

UNITED STATES FEDERAL AGENCY PROGRAMS IN DISASTER COUNTERMEASURES

By

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INTRODUCTION

The purpose of this paper is to present an overview of the roles and responsibilities of U.S. Federal Agencies and the major programs they are conducting which involve mitigating the impacts of natural and man-made or technological hazards on vulnerable populations, economic investment and critical facilities both in the United States and abroad. The United States through its many Federal Agencies, state and local governments is committed to protecting its people, businesses, communities and economic resource base in the face of disaster.

According to the U.S. National Academy of Sciences, Advisory Committee on the International Decade for Natural Disaster Reduction, as many as 70 million people in 39 states face significant risk from earthquakes and secondary hazards such as landslides. It is estimated that more than \$100 billion in total economic losses could occur from a single major California earthquake. Billions of dollars in damage could occur from a devastating hurricane such as Agnes in 1972 or Hugo in 1989 which we know resulted in \$9 billion in losses, including 8,800 square miles of downed timber. The U.S. experiences some 900 tornadoes annually; wildfires destroy hundreds of thousands of acreage each year and volcanoes are a constant

threat. The eruption of Mount St. Helens in 1980 caused over \$1 billion in damage. Recent estimates indicate landslides cause \$1 to \$2 billion in economic losses each year with flood disasters (\$1 billion annual loss) and drought impacts (\$40 billion estimated loss in 1988 alone) causing recurring intermittent losses.

The Office of U.S. Foreign Disaster Assistance, Agency for International Development, estimates that more than 3 million people have died and more than 900 million have been seriously affected worldwide by disaster during the past 22 years. Property damage and economic losses are believed to exceed \$75 billion during the same period, although data collected over the years remains imprecise.

The magnitude of destruction and human loss both physical, social, and economic is dramatic when viewed on a global scale and at the national level. Governments have, in several instances, failed following significant disasters and their impacts. We, in the United States, recognize that we live in a disaster-prone world and nation and have determined to take concerted action to mitigate these negative impacts now and in the future.

DISASTER REDUCTION PROGRAMS OF
THE U.S. GOVERNMENT

Within the 14 cabinet level departments of the federal government and more than 70 independent agencies, there are thousands of bureaus and offices dealing with various aspects of hazard reduction either at the personal, local, state, federal or global scale. Billions of dollars are expended annually to monitor, regulate, control, document and respond to the many facets of natural and technological hazards as they affect the American people both in the public and private sectors. The nature of our government is to protect its citizens, as well as to provide humanitarian assistance to those in need abroad. The lead U.S. domestic agency responsible for disaster management and civil defense is the Federal Emergency Management Agency (FEMA). The Agency for International Development's (A.I.D.) Office of U.S. Foreign Disaster Assistance (OFDA) coordinates U.S. international disaster assistance to host countries abroad. Both FEMA and OFDA work closely with other federal agencies to ensure effective and timely implementation of disaster countermeasures as mandated by legislated laws and regulations at all levels of government. The federal departments and their many agencies have specific missions and programs designed to prevent, mitigate, prepare for, respond to, rehabilitate or otherwise ameliorate the impacts of disaster.

The Lead Role of the Federal Emergency Management Agency (FEMA) in Earthquake Hazards Reduction

Under the 1980 amendments of the U.S. Earthquake Hazards Reduction Act, the Federal Emergency Management Agency (FEMA) was assigned the leadership role for the National Earthquake Hazards Reduction Program (NEHRP). FEMA's leadership responsibilities include a range of activities that focus on planning and coordinating the work of the NEHRP, and broadening its scope of participation and effect.

The purpose of the *National Earthquake Hazards Reduction Program* is to reduce the risk to lives and property. This is accomplished through a comprehensive, multi-agency program

of scientific research, mitigation, preparedness and response planning and public education. FEMA, as the lead agency, has the statutory responsibility to plan, coordinate and recommend goals, priorities and budgets for earthquake activities among the principal agencies authorized under the Earthquake Hazards Reduction Act of 1977, as amended. The agencies include the United States Geological Survey, the National Science Foundation and the National Institute for Standards and Testing.

The primary activities of the program are to:

- (1) develop improved seismic design and construction practices for adoption by Federal agencies, State and local governments and the private sector;
- (2) provide financial and technical assistance to State and local governments to implement comprehensive earthquake hazard reduction programs;
- (3) develop public education and awareness programs and
- (4) plan for and coordinate an adequate Federal capability to respond to a catastrophic earthquake.

FEMA's Role in Managing Other Natural and Technological Hazards and Emergency Response

FEMA's natural and technological hazards programs include the following elements: (1) National Earthquake Hazards Reduction, (2) Hurricane Preparedness, (3) Dam Safety, (4) Radiological Emergency Preparedness, (5) Hazardous Materials and (6) Chemical Stockpile Emergency Preparedness Program.

The goal of the *Hurricane Preparedness Program* is to reduce the loss of life and property damage from hurricanes in high-risk populations and to develop State Hurricane Evacuation Plans. FEMA, as the chair of the Interagency Coordinating Committee on Hurricanes,

coordinates ongoing hurricane-related planning and mitigation activities of the U.S. Army Corps of Engineers, the National Weather Service, the National Hurricane Center and the Office of Ocean and Coastal Resource Management.

The objective of the *Dam Safety Program* is to enhance the safety of the Nation's dams, thereby protecting lives and property. FEMA exercises dual responsibilities through its Dam Safety Program to (1) coordinate Federal dam safety activities and (2) coordinate and implement activities designed to encourage States to implement strong dam safety programs.

The mission of the *Hazardous Materials Program* is to provide technical and financial assistance to State and local governments. In addition, FEMA coordinates and cooperates with the private sector in developing, implementing and evaluating hazardous materials emergency preparedness programs for State and local governments. The mission is accomplished through five separate functional elements--planning, training, exercising, information exchange and intergovernmental coordination/cooperation. FEMA develops and distributes planning and preparedness guidance to State and local governments in cooperation with the 13 member agencies of the National Response Team. Hazardous materials training courses and course materials are developed and financial assistance is provided to State and local governments.

As a result of a Presidential Directive in 1979, FEMA was assigned the lead Federal role for radiological emergency planning and response. Under FEMA's *Radiological Emergency Preparedness Program*, the goal is to enhance integrated emergency planning and response for all types of peacetime radiological emergencies by the State, local and Federal governments. The primary emphasis is directed to planning and preparedness for commercial nuclear power plants, nuclear fuel cycle and material license holders, Department of Defense and Department of Energy facilities and transportation accidents. Key activities pertaining to offsite radiological emergency planning and

preparedness include evaluation of emergency response and utility plans, review of public emergency information materials, review and testing of utility alert and notification systems, periodic exercises to test emergency response plans and periodic program activities such as drills, plan updates and public meetings.

FEMA, more than any other Federal agency, provides the financial and technical assistance to State and local governments to prepare for, respond to, and recover from natural disasters. This is done through the Civil Defense Program, which provides a system of survival capabilities to protect life and property from natural hazards through the construction of emergency operation centers, warning systems, and training of State and local emergency managers. Other relevant FEMA programs assisting natural hazard reduction efforts of State and local governments are (1) The national Flood Insurance Program, which makes flood insurance backed by the U.S. Government available to communities that have agreed to adopt and enforce floodplain management ordinances to reduce future flood losses through wise utilization of their floodplains; and (2) The Fire Prevention and Control Programs of the U.S. Fire Administration, which provides training and grants that support the efforts of State and local governments to reduce the number of fires nationwide and the loss of life and property from fire.

The Role of the Department of the Interior's U.S. Geological Survey (U.S.G.S.) in Geophysical Hazards Countermeasures In the United States

A principal goal of the National Earthquake Hazards Reduction Program is to identify, evaluate, and characterize accurately the seismic hazard in areas subject to high or moderate seismic risk. The U.S. Geological Survey (USGS) is the principal agency responsible for addressing this goal. There are two primary program objectives: to determine the tectonic and geologic framework and earthquake potential of the various earthquake-prone (or seismogenic) zones in the United States

through detailed seismological and geological studies; and, as these zones are defined and their seismic potential quantified, the hazards and risks to the population, structures, and lifelines must be identified, evaluated, and documented. Decisions made by various governmental and private sector entities regarding construction practices, land use planning, and disaster preparedness should be based on accurate and complete assessments from work under this program element.

The USGS also conducts earthquake engineering research focused on strong ground-motion data collection, processing and analysis, maintains centers for seismological data collection and dissemination and leads the nation's earthquake prediction research programs in prediction methodology and experiments; theoretical, laboratory and fault zone studies; and induced seismology research.

The USGS currently is managing several projects focusing on earthquake hazards in the Eastern United States. These include: studies of the structure of the crust in earthquake prone areas, examination of faults, calculation of horizontal stresses over large areas, modeling of the local amplification of shaking due to earthquakes, and earthquake monitoring networks. The Parkfield Earthquake Prediction experiment on the San Andreas fault in central California is now fully operational and being monitored in real time. The use of high-precision geodetic surveying across large distances of the Earth's surface now allows scientists to monitor minute changes in the dimensions of the Earth's crust in earthquake-prone regions. This information provides a more accurate assessment of where and how stresses are accumulating in the crust.

In earthquake engineering research the USGS in cooperation with other agencies is conducting laboratory simulation of earthquake strong ground motions which promises to increase dramatically our ability to learn about the effect of damaging earthquakes on engineered structures. Research on spatial variation of strong ground motion is helping to illuminate the

patterns of local damage during earthquakes. Understanding this variability is prerequisite to controlling it by means of protective measures or appropriately conservative seismic design.

The USGS is at the forefront of producing and deploying arrays of new digital seismographs in the U.S. and elsewhere in the world. The southern Quebec Earthquake of November 25, 1988, was a real-time test of the Earthquake Early Alert Service.

Understanding earthquake risk is fundamental to disaster planning and mitigation policy and implementation of countermeasures. Despite the Loma Prieta Earthquake, the risk of a damaging earthquake in the San Francisco Bay region still confronts nearly 6 million people. A new study, released in July 1990 by the USGS, says that there is approximately a 70 percent chance of another earthquake equal to or larger than Loma Prieta in the next 30 years, meaning that the earthquake is twice as likely to happen as not. The same report examined individual segments of Bay Area faults and gave probabilities of major earthquakes on each of those segments during the next 30 years. It is important to recognize that there are various potential sources for the next big earthquake, and that these sources are much closer to heavily populated areas than the Loma Prieta event, hence the potential for loss is greater.

USGS Technical Support For International Activities in Geophysical Hazards Reduction

Since 1983 the U.S. Geological Survey (USGS) has worked closely with the Agency for International Development's Office of US Foreign Disaster Assistance (AID/OFDA) in support of geophysical hazards reduction programs in the less developed countries (LDCs).

These programs have produced results that have placed AID/OFDA and the USGS in a highly visible role as leaders in reducing the impact of natural disasters. In addition to cooperating with OFDA in crisis responses such as the catastrophic eruption of Ruiz Volcano (Colombia), the toxic gas emissions of Lake Nyos

(Cameroon), and the earthquake devastation in Armenia (USSR), the USGS provides ongoing technical assistance in OFDA's prevention, mitigation and preparedness activities.

In 1984 the USGS and OFDA sponsored a Geologic and Hazards Training Program in Denver which has proven to be a milestone in the technology transfer of earthquake countermeasures information to the LDCs. The purpose was to develop hazard mitigation expertise in order to save lives and reduce economic losses in countries where geologic and hydrologic hazards are prevalent. Forty-two international participants from 28 disaster-prone countries attended. The proceedings volume (1,112 pp.), has been used extensively by other organizations as a text for subsequent hazards training courses.

In 1988 the USGS completed a series of detailed earthquake conditional probability maps and reports which cover the Circum-Pacific region and show comparative earthquake and tsunami potential for zones in the U.S., Central and South America, Southeast Asia, Japan and Alaska.

The Volcano Monitoring and Research Project in Indonesia has been a cooperative AID/Jakarta-funded five-year volcanology program between the Volcanological Survey of Indonesia and the USGS. At the conclusion the agreement was renewed by AID/OFDA. The purpose of the program was to provide the on-site consultant services of an eminent advisory volcanologist, who, with a number of USGS scientists and technicians, prepared a national volcano hazards assessment of Indonesia and trained the Indonesians so that they could respond to volcanic crises. This work included upgrading the volcano monitoring networks and providing transfer of technology and expertise in volcanology.

In 1986, as an outgrowth of the USGS's Volcano Crisis Assistance Team (VCAT) and as a result of the Ruiz Volcano disaster in Colombia, a 5-year program was set up between the USGS and AID/OFDA. This cooperative

program, equally funded by the USGS and OFDA, has established the U.S. capability of providing rapid, efficient and cost-effective volcano emergency response, initially in Latin America and also worldwide. VDAP provides on-site monitoring by a technically-qualified volcano crisis assistance team, ongoing mapping and analyses of volcano hazards, preparation of data on the threat information to facilitate evacuation planning, an equipment cache, and training. To date VDAP has responded to volcanic threats in Colombia, Costa Rica, Guatemala, Ecuador, and Peru.

The U.S. Geological Survey is currently implementing the Worldwide Earthquake Risk Management Program (WWERM) as a one-year interagency cooperative pilot program (1990-91) with OFDA. Subsequent activities will depend on co-funding commitments from other donors and organizations. The objective of WWERM is to develop an action plan and conduct the one-year pilot program in each of three earthquake-prone target regions to demonstrate the utility, importance, feasibility and need for uniform global earthquake hazard mapping and risk assessment/management in preparation for a program linked to the International Decade for Natural Disaster Reduction. In each of the pilot project's four target countries (Morocco, Peru, Chile and Indonesia) the USGS, in cooperation with host country experts, will prepare probability earthquake ground motion maps and preliminary estimates of expected physical losses within the "built environment" as a basis for risk management, life saving preparedness planning, and the development of mitigation strategies.

The Department of Commerce's National Institute of Standards and Technology (NIST) Improving Seismic Design And Construction Guidelines

The role of the National Institute of Standards and Technology (NIST) in the NEHRP is to conduct research and provide technical support for the development and application of improved seismic design and construction practices. The research conducted by NIST is driven by two general objectives: to make new

construction safe and economical with respect to earthquake hazards and to mitigate potential earthquake hazards in existing facilities. Thus, laboratory and analytical studies are conducted to provide technical information needed for improving building codes and standards pertaining to new construction, and to develop new criteria regarding the repair and strengthening of existing structures.

Several years ago, NIST initiated a multi-year research program to develop technical data on the behavior of connections between beams and columns to provide a basis for a rational seismic design method for precast beam-column connections. Inelastic deformations are concentrated in the connections, which are smaller and weaker than the precast elements being connected. Thus, the connections are often the weak links in the structure, and their strengthening is essential as an earthquake countermeasure. NIST is also developing other strengthening techniques which are aimed at improving lateral strength and ductility and are being applied to deficient structures. A set of design guidelines for assessing the overall capacity of strengthened reinforced concrete frame structures is being developed. A prerequisite to the establishment of such guidelines is knowledge of the interaction between existing structural members and strengthening elements and of the behavior of the anchoring elements used to join the structural members.

The National Science Foundation's (NSF) Responsibility For Upgrading Experimental Research Laboratories in Earthquake Mitigation

Experimental research in earthquake engineering is conducted at many laboratories located at universities across the United States. These laboratories vary from very large multi-purpose facilities to small specialized facilities. NSF is continually providing resources to upgrade and expand the capabilities and instrumentation at these facilities. At the present time, several major facilities exist that conduct research sponsored by the NSF. These include

The University of California (Berkeley and San Diego), University of Colorado, Cornell University, University of Illinois, State University of New York at Buffalo, University of Texas at Austin, Lehigh University and The University of Michigan.

Additionally the NSF has been at the forefront of supporting information dissemination centers and clearing houses in natural hazards. A number of these include: the National Information Service for Earthquake Engineering (NISEE) at the University of California, Berkeley, and the California Institute of Technology, which conducts comprehensive earthquake engineering dissemination programs; the National Information Service of the National Center for Earthquake Engineering Research (NCEER) at the State University of New York at Buffalo; and the Natural Hazards Information Center at the University of Colorado, a major clearinghouse for social science and policy information in the hazards field.

The information the NSF disseminates reaches a diverse audience that includes engineers, architects, building officials, planners, government officials, and researchers. Numerous channels of communication are employed to inform users about the results of countermeasures research from projects supported by the NSF in disciplines such as engineering, the social sciences, architecture, and planning.

The Role of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) In Mitigating the Impacts of Floods, Severe Storms and Tsunamis In the United States and Abroad

The primary mission of the National Weather Service (NWS) is the protection of life and property and the enhancement of the national economy. Hence, the basic functions of NWS are the provision of forecasts and warnings of severe weather, flooding, hurricanes, and tsunami events; the collection, exchange, and distribution of meteorological, hydrologic, climatic, and oceanographic data and information; and the preparation of hydrometeorological guidance and

core forecast information. The NWS is the single "official" voice when issuing warnings for life-threatening situations and is the source of a common national hydrometeorological information base. The national information base forms an infrastructure on which the private sector can build and grow.

Accurate and timely weather and river forecast and warning systems are vital to the safety and well-being of the Nation's population. Weather and water resources forecasting harnesses modern advances in information to increase the productivity of American industry, thereby contributing to economic growth.

The National Weather Service (1) collects and exchanges hydrometeorological data and information on a national and international basis; (2) issues warnings and forecasts of severe weather, floods, hurricanes and tsunami events which adversely affect life and property; (3) issues weather, river and water resources forecasts and related guidance materials used to form a common national hydrometeorological information base for the general public, private sector, aviation, marine, forestry, agricultural, navigation, power interests, land and water resources management agencies and emergency managers at all levels of government; (4) provides climatological summaries, quality controls for observed and collected data; and (5) other services such as global, national or general regional atmospheric models.

The National Weather Service (NWS) is charged with responsibility for the Tsunami Warning Service and for the preparation and distribution of Watches and Warnings of tsunamis that may threaten lives and/or property in and around the Pacific Ocean. The NWS operates and administers the Pacific Tsunami Warning Center (PTWC) and the Alaska Tsunami Warning Center (ATWC). The PTWC functions as the National Tsunami Warning Center responsible for providing tsunami warning services for all coastal States and other U.S. interests throughout the Pacific. The PTWC also provides regional warning services for Hawaii; the ATWC provides regional warning services for Alaska, British

Columbia, Washington, Oregon, and California. The PTWC is the International Operational Center for the Tsunami Warning System in the Pacific.

The relationship between earthquake size and historic tsunami generation is being studied by the PTWC on an area-by-area basis to determine the influence of regional and local tectonics and submarine geology on the generation of tsunamis. These studies are providing the basis for a better evaluation of the present warning thresholds and operational procedures.

The PTWC continues to work closely with Hawaii Civil Defense in coordinating and supporting State legislation for enhancement of tsunami mitigation measures for the State of Hawaii. The State Legislature approved funding for the installation of nine additional tide gauges within the Hawaiian Islands, equipped with digital data access via a computer telephone query. Each of the County Civil Defense Agencies, as well as the State Emergency Operating Center, will have microcomputers capable of automatically interrogating and plotting sea level data from any station using software developed at the PTWC. Telefax units are also being installed to provide a graphics communication link between the PTWC and all Civil Defense Agencies.

The National Geophysical Data Center (NGDC) located in Colorado acquires, processes, and analyzes technical data on earthquake hazards, and disseminates the data in many usable formats to Federal agencies, private industry, academia, and the public.

The NGDC Pacific Tsunami Data Base includes more than 1,600 events since 49 B.C. and more than 5,100 locations where tsunamis were observed. Times of generating earthquakes, tsunami arrival times, travel times, first motion of the wave, and periods have been added to the data base. The data base has been designed for use on IBM-compatible personal computers.

The Department of Energy (DOE) Program in

Environment, Safety and Health For Mitigating Technological, Earthquake and Other Hazards

The Department of Energy (DOE) plays a major role in the National Earthquake Hazard Reduction Program (NEHRP) and is committed to supporting the program through the Department's environmental, safety, and health obligations. The support has been forthcoming from all levels

of the Department, especially from the operations offices and power administrations that serve as NEHRP contacts. The Department's representatives have participated in NEHRP activities of the Interagency Committee on Seismic Safety in Construction and the Subcommittee on Federal Earthquake Response Planning.

In April 1989, the Department issued DOE Order 6430.1A, *General Design Criteria*, which specifies the use of design basis earthquake levels for nuclear processing facilities and other hazardous operations based on probabilistic hazard curves. The DOE Order requires the use of the *Design and Evaluation Guidelines for DOE Facilities Subjected to Natural Phenomena Hazards*. This was re-issued as an interim report in 1989, and its methodology is based on the approach used in the Uniform Building Code UBC (1988 Edition) and the U.S. Army's *Seismic Design Guidelines for Essential Building*. DOE's Office of Safety Appraisals is sponsoring workshops on the use of the guidelines.

The Department of Energy (DOE) continues to strengthen the awareness and broaden the involvement of its program offices, field organizations, and energy contractors in the National Earthquake Hazards Reduction Program (NEHRP). The following major organizational units of DOE are involved in natural phenomena hazard mitigation programs: 1) Management and Administration; 2) Defense Programs, 3) Energy Research, 4) Environment, Safety and Health, 5) Fossil Energy, 6) International Affairs and Energy Emergencies, 7) Nuclear Energy, 8) Civilian Radioactive Waste Management, 9) Power Marketing

Administrations, 1) Operations Offices and 11) Energy Technology Centers throughout the U.S.

These organizations are responsible for implementing the requirements of Departmental Orders, including specified consensus standards (e.g., seismic requirements of the Uniform Building Code (UBC) and the Seismic Design Guidelines for Federal Agencies).

Department of Defense (DOD) Activities in Civil Works, Research and Education for Disaster Reduction and International Humanitarian Response

The work of the U.S. Army Corps of Engineers (CE) military and civil works programs and activities in earthquake, tsunami and flooding countermeasures conducted by the U.S. Navy are important contributions to the protection of critical coastal facilities worldwide.

The Loma Prieta Earthquake demonstrated the need for an increased effort in the area of structural evaluation of existing structures and methods of retrofitting. This has set the stage for research work on base isolation and elastic damping systems. A large percentage of essential military installations are located in areas of high seismic activity, and therefore should be able to function during and after a seismic event. Many of these facilities are constructed of masonry units and are vulnerable to seismic damage.

The Corps of Engineers continues to develop and improve its seismic design and construction requirements, using the latest seismic design provisions and innovative design concepts for water resource type structures. A new geotechnical seismic design manual applying the latest findings of research for the practical design of shallow and deep foundations, retaining walls, buried structures, slopes, and embankment dams is in preparation. The manual, developed with the U.S. Naval Civil Engineering Laboratory, provides geotechnical design guidance for waterfront structures. In addition, structural engineering guidance is being prepared

for the seismic design of concrete towers required for the intake of outlet works for dams.

The U.S. Navy Facilities Engineering Command continues to investigate naval shore facilities located in areas of high seismic risk. The program is approximately 85 percent completed and will ultimately involve 95 Navy activities. Areas of vulnerability to potential liquefaction, tsunami flooding, and landslides have been identified, and widespread deficiencies are being addressed. Approximately 14,500 structures have been screened, approximately 1,600 structures analyzed, and 650 found to be seriously vulnerable. For the structures identified as hazardous, nonstructural components as well as the lateral force resisting system were evaluated. In areas where site hazards are identified, they are shown on planning documents, and new construction restricted or adapted to provide protection.

Bureau of Reclamation Earthquake and Flood Hazards Reduction Applications Research And Implementation

The Bureau of Reclamation (Reclamation) earthquake hazards reduction activities basically involve seismic analyses and the designs or modifications of embankment and concrete dams and large structures. These seismic analyses require a variety of state-of-the-art technical studies, including regional and local seismotectonic investigations, microseismic monitoring, subsurface drilling and trenching explorations, materials sampling and testing programs, and various types and levels of dynamic analyses, including risk-based analyses. The studies include the installation of field instrumentation and the development of a wide latitude of seismically related programs. Reclamation also conducts research related to earthquake effects on materials and structures. Projects underway in Fiscal Year 1990 include centrifugal modeling of embankment dam cracking and soil strength and deformation following liquefaction.

The Bureau of Reclamation is the lead technical agency in the Department of the

Interior's Safety of Dams Program and is involved in seismic issues throughout the contiguous 48 States and Alaska. There are, at present, 385 dams in Interior's Safety of Dams Program. Of these, 269 are Reclamation, 52 are Bureau of Indian Affairs (BIA), 29 are Fish and Wildlife Service (FWS), 26 are National Park Service (NPS), and 9 are Bureau of Land Management (BLM). This Bureau has identified about 70 dams that may require modifications for safety reasons; however, most of these safety issues are not associated with earthquakes.

Within the Bureau of Reclamation, a major program is continuing to evaluate the safety of existing dams and foundations of new dams in highly seismic areas. Dams or dam foundations that are suspected of being liquefiable are first evaluated using in situ field testing and simplified empirical methods. Techniques for determining in situ void ratio and the steady state of deformation are used in the evaluation of liquefaction potential on projects for which the simplified empirical methods do not give a definitive result.

The Role of the Department of Transportation In Protecting Critical Facilities and Lifelines In the U.S.

While the Department of Transportation (DOT) is emphasizing seismic safety in new construction, its long term objectives are to develop prioritized courses of action involving mitigation or retrofit programs for existing buildings and lifelines in high risk areas, and to promote long term research into ways to increase seismic resistance for both new and existing structures. DOT also expects that this seismic safety program will have the added benefit of reducing loss and disruption risk from other natural and man-made hazards affecting transportation systems.

A goal of DOT's hazards reduction program is to achieve earthquake resistance commensurate with the seismic risk for that region for new structures and lifelines. All agencies of the Department of Transportation (DOT) are encouraged to identify cost-effective,

low expense activities for quick enhancement of their present programs. In this regard, procedures are being established for a future review of the vulnerability of existing DOT facilities in areas of higher seismic activity.

Another goal calls for the review of DOT Orders that govern leasing of space, with adherence to local building codes on seismic safety as an evaluation factor in renting building space. Agencies are also encouraged to continue building a seismic knowledge base and sponsoring low cost research. Underlying these objectives is the Departmental policy to develop awareness and information programs for all its constituencies and employees on the need for increasing seismic resistance for the Nation's transportation system.

The 1971 San Fernando earthquake was a major turning point in the development of seismic design criteria for bridges in the United States. The earthquake started a chain of events which led to the American Association of State Highway and Transportation Officials (AASHTO) adopting, in 1983, a set of guidelines prepared by Federal Highway Administration (FHWA) to establish design and construction provisions for bridges to minimize their susceptibility to damage from earthquakes. DOT is also concerned with the additional effects of dynamic earthquake-induced ground shaking on the behavior of structures and on soils underlying ports and harbors, as well as tsunamic threat.

The Department of Veterans Affairs (VA) Hospitals and Medical Facilities Protection Against Disasters

The Department of Veterans Affairs (VA) develops plans and strategies for the provision of emergency health care services to veteran beneficiaries in Veterans Administration medical facilities, to active duty personnel and where possible to civilians in communities affected by national security emergencies. The VA works closely with other USG agencies to apply applicable building codes and construction techniques to protect its facilities and equipment against natural disasters. The VA also assists

The Department of Health and Human Services (HHS) in developing national plans to mobilize the health care industry and medical resources during times of national emergency.

The Department of Veterans Affairs (VA) seismic strengthening program strives to ensure the safety of patients and staff through the seismic strengthening or replacement of all essential substandard buildings in seismic-risk areas. Since the inception of the program in 1971, approximately 120 buildings have been strengthened, are being strengthened, or are presently in the design stage of a construction project for strengthening. The seismic structural strengthening program has made significant progress toward achieving its objective, although much more remains to be done.

The Loma Prieta Earthquake prompted the VA to reexamine its seismic correction program. A comprehensive study of VA requirements in this areas has been completed. There is an increased priority for projects that address seismic deficiencies. The seismic correction program has been instrumental in proposing funds for seismic projects; \$5.9 million for design of seismic correction at Long Beach Medical Center was budgeted for Fiscal Year 1990, with construction funding of \$67.2 million planned for Fiscal Year 1991. Design funding of \$15.3 million for seismic corrections at the Martinez Medical Center is planned for Fiscal Year 1991, with construction funding of \$157.8 million planned for future fiscal years.

Commensurate with a recent VA study, the development of future budgets will continue to give high priority to projects at medical centers requiring seismic correction, including future projects at Memphis, Albuquerque, American Lake, and Manlo Park. The Loma Prieta Earthquake significantly damaged the VA medical center in Palo Alto, California, and necessitated an emergency response by the VA. The VA has been provided \$54 million in emergency funds for medical supplies and staff equipment, temporary bed and support space, seismic upgrading, and the design and site preparation for a replacement facility. The total project cost of

the replacement facility is \$252 million.

Also included in VA earthquake hazard mitigation efforts is a wide range of programs initiated to: (1) Anchor major mechanical and electrical equipment to prevent dislodging or disruption during an earthquake. (2) Install an emergency radio network to provide direct communication between any of the VA facilities in the United States; (3) Provide emergency utility services, especially water and electrical power, in all VA medical centers; and (4) Install special earthquake provisions for equipment, furniture, and supplies to assure the operation of VA medical centers in the postearthquake period.

Nuclear Regulatory Commission (NRC) Seismic Countermeasures for Civilian Nuclear Electric Power Plants

Under its congressional mandate to regulate commercial production and use of nuclear materials, the Nuclear Regulatory Commission (NRC) conducts a variety of regulatory activities and manages a strong research program to support its regulatory operations. NRC-supported research encompasses the areas of seismicity, tectonics, and stress/strain measurements. These studies provide a scientific basis for regulating the activities of the nuclear industry and improving the safety of nuclear plants and waste disposal facilities. NRC-supported research programs in these areas contribute to the efforts of the National Earthquake Hazards Reduction Program (NEHRP).

Since 1980, the NRC has sponsored analytical and experimental research on low-rise reinforced concrete shear walls, buildings, and building segments. The research is focused on answering certain structural concerns related to (1) the adequacy of criteria currently used in design and analysis, and (2) the ability of existing nuclear power plants to withstand earthquakes greater than considered in the original design.

While the adequacy of nuclear plant equipment to withstand earthquakes has been a continuing consideration, only the more recent

plants have used a rigorous testing program to qualify their equipment for design level earthquakes. The resistance to earthquakes larger than design levels has not been documented. An extensive NRC and industry effort nearing completion has used both the collection of earthquake experience data from non-nuclear facilities and the synthesis of existing nuclear equipment qualification test data to form a program to reevaluate the seismic activity.

The studies performed have shown that, on a generic basis, much of the equipment used in nuclear plants is inherently seismically-rugged if properly anchored and not subjected to damaging interactions (e.g., the collapse of unreinforced masonry walls onto equipment). In general, it has been found that the seismic strength evaluation of electrical equipment is the most critical for operating nuclear plants.

In recent years, both industry and the NRC have been concerned with the appropriateness of NRC's piping design rules for seismic and other dynamic loads. An over-design of piping for dynamic inertial loadings can produce negative effects from thermal expansion and the relative displacement of piping and points and can reduce its overall reliability.

Both the NRC and the Electric Power Research Institute (EPRI) have sponsored programs to evaluate the earthquake experience of piping in heavy industrial facilities. The basic conclusion of these programs is that welded above-ground piping, designed according to the more relaxed criteria of the non-nuclear industry, performs very well during large earthquakes.

Environmental Protection Agency (EPA) Natural and Technological Hazards Abatement

The Environmental Protection Agency (EPA) works to prevent and respond to hazardous materials releases and related incidents that are caused by natural disasters. Building on EPA's existing statutory response activities under the National Oil and Hazardous Substances Pollution Contingency Plan, EPA provides managerial and technical leadership to State and local

governments requesting assistance with hazardous materials releases, damage to hazardous materials containers, fires involving hazardous materials, stabilizing leaks and spills to protect public safety and the environment, and related incidents caused by natural disasters. EPA also conducts environmental research contributing to our understanding of natural hazards. The Environmental Monitoring and Assessment Program (EMAP) provides statistically determined baselines on ecosystem status from which to measure and understand impacts of disasters. Research is also conducted to determine the environmental and ecological impacts of genetically engineered biological agents and to assess the cumulative loss of wetlands on the frequency and severity of floods.

The Role of the U.S. Department of Agriculture (USDA) in Mitigating Drought, Flood, Fire and Landslide Impacts

The United States Department of Agriculture's Office of International Cooperation and Development (USDA/OICD) is coordinating a Famine Mitigation Project for Africa under a Resource Support Service Agreement (RSSA) with OFDA for an initial two year period. It is widely acknowledged by emergency experts that much can be done to mitigate the effects of a famine situation prior to its onset. The intent of this activity is to identify, test under actual field conditions, and develop standard implementation models for a limited number of interventions that can dramatically reduce the impact of famines prior to their onset, and to reduce the recovery period after the conclusion of a famine. The major areas that will be investigated under this activity include *Early Warning Systems and Rapid Assessment*, *Seeds and Tools*, *Livestock Preservation*, *Water Resources*, *Cash for Work*, and *Conflict Modifications*. Expert teams will be formed to design and field test these interventions in Sudan, Ethiopia, Somalia, Angola, and Mozambique. Following implementation and evaluation of the selected interventions, the teams will develop generic guidelines so that these activities may be implemented wherever they are necessary and appropriate. Finally, workshops will be conducted for famine response personnel

in the United States and in East and Southern Africa to provide an overview of the tested activities and to develop practical plans for their use during future famine situations.

The Early Warning and Rapid Assessment team will examine current Early Warning Systems and options for OFDA, develop methods and survey instruments for establishing deviations from norms, and identify indicators for determining appropriate intervention measures for at-risk populations. The Seeds and Tools team will identify agricultural baselines and identify appropriate seed varieties, tools and methods that could be employed prior to famine onset. This team will also examine agronomic and horticultural packages and seed bank activities as well as traditional crops and practices. The Livestock team will identify and test activities to maintain livestock through famine situations. The Water Resource team will identify interventions that can be implemented at regional and local levels to maintain a reliable, safe water supply. Although Food for Work activities have been extensively employed and examined in the past, the Cash for Work team will identify direct cash transfer opportunities and how they may be employed to support and strengthen the agricultural, livestock and water resources activities to be tested by the other teams. The Conflict Modifications Team will identify the barriers to working in and applying the above interventions under conflict situations.

Additionally, the USDA, U.S. Forest Service conducts both domestic and international drought, flood, fire and landslide impacts programs which focus on disaster preparedness (primarily emergency planning, wildfire prevention, and wildland fuel modification) and wildfire suppression. The USDA also conducts research examining ecosystem processes; people/structure/hazard interactions; vegetation management and biological controls; climate/weather/hazard linkages, and post-hazard recovery.

The Soil Conservation Service of the USDA aids local communities sponsoring projects to reduce flood and drought hazards; provides

assistance for emergency intervention and recovery; education and awareness; drought prediction and warning; community mitigation planning; and research on the relationships between soil moisture regimes and agricultural productivity.

The U.S. Forest Service's Disaster Assistance Support Program (DASP) was established in 1985 to increase cooperative efforts between OFDA and the U.S. Department of Agriculture (USDA).

The primary goal of DASP is to assist OFDA in disaster prevention, preparedness, and emergency response, mainly to developing nations of Africa, Latin America and the Caribbean, and Asia and the Pacific regions. The Forest Service is thus able to:

- (1) Provide technical support in disaster prevention;
- (2) Develop and implement programs for training disaster management personnel from OFDA, United States embassies and USAID missions, and from host countries;
- (3) Develop and use a computerized roster system for identifying technical experts and disaster management specialists;
- (4) Plan and coordinate workshops, conferences, reports, and publications that promote effective disaster prevention, preparedness, and management; and
- (5) Mobilize disaster management specialists, equipment, and supplies to disasters.

DASP works with OFDA to strengthen the ability of countries to cope with disasters by helping them improve their own disaster preparedness and response capabilities. DASP has provided the following assistance to countries around the world through its support to OFDA:

- (1) Landslide hazard training and assessments in Asia, Latin America, and the Caribbean;

- (2) Development and implementation of disaster management training courses and simulation exercises;

- (3) Sponsorship of workshops and conferences;

- (4) Locust control operations in Africa;

- (5) Wildfire assessments and technical assistance in Latin America;

- (6) Operation of water purification systems at disaster sites;

- (7) Production of operations manuals and guidebooks for disaster management;

- (8) Shipment of fire suppression supplies and equipment; and

- (9) Supply of communications personnel and equipment.

U.S. Public Health Service (PHS), Centers for Disease Control (CDC), Epidemiological Surveillance and Emergency Management

The Centers for Disease Control, International Health Program Office in Atlanta, Georgia provides epidemiological technical assistance internationally in natural and man-made emergency situations. The CDC organizes and maintains a resource center (including a library and data base of consultants) to support CDC-wide organizational activities and objectives. CDC assists international organizations and their respective constituents in preparedness activities leading to more effective provision of assistance in emergency situations, and provides technical assistance internationally to U.S. government agencies and multilateral organizations involved in refugee health care.

In 1989, eighty-six members of CDC staff participated in forty-three emergency response missions and developed for the World Health Organization (WHO), a distribution network for rapid assessments for nine types of

emergencies. In 1990, CDC, WHO and AID are designing and implementing a project to develop the surveillance and response capabilities of African countries lying within the meningitis belt. CDC has also developed a briefing package for use by consultants in emergency and non-emergency situations. This package includes such information as communications procedures, cultural sensitivity guidelines, and instructions for shipping supplies and samples to the U.S. They are also conducting retrospective evaluations of recent emergency responses to determine most appropriate and effective response procedures.

Agency for International Development (A.I.D.), Office of U.S. Foreign Disaster Assistance (OFDA) Program in Disaster Prevention, Mitigation and Preparedness In The Developing World

A.I.D., through the Office of U.S. Foreign Disaster Assistance (OFDA), is responsible for providing emergency relief assistance to foreign nations affected by natural or man-made disasters and for providing other assistance in disaster prevention, mitigation, and preparedness. This program has been structured to (1) concentrate OFDA relief resources on those activities which save the greatest number of lives; (2) concentrate OFDA mitigation and preparedness resources on those activities which save the greatest number of lives and protect the economic infrastructure of developing countries; (3) reorient OFDA's approach to disasters by integrating development concepts into relief, rehabilitation, prevention, mitigation and preparedness activities; and (4) encourage other U.S. Government departments, private industry, international institutions and A.I.D. regional bureaus to integrate disaster preparedness and relief principles into their projects.

The ultimate goal of this program is to save lives and reduce human suffering in disaster-prone countries. A.I.D. recognizes that property loss and subsequent economic and social disruptions associated with disasters are major deterrents to A.I.D.'s and the developing countries' goals of fostering economic growth and sustaining the viability of development

assistance programs. OFDA currently works with the Agency's regional bureaus to reduce the threat posed by natural hazards to development.

A.I.D.'s strategy addresses the principal goal of saving the greatest number of lives by (1) responding with relief goods and services during disasters in foreign countries, and (2) preparing for and reducing the likelihood of economic impacts and loss of life prior to the occurrence of disasters. The two main components of this strategy are as follows: (1) U.S. Government Emergency Relief Coordination. Through the use of all appropriate U.S. Government resources and cooperation with private sector resources, A.I.D. seeks to alleviate suffering and reduce the number of deaths in the aftermath of disaster by providing efficient and rapid responses to requests for emergency relief and to enhance recovery through rehabilitation programs, and (2) Prevention, Mitigation, and Preparedness. A.I.D. seeks to apply multidisciplinary approaches in the fields of disaster prevention, mitigation and preparedness to reduce the impacts of disasters.

The program in disaster prevention, mitigation and preparedness (PMP) stimulates new and dynamic approaches to reduce the impacts of disasters on potential victims in target countries. The goal is to save lives. Through pre-disaster action, OFDA assists vulnerable countries in reducing the economic and social impacts caused by disasters. The PMP program provides support to applicants from the public and private sectors, institutions, universities and agencies. Groups implementing activities are encouraged to provide matching support to ensure the transfer of findings and results. The following illustrate areas of concentration which may constitute the multi-year disaster PMP program: (1) private sector activities; (2) famine; (3) hydrometeorological events; (4) geophysical conditions; (5) medical and health concerns; (6) environmental and technological disasters; (7) A.I.D. mission program support; and (8) project design, analysis, and evaluation. The A.I.D. PMP program will support the U.S. and international goals established for the U.N. International Decade for Natural Disaster

Reduction.

The program will provide the analytic, technical, economic and social expertise necessary to support A.I.D. policy and program interventions to reduce the impacts of disasters on development. Sustainability will be assured by not funding projects where the host government commitment is inadequate. Activities will contribute to sustaining economic development by reducing the vulnerability of the work force and economic assets to disasters.

This program supports A.I.D. efforts to provide more effective humanitarian assistance to those who potentially would suffer from natural and man-made disasters and to intervene on their behalf prior to the occurrence of disaster. The program will also help to protect private sector investment and economic development worldwide.

Principal beneficiaries will be the potential victims of disasters in the developing countries and officials in public and private sector organizations who have disaster PMP, relief, rehabilitation and reconstruction responsibilities.

Major outputs of this program are: (1) hazard-specific technical assistance and training in selected countries based on strategic planning; (2) building host country institutional capacity to manage disasters and monitor hazards; and (3) reduction of disaster potential through protection of infrastructure, mitigation of impacts, and helping host governments plan for, prepare and, where possible, prevent disasters.

U.S. FEDERAL PROGRAM STRATEGY FOR THE DECADE OF THE 1990'S

The U.S. Federal Program for reducing the impacts of natural disasters in the decade of the 1990's focuses on reducing fatalities, human suffering, environmental damage and economic losses by coordinating programmatic resources to resolve priority hazard-related issues and integrate and enhance planning and response

capabilities from the Federal to the local levels. Integration of extensive interdisciplinary expertise, various missions of the Federal agencies and State and local governments, and existing components of private sector disaster reduction efforts is key to the successful reduction of hazards during this decade. The federal program strategy seeks to integrate mitigation measures across hazards by applying common tools for pre-disaster interventions, examining causal relationships, geographic and spatial similarities and other factors leading to successful forecasting and implementation of appropriate risk reduction measures prior to event occurrence. The strategy for the 1990's will better define acceptable risks by hazard type and location and will increase public awareness as to those practical countermeasures which can be taken to reduce personal and community economic, social and physical impacts. The Federal Subcommittee on Natural Disaster Reduction of the Committee on Earth and Environmental Sciences of The President's Office of Science and Technology Policy (OSTP) has recently completed a draft report. This report will help establish the U.S. national strategy for disaster reduction in the 1990's. At the same time, these activities are complemented by current program planning by the National Research Council's U.S. National Committee on the Decade. Their report with a recommended plan of action, will be available in late June, 1991.

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