic risks with those from external and internal accidents). 1996-2001.
- Lead consultant on probabilistic performance assessment of the Yucca Mountain site as possible high-level waste repository, for the Electric Power Research Institute. This effort coordinated input from ten consultants on environmental and engineering factors that affect evaluation of the potential repository performance regarding radionuclide release and recommended site studies to balance uncertainties and risks. 1989-2001.
- Technical Director of project funded by the US Dept. of Energy to develop seismic design requirements for a Yucca Mountain nuclear waste repository. The recommendations must consider the seismic response of structures and components, safety factors in design, and probabilistic seismic hazards to achieve target seismic risk-based performance levels that are consistent with other risks to the repository. The report from this project was taken as Seismic Topical Report III. 1994-1996.
- Consultant to Senior Seismic Hazard Analysis Committee on developing and documenting methods of probabilistic seismic hazard calculations. Wrote Appendix I of SSHAC report. March 1993-September 1996.
- Technical Director of major project for Electric Power Research Institute to develop and apply methods of evaluating earthquake hazards in the central and eastern U.S. This work involved directing efforts of 50 earth scientists in characterizing the earthquake potential of the region, and in using this information to characterize the earthquake hazard. Results calculated for 57 nuclear plants in the CEUS. Oct 1984-Dec 1989.
- Consultant to numerous clients overseas on earthquake risk to major facilities, including applications to Switzerland, Japan, Korea, Italy, Taiwan, China, Norway, Germany and South Africa. March 1986-present.

EMPLOYMENT HISTORY:	<p>Risk Engineering, Inc., 1984 – Present Dames & Moore, 1979 – 1981 and 1983-1984 Earth Technology Corp, 1981-1983 U.S. Geological Survey, 1974-1979</p>
PROFESSIONAL AFFILIATIONS AND AWARDS:	<p>Member, National Academy of Engineering (elected 2007)</p> <p>President, Seismological Society of America, 1991-1992, and Board of Directors, 1989-1995</p> <p>Board of Directors, Earthquake Engineering Research Institute, 1989-1993, and Chair, Seismic Risk Committee, 1984-1990. Member since 1975.</p> <p>Chair, Panel on Risk Assessment Techniques, Commission on Earthquake Hazards for the International Association of Seismology and Physics of the Earth's Interior, 1983-1995.</p> <p>Member, Committee on Seismology, National Research Council (National Academy of Sciences), 1984-1987.</p> <p>Fellow, American Society of Civil Engineers and Member, Technical Council on Lifeline Earthquake Engineering, 1982-present. Member since 1968.</p> <p>Member, Society for Risk Analysis. Member since 1981.</p> <p>Member, Chi Epsilon (National Civil Engineering Honorary Fraternity), Tau Beta Pi (National Engineering Honorary Fraternity), Sigma Xi (National Scientific Society).</p> <p>Registered Professional Engineer, Colorado (#13654), Massachusetts (#27930)</p>
REPRESENTATIVE PUBLICATIONS:	<p>McGuire, R.K., <i>Seismic Hazard and Risk Analysis</i>, Monograph MNO-10, Earthq. Eng. Res. Inst., Oakland, CA, 2004.</p> <p>McGuire, R.K. et al, "Technical Basis for Revision or Regulatory Guidance on Design Ground Motions: Development of Hazard and Risk-consistent Seismic Spectra for Two Sites," US Nuclear Regulatory Commission, NUREG/CR-6769, Apr. 2002.</p> <p>McGuire, R.K. et al, "Technical Basis for Revision or Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines," US Nuclear Regulatory Commission, NUREG/CR-6728, Oct. 2001.</p> <p>McGuire, R.K., "Probabilistic Seismic Hazard Analysis and Design Earthquakes: Closing the Loop," <i>Bull. Seis. Soc. Am.</i>, Oct. 1995.</p> <p>McGuire, R.K., ed., <i>The Practice of Earthquake Hazard Assessment</i>, International Association of Seismology and Physics of the Earth's Interior and European Seismological Commission, Dec. 1993.</p> <p>McGuire, R.K., "Perceptions of Earthquake Risk," Presidential Address, <i>Bull. Seis. Soc. Am.</i>, 82, 4, 1977-1982, Aug. 1992.</p> <p>(A full list of publications numbering more than one hundred is available upon request.)</p>

JOHN R. DAVIE
Senior Principal Engineer
Geotechnical Specialist

WORK HISTORY

SENIOR PRINCIPAL ENGINEER - Bechtel (28 Years)

Dr. Davie is currently a senior principal engineer and group supervisor with the Geotechnical Group in Bechtel's Frederick office, engaged in geotechnical investigations and foundation engineering for power plant facilities and other Bechtel projects, including major industrial, petroleum, and transportation work, both in the United States and overseas.

Dr. Davie's assignments for Bechtel have included onshore and offshore field and laboratory investigations; bearing capacity and settlement analyses; design and testing of pile and pier foundations; design of retaining structures, including reinforced soil walls; stability analyses; evaluation of liquefaction potential; and road and railroad foundation design. He has supervised several ground improvement projects, including installation of mini-piles and stone columns, chemical grouting, large-scale underpinning, and accelerated consolidation of soft clay using wick drains.

In 1988, Dr. Davie completed a 6-month engineering and construction assignment on the Ankara-Gerede Motorway in Turkey. From 1989 to 1999, he was an advisor to the Bechtel/Parsons Brinckerhoff geotechnical team on the Boston Central Artery/Third Harbor Tunnel Project.

GEOTECHNICAL CONSULTANT - McClelland Engineers, Inc. (5 Years)

Before joining Bechtel, Dr. Davie was a member of the staff of McClelland Engineers, Inc., geotechnical consultants in Houston, Texas. His field experience included offshore pile driving inspection and supervision of drilling operations in the Gulf of Mexico and the Persian Gulf. Dr. Davie was also involved in foundation design studies for offshore structures in various parts of the world. Onshore foundation design projects included refineries, natural gas liquefaction facilities, chemical plants and other industrial and commercial projects, and high-rise office buildings in downtown Houston.

LECTURER - University of Glasgow (4 Years)

Earlier, Dr. Davie was a member of the teaching staff at the University of Glasgow with primary teaching interests in traffic engineering and soil mechanics. His research projects included investigation of the behavior of cohesive soils under vertical uplift forces.

J. R. DAVIE (Continued)

EDUCATION

PhD, Soil Mechanics, University of Glasgow, Scotland (1974)
ME, Civil Engineering, Cornell University (1969)
BS, Civil Engineering, University of Glasgow, Scotland (1968)

REGISTRATION/CERTIFICATION

Professional Engineer in Maryland, Oregon, Ohio and Wisconsin
Chartered Engineer, United Kingdom
NCEES Council Record Holder

PROFESSIONAL MEMBERSHIPS

Member, Institution of Civil Engineers (ICE)
Member, American Society of Civil Engineers (ASCE)
Secretary, Shallow Foundations Committee, ASCE
Member, American Society for Testing and Materials (ASTM)
Member, International Society for Soil Mechanics and Geotechnical Engineering
Member, European Federation of National Engineering Associations (FEANI)

PUBLICATIONS

Dr. Davie has written numerous project-specific geotechnical reports. In addition, he has authored or co-authored over 40 technical papers that have been published in professional journals and in national and international conference proceedings. He recently co-edited an ASCE Geotechnical Publication on the effects of construction on existing structures.