U.S. NUCLEAR REGULATORY COMMISSION
NOTICE OF GRANT/ASSISTANCE AWARD

1. GRANT/AGREEMENT NO.	2. MODIFICATION NO.	3. PERIOD OF PERFORMANCE	4. AUTHORITY
NRC-04-09-144	M003	FROM: 06/26/2009 TO: 12/31/2010	Pursuant to Section 31b and 141b of the Atomic Energy Act of 1954, as amended

5. TYPE OF AWARD	6. ORGANIZATION TYPE	7. RECIPIENT NAME, ADDRESS, and EMAIL ADDRESS
☐ GRANT ☒ COOPERATIVE AGREEMENT	062511126	ELECTRIC POWER RESEARCH INSTITUTE, INC. 3420 HILLVIEW AVE PALO ALTO CA 943041338 rreid@epri.com

8. PROJECT TITLE:
Central and Eastern United States (CEUS) Seismic Hazard Update Project

9. PROJECT WILL BE CONDUCTED	10. TECHNICAL REPORTS ARE REQUIRED	11. PRINCIPAL INVESTIGATOR(S) NAME, ADDRESS and EMAIL ADDRESS
PER GOVERNMENT'S/RECIPIENT'S PROPOSAL(S) DATED 08/25/2010 AND APPENDIX A-PROJECT GRANT PROVISIONS	☒ PROGRESS AND FINAL ☐ FINAL ONLY ☐ OTHER (Conference Proceedings)	Electrical Power Research Institute (EPR Attention: Richard Reid 3420 Hillview Avenue Palo Alto CA 94304-1338 rreid@epri.com

12. NRC PROGRAM OFFICE (NAME and ADDRESS)	13. ACCOUNTING and APPROPRIATION DATA	14. METHOD OF PAYMENT
US Nuclear Regulatory Commission Office of Research Attention: Robert Roche Rivera Mailstop: CSB C5A24M Washington DC 20555 301-251-7645	APPN. NO: 31X0200.060 B&R NO: 060-15-171-277 JOB CODE: K6877 BOC NO: 4110 OFFICE ID NO: RES-09-144	☐ ADVANCE BY TREASURY CHECK ☐ REIMBURSEMENT BY TREASURY CHECK ☐ LETTER OF CREDIT ☒ OTHER (SPECIFY) Electronic ASAP.gov (See Remarks in Item #20 "Payment Information")

15. NRC OBLIGATION FUNDS		16. TOTAL FUNDING AGREEMENT	
THIS ACTION	$120,003.00	NRC	$731,845.11
PREVIOUS OBLIGATION	$611,842.11	RECIPIENT	$0.00
TOTAL	$731,845.11	TOTAL	$731,845.11

This action provides funds for Fiscal Year 10 in the amount of $120,003.00

17. NRC ISSUING OFFICE (NAME, ADDRESS and EMAIL ADDRESS)

U.S. Nuclear Regulatory Commission
Div. of Contracts
Attn: Erika Eam, 301-492-3492
Mail Stop: TWB-01-B10M
Washington, DC 20555

18. Acceptance of or objections to the Terms and Conditions of Award must be Emailed to the NRC Issuing Office (Block #17) within three (3) business days following the Award issue date. NRC considers lack of response as acceptance by the grantee of the terms and conditions of award.

19. NRC CONTRACTING OFFICER

Sheila Bumpass 9/15/2010
(Signature) (Date)

NAME (TYPED) Sheila Bumpass
TITLE Contracting Officer
TELEPHONE NO. 301-492-3484

20. PAYMENT INFORMATION

Payment will be made through the Automated Standard Application for Payment (ASAP.gov) unless the recipient has failed to comply with the program objectives, award conditions, Federal reporting requirements or other conditions specified in 2 CFR 215 (OMB Circular A110).

21. Attached is a copy of the "NRC General Provisions for Grants and Cooperative Agreements Awarded to Non-Government Recipients. Acceptance of these terms and conditions is acknowledged when Federal funds are used on this project.

22. ORDER OF PRECEDENCE
In the event of a conflict between the recipient's proposal and this award, the terms of the Award shall prevail.

23. By this award, the Recipient certifies that payment of any audit-related debt will not reduce the level of performance of any Federal Program.

Accordingly, the following changes are as follows:

1. **Extend the period of performance** – Delete the dates in Block in its entirety and replace with the following, "FROM: 06/26/2006 TO: 12/31/2010"
2. **Increase the award ceiling** – In the amount of $120,003.00 from $611,843.11 to $731,845.11. Block 16 TOTAL FUNDING AGREEMENT, delete in its entirety and replace with the following.

   "NRC $731,845.11
   RECIPIENT $0.00
   TOTAL $731,845.11"

3. **Incrementally fund the award** – In the amount of $120,003.00 from $611,843.11 to $731,845.11. Blocks 15, delete in its entirety and replace with the following,

   "THIS ACTION $120,003.00
   PREVIOUSE OBLIGATION $611,842.11
   TOTAL $731,845.11"

4. **Program Description, add in its entirety. See attached beginning on the next page.**

NRC-04-09-144 M003

Project Plan
Central and Eastern United States
Seismic Source Characterization for Nuclear Facilities

PRODUCT DESCRIPTION

This Project Plan outlines the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities (CEUS SSC) project, which will replace the seismic source characterization that is part of the 1986 EPRI-SOG seismic hazard analysis.

The objective of the CEUS SSC Project is to develop an up-to-date assessment of probabilistic seismic hazard analysis (PSHA) seismic source characterization (SSC) for the CEUS that includes (1) full assessment and incorporation of uncertainties, (2) the range of diverse technical interpretations from the informed scientific community, (3) consideration of an up-to-date database, (4) proper and appropriate documentation, and (5) peer review. If this objective is achieved, the CEUS SSC project will lead to stability and longevity. Stability means that the study enjoys public and regulatory confidence that it is generally accepted by the technical community. Longevity means that the technical underpinnings will remain valid in the future, despite the development of new scientific findings. 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. Accordingly, the project will be conducted using processes described in the Senior Seismic Hazard Analysis Committee (SSHAC) (1997) guidance.

The CEUS SSC Project Team is composed of Program & Project Management, a Technical Integration (TI) Team, TI Staff, a Participatory Peer Review Panel (PPRP), Specialty Contractors, Sponsors, and Agency Experts.

The work consists of several tasks and three (3) workshops over a three -year period. The major tasks and workshops consist of the following:

- Develop Project Plan defining a SSHAC Study Level 3 approach, team personnel & functions, work plan, and schedule. This includes a meeting with the participatory peer review panel to resolve comments on the project plan
- Develop a CEUS geological, geophysical, and seismological database in GIS format with emphasis on data important for the source characterization efforts. This task will include compilation of relevant geological & geophysical data available since mid 1980s
- Update CEUS earthquake catalog that merges and reconciles several regional catalogs and develops uniform moment magnitudes
- **Workshop 1:** Identify hazard-significant SSC issues and identify and discuss important databases with resource experts (to be scheduled in July 2008)
- **Workshop 2:** Present, discuss and debate alternative interpretations of significant seismic source issues with proponents of alternative models (to be scheduled in February 2009)
- Construct a preliminary seismic source characterization (SSC) model and perform hazard calculations and sensitivity analyses

- **Workshop 3:** Present preliminary seismic source characterization (SSC) model and discuss hazard feedback and sensitivity analyses; discuss uncertainties and obtain feedback from resource experts (to be scheduled in August 2009)
- Finalize SSC model including quantifying all uncertainties
- Develop draft CEUS SSC project report for review
- Support reviews by PPRP, Sponsors and oversight groups
- Finalize report incorporating review comments

Results and Findings

The product of this report is a vetted plan to develop a generic Central and Eastern United States (CEUS) seismic source characterization (SSC) model. This model includes consideration of an updated database, full assessment and incorporation of uncertainties and the range of diverse technical interpretations from the informed scientific community. This model is applicable to the Central and Eastern United States (CEUS).

Challenges and Objectives

The generic CEUS SSC model will be of interest to readers who are involved in probabilistic seismic hazard assessment (PSHA) work, and who wish to use an updated seismic source characterization model. This model will be based on a comprehensive and traceable process, in accordance with Senior Seismic Hazard Assessment Committee (SSHAC) guidelines in NUREG/CR-6372, "Recommendations for PSHA: Guidance on Uncertainty and Use of Experts," to assess the present-day composite distribution of the informed scientific community for seismic sources and their characterization in the CEUS and its uncertainty. In addition this model will be in a form suitable for use in PSHA evaluations for regulatory activities such as Early Site Permit (ESP) and Combined Operating License (COL) applications.

Applications, Values, and Use

Development of a generic Central and Eastern United States (CEUS) seismic hazard model will provide value to a) Members that have submitted an Early Site Permit (ESP) or Combined Operating License Application (COLA) for Nuclear Regulatory Commission (NRC) review before 2010, b) Members that will submit an ESP or COLA for NRC review after 2010 and c) Members that must respond to safety issues resulting from NRC Generic Issue 199 (GI-199) for existing plants. This work replaces a previous study that was performed about 20 years ago. Since that study was completed, substantial work has been done to improve the understanding of seismic sources and their characterization in the CEUS. Thus, providing a new generic SSC model will provide a consistent, stable basis for computing PSHA for a future time span. The risk for delays in new plant licensing due to new, more conservative interpretations in the existing and future literature will be reduced.

EPRI Perspective

The purpose of this study is to develop a "new" CEUS seismic source characterization model. The team assembled to accomplish this purpose is composed of distinguished subject matter experts from industry, government and academia. The resulting model will be unique and

because this project will solicit input from the present-day informed scientific it is not likely to be repeated for a number of years.

Approach

The goal of this report was to present the work plan for developing a generic CEUS SSC model. The work plan was developed by a Technical Integration (TI) team, and it consists of a series of tasks designed to meet the project objectives. This report was reviewed by a Participatory Peer Review Panel (PPRP) and Sponsor Reviewers, and the comments from the PPRP are reflected in the report. A meeting on May 8, 2008 was held to facilitate resolution of comments received regarding the project plan.

Keywords

Seismic sources

Probabilistic Seismic Hazard Assessment (PSHA)

ACKNOWLEDGEMENTS

The authors of the report wish to acknowledge the contributions from the Technical Integration (TI) Team, the Participatory Peer Review Panel (PPRP) and Sponsor Reviewers. Their knowledge of the current state of practice provided important insights and support during the preparation of this report. The agreement from this distinguished group of subject matter experts from industry, government and academia to participate in this "landmark" study is greatly appreciated.

CONTENTS

Introduction and context of the study

This Project Plan outlines the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities (CEUS SSC) project, which will replace the seismic source characterization that is part of the EPRI-SOG seismic hazard analysis. The CEUS SSC project will take full advantage of the data used to develop the EPRI-SOG, the United States Geological Survey (USGS) seismic hazard model and other hazard analyses, the data and information developed over the past 20 years, and the information developed as part of ongoing COLA and ESP submittals.

Input to a probabilistic seismic hazard analysis (PSHA) consists of two elements: seismic source characterization (SSC) and ground motion characterization (GMC). These two components are used to calculate probabilistic hazard results (or seismic hazard curves) at a particular site. The 1986 EPRI-SOG study included both an SSC and GMC component. The SSC component was developed through an expert elicitation process. The SSC model was developed so that it would be appropriate for any site within the CEUS and calculations were made for 59 sites in the central and eastern US. The ground motion component was not developed using an elicitation process. Three GMC models were used to represent epistemic uncertainty in median motions and a single value of aleatory variability was used.

Following completion of EPRI SOG, EPRI performed a major CEUS ground motion study targeted on developing an understanding of aleatory variability. The study resulted in the EPRI (1993) Ground Motion Model, which included an assessment of epistemic uncertainty in the median motions and an assessment of aleatory variability. The study involved nearly all of the then active ground motion modeling experts and stimulated follow-on research by a number of the participants that produced an equal number of ground motion models. The EPRI (1993) model together with models developed by individual researchers formed the body of information for development of the EPRI (2004) GMC model, which provided an assessment of epistemic uncertainty in the median models and aleatory variability. This model, together with an updated assessment of aleatory variability (EPRI, 2006) are the most current and applicable ground motion studies for the CEUS and are currently being used in ground motion analyses for COLAs.

The SSC component of the 1986 EPRI-SOG has not been replaced. Current licensing applications have followed regulatory guidance by using the EPRI-SOG study as a starting point, with updates as appropriate on a site-specific basis. The CEUS SSC project is aimed at replacing the SSC component of the EPRI-SOG study. As was the case for EPRI-SOG, the CEUS SSC seismic source model will be applicable to any site within the CEUS and can be used with the EPRI (2004, 2006) GMC model to calculate seismic hazard at any site of interest. Long-term efforts to replace the EPRI (2004, 2006) GMC are just beginning (the NGA East project) and results are not expected for at least five years.

Because the EPRI CEUS SSC Project is aimed at developing a comprehensive seismic source model for any site in the CEUS, it will be important to evaluate the sensitivity of specific source parameters on the hazard at sites in different geographic regions and under different site conditions. Thus, seismic hazard calculations will be conducted solely for the purpose of

assisting in the development of the SSC model. A diverse range of site locations (six sites) will be identified and a representative range of site conditions will be assumed for purposes of evaluating the important components of the seismic source characterization. For example, sites will be selected that are near and at a distance from the Charleston source in order to examine the relative importance of seismic source characteristics such as source geometry, Mmax, and recurrence. This Project Plan anticipates that sensitivity analyses will be conducted at two levels: 1) the relative importance to seismic source parameters (e.g., the impact of alternative approaches to assessing Mmax on the Mmax distribution for a seismic source, or the impact of different smoothing parameters on the spatial distribution of a-values within a region or source); and 2) the importance of source characteristics to mean hazard.

The EPRI CEUS SSC Project will allow for a replacement of the 1986 EPRI-SOG seismic source model. Following the completion of the EPRI CEUS SSC Project, seismic hazard results can be calculated using the EPRI (2004, 2006) GMC models at any site of interest. To so implement a site-specific analysis, assessment must be made of the effect of local site conditions (site amplification). In order to use the results for site licensing, applicable regulatory guidance must be followed (e.g., RG 1.208) that calls for evaluating the site region (200 mile radius) and site vicinity (25 mile radius or 40 kilometers) for any detailed seismic sources that would not be identified from the new EPRI CEUS SSC Project. By incorporating site-specific conditions, defendable ground motion response spectra (GMRS) can be developed.

Objectives

The objective of the CEUS SSC Project is to develop an up-to-date assessment of PSHA seismic source characterization for the CEUS that includes(1) full assessment and incorporation of uncertainties, (2) the range of diverse technical interpretations from the informed scientific community, (3) consideration of an up-to-date database, (4) proper documentation, and (5) peer review. If this objective is achieved, the CEUS SSC project will lead to stability and longevity. 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. SSHAC (1997) specifically addresses this issue and concludes that the goal of all probabilistic hazard analyses should be the same:

> "To represent the center, the body, and the range of the technical interpretations that the larger informed technical community would have if they were to conduct the study."

In this context, the "informed" community is one that is familiar with all relevant data.

The focus of the CEUS SSC Project is the seismic source characterization model and not the ground motion attenuation or site-response models. However, there is a need in this project to establish the hazard-significance of various SSC issues in order to properly prioritize the work activities and the uncertainty characterization efforts. Therefore, the use of an appropriate ground motion model, which will be "held constant" to isolate the relative importance of SSC issues will be required. The SSC model will be widely applicable to the entire CEUS, so this project will use a ground motion model that includes generic variations to allow for a range of representative site conditions (deep soil, shallow soil, hard rock). Hazard and sensitivity calculations will be conducted at six representative demonstration sites representative of different hazard environments.

Selection of SSHAC Study level

SSHAC defines four Study Levels, with Level 4 being the most elaborate, that can be used to capture the knowledge and uncertainties of the larger technical community. The higher the Study Level, the higher the assurance that the views of the community have been captured and represented. The SSHAC guidance allows for specific technical issues to be addressed using a particular Study Level, although, in practice, the entire project often employs a particular Study Level for all issues. Balancing the need for stability and longevity with the need to expedite the study, the CEUS SSC project will be conducted using a Study Level 3 process for the key SSC issues. Lesser emphasis and Level 2 processes will be given to those issues having lesser hazard significance or are not subject to large uncertainty. The identification of key issues will be based on experience and sensitivity analyses conducted for this study and for recent Probabilistic Seismic Hazard Analysis (PSHAs) at a number of sites in the CEUS.

As discussed above, all SSHAC Study Levels have the same goal of capturing the knowledge and uncertainties of the larger technical community. Higher Study Levels increase the likelihood that the community views are represented, particularly because these levels call for the direct participation of the community. Study Level 4 structures and formalizes the processes in which judgments of members of the expert community are elicited. The experts are charged with representing not only their personal views, but to also act as "evaluators" of the views of the larger community. Experience has shown that Level 4 processes can be resource intensive relative to both time and budget. It is viewed by project management and the sponsors that the potential benefits of higher levels of assurance that the larger community views have been represented are outweighed by the cost in time and money to implement a Level 4 analysis for the CEUS SSC Project. A Level 4 Study would likely cost $8 -10 million and require 4-5 years to implement.

For Study Levels 1 to 3 the assessments are made by the Technical Integrator (TI) team, who intellectually "owns" the assessments and the results. Process and technical peer review (defined in SSHAC 1997, p. 49), using a participatory peer review process, are key to ensuring the success of these Study Levels. The peer reviewers, for example, can assist in helping the TI team to identify the range of community viewpoints. Study Level 3 formalizes the process of interaction with the community through a series of workshops, which can also be attended by the peer reviewers and other oversight groups. These public interactions lead to higher levels of acceptance and assurance that the community views have been considered.

Work Plan

The Work Plan consists of a series of tasks designed to meet the project objectives. The Plan is based on the assumption that a Level 3 process will be used for most SSC issues (the actual identification of key SSC issues will occur as part of Task 4). The tasks are described below.

Based on the results of Workshop #1 held in July of 2008, resource expert presentations and input from the PPRP/DOE/NRC, additional data needs and tasks have been identified for the project. Accordingly, eight new tasks have been added as sub tasks below.

Task 1: Development of Project Plan and Approval by Participatory Peer Review Panel (PPRP)

Principally, this task entails the development of this Project Plan. It also includes a decision by the TI team regarding the region of interest that will be used for: 1) data compilation, and 2) defining seismic sources. The TI team will also identify six representative sites that will be used for hazard calculations and sensitivity analyses at the appropriate time in the project schedule (Task 4). The Project Plan will be reviewed by the PPRP and comments will be addressed in the finalization of the Plan. A Task 1 meeting will be held to facilitate resolution of comments received regarding the Project Plan.

Task 2: Database Development

The goal of this task is to develop a comprehensive, uniform regional database for use in seismic source characterization. The task will be conducted by a database contractor with knowledge of seismic source characterization issues. Where appropriate, data will be placed in a common GIS format that is readily usable for SSC model development. Task 2 Data Compilation will begin at the time of project authorization. The Database Contractor will take an active role in identifying data and data sources, including the information made available at the first workshop (Task 5) and interactions with members of the PPRP and the technical community. Data sources will include, as appropriate, readily available information from the following:

- professional literature,
- data held in the public domain by groups such as the USGS and state geological surveys,
- private domain data developed as part of recent licensing activities for nuclear power plants and other critical facilities,
- available data in the academic sector,
- data from the original EPRI study, and
- Selected data sets developed for federal facilities such as DOE sites.

The database will be designed to include the following regional data layers to provide coverage of the entire CEUS and extend a minimum of 200 miles beyond the coastline (or the edge of the continental slope if it is less) and 200 miles from the US borders with Canada and Mexico. The western boundary of the study region will be the foothills of the Rocky Mountains (about longitude 105° W), except that it will include the Rio Grande Rift system:

- Aeromagnetic (USGS and DNAG)
- Bouguer gravity (USGS and DNAG)
- Free air gravity (USGS and DNAG)
- Crystalline basement geology
- Tectonic features and tectonic/crustal domains
- Tectonic stress field
- Thickness of sediments
- Crustal thickness
- Vp and Vs at top of crystalline basement
- Seismic reflection data at Charleston
- Earthquake Catalog (developed in Task 3)
- Quaternary faulting and potential Quaternary features
- Mesozoic rift basins
- Paleoliquefaction sites
- Topography and bathymetry
- Liquefaction dates from published literature for the Wabash zone, New Madrid zone, and Charleston zones; M. Tuttle and Associates will contribute to the database development, to compilation of data collected by M. Tuttle in the central US and in northeastern US and southeastern Canada and by several others working in the central US (e.g., Cox, Mahdi, Van Arsdale, and Vaughn), and to the final report.
- Index map showing locations of published crustal scale seismic profiles and geologic cross sections

It is anticipated that study participants (TIs, PPRP, and resource experts) will request additional data sets (regional and local) be incorporated into the GIS database. The current budget for this task reflects the incorporation of the above listed regional data sets as well as a few local data sets for specific seismic sources. However, given that the database development is designed to support the needs of the TIs, future decisions by the TIs and others developing the SSC will dictate the amount, type, extent, and scale of data required to develop the SSC. We recognize that some data requests made during the course of the project may be outside the scope estimated for this task. The TIs and Project Manager may need to assess the need for additional data and prioritize what data should be incorporated into the database based on the particular dataset's usefulness in defining seismic sources and the available budget provided to the database contractor. Costs for the database development will likely be reevaluated after reviews by the PPRP and completion of Workshop #1 (Task 5), which is designed to identify any additional data required to address significant issues.

In addition to the GIS database, a comprehensive bibliography of literature will be compiled for use by the TIs. Copies of key papers will be provided to the TIs for their review as required.

In addition to the compilation of data, this task will also include (1) the management and documentation of data and (2) the presentation of data for the TIs and TI staff to use in development of the seismic source model. The management and documentation of the data will be done in accordance with data management procedure developed specifically for this project.

Although the fundamental user of the database is the TI Team, the database will also be made available to the PPRP and Project Sponsors in a manner that allows for distribution based on user requests. Data will be assessed by project geologists and GIS analysts to ensure completeness and appropriateness of the data for use in the SSC model development. The GIS database will be stored on a server in the WLA Walnut Creek office and updated by the project GIS Manager. For completeness and transparency, each GIS data layer developed for this project will include thorough metadata information. The data will be presented for the TIs, TI staff, and workshop participants as directed by the TI's. This may involve both map sheets of data compilations as well as real-time plotting of data on screen or projector. A GIS analyst will be present at each of the workshops to facilitate the display of GIS data.

Additionally, M.Tuttle and Associates will:

- Compile paleoliquefaction data for the ALM area and assisting the TI team in review and evaluation Randy Cox's field logs and photographs.

- Assist the TI team with the evaluation of the paleoliquefaction data and development of the source models for the Marianna, Arkansas region. This is a consequence of the Marianna region being elevated to an RLME because of recently collected paleoliquefaction data.

- Assist the TI team with the evaluation of the paleoliquefaction data and development of the source model for the Charlevoix seismic zone in Quebec. This is a consequence of the Charlevoix seismic zone being elevated to an RLME partly because of recently collected paleoliquefaction data.

- Develop new maps of river searched for liquefaction features in the New Madrid, St. Louis, and eastern Massachusetts regions.

All data in the CEUS SSC database will be made publicly available at the conclusion of the study.

Task 2.1: Gravity Field Compilation and Processing

The existing gravity field potential data discussed in the CEUS SSC Workshop 1 requires reprocessing as described by Dr. Keller. The PPRP has recommended this work be performed in support of Task 7 of this Project Plan.

Specific activities and deliverables include:

1. Compile gravity data incorporating Canadian and Mexican data sets along with relevant offshore data to cover entire CEUS study region along with 200 mile buffer.
2. Produce atlas of filtered maps for entire CEUS selected to best represent major features.

This task was identified in Workshop 1 and was recommended by the TI Team and PPRP.

Additional effort is required added to this task to account for an increased level of effort based on (1) having to create the majority of the metadata associated with the datasets provided so that it is consistent with project database deliverables and (2) to account for multiple revisions to the data based on comments and requests from PPRP members.

Task 2.2: Magnetic Field Compilation and Processing

The existing magnetic field potential data discussed in the CEUS SSC Workshop 1 requires reprocessing as described by Dr. Ravat. The PPRP has recommended this work be performed in support of Task 7 of this Project Plan.

Specific activities and deliverables include:

1. Furnish improved magnetic map of the CEUS study region
2. Differential Reduction to Pole
3. Total Gradient / analytic signal
4. Tilt derivative
5. Documentation of data compilation

This task was identified in Workshop 1 and was recommended by the TI Team and PPRP.

Additional scope is added to this task to account for an increased level of effort based on (1) having to create the majority of the metadata associated with the datasets provided so that it is consistent with project database deliverables and (2) to account for multiple revisions to the data based on comments and requests from PPRP members.

Task 2.3: Compile Existing Liquefaction Data for CEUS

Various researchers have compiled and published liquefaction data for various and specific regions and seismogenic zones in the CEUS. This is a critical discriminator for determining potential and uncertainty of seismic activity. This effort includes interviewing key researchers and compiling the data into a GIS coverage that can be utilized by the TI Team and staff for defining source zone parameters.
Specific activities and deliverables include:

1. Contact research experts and arrange interviews to review study areas and data
2. Compile and normalize the data
3. Develop coverage maps
4. Define uncertainty as quantitatively as possible
5. Document data compilation and write text for report

The need for this coverage was determined in the closing meeting after Workshop 1 between the TI Team and PPRP.

Task 2.4: Update Current World Stress Map

This task entails compiling the available stress data to update the world stress map in the CEUS. The activity includes compiling and analyzing the available indicators of in-situ stresses throughout the CEUS, including earthquake focal mechanisms, in-situ stress measurements, borehole breakouts, etc. The data will be evaluated in the same way that data were evaluated for the current world stress map such that the TI team will have an indication of the data quality and relative significance of the various stress indicators. This task was identified in Workshop 1 and was recommended by the TI Team and PPRP.

Task 3: Seismicity Catalog Development

The goal of this task is to develop a uniform and up-to-date catalog of historical and instrumental events in the CEUS that can be used for seismic source characterization. Consistent with modern ground motion models, the catalog will provide moment magnitudes (**M**) for all events.

The 1986 EPRI-SOG study developed a comprehensive earthquake catalog for the CEUS. The EPRI-SOG catalog was extensively reviewed by Seeber and Armbruster (1991), leading to the NCEER-91 catalog. The NCEER-91 catalog was ultimately incorporated into the catalog used by the USGS in the National Seismic Hazard Mapping project (Mueller et al., 1997). The subtasks needed to update this catalog for use in the CEUS SSC project consist of following:

- Earthquakes that have occurred post March 1984 will be added to the catalog. These will be obtained from the ANSS catalog and from regional catalogs (e.g. SECSSN, CERI, New England, USGS PDE, and Canadian Seismic Network). Use will be made of the catalogs developed for recent COLAs.
- Review modifications to the EPRI-SOG catalog made by subsequent researchers (e.g. Seeber and Armbruster, 1991; Mueller et al., 1997; COLA applications). These modifications include additional data on size and location, and reclassifying some events as non-tectonic. Quantitative assessments of location uncertainty will be included for older events.
- Examine the results of studies that have identified additional historical events (e.g. Metzger, 2000; Metzger et al., 2000; Munsey, 2006). Assess the adequacy of the size and location estimates provided by authors and add uncertainty estimates.
- Review archives for additional earthquakes in areas not previously studied. (Optional Task dependent on budget and schedule constraints)
- If practical, consider the development of a catalog of prehistoric events based on existing studies of paleoseismic events.
- Review and develop as necessary, relationships to provide estimates of moment magnitude, **M**, for earthquakes as a function of the available size estimates (e.g. m_{bLg}, other magnitude scales, maximum intensity, felt area, extent of liquefaction effects). This will include Hermann's catalog of regional earthquakes and the CMT catalogs that include moment calculations (to make the conversion between mblg and Mw). The EPRI-SOG project provided a mathematical framework and software for developing a catalog of uniform magnitudes with uncertainty estimates. This framework will be adapted to using **M** as the uniform magnitude scale.
- Identify dependent events within the catalog. The EPRI-SOG project provided a mathematical framework and software for performing this analysis. This framework will

be adapted to using **M** as the uniform magnitude scale. Alternative approaches will be examined.

- Assess catalog completeness. The EPRI-SOG project provided a mathematical framework and software for assessing catalog completeness. This framework will be adapted to using **M** as the uniform magnitude scale.

Task 4: Assessment of Hazard-Significant Issues

Prior to the workshop, the TI team will make a preliminary assessment of the key SSC issues that would be most important to the hazard at the range of demonstration sites. This assessment will be based on the following assessments: 1) identify about six test sites in the CEUS and develop seismic hazard representations at those sites using the EPRI-SOG sources and the EPRI (2004) ground motion equation with revised sigmas (EPRI, 2006), 2) conduct Phase 1 sensitivity studies on parameters (e.g., Mmax, smoothing assumptions on seismicity parameters, source boundaries) to illustrate the importance of these assumptions, and 3) develop the technical basis for establishing the precision of mean seismic hazard estimates, considering such effects as (a) differences in mean hazard among interpretations, (b) differences in mean hazard caused by estimates of parameters based on random events (earthquake history), (c) difference in mean surface hazard caused by statistical (borehole) data for example on shear wave velocities and (d) differences in mean hazard caused by different software/analysts, given the same input.

The six test sites will be identified based on their potential to illustrate the significant seismic source characterization issues. For example, sites that are near the large earthquake sources such as Charleston and/or New Madrid will be considered, sites near zones of known seismicity, and sites that lie within background zones of observed low seismicity. The goal is to use the sites to illustrate the relative importance of various components of the SSC model to seismic hazard. Chosen sites will be as generic as possible.

The sensitivity studies will concentrate on a subset of the test sites that illustrate the importance of certain parameters, e.g. the importance of M_{max} for sites dominated by sources with M_{max} less than 6.0, and the importance of smoothing assumptions for large regional sources where historical seismicity varies spatially. These sensitivity studies will be documented to illustrate to project participants when and why the mean values and uncertainties of these parameters are important. Precision estimates will be developed on a quantitative basis using examples from past seismic hazard studies, from historical data (i.e. calculating and integrating uncertainties in rates and b-values into hazard estimates, and calculating the resulting uncertainty in mean hazard), and from common unstated assumptions (e.g. the precision associated with uncertainties in source boundaries).

NRC-sponsored studies regarding updated ground motion models for the Central and Eastern U.S. (the NGA - East project) will not be available for at least five years and, as a result, will have no impact on the CEUS SSC project.

Three hypothetical site conditions will be applied at each site: hard rock, shallow soil, and deep soil. This will span the range of effects of site conditions on surface spectra.

Task 4.1: Add a 7th Demonstration Site

This task entails the calculation of seismic hazard at a seventh demonstration site that lies in the Nebraska-Kansas region. It would be used to demonstrate the potential SSC issues that are important to a site that lies within the Great Plains background zone, but may also have contributions to hazard from sources lying to the west of longitude 105o W such as the Rio Grande Rift. This task was recommended by the PPRP.

Task 5: Workshop #1 Significant Issues and Databases

The goal of this workshop is to identify the issues of highest significance to a SSC model for the CEUS and to identify the data and information that will be required to address those issues. The workshop will assemble the Management Team, TI Team, and TI Staff, Resource Experts, PPRP, and observers to discuss the significant issues and to identify the existing databases. To assist with identifying hazard-significant issues, the TI team will present the sensitivity studies conducted in Task 4 as motivation for identifying important assessment issues in PSHA that should be addressed with new data. An initial scanning of the existing COLAs and ESPs will also provide a basis for identifying important issues, as will discussions with the PPRP and Sponsors, who have considerable PSHA experience at nuclear facility sites. The effects as a function of site location will be shown (chosen to illustrate different hazard environments) and site conditions (rock, shallow soil, deep soil). A model will be presented for determining the precision of mean seismic hazard estimates. The sensitivity studies and precision model will be documented in a written handout.

The resource experts present at the workshop will include researchers who have been involved in the development of pertinent databases, such as the USGS and university-based groups. Resource experts involved with the development of seismicity catalogs will also participate in the workshop. Discussions will be held regarding all databases that may be available for use by the project, and identification of researchers who should be contacted to gain access to the data.

In this workshop and subsequent workshops, it is anticipated that a select group of international observers will be in attendance to monitor the methodology being carried out. NRC sponsors will work with EPRI management to identify potential observers and to arrange for their attendance.

This task includes the workshop planning, identifying and contacting participants, preliminary identification of significant issues, presentations, and documentation of the workshop. Documentation of the workshop will be provided on a CD and will include a workshop summary and copies of all presentations. This workshop is anticipated to last two days.

Task 6: Workshop #2: Alternative Interpretations

The goals of this workshop are: to present, discuss, and debate alternative viewpoints regarding key SSC issues; to identify the technical bases for the alternative hypotheses and to discuss the associated uncertainties; and to provide a basis for the subsequent development of an SSC model that includes these alternative viewpoints. The workshop will also provide an opportunity to review the progress being made on the database and catalog activities and to elicit additional input regarding these activities. Proponents and resource experts will be invited to present their interpretations and the data supporting them. Alternative viewpoints will be juxtaposed and facilitated discussion will occur with a focus on implications to SSC for hazard analysis (not just

on scientific viability) and on uncertainties (e.g., what conceptual models would capture the range of interpretations and what weights should be applied). Individuals and their interpretations will also be identified who are not present at the workshop.
The preparation for the workshop will draw upon the significant issues identified in the existing COLAs and ESPs (submitted and under preparation). A basis for the estimated level of effort is that the COLAs and ESPs all are readily available to the project team for use on this project. Preparation for the workshop will involve compiling these issues and identification of the appropriate resource people to present the relevant data and interpretations.

This task includes preparation for the workshop, identification of appropriate proponents and resource experts, facilitation of discussions, presentations, and documentation of the workshop. Documentation of the workshop will provided on a CD and will include a workshop summary and copies of all presentations. This workshop is anticipated to last three days.

Task 7: Construct Preliminary SSC Model
Based on the results of the first two workshops (which identify the key issues, available data, and alternative interpretations) as well as the database and earthquake catalog, a preliminary SSC model will be developed. A key component of the SSC model will be the quantification of uncertainties in alternative conceptual models as well as in parameter values. The SSC model will include the spatial distribution of future events, maximum magnitudes, and recurrence, as discussed below.

Spatial Distribution
The spatial distribution of future earthquakes will include the following: 1) definition of the locations of future earthquakes using area zones, spatial smoothing, combinations of both zones and smoothing, faults, etc.; 2) identification of alternative conceptual models regarding spatial distribution (e.g., alternative source zone boundaries due to different interpretations of tectonics or structure) and assignment of weights to the alternatives, including the probability that particular tectonic features are seismogenic in the present tectonic regime; 3) assessment of parameters required to exercise the spatial models such as smoothing operator, smoothing distance, nature of zone boundaries, etc.; and 4) assessment of characteristics of future events including rupture orientations, magnitude-dependent rupture dimensions, depth distribution and magnitude dependency, styles of faulting, and geometries of specific fault sources. Due consideration will be given to the criteria for identifying and characterizing seismic sources (seismogenic sources, capable tectonic sources) given in NRC Regulatory Guide 1.165.

Maximum Magnitude Assessment
A first task will be to update the EPRI maximum magnitude data and associated regressions (Johnston et al. 1994), which allow for a Bayesian approach to be used to evaluate maximum magnitudes. The update will incorporate studies of large SCR events that have occurred over the past 15 years and will provide prior distributions of maximum magnitude for various source types, which will then be updated using likelihood functions based on the observed seismicity associated with a source of interest. Consideration will also be given to the range of supportable interpretations in LLNL (1989, 1993), LLNL/TIP (2002), Chapman and Talwani (2002, SCDOT study), USGS (1996, 2002, 2007), research that occurred in the southeastern United States and published in USGS open file reports, the Bulletin of the Seismological Society of America,

university publications and contractor and consultant reports (e.g., Westinghouse Savannah River Company). A current project for the evaluation of Mmax in the CEUS is being conducted by the USGS with support from the NRC. The results and methodologies developed as part of that study will be considered as part of this task.

If data are available, constraints on maximum magnitude may also be developed based on maximum rupture dimensions. Consideration will also be given to the use of updated empirical models between rupture dimensions and magnitude.

Earthquake Recurrence

The earthquake catalog will have been prepared for recurrence analysis as part of Task 3 (including completeness, declustering, and magnitude uncertainty analysis). This task will entail the assessment of recurrence models and calculation of recurrence parameters and associated uncertainties for identified seismic sources. It is anticipated that new computer codes will be developed for the estimation of seismicity rates and b-values. These codes will apply algorithms that remove the restrictions of previous methods (i.e. the estimation of a- and b-values in geographical degree cells that arbitrarily depend on longitude and latitude lines) and generalize those concepts into smoothing functions that can be estimated on a finer grid, even in the presence of low historical rates of activity. These computer codes will be documented and made available as part of project documentation. Where data are available, paleoseismic recurrence will be incorporated and merged with constraints on recurrence from observed seismicity.

Two additional working meetings will be added to the project scope.

Task 8: Develop Hazard Input Document and SSC Sensitivity Analyses

Based on the assessments made in Task 6, a hazard input document (HID) will be developed that documents and summarizes the key elements of the SSC model including logic trees, parameter distributions, and derived Mmax and recurrence parameters. To support Workshop #3 Feedback, several sensitivity studies will be conducted of intermediate results using the preliminary SSC. These will include importance of various parameter values to maximum magnitude and recurrence distributions and their uncertainty, summed moment rates based on recurrence models, comparison of predicted and observed seismicity rates, and predicted spatial intensity maps. Sensitivity to catalog analysis (e.g., completeness) will also be considered. The seismicity parameters will be generated in this task. Following finalization of the SSC Model, a final HID will be developed, and it will be included in the Project Report.

Task 9: Perform Preliminary Hazard Calculations and Sensitivity Analyses

Using the HID developed in Task 8, the preliminary SSC model will be used to develop Phase 2 sensitivity studies on seismic hazard, presenting means and fractal hazards at the six test sites (discussed previously in Task 4). These sensitivity studies will show changes from EPRI-SOG sources, effects of alternative source parameters and smoothing assumptions (following the format of the sensitivity studies conducted for WS#1), and estimates of precision on a quantitative basis. This task will use the updated earthquake catalog, and will compare hazard results with the updated catalog (through 2008 using moment magnitude **M**) with hazard results presented in WS#1. Sensitivity results will be presented both with and without CAV filter applied to ground motions. De-aggregation analyses and sensitivity analyses will be conducted

to identify important sources and source characteristics such as M_{max} and source boundaries, contributions to uncertainty, and the effect of impact of alternative competing hypotheses.

Task 9.1: Comparison of CEUS SSC Model and USGS SSC Model
This task includes a comparison of the CEUS SSC model and the USGS SSC Model prior to Workshop #3 in order to understand any differences. Comparisons will be made of mean hazard at 10e-4/yr at seven (7) demonstration sites using the currently planned approach in Task 8 of this Project Plan for making hazard calculations and sensitivity analyses (e.g. simplified attenuation relations, annual probabilities of exceedance, ground motion measures). Quantitative and qualitative comparisons will also be made of the similarities and differences in seismic source spatial distributions, recurrence rates and maximum magnitudes in order to understand and explain any differences observed. This task was recommended by the Project Manager following discussions with the USGS.

Task 10: Workshop #3 Feedback
The goal of this workshop is to present and discuss the preliminary SSC model in a public forum with the opportunity for feedback from resource experts and proponents from the technical community. Feedback will also be given in the form of SSC sensitivity analyses (Task 8) and hazard results and sensitivity analyses (Task 9) to shed light on the most important technical issues. The feedback gained at this workshop will ensure that no significant issues have been overlooked and will allow the TI team to gauge the reaction of the community to the SSC model, uncertainties, and assessments of weights. This information will provide a basis for the finalization of the SSC model.

The approach planned for this workshop will begin with the TI team presenting the preliminary SSC model, with particular emphasis on the manner in which alternative viewpoints and uncertainties have been captured. The technical bases for the assessments and weights will be described to allow for a reasoned discussion of the constraints provided by the available data. Presentation of the hazard calculations and sensitivity analyses will provide a means of focusing the discussions on those SSC issues having the greatest hazard significance, including the largest contributors to uncertainty. The effects will be shown as a function of site location (chosen to illustrate different hazard environments) and site conditions (rock, shallow soil, deep soil). Prior to the workshop, streamlined hazard calculations will be developed so changes can be made in real time, to determine effects of alternatives suggested at the meeting, in order to promote final approval of a revised model. The final precision model will be applied to preliminary and final sets of seismic sources.

This task includes preparation for the workshop, identification of appropriate proponents and resource experts, facilitation of discussions, presentations, and documentation of the workshop. Documentation of the workshop will be provided on a CD and will include a workshop summary and copies of all presentations. This workshop is anticipated to last two days.

An additional 2-day PPRP meeting will be added to the project scope.

Task 11: Finalize SSC model

In light of the feedback discussed in Workshop #3 and using the final database and seismicity catalog, the TI team will finalize the SSC model as part of this task. Uncertainties will be fully characterized using logic trees (for alternative conceptual models) and probability distributions (for continuous parameter distributions). Alternative models will be weighted and the technical basis for relative weights developed. Finalization of the software used for developing seismicity parameters will occur in this task.

Task 12: Document CEUS SSC Project in Draft Report

This task includes the documentation of the CEUS SSC project in a draft report. The documentation of the report will include all process and technical aspects of the study and will provide the fundamental basis for the acceptance and subsequent use by other parties. The draft report will include:

- A description and justification for the methodology followed, including justification for the SSHAC Study Levels for the various SSC issues, identification of the participants, etc.
- The databases developed and used in the analysis; a description of the seismicity catalog development
- Description of SSC model including all elements, uncertainties, logic trees, and weights. The technical basis for all assessments will be included in the documentation, including the data that were relied upon.
- The finalized Hazard Input Document providing sufficient documentation for users to implement the SSC model in PSHA calculations for future applications.
- Descriptions of the sensitivity analyses conducted to show the importance of various inputs to intermediate SSC parameters
- Description of sensitivity studies at the six test sites. Sensitivity results will be presented both with and without CAV filter applied to ground motions, and for the three site conditions at each of the test sites; documentation of the precision model and its application to the test sites, and general conclusions on how the estimate of precision can be translated to "significant" or "non-significant" changes in future hazard; documentation of computer files with final sources representing HID, i.e. the geometry of seismic sources and their seismicity parameters sufficient for calculating hazard.
- Documentation and test cases for any new software developed to estimate seismicity parameters.
- Discussion of implementation guidance for use of the CEUS SSC at specific sites (e.g., interface issues with ground motions, relation to existing studies)
- Data Evaluation Tables - These tables present the evaluation of relevant information as to how that data was used to define seismotectonic sources and RLME sources.

Task 13: Review of draft report by PPRP

The PPRP will function in the Project as defined in the SSHAC Guidelines. Panel members will attend workshops, meet with the TI Team to provide feedback and summarize its comments in a report following each workshop. Members of the PPRP may participate in working meetings, workshop planning and workshops as resource experts. The task includes the review of the draft project report by the Management Team, PPRP and reviewers selected by the sponsors. As defined in SSHAC guidelines, the PPRP will be reviewing the report from the standpoint of both the *technical* content as well as the *process* followed. The draft report will be sent to the PPRP

and the Sponsor reviewers. A meeting will be held with the PPRP and the Sponsor reviewers to discuss their comments and the manner in which they will be addressed.

Task 14: Finalize and Issue CEUS SSC report
Review comments made by the PPRP and Sponsor reviewers will be resolved and the final CEUS SSC report developed. The report will be issued as an EPRI Technical Report.

Task 15: Brief NRC, DOE, and DNFSB on CEUS SSC Study
Meetings will be held with the NRC and the Defense Nuclear Facility Safety Board (DNFSB) in two-1-day meetings in Washington, DC. Preferably a single meeting can be held with all groups. The meetings will be held to present the methodology, the seismic source model, and to explain how to apply the results. In addition, the "lessons learned" from the study will be discussed. As part of that discussion, the key uncertainties will be identified and potential long-term research approaches to reducing the uncertainties will be identified.

Task 15.1: Additional GIS Support for Working Meetings, Workshops and Sponsor Reviews
This task provides support to the TI Team and the Database Manager in the preparation of presentation materials at Workshop #2, Workshop #3, five (5) working meetings and at the final project presentation in Washington DC, attended by the NRC, DOE and the DNFSB. Interact with GIS analysts related to interactive presentations and graphics displays to assist in the seismic source characterization effort. This task for additional GIS support was recommended by the Project Manager and TI Team Lead to facilitate the communication of information during working meetings, workshops and sponsor reviews. Additional support will be provided to the TI Team members and PPRP members by providing GIS metadata, GIS maps and figures in various formats to facilitate their review and comment on data and quality, as well as dialog on several issues.

Task 15.2: Briefing Meeting with NRC on CEUS SSC Project Report
This task will provide the support (professional time and travel and living expenses) for the participation at a one-day briefing with the NRC staff in the Washington area. Key EPRI contractors will prepare a presentation regarding the methodology aspects of the project and answer questions related to the contents of the CEUS SSC Draft Project Report.

Task 16: Participatory Peer Review Panel (PPRP)
This task includes the activities associated with participation on the PPRP. Meetings of the PPRP will occur at the initiation of the project to review the Project Plan, meetings in association with the three workshops, and a meeting to review the CEUS SSC draft report. It is also expected that additional meetings or teleconferences will occur throughout the course of the project as required to monitor progress. As discussed above in Task 13, the members of the PPRP may also participate in interactions with the TI Team to provide their feedback. The PPRP will be asked to review the list of hazard-significant issues, to provide written comments following each workshop, and to review the draft report. Written comments from the PPRP developed following each of these project activities will be developed into a single consensus

letter that reflects the views of the entire Panel. Other functions may be requested by the Project Manager.

Task 16.1: Additional Participation by the PPRP
This task includes additional participation by members of the PPRP beyond that anticipated in the above Task 16 to ensure that the PPRP has every opportunity to review the process and technical assessments being made. It is assumed that up to three PPRP members will attend each of six working meetings with the TI Team. Also, it is assumed that a one-day meeting will be held with the PPRP and the TI Team to report and discuss progress and issues. The meeting will be held in the San Francisco Bay Area to minimize the costs associated with travel. This task was recommended by the PPRP and the government sponsors.

Task 17: Project Management and Oversight
This task includes the activities associated with the management of the CEUS SSC project by the EPRI Program Manager, EPRI ANT Project Manager and Project Manager as discussed in the section that follows.

PROJECT ORGANIZATION

The project organization is shown on Figure 5-1, and the functions are summarized below:

EPRI Management

- Responsible for contracting with all project participants
- Responsible for establishing and maintaining project budgets and schedules
- Interfaces with utilities

Project Manager

- Assist EPRI Management, as requested, in establishing and maintaining project budgets and schedules
- Principal interface with PPRP, TI Team, Sponsors and Utilities
- Review of technical products
- Primary responsibility for all technical products
- Principal spokesperson for project to external community, including NRC and DNFSB

Participatory Peer Review Panel (PPRP)

- Provide timely reviews of process and technical assessments
- Individual members may work with TI Team to review details
- Attend workshops, meet with the TI team to provide feedback and summarize its comments in a report following each workshop.
- Participate in working meetings, workshop planning and workshops as resource experts
- Review and approval of CEUS SSC draft and final report

TI Team

- Develop input to Project Plan
- Responsible for maintaining scope, schedule, and budget for respective organizations
- Responsible for developing and implementing SSHAC Study Level methodology
- Responsible for all technical products, technical assessments and for defending their bases
- Responsible for documentation and responding to reviews

Database Manager

- Responsible for retrieving and compiling applicable data for the seismic source characterization
- Provides datasets in appropriate formats for the TI Team's deliberations

Sponsors

- Financial and technical sponsors monitor spending and adherence to Project Plan
- As sponsor availability allows, technical sponsors may assist and interact with the PPRP and the TI team
- Review and approval of CEUS SSC draft and final report
- Work at the direction of the TI Team on technical assessments

Specialty Contractors

- Provide specific activities and products supporting the activities by the TI Team and the TI Staff

Resource Experts

- Provide knowledge and experience regarding specific topics of discussion at the workshops

LINES of COMMUNICATION and POINTS of CONTACT

The lines of communication and points of contact are given in Figure 6-2. Figure 6-2 is provided to assist in the flow of information and ensure that the appropriate members of the SSC team are aware of project developments and communications in a timely manner. EPRI Management and the Project Manager shall be copied on all correspondence and work products. The Project Manager shall be the point of contact for transmitting correspondence and work products to and from the PPRP and the Sponsors and for sending invitations to the resource experts proposed for the workshops by the Project team. The Project Manager with the assistance of the TI Team shall inform the Chairmen of the PPRP and Sponsors of process and technical developments. The TI Team shall ensure that the TI Staff, Specialty Contractors and the Resource Experts have the required information to support the project.

SCHEDULE

The schedule for the project is shown in Figure 7-1. Figure 7-1 shows the timelines for the 16 tasks that comprise the CEUS SSC project. Inputs to and from one task to another are indicated by the arrows. The three workshops and the associated task inputs are shown. The exact dates for the workshops have not yet been identified. Meetings of the PPRP are indicated as occurring in May to review this Project Plan, in association with each of the workshops, and following review of the Draft Report. Additional meetings and/or teleconferences with the PPRP are not shown.

Key project milestones are:

EPRI Technical Update: CEUS SSC Project Plan	June 2008
Workshop #1	July 2008
Workshop #2	February 2009
Workshop #3	August 2009
Draft EPRI Technical Report	July 2010
Final EPRI Technical Report	December 2010

QUALITY ASSURANCE

The technical assessments made as part of the CEUS SSC will entail the use of a wide range of databases, including those that have been subject to peer review in the professional literature, those that have been gathered for scholarly research, and those that have been developed for site-specific commercial application. The methodology planned, which includes extensive interactions with the technical community in the identification of data, evaluation of alternative hypotheses, and feedback regarding all assessments, will provide a high level of review of the technical assessments made by the TI Team. Further, a participatory peer review process is planned for both the technical and process elements of the project. These methodology attributes will provide assurance with high confidence that the project assessments and results are accepted by the technical community. The level of assurance will meet or exceed that associated with publication in a peer-reviewed technical journal.

In addition to the peer review process that is afforded by the SSHAC Level 3 process, certain other work activities will be conducted that serve to provide best business practices. A hazard input document (HID) will be developed that documents and summarizes the key elements of the SSC model including logic trees, parameter distributions, and derived Mmax and recurrence parameters. The HID specifies the exact inputs provided by the SSC model to the hazard calculations and thus provides a clear record of the manner in which the SSC model has been represented for purposes of calculations. As discussed in Task 2 Database Development, the management and documentation of the data will be done in accordance with a data management procedure developed specifically for this project. As part of Task 7 Construct Preliminary SSC Model, it is anticipated that new computer codes will be developed for the estimation of seismicity rates and b-values. These computer codes will be documented and made available as part of project documentation.

All hazard calculations will be conducted using software that has been qualified according to 10 CFR 52, Appendix B requirements. Also, an internal documentation package will be prepared to archive the hazard calculations. The results will be documented in the project report as example calculations. This approach follows the EPRI and LLNL example calculations from the 1989 studies.

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Figure 5-1 CEUS
SSC Project Organization Chart

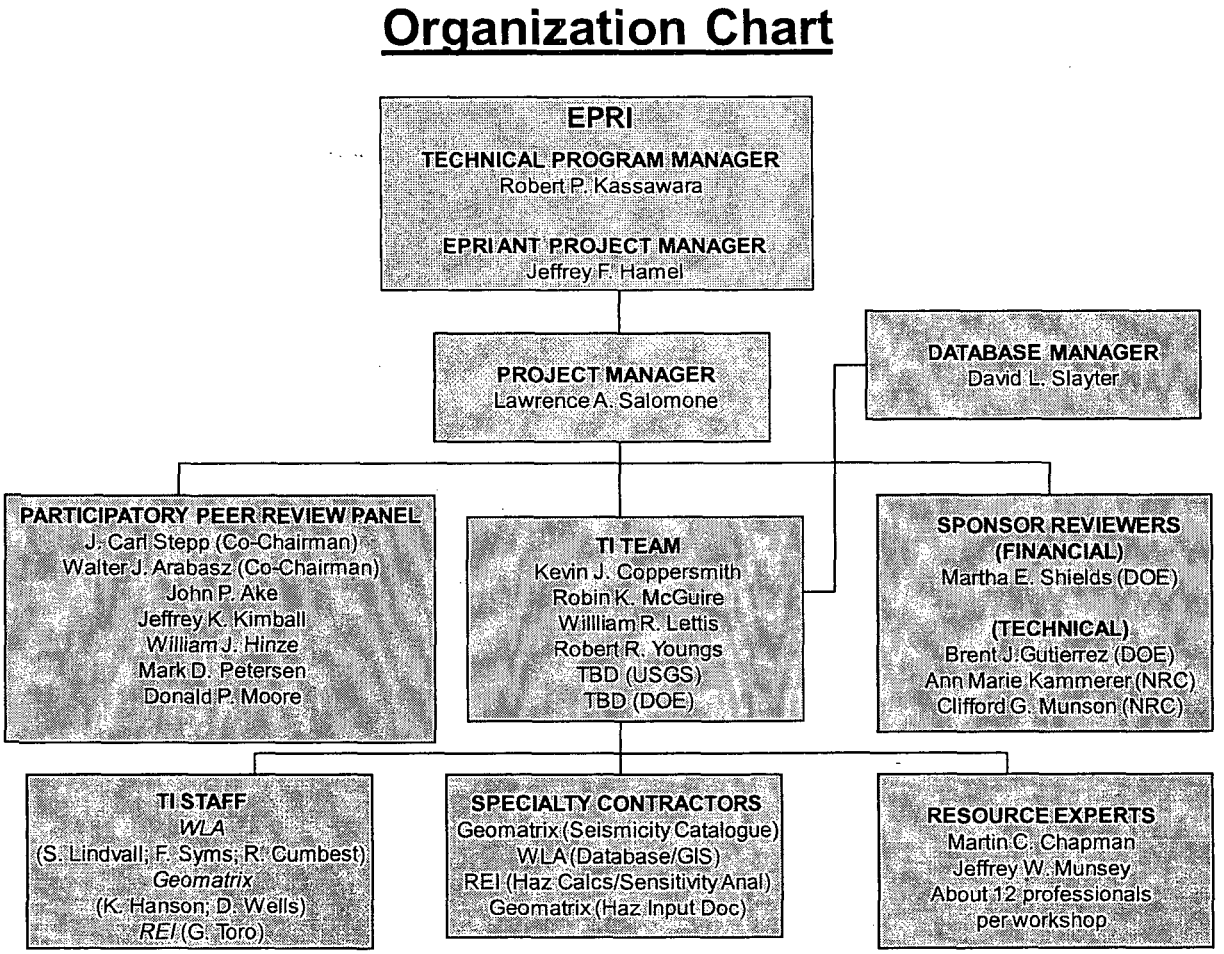

Figure 6-1
Lines of Communication and Points of Contact for CEUS SSC project.