Project Plan for Development of the Diablo Canyon Seismic Source Model Using SSHAC Level 3 Methodology Revision 2

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Record of Revisions			
Revision	Date	Authors	Summary of Changes
1	July 18, 2012	W. Lettis	• Updated to reflect change in Project Schedule in response to NRC Letter 10 CFR 50.54(f) • Updated to separate the SSC and GMC models into two separate SSHAC Level 3 Studies. This project plan carries forward the SSC Level 3 Study. • Updated to be consistent with NRC, 2012, Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies.
2	September 16, 2013	S. Thompson W. Lettis	• Updated to reflect changes to project TI Team and Project Schedule. • Updated to more fully describe "replacement" of the SSC Model.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

CGS	California Geological Survey
CBR	Center, Body, and Range
CEUS	Central and Eastern United States
CRADA	Cooperative Research and Development Agreement
EE	Evaluator Expert
EPRI	Electric Power Research Institute
GIS	Geographic Information Systems
GMC	Ground Motion Characterization
GMPE	Ground Motion Prediction Equations
HID	Hazard Input Document
ITC	Informed Technical Community
LTSP	Long Term Seismic Program
NGA	Next Generation of Attenuation Relationships
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulation
PE	Proponent Expert
PG&E	Pacific Gas & Electric Company
PPRP	Participatory Peer Review Panel
PSHA	Probabilistic Seismic Hazard Analysis
PTI	Project Technical Integrator
QA	Quality Assurance
RE	Resource Expert
RG	Regulatory Guide
SSC	Seismic Source Characterization
SSHAC	Senior Seismic Hazard Analysis Committee
SWUS	Southwestern United States
TDI	Technically Defensible Interpretations
TI	Technical Integrator
USGS	United States Geological Survey

INTRODUCTION AND CONTEXT OF THE STUDY

A seismic hazard update will be performed for the Pacific Gas and Electric (PG&E) Diablo Canyon Power Plant (DCPP) Long Term Seismic Program (LTSP), using an updated Seismic Source Characterization (SSC) model and updated Ground Motion Characterization (GMC) model as basic inputs to a site-specific probabilistic seismic hazard analysis (PSHA). The SSC describes the future earthquake potential (e.g., magnitudes, locations, and rates) for the region surrounding the DCPP site, and the GMC describes the distribution of the ground motion as a function of magnitude, style of faulting, source-to-site geometry and site condition. For the seismic hazard update, both of these models will be developed following the guidelines of the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 process (Budnitz et al., 1997; NRC, 2012). The SSC model is specific to the Diablo Canyon site region (320-kilometer radius), and will be developed through an independent SSHAC Level 3 study for the DCPP site. The GMC model for rock ground motions will be developed as part of a larger study that is applicable to the southwestern United States (SWUS). The SSC SSHAC Level 3 study will "update" and "replace" the existing DCPP LTSP SSC model (PG&E, 1988, 2004, 2011) as defined in Section 6 of the SSHAC Implementation Guidelines (NRC, 2012). The GMC logic tree model will incorporate relevant empirical ground motion models as well as results from numerical simulations. The PSHA calculations and the development of surface response spectra considering site-specific site amplification will be performed subsequent to the SSC and GMC SSHAC Level 3 studies.

This Project Plan describes the SSHAC Level 3 approach for conducting the Diablo Canyon SSC study. The SWUS GMC Project Plan is described under separate cover. Because the separate components of a SSC model and GMC model are combined in the hazard calculation, it will be important that the interfaces between the SSC and GMC models are addressed. This integration between the SSC and GMC studies will be accomplished by having Dr. Norm Abrahamson serve as the PG&E Project Technical Integrator (as described below), having representatives from the SWUS GMC study attend all workshops of the Diablo Canyon SSC study, and by having a representative from the Diablo Canyon SSC project attend all workshops of the SWUS GMC study. As shown on the Project Organization Chart (Figure 1), PG&E is the Project Sponsor for the Diablo Canyon SSC study under the direction of Mr. Kent Ferre. The Project Schedule is shown on Figure 2. Both the project organization and schedule are described further below.

This Project Plan has been modified twice since the inception of the seismic hazard update project. The initial release of the Project Plan is dated November 23, 2011. The initial Plan described a combined SSC and GMC study with one Participatory Peer Review Panel. In March 2012, the NRC issued letter 10 CFR 50.54(f) requiring that nuclear sites in the Western United States perform a SSHAC Level 3 study to develop a probabilistic seismic hazard analysis. In July 2012, therefore, Revision one to the Project Plan was prepared to divide the SSHAC study into two separate SSHAC

Level 3 studies: a site-specific SSC study for Diablo Canyon, and a regional GMC study that would be applicable to the SWUS (for use by Diablo Canyon, San Onofre and Palo Verde). This separation of the project into separate SSC and GMC studies occurred after the completion of Workshop 0 "Kick-Off" and Workshop 1 "Key Issues and Data Needs." The Diablo Canyon SSC project has continued as a separate project. The SWUS GMC study, however, started over with Workshop 1, but key recommendations from the initial Workshop 1 were incorporated into the SWUS GMC project. The first revision to the Diablo Canyon SSC Project Plan is dated July 18, 2012, and reflects this major change to the Project scope.

This current version of the Project Plan is the second revision, and includes changes to the Technical Integrator (TI) Team personnel and the Project schedule. In addition, although the original Project Plan called for an "update" and "replacement" of the LTSP SSC model, the SSC Technical Integration Team has now completed their "update" review of the existing DCPP LTSP SSC model, and formally concluded that the 2011 SSC model must be replaced. Sufficient new data, methods, interpretations and models have been developed such that the existing 2011 SSC model cannot be reliably modified or refined. Thus, this revision of the Project Plan includes additional language to "replace" the previous SSC model.

A SSHAC Level 3 process is a formal, structured process for developing SSCs and GMCs, and has been identified in NRC regulatory guidance (RG 1.208, NRC, 2007) as an acceptable process for use in performing PSHA for nuclear sites. The SSHAC process provides guidelines for how all aspects of the SSC development should be conducted, including: (a) identification of significant issues and data; (b) identification and solicitation of expert opinions and alternative models; (c) evaluation of the available data, expert opinions and alternative models; (d) integration of the information into SSC and GMC models that incorporate the range of technically defensible interpretations; (e) documentation of the model development; and (f) participatory peer review of the technical results and process. As described within the SSHAC guidelines (Budnitz et al, 1997; Hanks et al., 2009; Coppersmith et al., 2010; NRC 2012), the goal of following a SSHAC process is to provide reasonable regulatory assurance that the center, body and range (CBR) of the technically defensible interpretations (TDI) in the SSC models have been adequately captured. The purpose of this Project Plan is to describe how the SSHAC Level 3 process will be applied to develop the SSC model for the DCPP site.

OBJECTIVES OF THE STUDY

The objective of the Diablo Canyon SSC study is to update the existing LTSP SSC model (PG&E 1988, 2004, 2011) for use in an updated PSHA for DCPP. In accordance with SSHAC implementation guidelines (NRC, 2012), this update will constitute a "replacement" of the existing SSC model. The previous SSC model was developed in 1988 as part of the LTSP for Diablo Canyon (PG&E, 1988), and refined as part of the ISFSI hazard study (PG&E, 2004) and again as part of the Shoreline fault zone study (PG&E, 2011). The 2004 SSC refinement mainly involved revising the Hosgri fault characterization to be primarily strike slip based on new data that rejected the reverse and reverse-oblique alternatives that were included in the SSC logic trees in the 1988 LTSP study. The 2011 SSC update involved adding the Shoreline fault zone in the model, reassessing the down-dip geometry of the Hosgri fault zone and Los Osos fault, and reassessing the existence and offshore continuation of the Rattlesnake and Olson traces of the San Luis Bay fault zone. The current SSHAC Level 3 update will re-examine parameters of the SSC logic tree model in light of recent and ongoing studies with the objective of developing a new SSC model that captures the center, body and range (CBR) of the technically defensible interpretations (TDI). As described in NUREG 2117 (NRC, 2012), TDI are defined as the development, assessment, and weighting of the scientifically justifiable and defensible interpretations of earth science and geotechnical data by appropriate experts in these fields using a structured process of Evaluation and Integration with full access to all available data..

The Diablo Canyon SSC model will focus on the epistemic uncertainties in SSC seismic sources and/or parameters that have significant impacts on the hazard. Hazard sensitivity studies will be used throughout the project to focus the evaluation effort on those issues most significant to hazard at the site. The sensitivity analyses will be performed using preliminary updates of the GMC model developed under the parallel SWUS GMC study, and will require close integration of the SSC and GMC studies. Although all aspects of the SSC logic tree model will be considered and discussed based on current scientific understanding and concepts, the intent of the sensitivity analyses will be to inform the SSHAC participants of those issues of greatest significance to the hazard results and to focus further evaluation and integration of data and information on characterizing the uncertainty in these key model parameters.

Beyond capturing the CBR of the TDI given the currently available data, this study will also integrate new data with the objective of reducing the epistemic (i.e., non-random) uncertainties in the Diablo Canyon SSC. Planned data collection studies include onshore and offshore field investigations performed by PG&E, the USGS through the ongoing PG&E-funded CRADA program, and other researchers. In particular, California Assembly Bill AB1632 specifically provides for the acquisition of new offshore and onshore 2D and 3D seismic-reflection data to identify and characterize faults in the vicinity of Diablo Canyon. Because of the significant amount of new data that will progressively become available, elements of the traditional SSHAC Level 3 Workshop 2 (Proponent Expert models) will be repeated at Workshop 3 to allow the new data to be fully evaluated and integrated into the SSC model. In part because of the field studies, and to comply with the NRC schedule imposed in Letter 50.54(f), the study will be performed over a four-year period, with a final report prepared by March, 2015.

Another objective is to conduct the study under an open and transparent process. To meet this objective, all of the workshops will be open to the public. The attending public will be able to observe the technical proceedings of the SSAHC process. Each public workshop will include a "public comment" session at the end of each day.

Because there are recent SSC studies available for DCPP (e.g., PG&E, 2004; 2011), an important aspect in developing the replacement model will be to avoid cognitive bias (e.g., anchoring) to the pre-existing characterizations and to be open to new data, evaluations, and alternative interpretations. This will be accomplished by including discussion of cognitive bias at the start of each workshop and working meeting by the TI Lead, and by conscious reminders by the TI Lead or other TI team members or staff during each workshop and working meeting if apparent cognitive bias arises.

DESCRIPTION OF SSHAC METHODOLOGY

In 1997, the Senior Seismic Hazard Analysis Committee (SSHAC) published NUREG/CR-6372 (Budnitz et al., 1997) that detailed a methodology for capturing the epistemic uncertainty in input parameters for PSHAs. Factors motivating the development of this methodology were the observations that: (1) different PSHA studies (e.g., EPRI, 1988; Bernreuter et al., 1989) developed significantly different estimates of the mean seismic hazard for nuclear facilities; and (2) the primary reason for the difference in hazard estimates was that the SSCs and GMCs did not adequately characterize the epistemic uncertainty within those characterizations. Recognizing the importance of characterizing epistemic uncertainty, the SSHAC spent approximately four years developing a methodology for characterizing epistemic uncertainties in SSCs and GMCs. Since publication of the original SSHAC methodology, there have been additional publications that have elaborated on the guidance and how it should be applied (e.g., Hanks et al., 2009, Coppersmith et al., 2010; NRC, 2012). The following summary of the SSHAC methodology and this Project Plan for the Diablo Canyon SSC study are consistent with these publications.

The stated goal of the SSHAC guidelines is to provide a methodology for developing SSC and GMC that "...represent the center, the body, and the range of technical interpretations that the larger informed technical community would have if they were to conduct the study" (Budnitz et al., 1997, p. 21). The terminology "center, body, and range" refers to the complete characterization of uncertainty. For simplicity, consider the single parameter of the maximum earthquake magnitude for a fault. In this case, "center" can be thought of as the average (i.e., median) maximum magnitude, "range" can be thought of as the extreme upper and lower estimates of the maximum magnitude limits, and "body" can be thought of as the shape of the distribution of potential maximum magnitudes within that range (e.g., symmetric or skewed distributions).

The use of the terminology "informed technical community" (ITC) also has an explicit meaning within the SSHAC guidance. This terminology is meant to communicate the hypothetical idea that if technical experts within the appropriate fields (e.g., GMC, SSC) (1) had detailed knowledge of the same data as those who developed the SSC and GMC, and (2) went through the same interactive process as the developers of the SSC and GMC, this ITC would develop characterizations that fit within the center, body, and range of those developed for the project. More recently, the NRC (2012, NUREG 2117) suggests replacing the term ITC with "technically defensible interpretations (TDI)" of the available data, models and methods to more clearly reflect the intent of the SSHAC process. They continue to emphasize that the careful evaluation of the larger technical community's viewpoints remains a vital part of the SSHAC process. By following the structured methodology of the SSHAC process, the intent is to provide reasonable regulatory assurance that the goal of representing the center, body, and range of the characterizations has been met, and thus provides the basis for developing seismic hazard estimates that are reproducible, defensible, transparent, and stable (i.e., if someone else were to conduct a similar study they would not get significantly different results). For the remainder of this Project Plan, the term "technically defensible interpretations" (TDI) will be used instead of the earlier term "informed technical community" (ITC).

Selection of SSHAC Level

The SSHAC methodology defines four different levels of study that can be conducted to achieve the goal of capturing the CBR of the TDI. The four study levels, Level 1 through Level 4, are distinguished by an increasing level of sophistication, resources, and participation by technical experts. Given the technical complexity of seismic sources and recent identification of the Shoreline fault in the DCPP site vicinity, PG&E, as the Project sponsor, selected a SSHAC Level 3 study to evaluate and integrate all of the available data, methods, and alternative models into an updated SSC model.

A SSHAC Level 3 study was selected based on recent and ongoing SSHAC Level 3 studies sponsored and endorsed by the NRC and a draft version of NUREG 2117. At the time of project conception and initiation in early 2011, major updates to the Central and Eastern United States (CEUS) ground motion model (EPRI, 2004; 2006) and seismic source model (CEUS SSC, 2012; study initiated in 2008) had been completed or were in progress. These studies were jointly sponsored by and endorsed by the NRC, U.S. Department of Energy, and Electric Power Research Institute (EPRI), and establish precedence for using a SSHAC Level 3 approach for complex, controversial tectonic settings such as the New Madrid seismic source zone. NUREG 2117 (NRC, 2012) explicitly states, "From the regulatory perspective of the NRC, there is no essential difference between Level 3 and Level 4 studies, and throughout these guidelines they are considered as parallel and equally valid options." Thus, considering the CEUS seismic hazard model update studies as precedent and having access to draft versions of NUREG 2117, PG&E determined that a Level 3 study was an appropriate SSHAC level for the hazard update for DCPP. More recently, the NRC issued the 10CFR50/54f letter in March 2012 that explicitly requires a SSHAC Level 3 study for nuclear sites in the Western United States, including Diablo Canyon.

DIABLO CANYON SSC PROJECT ORGANIZATION

The project organization for the LTSP SSHAC Level 3 update is shown on Figure 1. As described by Budnitz et al. (1997) and Hanks et al. (2009), specific roles and responsibilities of individuals within a SSHAC process must be clearly defined because the guided interaction between the different roles allows for the center, body, and range of the SSC to be robustly characterized. For the Diablo Canyon SSC study, the roles listed below will be explicitly designated and documented as shown on Figure 1. Members of the project team (TI Team and PPRP) were selected based on the following criteria:

(1) past experience on the LTSP SSC logic tree model and SSC model updates;
(2) knowledge of the seismic and tectonic setting of the DCPP area;
(3) knowledge of data, methods and technical approaches that may be relevant to the DCPP area;
(4) prior SSHAC Level 3 experience; and/or
(5) no prior knowledge of the LTSP SSC model or the DCPP area (to provide fresh, unbiased perspectives).

In addition, there is a goal identified by the NRC (2012) to involve younger scientists on the TI team. This capacity-building goal aims to build up the number of people with experience with the SSHAC process within the scientific community in general and within the owner organization specifically, and to provide a legacy for future SSHAC projects. Scientists from the CGS, USGS, and NRC meeting the above criteria were considered (and in some cases, invited) for participation on the project team, but members of these organizations were unable to participate because of potential conflict of interest during ongoing parallel review of the Diablo Canyon seismic hazard. The justification for the selection of the TI team and PPRP members given these criteria is provided below within the descriptions of the project roles.

For those members of the project team without prior experience or knowledge of the DCPP area and LTSP models, and/or with no prior SSHAC experience, the Project Plan provides for bringing all members of the project team to a common level of understanding of the technical data as well as explicit training in the SSHAC process. In addition, as described below, Dr. Norman Abrahamson will be the Project Technical Integrator (PTI) responsible for coordination of the Diablo Canyon SSC study with the parallel SWUS GMC SSHAC Level 3 study. Dr. Abrahamson is an employee of the Project Sponsor, PG&E. However, the SSHAC process has sufficient checks and balances to avoid any conflict of interest (e.g., PPRP review of technical assessments and process). Specific roles of the Diablo Canyon SSC Project Team are described below.

Project Sponsor – PG&E is the Project Sponsor for the Diablo Canyon SSC project. The project sponsor provides financial support and "owns" the results of the study in the sense of property ownership. Mr. Kent Ferre will be the Project Manager for the project on behalf of PG&E.

Project Technical Integrator (PTI) – The PTI is a technical expert with knowledge of the SSHAC process and both GMC and SSC studies. The PTI is responsible for ensuring coordination and compatibility between the GMC and SSC studies and for providing oversight of the overall DCPP SSHAC process. Dr. Norman Abrahamson will be the PTI for the Diablo Canyon SSC study.

Participatory Peer Review Panel (PPRP) – The PPRP is a panel of experts with SSHAC methodology and/or PSHA experience that provide participatory peer review of the SSHAC methodology implementation process and technical judgments of the TI Team. The PPRP assures that the range of TDI is captured and documented through proper implementation of the SSHAC process. Members of the PPRP will attend all of the formal workshops and are encouraged to participate in field reviews and selected working meetings of the TI Team. Opportunities to participate in field reviews and working meetings will be identified, as needed, in collaborative discussions between the project leadership (Project Manager, PTI and TI Lead) and the PPRP. Members of the PPRP are shown on Figure 1 and will consist of Dr. Kevin Coppersmith, President of Coppersmith Consulting, Inc. (Chair), Dr. Steven Day, Professor of Seismology at San Diego State University, Dr. Neal Driscoll, Professor at Scripps Institution of Oceanography, U.C. San Diego, and Dr. Thomas Rockwell, Professor of Geological Sciences at San Diego State University. Dr. Coppersmith provides expertise and experience with the SSHAC Level 3 process, familiarity with the LTSP SSC at Diablo Canyon, and knowledge of methods and technical approaches used in seismic source characterization. Dr. Day provides experience with the SSHAC Level 3 process and expertise in seismology and earthquake physics with relevance to seismic source characterization. Both Dr. Rockwell and Dr. Day are also serving on the PPRP for the SWUS GMC study and thus help ensure coordination between the two parallel projects. Dr. Driscoll provides expertise with marine geology and geophysics data acquisition and interpretation, and has familiarity with ongoing seismic studies for the San Onofre Nuclear Generating Stations (SONGS) site. Dr. Rockwell has familiarity with the seismic and tectonic setting of Diablo Canyon, and has expertise in earthquake geology and fault characterization for PSHA. The composition of the PPRP thus includes individuals with prior SSHAC Level 3 experience, as well as captures the breadth of technical requirements for the project.

Technical Integrator Team (TI Team) – The TI Team consists of Evaluator Experts with PSHA and/or SSC experience that are responsible for conducting the evaluation and integration process and development of the SSC logic tree model. The TI Team also will have a staff of Evaluator Experts that are not officially part of the TI Team but will assist the team during the data evaluation part of the project. Members of the SSC TI Team and support staff are shown on Figure 1. Although the TI staff will assist with the data evaluation, it is the exclusive role of the TI Team to perform the integration and model-building part of the study and ultimately to take intellectual responsibility for the results of the study. As such, the TI Team is solely responsible for ensuring: (1) that the various data, models, and methods proposed by the larger technical community and relevant to the hazard analysis are considered in the evaluation; and (2) that the final SSC model represents the CBR of the TDI.

For the Diablo Canyon SSC project, Dr. William Lettis, President of Lettis Consultants International, Inc., will be the TI Team Lead. Dr. Lettis provides expertise with the SSHAC Level 3 process, seismic source characterization, and PSHA. In addition, Dr. Lettis has familiarity and expertise with the LTSP SSC model and significant updates to the Diablo Canyon LTSP model including for the ISFSI study and the Shoreline fault zone study. The other TI Team members are Mr. Hans AbramsonWard, Principal Geologist with Lettis Consultants International, Dr. Glenn Biasi, Research Associate Professor with the Nevada Seismological Laboratory at the University of Nevada Reno, Dr. John Caskey, Associate Professor of Geosciences at San Francisco State University, and Dr. Stephen Thompson, Principal Geologist with Lettis Consultants International. Mr. AbramsonWard provides earthquake geology and fault characterization expertise and expertise with the interpretation of marine geophysical data for purposes of characterizing faulting and active tectonics. Dr. Biasi provides expertise with seismology and SSC for PSHA through evaluation of earthquake recurrence data and statistical evaluation of historical surface-fault ruptures. Dr. Biasi is a contributor to the Uniform California Earthquake Rupture Forecast (UCERF) effort and has familiarity with the process and results of that study and how they may be considered for the DCPP site SSC. Dr. Caskey provides earthquake geology and fault characterization expertise and has conducted research on faults in central coastal California, including the San Gregorio fault. Drs. Biasi and Caskey have no prior experience working on SSC for Diablo Canyon, and thus provide fresh perspectives with no cognitive bias. Dr. Thompson has expertise in earthquake geology and seismic source characterization for PSHA and is familiar with the seismic and tectonic setting of Diablo Canyon through recent involvement in the Shoreline fault zone study and resulting SSC logic tree model update. Mr. AbramsonWard and Dr. Thompson are younger scientists whose involvement satisfies the goal of broader capacity building for future projects following the SSHAC methodology.

Evaluator Expert (EE) – An EE is an expert with PSHA experience capable of evaluating the relative credibility of multiple alternative hypotheses to explain observations. All members of the TI Team will be EEs. EEs use their professional judgment to objectively quantify epistemic uncertainty based on evaluations of the data, knowledge, and alternative models presented by the Resource and Proponent Experts. In addition, a support staff of selected EEs will assist the TI Team in their evaluation of certain datasets and proponent models. Members of the TI staff have individual knowledge of data, interpretations, or proponent models, or are participating in the ongoing PG&E-funded onshore and offshore geologic and geophysical studies, and, thus, are valuable contributors to the TI Team evaluation process. However, they will not participate in the integration and model building part of the process, and thus will not have intellectual ownership of the SSC model. These support staff EEs are identified in the project organizational chart shown on Figure 1.

Resource Expert (RE) – A RE is an expert with a specialized knowledge of a particular data set, interpretation, or hypothesis who can present this information without a proponent bias. REs generally are invited to one or more workshops and/or may be contacted outside of the workshop environment by the TI Team to present and discuss their specialized knowledge regarding the strengths and weaknesses of alternative models and data sets. For the Diablo Canyon SSC study, REs will be identified as needed during the project.

Proponent Expert (PE) – In contrast to the unbiased RE, a PE is an expert who advocates a particular hypothesis or technical position. The PE's opinion may range from mainstream to extreme (outlier) views. PEs generally are invited to one or more workshops and/or may be contacted outside of the workshop environment by the TI Team to present and discuss their position. For the Diablo Canyon SSC study, PEs will be identified as needed during the project.

Hazard Analyst – The Hazard Analyst is a PSHA expert responsible for performing the PSHA calculations. Hazard Analysts are incorporated into all phases of the study (e.g., evaluation, integration) because they can provide: (a) valuable insight into how to represent uncertainty within different parameters; and (b) sensitivity feedback with respect to what parameters have the most impact to the hazard calculations. For the

Diablo Canyon SSC study, Dr. Nick Gregor and Ms. Kathryn Wooddell will be the Hazard Analysts.

Database Manager.
A comprehensive seismic source database will be established for the project. It is essential for the success of the project that a complete database be maintained and be available for review and use by all members of the TI Team and PPRP. Mr. Serkan Bozkurt will be the SSC Database manager for the Diablo Canyon SSC study.

Outside Observers – Outside observers are not explicitly defined within the SSHAC guidance (Budnitz et al., 1997), but are discussed in the implementation guidelines (NRC, 2012, NUREG 2117). Observers may include sponsors, regulators, public representatives, or other stakeholders. 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. For the Diablo Canyon SSC study, the workshops will be open to the public. Time for both observer comment and public comment will be accommodated at the end of each day and at the conclusion of each workshop. In addition, we anticipate that at least one observer from the NRC and other interested State agencies will attend each workshop.

DIABLO CANYON SSC WORK PLAN AND KEY STUDY TASKS

For the Diablo Canyon SSC project, the SSHAC Level 3 study will involve four components: (1) evaluation, (2) integration, (3) participatory peer review, and (4) documentation. Evaluation refers to the process of compiling and evaluating relevant data, alternative models/concepts, and alternative interpretations of the TDI. Integration refers to the assessment process where the various datasets, models, and interpretations are combined into a representation of the CBR of the TDI for the SSC. Participatory peer review refers to review of the evaluation and integration process by a peer review panel capable of providing feedback, during the project, on technical aspects of the project and whether the SSHAC Level 3 process was followed appropriately. By providing feedback during the project, the TI team can make necessary corrections before the project is complete. Documentation refers to the data summary and evaluation tables and final reports produced by the project that document the technical results (i.e., the SSC logic tree model), how they were reached, and how the SSHAC Level 3 process was implemented.

The SSHAC Level 3 study will be conducted using a series of formal workshops, working meetings, and internal work. Given the extensive amount of new data and information that will be developed and collected over the duration of the project, the process of evaluation followed by integration and model development will be repeated several times. The project schedule is shown on Figure 2.

The following sections of the Project Plan summarize the:

- SSHAC process components (evaluation, integration, peer review, and documentation);
- Structure of workshops and working meetings;
- Project database that will be the repository for geospatial data relevant to the project; and
- Key study tasks that will be conducted for the Diablo Canyon SSC project.

SSHAC Process Components

The process of evaluation, integration, documentation, and peer review will occur in a series of workshops, working meetings, and internal work. These process components are described below.

> Evaluation: The consideration of the complete set of data, models and methods proposed by the larger technical community that are relevant to the hazard at DCPP.
>
> The process of evaluation includes, but is not limited to, the: (a) identification of hazard-significant issues; (b) compilation of relevant data, models, and interpretations (e.g., published research papers, geologic and geophysical data); (c) collection of new data as needed; and (d) evaluation of the data, models, and interpretations with respect to their impact on the SSC model. The overall goal of the evaluation process is to compile and evaluate all of the data that is relevant to the SSC. The project database will include relevant seismic, geologic, and geophysical data and will be based initially on the existing LTSP database (current through the 2011 Shoreline fault zone report). The project database will be updated progressively as new information becomes available. The data evaluation process will be led by the TI Team, who will be assisted by the TI Team staff and Resource and Proponent Experts. Many of the interactions between the Experts and the TI Team occur at official project workshops, but various Experts may also be called upon by the TI Team as needed in other settings (e.g., working meetings). Because the SSC logic tree model will be a replacement for the existing LTSP SSC logic tree model, an important part of the evaluation process will be to avoid cognitive bias (e.g., anchoring) to pre-existing characterizations. Through sensitivity analyses, those parts of the SSC logic tree that are most significant to hazard will be the focus for evaluation and update. Those parts of the logic tree model that are not significant to hazard will be reviewed and updated to reflect the current state of scientific knowledge, as appropriate, but will not be the focus of detailed evaluation or further

refinement. The PPRP will be involved in the evaluation process through attending workshops, reviewing interim project documentation, and participating in field reviews and/or working meetings, as needed.

Integration: Representing the CBR of the TDI in light of the evaluation process (i.e., informed by the assessment of existing data, models and methods).

Following the evaluation process, the TI Team will integrate the relevant data, models, and interpretations to develop a replacement SSC logic tree model that captures the CBR of the TDI. The process of integration commonly includes: (a) development of a version of the SSC logic tree model; (b) hazard sensitivity analyses to document the impact of model parameters on the seismic hazard at the frequencies of interest; (c) feedback from the Resource Experts, Proponent Experts, and PPRP members on the logic tree model and hazard sensitivity; and (d) development of the next version of the SSC logic tree. This process is iterated until a final SSC logic tree model is developed.

For the SSC model update, we anticipate three iterations of the logic tree (versions SSC model V0 to V2) before development of the final logic tree model (SSC model V3). Initial versions of the SSC logic tree model will capture the CBR of the TDI as best understood by the TI Team at the time, and/or will be designed as "sensitivity" logic trees to focus on what logic tree parameters are most sensitive to hazard. The final logic tree model (SSC model V3) will be finalized following review and feedback from the PPRP.

The SSC TI Team will lead the integration process; the Hazard Analysts will conduct the iterative hazard sensitivity analyses. The REs and PEs will be less active in this process, but they can be called upon by the TI Teams as needed to provide clarification, resolve new issues, and provide feedback on the preliminary logic tree models. The majority of the integration process will occur through informal working meetings and internal work. The workshops are designed to present the models and sensitivity results, and to collect feedback. The PPRP will be involved in the integration process through attending workshops, reviewing interim project documentation, and attending selected working meetings, as needed.

Peer Review – Participatory peer review is an integral component of a SSHAC Level 3 study. The overall goals of this review will be to ensure that the SSHAC process is adequately followed and that the technical results adequately characterize the CBR of the TDI. The review is participatory in that it will be a continuous process throughout the study, and not a singular review that occurs at the end of the study. As such, the PPRP will be kept abreast of project developments through a combination of attending workshops, reviewing interim project documents, and attending selected field reviews and/or working meetings, as needed. The TI team will have the opportunity to address PPRP comments and make modifications during the project.

Documentation – Documentation also is an integral component of a SSHAC Level 3 study in that it provides a record of the final technical results, how they were reached, and 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 of the Diablo Canyon SSC project also will provide the basis for future PSHA updates for DCPP. Documentation for the study will include workshop summaries and presentations (including videotapes of public workshops), PPRP letter reports and TI Team responses, summary tables that describe the contents of the project geospatial database and the reference library, source-specific source evaluation sheets, the SSC logic tree models, including the model Hazard Input Document (HID), and draft and final reports including PPRP comments.

The SSC project geospatial database will serve as a repository for all project-related geospatial data. The elements of the database will include geospatial data such as: georeferenced geologic and geomorphic maps and associated GIS files, lidar and other topographic survey data, aerial imagery, geographic boundary layers, earthquake catalogs, magnetic and gravity data, oil and gas, water, and geotechnical borehole data, fault trench data, geologic sampling locations, etc. The geospatial database will also house the substantial collection of seismic survey data, mainly in SEGY format. A catalog detailing the individual geospatial database components will be compiled in Microsoft Excel. The catalog will include a brief description of the data set, data type, date, file path, author, and version information. Examples of records from the project geospatial database are presented in Attachment 1.

The references and datasets considered by the SSC TI Team for construction of the SSC logic tree models will be compiled in a reference library. A record of the library contents and how they were considered by the SSC TI Team will be provided by data summary tables and source evaluation sheets. The data summary tables will be compiled from a reference database designed with Microsoft Access software and maintained by SSC TI Team staff. The data summary tables are an output of the reference database that provide a record of what documents and datasets were reviewed and considered by the SSC TI Team for input in the SSC logic tree model. The source evaluation sheets are a separate output that includes compiled information from the reference database and is a record that describes the basis for each branch value and weight in the SSC logic trees, starting with SSC model V2 and going through the final SSC model V3. Examples of the data summary table and source evaluation sheets are provided in Attachment 1.

Structure of Workshops

Each workshop will have an opening session to present results of the sensitivity analysis, followed by presentations from Resource and/or Proponent Experts. The Expert presentations will be organized into themes, with several presentations on a common topic, issue, proponent model or data set, followed by a discussion session to fully query each speaker regarding their data, interpretation, or proponent model. A summary session will be provided at the conclusion of each day. All workshop materials and presentations will be documented and made publically available.

Structure of Working Meetings

Working meetings will take place on an approximately monthly to quarterly basis and will provide an opportunity for the TI Team to identify and review topics of relevance to SSC at Diablo Canyon, develop the structure and content of the SSC logic tree models, and plan workshops. The working meetings involve the TI Team, appropriate members of the TI Team staff and/or the Database Manager (depending on the topic), and one of the Hazard Analysts and/or a member of the SWUS GMC TI Team. Members of the PPRP are invited to attend and observe the working meetings.

Project Geospatial Database

A key tool that will be utilized in the Diablo Canyon SSC study is the geospatial database of seismic, geologic, geophysical, and geographic information that has been in development through PG&E's LTSP update program. This geospatial database will be developed further as the SSC study progresses in response to data needs identified by the TI Team, the PPRP, and other experts (RE and PE) queried by the TI Team. As described above under Documentation, the geospatial database includes geospatial data such as: georeferenced geologic and geomorphic maps and associated GIS files, lidar and other topographic survey data, aerial imagery, geographic boundary layers, earthquake catalogs, magnetic and gravity data, oil and gas, water, and geotechnical borehole data, fault trench data, geologic sampling locations, etc. The geospatial database will also house the substantial collection of seismic survey data, mainly in SEGY format. This database will be available at working meetings and workshops for querying, review, and analysis. The project geospatial database developed for the SSC study will become part of the SSHAC documentation and will be publically available. All of the relevant database content that contributes to the final SSC model (either directly or indirectly by informing the evaluation and integration process) will be described within the final SSHAC documentation.

Key Study Tasks

The current version of this Project Plan was revised in June, 2013, after several of the following tasks were completed. Those completed tasks will be indicated as such.

Task 1: Preparation of Draft Project Plan and Initial Sensitivity Analysis

The initial task for the SSC project was to prepare the draft Project Plan and prepare for Workshop 0 (the Kick-off Meeting). Preparation for Workshop 0 included reviewing the 2011 LTSP SSC model (based on the PG&E (2011) Final Shoreline Fault Report model), conducting sensitivity analyses using the initial SSC model and the existing GMC model, and establishing contractual relationships with the PPRP, TI Team and staff, Database Manager, and Hazard Analysts. This task was completed in August, 2011.

Task 2: Workshop 0 (Kick-off Meeting)

Workshop 0 (the Kick-off meeting) was attended by the PTI, the SSC TI Team and staff, the PPRP, the Database Manager, and the Hazard Analysts. Because the Diablo Canyon SSHAC project included both SSC and GMC components at that time, the GMC TI Team and staff and additional PPRP members were also present. The meeting took place on August 25, 2011. The meeting objectives were to: (a) present and explain the SSHAC methodology (i.e., SSHAC training), (b) present the draft Project Plan and schedule for the study; (c) present the 2011 LTSP model sensitivity analysis to identify key parameters and features most significant to hazard at the site; and (d) identify REs and PEs that will be used in the study to address the significant parameters and features. A review of the LTSP program from initial development of the 1988 SSC and GMC models (PG&E, 1988) to the 2011 SSC and GMC models developed as part of the Shoreline Fault Study (PG&E, 2011) was provided. The outcomes of Workshop 0 included revisions to the draft Project Plan and the identification of the initial set of REs for Workshop 1. The PPRP provided a letter documenting their observations and comments on the draft Project Plan. Important data needs or data gaps identified during the meeting were submitted to PG&E for integration with the ongoing PG&E field program. This task was completed in August, 2011.

Task 3: Preparation for Workshop 1 and Initial Evaluation

Following Workshop 0, additional data developed by the ongoing PG&E field program were gathered and input into the project geospatial database. Results from the ongoing PG&E field program were considered and evaluated. These studies included:

- Initial 3-D Tectonic Model Results
- Initial Low Energy 3D Seismic Survey Results.
- Initial Los Osos/Edna Fault Map Results

Based on the sensitivity analysis performed for Workshop 0, key parameters of the SSC model that were identified as significant to hazard were noted, and data availability, gaps and needs to address those hazard-significant parameters were considered during the selection of REs to present at Workshop 1. Prior to Workshop 1, REs were identified and a list was provided to the PPRP for their review. The PPRP was provided the opportunity to identify additional REs for consideration and/or significant issues or topics to be covered at the workshop. The REs were contacted prior to the workshop and provided with a specific request for information, data or discussion topics as described in task 4. This task was completed in November, 2011.

Task 4: Workshop 1 – Significant Issues, Available Data and Data Needs

Workshop 1 lasted for three days between November 29 and December 1, 2011, and was attended by the PTI, the SSC TI Team and staff, GMC TI Team and staff, the PPRP, the Database Manager, the Hazard Analysts, and Resource Experts (REs). Because the workshop was held prior to the separation of the Diablo Canyon SSC and the SWUS GMC projects (and prior to the most recent revision of this SSC Project Plan), the PPRP then consisted of six members, including the four on the current PPRP for the Diablo Canyon SSC study (Figure 1). The goal of WS1 was to discuss issues significant to hazard, identify available data to address the significant issues, and identify gaps in data or knowledge that can be obtained through further investigations to reduce epistemic uncertainty related to the significant issues. REs were asked to discuss specific data sets and to assist in identifying available data to address significant issues. Legacy data from the prior LTSP studies were presented, if relevant to the current Diablo Canyon SSC project. Prior to the workshop, letters were sent to selected REs identifying directed topics and issues that they should be prepared to address at the meeting. The letters helped focus the workshop discussion on key issues related to a particular data set, including quality and resolution of data, expected use of data, uncertainty or limitations in the data or interpretations, etc. The REs were asked to present data in oral sessions and/or to participate in interactive discussion sessions with the TI Team and other REs. The presentations and following discussion informed the TI Team of the available data and evaluations and interpretations of the data. In addition, data needs identified during the course of Workshop 1 were compiled by the TI Team and used to help define the scope of further PG&E-funded field investigations and research studies. Digital video files of the workshop and electronic files of presentation materials were posted on PG&E's website and made publically available following the meeting.

The PPRP attended Workshop 1 as observers, and provided verbal comments at the end of each day and at the conclusion of the workshop. The day following the three-day workshop, the PPRP caucused for a half-day meeting to review the workshop proceedings. During this meeting, the PPRP prepared written comments and feedback to the PTI and TI Teams. The PTI and TI Team Leads provided written responses to the PPRP comments. Following the workshop and PPRP meeting, the proceedings of the workshop were documented in a brief workshop summary for distribution to the Project Sponsor and members of the PPRP. The workshop summary and PPRP letter will be publically available and become part of the final documentation of the Diablo Canyon SSC project.

Topics addressed at Workshop 1 included the following:

- Project overview and objectives
- Review of SSHAC procedures and workshop ground rules
- Presentation of sensitivity analyses on SSC and GMC logic tree version V0 models
- Presentations of new data and information collected from ongoing PG&E and USGS CRADA programs
- Interactive discussion with Resource Experts (selected presentations)
- Exploration of key data, data uncertainties, and appropriate use and limitations of the data interpretations
- Identification of additional data gaps, data needs, and/or analyses

Task 5: Data Evaluation and Preparation for Workshop 2

Task 5 started following Workshop 1, and during this task the decision was made to separate the Diablo Canyon SSHAC study into the Diablo Canyon SSC project (covered by this Project Plan) and the SWUS GMC project (covered by a separate Project Plan). Task 5 consisted of SSC TI Team evaluations of the data, information, and interpretations provided by the REs, and additional information collected from the ongoing field and research programs through a series of working meetings and internal work between working meetings. The project geospatial database and reference database were updated and utilized during the working meetings. A primary objective of Task 5 was to identify the range of potential alternative interpretations or models resulting from the evaluation of available data, and to identify PEs to discuss and defend these alternative interpretations or models. The SSC TI Team compiled and evaluated additional relevant data identified in Workshop 1, considered the range of alternative interpretations of these data, and developed sensitivity logic trees that constituted SSC logic tree model V1. The primary purpose for this initial update model was to perform sensitivity analyses to identify those models and/or interpretations of the data that are most significant to hazard. The sensitivity analyses were performed by the Hazard Analysts using version V0 of the GMC logic tree. The sensitivity analyses were used to (1) assist the SSC TI Team in their evaluation of the data, and (2) identify potential PEs for invitation to Workshop 2. Working meetings of the TI Team included presentations of hazard sensitivity results by the Hazard Analysts, and several were observed by one or more members of the PPRP. Prior to Workshop 2, PEs were identified and their names provided to the PPRP for their review. The PEs were contacted prior to the workshop and provided with a specific request for discussion topics as described in Task 6. Task 5 was completed in October, 2012.

Task 6: Workshop 2 – Proponent Models

Workshop 2 occurred over three days between November 6 and 8, 2012. The workshop was attended by the PTI, the TI Team and staff, the PPRP, the Database Manager, the Hazard Analysts, selected members of the SWUS GMC TI Team, and Proponent Experts (PEs). The primary goal of Workshop 2 was to use the PEs to explore the center, body, and range of TDI for the SSC, with a focus on those parameters of the logic trees in SSC model V1 that are most significant to hazard. In addition, several of the PEs identified other alternative models or technical issues that were not captured in the V1 logic trees. These alternative models or technical issues were identified during the Workshop for future evaluation by the TI Team and will be considered for inclusion in later versions of the SSC logic tree model, as appropriate. The workshop provided a forum to explore alternate interpretations of data and alternative hypotheses derived from the data in a series of presentations and structured dialog between the various PEs and the TI Team. The information gained from these interactions will, combined with information within the project geospatial database and reference database, form the basis for defining the center, body, and range of the TDI and be used to update the SSC model V1. Workshop 2 also will be used to identify additional data gaps, data needs, and/or analyses that may be performed to further evaluate alternative models or key model parameters and uncertainties. Digital video files of the workshop and electronic files of presentation materials were posted on PG&E's website and made publically available following the meeting.

The PPRP attended Workshop 2 as observers, and provided verbal comments at the end of each day and at the conclusion of the workshop. Following the three-day workshop, the PPRP caucused to review the workshop proceedings. The PPRP prepared written comments and feedback to the Project Sponsor, PTI and TI Team. The PTI and TI Team Lead provided written responses to the PPRP comments. Following the workshop, the proceedings will be documented in a brief workshop summary for distribution to the Project Sponsor and members of the PPRP. The Workshop summary and PPRP letter will be publically available and become part of the final documentation of the Diablo Canyon SSC project.

The topics addressed at Workshop 2 included the following:

- Introduction
- SSHAC procedures and workshop ground rules
- New data and information collected from ongoing PG&E and USGS CRADA programs
- Interactive discussion with Proponent Experts (selected presentations)
- Exploration of key parameters, data or model uncertainties, and alternative models
- Identification of additional data gaps, data needs, and/or analyses

Task 7: Data Evaluation and Integration for SSC Model V2 Development

Following Workshop 2, a series of working meetings and internal work will be performed to evaluate the available data and range of alternative proponent models. The SSC TI Team will evaluate the data presented at Workshop 2 and new data that become available from ongoing studies and integrate the information into logic trees that constitute SSC model V2. Formal RE and PE presentations based on newly available data will be provided at working meetings, where possible. These presentations at working meetings will be provided as part of the final documentation of the Diablo Canyon SSC project. The basis for the SSC model V2 characterizations (e.g., earthquake magnitudes, rupture geometries, earthquake rates) will be documented within the reference database and in source evaluation sheets. The SSC model V2 logic trees and supporting source evaluation sheets will ultimately become part of the documentation of the SSC project. The logic trees and source evaluation sheets will be provided to the PPRP prior to Workshop 3 so that the PPRP will be able to fully evaluate the SSC model V2 before the workshop.

Task 8: Workshop 3 – Preliminary Model and Hazard Feedback Workshop

Workshop 3 will last three days and be attended by the PTI, the TI Team and staff, the PPRP, the Database Manager, the Hazard Analysts, members of the SWUS GMC TI Team, and selected REs and PEs that are identified by the TI Team, as needed. The first part of Workshop 3 will be allocated to select PE presentations based on data or analyses performed following Workshop 2. Following the select PE presentations, the main activities of Workshop 3 will begin. In contrast to Workshops 1 and 2, the PPRP will be active participants in Workshop 3 to fully query the model parameters, level of documentation, uncertainty, and rationale in developing the model. The primary focus of Workshop 3 will be for the TI Team to integrate information into models that represent the CBR of TDI.

During Workshop 3, the SSC model V2 logic trees will be presented to the PPRP and selected REs and PEs, as needed. The workshop provides an opportunity for the REs, PEs, and PPRP to review and challenge the TI team's evaluations and the technical justifications used to develop the structure of the SSC logic trees and weights on branches of the logic trees (e.g., whether any significant interpretations are missing, how the TI Team has integrated the alternative models and data uncertainties into a single SSC, etc.). The TI Team will use this feedback in developing the final version of the SSC logic trees.

At Workshop 3, the Hazard Analysts will present preliminary hazard calculations and sensitivity analyses based on the SSC model V2 logic trees to the TI Team and the PPRP to provide the TI Team with feedback about the implications of the SSC logic trees on hazard. The preliminary hazard calculations and sensitivity analyses will be performed using the most current GMC models developed during the parallel SWUS GMC project. The hazard sensitivity also will be used to focus the discussion by the REs, PEs, and PPRP on the technical issues and parameters that have the greatest effect on the hazard at the DCPP site.

The proceedings of Workshop 3 will be documented in a brief workshop summary report for distribution to the Project Sponsor and members of the PPRP, and the PPRP will submit a letter to the Project Sponsor, PTI, and TI Team Lead documenting their observations of the workshop. The PTI and TI Team Lead will provide written responses to the PPRP comments. The workshop summary and PPRP letter will be publically available and become part of the final documentation of the Diablo Canyon SSC project.

The topics to be addressed at Workshop 3 will include the following:

- SSC model V2 logic tree
- Preliminary hazard calculations and sensitivity analysis of SSC model V2 logic tree to identify hazard-significant issues and parameters
- Review and challenge of the TI Team logic tree (SSC model V2)
- Identification of shortcomings of the logic tree
- Identification of key models and parameters requiring further evaluation
- Identification of additional analyses to better constrain logic trees

Task 9: SSC Model V3 Development and Reporting

Following Workshop 3, the TI Team will revise the SSC model V2 logic trees in response to the PPRP comments, Expert comments, and any additional information that is collected or discovered as part of the SSHAC process and ongoing PG&E field program.

The model developed during this stage will be the SSC logic tree model V3. To develop the model, the TI Team will hold a series of Working Meetings to discuss significant issues that were raised by the PPRP and/or experts on the SSC model V2 logic trees. The TI Team may also utilize REs and PEs, as necessary, to further refine alternate interpretations within the characterizations. As part of finalizing the model, the TI Team will finalize the source evaluation sheets, data summary tables, and project geospatial database and will prepare the draft SSC technical report. The SSC model V3 logic trees will be transferred to the Hazard Analysts through a Hazard Input Document (HID) for a series of hazard calculations and sensitivity analyses. The final draft SSC model V3 will be implemented using the final draft GMC model developed by the parallel SWUS GMC project.

The SSC logic tree model V3 and the supporting documentation will be provided to the PPRP prior to a final briefing meeting so that the PPRP will be able to review the technical content of the SSC model. The final briefing meeting will include presentation of the final draft SSC model V3 and hazard calculations and sensitivity analyses to the PPRP. The meeting will be attended by the Project Sponsor, PTI, the TI Team and staff, the PPRP, the Database Manager, the Hazard Analysts, and members of the SWUS GMC TI Team. The goals of the final briefing meeting are for the TI Team and Hazard Analysts to present to the PPRP: (1) a review of the SSHAC Level 3 process that was used to develop the final logic trees; (2) the final draft SSC V3 model including how the PPRP, PE, and RE comments from workshop 3 were addressed; and (3) the final hazard feedback (model V3 hazard results and sensitivity analyses) at the DCPP site from the combination of the final draft SSC model developed during this study and the final draft GMC model developed in the parallel SWUS GMC project. The intent of these presentations is to provide the PPRP with a clear representation of how the TI Team integrated the CBR of the TDI into the SSC model and how these characterizations impact seismic hazard. The dialogue and interaction with the PPRP will be used to help refine the final SSC model and the final project documentation of the Diablo Canyon SSC project. The proceedings of the final briefing meeting will be documented in a brief summary for distribution to the Project Sponsor and members of the PPRP, and the PPRP will submit a letter to the Project Sponsor, PTI, and TI Team Lead documenting their observations of the final briefing meeting. The meeting summary and PPRP letter will become part of the documentation of the Diablo Canyon SSC project.

Following the final briefing meeting, the SSC logic tree model V3 will be finalized and a final HID will be provided to the Hazard Analysts. In a separate project, the final SSC model V3 will be implemented using the final GMC model developed by the parallel SWUS GMC project to calculate the final hazard. The site response will be incorporated as part of the development of the GMRS as per the 50.54(f) letter. Concurrent with this activity, the final draft SSC technical report will be prepared that will incorporate the results of the final briefing meeting.

Task 10: Report Finalization

This task includes development of the final documentation of the Diablo Canyon SSC project. This documentation includes the final technical report and final HID, and finalization of the supporting materials, including: workshop and Expert presentation documentation, data summary tables and source evaluation sheets, and project geospatial database contents. The final draft report will be provided to the PPRP for their review. It is anticipated that the technical content of the SSC logic tree model V3 will not change following the final briefing meeting and submittal of the final HID under Task 9, and that review of the final draft technical report by the PPRP following submittal of the final HID will be focused on the model documentation, not model content. Upon completion of their review, the TI Team will respond to PPRP comments and finalize the report. The PPRP will review the response to comments and Final Report, and provide a letter to the Project Sponsor, PTI, and TI Team Lead documenting their evaluation of the report and the project's compliance with the SSHAC Level 3 process. This letter will be included in an appendix of the Final Report.

Project Schedule

The schedule for completing the Diablo Canyon SSC project is presented on Figure 2. The project commenced with Workshop 0 (Kickoff Meeting) in 2011, and is targeted for completion in November, 2014, a 3½-year duration. Workshops are anticipated to be held at 12- to 16-month intervals during the study.

As described above, the goal of following the SSHAC Level 3 methodology is to have reasonable assurance that epistemic uncertainties in the SSC logic trees have been adequately captured for use in an updated PSHA for Diablo Canyon. Accurately capturing these uncertainties is essential to developing an SSC model that will: (1) be accepted by the NRC, and (2) provide a robust characterization of the hazard at the DCPP site. This goal is accomplished by following the formal SSHAC process of data collection, evaluation, integration, participatory peer review, and documentation. While the process is formal, in that the required process steps are defined within the SSHAC documentation (Budnitz et al., 1997), the process is very dynamic. For example, the discovery of new data can trigger additional evaluation steps, and attempts to integrate unexpected alternative models identified and/or supported by experts can slow the integration process. Comments by the PPRP and experts can trigger the need for unexpected analysis and revisions to the SSC. All of these dynamic events are part of the SSHAC process, and the unexpected work they trigger needs to be conducted to ensure that the uncertainties in SSC are appropriately characterized.

The schedule for the Diablo Canyon SSC project on Figure 2 considers the development of new data, the complex tectonic setting of the site region, and possible requests or need to develop new information to address specific SSC parameters and uncertainties. In particular, the SSC project schedule incorporates the schedule for the ongoing PG&E field studies and geophysics program, and the USGS CRADA Program. However, because of possible unexpected events, we view the schedule as dynamic. Task durations and start dates will be adjusted throughout the course of the project to accommodate these unexpected events to the extent possible, but the target completion date for March, 2015 will be maintained in order to comply with the NRC mandated 50.54(f) schedule.

QUALITY ASSURANCE

Quality Assurance for development of the SSC model is the SSHAC process itself and the participatory peer review. As stated in NUREG 2117 (NRC, 2012) "participatory peer review is a fundamental element in ensuring the quality of the resulting PSHA product." ... "Hence, following the guidance contained in these documents for either a Level 3 or 4 assessment, NUREG/CR-6372, ANSI/ANS-2.29-2008 and ANSI/ANS-2.27-2008 will result in a study that satisfies the intent of national quality standards." 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. Thus, the SSHAC process will not be required to follow the PG&E Geosciences QA procedures.

Implementation of the final SSC model into hazard inputs, however, will be required to follow the PG&E Geosciences QA procedure. The translation of the SSC model into PSHA inputs will be documented in Hazard Input Documents (HIDs) and the HIDs will be part of the QA documentation. Any changes to the hazard code that is required to implement the SSC model will require that the revised hazard program be verified under the QA program. The final PSHA calculations will be conducted under the PG&E Geosciences QA program.

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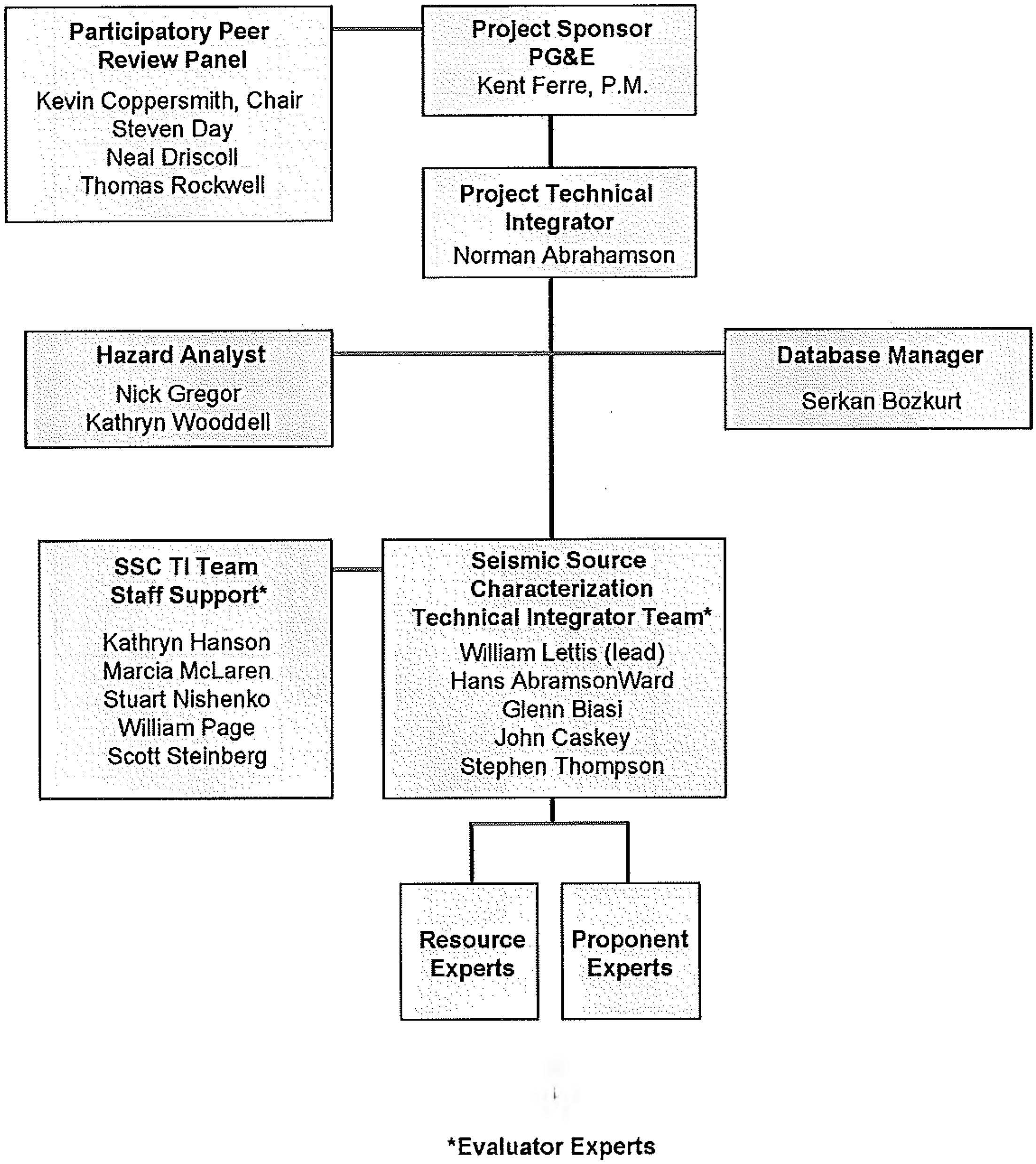

Figure 1. Diablo Canyon SSC Project Organizational Chart

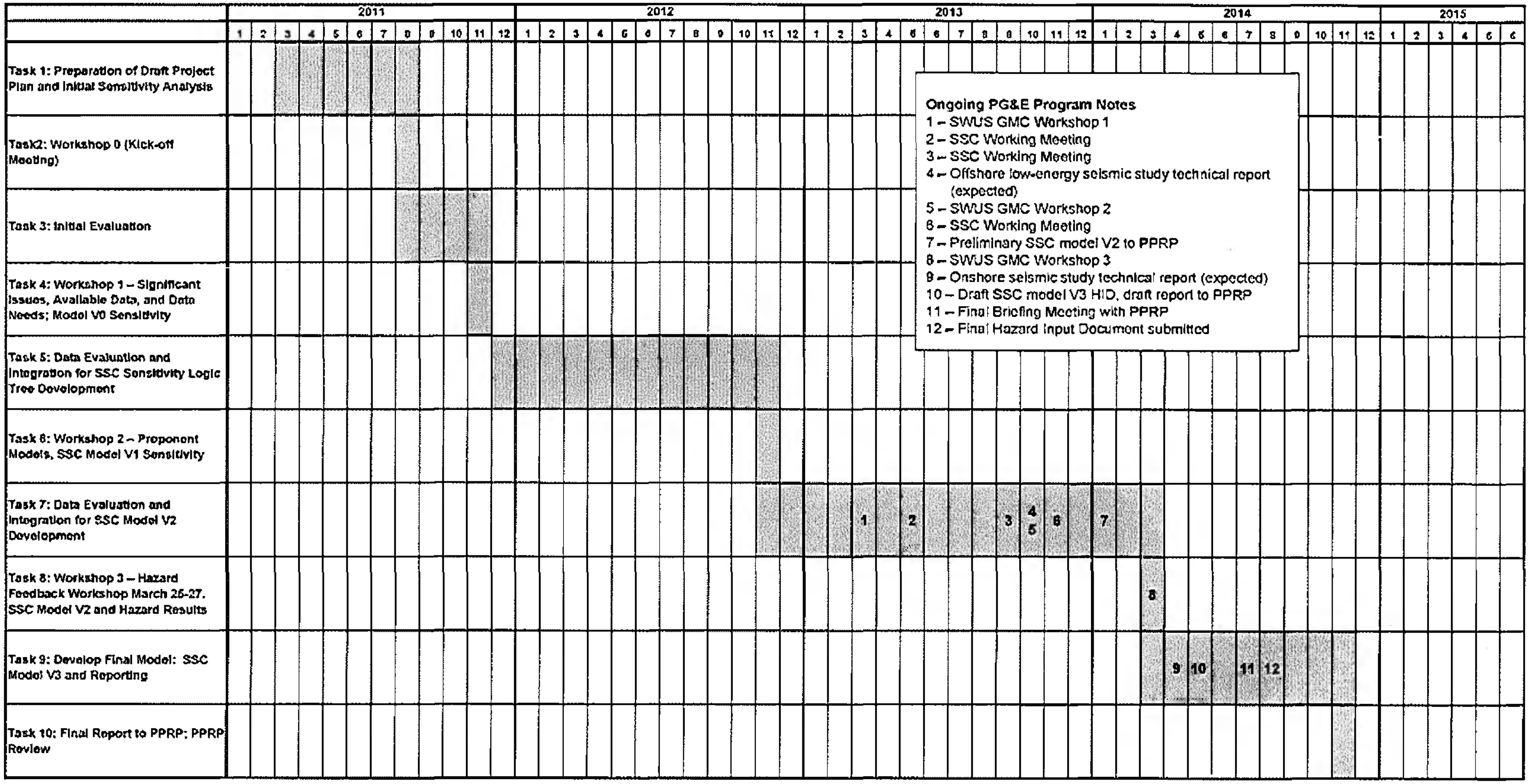

Figure 2: Diablo Canyon SSC Project Schedule

Attachment 1

Examples of Diablo Canyon SSC Project Documentation Forms

Contents:

A1. Project Geospatial Database Table Example

Short data description	Data type	Data condition	Data Scale or resolution	Data date	Author	Data delivery method	Status	Updated by	Date of table update
Regional basemap with culture	.mxd map file	other	1:200,000	12/2/2010	AMEC Geomatrix	created by GIS Group		B. Gray	12/9/2011
Map of DCPP at 1:1500 with 2010 coastal LIDAR	ArcMap .mxd map document	other	1:1,500	8/12/2010	AMEC Geomatrix	created by GIS Group		B. Gray	12/8/2011
Map of DCPP at 1:2000 with 2010 coastal LIDAR	ArcMap .mxd map document	other	1:2,000	8/12/2010	AMEC Geomatrix	created by GIS Group		B. Gray	12/8/2011
2 ft contours generated from 2010 coastal LIDA	CAD file	other	2ft	7/14/2011		created by GIS Group		B. Gray	12/8/2011
bathymetry DEM from unknown source and dat	DEM raster image	Digital GIS layer	5 m	5/6/2010	AMEC Geomatrix	created by GIS Group		B. Gray	12/8/2011
Composite DEM 2009 V1 DEM, offshore and on	DEM raster image	Digital GIS layer	2 m	3/10/2009	AMEC Geomatrix	created by GIS Group	Superseded	B. Gray	12/8/2011
Composite DEM 2009 V1 DEM, offshore and on	DEM raster image	Digital GIS layer	2 m	3/10/2009	AMEC Geomatrix	created by GIS Group	Superseded	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m A1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI	created by GIS Group	Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m A2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI	created by GIS Group	Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m A3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI	created by GIS Group	Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m A4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m B1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m B2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m B3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m B4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m C1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m C2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m C3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m C4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m D1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m D3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile 2m D4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile A1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile A2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile A3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile A4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile B1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile B2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile B3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile B4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile C1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile C2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile C3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile C4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile D1	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile D2	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile D3	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
Composite DEM 2011 V7 tile D4	DEM raster image	Digital GIS layer	1m for most, 5+m for no	11/8/2011	LCI		Current	B. Gray	12/8/2011
2011 onshore LIDAR DEM, tile A1	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile A2	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile A3	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile B1	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile B2	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile B3	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile B4	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011
2011 onshore LIDAR DEM, tile C1	DEM raster image	Digital GIS layer	0.5 m	9/2/2011	LCI		Current	B. Gray	12/9/2011

Summary Reference Evaluation Report
DCPP SSHAC3 Program

Critical	Used in SSC?	Authors (first three)	Year	Title	Source	Description and Relevance	Relevant Seismic Source Model Component*	Relevant Fault(s)*	Evaluator	Checker(s)	RefID
☐	☐	Walker, A., W., Mooney, W., D.,	1987	Interpretations of the SJ-6 seismic reflection/refraction profile, south-central California, USA	U.S. Geol. Surv. Open File Rpt	A collection of papers presented during a workshop held to analyze a single seismic line extending from Morro Bay to the Sierra Nevada foothills. Provides analysis of velocity and crustal structure utilizing both reflection and refraction data.	C U ☐☐ Fault Model ☑☐ Deformation Model ☐☐ Earthquake Rate Model ☐☐ Probability Model ☐☐ None	C U ☐☐ Hosgri Fault ☐☐ San Simeon Fault ☐☐ Los Osos Fault ☐☐ Wilmar Ave Fault ☐☐ San Luis Bay Fault Zone ☐☐ Shoreline Fault ☐☐ San Miguelito Fault ☐☐ Blind Ramp ☑☐ Other Regional Faults ☐☐ All Faults	Gray, Brian		700
☐	☐	Pantosti, D., Pucci, S., Palyvos, N.,	2008	Paleoearthquakes of the Duzce fault (North Anatolian Fault Zone): insights for large surface faulting earthquake recurrence	J. Geophys. Res.	Details a paleoseismic study on the Duzce fault in northern Turkey. Four events were recognized, including 1999, with an average recurrence of 320-390 years, generally consistent with other observations. The three most recent events are more closely spaced than the overall recurrence interval. Based on this, rupture does not appear to occur be periodic.	C U ☑☐ Fault Model ☐☐ Deformation Model ☑☐ Earthquake Rate Model ☑☐ Probability Model ☐☐ None	C U ☐☐ Hosgri Fault ☐☐ San Simeon Fault ☐☐ Los Osos Fault ☐☐ Wilmar Ave Fault ☐☐ San Luis Bay Fault Zone ☐☐ Shoreline Fault ☐☐ San Miguelito Fault ☐☐ Blind Ramp ☐☐ Other Regional Faults ☑☐ All Faults	Gray, Brian	AbramsonWard	350
☐	☐	Walker, R., Jackson, J.,	2002	Offset and evolution of the Gowk fault, S.E. Iran: a major intra-continental strike-slip system	J. Struct. Geol.	Provides geologic and geomorphic context for the Gowk fault, which may be used to understand fault linkage and rupture scenarios for faults near DCPP. The Gowk fault occupies a restraining bend in the larger fault system. Uses drainages and other geomorphic features to reconstruct the last 3 and, more crudely, 12 km of slip along the fault. Slip rate of the fault system (including the Nayband fault to the north) is estimated to be 1.6-2.4 mm/yr, in the range of estimated slip rate for the Hosgri. Proposes a ramp-flat geometry at depth in which strain is partitioned between the Gowk (strike slip) and Shahdad (reverse faults).	C U ☐☐ Fault Model ☐☐ Deformation Model ☑☐ Earthquake Rate Model ☐☐ Probability Model ☐☐ None	C U ☐☐ Hosgri Fault ☐☐ San Simeon Fault ☐☐ Los Osos Fault ☐☐ Wilmar Ave Fault ☐☐ San Luis Bay Fault Zone ☐☐ Shoreline Fault ☐☐ San Miguelito Fault ☐☐ Blind Ramp ☑☐ Other Regional Faults ☐☐ All Faults	Gray, Brian	Caskey	357

*C = considered in the SSC, U = used in the SSC

A3. Source Evaluation Sheet Example

Example Source Evaluation Sheet (draft Rev. A)
Diablo Canyon SSC Project

FAULT ID	TBD
FAULT NAME	Example fault
Parent Fault System	Example fault system
Approximate Distance from Site (km)	5 km

Seismotectonic Setting
Describe fault location with respect to physiographic province, nearby mountain ranges and/or basins, or other significant sub-provinces. Describe general pattern of seismicity, location within general plate boundary framework, etc.

Style of Faulting
Data: Summarize relevant studies that provide slip indicators, focal mechanisms, interpretations based on stress field, GPS data, etc.

Previous Characterizations: Describe brief history of alternative interpretations of style of faulting.

Fault Activity and Age of Last Slip
Data: Summarize previous studies that note age of last slip based on offset surficial deposits or strata, paleoseismic investigations, marine geophysical studies, etc. Mention presence or absence of information related to recurrence interval of large events.

Previous Characterizations: State how fault was characterized in prior logic trees.

Slip Rate Data
Data: Describe previously published slip rates and time over which slip rate was estimated (e.g., geodetic-based, Holocene, Late Pleistocene, Neogene, etc.)

Previous Characterizations: Describe previously implemented slip rates.

Fault Length, Segmentation, and Rupture Length
Data: Describe the lengths depicted in previous mapping, note any previous interpretations of segmentation. Describe distances to adjacent faults and compare fault orientation, dip, and sense of slip, and basis for kinematic linkages (or lack thereof) between the fault and adjacent faults.

Previous characterizations: Describe the fault lengths used in prior characterizations, rupture lengths used in prior characterizations, basis for rupture lengths, and whether ruptures were fixed to segments or floated.

Fault Dip
Data: Describe references and datasets that bear on fault dip, especially at locations nearest the site, describe data-driven (seismic lines, hypocenters) versus model-driven (assumed based on sense of slip) justifications for fault dip.

Previous characterizations: Describe the dip values selected in prior source models.

Source Evaluation Sheet, Rev. A p. 1 May 4, 2012

Example Source Evaluation Sheet (draft Rev. A)
Diablo Canyon SSC Project

Fault Depth

Data: Describe the data used to justify depth of the seismogenic fault source; for example, heat-flow data, hypocenter depths from small earthquakes in region; depths of moderate or large earthquakes in area (e.g., 2003 San Simeon); discuss published data on fault depths limited by truncations by other structures (from cross-sections, kinematic models, etc.

Previous characterizations: Describe the fault depths used in previous source characterizations.

Earthquake Magnitude PDF

Data: Describe whether microseismicity or historic moderate to large earthquakes are associated with the fault. Provide published data on past slip per event from paleoseismology, or other indicator of past earthquake size. Provide published values or data on rates of small earthquakes on the fault and/or surrounding the fault.

Previous Characterizations: Describe previous magnitude distributions modeled on the fault.

REFERENCES:

Provide full citation list plus RefID numbers from reference database / Data Summary table.