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Consolidated PPRP Comments on
DRAFT PROJECT PLAN: CENTRAL AND EASTERN UNITED STATES SEISMIC SOURCE CHARACTERIZATION FOR NUCLEAR FACILITIES, REV 00 04/14/08

For discussion and resolution at Project Planning Meeting #2, May 8, 2008

For discussions at the May 8, 2008 EPRI CEUS SSC Project meeting to address the PPRP review of the draft Project Plan, non-editorial PPRP review comments that require discussion are consolidated in this document. No effort has been made to integrate the comments; some address overlapping issues and can be grouped under a single agenda item. In addition, some comments go to details of implementation and may more appropriately be addressed in the detailed task implementation planning.

Jon P. Ake, Annie Kammerer, Clifford Munson

NRC staff generally has a positive response to the DPP. However, we do have a few specific comments, which are summarized below according to section of the DPP. Some high-level concerns we have identified include:

- The ability to fulfill the project objectives with only three workshops,
- The timeline, which seems fairly aggressive,
- The specific roles and responsibilities of the participatory peer review panel (PPRP) and the sponsor representatives. In particular the relationship between the PPRP, sponsors, and TI team needs to be clarified.
- In general the Project Plan needs more detail if the aggressive timeline laid out is to be met.
- The project documentation is to be captured as an EPRI Technical Report, it needs to be explicitly stated that this information will be readily available to the general public at nominal cost (i.e. for reproduction) or through download at the NRC or DOE website.
- The makeup of the TI team is entirely industry representatives, some thought should be given to the potential addition of an NRC or DOE person to the team.
- Given that the objective of this project is to produce a new seismic source characterization model, the role of the ESPs in this project is not clear. The ESPs focused on updating or modifying the EPRI-SOG model.

Executive Summary
On a philosophical note, the purpose of the project is to produce an up-to-date, comprehensive, robust and defensible characterization of seismic sources in the CEUS. As a result of following a disciplined, structured process (such as that in the SSHAC guidelines) we will achieve stability and longevity. However, stability and longevity is not the purpose in itself.

Given that the first meeting of project personnel, the peer review team and project sponsors will not occur until May 8th, it seems that scheduling the first workshop in July

is somewhat optimistic. Perhaps more detailed discussion of exactly what needs to be done by the time of the meeting would make the basis for this timeline clearer.

After the review of the draft report by the PPRP it would be appropriate to have a final meeting (not necessarily a workshop) to close out any remaining comments from PPRP and project staff prior to production of the final report.

Introduction and Context of Study
The specification of six sites to be used in the seismic hazard calculations may be premature. To fully capture and understand the effects of certain source model assumptions or choices it may necessary to evaluate more than six sites. To assess the impact of seismicity boundaries and smoothing assumptions it may useful to look at a larger number of sites in a small area.

The discussion in this section (second paragraph on page 3) regarding Mmax leads to some questions regarding the conduct of a Level 3 versus Level 4 study. In a Level 4 study the experts/teams would each develop a distribution for Mmax and by integrating across the teams we have a measure of the range of technical interpretations of the broader informed community. Achieving that goal in a Level 3 study is somewhat more challenging. It appears that achieving the goal of broad community input will be a shared responsibility of the participatory peer review panel and TI team. This will lead to additional interactions between the PPRP and TI team. It would be beneficial to specifically schedule time before each of the workshops for the PPRP to meet and "get on the same page" and then to meet and debrief with the TI team immediately after each of the workshops. This additional meeting time would be an opportunity to effectively maximize the usefulness of participatory peer review. If this work is not performed in a thoughtful and thorough way, we will probably not achieve the goal of representing the full spectrum of community opinion.

Objectives
Please see the comment above regarding the philosophy of study objectives.

The specification of six sites to be chosen from next generation power plants and/or sites within the DOE complex for the sensitivity calculations needs to be carefully considered and justified.

Selection of SSHAC Study Level
In the first paragraph, there is discussion of the possibility of specification of lower levels of evaluation (SHAC Level 2) for some issues that are not as important. When will the importance of issues be defined? It seems like that will be done in Task 4 which should be done prior to Task 5 (Workshop #1), which is scheduled for July of 2008. Any decision making in this regard should be conducted with input from the PPRP.

Work Plan
Task 2: Database Development

Any literature compiled for use by the TI team should also be made available to the PPRP, and should ultimately be compiled into a publically available database.

Task 3: Seismicity Catalog Development
There is lots of good detailed discussion in this section. In the last bullet it seems an assessment of hazard sensitivity to catalog completeness estimates is needed (perhaps this will be done in Task 9?).

Task 4: Assessment of Hazard-Significant Issues
It is noted that three hypothetical site conditions will be assumed for each demonstration site to be evaluated (hard rock, shallow soil, and deep soil). Will these be the same conditions and amplification functions used in EPRI-6395 or will new functions be developed? If so, when will the PPRP be able to evaluate the choice of properties for the profiles?

Task 5: Workshop #1-Significant Issues and Databases
Please note the comment above regarding the timing of this workshop. It also not clear exactly who the resource experts will be and if it is possible to make arrangements (i.e. contract or travel or USGS support) to have them participate in a meeting in July.

Task 6: Workshop #2-Alternative Interpretations
This is the key task in the project. The objectives for this workshop described in the DPP are broad in scope and will be complex. The challenge of evaluating and incorporating alternative viewpoints into a hazard model that is flexible and broad enough to incorporate the evaluation of alternative conceptual models that might arise at a later date will be challenging. It seems that specifying a workshop duration of two days a priori is somewhat optimistic. This workshop should be of whatever duration is required to explore the reasonable alternative interpretations.

Task 7: Construct Preliminary SSC Model
Alternative methods for the assessment of maximum magnitude, such as those used in the PEGASOS Project, should also be evaluated. A current project for the evaluation of Mmax in the CEUS is being conducted by the USGS with support from the NRC. The results of that study should be considered or incorporated in Task #7.

Task 9: Perform Preliminary Hazard Calculations and Sensitivity Analyses
The DPP suggests that the sensitivity studies will show changes with respect to alternative source parameters, smoothing assumptions and relative to the EPRI-SOG sources. Since the objective of the project is to develop a SSC model that replaces the EPRI-SOG model, we assume this comparison is only of use to illustrate the change in hazard due to the evolution in our (the earthquake community) perceptions of hazard. Is this correct or is there another reason for this comparison?

Task 12: Document CEUS SSC Project in Draft Report
The discussion of the approach for documentation seems sound. Based on our reading of this section of the DPP it is not clear how many documents will be prepared. Will there

be a document that summarizes the technical bases for the assessments used in the hazard model and a separate Hazard Input Document or a single document? This is important from the standpoint of assessing how realistic the schedule and budget is. The development of complete and transparent documentation is essential for the longevity of the results by allowing for new information to be appropriately assessed.

Task 13: Review of Draft Report by PPRP
We assume the meeting described in this section will be between the TI team, PPRP, and Sponsor reviewers. What is not defined is when this meeting will take place (we find it hard to see from the spreadsheet) and exactly how the incorporation of comments will be done. There is a need to define the relationship between the various entities (TI team, PPRP, and Sponsor reviewers) and to consider how PPRP and Sponsor reviewer comments will be incoroporated. Some thought needs to be given to this beyond the box charts shown in Figures 1 and 2. We believe that the Sponsor reviewers should be treated as de facto members of the PPRP, in addition to the special responsibilities of representing the sponsor agencies.

Task 15: Brief NRC and DNFSB on CEUS SSC Study
DOE should be explicitly identified in the list of groups to be briefed.

Task 16: Participatory Peer Review Panel
Given the significant amount of material that will need to be reviewed and evaluated by the PPRP, and the responsibility that the PPRP has to assure that the breadth of the informed technical community is represented, it seems meetings of the PPRP beyond what is outlined in this section will be needed. This may or may not need to be physical meetings in all cases; teleconferences may work for some issues.

Walter J. Arabasz

1. The Draft Project Plan is well organized and structured—reflecting considerable thought and effort. Key information I lack as a reviewer is some indication of the qualifications of the individuals or teams or contractors who will perform some of the tasks (perhaps outside the scope of desired comment at this point). As an example, will some expert(s) in statistics be involved in Task 3 (Seismicity Catalog Development) or only seismologists? My confidence in the expected products and their stability and longevity depends not only on knowing task breakdowns but also on having some idea of who will be doing the work.

2. Will there be a Web-based resource (possibly managed by the database contractor) to facilitate controlled access to basic project information and data—e.g., project documents, bibliographic literature, data and/or information products associated with relevant data, PowerPoint presentations made at workshops, etc.? Given the complexity and duration of the project, participants (including the PPRP) will be able to function far more efficiently and incisively if they don't have to be their own information managers. (We've all been there!)

3. *Figure 1:* Given the long intervals between the activity points (stars) for the PPRP, I suggest there be at least one teleconference, or some other form of communication, for the PPRP between each milestone to keep them informed and reasonably engaged. Access to a well-designed project Web site would motivate them to stay engaged (even on unpaid time).

4. *Task 2 (Database Development), page 6:* Regarding "available data in the academic sector," expect the usual problem of quality control for data and peer-reviewed status for information that may be introduced. Guidelines will likely have to be established by the TI team for using unpublished data and information from the academic sector (a common source of "red herrings").

5. *Task 3 (Seismicity Catalog Development), page 8:* The task breakdown includes tasks that, in my judgment, need to be performed or overseen by one or more experts in statistics. The plan importantly states that alternative approaches will be examined for the identification of dependent events within the catalog. Various stochastic approaches have been developed by statisticians since the work of Veneziano and Van Dyck as part of the EPRI-SOG project, so stability and longevity are issues here. Similarly, other approaches have subsequently been developed for assessing catalog completeness, and alternative approaches should be considered in order to give confidence to other practitioners about the stability of results.

6. *Task 7 (Construct Preliminary SSC Model), page 10:* Many practitioners in seismic source characterization tend not to use terms identical to those defined in Appendix A of NRC Regulatory Guide 1.165 (e.g., *capable tectonic source, seismogenic source*). The project may want to consider adopting—or at least incorporating—terms consistent with NRC terminology to avoid having to translate later.

7. *Task 7 (Construct Preliminary SSC Model), Earthquake Recurrence, page 11:* Mention is made of "Where data are available, paleoseismic recurrence will be incorporated…" If fault sources are identified, moment balancing may need to be considered for fault rupture models.

8. *Task 11 (Finalize SSC Model), page 13, paragraph 1:* What does it mean that, "Alternative models considered will be discussed"? Draft documentation part of this task?

9. *Task 12 (Document CEUS SSC Project in Draft Report), page 13:* Apart from "documentation" of software, are there project requirements for validation or other forms of quality control?

10. *Project Organization, page 15:* Other than the Database Manager, it's not clear how other Specialty Contractors (mentioned in the Executive Summary) fit into the Project Organization.

Brent J. Guetierrez (DOE)

1. *Executive Summary, 2nd paragraph;* clarify the overall purpose of the CEUS SSC project is in achieving stability and longevity; e.g., in what? Isn't the real purpose of the project to develop a new and updated CEUS SSC model with the benefits of wide

acceptance in the technical community and with sufficient technical robustness that affords longevity of the SSC model?

2. *Executive Summary, 2nd paragraph;* the sentences defining stability and longevity at present appear somewhat incongruous as written. How can you achieve the longevity as defined and expect the technical underpinnings to remain valid when new scientific findings becomes generally accepted by the technical community?

3. Page 7, 2nd paragraph; make the copies of the key papers available to the project sponsors and agency technical representatives.

4. *Page 7, last paragraph before Task 3 and Page 16, Quality Assurance:* This paragraph describes the management and documentation of data in accordance with a data management procedure, data assessment, and data storage, yet the quality assurance "tone" for this project is described as that meeting or exceeding the quality assurance associated with publication in a peer reviewed technical journal without being under the auspices of a project quality assurance program. Given the apparent vast nature of the data to be complied across several existent databases and sources, a more defined quality assurance/quality control program should be implemented for this project.

5. *Page 3 and Page 9;* on both of these pages reference is made to the NGA East project. For completeness, suggest you add additional text describing how the results of the NGA East project will be incorporated into this project (as they are available) and what potential impacts the results may have on this project.

William J. Hinze

1. *Executive Summary:* The two sentences – "*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.*" - are the lynchpin of the Project Plan. I understand the stability issue and this is well documented in the SSHAC report. However, I do have concerns about the "longevity" issue. Longevity is an ambiguous term. Its meaning will change depending on the user. I find no reference to longevity in the SSHAC report. The "experience" that shows longevity is " … best achieved…" needs to be documented to make this a credible statement. I am concerned that longevity will mean to some users of the results of the proposed study that we can anticipate no improvements in seismic source characterization in the central and eastern U.S in the foreseeable future. This is potentially dangerous because science and databases continue to improve. Examples are the perceived need for this study and DOE's Probabilistic Volcanic Hazard Analysis – Update of Yucca Mountain. I suggest that some constraints be placed on the longevity issue to clarify its meaning in this context. Furthermore the results of Earth Scope studies in the central and eastern US are likely to impact seismic source characterization.

2. *Selection of SSHAC Study Level: "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." Is it possible that these two criteria may work contrary to each other, i. e., some regions of lesser hazard may have a larger uncertainty? Which will take precedence?

Jeffery W. Kimball

1. *CEUS SSC Objective:* The DPP states that the overall objective of this work is to achieve stability and longevity. It is suggested that stability and longevity should be desired attributes for the work being performed, but not the objective. The objective of the CEUS SSC Project should be to develop an up-to-date assessment of probabilistic seismic hazard analysis (PSHA) seismic source characterization for the CEUS that (1) includes full assessment and incorporation of uncertainties, (2) appropriately includes the range of diverse technical interpretations from the informed scientific community, (3) includes consideration of an up-to-date data base, (4) that is properly documented, and (5) peer reviewed. If these objectives are achieved then the product (CEUS SSC input) should have stability and longevity.

2. *Focus on replacing 1986 EPRI-SOG:* In a number of places the DPP speaks to replacing the 1986 EPRI-SOG PSHA work. It is not clear why this emphasis is necessary. The introduction properly notes that the project will take full advantage of data from several seismic hazard studies. If all participants agree that we should work towards developing a community based CEUS PSHA, then this effort becomes a key part of that goal. If that goal is achieved all users, including critical facility owners, would be comfortable with using the results.

3. *Role of the United States Geological Survey (USGS):* The DPP appropriately includes a representative from the USGS on the participatory peer review panel. To work towards a community based CEUS PSHA it may be good to add an appropriate USGS person to both the TI Team and TI Staff. That would work if the USGS would agree to support the time and travel of these people. This would have the added benefit of increasing USGS confidence that the CEUS SSC products should become the national map products (supporting a community based PSHA). While it is understood that USGS personnel are not "officially" representing their agency (neither am I, for example), getting the right people throughout the organizational framework of this effort will provide long term benefits.

4. *SSHAC Level:* The DPP states that the higher the Study Level, the higher the assurance that the views of the community have been captured and represented. While this tends to be true, the intent of the SSHAC guidance report would be to have adequate confidence with any Study Level, otherwise how could you support anything less than SSHAC Study Level 4? Following SSHAC guidelines, the responsibility for assuring that the views of the community have been captured and represented rests with the Technical Integrator (TI) or Technical Facilitator/Integrator (TFI). The DPP is based on the assumption that an overall SSHAC Study Level 3 is appropriate for this effort, thus the overall approach is based on using a TI. As a starting basis this approach is workable,

but this should be confirmed at the end of Task 5, once it is determined which CEUS SSC issues are most significant. While all PSHA's assign an overall SSHAC Study Level to the project, the SSHAC guidance can be read as intending that SSHAC Study Levels apply to issues, not projects. The DPP recognizes that some issues may be addressed at Study Level 2. It may be that certain issues require some aspects of a Study Level 4. They key is to manage this appropriately given the available resource and time constraints.

5. *Task 4 – Assessment of Hazard-Significant Issues:* While in concept the completion of sensitivity studies on PSHA parameters is an important aspect of assessing the significance of PSHA SSC issues, care must be taken to ensure that no bias is introduced into this assessment. It is assumed that the purpose of the sensitivity studies will be to prioritize PSHA issues, and that the CEUS SSC input will be a "complete" update; not relying on existing SSC input from the 1986 EPRI-SOG study. It may be appropriate for the TI Team to request that the participatory peer review panel provide their PSHA experience in listing those PSHA SSC issues that could be significant. For example, experience with CEUS PSHAs would suggest that the following issues may be potentially significant. Many of these issues represent state-of-practice advances since the EPRI-SOG work.

Potentially Significant CEUS PSHA SSC Issues:

- Relationship between moment magnitude and source dimension such as source area or fault length.
- Treating seismic sources as point sources versus extended sources, for both specific seismic source zones (such as New Madrid, Charleston), and within broader areas of lower seismicity.
- Magnitude distribution approach, such as characteristic magnitude distribution versus truncated magnitude distribution. When to use which relationship.
- Magnitudes assigned to earthquakes found via paleoliquefaction evidence. In particular, the proper assessment of site response impacts on assignment of magnitudes.
- Approach to establishing maximum magnitude for regions of low seismicity.
- The seismic source approach to areas of low seismicity, specifically defined source zones versus use of smoothed seismicity.
- Approach to modeling faults for well defined source zones such as New Madrid and Charleston. Should faults be oriented randomly, or with specific orientations?

6. *Project Documentation:* The DPP could be improved in terms of listing expected documentation for each of the tasks and/or expected from project participants. In terms of the participatory peer review panel, will it operate as a unit, with written comments provided from the panel as a whole?

Donald P. Moore

I have reviewed the draft project plan and find it to be an excellent document that provides sufficient detail of the tasks required. As a SSHAC Level 3 effort and issues related to QA I think it is very important to retain complete documentation of all tasks and interactions that will form the basis for the new seismic source characterization. Also this documentation should be stored in a controlled fashion to allow easy recover of information. Possiblely a procedure could be developed for this purpose.

Mark D. Petterson

The U.S. Geological Survey recently completed a national seismic hazard model considering many of the Central and Eastern U.S. hazard issues that will be discussed by the TI team. There has been some discussion about whether or not the USGS should participate on the TI team. After internal discussions, we feel that we should not be involved as technical integrators because of a perceived conflict of interest. The plan needs to make it clear that my participation on the review panel does not imply an endorsement by the USGS. I plan to contribute as an advisor to the NRC in reviewing this new source characterization.

The success of this project will depend on new databases of input data (e.g., moment magnitude catalogs, magnitude uncertainty and round-off estimates, liquefaction data, etc.); as well as objective and reproducible assessments of earthquake sources, rates, and magnitudes. We expect that all of this will be open to the public.

Section Objectives page 4 states: “the use of an appropriate ground motion model, which will be held constant” to isolate the relative importance of SSC issues will be required. Recent ground models vary by a factor of two between median ground motions for most magnitudes and distances. It seems like you may want to apply two equations that span the epistemic uncertainty within the relations.

Task 2: Database Development

The list of datasets should also include :

(1) the liquefaction dates from published literature. This is the basis for the recurrence models of the Wabash zone, New Madrid zone, and Charleston zones.

(2) Reflection data in localized or regional areas such as Charleston SC where the data indicated folded Miocene strata in the offshore region, Helena Banks fault zone.

(3) Bob Hermann’s catalog of regional earthquakes and the CMT catalogs that include moment calculations (to make the conversion between mblg and Mw – Task 3).

Task 7: Construct Preliminary SSC Model

Spatial distribution: I was confused by the meaning of item 2) identification of alternative

conceptual models regarding spatial distribution and assignment of weights to the alternatives. How will zones be delineated?

Maximum magnitude Assessment: I am confused by the Baysian estimation procedure (i.e., how the prior distribution is obtained and how the short catalog gives information that can update the maximum magnitude prior distribution. Are other models going to be considered?

Earthquake Recurrence: I was confused by the statement that these codes will be updated to produce a- and b-values on a finer grid and in low historical activity rates. What methods will be used to determine rates?