SAN ONOFRE NUCLEAR GENERATING STATION
SEISMIC SOURCE CHARACTERIZATION
SENIOR SEISMIC HAZARD ANALYSIS COMMITTEE
PROJECT PLAN

December 27, 2012

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LIST OF ACRONYMS

CGS	California Geological Survey
GIS	Geographic Information System
GMC	Ground Motion Characterization
GMRS	Ground Motion Response Spectrum
GPS	Global Positioning System
HID	Hazard Input Document
HC	Hazard Calculation
IPEEE	Individual Plant Examination of External Events
ITR	Internal Review Panel
NI/RC	Newport-Inglewood/ Rose Canyon
OBT	Oceanside Blind Thrust
PM	Project Manager
PPRP	Participatory Peer Review Panel
PSHA	Probabilistic Seismic Hazard Analysis
QA	Quality Assurance
SCE	Southern California Edison
SCEC	Southern California Earthquake Center
SOPAC	Scripps Orbit and Permanent Array Center
SONGS	San Onofre Nuclear Generating Station
SSC	Seismic Source Characterization
SSHAC	Senior Seismic Hazard Analysis Committee
TI	Technical Integrator
UCERF3	Uniform California Earthquake Rupture Forecast, Version 3
UCSD-Scripps	University of California at San Diego—Scripps Institution of Oceanography
UNAVCO	University Navstar Consortium
U.S.NRC	United States Nuclear Regulatory Commission
USGS	United States Geological Survey
WGCEP	Working Group on California Earthquake Probabilities
WUS	Western United States

RECORD OF CHANGES

Version	Date	Changes
rev0	November 28, 2012	Original version
rev1	December 27, 2012	- Added Record of Changes table - Added PPRP member and changed text/figures accordingly - Updated Appendix A to reflect new PPRP member and clearer format

1. INTRODUCTION AND CONTEXT OF THE STUDY

This document presents the project plan for completing the Southern California Edison (SCE) sponsored Seismic Source Characterization (SSC) element of the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 Project (Project) for the San Onofre Nuclear Generating Station (SONGS) in compliance with the United States Nuclear Regulatory Commission's (U.S.NRC) March 12, 2012 letter "REQUEST FOR INFORMATION PURSUANT TO TITLE 10 OF THE CODE OF FEDERAL REGULATIONS 50.54(f) REGARDING RECOMMENDATIONS 2.1, 2.3, AND 9.3 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHMA DAI-ICHI ACCIDENT" (U.S.NRC, 2012a). This Project will complete the essential steps needed to develop SSC models that will envelop the center, body, and range of technically defensible interpretations of the characteristics of those faults that contribute to the seismic ground motion hazard at SONGS. The procedures presented under each of these steps in the project incorporate the guidelines described in the U.S.NRC's NUREG/CR-6372, entitled "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts" (U.S.NRC, 1997) and U.S.NRC's NUREG-2117, entitled "Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies" (U.S.NRC, 2012b).

As stated in U.S.NRC (2012a), "Compiling data for the project is critical to developing a model that is based on the most complete and up-to-date information. Documenting the effort is important for demonstrating that efforts have been made to consider that range of views of the informed technical community." As such, a critical initial task of the SSC SSHAC Level 3 participants, in particular the Participatory Peer Review Panel (PPRP), will be responsible for confirming that the Technical Integrator (TI) Team has access to and has evaluated the available relevant data and information.

In accordance with Enclosure 1 "Recommendation 2.1 – Seismic" of the U.S.NRC's March 12th letter (U.S.NRC, 2012a), this Project will fulfill the requirements contained within 10 CFR 100.23 (U.S.NRC, 2012c) and Regulatory Guide 1.208 (U.S.NRC, 2007). The Regulatory Guide 1.208 specifies that the scope of this Project should include a tiered evaluation of the regional geological, geophysical, seismological, and geotechnical setting within a radius of 200 miles (320 kilometers) of SONGS. The SSC developed through this Project will thus consider those seismic sources within a 200 mile radius of SONGS.

The knowledge base regarding the seismic source characteristics of active faults in southern California and their imposed seismic hazard has advanced since SONGS was designed and built in the 1970s and 1980s. These scientific advancements were formally acknowledged in 1995 with a Probabilistic Seismic Hazard Analysis (PSHA) completed as part of the Individual Plant Examination of External Events (IPEEE) (SCE, 1995); however, the knowledge base continues to grow with the advancements in science and technology. More recent PSHAs and sensitivity analyses completed for SONGS (SCE, 2001;

GeoPentech, 2010) showed that distant seismic sources have low or negligible contributions to the ground shaking hazard at SONGS, and the seismic ground motions at the plant are dominated by the Newport-Inglewood/Rose Canyon (NI/RC) Fault Zone and Oceanside Blind Thrust (OBT) Fault. These sensitivity studies will be presented in the SSHAC forum as appropriate, and new or supplemental parameter sensitivity studies will be also completed in this SSHAC Project as appropriate. However, given the existing knowledge base (i.e., recently completed sensitivity studies), extra focus will be given to the NI/RC and OBT sources in this Project.

Significant literature and data review efforts accompanied and followed these recent PSHAs (SCE, 2001; GeoPentech, 2010), resulting in a SSC database for SONGS containing, "… appropriate information from the following:

- Professional literature,
- Data held in the public domain by groups such as government agencies,
- Private domain developed as part of exploration activities or other projects *(i.e., recently released, now publicly-available marine geophysical data)*,
- Available data in the academic sector and other research institutions, *(i.e., pertinent seismological data and geodetic data)*,
- Site-specific data developed in the site vicinity (for site-specific studies)."

The important data and information, useful in constraining the seismic source characteristics of the NI/RC and OBT faults comes from both the onshore and offshore regions near SONGS. Several geoscientists have contributed to the knowledge base for the onshore portion of the NI/RC, including individuals from the oil industry as far back as the early 1900s who provided information from the oil fields in the Los Angeles Basin. In addition, geoscientists from the groundwater supply and recharge industry, urban development, and academia have provided relevant data and information useful in evaluating the seismic source characteristic of the NI/RC Fault Zone. The available data and information also includes the results of the initial onshore and offshore geoscience investigations completed for SONGS Units 2 and 3. It also includes recently released confidential private oil company marine geophysical and boring records from their investigations completed in the 1970s and 1980s offshore of southern California. With the release of these old oil company records have come subsequent published interpretations of those records regarding the offshore faults, such as the NI/RC, OBT, Palos Verdes Fault Zone, and more distant offshore faults. With this diversity in both the age and interests of these past geoscience investigations and their results comes the need for the diversity in expertise within the SONGS SSC SSHAC Level 3 participants.

During the course of this two year SONGS SSC SSHAC Project new publically available reports and documents may be issued, including:

- Publically available results of marine geophysical surveys recently completed off shore of southern Orange and northern San Diego counties' coastlines by the U.S. Geological Survey (USGS) and by the University of California at San Diego – Scripps Institution of Oceanography (UCSD-Scripps)
- Reports by the USGS with data and information on the NI/RC and blind thrust faults in the Los Angeles/Orange County Groundwater basins
- Future fault and seismic hazard reports coming from the USGS, the California Geological Survey (CGS), the Southern California Earthquake Center, and the several academic research centers such as "The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3)"
- Data on the secular motion of geodetic benchmarks from Global Positioning System (GPS) technology that is routinely processed by the Scripps Orbit and Permanent Array Center (SOPAC) and University Navstar Consortium (UNAVCO), expanding geodetic coverage in the coastal area of southern Orange and northern San Diego Counties
- Earthquake data from broadband seismometers installed in a denser network by the USGS, UCSD-Scripps, and California Institute of Technology
- Geologic mapping of marine terrace deposits in the region around SONGS to assess the degree of uplift and deformation (if any) of those units within the coastal marine terrace system along southern Orange and northern San Diego counties in California;
- Paleoseismic studies on the Rose Canyon Fault in San Diego to constrain late Holocene recurrence intervals and the clustering of seismic events
- New marine geophysical and seafloor sampling surveys offshore of SONGS

Due to the time constraints placed in U.S.NRC's March 12, 2012 letter, no new data will be collected specifically to support this SONGS SSC SSHAC Project. However, in accordance with the SSHAC guidelines, new data will be incorporated in the SONGS SSC SSHAC Level 3 Project if the new data become available in time to meet this SONGS SSC SSHAC Project's schedule.

With the availability and quantity of previously acquired SCE and private oil company data, and with the newly acquired data, different interpretations of those data may become available, which in turn leads to different seismic source characterization models. Thus, it becomes more complex to capture the center, body and range of the technically defensible interpretations of the data and appropriately identify the limitations of the alternative configurations of the model. The approach toward reaching a seismic source characterization model that properly incorporates the current knowledge and uncertainties is to provide a modern, complete, and relevant project database and to utilize the SSHAC Level 3 procedures to evaluate the viewpoints of the larger technical community.

Utilizing relevant and available data resources, including a library of published and unpublished documents assembled by SCE, members of the SONGS SSHAC team participated in SCE's Seismic Source Characterization Topical Meeting (SCE, 2011) to discuss and present judgments as to the value and limitation of the presently available and relevant seismic source characterization data. The purpose of the following plan is to layout the steps needed to be completed to provide a seismic source characterization model in support of the overall SONGS SSHAC Level 3 Project, in consideration of the center, body and range of the technically defensible interpretations available to-date. Particular focus will be given to the NI/RC Fault Zone and the postulated activity of the OBT Fault, as these faults have been shown to be the dominating seismic shaking sources at the plant (GeoPentech, 2010; SCE, 2001). Additional sources, including the San Joaquin Hills Blind Thrust Fault and Palos Verdes Fault Zone, will be characterized.

The SONGS SSC SSHAC Level 3 Project, as planned, will (1) consider an up-to-date database; (2) address the range of diverse technical interpretations from the informed technical community; (3) make a full assessment and incorporation of uncertainties; (4) provide proper documentation; and (5) complete a thorough peer review. Accomplishing all of these objectives will lead to stability and longevity in interpretations of the seismic source characteristics most important to seismic hazards at SONGS. Experience has shown that stability and longevity are best achieved through proper characterization of our knowledge and uncertainties, coupled with the involvement of the technical community, regulators, and oversight groups. The resulting seismic source characterization model, with its variations, associated uncertainties, and assigned relative weights, will then be captured in a logic tree for use in completing a PSHA.

2. OBJECTIVE

The objective of the SONGS SSC SSHAC Level 3 Project is to develop a seismic source characterization model that will be integrated with a parallel-developed ground motion characterization (GMC) model. These two models will be combined with site-specific foundation characteristics and utilized in probabilistic hazard calculations leading to hazard curves and the Ground Motion Response Spectrum (GMRS) for the site through site response analysis.

The seismic source characterization model will consist of a logic tree that delineate the center, body, and range of technically defensible interpretations of the location and geometry of the active faults within the region surrounding SONGS, the measured and inferred fault slip rates, activity rates of segments of these faults, and the anticipated magnitudes and recurrence intervals of the earthquake these faults are likely to generate.

The results of the SONGS SSC SSHAC Project will be presented in a report that documents the derived seismic source characterization model along with the corresponding limitations in the geology, geophysics, geodetic, and seismology data. Explanations of the range in uncertainties associated with the elements of the seismic source characterization model will also be provided in the report. The results of the SONGS SSC SSHAC project will also be used as input, supporting SCE's response to the U.S.NRC's March 12, 2012 50.54(f) letter that requires completion of a subsequent Seismic Hazards Evaluation for SONGS Units 2 and 3 (SCE, 2012).

3. SELECTION OF SSHAC STUDY LEVEL

In the U.S.NRC (2012a) March 12, 2012 letter, it was requested that for plants that lie in the Western United States (WUS) an updated, site-specific PSHA be developed. Any new or updated seismic hazard assessment should consider all relevant data, models, and methods in the evaluation of seismic sources and ground motion models. Consistent with U.S.NRC (2007) Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site Specific Earthquake Ground Motion," SCE was directed to use a SSHAC study, as described in U.S.NRC (1997) NUREG/CR-6372, “Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts." Consistent with current practice, as described in U.S.NRC (2012b) NUREG-2117, "Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies," a SSHAC Level 3 study should be performed.

Accordingly, a SSHAC Level 3 study will be performed. This Project will establish the hazard-significance of various seismic sources in order to prioritize the work activities and properly address the uncertainty in the data and seismic source model interpretations. The SSHAC Level 3 procedure presented in U.S.NRC (2012b) NUREG-2117 provides guidance and an organized approach to accomplish this objective while maintaining the quality assurance necessary for greater regulatory assurance and stability. As stated in U.S.NRC (2012b) NUREG-2117 this project’s objective will be achieved by “(1) determination of more accurate and consistent assessments of seismic hazard and the associated uncertainty, (2) standardization and complete and transparent documentation of the assessment process undertaken, the input data, and the basis for the resulting model and findings, (3) increased regulatory assurance based on the transparency of the study’s technical basis, and (4) the increased longevity of a study as a result of the ability to assess new data against the existing model and its basis and assumptions.”

The purpose behind the SONGS SSC SSHAC Level 3 Project is to evaluate the available data relative to the viability of each alternative seismic source characterization model and its associated slip rates, and to arrive at a representation of the knowledge and uncertainties. Addressing the model uncertainties, as well as the parameter uncertainties, would include assigning the relative weights to each model that reflects the larger technical community’s relative confidence in the alternative interpretations. This SSHAC process is intended to represent the center, the body, and the range of the technically defensible interpretations that the larger technical community would have if they were to have conducted the study (U.S.NRC, 1997 and 2012b). In this context, the larger technical community is one that is familiar with the relevant data.

4. PROJECT ORGANIZATION - ROLES AND RESPONSIBILITIES

SCE's Source Characterization SSHAC Level 3 project organization chart is presented on Figure 1. The functions the project participants are summarized below.

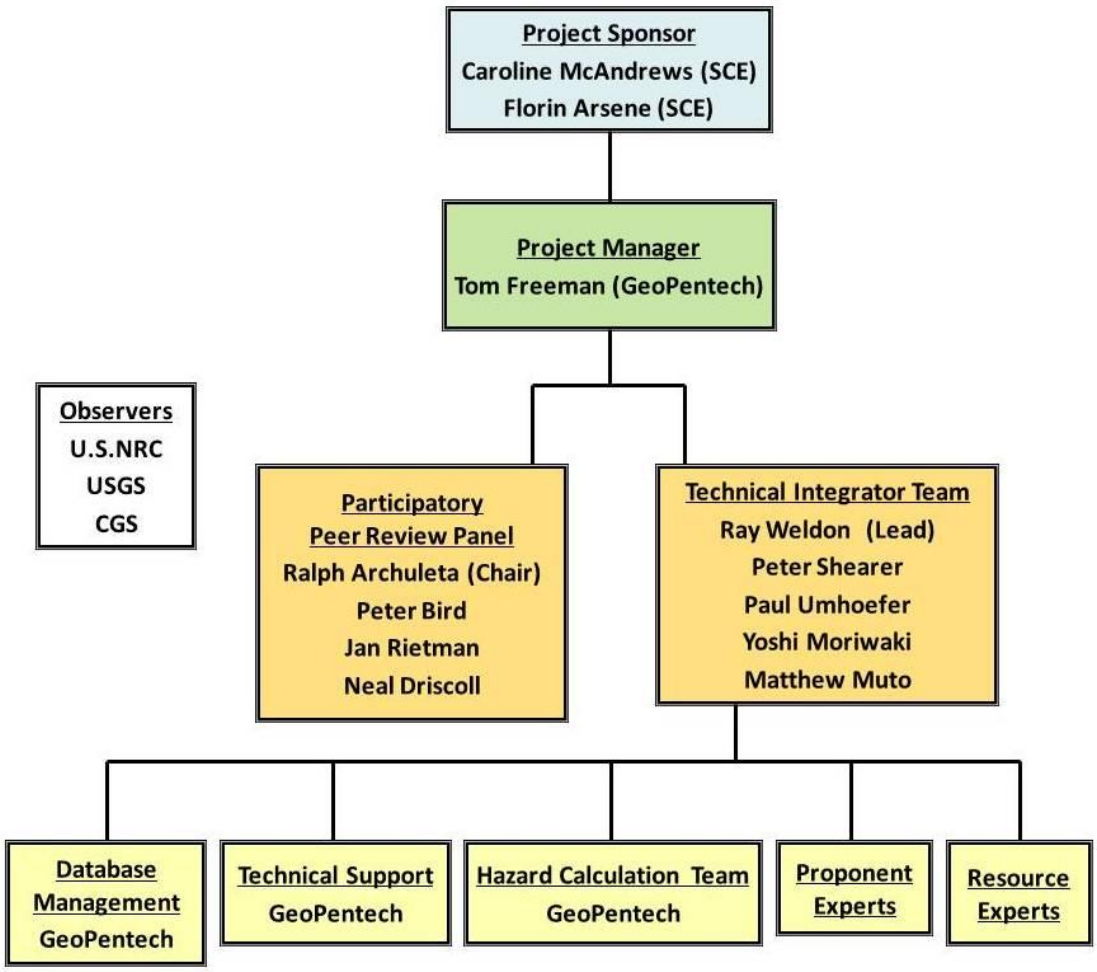

Figure 1: Planned organization chart showing project participants.

Project Sponsor (SCE) – The sponsor is responsible for oversight of the project, ensuring open channels of communications with participants, defining the deliverables and schedule requirement, approving key appointments (TI lead and PPRP members, etc.) and approving the project plan including budget and schedule.

Appendix A summarizes the roles and responsibilities of the main project participants together with their selection criteria.

In addition to the project participants with defined roles and responsibilities, outside observers are discussed in the implementation guidelines (U.S.NRC, 2012b). Observers may include sponsors, regulators, and other technically qualified individuals. Outside observers do not participate in any aspect

of the SSHAC process (e.g., evaluation, integration, peer review, documentation), but they may be invited to observe some Workshops depending on the specific needs of the Project Sponsor. Key staff from the U.S.NRC, USGS, and CGS, as well as senior management from SCE will be invited to monitor the progress of the SSHAC Program and will act as observers. Per U.S.NRC (2012b), the role of observers will be limited to observation and not include participation in technical discussions.

Lines of Communication and Points of Contact

Figure 2 identifies the individuals selected based on the criteria in Appendix A for the Project Management (PM), PPRP, TI Lead and Team, Hazard Calculation (HC) Team, and the figure illustrates the lines of communication and points of contact across the Project team.

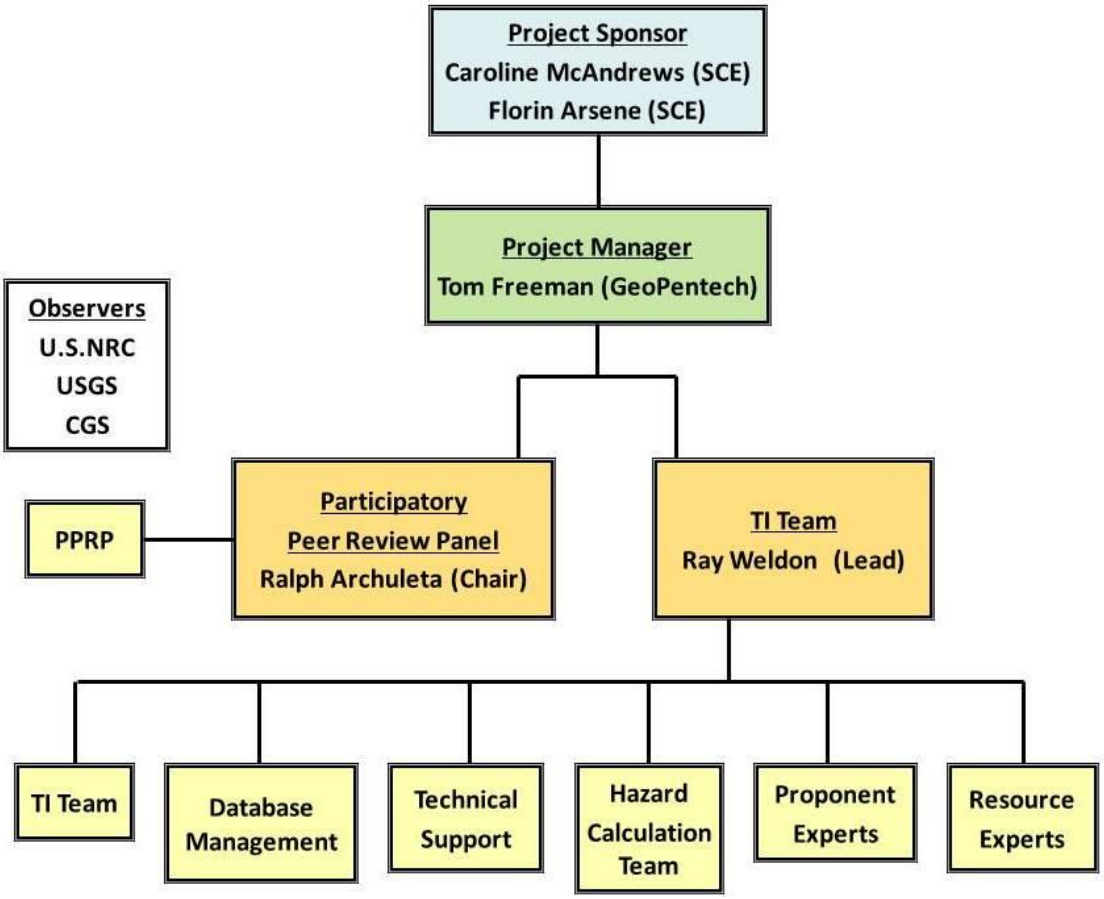

Figure 2: Points of communication and lead project participants.

5. WORK PLAN AND KEY STUDY TASKS

The SONGS SSC SSHAC Project will produce seismic source characterization models utilizing the most current data, identifying the range of technically defensible interpretations, and assessing and incorporating uncertainties appropriately. This will be accomplished by following the applicable SSHAC guidelines and processes outlined in U.S.NRC (2012b) NUREG-2117. As defined in these guidelines the SSHAC process involves the following four elements:

Evaluation
Integration
Participatory Peer Review
Documentation

The completion of these four elements of the SSHAC process will be accomplished through individual work; through a series of workshops that formalizes the interaction between the technical community, the TI Teams, and the PPRP; and through meetings and networking between the Project participants; all adhering to the intent and guidelines for each Project element, which is generalized in the follow summaries.

Evaluation involves assembling relevant information and data in to a readily accessible database and reviewing that database to identify its relative merit toward achieving the goal of the SSC element of the project. With the database, the evaluation process also includes assessing alternative, technically defensible interpretations, models and concepts proposed by the larger technical community as to the characteristics of those seismic sources that are relevant to the ground motion hazard at SONGS.

The majority of the evaluation element of the Project will occur through individual work, informal working meetings. A key objective of the first workshop, which occurs during the evaluation element of the Project, is to identify relevant and applicable data sources to assemble the Project's database. Based on this assembled database, authors of alternative, technically defensible models interpreted from the database, will be invited to prepare and present their interpretations as alternative model Proponent Experts during the second workshop during the evaluation element of the Project. During the evaluation element of the Project, the PPRP will be involved by attending the two workshops, attending selected working meetings as needed, and reviewing interim project documentation.

The primary focus of the SSC SSHAC evaluation process will be on those seismic sources within the surrounding region that might influence the seismic ground motion hazard at SONGS.

Through sensitivity analyses, the SSC Logic Tree that imposes the most significant ground motion seismic hazard at SONGS will be the focus for the discussions at the workshops. As appropriate, those parts of the SSC Logic Tree model that are not significant to the ground motion hazard at SONGS will be reviewed and updated to reflect the current state of scientific knowledge but will not be the focus of the detailed evaluations or further refinements.

Integration refers to the assessment element of the Project where the dataset, alternative models and interpretations assembled in the evaluation element of the Project are combined into a technically defensible representation of the SSCs influencing the seismic ground motion hazards at SONGS. In this integration element of the Project, the TI Team will integrate the relevant data and alternative models and interpretations into a SSC logic tree for SONGS. The objective of this SSC logic tree is to capture the center, body, and range of the technically defensible interpretations. The process of integration commonly includes the development of an initial version of the SSC logic tree. Then, following hazard sensitivity analyses, the next versions of the SSC logic tree will be developed through feedback from the PPRP, the Resource Experts, and if necessary the alternative model Proponent Experts. This process is iterated until a final SSC logic tree is developed for SONGS.

The SSC TI Team will lead this integration process; the HC Team will conduct the iterative hazard sensitivity analyses. The Resource Experts and alternative model Proponent Experts will have less involvement in this Integration element of the Project, but they can be called upon by the TI Team as needed to provide clarification, resolve new issues, and provide feedback on the preliminary SSC logic tree. Similar to the evaluation element of the Project, the majority of the integration process will occur through individual work, network interaction, and informal working meetings by the TI Team. The workshop during the integration element of the Project is designed to present the SSC logic tree and the results of the sensitivity analyses and collect feedback. The PPRP will be involved in the integration process by attending the workshop, attending selected working meetings as needed, and reviewing interim project documentation.

Participatory Peer Review is an essential part of all elements of the SSHAC Level 3 process and will be a continuous process throughout this Project. Participatory peer review refers to review of the evaluation, integration and documentation elements of the project by a PPRP capable of providing feedback on the procedural and technical aspects of the project and ensuring the SSHAC Level 3 process was followed appropriately during the course of the study. The overall goals of the PPRP will be to ensure that the SSHAC process is adequately followed and that the technical results adequately characterize the center, body and range of the technically defensible interpretations of the available relevant data and information by the informed technical

community. As such, the PPRP will be kept fully abreast of the Project's development by attending the workshops; by attending, on an as needed basis, selected field reviews and/or working meetings, and reviewing interim documentation. By receiving the PPRP's feedback during the evaluation, integration and documentation elements of the Project, the TI team will have the opportunity to address the PPRP comments and make modifications and necessary corrections to the course of their actions before the Project is complete.

Documentation also is an integral component of this Project. Documentation refers to preparing the Project's final reports that document: 1) the final technical results and how they were reached; 2) the basis for the assigned weights on the SSC logic tree; and 3) how the SSHAC Level 3 process was implemented. In addition, the documentation provides the basis for review by any pertinent regulatory officials, if needed. Documentation for the study will include summaries of the workshops and their presentations, the PPRP's letter reports and TI Team's responses, summaries of the assembled database and relevant supporting Geographic Information System (GIS) files, the SSC logic tree, and the final report including the PPRP review of comments on the final report.

The final seismic source characterization model developed through the SONGS SSC SSHAC Level 3 process will be integrated with the ground motion characterization SSHAC Level 3 Project to complete the final hazard calculation and sensitivity analyses. The results of the final hazard calculation and sensitivity analyses will then be assembled in a report that presents the final hazard curves and GMRS. This report will include Appendices presenting complete documentation of the SONGS SSC SSHAC Level 3 Project. Once reviewed by the PPRP, a final version of these SONGS SSC SSHAC Level 3 Project Appendices will be completed by the end of 2014 for incorporation with the final hazard curves and GMRS.

During the execution of the Project, the interaction and sequencing of the evaluation, integration, participatory peer review, and documentation elements of the SSHAC process will be accomplished through the following principal tasks.

Logistics and Coordination

This is an on-going task being conducted though the PM and the PM Team during the course of the Project. The work involved in this task includes overall project management, accounting, scheduling. The work also involves meetings and document logistics and assisting with participant coordination.

Selection of Project Participants

This task consisted of defining the criteria for selecting the individuals that will fill the different positions on this SSHAC Level 3 Project. In defining the selection criteria, the attributes given in Section 3.6 and the

criteria discussed in Section 4.4 and 5.2 of U.S.NRC (2012b) were considered. Based on the specific roles and responsibilities of individuals within a SSHAC process, a pool of candidates was identified to represent a broad diversity of independent opinions and approaches for addressing the topics in question. The individuals identified in Figure 2 for the PM, the PPRP, the TI Team, the HC Team were selected based on the criteria summarized in Appendix A. The pool of final participants that will serve as the Resource and model Proponent Experts and observers will be selected depending on their availability, willingness to commit to the project's schedule and deliverables; demonstrated ability to apply their knowledge and expertise; and willingness to be identified publicly on the record, their judgments, and if appropriate their potential conflict of interests.

Development of Project Plan

The PM and PM Team will develop the initial SSC SSHAC Level 3 Project plan and will provide it to the TI Lead for review. As stated above, the SSC element of the SONGS SSHAC plan adheres to Regulatory Guide 1.208 by considering all faults within a 200-mile radius of the plant. Based on recent PSHAs and sensitivity analyses completed for SONGS (SCE, 2001; GeoPentech, 2010) showing that distant seismic sources have low or negligible contributions to the ground shaking hazard at SONGS, a primary focus will be on the closest and most important earthquake source faults relative to the seismic ground motions at the plant. Upon acceptance by the TI Lead, the plan will be provided to the PPRP for approval. The PM and TI Lead will address the PPRP's comments and obtain approval of the SSC SSHAC Level 3 Project plan. The PPRP will provide formal approval of the SSC SSHAC Level 3 Project plan. The PPRP formal statement regarding the Project will be included herein as Appendix B. The PM will then issue the SSC SSHAC Level 3 Project plan to the entire TI Team and PPRP.

Develop Database

One of the initial tasks in the Evaluation element of the Project is the development of the database that will be used during the course of the study. Most of the appropriate and available references for the project were compiled and cataloged into the Project's data base during the 2010 PSHA (GeoPentech, 2010), as an outcome of SCE's August 2011 Topical Meeting (SCE, 2011), and from available reference sources since the topical meeting. This database will be assimilated and distributed to the project participants. Any new data that becomes available in time for incorporation into the source model during the course of this Project will be evaluated within the context of the applicable SSHAC guidelines. The data from outside sources and the newly collected data will be integrated in the program's database library and GIS database.

The reference database, the GIS, the geodetic database, and the most up-to-date and appropriate coverage seismicity catalog will be distributed to the SSHAC Project participants as they become available.

All readily available and relevant data and information that can be assembled in the time frame of the SONGS SSC SSHAC Project and captures the center, body and range of technically defensible interpretations will be used by the TI Team in completing their work.

Prepare Significant Issues and Available Data Workshop I Program

This task in the Evaluation element of the project encompasses preparing the Workshop I program. This will involve establishing the workshop's agenda and documenting the planned SSHAC procedures in more detail in order to delineate the focus of the Significant Issues and Available Data Workshop I.

After its assembly, the initial draft of the Workshop I program, including website connections to the assembled database, will be distributed to the project participants for their review and comments. Once review comments are received, they will be addressed, and the final SONGS SSHAC Significant Issues and Available Data Workshop I Program will be prepared and redistributed for use prior to and during the workshop.

This process in preparing the workshop program allows most editorial comments, suggestions, and key statements to be identified and addressed prior to finalizing the program. This approach will also help ensure that all participants are aware of the currently assembled data and SSHAC procedures prior to the actual workshop. The process will aid in focusing discussions during the Significant Issues and Available Data Workshop I.

Conduct Significant Issues and Available Data Workshop I

This first workshop will be conducted during a one or two day meeting to present to the workshop participants 1) an explanation as to what a SSHAC is, and how it works; 2) a summary of the supplemental data and information collected since the August 2011 Topical Meeting (SCE, 2011); and 3) a refresher on the 'rules-of-the-road' during the SSC SSHAC Project. Workshop I will also provide and avenue to solicit and disseminate comments on the overall SONGS SSHAC Project plans for forthcoming workshops and activities and to finalize the specific objectives of the next Alternative Models Workshop II. Workshop I will also allow for the presentation of past PSHAs and sensitivity studies (SCE, 2001; GeoPentech, 2010) to demonstrate the relative contribution of the seismic source parameters to the ground shaking hazard at the site, as determined in those studies. Updated sensitivity studies using the most current source parameters will be completed specifically for Workshop I by USGS, CGS, and/or UCERF geoscientists and be presented at the workshop to further evaluate the sensitivity of ground motion at the site to variations in ground motion parameters.

Workshop I will be attended by all the key participants in the SONGS SSC SSHAC Project, including representatives from the SCE sponsors, the PM and the PM Team, the TI Team, the PPRP, Model Proponents and Resource Experts, the HC Team, and the invited Observers.

Prepare Significant Issues and Available Data Workshop I Proceedings

The proceedings of Workshop I will be prepared, reviewed by the participants and finalized to document the activities of the workshop. The database library digital files will be updated with any new relevant data to facilitate access by each of the participants through the website connections for their use in preparing for the Alternative Models Workshop II.

Prepare Alternative Models Workshop II Program

This task encompasses preparation of the initial draft for the Workshop II program. This will involve three key parts:

1. Update the available database to incorporate any relevant new data and information that becomes available within the appropriate limitation of the SONGS SSC SSHAC Project's schedule,
2. Allow the alternative model Proponents to utilize the available data to refine their interpretations and update their prospective relevant seismic source characterization model, and
3. Update the draft workshop's agenda to delineate the focus of the workshop by inserting initial drafts of the position papers prepared by the individuals in the workshop's seismic source characterization model proponents group.

After its assembly, the initial draft of the Workshop II program, including drafts of the model Proponent's articles, will be distributed to the participants in the project for their review and comments. Once review comments are received, they will be addressed, and the final SONGS SSHAC Alternative Models Workshop Program will be prepared and redistributed for use prior to and during the workshop. This process will aid in focusing discussions during the Alternative Models Workshop II on resolving any contrasting ideas and alternative viewpoints.

Conduct Alternative Models Workshop II

The Alternative Models Workshop II will be held to establish direct interaction between the TI Team and the Alternative Model Proponents over the seismic source characteristics of the faults, based on the available data, that most affect the seismic shaking hazards at the SONGS. Because of findings in the recent PSHA studies for SONGS (SCE, 2001; GeoPentech, 2010), it is expected that there will be particular focus on the NI/RC Fault Zone and the OBT Fault. All individuals on the project organization chart (Figure 1) will be in attendance in the workshop. The objective Workshop II is to facilitate in the TI Team, as well as in the PPRP, a clear understanding of the details of the Proponents' alternative models,

including their seismic source fault's location and geometry, its seismic characteristics, and the data used in developing their models. This direct interaction will also facilitate a clear understanding of the uncertainties in the models and the parameters that impact hazard. These measures also will lead to identifying likely measures that might be applied to reduce uncertainties. The Workshop will facilitate feedback from resource experts as necessary. By the time of the Alternative Models Workshop, the model Proponents will be thoroughly prepared to focus their presentations on those aspects of their models that are the key factors driving the seismic source characterization issues in order to maintain the direction and efficiency of the workshop.

Day 1 and into Day 2 (if necessary) - After the appropriate introductions and clarification of the workshop goals and procedures by the Project Manager, the presentations by the Proponents of alternative models would begin. The alternative model Proponent Experts will present their models using what they believe to be the best available data, and they will provide justification for their data selection.

Days 2 and into Day 3 (if necessary) - In the other half of the workshop, presentations would be given by Model Proponents of the onshore portions of the NI/RC Fault Zone and nearby blind or surface rupturing thrust faults, as well as other relevant onshore or offshore faults. The goal of this second half of the workshop is provide a perspective of other alternative model configurations and properties that were based on more complete and confident data packages and might provide additional perspectives of likely alternative characteristic models of the offshore NI/RC and OBT faults. This correlation approach will be useful in establishing alternative model configurations and properties to capture the center, body and range of technically defensible interpretations and to appropriately identify the limitations of the alternative model configurations of the offshore NI/RC and OBT faults.

Prepare Alternative Models Workshop II Proceedings

The proceedings of the Alternative Models Workshop II will be carefully documented by the TI Team's staff. The workshop program will be supplemented with the records of the workshop activities collected by the TI Team and their staff into an initial draft of the workshop proceedings. The initial draft of the workshop proceedings will be distributed amongst the workshop participants for their review and comments. The review comments on the initial draft of the workshop proceedings will be addressed and the workshop proceedings will be finalized and redistributed to all participants.

Prepare Seismic Source Characterization Model Development Workshop III Program

This task encompasses preparing the initial draft of the SSC Model Development Workshop III program. This task will involve updating the workshop's agenda. The available database that will be used in Workshop III will be updated to incorporate any relevant new data and information that becomes available

consistent with the Project's schedule from the more recent literature and from SCE's SSC Research Projects.

Conduct Seismic Source Characterization Model Development Workshop III

Through Workshop III and one or two working meetings and frequent email interchanges, the TI Team, with the support of the Resource Team and other invited participants will formulate an initial interpretation of the seismic source characterization model based on the available relevant references, newly acquired marine geophysical, seismology and geodetic data, and the proceedings of the Alternative Models Workshop. The focus of the first working meeting will be to establish an initial draft of the center, body, and range of technically defendable seismic source characterization models. Appropriate limitations and uncertainties in the models will be identified, and a logic tree will be prepared to document the results. Final proceedings of this workshop will be prepared and distributed to all the participants.

Once completed, the logic tree and other supporting information relevant to the model will be transmitted to the members of the PPRP for their review and comments, focusing on whether the logic tree captures the center, body, and range of the technically defensible interpretations of the data and appropriately identifies the limitations of the models.

Complete Preliminary Hazard Calculations, Sensitivity Analyses and Hazard Input Document

Initial hazard calculations will be completed by the HC Team using the logic trees developed by the TI Team during Workshop III and subsequent working meetings and email exchanges. Based on the uncertainties and limitations defined during the SSHAC Project, the preliminary hazard calculations will be tested for their sensitivity in contributing to the ground motions at SONGS. Initial drafts of the Hazard Input Document (HID) will also be prepared. The preliminary hazard calculations, sensitivity analysis and HID will be reviewed by the PPRP.

Finalize Seismic Source Model

After receiving the PPRP's review comments on the preliminary seismic source characterization models, the hazard calculations, and the sensitivity analysis, the TI Team will re-convene in a working meeting to address the PPRP's comments and to appropriately adjust the seismic source characterization logic tree. The goal of the meeting will be to refine the seismic source characterization models and the logic tree to better captures the center, body, and range of the technically defensible interpretations of the data and to further quantify the limitations and uncertainties in the alternative model configurations to provide the stability and longevity acceptable to the technical community.

Finalize Hazard Calculations, Sensitivity Analyses and Hazard Input Document

The hazard calculations and sensitivity analysis will be redone with the final seismic source characterization logic tree from the TI Team.

Addressing PPRP Comments

Throughout the Project, the PPRP will be kept abreast of the results of the various tasks including this project plan, the proceeding of the workshops, the preliminary results of the hazard and sensitivity analysis and SSC logic tree development, and the preliminary and final documents. As needed the PPRP's comments will be addressed and incorporated into the final SSC logic tree and reports, as timely as possible.

Documentation

The preliminary and final documentation of the Project will be developed by TI Team. This report will include complete documentation of the development of the SSC logic tree and all of the parameters included. An initial draft of the report will be submitted to the PPRP for their review and comments. Given the frequent and direct involvement of the PPRP, their comments on the actual documents are not expected to be insurmountable. After responding to the PPRP's comments, the TI Team will prepare the final report. The PPRP will then review and provide their final comments on the Final Report in a letter to the Project Sponsors and TI Team Lead. This letter will then be included in an appendix to the Final Report.

6. PROJECT SCHEDULE

Figure 3 shows the schedule for the SONGS SSC SSHAC Level 3 Project.

The Significant Issues and Available Data Workshop I is tentatively scheduled in January 2013 and the Alternative Models Workshop (Workshop II) is tentatively scheduled to follow in August 2013. The Seismic Source Characterization Model Development Workshop III is tentatively scheduled for the January 2014 as listed on Figure 3.

Pre- and post- SSHAC tasks will be completed in workshop meetings, in individual offices and through networking between the Project participants with coordination through the PM and PM Team. Additional meetings and/or teleconferences between the Project's sponsor (SCE), the PM and the PM Team, the PPRP, the TI and TI Team, the Resource and model Proponent Experts, and invited Observers are not shown in this schedule, but will be held as necessary.

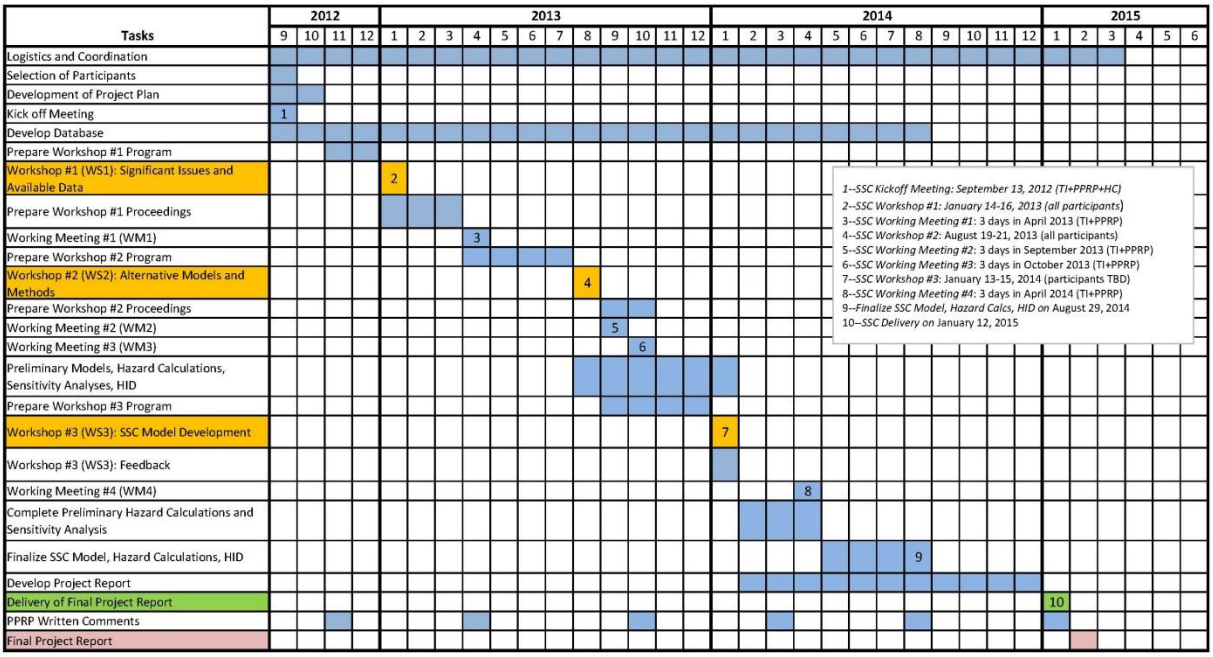

Figure 3: Planned schedule

7. DELIVERABLES

A draft of the HID and an initial draft report will be developed during the course of the study to present the SSC model and to document the SONGS SSC SSHAC Level 3 Project. Appropriate new data from the SONGS SSC Research Projects will be incorporated in the SSC SSHAC Level 3 process if it becomes available to support the SSC SSHAC Level 3 process. The initial SONGS SSC SSHAC Project's draft report will include the resulting changes in the SSC model considering the results of sensitivity analyses of key parameters from hazard calculations. The project's Workshop I and II proceedings will also be attached to the draft SONGS SSC SSHAC Level 3 Report.

The results of the SSC SSHAC Level 3 Project will also be used along with the corresponding results from the GMC SSHAC Project in the development of the site specific Hazard Curves and GMRS. The results of the SSC and GMC SSHAC projects will be integrated with the data from the site characterization/response research project and used in developing the Hazard Curves and the GMRS for the site.

8. VALIDATION, VERIFICATION AND PEER REVIEW

Validation, verification and peer review provides the necessary quality assurance for development of the SSC models and is inherent in the SSHAC process itself through the participatory peer review. The participatory peer review is comparable to and, in many areas, much more thorough and comprehensive than the standard Independent Technical Review (ITR) of the QA procedures given in 10 CFR 50 Appendix B (U.S.NRC, 2012c). Thus, following the guidelines in NUREG 2117 (U.S.NRC, 2012b), the SSHAC process will not be required to follow a formal 10 CFR 50 Appendix B (U.S. NRC, 2012c) QA procedure.

9. REFERENCES

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U.S.NRC, 2007, Regulatory Guide 1.208: A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion, US Nuclear Regulatory Commission, 53 pp.

U.S.NRC, 1997, Recommendations for probabilistic seismic hazard analysis: Guidance on uncertainty and use of experts, prepared by Senior Seismic Hazard Analysis Committee, Lawrence Livermore National Laboratory, Volume 1, Main Report, NUREG/CR-6372, UCRL-ID-122160, 280 pp.

Appendix A

PARTICIPANTS ROLES AND RESPONSIBILITIES AND SELECTION CRITERIA

ROLES AND RESPONSIBILITIES

1	With TI Lead, prepare Project Plan
2	Point of contact between Sponsors, TI Lead, PPRP, and QA
3	Responsible for developing and adherence to scope, schedule and budget
4	Responsible for establishing contracts and contractual compliance with all participants
5	Coordinate and assist in conducting workshops and working meetings
6	Oversight of QA implementation
7	Status reporting to Sponsors on schedule, scope, budget
8	Delivery of all technical products

SELECTION CRITERIA

1	Technical background in seismic hazard
2	Experience and familiarity with NRC regulations, quality assurance, and regulatory compliance
3	Communication and management skills

S. THOMAS FREEMAN

PRINCIPAL, ENGINEERING GEOLOGY CONSULTANT
GeoPentech, Inc.

Expertise

- Earthquake Geology
- Engineering Geology
- Seismic Hazard Assessment

Education

MS, Geological Engineering, 1974

BS, Geology, 1972

Professional Registrations

CEG, California, No. 1015

CHg, California, No. 712

PG, California, No. 3483

Mr. Freeman has over forty years of experience in the field of engineering geology, with demonstrable expertise in earthquake geology, paleoseismology, and seismic hazard assessment. He is well respected and published in his field.

Mr. Freeman has served as an engineering geologist and project manager on numerous geologic hazard studies for critical structures and lifelines, including power plants, dams, pipelines, and tunnels. Specifically, he has served as a technical specialist for the **Yucca Mountain** project and several U.S. and international nuclear generating stations, including SONGS and Seabrook. He was a technical specialist during the siting investigations for the proposed Rice and Vidal Junction nuclear power plants and the proposed Yuma nuclear desalination plant.

Mr. Freeman's well-rounded expertise managing seismic hazard assessments and his extensive regulated-industry experience make him well suited for the role of Project Manager for the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

ROLES AND RESPONSIBILITIES

1	With Project Manager, prepare project plan
2	Point of contact for all technical activities on the project
3	Selection of TI Team to include appropriate evaluator and integration experts
4	Leading the evaluation and integration activities of the TI team, including the conduct of multiple working meetings
5	Finding and assuring participation of suitable resource and proponent experts
6	Running workshops and ensuring that the participants clearly understand the workshop objectives, their individual roles, the required output from the workshops, and the implication to hazard
7	Coordination with the GMC component of the project
8	Ensure that the project documentation is complete and comprehensive

SELECTION CRITERIA

1	A thorough understanding of the SSHAC goals and processes.
2	Acknowledged technical expertise with particular emphasis in the SSC issues being addressed and in a PSHA.
3	Strong communication skills to work with the technical evaluators
4	Project management skills to ensure technical products are high-quality and delivered in a timely manner
5	Experience and familiarity with NRC regulations, quality assurance, and regulatory compliance

RAY J. WELDON, II

PROFESSOR & HEAD OF GEOLOGY
University of Oregon

Dr. Weldon has over twenty-five years of experience in the field of neotectonics, with demonstrable expertise in Quaternary geology, paleoseismology, geodesy, and fault-rupture dynamics in southern California. He is well respected and well-published in his field.

Dr. Weldon has been **formally instructed on the procedural application of the SSHAC process** in a training course taught by Dr. Julian Bommer and Dr. Kevin Coppersmith at PEER in Berkeley, CA in fall 2010.

Dr. Weldon has served as an Executive Committee member for the Working Group on California Earthquake Probabilities (WGCEP) effort to produce a earthquake-rupture forecast for the state. The WGCEP's Uniform California Earthquake Rupture Forecast, Versions 2 and 3 (UCERF2 and UCERF3), were conducted using QA procedures modeled on the **SSHAC** guidelines. Accordingly, Dr. Weldon has served roles akin to **Resource Expert** and **Proponent Expert** in his work for UCERF.

Expertise

- Neotectonics
- Quaternary Geology
- Structural Geology
- Paleoseismology
- Fault Rupture Dynamics
- Seismic Hazard Assessment

Education

PhD, Geology, 1986

BA, Geology, 1977

Dr. Weldon also has served as an expert reviewer on active faulting and earthquake studies for critical structures and lifelines, including nuclear power plants. Specifically, he has served as on the Seismic Advisory Panel (SAP) for the **Diablo Canyon Power Plant** (DCPP) in central California.

Dr. Weldon's well-rounded expertise in neotectonics and SSHAC experience make him well suited for the role of TI Team Lead for the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization. His **NRC-endorsed instruction of the SSHAC process** will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

ROLES AND RESPONSIBILITIES

1	Identify existing data, models, and methods of significance to SSC
2	Evaluate data in terms of relevance, quality/reliability, and their specific applicability to SSC
3	Identify resource experts to be invited to Workshop #1 and proponent experts for Workshop #2
4	Work with the TI Team to develop a preliminary and final SSC model that reflects the center, body, and range of technically defensible interpretations
5	Challenging the technical basis of assessments made by proponents and other evaluators and defending their own assessments to the same challenge
6	Provide complete and clear written justifications of the technical bases for all elements of the SSC model
7	Adhere to all project schedules and project deliverables

SELECTION CRITERIA

1	Strong technical experience and expertise applicable to SSC for a PSHA
2	The ability to objectively evaluate the strengths and weaknesses of alternative models and methods
3	Familiarity with approaches to quantifying uncertainties for hazard
4	Ability to work in team environment good communication skills
5	As an evaluator, able to act with objectivity and willing to forsake the role of proponent
6	As an integrator, able to work with TI Team to represent the center, body, and range of technically defensible interpretations
7	Able to commit significant time and effort to the project, including all workshops and working meetings
8	Able to produce clear and complete documentation on schedule

YOSHIHARU MORIWAKI

PRINCIPAL, GEOTECHNICAL ENGINEERING CONSULTANT
GeoPentech, Inc.

Dr. Moriwaki has over thirty-five years of experience in the field of geotechnical engineering, with demonstrable expertise in earthquake engineering, soil dynamics, soil-structure interaction, and numerical and probabilistic analysis. He is well respected and published in his field.

Dr. Moriwaki has served as an expert reviewer on geotechnical and earthquake engineering studies for critical structures and lifelines, including nuclear power plants. Specifically, he has served as an **NRC reviewer** for the geotechnical aspects of the **DTE Fermi 3 COLA**. Dr. Moriwaki has also served as **a project engineer for multiple nuclear power plants**, including South Texas NGS, Hope Creek NGS, Salem Creek NPP, Catawba NS, Sequoyah NGS, Watts Bar NGS, Hatch NPP, Braidwood GS, Clinton PS, Diablo Canyon PP, and Tsuruga NGS (Japan). His work for these plants included site response analysis, ground motion evaluation, soil-structure interaction analysis, probabilistic risk assessment, seismic margin assessment, liquefaction evaluation, numerical analysis, and geotechnical foundation issues. Dr. Moriwaki's integral role in these projects leads him to fully understand the technical aspects and limitations of source fault models used to support ground motion analyses. He is also serving as a **Project Technical Integrator for the Southwestern United States** (SWUS) **SSHAC Level 3 Ground Motion Characterization**.

Expertise

- Geotechnical Engineering
- Earthquake Engineering
- Soil-Structure Interaction
- Numerical and Probabilistic Analysis
- Seismic Hazard Assessment

Education

PhD, Geotechnical Engineering, 1975

MS, Engineering Mechanics, 1968

BS, Civil Engineering, 1975

Professional Registrations

GE, California, No. 2499

CE, California, No. 40972

Dr. Moriwaki's well-rounded expertise in probabilistic seismic hazard assessment and his **extensive nuclear industry experience** make him well suited for the role of TI Team member for the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

PETER M. SHEARER

PROFESSOR
Scripps Institution of Oceanography at University of California, San Diego

Dr. Shearer has over twenty-five years of experience in the field of seismology, with demonstrable expertise in observational seismology, earthquake locations, earthquake source physics, and deep-earth structure in southern California. He is well respected and well published in his field, and he is also a member of the National Academy of Sciences.

Expertise

- Seismology
- Earthquake Source Physics
- Deep Earth Structure

Education

PhD, Geophysics, 1986

BS, Geology and Geophysics, 1978

Dr. Shearer contributed to the Working Group on California Earthquake Probabilities (WGCEP) effort to produce a earthquake-rupture forecast for the state. The WGCEP's Uniform California Earthquake Rupture Forecast, Versions 2 and 3 (UCERF2 and UCERF3), were conducted using QA procedures modeled on the **SSHAC** guidelines. Accordingly, Dr. Shearer has served roles akin to **Resource Expert** and **Proponent Expert** in his work for UCERF.

Dr. Shearer was selected for the role of TI Team member based on his extensive knowledge of southern California seismicity. His published work demonstrates this knowledge, as well as his willingness and ability to cooperate with other researchers and other research methods. This open-minded but analytical approach to seismology theory and application will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization.

PAUL J. UMHOEFER

PROFESSOR
Northern Arizona University

Dr. Umhoefer has over twenty years of experience in the field of geolgy, with demonstrable expertise in geophysics, neotectonics, tectono-stratigraphy, basin stratigraphy, and fluvial stratigraphy. He is well respected and well published in his field.

Expertise

- Geophysics
- Neotectonics
- Stratigraphy
- Structural Geology

Education

PhD, Geology, 1989

MS, Geology, 1979

BS, Geology, 1977

Dr. Umhoefer was selected for the role of TI Team member based on his extensive knowledge of geophysical data, processing, and interpretation with regard for sequence stratigraphy in tectonic and fluvial environments. His published work demonstrates this knowledge, as well as his willingness and ability to cooperate with other researchers and other research methods. This open-minded but analytical approach to geophysical investigations will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization.

MATTHEW M. MUTO

TECHNICAL SPECIALIST
Southern California Edison Company

Expertise

- Geotechnical Engineering
- Seismic Hazard Assessment
- Ground Motion Analysis
- Numerical Analysis

Education

PhD, Civil Engineering, 2006

BS, General Engineering, 2000

Dr. Muto has over five years of experience in the field of geotechnical engineering, with experience in earthquake engineering, seismic hazard assessment, ground motion simulation, and numerical analysis. He is well respected and published in his field.

Dr. Muto has served as technical reviewer on earthquake engineering studies for critical structures and lifelines, including tunnels, dams, transmission towers, and pipelines. Specifically, he has served on a Federal Energy Regulatory Commission (FERC) committee for developing risk-informed dam safety engineering guidelines. These guidelines are comparable the **SSHAC** guidelines; accordingly, Dr. Muto has served the role akin to **PPRP member** in the FERC committee.

Dr. Muto was selected for the role of TI Team member based on his extensive knowledge of southern California seismic hazard analysis. His published work and professional history demonstrates this knowledge, as well as his willingness and ability to cooperate with other researchers and other research methods. This open-minded but analytical approach to seismic hazard analysis will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization.

ROLES AND RESPONSIBILITIES

1	Technical review, ensure that the full range of data, models and methods are considered
2	Process review, ensure that process conforms to the requirements of SSHAC Level 3
3	Participation in the formal workshop #1 and #2 as observers, provide feedback on SSC model development at workshop #3
4	Provide clear and timely written feedback following each workshop
5	Provide written review of project plan and draft final project report
6	Issue PPRP closure letter summarizing final review

SELECTION CRITERIA

1	Experience in both the process and technical aspects of conducting SSHAC Level 3 studies
2	Acknowledged technical expertise in a discipline of importance to PSHA
3	Ability to represent their own expert perspectives and not those of their organizations
4	Willingness to provide independent review without bias or preconception
5	Willingness to commit to the time and effort necessary to carry out the participatory peer review process throughout the course of the study

RALPH ARCHULETA

PROFESSOR
University of California, Santa Barbara

Dr. Archuleta has over thirty-five years of experience in the field of seismology, with demonstrable expertise in crustal modeling, earthquake rupture processes, wave propagation, and strong ground motions. He is well respected and well-published in his field.

Dr. Archuleta has served as an expert reviewer on ground motions analyses for critical structures and lifelines, including nuclear power plants. Specifically, he has served as an **NRC panel reviewer** for the seismic analysis of the **Diablo Canyon Power Plant** (DCPP). He has also worked with the Federal Energy Regulatory Commission (FERC) on major dam and facilities projects. Dr. Archuleta is currently the Chair of the Working Group on Ground Motion Simulations for NGA-East. The NGA-East project is being conducted as a **SSHAC Level 3** study; accordingly, Dr. Archuleta has served the roles akin to **Resource Expert** and **Proponent Expert** in his work for NGA-East.

Expertise

- Strong Ground Motion
- Seismic Hazard Assessment
- Earthquake Source Physics

Education

PhD, Earth Sciences, 1976

MS, Physics, 1971

BS, Physics, 1969

Dr. Archuleta's well-rounded expertise in seismology and his regulated-industry experience make him well suited for the role of PPRP Chair for the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

JAN D. RIETMAN

INDEPENDENT CONSULTING GEOPHYSICIST

Dr. Rietman has over forty-five years of experience in the field of geophysics, with demonstrable expertise in geophysical data collection, processing, and interpretation. He is well respected in his field.

Dr. Rietman has served as an expert reviewer on geophysical and geologic investigations for critical structures and lifelines, including nuclear power plants. Specifically, he has served as on the Seismic Advisory Panel (SAP) for the **Diablo Canyon Power Plant** (DCPP) in central California and the Seismic Technical Advisory Board (STAB) for the **San Onofre Nuclear Generating Station** (SONGS) in southern California. He has also served the **International Atomic Energy Agency** (IAEA) as a technical consultant for siting studies. These studies were conducted using QA procedures comparable to the **SSHAC** guidelines. Accordingly, Dr. Rietman has served the role akin to **TI Team member** in his work for IAEA. Currently, Dr. Rietman is serving as a **Resource Expert for DCPP's SSHAC Level 3** Seismic Source Characterization.

Expertise

- Marine Geophysics
- Marine Geology
- Seismic Hazard Assessment

Education

PhD, Geophysics, 1966

MS, Geophysics, 1959

Professional Registrations

PGp, California, No. 53

PG, California, No. 1430

Dr. Rietman's well-rounded expertise in geophysics and his **extensive nuclear industry experience** make him well suited for the role of PPRP member for the SONGS SSHAC Level 3 Seismic Source Characterization. His procedural knowledge and **demonstrated application of the SSHAC process** will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

NEAL W. DRISCOLL

PROFESSOR
Scripps Institution of Oceanography at University of California, San Diego

Expertise

- Marine Geophysics
- Marine Geology
- Seismic Hazard Assessment

Education

PhD, Marine Geology and Geophysics, 1992

MS, Geological Oceanography, 1987

BS, Geology, 1981

Dr. Driscoll has over twenty-five years of experience in the field of marine geology and geophysics, with demonstrable expertise in geophysical data collection, processing, and geologic interpretation. He is well respected and well published in his field.

Dr. Driscoll is currently serving as a **PPRP member for DCPP's SSHAC Level 3** Seismic Source Characterization.

Dr. Driscoll was more recently added to the PPRP to complement the panel with his well-rounded expertise in marine geology and geophysics (particularly off the coast of Baja and southern California) and his **demonstrated application of the SSHAC process**, This expertise and experience make him well suited for the role of PPRP member for the SONGS SSHAC Level 3 Seismic Source Characterization. His procedural knowledge and concurrent application of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

PETER BIRD

PROFESSOR EMERITUS
University of California, Los Angeles

Expertise

- Tectonic Geodesy
- Kinematic Modeling
- Dynamic Modeling
- Seismicity Forecasting
- Seismic Hazard Assessment

Education

PhD, Earth and Planetary Sciences, 1976

BA, Geological Sciences, 1972

Dr. Bird has over thirty-five years of experience in the field of geology and geophysics, with demonstrable expertise in tectonic geodesy and kinematic and dynamic crustal modeling in southern California. He is well respected and well-published in his field.

Dr. Bird contributed to the Working Group on California Earthquake Probabilities (WGCEP) effort to produce a earthquake-rupture forecast for the state. The WGCEP's Uniform California Earthquake Rupture Forecast, Versions 2 and 3 (UCERF2 and UCERF3), were conducted using QA procedures modeled on the **SSHAC** guidelines. Accordingly, Dr. Bird has served roles akin to **Resource Expert** and **Proponent Expert** in his work for UCERF.

Dr. Bird's well-rounded expertise in geology and geodetic modeling and his UCERF experience make him well suited for the role of PPRP member for the San Onofre Nuclear Generating Station (SONGS) SSHAC Level 3 Seismic Source Characterization. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

ROLES AND RESPONSIBILITIES

1	Work with the TI Team to identify hazard-sensitive source parameters
2	Provide preliminary and intermediate hazard calculations and sensitivity analyses
3	Provide thorough documentation (report, figures, limitations, etc.) of final hazard calculations and sensitivity analyses
4	Adhere to all project schedules and project deliverables

SELECTION CRITERIA

1	Strong technical experience and expertise applicable in PSHA
2	Ability to identify and communicate data, parameters, calculations, and models needed for inclusion in the Hazard Input Document (HID)
3	Expertise in approaches to quantifying uncertainties for hazard
4	Ability to work in team environment good communication skills
5	Able to commit significant time and effort to the project, including all workshops and able to attend many working meetings
6	Able to produce clear and complete documentation on schedule

PHALKUN TAN

ASSOSIATE, GEOTECHNICAL ENGINEER
GeoPentech, Inc.

Expertise

- Geotechnical Engineering
- Earthquake Engineering
- Soil-Structure Interaction
- Numerical and Probabilistic Analysis
- Seismic Hazard Assessment

Education

PhD, Civil Engineering, 1989

MS, Civil Engineering, 1982

BS, Civil Engineering, 1980

Professional Registrations

CE, California, No. 54654

Dr. Tan has over twenty years of experience in the field of geotechnical engineering, with demonstrable expertise in earthquake engineering, soil dynamics, soil-structure interaction, and numerical and probabilistic analysis. He is well respected and published in his field.

Dr. Tan has served as a project engineer on multiple earthquake engineering studies for critical structures and lifelines, including dams, pipelines, tunnels, and nuclear power plants. Specifically, he was a lead engineer for the operational-level probabilistic seismic hazard analysis for the **San Onofre Nuclear Generating Station** (SONGS). The 2010 SONGS PSHA was conducted using QA procedures similar to the **SSHAC** guidelines. Dr. Tan is serving as a **Hazard Analyst for the Southwestern United States** (SWUS) **SSHAC Level 3 Ground Motion Characterization**. He is also currently a leading engineer in the site characterization project for SONGS.

Dr. Tan was selected for the role of HC Team member based on his technical experience in probabilistic seismic hazard assessments and sensitivity analyses. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

ANDREW DINSICK

ASSITANT PROJECT ENGINEER
GeoPentech, Inc.

Mr. Dinsick has ten years of experience in the field of geotechnical engineering, with experience in earthquake engineering, seismic hazard assessment, seismic stability evaluation, and numerical and probabilistic analysis. He is well respected in his field.

Mr. Dinsick has served as an engineer on several earthquake engineering studies for critical structures and lifelines, including dams and nuclear power plants. Specifically, he has developed fault logic trees for an operational-level probabilistic seismic hazard analysis for the **San Onofre Nuclear Generating Station** (SONGS). The 2010 SONGS PSHA was conducted using QA procedures similar to the **SSHAC** guidelines. Mr. Dinsick is currently serving as a technical specialist supporting the Hazard Analysts for the **Southwestern United States** (SWUS) **SSHAC Level 3 Ground Motion Characterization**. He is currently also a leading engineer in the site characterization project for SONGS.

Expertise

- Geotechnical Engineering
- Earthquake Engineering
- Seismic Stability Analysis
- Numerical and Probabilistic Analysis
- Seismic Hazard Assessment

Education

MS, Geotechnical Engineering, 2012

BS, Civil Engineering, 2003

Professional Registrations

CE, California, No. 72802

Mr. Dinsick was selected for the role of HC Team member based on his technical experience in probabilistic seismic hazard assessments and sensitivity analyses. His procedural knowledge of the SSHAC process will serve to ensure this Project adheres to the applicable regulatory guidelines, and his technical knowledge of the tectonic issues of interest to SONGS will serve to ensure the center, body, and range of the data, models, and methods of the technically informed community are appropriately integrated and evaluated in this Project.

ROLES AND RESPONSIBILITIES

1	Present data, models and methods in an impartial way.
2	Respond candidly and impartially to questions posed by the evaluator experts.

SELECTION CRITERIA

1	Deep and broad knowledge of the tectonics, geology, or seismicity of Southern California
2	Ability to withhold judgment with regard to hazard implications

Roles and responsibilities for the Resource Experts are listed in the tables above. The Resource Experts are selected by the TI Team. Resource Experts will be selected throughout the course of this Project based on the data needs of the TI Team.

ROLES AND RESPONSIBILITIES

1	Advocate a specific model, parameter to use in the hazard analysis
2	Promote the adoption of the model as input to hazard calculations
3	Demonstrate the technical basis for the model
4	Defend the model in the face of technical challenge

SELECTION CRITERIA

1	Deep and broad knowledge of the tectonics, geology, or seismicity of Southern California
2	Ability to defend model and its basis

Roles and responsibilities for the Proponent Experts are listed in the tables above. The Proponent Experts are selected by the TI Team. Proponent Experts will be selected throughout the course of this Project based on the data needs of the TI Team

Appendix B

LETTER REPORT FROM PARTICIPATORY PEER REVIEW PANEL

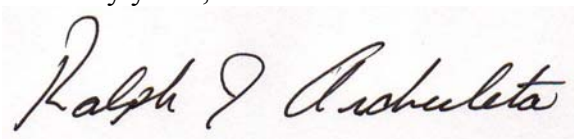
November 30, 2012

Tom Freeman
GeoPentech, Inc.
525 N. Cabrillo Park Drive, Suite 280
Santa Ana, CA 92701

Dear Mr. Freeman,

This letter concerns the Project Plan for the Seismic Source Characterization of the San Onofre Nuclear Generating Station (SONGS) dated November 28, 2012. The Participatory Peer Review Panel (PPRP), consisting of Ralph Archuleta (Chair), Peter Bird and Jan Rietman, reviewed two earlier drafts of this plan as well as the Project Plan of November 28, 2012. Having been responsive to our comments on earlier drafts, the PPRP finds the Project Plan acceptable for a Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 study. This plan certainly appears to be a thoughtful approach by which we can ascertain the appropriate seismic hazard for SONGS. The personnel on the various committees are qualified and capable of providing a final analysis that will encompass "the center, body, and range of technically defensible interpretations of the characteristics of those faults that contribute to the seismic ground motion hazard at SONGS."

Sincerely yours,



Ralph J. Archuleta, Chair PPRP

Peter Bird, Member PPRP

Jan Rietman, Member PPRP