Advanced National Seismic System Northeastern United States (ANSS-NE) Implementation Plan

ROAD DAMAGE CAUSED BY THE AUSABLE FORKS, NY EARTHQUAKE OF APRIL 20, 2002

Prepared by:

The ANSS-NE Steering Committee
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for
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I. BACKGROUND

Through the National Earthquake Hazard Reduction Program, the U.S. Congress directed the U.S. Geological Survey to implement the Advanced National Seismic System (ANSS). The ANSS serves as the mechanism to improve seismic instrumentation, data distribution, data archiving and interaction between data producers and users. The management structure for the ANSS is composed of representatives from both seismological (data producers) and end-user (data and information consumers) communities at both the national and regional levels.

One of the regions is the northeastern U.S. (ANSS-NE) The northeastern region spans twelve states : Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia and the District of Columbia. It includes the densely populated urban corridor of the northeastern U.S., with a population of more than 60 million people. The history of damaging earthquakes in the region, combined with the large number of urban areas with older structures not designed or built to withstand earthquake shaking, mean that there is a sizeable earthquake risk in the region. Moreover, there is a lack of basic research and understanding of what causes earthquakes to occur in the northeast, how large they might be, where and how frequently they can occur and how they would impact the region. For this reason, many states and localities in the region have adopted seismic provisions in their building codes, have prepared emergency management plans for damaging earthquakes and undertaken other earthquake hazard mitigation measures.

There is a wide variety of stakeholders in the region with whom the ANSS-NE must interact and coordinate. Accordingly, a planning roundtable was held on September 17-18, 2007 at Boston College. The primary purpose of the roundtable was to begin developing an implementation plan for the ANSS-NE for the next 5 years based on the needs of the stakeholders. A diverse Steering Committee comprised of representatives of key government agencies universities and organizations that play a major role in earthquake hazard research, preparedness and mitigation, and representatives from private industry, was established to develop the Implementation Plan. Members of the steering committee are listed in Appendix I.

II. PURPOSE OF THE IMPLEMENTATION PLAN

The purpose of the implementation plan, contained herein, is to identify and prioritize goals and to propose specific actions and activities to achieve these goals. These actions will ultimately improve efforts to mitigate the effects of earthquakes, especially seriously damaging earthquakes, in the northeast U.S. The plan explains from the stakeholders' point of view what the important earthquake hazards and monitoring issues are for the next 5 years. The plan coordinates the activities of a number of different seismological research and monitoring centers at the federal and local levels (including internationally), as well as those of a large and diverse set of states and urban areas. The plan also addresses what priorities should be assigned to proposed ANSS-NE activities, and identifies potential funding sources.

III. STATEMENT OF GOALS

The Steering Committee has established the following goals listed in order of priority for implementation over the next five years:

Goal 1: Continue the operation of two full-service seismic monitoring centers in the region, one focused on New England and one focused on the Middle Atlantic States

The area covered by the ANSS-NE is comprised of two geopolitically distinct regions, New England and the Middle Atlantic States. The people in the New England region look to the Boston based academic institutions for leadership and information on seismic issues, while the people in the Middle Atlantic States view the New York institutions in precisely the same way. Both traditionally and at the present time, Weston Observatory of Boston College has been the authoritative source of earthquake information for the New England region. For the Middle Atlantic States, at one time Fordham University in New York City was the primary source concerning earthquakes information, but during the past four decades, this role has been filled by the Lamont-Doherty Earth Observatory of Columbia University. To maximize the impact and effectiveness of earthquake hazard mitigation measures throughout the ANSS-NE region, it is necessary that these two current seismic monitoring centers remain fully operational and authoritative, providing both information about current and past earthquakes and research results concerning the earthquake hazards in the northeastern U.S. Weston Observatory and Lamont-Doherty should continue to work mutually with the USGS and cooperatively with each other and with the Canadian Geological Survey to operate seismic network monitoring in the northeast in the most coordinated and cost effective manner possible.

The following action items are necessary to achieve this goal:

1) Stakeholders in the region should encourage federal, state and local agencies to continue to provide funding for authoritative earthquake monitoring centers at Weston Observatory and at Lamont-Doherty Earth Observatory.
2) Weston Observatory and Lamont-Doherty Earth Observatory should develop new and better earthquake information products and information concerning seismic hazards and seismic risk for dissemination in their authoritative regions.
3) Weston Observatory and Lamont-Doherty Earth Observatory should improve coordination and collaboration of earthquake monitoring activities, both between themselves and with the Canadian Geology Survey and the USGS National Earthquake Information Center.

Goal 2: Improve Delivery of Seismic Information to Users

This goal involves the development of a comprehensive plan to deliver timely earthquake information to the region. Weston Observatory, Lamont-Doherty Earth Observatory, the USGS National Earthquake Information Center and the Canadian Geological Survey must work with the stakeholders of the region to define distribution protocols, formats for the information to be distributed, magnitude thresholds at which different types of information are required, etc., for all seismic events in the region. The outcome of this goal will be a coordinated, region-wide

seismic information system that improves the speed and content of the seismic information delivered to users.

The following action items are necessary to achieve this goal:

1) Develop operational protocols between Weston Observatory, Lamont-Doherty Earth Observatory, ANSS, the Canadian Geological Survey and Northeast state emergency managers and other users.
2) Provide real-time reporting of all felt and damaging seismic events.
3) Provide real-time identification of earthquake vs. blast events.
4) Provide timely seismic information to critical facilities (e.g., Nuclear and Chemical Facilities)
5) Implement Shake Map in the Northeast

Goal 3: Improve Fundamental Understanding of Seismic Hazard in the Northeast

This goal is to define the research priorities for seismic hazard studies for the region and to develop action items to plan the operation of the regional seismic network to achieve the research priorities.

The outcome of this goal will address a number of fundamental questions that need to be answered in order to assess the seismic hazard of the region and to respond most effectively immediately following the occurrence of a strong earthquake in the region. Regarding the seismic hazard of the region, the stakeholders want to know the locations of earthquake source zones, the probabilities of earthquakes, especially those capable of causing damage, the spatial distribution of expected ground motions as a function of earthquake magnitude and location, and the rate of attenuation of strong ground motions away from the epicentral region of an earthquake. Because most past strong earthquakes in the region took place before the installation and operation of modern seismic instrumentation, new strong-motion data, especially near-source data, from future earthquakes is required. These data can only be gathered by a broad, coordinated, continuous operation of strong-motion seismic instruments spread throughout the region. One important long-term goal of continued earthquake monitoring and research is to try to identify active faults in the region that are capable of experiencing strong earthquakes. Analyses of data acquired from past and future regional seismic network monitoring, combined with focused paleoseismicity studies, are needed to achieve this long-term goal. Over the long term, earthquake data at all magnitudes from regional seismic network monitoring may also isolate possible or probable source zones capable of being the focus of a strong earthquake even in those localities where no paleoseismological evidence of past strong earthquakes has been found. This requires a long-term database of earthquakes with well-determined locations and magnitudes down to the smallest possible magnitudes that can be detected and analyzed.

In order for the stakeholders of the region to respond most effectively following the occurrence of a strong earthquake, the results of seismic hazard studies must be translated into products that are immediately usable by government officials and private individuals. Reliable ShakeMaps are needed. The effect of local soil conditions on the amplification of strong ground motions and on the possibilities of ground liquefaction need to mapped, especially in the many urban areas throughout the region.

The following action items are necessary to achieve this goal:

1) Determine the number and locations of additional seismic stations needed to give adequate coverage for detecting, locating and studying the earthquake activity throughout the entire northeast US.
2) Determine the optimum number and location of strong-motion stations needed in the northeast US.
3) Focus research on where and how often moderate or large earthquakes are likely to occur in the Northeast US.
4) Investigate hazard-related issues such as preparation of maps of ground-shaking amplification potential in urban areas, identification of liquefiable deposits in populated areas, and mapping earthquake-induced landslide potential throughout the region.
5) Accumulate and catalog research findings, as well as ongoing research, in an integrated manner that is accessible to non-scientists in the region, and make this information publicly available in an easily accessible format.

Goal 4: Improve and Expand Seismic Education and Outreach in the Northeast

This goal is to define and develop educational and outreach programs that increase and better integrate earthquake monitoring with education in the region using new and innovative approaches.

The outcome of this goal will be products and services that improve the understanding of the earthquake threat in the northeast region. There is an urgent need for information immediately following the occurrence of a felt earthquake, and this need increases dramatically if the earthquake causes damage. The information that is sought immediately following a felt earthquake is the time, location, and magnitude of the event, as well as whether or not the earthquake was damaging. The media and public officials want to know what fault the earthquake occurred on, what are the probabilities of aftershocks (especially strong aftershocks), and whether an even larger earthquake is imminent. They also want to know what caused the earthquake and whether other such earthquakes might take place. They look to their local scientists, especially those at Weston Observatory and Lamont-Doherty Earth Observatory, to help them understand what took place and what to expect in the future. They want to see the data and get some understanding how these data are being used by those scientists.

Even when no earthquake has taken place recently, there is a need for better general information about earthquakes. The public wants to know about the past earthquake history, the causes of earthquakes in the region, and the potential for future earthquakes, especially strong earthquakes. They want to know how to interpret seismic hazard maps, especially the National Seismic Hazard Maps produced by the US Geological Survey, and how recent earthquake activity relates to those maps. They want to be assured that the local scientists are monitoring the current earthquake activity and are looking for indications about future earthquakes.

Experience has shown that regional seismic network monitoring is intimately related to seismology education. For several years, Weston Observatory has been running its Boston

College Educational Seismology Project (BC-ESP). This project puts simple seismographs into K-12 schools and provides instruction to teachers and exercises for students on seismic monitoring and earthquake research. The students are impressed that the same scientists who are actively involved in regional earthquake monitoring on a day-to-day basis are coming into their classrooms to talk about seismology and earthquakes, both regional and global. Lamont-Doherty Earth Observatory (LDEO) operates the Lamont-Cooperative Seismic Network (LCSN), where seismic stations are sited at high schools and colleges and are run by the local schools. Not only do the LCSN members participate in the earthquake monitoring in the region, but Lamont-Doherty also brings the operators together annually to teach them more about seismology and earthquakes. These Weston Observatory and LDEO educational activities only reach a limited audience, and a wider access to these educational resources is needed.

Another outcome of this goal that is needed is the development of new, targeted outreach materials concerning earthquakes and earthquake hazard. Some of the audiences that need such materials are emergency managers, building code officials, school officials, utility operators and regulators, state geologists, and federal and state government legislators. These individuals can only make proper decisions concerning earthquakes and seismic hazards if they have been educated about those hazards and if they have informative reference materials.

The following action items are necessary to achieve this goal:

1) Develop new web-based public and media information systems for seismic education and information. This includes maintaining current web pages and social networks with the latest information about earthquakes and earthquake research results.
2) Develop a marketing approach and strategy for outreach to government agencies and elected officials.
3) Implement a creative outreach program that aggressively links to the broader public, media outlets, professional organizations and others not traditionally touched by more traditional earthquake awareness and educational efforts. These efforts should include innovative ways to use the internet, such as social networks, to reach web users of all ages.

Goal 5: Identify Multi-Hazard Uses for Regional Seismic Information and Networks

This goal is to define actions to help diversify the sources of funding for the regional seismic networks, such as by expanding their scope of work to include hazards other than earthquakes. This would include possible use of the networks for homeland security purposes such as identifying the location of explosions and blasts, as well as distinguishing earthquakes from other man-made hazards that can produce ground shaking.

The outcome of this goal will be a strong seismic instrumentation program that serves as the backbone of much of the earthquake-related work that needs to be done in the Northeast. Wherever possible, regional seismic network operators should attempt to develop cooperative relationships with organizations that study other hazards, natural and man-made (such as tsunamis, floods, severe windstorms, landslides, explosions, terrorism, etc.) to look for synergies that will help improve earthquake data acquisition and analysis in a cost-effective way.

The following action items are necessary to achieve this goal:

1) Investigate the feasibility of developing new sources of funding support for the regional seismic networks in the northeast US through multi-hazard collaborations including homeland security applications.
2) Identify ways to develop multi-hazard, natural and man-made, expanded capabilities and scopes of work at the regional seismic networks.
3) Expand and strengthen the existing regional seismic monitoring system and supporting staff.

III. IMPLEMENTATION STRATEGY AND TIMELINE

The 2007 ANSS-NE Roundtable defined a number of goals to be accomplished, and those goals are described in Section II of this report. In order to achieve these goals, specific action steps must be developed and carried out both by the regional seismic network operators in the region and by the stakeholders who benefit from the operations of the Advanced National Seismic System in the northeastern US. In this section of this report, those steps that need to be undertaken to implement the ANSS-NE goals are specified.

Goal 1 calls for maintaining and strengthening the authoritative earthquake monitoring operations at both Weston Observatory and at Lamont-Doherty Earth Observatory. Each center should work with stakeholders in the region to identify and develop sources of funding for their operations in addition to the base funding provided by the USGS. Each center also should develop new and better earthquake information products and information concerning seismic hazards and seismic risk for dissemination in their authoritative regions and report these to the ANSS-NE Steering Committee. Weston Observatory and Lamont-Doherty Earth Observatory should report to the ANSS-NE Steering Committee those steps they intend to take to improve coordination and collaboration of earthquake monitoring activities, both between themselves and with the Canadian Geology Survey and the USGS National Earthquake Information Center. This reporting should take place on an annual basis.

Goal 2 calls for the improved delivery of seismic information to users and stakeholders in the ANSS-NE region and beyond. Action item 1 calls for operational protocols between Weston Observatory (WO), Lamont-Doherty Earth Observatory (LDEO) and the Canadian Geological Survey (CGS). These protocols should be spelled out in a joint document developed by these three organizations and submitted for approval to the ANSS-NE Steering Committee by December 1, 2009. Furthermore, the ANSS-NE Steering Committee should require that all approved protocols be fully implemented by March 31, 2010. Action items 2, 3, 4 and 5 are already being implemented in some fashion by these three regional seismic networks. By December 1, 2009, WO and LDEO should report their current capabilities concerning these items to the ANSS-NE Steering Committee along with their plans to improve these capabilities. This report should be reviewed by the ANSS-NE Steering Committee with comments returned to WO and LDEO by February 1, 2010.

Goal 3 calls for improving the fundamental understanding of seismic hazards in the northeastern US. This is a broad and ambitious goal for which only incremental progress can be made in the near term. Achieving this goal will require the installation and operation of new seismic equipment while at the same time maintaining the operations of the current seismic stations. Much planning needs to be carried out for achieving this goal. Thus, to implement these goals, WO and LDEO each are asked to prepare a report describing the needs for improving and expanding the number of seismic stations for their regions of monitoring over the next five years. Both weak-motion stations capable of detecting small, local earthquakes and strong-motion stations capable of faithfully recording the ground motions from strong earthquakes should be included in this report. Each report should propose the number and locations of new seismic stations that should be installed, identify which existing seismic stations should be upgraded, and explain how the expanded seismic monitoring will improve the detection and location of the earthquakes in the region. The impact on the regional network operations at the WO and LDEO monitoring centers must be addressed. The planned network expansions should be prioritized to allow them to be implemented in a planned and orderly manner as funding becomes available. Each report should also describe the kinds of basic scientific research that can be carried out with the improved seismic network monitoring and how to disseminate those research results to users and stakeholders in the region. Finally, each report should describe how the network expansions would be coordinated between WO and LDEO. The reports are to be submitted to the ANSS-NE Steering Committee by December 1, 2009. The ANSS-NE Steering Committee will review the proposed network expansions, review the prioritization of the work and make recommendations about how the network expansions should proceed. This review by the ANSS-NE Steering Committee should take place during the fall of 2009 and completed by February 1, 2010.

Goal 4 calls for improving and expanding seismic information and education in the ANSS-NE region. Both WO and LDEO already are engaged in active programs involving both the public dissemination of seismic information and efforts to include seismology in education from grade schools to universities. However, Goal 3 envisions that each monitoring center will develop new resource and educational materials and will disseminate them more widely. Clearly, the worldwide web is creating new possibilities for widely disseminating information about earthquakes and seismology. Both WO and LDEO should provide a report to the ANSS-NE Steering Committee describing prioritizing the action items they intend to pursue during the next 5 years to improve and expand earthquake information dissemination and seismology education and outreach. These reports should be submitted to the ANSS-NE Steering Committee by December 1, 2009. The ANSS-NE Steering Committee will review these reports and return comments to WO and LDEO by March 31, 2010. Based on these comments, WO and LDEO will be expected to begin implementing the most important action items starting in the fall of 2010.

Goal 5 calls for the identification of multi-hazard uses for regional seismic networks. There is very little precedent for this use of regional seismic networks, and so the regional network operators must be creative and assertive in carrying out the action items for this goal. WO and LDEO are asked to report to the ANSS-NE Steering Committee by March 31, 2010 of progress they have made toward achieving this goal.

Once the reports by WO and LDEO have been submitted and reviewed by the ANSS-NE Steering Committee, the reports and reviews should be presented at a stakeholders' workshop.

This workshop should be held during the winter of 2010. Stakeholders from throughout the region and from all constituencies with an interest in seismic hazard and loss issues should be invited. At the workshop the reports and their reviews should be presented, comments should be solicited, and input on existing and new ANSS-NE goals will be sought.

This section calls for a number of actions items that are to be carried out by the regional seismic network operators and by the ANSS-NE Steering Committee. The following is a timeline of activities and deadlines:

December 1, 2009: Reports on Goals 1, 2 and 3 due from WO and LDEO to the ANSS-NE Steering Committee

February 1, 2010. Comments by the ANSS-NE Steering Committee on the Goal 1 and Goal 2 reports returned to WO and LDEO

March 31, 2010. Comments by the ANSS-NE Steering Committee on the Goal 3 report returned to WO and LDEO. Goal 4 reports by WO and LDEO due to the ANSS-NE Steering Committee.

April 1, 2010-April 1, 2011. WO and LDEO carry out the highest priority items, as determined by the ANSS-NE Steering Committee, from their Goal 1, Goal 2 and Goal 3 reports as funding permits.

Fall 2010. There is a 1-2 day meeting for ANSS-NE stakeholders to review ANSS-NE activities and goals.

IV. BUDGET

Currently, all funding for ANSS-NE operations comes from the US Geological Survey to WO and LDEO. Some of the funding for seismic station equipment has come from local sources such as universities. To properly execute the implementation plan outlined in this document, significant new funding revenues are required. While it is the primary responsibility of WO and LDEO to seek funding sources for ANSS-NE operations and research, it is also important that stakeholders in the ANSS-NE region who have a need for earthquake data and information assist in the search for funding. The ANSS-NE Steering Committee should take a lead role in encouraging stakeholders in the region to develop new sources of funding for ANSS-NE activities.

The following is a discussion of possible sources of funding for ANSS-NE operations and research.

1. Federal funding. The president has called for a doubling of the federal funding for basic scientific research (http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-at-the-National-Academy-of-Sciences-Annual-Meeting/). This funding target also should be applied to the ANSS-NE operations and research activities at WO and at LDEO. That funding should be provided by the US Geological Survey, by the US Nuclear Regulatory Commission, by the US Army Corps of Engineers, and by other federal agencies that have a direct need for data and research concerning earthquakes and seismic hazard in the northeastern U.S. These agencies should make available sufficient funding for upgrading and expanding the ANSS-NE

regional seismic networks as called for in the Goal 2 and Goal 3 documents that will be prepared and approved by the ANSS-NE Steering Committee in 2010.

2. State funding. Each of the states in the ANSS-NE region should be encouraged to provide some funding support for ANSS-NE operations in the region. The funding could be operational funds, in-kind services such as dedicated data communications systems, or the purchase and provision of seismic equipment for ANSS-NE use. WO and LDEO, in conjunction with members of the ANSS-NE Steering Committee and other interested stakeholders I the region, should work to develop state support for ANSS-NE operations and activities.

3. Local and private funding. Local governments and private industry can be users of ANSS-NE data and analyses, and they should be encouraged to provide funding for ANSS-NE activities wherever possible. The ANSS-NE Steering Committee, working with other stakeholders in the region, should take the lead in identifying local governments and private industries that can provide support for ANSS-NE operations and activities. Once identified, WO and LDEO should take the primary responsibility for making funding requests and negotiating funding specifics.

At its meetings, the ANSS-NE Steering Committee and stakeholders should review the success of all efforts to obtain funding for ANSS-NE operations and activities, and the most promising efforts should be expanded and duplicated as appropriate. Since competition for funding can be quite keen, the ANSS-NE stakeholders need to be pro-active in encouraging federal, state, local and private funding for the work of the ANSS-NE.

APPENDIX I – STEERING COMMITTEE MEMBERS

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