# NEHRP AGENCY RESPONSES TO 2013 RECOMMENDATIONS

# OF

# ADVISORY COMMITTEE ON EARTHQUAKE HAZARDS REDUCTION (ACEHR)

The full text of the March 15, 2013, annual ACEHR report to NIST Director Patrick Gallagher is available at **http://www.nehrp.gov/pdf/2013ACEHRReportFinal.pdf.** In the following, only the specific recommendations found in the report are listed, and they are accompanied by brief responses from the appropriate National Earthquake Hazards Reduction Program (NEHRP) agencies. For each recommendation, its title from ACEHR, the text of the recommendation, and the agency response are listed. The full text of the ACEHR report provides substantial background information for each of the ACEHR's recommendations.

## ACEHR RECOMMENDATION: REINVIGORATE THE IMPLEMENTATION COMPONENT OF NEHRP

***The committee recommends that FEMA be given, and FEMA management allocate, increased funding to restore all mitigation activities, including state and local government mitigation and preparedness programs, to their historic levels.***

FEMA Response: This recommendation specifically targets the activities of the Federal Emergency Management Agency (FEMA) within NEHRP. FEMA continues to work diligently to meet its statutory NEHRP responsibilities to the greatest extent possible within the constraints of available resources. FEMA has allocated $7.8M in FY 2014 for FEMA's NEHRP activities and the President has requested $7.8M for FEMA's planned NEHRP activities in FY 2015.

## ACEHR RECOMMENDATION: DEVELOP A BUILDING PERFORMANCE RATING SYSTEM THAT CAN STIMULATE MITIGATION ACTIVITIES

***The committee recommends that a building performance rating system be developed and implemented, and that to accomplish this, NIST should make the development of required tools and standards a priority, and FEMA should make implementation of the system a priority.***

FEMA/NIST Response: FEMA had begun examining the issue of developing building performance rating systems several years before the ACEHR made this recommendation, so it was appropriate to engage FEMA in the NEHRP response to the recommendation. FEMA has produced a substantial white paper, *NEHRP Response to 2013 ACEHR Recommendation Regarding Building Rating Systems*, on this topic that is included at the end of this document. The white paper includes brief discussion of related NIST activity.

## ACEHR RECOMMENDATION: PROVIDE INCREASED MONITORING TO ASSESS THE IMPACT OF INDUCED SEISMICITY

***NSF should begin sponsoring the conversion of EarthScope Transportable Array stations to permanent seismic stations maintained and operated by the USGS as soon as possible.***

USGS Response: By the end of 2013, the "Transportable Array" (TA), a massive array of portable seismometers that is part of the NSF-sponsored EarthScope facility, had moved into the Eastern United States. Also in 2013, the National Science Foundation began to invest in a cooperative project to operate about 160 of the TA stations for a longer-term, at least through 2017. Of the additional funding appropriated to the USGS by Congress in 2014 for ANSS products and monitoring in the Central and Eastern States, a portion is being used to extend NSF's investment (see NSF response, below). Over time, and with adequate funding, operations of the TA stations will be transferred to the USGS—that is, making the temporary TA resource a 'permanent' feature of the USGS Advanced National Seismic System.

NSF Response: NSF has begun sponsoring these conversions and anticipates supporting further conversions and operations of the Central and Eastern US Seismic Network stations through FY2017, subject to the availability of future funding. In FY2013, NSF provided $2.5M, and in FY2014, NSF anticipates providing approximately $3.5M to IRIS, our awardee responsible for the Transportable Array. We are in close coordination with USGS Earthquake Hazards Program staff, which have indicated their intention to provide at least $200,000 for operations in FY2014, ramping upward to at least $800,000 in FY2017 and beyond, again pending availability of future funding. NSF intends to end its support for these stations in FY2017. Currently, all 158 stations that are planned for conversion are collecting data, which are available both directly to agency partners and to the community via the IRIS Data Management Center.

***The ICC should assist the USGS in engaging DOE to create a partnership that will assure access to $CO_2$ sequestration sites in order to monitor induced seismicity both near and far from the sites, thereby addressing local seismic risks related to injection as well as providing new ground motion data to constrain attenuation models.***

General NEHRP Response: The Interagency Coordinating Committee (ICC) has not had the opportunity to give advice on this issue, having last met in early 2012. This topic will be discussed as appropriate at the next ICC meeting.

USGS Response: Since 2012, the USGS a temporary network of 12 seismic stations in the vicinity of a $CO_2$ sequestration site near Decatur, IL. This site is being developed by Archer Daniels Midland (ADM) in cooperation with the State of Illinois, DOE, and Schlumberger. USGS efforts to develop a cooperative effort with this consortium have have resulted in a Technical

Assistance Agreement with ADM for cooperative monitoring at the site, including data exchange.

***The USGS should evaluate the impact of induced seismicity on seismicity rate models.***

USGS Response: Additional funding for induced seismicity research and related activities, appropriated by Congress to the USGS in 2014 ($1 million), is being used to: develop methods to forecast whether or not a particular type of injection operation in a specified geologic setting would be likely to induce or trigger earthquakes; perform comprehensive studies at two carefully selected field sites, and establish procedures to adapt the USGS National Seismic Hazard Maps to account for the additional hazard due to earthquakes induced by wastewater disposal associated with the production of oil and gas.

Since 2012, the USGS has redirected existing staff and considerable resources to address the induced seismicity issue. The USGS has also hired additional staff and supported postdoctoral researchers for focused work on the induced seismicity issue.

***The USGS should partner with private industry to provide additional funding for the installation of temporary seismic instrumentation in dense arrays near injection sites to collect ground motion data in the near-source region.***

USGS Response: In recent years, the USGS or its partners have installed new seismic instrumentation near sites of suspected induced seismicity in Arkansas, Colorado, Oklahoma, Ohio, Texas, and Kansas. Most of these installations have been done in cooperation with State geological surveys or interested academic institutions. To date, we have received no financial support from private industry for this work. Our experience to date is that, on the issue of induced seismicity, the oil and gas industry has business models that are not inclined toward partnerships with federal science agencies and may be concerned about liability issues. Still, despite this challenge, USGS has successfully collaborated with industry on the study of potentially induced seismicity in the Raton Basin of southern Colorado.

At the national level, there is a collaborative interagency research and development effort by the USGS, the DOE, and the Environmental Protection Agency (EPA) to conduct a national science, research, and development program aimed at understanding and reducing the potential environmental, health, and safety impacts of hydraulically fractured oil and gas resources. The primary objective of this effort is to address the most urgent questions and decision-support needs surrounding hydraulic fracturing. To accomplish this, Interior, the DOE, and the EPA are developing a multi-year National Research Strategy designed to address the highest priority research questions, new and innovative technological opportunities, and

community concerns associated with safely and prudently developing resources through hydraulic fracturing.

## ACEHR RECOMMENDATION: ENDORSE THE CONTINUATION OF NEES

***The committee recommends continued support of the NEES infrastructure and collaboratory and of the associated research that uses these facilities, at current or increased levels.***

NSF Response: NSF has issued the NSF 14-054 Dear Colleague Letter (DCL) "Support for Natural Hazards Engineering Research Infrastructure and Research during FY 2015-FY 2019" http://www.nsf.gov/pubs/2014/nsf14054/nsf14054.jsp?WT.mc_id=USNSF_25&WT.mc_ev=click , which includes a discussion of planned support for earthquake engineering research infrastructure and research during FY 2015-FY 2019. Further information will be provided in the NSF program solicitations to be issued later in FY 2014.

# NEHRP RESPONSE TO 2013 ACEHR RECOMMENDATION REGARDING BUILDING RATING SYSTEMS

**BY MIKE MAHONEY, SENIOR GEOPHYSICIST, FEMA**

In its March 2013 report, the National Earthquake Hazards Reduction Program's (NEHRP) Advisory Committee for Earthquake Hazard Reduction (ACEHR) made the following recommendation:

> **"**The committee recommends that a building performance rating system be developed and implemented, and that to accomplish this, NIST should make the development of required tools and standards a priority, and FEMA should make implementation of the system a priority."

In response to that recommendation, this white paper details the work that the NEHRP agencies, primarily the Federal Emergency Management Agency (FEMA), have already accomplished to address the issue of a building rating system, and explains why further NEHRP work on this issue is not being planned.

The work of the NEHRP agencies regarding a building rating system can be traced back to a recommendation that came out of the NEHRP *Workshop on Meeting the Challenges of Existing Buildings* that was held in September, 2007, in San Francisco, CA. The workshop was co-organized by the Applied Technology Council (ATC) and the Earthquake Engineering Research Institute (EERI), and was funded by the four NEHRP agencies. The two-day workshop included active participation of over 90 individuals representing the viewpoints of engineering practitioners, researchers, regulators, building owners, and public policy experts. As a result of the workshop, ATC (under the ATC-71 project) produced a series of three reports based on the findings at this workshop.

The third of these reports, *NEHRP Workshop on Meeting the Challenges of Existing Buildings, Part 3: Action Plan for the FEMA Existing Buildings Program*, provided a prioritized list of recommendations for the FEMA Existing Buildings Program, including uncompleted tasks from previous action plans that best serve the goal of reducing the number of seismically at risk buildings through a program of earthquake risk identification and seismic retrofitting. One of the recommendations in that report called for investigating the possible development of an existing buildings rating system that would provide a mechanism for identifying at-risk buildings and recognizing buildings where actions had been taken to reduce that risk. Such a rating system would inform the public about the condition of the buildings they live and work in and would highlight seismic risk for elected officials, hopefully increasing pressure to require seismic retrofitting of at-risk buildings.

To address the recommendation regarding the development of a rating system that communicates risk in consistent, reliable terms understandable to tenants, owners and other stakeholders,

FEMA contracted with ATC (the ATC 71-2 project) to conduct a *Workshop on a Rating System for the Earthquake Performance of Buildings*. That workshop was held in March, 2011 in San Francisco.

The purpose of that workshop was to gather input on developing and successfully implementing a new system for rating the earthquake performance of new and existing buildings. The workshop was designed to identify and discuss relevant issues, including the extent to which such a rating system would encourage and promote building seismic evaluation and rehabilitation, technical difficulties and related consistency issues, potential socio-economic impediments, and stakeholder concerns and advantages.

To help accomplish this goal, the ATC Project Team spent significant time querying the "building owner community", which included representatives of the mortgage, banking and insurance industries, private and public sector owners, real estate representatives, developers, social scientists, government and public policy advocates and building regulators. To do this, the Project Team approached the World Bank (WB), to inquire if the WB would be willing to allow the creation of a web-based Discussion Group on the WB *Understanding Risk* website. The WB agreed, and with WB technical guidance, the Team created an *Earthquake Rating System for Building Performance Discussion Group*, with seven Discussion Group Moderators and seven Discussion Threads. Several hundred colleagues were invited to join the Discussion Group, as well as the entire *Understanding Risk* community. The resulting discussions provided much valuable input, and ultimately improved the workshop agenda.

The workshop report provided the results of the workshop discussions, as well as a roadmap on the steps necessary to develop a rigorous, but practical, building rating system. It also described the workshop planning efforts and the workshop program; and provided a record of the discussions, a summary of the balloted issues, and a summary of the key issues resulting from each of the discussion groups. The report also provided a summary of the pros and cons of developing a rating system and a road map on the steps necessary to develop a practical rating system.

The report concluded with the following statement:

> "A significant majority of the attendees were in favor of the development of a rating system. Most were in favor of a separate system for residential and commercial buildings primarily because the cost of the two systems must be quite different. The consensus was for a certified licensed engineer to perform the ratings for commercial buildings and a certified credentialed individual to perform the ratings of a residential property. In addition an organization that oversees the process and provides a peer review process will be useful for the long term credibility of the system.

> "The rating system should use existing standards and therefore provide an overlay or a translation matrix on top of the results obtained from existing evaluation methodologies. One major challenge will be the development of an organization that is capable of both certifying raters and providing a mechanism to peer review the ratings that are being performed to ensure technical validity of the ratings. A new rating system needs to avoid the pitfalls of the commoditization that has occurred with PML's.
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> "There was a consensus to incorporate safety, damage/repair costs and downtime (either or both time to re-occupy and time for operability) as key dimensions of a rating system. The consensus of the discussion in the breakout groups was that the rating system should include multiple dimensions and that these should be combined into a final single rating for presentation to the community. The individual key dimensions used to generate the final single rating should be available to anyone requesting such information as it would be an integral part of the rating. In addition there was overwhelming support for an absolute rating of whatever dimensions are included.
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> "The rating system should begin as a voluntary system and may migrate to some mandatory applications over time. It should offer a common vocabulary for understanding post-earthquake performance of buildings. With data on safety, repair cost, and time to recover occupancy and operations, an earthquake rating will contain information for real estate decisions that current seismic assessment reports either obscure or altogether lack. It was the consensus of the attendees that a rating system when available will encourage effective earthquake mitigation and improve the earthquake resiliency of our cities."

The entire report can be found at https://www.atcouncil.org/Projects/atc-71-2.html.

While FEMA was pleased to sponsor the above workshop, FEMA made it very clear that FEMA was in no way obligated to pursue the issue of a building rating system any further, nor was FEMA bound by any of the report's recommendations. Previous FEMA experience regarding rating systems has been that they can be controversial, especially to those owners and representative organizations that could be impacted by a loss of building value due to a negative (or other than a positive) rating.

However, there was one recommendation that came out of the workshop that FEMA did find acceptable and agreed to pursue: that was regarding the updating of an existing residential seismic rating system, known as ATC 50. The reason for FEMA's interest in updating the residential rating system was that in recent earthquake events, typical wood-frame residential structures were observed to have suffered more damage than had traditionally been thought. This risk is magnified by the sheer numbers of these buildings that exist in moderate and high seismic regions in our country.

After the 1994 Northridge earthquake, the City of Los Angeles requested FEMA disaster funds be used to develop a residential seismic rating system specifically for their jurisdiction. The development work was performed by ATC under the ATC 50 project. The final rating system

was tested on over 100 homes throughout Los Angeles. However, once the final product was published by ATC, it only saw very limited use.

The recommendation that came out of the building rating systems workshop was to update and expand the original ATC-50 system for national use. FEMA supported the development of this expanded residential rating system and accompanying retrofit guideline so as to be applicable in all high seismic areas of the country. The work was done by ATC under the ATC 71-3 project. In late 2012, FEMA released two publications: *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings* (FEMA P-50) and *Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (FEMA P-50-1).

The FEMA P-50 document contains procedures for calculating a Seismic Performance Grade using a Simplified Seismic Assessment Form, including a matrix of Performance Grades as a function of Structural Score and Seismic Hazard Score, and the ranges of expected damage for each grade. The form uses location-specific data available through online websites. The FEMA P-50-1 document contains low cost seismic retrofitting techniques to address deficiencies identified in the Simplified Seismic Assessment Form, and identifies how implementing those techniques could improve a home's score. FEMA supported this work primarily to provide a tool that communities or other entities could then use to encourage seismic retrofit of residential structures, thereby reducing future earthquake losses.

During the same time period that FEMA-funded work was progressing, the Structural Engineers of Northern California (SEAONC) Existing Buildings Committee formed a Building Rating Subcommittee to examine the issue of a building rating system. FEMA was approached to provide some support in this endeavor, and responded by funding two of the primary authors, David Bonowitz and Kate Stillwell, through an ATC task order to support subject matter experts. Their work was joined by others and ultimately resulted in a paper that was published for the 2011 SEAOC Annual Convention. (http://www.usrc.org/Documents/2011_SEAOC%20Convention%20Paper.pdf).

The paper's abstract reads as follows:

> "There is an unmet need for information and terminology that non-engineer stakeholders can use to compare the seismic performance of different buildings and to make facility-related decisions. This paper presents a ratings system under development by SEAONC Existing Buildings Committee (Building Ratings Subcommittee) intended to communicate information about seismic risk of buildings to the general public. It utilizes existing evaluation methodologies, and translates their results into a format that is easily understood. Included are the findings from an ATC workshop held in March 2011, which gathered input from potential rating system users, including owners and individuals from the real estate and insurance industries. Also included is an outline of the rating system as it relates to the standard known as ASCE 31-03."

In 2012, several of the SEAOC paper's authors formed the U.S. Resiliency Council, a 501(c) 3 non-profit corporation, to further promote the proposed building rating system plan. At that point, FEMA was unable to provide any further assistance without formal solicitation and contract competition (the same would also be true for other federal agencies).

There are several other existing NEHRP and FEMA products that could possibly be used to help rate buildings and/or serve as the basis for a building rating system. These include:

- *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook. Second Edition (FEMA 154 and 154CD).* The Rapid Visual Screening (RVS) handbook can be used by trained personnel to identify potentially hazardous buildings before an earthquake. The RVS procedure comprises a method and several forms that help users quickly identify, inventory, and rank such buildings according to their expected safety and usability during and after earthquakes. The target audiences for this guide are building officials, engineers, architects, building owners, emergency managers, and interested citizens. This document, along with the companion FEMA 155 supporting documentation publication, is currently being updated, with a fall 2014 target release date.

- *Rapid Observation of Vulnerability and Estimation of Risk (FEMA P-154 ROVER CD).* ROVER is mobile software that automates the pre-earthquake rapid visual screening procedure presented in FEMA 154 and the ATC-20 procedures for post-earthquake safety evaluations of buildings. The software is a client-server package and the server software can be installed to support both web-based and smartphone-app clients.

- *Seismic Performance Assessment of Buildings (FEMA P-58).* This new three-volume publication is the first-phase product of FEMA's Performance-Based Seismic Design Project, and provides a performance assessment methodology for determining how well a new building design or an existing building is likely to perform in an earthquake. FEMA P-58-1, Volume 1 Methodology, presents the actual assessment methodology; FEMA P-58-2, Volume 2 Implementation Guide, describes how the methodology can be implemented; and FEMA P-58-3 CD, Volume 3 Supporting Materials, is a CD-ROM containing Volumes 1 and 2 as well as supporting electronic materials and background documents, including the Performance Assessment Calculation Tool (PACT) spreadsheet and information about environmental benefits.

- *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories (FEMA P-807).* This publication provides guidelines for the seismic retrofitting of weak-story, wood-frame buildings in seismically active regions, with a focus on multi-family, multi-story buildings with weak first stories, such as those damaged in the 1989 Loma Prieta earthquake, and on apartment buildings with tuck-under parking, such as those damaged in the 1994 Northridge earthquake. These are the first guidelines to focus solely on weak first stories and on incorporating just enough added strength to protect the first floor from collapse but not enough to drive earthquake forces into upper stories, placing them at

risk of collapse. They are also the first guidelines to take into account the strength provided by existing nonstructural walls, which makes retrofitting more affordable.

In addition to the above-mentioned products, there is ongoing work to develop guidelines for the identification of hazardous non-ductile concrete buildings. This work consists of two projects one funded by FEMA and one funded by NIST, both of which are being performed by ATC. The project funded by NIST has resulted in NIST GCR 14-917-28, *Review of Past Performance and Further Development of Modeling Techniques for Collapse Assessment of Existing Reinforced Concrete Buildings* (http://www.nist.gov/customcf/get_pdf.cfm?pub_id=915400 ). The project funded by FEMA utilizes the NIST work and funds ATC under the ATC-78 project to develop a guide on how collapse-hazard non-ductile concrete builds could be readily identified and assessed.

NIST also completed NIST GCR 13-917-23, *Development of NIST Measurement Science R&D Roadmap: Earthquake Risk Reduction in Buildings* (http://www.nehrp.gov/pdf/nistgcr13-917-23.pdf ), which is intended to guide future NIST earthquake engineering research. The project was led by John Hooper, a nationally renowned structural engineer, who is also a member of the NEHRP Advisory Committee on Earthquake Hazard Reduction (ACEHR), but it also included numerous other structural engineering practitioners and researchers. That report addressed the need for a building rating system, and specifically states the following:

> "Development of a seismic rating system for buildings that would put a marketplace value on expected seismic performance has been recommended at numerous workshops in the last 10 years. The Structural Engineers Association of Northern California (SEAONC) has been working on this idea for several years. A workshop, funded by FEMA, was held in March, 2011 to better understand the demand for, and uses of, such a rating system. The results of the workshop were mixed with no overwhelming conclusion as to the desirability (or non-desirability) of a rating system. Many public policy issues were identified that would apparently be outside the scope of federal government (NEHRP) resolution and FEMA is not currently funding development efforts. Technical issues were also identified, primarily related to consistently predicting seismic performance for the purpose of establishing a rating. Many of the proposed projects scattered across several of the research categories are crucial to developing this technical basis, and the Project Technical Committee chose to acknowledge the importance of the topic here, without identifying a specific task to develop the rating system."

In summary, the response to the ACEHR recommendation is that NEHRP (primarily FEMA) has taken significant steps towards encouraging the development of a building rating system.

However, three points must be made:

1. While it may be possible to develop a building rating system, implementing such a system is outside of the authority of the federal government and must be done at the local government or private sector level.

2. Given current resource limitations at both FEMA and NIST, additional pursuit of this issue can only be undertaken at the expense of other research and implementation activities. As mentioned above, the expert team that developed NIST GCR 13-917-23, which was released shortly before the 2013 ACEHR report, did not specifically prioritize building rating system development above other research recommendations.

3. The USRC has recently reached its goal of obtaining enough committed start-up funding from their founding members to begin operations and held its first stakeholders meeting on June 17, 2014. One of the primary issues they immediately face is developing a plan for technical operations. They are currently in discussions with ATC, one of the USRC founding members, about possibly becoming involved in this issue. In a boost for USRC, Los Angeles Mayor Garcetti has called for implementing a building rating system for his city by this fall. Lucy Jones, a USGS seismologist on temporary detail to the City of Los Angeles, has been tasked with coming up with an implementation plan. She has approached the USRC about their helping the city in this regard.