

RESUME

IVAN G. WONG, P.G.

Principal Seismologist



Expertise

Earthquake Geology
Engineering Seismology
Seismic Geology
Geophysics

Registration

Professional Geologist,
Utah 5272248-2250

Work Experience

Lettis Consultants International,
Inc. (2016-present)
AECOM (formerly Woodward-
Clyde and URS)
(1976-2016)

Education

University of Utah, Graduate
Studies, Geophysics,
2002-2007
U.C. Berkeley Extension,
Graduate Studies, Earthquake
Engineering
2002-2003
U.C. Berkeley, Graduate
Studies, Geophysics,
1975-1976
University of Utah, M.S.,
Geophysics
1976
Portland State U., B.S.,
Geology, 1972
Oregon State U., B.S., Physics,
1970

Affiliations

American Geophysical Union
Earthquake Engineering
Research Institute
Geological Society of America
Seismological Society of
America
International Association of
Earthquake Engineering
Seismological Society of
America

REPRESENTATIVE EXPERIENCE

Mr. Wong is a Principal Seismologist for Lettis Consultants International, Inc., an Earth Science firm specializing in the assessment of geologic and seismic hazards for critical and important facilities. He is a nationally and internationally recognized expert in seismic hazard and seismic risk evaluations with more than 40 years of experience in the fields of seismology and seismic geology with an emphasis on studies in seismicity, seismotectonics, and earthquake ground motions. Mr. Wong has directed and participated in seismological and geological studies and research for the seismic hazard assessments and seismic design of more than 700 important and critical facilities in the United States and worldwide.

REPRESENTATIVE PROJECTS

Principal seismologist for seismic hazard evaluations of numerous facilities including, for example: Monticello, Salinas, Pit 1 Forebay, Calaveras, and Los Vaqueros Dams in California; Kemmerer City Dam, Wyoming; Blue Ridge Dam, Arizona; Toston Dam, Montana; Tolt Dam, Washington; BC Hydro dams in British Columbia; Piute Dams, Utah; Port of Anchorage, Alaska; Vesuvius Dam, Ohio; Kaeng Sua Ten, Khao Laem, and Srinagarind Dams, Thailand; and Toker Dam, Eritrea; Maracaibo bridge and tunnel, Venezuela; LDS Temples in the western U.S., Philippines, and Japan; uranium mill tailings pile in Moab, Utah; petroleum tank farm and mining development in Ecuador; cogeneration plants near Mt. Poso, Stockton and Mecca, California; the City of Redding, California as part of their Seismic Safety Element; hazardous waste facility near Caswell, California; geothermal developments in Nevada; pipelines in Utah, California, and Oregon; numerous LNG facilities the eastern U.S., and petroleum development area in the East Java Sea, Indonesia. Mr. Wong has also participated in earthquake studies for offshore platforms, Alaska and Aswan Dam, Egypt.

Nuclear Power Plants: Mr. Wong has been involved in the site characterization and seismic design reviews for nuclear power plants since the mid-1970s. He has performed seismic hazard studies for proposed plants near Modesto, California, Farmington, New Mexico, Hanford, Washington, and Shivta, Israel; and existing plants at Humboldt Bay and San Onofre, California, and Palo Verde, Arizona. More recently, Mr. Wong provided assistance to Mitsubishi Heavy Industries in the generic site characterization and seismic design for the U.S. Advanced Pressurized Water Reactor and to General Atomic for the Next Generation Nuclear Power Plant. Mr. Wong recently was part of the review team on the seismic probabilistic risk analysis of the Perry nuclear plant in Ohio.

U.S. Department of Energy: Mr. Wong has worked extensively for DOE throughout his career. He served as Project Seismologist from 1979 to 1987 for DOE's Nuclear Waste Isolation Program in the Paradox Basin, Utah. Mr. Wong developed and managed a program to evaluate the seismic hazard to a potential nuclear waste repository. He also participated in the seismic design of an exploratory shaft facility at a proposed repository site in west Texas.



From 1988 to 2001, Mr. Wong directed seismic hazard studies at DOE's Idaho National Laboratory (INL) including paleoseismic fault studies and strong ground motion evaluations. He developed seismic design criteria for individual facility sites and the Three Mile Island interim storage facility. He also served on the Strong Motion Expert Panel for Lawrence Livermore National Laboratory in its probabilistic seismic hazard evaluation of the proposed New Production Reactor at the INL. Mr. Wong was a reviewer for the 10-year review of the probabilistic seismic hazard analysis.

From 1991 to 1995, Mr. Wong was the Project Manager for a comprehensive seismic hazards evaluation of DOE's Los Alamos National Laboratory in northern New Mexico. Since then, he has provided consultation on seismic design issues and also managed two probabilistic fault displacement hazard analyses for the Laboratory. A 3-year update of the LANL seismic hazards evaluation was completed in 2009.

Mr. Wong was involved in seismic hazard/seismic design studies for DOE's proposed underground nuclear waste repository at Yucca Mountain since 1992. He was the Principal Investigator for the development of seismic design input and managed geotechnical characterization activities of the site. He served as Deputy Project Director for the SSHAC Level 4 Probabilistic Seismic Hazards Analysis Project, still the most comprehensive seismic hazards evaluation for ground shaking and fault displacement ever performed in the world. He also served on the Earthquakes and Tectonics Expert Panel convened by the Electric Power Research Institute for the High-Level Waste Project Performance Assessment for Yucca Mountain, and was a key member of the team that developed the preliminary seismic design criteria for the Exploratory Studies Facility.

Mr. Wong and his Group completed a seismic hazard evaluation of DOE's Western New York Nuclear Service Center in 2004. The purpose of the study was to develop seismic design parameters for eventual closure of the facility. Similarly, Mr. Wong and his Group evaluated the seismic hazard and developed seismic design parameters for a low-level radioactive waste storage site along the Texas-New Mexico border in 2004. Recently, Mr. Wong re-evaluated the site for the license application as an interim high-level nuclear waste repository.

In 2006-2007, Mr. Wong led a review panel that reviewed the seismic design of the Waste Treatment Plant at DOE's Hanford site in Washington. Mr. Wong has also been a reviewer of seismic hazard studies at DOE's Savannah River Site, South Carolina and the Pantex site, Texas.

U.S. Bureau of Reclamation: From 1991 to 2011, Mr. Wong evaluated the seismic hazards of U.S. Bureau of Reclamation dams in the western U.S. He has analyzed and developed seismic safety evaluation criteria for more than 120 USBR dams in all 11 western states. Mr. Wong served on Consulting Review Boards for the Bureau on Wickiup, Stony Gorge, and Morrow Point Dams.

U.S. Army Corps of Engineers: Mr. Wong has led the seismic hazard evaluations of several facilities for the Corps including Folsom, Martis, Lake Isabella, Hidden, Terminus, and Success Dams in California, Santa Cruz Dam in New Mexico, Portuguese Dam in Puerto Rico, and the Blue Grass Chemical Depot in Kentucky. He also assisted the Corps in developing time histories for the Cascadia subduction zone.

California Department of Water Resources: From 2003 to 2009, Mr. Wong served as the Advisory Engineering Seismologist to DWR. His tasks were to provide expert consultation, review, and guidance on seismic hazard/seismic design evaluations of State water project facilities. He assisted with studies for several dams including Perris, Sisk, Tehachapi, Patterson, and Dyer Dams. As part of DWR's Delta Risk Management Strategy Project, Mr. Wong managed the seismic hazard evaluation of the Delta levees.

PacifiCorp Energy: Since 2010, Mr. Wong has managed or is managing the site-specific seismic hazard evaluations and developed Safety Evaluation Earthquake ground motions for 16 PacifiCorp dams located in Oregon, Washington, Idaho, Montana, and Utah.



Tennessee Valley Authority: In addition to performing site-specific probabilistic seismic hazard analysis (PSHA) and developing design spectra for TVA's Watts Bar 2 nuclear plant, Mr. Wong has performed PSHAs for 27 of TVA's dams and developed CMS and time histories as part of their dam safety program. He is currently assisting in the development of design ground motions for TVA's proposed small modular reactor at the Clinch River site.

Municipal Water Districts: Mr. Wong has evaluated the seismic hazards of the major components of the water supply systems for the City of Tacoma, Washington; Metropolitan Water District of Southern California; the Metropolitan Water District of Salt Lake City and Sandy, Utah; and the San Francisco Public Utilities Commission. Deterministic and probabilistic ground motions have been computed to evaluate the seismic stability and safety and design of their water system components. From 2006 to 2012, Mr. Wong was a technical lead for a regional seismic hazard evaluation of Mid-Columbia, Washington dams owned by the Chelan County, Douglas County, and Grant County Public Utility Districts. The project was performed in cooperation with the Federal Energy Regulatory Commission as a pilot project to develop a consistent approach for earthquakes hazard assessment.

Tailings Dams: Mr. Wong has led the seismic hazard evaluations of numerous tailings dams located throughout the world for several mining corporations. Examples include numerous Freeport-McMoRan dams in the western U.S. and South America; Kennecott Copper dams in Utah and Arizona; Yanacocha, Conga, Quebrada Honda, Las Bambas, and Cerro Verde dams in Peru; El Abra, Chile; and proposed tailings dams in Idaho and Ecuador.

U.S. Geological Survey and State Geological Surveys: Since 1987, Mr. Wong has been awarded 14 grants from the U.S. Geological Survey under the National Earthquake Hazards Reduction Program (NEHRP). He was the Principal Investigator for an evaluation of the seismicity along the Coast Ranges - Great Valley boundary in California. He also led the development of earthquake ground shaking microzonation maps for the Portland, Oregon, and Salt Lake City, Utah metropolitan areas, and the Albuquerque-Santa Fe, New Mexico, and the Wasatch Front, Utah, urban corridors under five NEHRP grants. He has compiled and augmented a geologic, geotechnical and geophysical database to characterize site response in the Seattle, Washington, metropolitan area, and was the co-PI to investigate seismicity along the Front Range near Denver, Colorado. He assisted in the evaluation of the seismicity in the Jackson Lake-Teton, Wyoming, region. He has evaluated the site response effects on the 2001 M 6.8 Nisqually, WA earthquake strong motion records, analyzed strong motion data along the Wasatch Front for source, site, and path effects and developed a ground motion prediction model for deep Hawaiian earthquakes. His current grant is for leading the Working Group on Utah Earthquake Probabilities.

Mr. Wong led a Project Team to develop statewide earthquake hazard maps for the Montana Department of Natural Resources and Conservation's Dam Safety Program. The maps have been published and are now being used by the engineering community.

Through research grants from the States of Utah and Oregon in 1991 through 1993, Mr. Wong evaluated potential earthquake strong ground motions in the metropolitan areas of Salt Lake City and Portland.

FEMA: From 1998 to 2001, Mr. Wong led a Project Team to assist FEMA in developing training courses and providing instruction for earthquake mitigation professionals in the use of the loss estimation software HAZUS in the San Francisco Bay and Los Angeles areas. He was the Technical Director for a comprehensive HAZUS evaluation for the State of South Carolina. He led four working groups to develop the capability for producing near-real time ShakeMap/HAZUS products in the Puget Sound, Washington; Wasatch Front, Utah; Reno/Carson City, Nevada; and the New England region. Mr. Wong also managed a project to calibrate Hawaii's customized HAZUS software with the 2006 Kiholo Bay earthquake.



Seismic Monitoring: Mr. Wong supervised or advised on the design, installation, and/or operation of several seismographic networks and the subsequent analysis and interpretation of data. Networks included those for the Idaho National Engineering Laboratory, Stanislaus Nuclear Project in central California, the proposed DOE Paradox Basin nuclear waste repository in southeastern Utah, the Bear Creek Dam in Denver, Colorado, the Chulac and Xalala Hydroelectric Projects in Guatemala, Los Vaqueros Dam, California, and the proposed Nechi and Ituango Dams, Colombia.

Mine Seismicity: Mr. Wong has supervised and performed research on rockbursts and mine seismicity including the operation of two mine microseismic networks in Utah: coal mines in the eastern Wasatch Plateau and a potash mine in southeastern Utah. His studies have focused on source processes, the effects of geology and tectonic stresses, and the implications of mine seismicity to the underground storage of nuclear waste. He served on an expert panel to develop recommendations for seismic monitoring in coal mines in the U.S. He managed the data analysis of a seismic network monitoring coal mine seismicity in western Colorado.

Fluid-Induced Seismicity: Mr. Wong has evaluated the hazards and impacts of several cases of seismicity induced by the injection of fluid as part of oil and gas extraction activities, disposal of hazardous fluids, salt dissolution, and geothermal power production. Cases include the Rocky Mountain Arsenal near Denver, Colorado, a potash solution mine near Moab, Utah, the Permian Basin gas field in west Texas, The Geysers geothermal field in northern California, and the Marcellus shale in West Virginia. He has served on the U.S. Bureau of Reclamation's expert panel on the Paradox Valley, Colorado injection project. For the past 7 years, Mr. Wong has been evaluating the data recorded by a seismic network that is monitoring The Geysers. He has also authored EIRs on induced seismicity in The Geysers. He has or is evaluating induced seismicity from hydraulic fracturing and wastewater injection in Alberta, Canada, southeastern Ohio; West Virginia; and northeastern Texas. Mr. Wong is currently serving on two review panels on induced seismicity for the Groningen gas field in the Netherlands.

Mr. Wong coauthored DOE's Protocol and Best Practices documents for geothermal induced seismicity. The Ground Water Protection Council partnered with state oil and gas regulatory agencies and the Interstate Oil and Gas Compact Commission to prepare a primer on technical and regulatory considerations on injection-induced seismicity. Mr. Wong was a coauthor and served on the Editorial Committee.

Mr. Wong has also evaluated reservoir-induced seismicity on a worldwide basis and has helped develop an approach for assessing the probability of induced seismicity.

PROFESSIONAL ACTIVITIES

Mr. Wong is actively involved in the activities of several professional organizations. He has been meeting, symposium, and session chair, organizer, and invited speaker at numerous professional conferences and meetings. He has been an invited lecturer at many universities, an invited speaker at several federal and state agencies, and for numerous workshops sponsored by the U.S. Geological Survey. Mr. Wong has been particularly active in serving the USGS in a number of roles as detailed below. A complete list of significant professional and scientific assignments is available upon request.

American Geophysical Union

- Special Session Co-Chair, 2003 Fall Annual Meeting

Earthquake Engineering Research Institute

- Earthquake Spectra Editorial Board, 2003-2008
- President-Elect, Northern California Chapter, 2004-2005
- President, Northern California Chapter, 2005-2008



- Organizing Committee, 100th Anniversary Conference Commemorating the 1906 San Francisco Earthquake
- Chair, Steering Committee, NEHRP Earthquake Scenario Project
- Organizing Committee, 2010 Annual Meeting
- Co-Leader, China-USA Symposium for the Advancement of Earthquake Sciences and Hazard Mitigation Practices, 2010
- Board of Directors, 2011-2014
- Chair, Membership Committee
- Seismic Safety of Schools Committee
- Friedman Family Visiting Professional
- Executive Committee, School Earthquake Safety Initiative

Geological Society of America

- Symposia Chair and Convenor, 1988 and 1997 National Meetings, and 1996 Cordilleran Section Meeting
- Co-Chair, 1991 Cordilleran Section Meeting
- Organizing Committee, Cordilleran Section Meeting 1999
- Co-Convenor, 2000, Penrose Conference on the Great Cascadia Earthquake Tricentennial

Seismological Society of America

- Chair, 1991 Annual Meeting
- Special Session Co-Chair, 2001, 2008 to 2010, 2013 to 2016 Annual Meetings
- Board of Election, 1979, 1982, 1987, 1996, 2001-2003, 2006
- Bulletin Associate Editor, 1999-present
- Organizing Committee, 2010 Annual Meeting
- Co-Chair, 2013 Annual Meeting

SELECTED PROFESSIONAL COMMITTEES, PANELS, AND ASSIGNMENTS

Review Panels, National Earthquake Hazards Reduction Program, External Grants Program, U.S. Geological Survey, 1992, 1993, 1995-2000, 2002-2006, 2008-2010, 2012, 2014, 2016

Advisory Panel, North Coast Earthquake Planning Scenario for Cascadia Subduction Zone Earthquake, California Division of Mines and Geology, 1993

Working Group, U.S. Geological Survey Northern California Earthquake Potential, 1995-1996.

Working Group, ATC-35 National Ground Motion Mapping Project, 1995

Review Panel, U.S. Geological Survey National Seismic Hazard Mapping Project, 1996

Review Panel, U.S. Geological Survey National Earthquake Information Center, 1996

Corresponding Member, U.S. Committee for Advancement of Strong Motion Programs, 1996-1999

Working Subgroups, U.S. Geological Survey Northern California Earthquake Probabilities, 1998-1999

Advanced National Seismic System Intermountain West Regional Advisory Committee, 2001-2010

Chair, Working Group on Validation of Probabilistic Seismic Hazard Analysis Computer Programs Project, Pacific Earthquake Engineering Research Center Lifelines Program, 2002-2009

Chair, Utah Earthquake-Ground Shaking Working Group, 2003-Present

Utah Quaternary Fault Parameters Working Group, 2003-Present

Organizing Committee, Basin and Range Province Earthquake Working Group, 2006

American Nuclear Society Working Group 2.29 on Probabilistic Seismic Hazard Analysis, 2006 and 2014

Nevada Quaternary Fault Working Group, 2007

Expert Panel, Seismic Monitoring Applicable to Deep Coal Mines, 2008-2009

Organizing Committee, 3rd Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, 2008

Advisory Board, "Living on Shaky Ground, North Coast" document, 2008-2009

External Review Panel, Project SHARE Iberia (Spain/Portugal), 2010-2012

Chair, Working Group on Utah Earthquake Probabilities, 2010-Present



Chair, American Nuclear Society Working Group 2.30 on Surface Faulting at Nuclear Facilities, 2010-Present
American Nuclear Society Subcommittee on Siting: Seismic, 2010-Present
Oregon Cascadia Resiliency Plan Earthquake Scenario Working Group, 2012
National Steering Committee, Advanced National Seismic System (ANSS), 2013-Present
Global Earthquake Model (GEM) Seismic Hazard Advisory Panel, 2014
California Integrated Seismic Network (CISN) Advisory Panel, 2014-Present
Program Committee, 3rd Basin and Range Province Seismic Hazards Summit, 2014-2015
Editorial Committee, StatesFirst Induced Seismicity by Injection Work Group, 2014-2015.

AWARDS AND RECOGNITIONS

Invited speaker at more than 150 local, national, and international professional and nonprofessional meetings, conferences, workshops, and courses including: First Workshop on Seismic Design of Structures, Bangkok, Thailand, 1995; 5th Seismic and Cyclone Hazards Mitigation Course, Asian Disaster Prevention Center, Bangkok, Thailand, 1997; Oregon Center for Advanced Technology Education, Civil Engineering Lecture Series on Earthquakes, Beaverton, OR, 2000; Conference on Understanding Extreme Geohazards: The Science of the Disaster Management Cycle Conference, Sant Feliu de Guixols, Spain 2011; NEES-EERI Webinar on Shear-Wave Velocity Profiling and its Importance to Seismic Design, 2011; Annual meeting Association of State Dam Safety Officials, Seattle, OR (Keynote) 2010; Public policy lecture Annual Meeting, Seismological Society of America, Salt Lake City, UT 2013.

Invited Lectures: University of California, Berkeley; University of Arkansas; Northern Arizona University; University of Utah; Utah State University; Portland State University; University of Washington; University of Texas, Austin; Humboldt State University; California State University, Sonoma; Asian Institute of Technology, Bangkok, Thailand; Instituto Geofisico, Escuela Politecnica Nacional, Quito, Ecuador; Instituto Nazionale di Geofisica e Vulcanologia, Rome, Italy.

Best Technical Presentation Award, 20th Northwest Geotechnical Workshop on Geotechnical Aspects of Seismic Design, 1994.

Invited Contributor to Two Books: "Comprehensive Rock Engineering, Principles, Practice, and Projects" and "The Oxford Companion to The Earth".

Outstanding *Earthquake Spectra* Paper Award for 2001, Earthquake Engineering Research Institute (second author).

2004 National Earthquake Conference Award of Excellence to Metropolitan Water District of Salt Lake and Sandy for "Development and Implementation of Seismic Design Policy" (co-recipient).

Lifetime Service Award, Utah Seismic Safety Commission, 2013

TEACHING

Mr. Wong has taught several courses on seismic hazard analysis for the Association of Engineering Geologists, the Association of State Dam Safety Officials, Montana Dam Safety Program, Earthquake Engineering Research Institute, and FEMA. From 1989 to 2001, he also taught courses on earthquakes at the California Academy of Sciences.



PUBLICATIONS

Mr. Wong has presented numerous papers at professional meetings and conferences and has authored or co-authored more than 300 publications including more than 130 papers (26 in peer-reviewed journals), and more than 190 abstracts published in professional journals and conference proceedings, two national standards, seven map series, and one book chapter. A complete list is available upon request.

CHRONOLOGY

2016 - Present: Lettis Consultants International, Inc. (LCI), Principal Seismologist, Walnut Creek, CA

2014 - 2016: AECOM, Principal Seismologist and Vice President, Oakland, CA

98 - 2014: URS Corporation, Principal Seismologist and Vice President, Oakland, CA

93 - 98: Woodward-Clyde Federal Services, Vice President, Seismic Hazards Branch Manager, Senior Associate, Oakland, CA

90 - 92: Woodward-Clyde Consultants, Associate, Oakland, CA

76 - 90: Woodward-Clyde Consultants, Staff to Senior Project Seismologist, Oakland, CA

86 - 00: Arizona Earthquake Information Center - Northern Arizona University, Adjunct Research Associate

89 - 91, 93 - 95, 98 - 01: California Academy of Sciences, Seismology Instructor

75 - 76: University of California, Seismological Research Assistant, Berkeley, CA

74 - 75: University of Utah, Seismological Research Assistant, Salt Lake City, UT

74 - 75: U.S. Geological Survey, Seismological Field Assistant, Salt Lake City, UT

67 - 69, 71 - 72 (Summers): U.S. Army Corps of Engineers, Physical Science Technician and Geologist, Portland, OR

MILITARY SERVICE

70 - 79: U.S. Marine Corps Reserve, Combat Engineer and Administrative Chief