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February 17, 2014

Dr. Suzette Kimball, Acting Director
U.S. Geological Survey
12201 Sunrise Valley Drive, Mail Stop 100
Reston, VA 20192

Dear Acting Director Kimball,

On behalf of the members of the Scientific Earthquake Studies Advisory Committee (SESAC), I am providing the committee's report on the U.S. Geological Survey (USGS) Earthquake Hazards Program (EHP) for transmission to Congress, the Department of Interior, and the USGS's federal partner agencies in the National Earthquake Hazards Reduction Program (NEHRP).

This report is based on the SESAC meetings during 2013. Following our discussions the committee makes the following recommendations:

1. Funding for the Earthquake Hazards Program must be significantly increased. EHP cannot sustain its current program much less expand into the areas that are critical to the nation. The current budget is almost equivalent to that in the 1970's when it was established.
2. The USGS is rightfully concerned about induced seismicity, but EHP lacks resources to aggressively pursue the research and monitoring that may provide the guidelines for incorporating their effects into the national seismic hazard maps.
3. Earthquake early warning (EEW) is an initiative that has support in the public, in some state agencies and in Congress. The USGS is central to this initiative but cannot possibly afford to put it into operation without dire consequences for other critical elements within the EHP. The USGS should look for a separate funding stream if it is going to make a serious effort in EEW.
4. The USGS has a grand opportunity to improve its monitoring of earthquakes in the central and eastern US by acquiring seismic stations from the NSF EarthScope program (USArray) and augmenting some stations with accelerometers. The USGS should take this opportunity.

The attached report provides more detail on these recommendations. The EHP is at a critical stage. If it is unable to launch new initiatives while pursuing its current research objectives, it will not attract the scientific and technical talent that has been its hallmark for the past 40 years.

As we have said before, SESAC appreciates the dedication, expertise and professionalism of the USGS personnel. The information and reports SESAC receives are of the highest quality. Moreover, SESAC feels that the EHP has been and continues to be one of the crown jewels in the USGS. The larger community of earthquake scientists and engineers has always held EHP in high regard for its combination of basic science with its application and transfer of this science to the needs of the nation. This may change as the current funding level reduces the scope of activities within EHP.

We were pleased to learn that President Obama nominated you for Director of the USGS with the unequivocal support of Secretary Jewell. We look forward to your imminent confirmation. The nation looks to the USGS to provide unbiased scientific analysis as the foundation for critical decisions in many different areas, among them earthquake hazards. If SESAC can assist in any way, please ask. SESAC is always open to hearing from you regarding the Earthquake Hazards Program.

With warm regards,

Ralph J. Archuleta, Chair of SESAC
Professor of Seismology

cc: Members, Scientific Earthquake Studies Advisory Committee
David Applegate, Associate Director, Natural Hazards
William Leith, Program Coordinator, Earthquake Hazards Program

# Scientific Earthquake Studies Advisory Committee

# Report for 2013

# To the Director of the U. S. Geological Survey

# and to the Congress of the United States of America

This is the report of the Scientific Earthquake Studies Advisory Committee (SESAC) to the Director of the U. S. Geological Survey (USGS), for transmission to Congress. This report, which covers the SESAC meetings of April 4 and 5, 2013, and Nov. 6 and 7, 2013, addresses issues that arise through the USGS's roles within the National Earthquake Hazards Reduction Program (NEHRP). The members of SESAC are listed in Appendix A at the end of this report.

## SESAC MANDATE

The Scientific Earthquake Studies Advisory Committee was appointed and charged, through Public Law 106-503 re-authorizing NEHRP, to review the USGS Earthquake Hazard Program's roles, goals, and objectives; assess its capabilities and research needs; and provide guidance on achieving major objectives and the establishment of performance goals.

## INTRODUCTION

To provide the context for this report the Committee reiterates the mission of the USGS within NEHRP: *To develop effective measures for earthquake hazards reduction, promote their adoption, and improve the understanding of earthquakes and their effects on communities, buildings, structures, and lifelines,* as well as *to provide the Earth science content needed for achieving these goals through research and the application of research results, through earthquake hazard assessments, and through earthquake monitoring and notification.*

SESAC met April 4th and 5th, 2013, at the IRIS Headquarters in Washington DC. SESAC held a second meeting at Stanford University on November 6, 7, 2013.

All SESAC members were in attendance for both meetings: Ralph Archuleta (Chair), Greg Beroza, Julie Furr, Jeff Freymueller (by conference call in the second meeting), John Parrish, Christine Powell, David Simpson, Terry Tullis.

Attending the first meeting were USGS Personnel: David Applegate, Mike Blanpied, John Filson, Doug Given, Bill Leith, Elizabeth Lemersal, Cecily Wolfe; and by remote

connection: Tom Brocher, Elizabeth Cochran, Steve Hickman, Keith Knudsen, Jill McCarthy, Art McGarr, Ross Stein.

Others: Elizabeth Duffy (Seismological Society of America), Jack Hayes (NIST, Director of the National Earthquake Hazards Reduction Program), Gari Mayberry (USAID), Travis Reed (California Institute of Technology); Kaitlin Chell (Lewis-Burke Associates).

USGS personnel in attendance in November were Bill Leith, Mike Blanpied, Jill McCarthy, Keith Knudsen, and Chuck Mueller with Elizabeth Lemersal and Cecily Wolfe by remote connection. Others from the USGS attended in person or via a conference call. John Anderson, University of Nevada, Reno, chair of the National Seismic Hazard And Risk Assessment Steering Committee, attended the first day.

The April meeting focused on three broad topics: 1) sequestration, 2) induced seismicity and 3) seismic monitoring—the Advanced National Seismic System (ANSS), the Global Seismographic Network and the NSF Transportable Array (USArray). In addition, we had reports about how the USGS interacts on an international scale.

The November meeting focused on 1) sequestration, 2) earthquake early warning (EEW), and 3) induced seismicity. The committee also discussed the long-term sustainability of the USGS Earthquake Hazards Program (EHP).

The agendas for the both meetings are attached in Appendix B.

**Summary**

The budget sequestration within the Federal Government will have a profound effect on the USGS Earthquake Hazards Program (EHP). While the immediate reductions to the USGS budget for EHP may be mitigated for the 2013-14 fiscal year, the sequestration as written into the Budget Control Act of 2011 will be in effect until 2021. The long-term consequences—hiring freezes, furloughs, reduction of external grants, limits on travel to scientific meetings, etc.—will erode the effectiveness of the USGS commitment to monitoring earthquakes and mitigating their effects.

SESAC thinks that no further cuts to the external grants activity (research in response to the annual RFP) should be made as a response to sequestration. Further cuts to projects should come from those that had a lesser percentage cut than the external grants. With sequestration the USGS will have to make decisions for the Earthquake Hazards Program (EHP). SESAC also recommends that no more than 50% be expended for monitoring; there must be a balance between monitoring and the combination of hazard assessment and research. This percentage has changed over time from a 40-60 ratio (monitoring/ hazard assessment plus research) to what is now nearly 50-50. Balance in the program is essential for the health of the EHP.

Induced seismicity is a phenomenon that will grow in prominence as there is a greater effort to extract hydrocarbons from shale formations, exploit geothermal fields and develop means for carbon dioxide sequestration in subterranean reservoirs. Importantly, many of these activities are taking place in areas of the U.S. that are not associated with active tectonics. Thus current seismic networks, which have correctly been deployed to focus on tectonically active regions in the US, may not be able to accurately locate and measure the strength of the induced earthquakes. Moreover, these induced earthquakes affect the seismic hazards maps

that are produced by the USGS. SESAC recommends that USGS develop strategies both for monitoring earthquakes associated with anthropogenic activities and for their incorporation into the assessment of seismic hazard.

The USGS collaborates closely with the National Science Foundation on two primary seismic networks: the Advanced National Seismic System (ANSS), which has leveraged the Earthscope/USArray project, and the Global Seismographic Network (GSN), which is partnered with NSF. As the USArray Transportable Array (TA) finishes its sweep across the lower 48 states, the NSF, USGS and IRIS have reached an agreement by which NSF will support the initial conversion of as many as 200 broadband stations located in the central and eastern US to permanent operation. These 200 stations will provide the USGS an unprecedented capacity for monitoring earthquakes in the central and eastern U.S., including induced earthquakes. The effect of sequestration on this agreement is unknown.

With NSF and USGS funds, augmented with funding through the American Reinvestment and Recovery Act (ARRA), and support from DOE, the GSN is currently undergoing a network-wide upgrade of digital acquisition systems (to be completed in 2014) and refurbishment/replacement of primary sensors. SESAC feels that it is critically important that these upgrades be completed, as many of the stations have equipment that is 20 years old and cannot be serviced remotely. SESAC notes that the GSN primary sensors also need replacement, and understands that funding for procuring new sensors has been provided by the Department of Energy. However, funding for installation is currently not available.

Support of earthquake early warning (EEW) is an area where the USGS EHP is caught in a dilemma. On one hand EEW is a highly visible project, which has been supported by the USGS, and has the attention of the public as well as state and federal representatives. In essence, EEW should be a product of a thoroughly developed Advanced National Seismic System (ANSS) and USGS should play an important role in monitoring and issuing formal warnings. It is simply not possible to think of EEW as a minor perturbation to the EHP that could be adequately addressed by a slight shifting of the overall priorities of the EHP. The cost of EEW requires a major influx of additional funds to the USGS EHP. If EEW is implemented without additional funds, other critical elements of the USGS EHP will suffer irreversible harm. SESAC recommends that the USGS put EEW as a line item, similar to the Global Seismic Network (GSN), into the Department of Interior budget.

SESAC notes that some of the issues and recommendations made herein are addressed, or partially addressed, by small funding initiatives that the Administration has put forward in its Fiscal Year 2014 budget proposal for the USGS Earthquake Hazards Program. The Congress should view that proposal as the minimum needed to maintain the Program at a viable level into the future. The USGS EHP has stayed on the cusp of fundamental science for the benefit of the entire country. However, new initiatives related to some of the most urgent needs of the nation are stifled by the lack of funding. These new initiatives cannot be realized at the expense of the rest of the EHP. The EHP budget must be significantly expanded. EHP has proven that it is a stellar organization that couples fundamental research with practical outcomes that benefit the entire nation. It should not take another damaging earthquake for the Department of Interior and the Congress to recognize that resilience requires being in front of the problem.

**Sequestration**

Both Dr. Applegate and Dr. Leith provided a general overview of how the USGS, and in particular the Earthquake Hazards Program, would be affected by sequestration. In the first year, the USGS will try to avoid furloughs. An immediate effect is a freeze on hiring. Travel is being greatly restricted, negatively affecting the presence of USGS personnel at meetings of professional societies. The effects of the first year of sequestration may be slightly mitigated by frontloading some savings, but this is clearly not sustainable in the long-term. Importantly the sequestration allows for no flexibility in the USGS capability for dealing with unexpected events. The USGS will have to reevaluate its interaction and support for international collaborations such as the Global Earthquake Model (GEM), as well as its interactions with USAID/OFDA. SESAC is especially concerned about the budget impact on cooperative agreements with seismic networks, external grants program, and development initiatives such as Earthquake Early Warning (EEW), and earthquake research in eastern US.

Sequestration will seriously affect the USGS EHP regarding understanding and mitigating the effects of earthquakes. While sequestration during the first year is painful, the effects will certainly be worse in following years. In essence, the USGS EHP mission will be severely compromised; sequestration creates unfunded mandates for the USGS EHP as responsibilities are not reduced along with funding.

**Induced Seismicity**

The expanded occurrence of induced seismicity is an important topic, and one that the USGS ought to pursue aggressively. As a recent report by the US National Academy of Sciences makes clear, the problem of induced earthquakes has grown into a major policy issue. A broad array of activities, including: wastewater injection, hydraulic fracturing, $CO_2$ sequestration, geothermal energy production, reservoir impoundment, and mining, have the potential to induce earthquakes. Most of these activities bear directly on future energy options for the nation and are thus critically important for the future.

Earthquake activity has increased in the central and eastern U.S. over the last decade. Substantial data exists to suggest this increase in intraplate seismicity is the result of anthropogenic activities. Some of these earthquakes have resulted in damage and necessitated governmental intercession to shut down the causal activity. The M 5.6 2011 Oklahoma event resulted in damage to roads and numerous residences. Clearly, ground motions of this magnitude cannot be ignored, but what is the most appropriate way to incorporate them into the national seismic hazard maps? What societal effects should be considered regarding inclusion of induced seismicity in these maps? Different approaches may be presented representing the scientific and practicing engineering communities. Regardless of the approach chosen, we must consider: 1) How do we distinguish between induced and natural seismic activity? 2) How do we account for permanent versus transient causal activity? 3) Can the level of incremental seismic hazard be defined in a way that allows society to evaluate an acceptable level of increased risk?

In the present situation there is a regulatory gap concerning these events. The USGS ought to take the lead in establishing internal and external research programs and partnerships with other agencies and industry to better understand the causes and mechanisms that lead to

induced earthquakes. The USGS should also do what it can to develop its role as a trusted and non-biased arbiter of informed policy and regulation in this area, and by doing so to help the nation to understand, and to minimize, the risk posed by induced earthquakes.

There are a number of key areas where the USGS mandate intersects with induced earthquakes:

- Monitoring—USGS should include induced earthquakes as part of its national responsibility for reporting on significant earthquake occurrence. In this reporting, USGS should endeavor to distinguish between natural, induced and triggered earthquakes, including identification of the causative agent for the induced or triggered events. In this context, *induced* earthquakes are those which can be directly attributed to the stress changes associated with the causative, anthropogenic activity; whereas *triggered* earthquakes may include the release of a significant component of pre-existing, natural tectonic stress. Both represent a category of earthquakes that would not have occurred, at their location and time, in the absence of the causative agent (such as fluid injection).
- Research—The range of activities that potentially give rise to induced seismicity implies that there will be a broad array of relevant research. Research on the mechanisms by which earthquakes are induced or triggered is of critical importance in understanding and possibly controlling this phenomenon and has the potential to contribute to the understanding of natural earthquakes as well. The USGS, in collaboration with other federal agencies, should identify key areas for research and establish well-defined program goals and support for this effort, both internal and external to the USGS.
- Control—Since induced and triggered earthquakes are a response to external human activities, it is important to determine whether control of these activities can be used to minimize the seismic impact. Can areas with a high potential for induced seismicity be identified prior to initiation of the human activities? Can human activities (e.g. rates of fluid injection; volumes of fluid injected; control of water level in reservoirs; rate, depth and extent of mining) be managed in a way that minimizes the seismic impact? Collaborative research with facility operators, involving controlled field experiments will be required, as well as open access to data related to the management of the causative agent.
- Regulation—USGS should support other federal and state agencies as they review policies and regulations related to the permitting and management of potential causative agents and develop new policies and modes of enforcement, as appropriate. Consideration should be given to regulatory requirements for monitoring and public access to key data.
- Hazard—As national and regional assessments of earthquake hazards are updated, it is essential to consider whether and how induced and triggered earthquakes (or the potential for their occurrence) can be identified and included in these assessments. Induced seismicity is real and cannot responsibly be excluded from published seismic hazard maps. Inclusion of induced seismicity in these maps will require a clearly defined approach to properly balance available scientific information and new discoveries with the economic needs and practical uses of society (more on this issue, below).

- Education—As part of its education and outreach efforts, USGS should develop information to assist the public and policy makers in understanding: a) the causes and impact of induced and triggered earthquakes; and b) how this information is incorporated in development of national and regional hazard assessments.
- Funding—Since induced and triggered earthquake are a relatively new and increasingly significant phenomenon, USGS must seek additional funding to support research and monitoring efforts in this area, so as not to negatively impact its broad, ongoing efforts in earthquake risk reduction through the monitoring and assessment of natural seismicity.

A high-priority question is how the USGS ought to develop hazard maps that evaluate and incorporate the incremental seismic hazard posed by induced earthquakes? One option would be to discount them, but that seems inappropriate given the demonstrated potential for induced and triggered earthquakes to significantly exceed the anticipated seismic potential in areas presumed to be of low hazard. Another approach would be to somehow consider induced earthquakes separately, but then one has to differentiate natural from induced events, which will likely be problematic in many cases. Moreover, the factors influencing induced earthquake activity are to some extent known, but are highly time dependent. How should that be accounted for? Whatever the answers to these questions might be, they are clearly important, and they fall squarely within the purview of the USGS earthquake hazards program.

Improved monitoring is a key element of studying induced seismicity. Due to the large amount of territory involved, and the fact that most induced earthquakes are both small and shallow, this will be challenging. A combination of improved earthquake monitoring in the Central and Eastern US, and a rapid deployment capability would go a long way towards helping to develop an understanding of particular cases of induced seismicity. Focused experiments, such as that carried out at Rangely, Colorado, in the 1970s, are another approach that ought to be considered.

*Induced Seismicity and National Seismic Hazard Maps*

SESAC endorses the USGS decision to present the hazard represented by induced seismicity as a separate map in conjunction with the national seismic hazard maps. The national seismic hazard maps should be prepared with the best possible knowledge of natural earthquake hazards. The specific effects of induced seismicity can be quantified as an additional map, possibly an overlay of the primary maps. This may become the approach used for time-dependent hazard. The method of treating induced seismicity and time-dependent hazard and their inclusion is a subject to be considered by the newly constituted National Seismic Hazard And Risk Assessment Steering Committee.

**Seismic Monitoring**

The USGS collaborates closely with the National Science Foundation on two primary seismic networks: the Advanced National Seismic System (ANSS), which has leveraged the Earthscope/USArray project, and the Global Seismographic Network (GSN), which is partnered with NSF. As the USArray Transportable Array (TA) finishes its sweep across the lower 48 states, the NSF, USGS and IRIS have reached an agreement by which NSF will

support the initial conversion of as many as 200 broadband stations located in the central and eastern US to permanent operation; the USGS would eventually provide funding for the long-term maintenance of these stations. The effect of sequestration on this agreement is yet to be seen. These 200 stations will provide the USGS an unprecedented capacity for monitoring earthquakes in the central and eastern U.S., including induced earthquakes. With no additional funds, ANSS has relied on cooperation with other agencies, such as the Department of Defense, to add up to 40 stations in both Boston (in progress) and New York (planned), and with the Veterans Administration for seismic instrumentation within VA hospitals.

With NSF and USGS funds, augmented with funding through the American Reinvestment and Recovery Act (ARRA), and support from DOE, the GSN is currently undergoing a network-wide upgrade of digital acquisition systems (to be completed in 2014) and refurbishment/replacement of primary sensors. SESAC feels that it is critically important that these upgrades be completed, as many of the stations have equipment that is 20 years old and cannot be serviced remotely. SESAC notes that the GSN primary sensors also need replacement, and understands that funding for procuring new sensors has been provided by the Department of Energy. However, funding for installation is currently not available.

**Earthquake Early Warning–Eastern U.S.**

Support of earthquake early warning (EEW) is an area where the EHP is caught in a dilemma. On one hand it is a highly visible project, which has been supported by the USGS, and has the attention of the public as well as state and federal representatives. In essence, EEW should be a product of a thoroughly developed Advanced National Seismic System (ANSS) and USGS should play an important role in monitoring and issuing formal warnings.

However, the backbone of EEW is the network of instruments in the field and the data collection systems, only part of which are currently owned and operated by the USGS. In addition, almost all of the development of the early warning systems now comes from private funding to three external institutions: California Institute of Technology, University of California, Berkeley, and the University of Washington. Implementing EEW, even in a limited area, such as southern California, would be an unfunded program that would significantly over-extend current USGS resources. In the long-term, it is essential that USGS remain involved in the development, operation and eventual oversight of EEW, but new funding must be sought for this effort. In the meantime, with no additional funding in the core USGS budget, coupled with sequestration, USGS is encouraged to remain involved in planning and development efforts, but SESAC cannot endorse any significant new USGS expenditures on operational EEW.

SESAC recommends that the USGS establish EEW as a budget ‘line item’, similar to the Global Seismic Network (GSN), into the Department of Interior budget. It is simply not possible to think of EEW as a minor perturbation to the EHP that could be properly addressed by a slight shifting of the overall priorities of the EHP. The cost of EEW requires a major influx of additional funds to the USGS EHP. Otherwise other critical activities of the USGS EHP will suffer irreversible harm.

The capabilities and limitations of Earthquake Early Warning (EEW) need to be evaluated for the Eastern US, as the benefits and requirements of the system may be very different from the Western US. Because of low attenuation in the Eastern US, strong shaking will be

experienced over a larger area for a given size earthquake, compared to the Western US or Alaska. This means there would be more time to take action after an EEW alert. However, the density of observations in the East is lower than that in the west, and so the current network will not be able to provide as rapid an assessment of what is occurring as in the west; this shortcoming would be mitigated by the conversion to permanent of up to 200 Transportable Array stations, as noted elsewhere in this report. Still, given the much larger felt areas the station density may still may be sufficient to provide useful EEW, at least for distant areas. If the current network is not adequate, the density of stations needed for a useful EEW system will need to be evaluated. One important matter to consider is whether there will be enough interested individuals, companies, and governmental entities to receive and react to an EEW alert, given the lower frequency and awareness of earthquake hazards in the East.

**Appendix A**

SESAC Committee 2013

Professor Ralph Archuleta, Chair, University of California, Santa Barbara, CA

Professor Greg Beroza, Chair of the USGS Advanced National Seismic System (ANSS), Stanford University, Stanford, CA

Professor Jeff Freymueller, University of Alaska, Fairbanks, AK

Ms. Julie Furr, Professional Engineer, Chad Stewart and Associates Engineering, Inc., Lakeland, TN

Dr. John Parrish, California State Geologist, Sacramento, CA

Professor Christine Powell, Center for Earthquake Research and Information (CERI), University of Memphis, TN

Professor Emeritus Terry Tullis, Chair of the National Earthquake Prediction Evaluation Council (NEPEC), Brown University, Providence, RI

Dr. David Simpson, President of the Incorporated Research Institutions for Seismology (IRIS), Washington DC

**Appendix B**

**April 4, 2013 Meeting**

**Scientific Earthquake Studies Advisory Committee**

Meeting Location: IRIS Headquarters

1200 New York Av, NW, Suite 400, Washington DC

**Thursday April 4th - IRIS main conference room - 4th floor**

| | | |
|---|---|---|
| 8:30 | Coffee and Tea | |
| 8:45 | Introductions, Committee Matters | Archuleta |
| 9:00 | Sequestration Impacts on the Earthquake Hazards Program | |
| | *Bureau-level decisions and impacts* | Applegate |
| | *Earthquake Hazard Program 2013 Budget* | Leith |
| | *Impacts on external funding (networks, grants, coops)* | Leith |
| | *Impacts on the Geologic Hazards Science Center* | McCarthy |
| | *Impacts on the Earthquake Science Center* | Brocher |
| 10:45 | Break | |
| 11:00 | Memphis Update | McCarthy,Blanpied |
| 11:30 | CEUS Transportable Array Conversion Project | Leith |
| 12:00 | Lunch | |
| 13:00 | Induced Seismicity | |
| | *Overview and Funding* | Leith |
| | *Oklahoma earthquake sequence* | Cochran |
| | *Texas assessments and fieldwork* | Ellsworth/McGarr |
| | *Powell Center Study and Paradox Basin* | McGarr/Ellsworth |
| | *Decatur plans and 2014 Proposal* | Hickman et al |
| 14:45 | Break | |
| 15:00 | ANSS Update | |
| | *Overview, Management and Funding* | Leith |
| | *Highlights, initiatives, coordination* | Wolfe |
| | *Earthquake Early Warning update* | Given |
| | *VA Hospital instrumentation project* | Kalkan |
| | *Boston area instrumentation (DoD-funded)* | Leith |
| 16:00 | Global Seismographic Network connections | |
| | *OBS possibilities, Subduction Zone Observatories, etc* | Leith, Simpson |
| 16:30 | EHP-supported International Work | |
| | *USAID-funded Projects (EDAT and other)* | Mayberry, Blanpied |
| | *Global Earthquake Model projects* | Stein |
| | *Ongoing cooperation: Chile, China, Russia, Japan, IOC* | Leith |
| 17:30 | Adjourn | |

**Friday April 5th**

| | | |
|---|---|---|
| 8:45 | Coffee and Tea | |
| 9:00 | NEHRP update: ACEHR advice, Reauthorization | Hayes, Leith, Filson |
| 10:00 | Discussion and break, as needed | |
| 10:30 | Executive Session | |
| 12:00 | Adjourn | |

**November 13, 2013 Meeting**

**Scientific Earthquake Studies Advisory Committee (SESAC)**
November 6-7, 2013

Stanford and USGS Menlo Park, CA

**AGENDA with topic introductions**

**Nov. 6th** Green Earth Sciences Building, Room 361

8:30 Meet-n-greet

8:45 Introductions, Agenda, SESAC business (Archuleta)

9:00 Program overview and sequestration (Leith)

As discussed in the last meeting, the EHP budget has decreased 11% since 2010 (-$6.27M). We face another possible-to-likely ~3% reduction in FY 2014. In this and the subsequent presentation, we will report on the impacts of sequestration in 2013 and how we expect to handle another in 2014. SESAC should comment on how this challenge is being managed and advise on priorities, both high and low, within the Program.

10:00 Science Center State-of-Health reports (Brocher, McCarthy)

10:45 Break

11:00 NEPEC Report (Tullis)

Report from the NEPEC, which will have met the previous two days and considered, in particular, whether it's recommendation from 2004 still stands, to continue monitoring and research at Parkfield through a full earthquake cycle, both in light of Program-wide budget cuts and other opportunities/priorities that have arisen in the past decade.

11:30 Nat. Seis. Hazard Map Steering Committee Report (Anderson, Mueller)

The ad hoc steering committee for the National Seismic Hazard Mapping project will be formalized as a subcommittee of the SESAC (like the ANSS Steering Committee). The committee worked intensively this year in support of finalizing updates to the maps, and its Chair will report on the issues involved in that update and on future considerations.

12:00 Induced Seismicity (Leith and others)

Induced seismicity monitoring and research continues as a significant and visible effort within the Program, which has redirected funds over the past two years to support it. Several significant papers have been published or are in review currently, and some key grants have been funded. A new field effort has begun at the carbon sequestration site in Decatur, IL.

12:30 Lunch - bring in

13:00 ANSS Steering Committee Report (Beroza)

The ANSS Steering committee has been reenergized; the Chair will report on its recent deliberations (see letter read-ahead). Several key programmatic issues fall under the purview of the committee, including earthquake early warning, portable instrument capabilities, replacing aging equipment and integrating GPS into network operations.

13:30 Earthquake Early Warning (Given or Leith)

The cities of L.A. and Long Beach have funded an expansion of the SCSN using DHS (UASI) funding; the build-out plan includes expanded real-time GPS as well. The California Governor has signed into law a bill that directs CalOES to implement a system and to identify the funding to do so. Moore Foundation funding for R&D ends in Dec.

2014. The program must decide whether to continue EEW development in the face of budget cuts.

14:00 Projects and plans in the rock physics & friction labs (Beeler, Lockner)
The SESAC has called for a review of the rock physics labs and research. The EHP supports a modest but very active program in this area, with several talented early-career researchers and two unique labs, one containing a variety of equipment for testing rock friction, failure, and permeability, the other featuring a 2-meter "big block" earthquake simulation apparatus.

14:40 Earthquake seismology in laboratory experiments (McLaskey)

15:00 DEFORM and discussion (Tullis and all)
DEFORM proposes increased resources for rock labs nationally, to "build infrastructure to support collaborations, foster efforts to educate a greater number of students…, build the next generation of experimental apparatus, and provide opportunities for early-career scientists and users of experimental rock deformation data to visit state-of-the-art labs and conduct experiments". What is the appropriate USGS role in this effort?

15:30 Break and transit to Menlo Park

16:00 Rock Labs Tour (Lockner, Beeler, Kilgore, Moore, McLaskey, Morrow, Gray)

18:00 Adjourn

19:00 Group dinner - Rangoon Ruby (Burmese food, Palo Alto)

**Nov. 7th Green Earth Sciences Building, Room 361**

8:30 Open Discussion

9:30 Break

9:45 Executive Session

12:00 Adjourn