IV. Criteria for the Evaluation

The first issues in need of resolution deal with basic policy strategies. What framework is the implementation plan trying to establish for coping with the earthquake situation? What did Congress intend by establishing this law? What are the basic assumptions about Government, science, and society from which it proceeds? Why was this Act formulated as it was, and why is it to be implemented in this way?

ISSUE 1
FEDERAL VS. STATE AND LOCAL RESPONSIBILITIES

First, the division of power and responsibility} among the various levels of Government that are or must be involved in earthquake hazards reduction must be clarified.

The Federal agency would find it most convenient if its initiatives took priority and were uniform across the country. This, however, would ignore state and local differences in awareness, perspective, extent of hazard, and competing objectives of, and differences in, distribution of power and responsibility.

Matters of disaster preparedness have traditionally been left to the individual States, with county and local emergency services (civil defense) departments doing the actual work under State office coord i nation.

State departments of geology, while usually cooperating with the U.S. Geological Survey, are wholly independent of the Federal agency and may function as subdivisions of other State agencies. Few States have statetwide planning agencies to deal with land use, social and health services, or community affairs. County, city, and regional planning agencies often function independently of (and frequently at odds with) each other. Some States have statewode building codes, while others leave code adoption and enforcement to the individual counties and ciities.

Disaster relief has been the least fragmented hazards mitigation program to affect most States. Although private relief agencies contribute extensively, the largest amounts of money come from Federal sources. Even private programs, such as the Red Cross and the Salvation Army are coordinated through the Federal Disaster Assistance Administration.

The need for a coordinating or lead agency is obvious, yet the constitutional tradition leaves as much decisionmaking power with the individual States as possible. Most communities fight bitterly against statewide or county control of their affairs. It is clear that the implementation plan must take cognizance of the need to balance these tensions in order to accomplish the objectives of the Act.

Is the emphasis to be on Federal funding of programs and projects, or are the private sector and State/local governments to be encouraged to fund programs through the use of tax incentives, matching funds, fund raising from local profitmak - ing projects, local taxes, and the like?

Questions

1. How does the plan divide power and responsibility among Federal, State, and local levels of government and the private sector? By what measures is that division likely to be effective and cost-effective?
2. Where are the primary feedback and decisionmaking functions?
3. Does the plan allow for continuous feedback and interaction among the levels of government?
4. How is the veto power and appeal-from-decision right apportioned among the three levels of government?
5. To what extent does the plan encourage local and State agencies and the private sector to go beyond Federal plans and programs?
6. How are those modifications permitted, encouraged, or discouraged?

7. Does the plan provide for local/regional bodies to request cessation of Federal programs that do not fill the needs they were initiated to fil!?

8. Does the implementation plan depend totally upon Federal funding?

9. Does the plan encourage the use of part-Federal and part-State, part-local, or part-private sector funding? What funding assumptions underlie the plan?

10. Does the plan provide for resolution of intrastate legal conflicts between counties and municipalities receiving Federal funding?

11. Does the plan provide for equitable distribution of projects between the public and private sectors?

12. Does the plan effectively induce cost-sharing betweem public and private entities?

13. Does the plan encourage local government and the private sector to explore ways of funding programs for their own communities?

14. Does the plan provide safeguards to see that projects or programs are carried out by the entities that can do the job in the most effective, efficient, and economic manner, regardless of whether they are public or private?

I 5. Does the plan provide for expansion, contraction, or modification of voluntary activities in earthquake hazards reduction?
- If so, specifically, what are these anticipated changes and on what basis have they come forth?
- Have representatives of the affected voluntary agencies been consulted?

16. There is a wide range in severity of earthquake events in many of the regions of the country. Would there be value in defining a maximum credible earthquake disaster in various cities, counties, States, or regions and using this as a framework with wihch to plan public policy?

17. How will the plan go beyond the hortatory in informing, motivating, and activating flexible State and local actions?

ISSUE 2
EARTHQUAKES VS. AN ALL NATURAL HAZARDS STRATEGY

While it may be convenient for researchers and the large Federal agencies to handie hazards individually, the practicalities of State and local government organization and functions increasingly require integrated planning and operations for all hazards.

Earthquakes are only one of a number of natural hazards to which people and property are exposed. Some of the secondary hazards of seismic activity are also common to ocher disasters. In some cases, the adjustments to other hazards may be inappropriate for earthquakes and versa. However, money that is spent in the same way to reduce several kinds of hazards is wasted in duplication. Wherever possible, the implementation plan should seek to prevent duplication of funds and effort, while adhering to the desire of Congress to reduce the hazards from earthquakes.

Questions

1. How does the plan coordinate, or conflict with, other hazards reduction programs now in effect, needed, or planned?

2. Does the plan allow for flexibility in giving research grants and planning funds, in order to meet the needs for reduction of allied hazards?

3. Does the plan encourage consultation with researchers and planners working in other hazards reduction fields, to see where duplication can be avoided?

4. Does the plan allow for consolidation with other hazards reduction programs at the State and local levels?

5. To what extent can the earthquake plan become a part of-or the basis for-a program for managing all natural hazards?

6. As a result of subsea earthquakes, tsunami are a particulary important problem in the coastal States of the United States. How will tsunami research be related to earthquake research ? What relative importance is given to tsunami? On what basis?

7. Table 3 lists crier a hundred instruments of Government that could be a part of an orchestrated Fink-al approach to hazards mitigation. Which instruments from this or similar lists have been selected as part of the plan's activities and which have been rejected or deferred? By what criteria?

8. Will the plan overwhelm the research and operational systems for all other hazards with its emphasis on earthquake planning, organization, and research, etc. ?

9. Table 4 suggests specific earthquake risk mitigation measures tailored to various types of earthquake warning. To what extent are considerate ions of this sort integrated into the plan?

ISSUE 3
NARROWING CHOICES VS. WIDENING CHOICES: THE ACQUISITION OF INFORMATION

There are three information areas with which the implementation plan should be concerned: accuracy and adequacy of past information from which certain assumptions have been made, adequacy of current information necessary for program planning, and decisions on what information should be sought in further research.

Quality of Existing Information

Theories about the behavior of faults, of structures, and of people have been constructed from historical information, some of it quite recent. If the quality of that data is poor, then the assumptions based on that data may prove false and, in turn, action based on those assumptions may be a waste of money and effort. Such actions may even endanger lives and property by creating a false sense of security.

1. Does the plan depend upon acceptance of particular theories of geophysical, structural, or human behavior to the extent that contradictory evidence would seriously impair the usefulness of the plan for reducing earthquake hazards?

2. Have these basic assumptions about behavior of the Earth, of structures, and of human beings been subjected to rigorous professional criticism of the highest quality?

3. Do a majority of researchers in the appropriate fields of geophysics, geology, engineering, and social science support those assumptions on which planning and programs will be based?

4. Several developed nations, notably Italy and Japan, have a significant history of earthquakes. In the densely populated regions of Japan, extensive measures have been taken for earthquake prediction, mitigation, control, disaster response, and so on. What mechanisms have disclosed and will disclose such experience systematically? In terms of the present plan, to what extent has such information been used in planning?

Adequacy of Current Information

Successful execution of the implementation plan will depend upon coordination of myriad State, Federal, and local laws related directly or indirectly to earthquake hazards reduction. Conflict could easily arise between earthquake programs and flood control, environmental policy, historical preservation, building codes, and land use planning policies.

Knowledge of the existing "pool" of qualified professionals in hazards management is necessary to assign personnel for projects and programs requiring their expertise.

1. Does the plan provide for a clearinghouse (or regional clearinghouse) for information on State, Federal, and local laws that will affect or be affected by it?

2. Does the plan provide for resolution of legal conflicts, on the Federal, State, and local levels?

3. Does the plan provide for a personnel data clearinghouse (on at least statewide basis) so that programs and projects can be staffed by qualified persons and future personnel needs can be estimated?

4. How will the plan meet needs for reliable certified information in a timely fashion?

5. Does the plan provide for a broad, critical inventory of earthquake-related information relevant to private sector groups and individuals?

Table 3.—Instruments of Government

Information Related	Financial Measures	Measures	Operation	Policy-Related Function
Generation of information by means of: data collection, e.g., census surveys demonstration evaluations technology assessment public (e.g., congressional) hearings monitoring research and development on (a) social costs (b) public policy alternatives (c) the system (d) technology (e) basic science (f) intervention experiments The packaging of information: as by curriculum development definition of costs display of pros and cons The dissemination of information in terms of: reports seminars extension programs trade fairs conferences, symposia State technical services press releases and public information Stimulation of discussion, interest, concern by: providing a forum education publicity propaganda Withhold information Proposing model legislation	Taxes Residual charges Value added tax Excise tax Income tax Corporate tax Personal tax Customs duty Tax write-offs Tax deferment or abatement Subsidies Depreciation and depletion Allowances Grants Contracts Loans Rewards for innovation and invention Incentives, e.g., matching funds, scholarships, loans, grants, forgiveness of loans in return for special services, contests Earmarking funds, setting floors and ceilings Insure loans, crops, investments, etc. Compensate for loss Underwrite Set priorities on funding Allocate funds	Regulate/deregulate Legislate Set standards Certify License Codes Government control or monopoly Grant rights Form interstate compacts or special legal units Court decisions, injunctions, etc. Cease and desist orders Monopoly privileges Inspection requirements Fines and punitive damages Registration and mandatory reporting Audit Mandamus (a writ from a court ordering a lower court or public official to do some specified thing) Substitute criminal for civil sanctions or vice versa Institutionalize Rationing Quotas Limit Liability Import Export Copyrights Patents Prohibitions Ban Moratoria Require warranties Zone Eminent domain (the power of the State to take private property for public use with payment and compensation to the owner) Seize Occupy Declare martial law	Building civil works Build facilities: drug treatment centers sewage disposal plants Operate facilities: traffic (air, sea, and auto) control systems Reclaim land Establishment or support an industrial base by Government purchase Institutionalize, R & D, Government departments, semi-public corporations, and establishing new institutions Demonstrate	Setting of policy Defining priorities Set objectives import/export goals Delayed decisions Coordinate affairs

SOURCE: Joseph F. Coates, "What is a Public Policy Issue?" in *Judgment and Decision in Public Policy Formation*, Kenneth R. Hammond, Editor, pp. 33-69, Westview Press, Boulder, Col. 1978.

Table 4.— Earthquake-Risk Mitigation Measures

Earthquake-risk mitigation measures are chosen because an individual, an institution, or society wants to reduce losses from an earthquake. Mitigation measures are taken for the overall benefit of the social level (National. State, or regional) adopting them. For example. i f the State takes mitigation measures it will evaluate them in terms of costs and benefits to the entire State. The measures that are available for reducing the risks of earthquakes can generally be classified as follows:

- earthquake engineering.
- seismic zoning.
- disaster preparedness. and
- disaster relief and insurance.

Earthquake engineering and seismic zoning reduce the vulnerability of the built environment to the effects of the earthquake. Disaster preparedness prepares individuals or groups to deal with the effects of the earthquake on people. Disaster relief and insurance spread the financial losses incurred as a result of an earthquake to a larger segment of the society. Because the first three measures operate before an earthquake. they are directly related to the characteristics of an earthquake prediction. The last two measures interact with earthquake prediction in more indirect ways. Al l of these measures, however, can be taken i n the absence of an earthquake prediction. This raises the question of whether earthquake prediction is a necessary or useful adjunct to the application of these measures.

The selection of the mitigation measure is governed by the leadtime provided by a prediction. Consequently, knowledge of the time required for the effective implementation of each mitigation measure is essential:

- Earthquake *Engineering.* As earthquake engineering criteria might be applied to new structures, it will take many decades to significantly affect the earthquake resistance of the structural inventory in a region. However. in terms of strengthening existing structures and otherwise reducing their vulnerability much less time is required and the limiting constraint in many cases could become skilled manpower and resources.
- Seismic Zoning. As seismic zoning might be applied i n a normal environment. It too could take a long time to significantly reduce the seismic vulnerability of a region. In the long term. as higher risk structures in a Potentially vulnerable region reached the end of their economic lifetime only certain uses of the land would be allowed: for example. warehouses would replace office buildings. parks would replace homes. and in unbuilt areas only certain uses o f the land would be allowed as the region expanded. However. in a short-term emergency situation prompted by an earthquake prediction, designated areas or structures could be temporarily abandoned.
- *Disaster Preparedness.* Some disaster preparedness activities (e. g . evacuation) can be carried out with even a minimum warning leadtime. but some readiness measures cannot be maintained indefinitely. There IS probably an ideal leadtime for disaster preparedness that permits the achievement of an optimal posture for a given threat but IS not so long that the posture becomes burden some
- *Disaster Relief and Insurance* Private disaster insurance will pro probably not be available after an earthquake prediction However. for the relatively long period bebetween predictions of damaging earthquakes. It could again be made available. The question then becomes whether or not enough persons can be motivated to purchase it. Public disaster relief can become a substitute for private disaster Insurance. but public disaster relief is not sensitive to the warning period except to the extent that preparatory actions may be required as a condition of compensation for loss

Tailoring Mitigation Measures to Earthquake Warnings

A planning and operations guide could be developed to Identify measures to be taken for various types of warning (short term v. long term) in places outside and Inside the predicted damage area. The guide could be prepared and periodically updated as earthquake prediction is Improved and as changes occur in enabling legislation and other factors that influence the preparedness program. I f and when a damaging earthquake is predicted. appropriate guidance could be given to the concerned agencies as part of the warning process.

Case 1: Short-Term Warning

The first situation for which guidance could be prepared is that resulting from the prediction that a damaging earthquake will occur within a period of days. During such a period. it would be too late for preparedness measures that require a long leadtime. The recommended actions that might be included in a warning to communities within the predicted damage area are the following:

Short-Term Warning: Damaging Earthquake Probable
(Risk areas specified. time insufficient for extensive preparedness measuresl

Broadcast public information and advice for this situation:

- Order evacuation of known hazardous structures and restrict access to known hazardous locations:
- Advise public and private organizations to tie down equipment for security against shock or displacement and protect shelf items from falling;
- Urge public through all mass media to make final preparations without delay (e. g., cleaning up trash or filling water containers): advise them to stay out of specified areas and specific types of structures:
- Disseminate through mass media information on fire prevention, self-help firefighting, and medical self-help;
- Order shutdown of hazardous industrial operations:
- Direct operating departments to suspend all nonemergency functions, alert personnel. check equipment and supplies, and prepare for deployment of forces if ordered;
- Mobilize all available organized forces and deploy to preassigned emergency duty stat ions:
- Fully man all control centers and establish 24-hour operations;
- Establish and maintain communications with other jurisdictions and service facilities:
- Activate staging areas and make final preparations there:
- Take actions to ensure the safety of institutionalized persons:
- Discontinue all elective surgery, release all hospital patients except those who are critically ill. and take other actions to expand bed capacity and to protect remaining patients;
- Deploy assigned personnel, equipment. and supplies to designated staging areas:
- Advise utilities and industry to shutdown nonessential services throughout the emergency area,
- Deploy field units and maintain them on standby so that they can rapidly survey area for damage and other earthquake-induced problems:
- Move firefighting and other emergency equipment and supplies outside the stations: and
- Deploy engineering and other equipment.

Table 4.—Earthquake- Risk Mitigation Measures —cont.

Case 3: Long-Term Warning

The second situation for which guidance could be prepared IS a longer prediction that provides sufficient time to Implement measures to reduce seismic risk and substantially improve capability for disaster operations. The general character of the emergency measures that might be recommended in an initial warning to threatened communities is indicated below. The specific measures would depend on the nature of the prediction (weeks, months, years) and the characteristics of the threatened community.

Long-Term Warning: Damaging Earthquake Highly Likely
(Risk areas specified. time sufficient for preparedness measures)

Establish public policy for long-term situation.

Brief key Government and non. Government officials on situation and basic emergency plan and earthquake response plan.

Review. update, or. if necessary, develop listed items:

- Legislation and local ordinances dealing with this type of situation:
- Organization and assignment of responsibility to emergency service units:
- Mutual aid agreements with other local jurisdictions and State agencies:
- Plans for informing the public during emergencies:
- Preparedness plans for hospitals, other institutions, and organizations that operate essential utilities (power. water, natural gas. sanitation. communications, and transportation. including food and fuel distribution):
- Staffing and operation of emergency operating center and other headquarters; communications with emergency service units and with other localities;
- Maps indicating risk areas— fires. potential dam flood areas, landslides, structures that are susceptible to damage. etc.: and
- Procedures for determining (1) distribution of earthquake damage and ensuing hazards and (2) postearthquake capability of hospitals, water systems, and other vital facilities and services.

Conduct planning workshops for each service. Review checklist of postearthquake actions:

- Prepare instructions for service units and personnel, assign responsibility for specified actions. and indicate when, where. how, and with what resources the actions are to be accomplished. and by whom:
- Evaluate existing capability for performing the listed actions and where appropriate identify measures and resources that would improve capability;
- Identify measures that will reduce cart earthquake losses:
- Determine what normal activities and services could be deferred or curtailed to free funds for emergency preparations:
- Develop detailed plans for actions to be taken if a short-term warning is issued: and
- Determine requirements and prepare standby procurement orders for needed equipment and supplies.

Identify and mark hazardous structures and locations in the risk area. Consider actions to reduce risk (e. g.. removal. strengthening, prohibit of of occupancy).

Expand fire prevention programs and abate fire hazards:

- Augment firefighting resources: prepare mobilization instructions: and
- Survey community for current fire risk. modifying or confirming fire contingency plans as appropriate.

Begin actions to expand cadre and Improve capability of emergency operations:

- Recruit, train, and assign personnel as needed to increase service capabilities for rescue, first aid, firefighting, fire prevention. sanitation, etc.;
- Prepare mobilization instruction:
- Bring emergency operating center and other headquarters to full readiness: provide for auxiliary power and augment communications:
- Arrange for use of facilities selected for staging area. mass care. and other purposes. and prepare them for use: and
- Procure previous identified needed equipment and supplies.

Improve readiness in potential dam flood areas:

- Complete evacuation plans. warning system:
- Transfer key facilities:

Ž Develop engineering procedures to determine damage: and

- Consider lowering water level.

Improve readiness and capability of lifeline organizations, resource agencies, essential industries

- Identify measures to reduce earthquake losses and disruption of services:
- Activate standby agreements for transportation and other lifeline services:
- Activate standby agreements for utilization of commercial and educational facilities: and
- Consider moving up resources from locations outside the risk area.

Improve readiness and capability of hospitals. medical and allied professionals, and public health agencies:

- Prepare Instructions for mobilizing personnel and resources:
- Expand stocks of drugs. medicines, and sanitation supplies:
- Check readiness of hospitals to discharge or move patients and expand bed capacity. consider deferring elective surgery; and

. If appropriate, begin moving in resources from locations outside risk area.

SOURCE Leo W. Weisbecker and Ward C. Stoneman. *Earthquake Prediction* in *Society,* **Center for** Resource and Environmental Systems Studies, SRI Internatlonal February 1977 p 8

Providing for Future Information

There is great need for more research into all the problems associated with earthquakes. Every effort should be made to channel newly authorized funds toward research that has practical application to the earthquake problem.

New problems, such as those arising from new technologies, may require innovative approaches and creative solutions. Established bureaucracies, however, tend to restrict funding to "tried and true" methods. While any reliable methodology must be based on logic and clear reasoning, there is ample room for new ways to reconcile the conflicts between bureaucratically "safe" approaches and creative research.

Future needs for professional personnel in geophysicalgeotechnical, engineering, architcc--ture, planning, emergency preparedness, and many other related fields must be ascertained and plans made so that an adequate number of persons can be trained. Quality control standards must be set for future research, so that the information gathered can be used successfully for reduction of earthquake hazards.

1. Does the plan tend to emphasize new research at the expense of action on research already completed?
2. Does the plan tend to emphasize action in areas where more or better quality research is needed in order to determine the correct form such action should take?
3. Does the plan encourage practical research rather than esoteric projects that enhance the researcher's professional or academic status?
4. Does the plan provide for rigorous evaluation of future research proposals and monitoring of research in progress to assure high-quality projects?
5. How will a systematic, flexible, useful research and development program be established? How will it be managed and coordinated? What specific measures will be taken to feed information to all interested parties and to withdraw from them information about utility, new needs, etc.?
6. Does the plan provide for assessment of future personnel needs?
7. Does the plan provide for educating future personnel in the appropriate fields.'
8. Does the plan encourage colleges and universities to offer appropriate courses for persons entering disaster-related fields or to other professionals indirectly involved with disaster mitigation?

ISSUE 4
NARROWING CHOICES VS. WIDENING CHOICES: THE ROLE OF DISSEMINATION AND UTILIZATION OF KNOWLEDGE

Another basic imbalance lies between legislative or regulator}' imposition of solutions and the dissemination of needed information to local and State entities, which can then use the information to work out the alternatives and influence selection among themselves.

A mechanism by which users and their partic--ular needs can be identified is needed. While there is, on one hand, much usable data from prior research that is not being put to use, action sometimes occurs prematurely in areas where more or better quality research could lead to more rational and effective solutions.

The citizen who wants to be involved in local planning and decisionmaking also needs good in--formation keyed to the nonspecialist. Here the Federal specialist can prove invaluable as advisor and information source. Citizens may not reach the same conclusions as the experts, hut, unless their decisions are blatantly inhumane or unlawful, they have the right to determine their community's destiny.

Questions

1. Does the plan concentrate on problems rather than issues?
2. How does the plan provide for the timely dissemination of information to the appropriate users, in a form that can be readily utilized?
3. Does the plan encourage centralized funds, research, and efforts in a few agencies or geographical areas or decentralized organi-

zation among a large number of agencies, institutions, and researchers?

1. Does the plan encourage agencies and institutions to act autonomously, or does it confine individual agencies and institutions to restricted areas of research and program development?

5. Is there a mechanism for timely and effective feedback?

6. By what means, based on what principles, will the division of responsibility for information dissemination be made?

7. Does the plan encourage citizen participation in program planning and decisionmaking through the usual channels of public meetings, hearings, and the like?

8. Does the plan tend to impose decisions of "outside experts" on communities regardless of the wishes of those communities? When is that justified? Not justified?

9. Does the plan encourage external Federal or State controls at the expense of informed consensus?

10. How will utilization objectives be determined, promulgated, and evaluated?

11. If a community, county, or State chooses to make what outsiders would consider a poor public policy decision about hazards mitigation, that is, one which encourages the unnecessary loss of lives or property, what is the appropriate Federal role with regard to such decisions before and subsequent to a disaster? Does the answer depend on the size of population or property at risk?

ISSUE 5
ENGINEERING DESIGN VS. SOCIOECONOMIC STRATEGIES

Because they behave in a logical, consistent, predictable manner, yield easily quantifiable data, and perform their tasks unaffected by emotions or value judgments, mechanical devices and engineered structures tend to appeal to public officials and other decision makers.

Social scientists, planners, and public officials often rely on computer modeling for allocating human, economic, and natural resources, These models make use of assumptions, which-though easily quantifiable—may bear so little resemblance to the true local situation that they hinder or prevent effective decision making.

However, effective community decisionmaking requires that community experience and values be applied to problem solving through management of human systems, i.e., social, economic, legal, and political.

A historical example of the contlict between the engineering and management approaches can be found in changing attitudes toward adjustments to flood hazards, where dam building is being supplanted by insurance and land management strategies.

Questions

1. To what extent does the plan attempt to coordinate with or utilize other Federal statutes to enhance its objectives? Many statutes other than those containing or authorizing hazards reduction programs could be utilized for hazards management, for example, statutes dealing with land management, loan provisions, licensing requirements, etc.

2. How will engineering design measures and techniques be assessed and integrated with socioeconomic strategies? Does the plan view them as complementary?

3. What is the plan's approach to the role of remote sensing as a planning aid?

4. Does the plan provide for equitable distribution of funds, at both the research and applications levels, between engineering design measures or techniques and strategies for the management of human systems?

5. Does the plan encourage comprehensive, coordinated, long-range planning for disaster research and program development by social agencies and financial institutions?

6. Does the plan encourage State, regional, and local planning agencies to develop

comprehensive hazards-reduction and disaster programs?

7. Does the plan encourage the use of ready-made "canned" computer technology in place of the judgment of community decisionmakers? How will balance be achieved?

S. Is the plan likely to result in attempts to fit the community to the program instead of the program to the needs of the community?

ISSUE 6
LIFE SAFETY VS. PROPERTY VALUE-ORIENTED PROGRAMS: BALANCING NEEDS

It is accepted that no implementation plan would be written deliberately to place 1 lives in jeopardy or to protect one group at the expense of others. However, it is quite possible that the ultimate effect of certain procedures, regulations, or policies may be just that.

The welfare of the community-at-large needs to be considered along with the desires of particular publics. One person may belong to several publics, i.e., taxpayers, parents, union members, etc. Neighborhoods, socioeconomic classes, ethnic groups, hospital patients, senior citizens, bureaucrats, and others all constitute publics. The conflicts between the desires and needs of particular publics and the greater good of the community--at-large must be resell'ed if the applicable parts of the implementation plan are to find acceptance at the community level.

When planning only emphasizes preventing death and injury, there is a tendency to take only those minimum measures that protect 1 life, rather than to look beyond the minimum in order to protect economic investments that may be needed to restore social and economic health to the community after the quake.

Questions

1. Does the plan emphasize saving lives in contrast to protecting property?

2. Does the plan recognize that the needs and desires of the community may work to the detriment of one or more particular publics? How will these conflicts be probed?

3. Does the plan have the ultimate effect of treating some classes or groups as more expendable than others? Why? Why not? By what logic? Do these criteria shift, depending on the size of the potential disaster or the size of the comminity?

4. Does the plan contain adequate provisions for the resolution of intracommunity conflicts among property values, historical or esthetic values, and the life and health of human beings?

5. Does the plan provide recognition of certain key industries or businesses whose continued function is vital to the socio-economic health of the community, region, or Nation ?

6, How will the new law assure adequate funding and "clout" for agencies responsible for code implementation, planning, and management?

ISSUE 7
LIFE SAFETY VS. PROPERTY VALUE-ORIENTED PROGRAMS: HAZARDOUS BUILDINGS

The greatest single life-threatenin, earthquake hazard, and the one most difficult to alleviate, is the unreinforced masonry building.

In quake-prone cities, there are hundreds of thousands of these potential cleat deathtraps. Their collapse also could create debris barriers chat firefighters and emergency rescue vehicles could not pass.

Yet, these buildings represent sizable real estate investments, often by owners unable or unwilling to finance their retrofit or replacement. They are homes to those who lack the monev and/or the desire to live elsewhere. Some of these buildings have historic and esthetic value to communities which wish to preserve them, but which lack the means to bring them "up to code."

These buildings constitute a hazard too great to be ignored, but too expensive for individual owners or communities to alleviate.

Within buildings, repairable damage to nonstructural components usually constitutes more

than 50 percent of total earthquake damage and is a major life safety risk; present building codes generally are silent with regard to the selection and installation of nonstructural components in potentially seismic areas, especially so for small buildings that comprise the bulk of potential loss exposures.

1. Does the plan directly, or by some clear process, address the full range of social, economic, legal, political, and technical questions involved in decisions concerning the retrofitting or razing of hazardous buildings?
2. Does the plan consider sources of funding for reinforcing public buildings and other structures, where it is feasible, and the key relationships of other agencies, such as Federal Housing Administration (FHA), Federal Home Loan Bank Board (FHLBB), Occupational Safety and Health Administration (OSHA), etc., in this objective?
3. How can a sufficient number of qualified and adequately paid inspectors be maintained to supervise the retrofitting of old buildings or the implementation of new, upgraded seismic safety standards in new ones?

ISSUE 8
FEDERAL REGULATIONS OVERRIDING CONFLICTING STATE LAWS VS. STATE-BY-STATE RESOLUTION: BUILDING CODES

Building codes are the single most important direct way to mitigate earthquake hazards.

Some States have statewide building codes, others leave code adoption and enforcement to the individual counties and cities, some of which have no building codes at all. Much emphasis has been placed on the supporting structure of buildings, neglecting nonstructural components. There is a pressing need for more attention to code and design requirements for nonstructural elements, especially "lifeline systems," i.e., essential public Service delivery systems, such as transportation, communications, and utilities.

Building codes, whatever their emphases, tend toward only minimum 1 life safety standards, Mistalemly, public decisionmakers and their constituents often believe that the codes are all-inclusive and all-protective. The timelag between technological developments and their inclusion in the codes is often very great. Even when new developments are incorporated into the Uniform Building Code, few States require that local jurisdictions update their versions of the code.

Decisionmakers often refuse to adopt seismic hazards laws because they feel that the building code is sufficient protection. Yet, buildings constructed "to code" can suffer and have suffered partial or even total collapse.

1. Does the plan address the entire process and practice of building code formulation, revision, and enforcement?
2. How does the plan propose to meet the need for better quality, more realistic, and more cost-effective building standards?
3. How does the plan address the problem of assuring local code adoption? How will the plan utilize Federal instruments of Government to promote the adoption and enforcement of improved codes?

ISSUE 9
PREDICTION VS. PRESENT CAPABILITIES

Reasonably accurate and useful means of earthquake prediction may not lie far in the future. However, it is unlikely that reliable prediction technology will have arrived by the time the initial appropriation for Public Law 95- 124 expires, In addition, prediction methods that work in one geophysical province may not work in another. It is necessary that the plan for the wise use of earthquake prediction, but this must not be emphasized to the degree that it blinds us to the present problems what to do until we can make reliable predictions.

The plan must resolve the tension between the questions of developing future prediction capability with the problems of dealing with quakes here and now.

Figures 3, 4, 5, and 6 present basic background information on measuring earthquakes and on the technology for predicting earthquakes. Earthquake modification and control are even further away than prediction, and they will

Figure 3.— Measuring Earthquakes

The size of an earthquake is measured in terms of magnitude and intensity by two rather complex scales. The most fundamental and scientific unit of measurement is the earthquake's magnitude, a measure proportional to the logarithm of the total energy released by the event. The most common measure is the Richter scale, which is based on measurements of seismograph records scaled to a distance of 100 km (62 miles) from the center of surface energy release (epicenter) by the shock. Since the distance from an earthquake epicenter to any one of many seismic recording stations is never exactly 62 miles, tables are used to convert the seismograph records into a scale from 1 to 9.

The logarithmic feature of the scale means that an increase in magnitude of 1.0 corresponds to a tenfold increase in vibrational amplitude and an increase in energy released of about 31.5 times. Earthquakes whose magnitudes are less than 4.0 are not usually damaging. An earthquake whose magnitude is at least 7.9 is conventionally called a great earthquake. The largest magnitude ever recorded was about 8.9 in the case of two earthquakes in the Pacific: the great 1906 San Francisco earthquake had a magnitude of about 8.25.

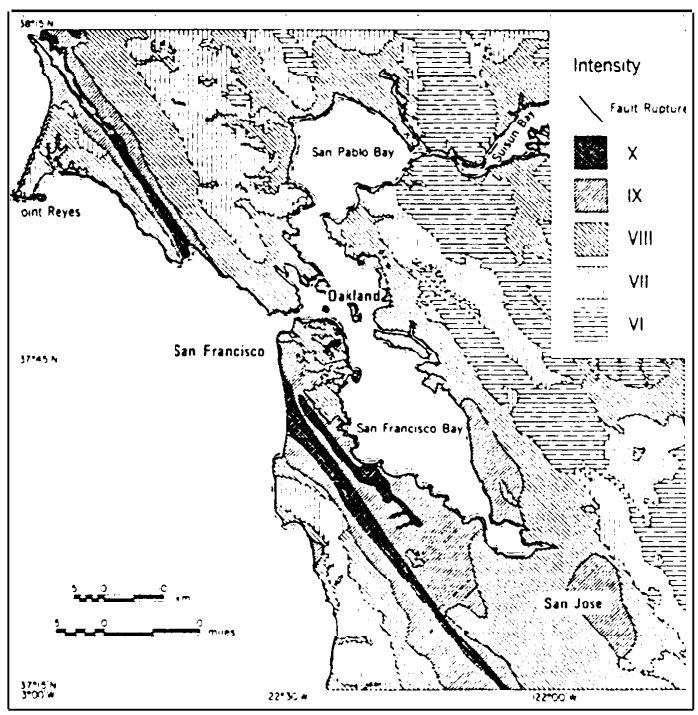
Earthquakes of the same magnitude (energy release) can cause vastly different consequences in different regions. This results partly because of different seismological/geological conditions and partly because of different structural practices. Therefore magnitude has a specific scientific meaning, but unless it is translated into specific effects to structures at given locations it has little sociocultural utility. However, the translation requires detailed knowledge of the tectonic/seismological characteristics of the source fault rupture, the transmission path source to site seismol. ogy/geology, the engineering geology and soils characteristics of the site of interest, and the foundation and structural design characteristics of the structure itself. This is a complex and expensive undertaking in either a retrospective or predictive model. There is uncertainty in this process because of the manner in which limited specific measurement of relevant properties are assumed to be representative and because of simplifying assumptions (or limits to our understanding of) important relationships.

Intensity scales have been contrived to measure the effects rather than the energy release of an earthquake. It is through a knowledge of energy release and site-specific intensities of past events that reasonable projections of the site-specific consequences of similar future events can be made. Through a careful definition of structural characteristics and observable effects. the uncertainty of the subjective interpretation of effects that define intensity is reduced to a minimum. Although there are several scales, the Modified Mercalli (MM) intensity scale is the one most commonly used in the United States. The MM scale employs Roman numerals from I to X11, each number corresponding to descriptions of earthquake damage and other effects. Because the damage and ground effects are influenced by numerous factors—such as distance from the causative fault, local geology, ground and soil conditions, and accuracy of personal observations— reported intensities can vary substantially from site to site. Thus an earthquake cannot be assigned a single intensity number. Rather, earthquake intensities observed at various locations are plotted on an intensity or isoseismal map.

Because the MM intensity scale and the Richter magnitude scale measure basically different parameters, they cannot easily be directly compared. **However, the relationship** between the two measures **for ordinary ground conditions** in metropolitan centers in California can be gauged from the following intensity map:

The Intensity Map for the San Francisco Bay Area 1906 Earthquake
(Intensities depend on distance from fault breakage and type of soil.)

Magnitude (Richter)	Intensity (MM)	Damage
1	I	Observed only instrumentally
2	I-II	Can be barely felt near epicenter
3	III	Barely felt. no damage reported
4	V	**Felt a few** miles from epicenter
5	V1-vll	Causes damage
6	VII-VIII	Moderately destructive: some severe damage
7	lX-X	Major, destructive earthquake
8	Xl	Great earthquake



SOURCE: Leo W Weilbecker and Ward C Stoneman, *Earthquake Prediction in Society,* **Center for Resource and Environmental Systems** Studies SRI International February 1977 p. 10

Figure 4.— Modified Mercalli Intensity Scale of 1931

To eliminate many verbal repetitions in the original scale. the following convention has been adopted. Each effect is named at that level of intensity at which it first appears frequently and characteristically. Each effect may be found less strongly, or in fewer instances, at the next lower grade of intensity: more strongly or more often at the next higher grade. A few effects are named at two successive levels to indicate a more gradual increase.

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional class A, B, C construction).

Masonry A. Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry El. Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

Masonry C. Ordinary workmanship and mortar: no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.

Masonry D. Weak materials, such as adobe: poor mortar: low standards of workmanship; weak horizontally.

i. Not felt. Marginal and long-period effects of large earthquakes.

Il. Felt by persons at rest, on upper floors, or favorably placed.

ill. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration may be estimated. May not be recognized **as** an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy bail striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of 4 wooden walls and frames creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by ail. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware, broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle—CFR).

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry 0, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments—CFR). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations—CFR). Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damge to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.

x, Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides, Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

xl. Rails bent greatly. Underground pipelines completely out of service.

X11. Damage nearly total. Large rock masses disc) laced. Lines of sight and level distorted. Objects thrown into the air.

SOURCE: Leo W Weisbecker and Ward C Stoneman. *Earthquake Prediction in Society,* **Center** for Resource and Environmental Systems Studies SRI International February 1977, p, 11

bring a whole new set of problems, including questions of international liability.

A great deal of emphasis has been placed on the negative consequences of earthquake prediction. However, there are no U.S. studies vet published that have actually measured or evaluated responses to a long-term disaster prediction. Some studies have been attempted, but i n the opinion of most social science researchers. it is risky to depend upon people's opinions of what they will do in a given situation rather than what they do when the situation becomes a reality. Some studies of actual prediction experience in Japan are being published in a volume edited by Professor Quarantelli (Ohio State University).

A study of reactions to a long-term prediction of the eruption of Mauna Loa and a short-term volcanic hazards advisory at Mount Baker, Wash., was conducted by Marts, Sharp, and Hedge (University of Washington). [1]

In contrast, there is a large body of literature on human reaction to threatening information

[1] Marion E. **Marts, David Hodge,** Virginia Sharp, Janet Cullen, et al., Social Implications of Volcano Hazard, Case Studies in the Washington Cascades and Hawaii (two **volumes). Univ. of** Washington, July 31, 1978.

Figure 5.—The Developing Technology of Earthquake Prediction

The factors most crucial to the development of practical earthquake prediction technology are the following:

- A well-deployed and varied instrumental network (see drawing).
- An active program of laboratory experimentation and simulation of rock behavior u rider stress.
- Computation facilities adequate for processing instrumental data and for extensive modeling of crystal rock behavior under stress.
- Theoretical studies for interpretation of analytical results based on field measurements and for integration of these results into existing theories and models.

Features of an Operational Earthquake-Prediction System

The form of an operational earthquake-prediction system is not yet known, but one possible type can be visualized as consisting of arrays of geographically dispersed instruments that are linked to a data-processing system through a telecommunications system. Such a system could even be incorporated into a public utility such as the telephone system. An operational earthquake-prediction system would consist of the following elements:

. Arrays of instrumentation requiring some kind of land acquisition or use rights.
- Field stations to make some periodic measurements and to provide maintenance and calibration of in-place instruments.
- Data-processing systems to reduce the field data on a real-time or near-real-time batch basis.
- Central control, probably incorporating not only the data-processing system but also the operational control and evaluation functions.

Example of Public Information Component of Earthquake Prediction

Leadtime[a]	6
Time window[b] (weeks)	3
Epicenter or region of	San Juan Bautista to Los Gates along the San Andreas Fault
Magnitude (Richter)	7.0-7.2
Confidence that event will occur[c]	85
Contingent effects	Possible 8.3 Richter magnitude along entire "locked" San Francisco Bay section of the San Andreas Fault (no confidence judgment possible)

aThe leadtime of an earthquake Prediction IS the anticipated elapsed time between the prediction and the most likely **OCCUrence of the** earthquake
The time window of the prediction IS the time period within which the event IS predicted **to occur.**
CThe confidence that the event will occuur, or probability represents a complex problem of Interpretation. **Any early probability statements are actually an indication** of what IS not known about the processes that generate earthquakes. rather than what can be expected in a new situation as a result of past experience in similar situations. However. when a track record IS accumulated the statements can be based on past experience

SOURCE. Leo W. Weisbecker and Ward C Stoneman. *Earthquake Prediction Ii Society.* Center for Resource and Environmental Systems **Studies** SRI International February 1977, p. 12

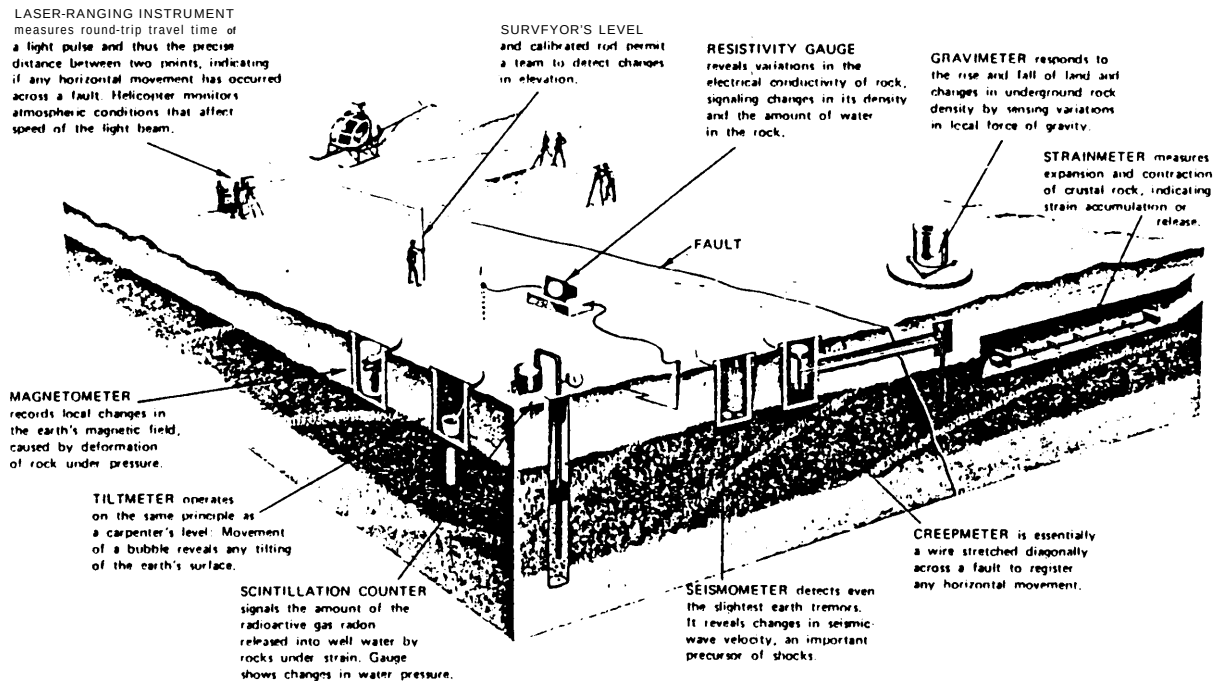
by denial of it. This process is called the '(normalcy bias," "illusion of invulnerability," or the " it-can't-happen-to-me" syndrome. Until a body of statistically valid and reliable research has been amassed, it may be better to be guided by accumulated data that point to apathy, procrastination, and disbelief as basic problems facing preparedness officials rather than adjustments motivated by fear. On the other hand, there may be differences between the reactions of those directly threatened, whose property lies in the target area, and those who reside in safer territory but whose financial investments are within the target area. These investors, not persona Iii' threatened by bodily harm, may not experience the threat-fear-denial syndrome and may withdraw their investments from the target area as a matter of fiscal prudence. Some ma v actually there invest there anticipation of realizing a net financial gain deriving from taxing, relief, insurance, or other practices.

The positive effects of prediction and of disaster itself have largely been overlooked. Power and others in a report on the Teton Dam disaster recovery, point out that once rebuilding begins the disaster areas mav experience an economic boom. ? The immediate injection of Federal disaster funds spurs the recoverv; there is a rush to get business and i ndustry back into shape. Here is where preplanning for postal isaster rehabilitation is vital if the rush to recoverv is to be channeled into improving the community. The prospect of newer, improved facilities a$_p$-pears to encourage investment. If preplanning is clone carefully and business is made aware that upgrading is possible, some capital flight that otherwise might occur after the disaster can be prevented.

Accurate prediction allows time for realistic preplanning by the business, financial, and industrial communities. It may also make it possible for community leaders, assisted 171 tile media, to mobilize commun itv spirit and, by so doing, create the "postdisaster euphoria" i n the predisaster period. [f the prepared-for disaster does n o r materialize, however, "postdisaster letdown" mav occur as well.

[John H. Powel, Jr., et al., *Adjustment Program for the Teton Disaster Area: Executive Summary*, Seattle, Wash., Boeing Computer Services, 1977.

Figure .6.—Concept of Earthquake Prediction Instrumentation



SOURCE. Painting by Davis Meltzer National Geographic Society. Reprinted with permission.

Still another positive effect is the opportunity for researchin$_g$ ways to circumvent the threat-fear-denial reaction so that effective preparation systems can be developed for future events. The resolution of tensions between positive and negative effects of prediction offers an opportunity that the implementation plan should not fail to address.

When earthquake prediction was first considered possible, debates arose over plans to evacuate large cities and over the problems that could result. Accordin$_g$ to structural engineers and emergency planners, the tide now seems to have turned more toward building reinforcement and the use of refuge areas. Most, if not all, cities in seismically active regions have areas that are highly vulnerable to earthquake damage, but they also have areas that are reasonably safe. Many buildings can be made more earthquake resistant bt practical means. The idea of mass evacuation is giving way to spot evacuation of the more hazardous sites. Long-term prediction, which will allow strengthening of buildings and dissemination of refuge information, and short-term warnings, which will allow temporary evacuation and school and business closures, should provide more safety with less disruption of the normal living patterns than mass evacuations.

Questions

1. Has too much emphasis been placed on prediction, to the detriment of the here-and-now management of the next damaging earthquake?
2. Does the plan rely so heavily on prediction that it will not be an effective tool for hazards reduction unless/until prediction technologies are perfected?
3. Does the plan recognize the differences between short-term programs, which need attention immediately, and long-term planning?
4. Does the plan tend to encourage actions that would make decisionmakers and the

public-at-large unrealistically dependent on prediction or warnings?

5. Does the plan give the impression that there is a large body of reliable data regarding either positive or negative effects of earthquake prediction?

6. Does the plan tend to emphasize the negative effects of prediction to the detriment of planning based on the positive effects?

7. Does the plan give the impression that it is based heavily on the expectation of certain negative effects?

8. Is the plan written in such a way that it may create self-fulfilling prophecies of negative impacts ?

9. Does the plan encourage community-based planning for implementing the positive effects of earthquake prediction and preparedness ?

10. Does the plan encourage community--based planning for in[-estimating and alleviating the true negative effects of earthquake prediction and preparedness?

11. Is there an equitable balance between research and planning funds apportioned for prediction/warning and those apportioned for immediate preparedness planning?

12. Does the plan provide for establishing: criteria for evaluating the current response capabilities of all Federal, State, and local entities concerned with earthquake preparedness and relief?

13. Does the plan encourage open scientific discussion with decisionmakers and the public-at--large about the progress of prediction research and its implications?

14. Does the plan provide for educating representatives of the news media regarding the facts and fallacies associated with prediction ?

15. Does the plan encourage planners and decisionmakers to rely on competent sociological studies regarding prediction and postdisaster behavior?

16. On what specific conclusions from social science research on disaster-related behavior-tor is the plan based? How specifically is this information utilized in the plan?

17. How does the plan balance emphasis on mass evacuation with refuge and reinforcement strategies?

18. Does the plan provide for allotment of funds to city and country governments for studies to determine refugee areas and spot evacuation areas?

19. Does the plan provide for readily available sources of funding for reinforcing public buildings and other structures for which reinforcement is feasible?

20. By what means are priorities set? What will be the need for, and how will one go about retracting, a prediction or forecast for a quake? Are the possible liabilities associated with prediction recognized?

21. There is a generally recognized uncertainty about forecasting earthquakes, but there is an equal, if not more important, uncertainty about the scale of risk. In a recent study, seven recognized experts evaluated the probability and year as well as the severity of a quake on a modified Mercalli scale, and horizontal ground motion, for 11 different regions of the country. It was clear that experts not only disagree but they disagree by factors of thousands to tens of thousands on important judgments. (See tables 5 and 6.) To what extent should this uncertainty be a key element in planning?

ISSUE 10
THE PICTURE OF THE PRESENT VS. THE IMAGES OF THE FUTURE: CHOOSING ALTERNATIVES

Present public policy actions are unlikely to have major short-term consequences for the quality of life or the public well-being. Their major effects, both planned and unplanned, will be in the future. It is useful, therefore, to look to the future and make explicit the assumptions about the future world.

Although human beings have the potential capacity for projecting themselves into the future and for making plans, they are essentially oriented to the here and now. For most people the idea of the "future" is either so remote that it

does not enter their consciousness, or it is largely based on the rules and conditions of the present.

Questions

1. What alternative futures have been examined and chosen for the variables entering into the plan ? By whom? On what rationale?
2. What are the explicit, extrapolative, and normative assumptions about the future with regard to earthquake hazards regions? What technology, public policy, population, and other variables have entered into those assumptions?
3. Does the plan provide a means for postdisaster planning to be completed in advance of the next disaster? How? By Whom? Under what guidelines and overall planning principles?
4. In the development of postdisaster recovery and rehabilitation programs, does the implementation plan encourage the use of safer sites, designs, a and techniques ?
5. Hour much hazards reduction is sought? How much is needed? How' much can be afforded ?
6. What implications do these choices have insofar as our other national priorities and resource commitments are concerned ?

ISSUE 11
THE PICTURE OF THE PRESENT VS. THE IMAGES OF THE FUTURE: RESOLVING AMBIGUITIES

The Act states that "It is the purpose . . . to reduce risks . . . from future earthquakes *in the United States . . .*"

Neither the faults that cause earthquakes nor the damages that result from seismic activity respect national boundaries. Thus, a quake with

Table 5.— Davis Besse (Ohio)

Expert respondent no.	1	2*	3	4	5	6	7	High/low differ by factor of
MM•• Intensity				Probability y per year				
V	10"'		10-'	7 x 10"'	lo"'"–		, 0 - 2	
VI	1 0-'		10-'	10-2	5 x 10-3		10"4	
VII	10-'		10"'	lo"'	1 0-3	1 o-'	lo"~	
VIII	lo"'			5 x 10-7	1 o-' 1		10-7	
Ix	10-5				10"6		10-"	
x	10"6						<10-8	
xl	10-'						< 10-'	
X11	10-a						<1 o-d	
Peak horizontal acceleration				Probability y per year				
.05g	1 o-'		10-5	8 X 10-3	5 x 10-'		10-2	
.1g	10-'	,0..	lo"'	2 x 10-'			10-4	
.15g	10-'			3 x 10-'	1 0-3	10-6	lo"'	,
.Zg	1 o"'	8 X 10-'		6 X 10-5			10-'	100000
.25g	1 o-'			6 X 10-'	1 0-'		, 0 - 6	
.3g	10-2			8 X 10-7			10-'	
.4g	10-'	5 x 10-'					lo"'	
.5g	10-5				1 0-6		10-'	
.6g	,0-6	3 x 10-'					< 10-3	
8g	10-7	2 x 10"5					<10-8	
1 .0g	10-a	1 x 10-'					<1 o-'	
== 1 .lg	10-'						<1 0"'	
				Dominant frequency and duration for 1O⁻²/year earthquake				
Cycles/sec	2	1-3	1-3	2-15		1/3-1 o		
Seconds	10	5	5	15		20		

'Probabilities per year are for accelerations greater than the Size indicated
" " Modified Mercalli Scale,

SOURCE D. Okrent, A Survey of Expert Opinion on Low Probability *Earthquakes.* University of California at Los Angeles UCLA.ENG.7515 February 1975.

Table 6. – Diablo Canyon (California)

Expert respondent no.	1	2"	3	4	5	6	7	High/low differ by factor of
MM•• Intensity				Probability y per year				
v			10-1	1 o-'	10-6		10-'	
VI				4 x 10-'			10-'	100,000
VII			1 0-'	2 x 10-2	5 x 10-3		, 0-2	
VIII			10"3	5 x 10-'	3 x 10-'		1 0"'	
Ix			10-5	10-4	10-4		,0-6	100
x			10 -'	10-5	2 x 10-6		10-7	
xI				2 x 10-'	10-6		<1 o"'	
X11							<10-7	
Peak horizontal acceleration				Probability y per year				
.05g		5 x lo"'	10-2	4 x 10-2			10-1	
.Ig		2 x 10-'	10-3	2 x 10-2	1 0 -'		1 0 -'	
.15g			1 0-3	7 x 10-'	5 x 1 o-'		1 0 -'	10
.20g		1 x 10-3	10-'	3 x 10-3	3 x lo"'		1 0 -'	
.25g			10-3	2 x 10-3	3 x 10-3		10-3	
.3g			, 0-4	10-'	10-3		,0-3	
.4g		6 x 10-4	10-4	3 x 10-4	2 x 10-'		10-5	
.5g			10-6	7 x 10-5	10-4		10-6	100
.6g		3 x 10-4		1 0 -'	2 x 10"'		1 0-'	
.8g		2 x 10-4		1 0-8	1 0-5		<1 0-'	500
1 .Og		10-'			2 x 10-'		<1 0	
>1.Ig					10-6		< 1 0 -	
				Dominant frequency and duration for 10-'/year earthquake				
Cycles/see		5	5-8	2-5				
Seconds			17	15				

• Probabilities per year are for accelerations greater than the size Indicated
. . Modified Mercalli Scale.

SOURCE D Okrent, *A Survey of Expert Opinion on LOW Probability Earthquakes,* University of California at Los Angeles UCLA-ENG.75 15 February 1975.

a U.S. epicenter may cause damage in Canada and Mexico, or a quake with an epicenter in Kamchatka may cause damage along the western coast of the United States. An earthquake originating beneath international waters may cause destructive tsunami along U.S. shores. The intent of the Act regarding these conditions is not clear. Does the United States assume legal and financial responsibility for reducing earthquake hazards in Canada, Mexico, and the U.S.S.R. h-em quakes *originating in* the United States? Is it the intent that the United States install monitoring equipment in Canada, Mexico, and the U.S.S.R. to protect against earthquakes that may cause damage *in the United States ?* Or is it possible that U.S. agencies could at some rime **refuse** responsibility for reducing tsunami haza ards because the causative fault is outside the 200-mile U.S. **territorial zone?**

There are fault systems that traverse the Canadian and Mexican borders. Does the Act raise the spectre of future legal hairsplitting over whose fault is at fault, or worse, international incidents over responsibility for prediction, control, and disaster relief? At some Future time may te Unitcd States be accused of permitting damage to (for instance) Russian installations by failing to control fault tension in the Aleutian-Alaskan area—or conversely, of causing damage when seismic control experiments misfire and result in larger earthquakes than intended? May one side of a transborder faults system be experimented upon without prior arrangements with the other country involved ?

These questions and others of international liability arise from the ambiguous wording in the Act itself and from its failure to address the nature of the geophysical phenomena.

Does the plan identify these and other ambiguities in the Act? How were these handled in the implementation plan? Is there a need to return to Congress for clarification of any ambiguities or uncertainties of intentions?

ISSUE 12
THE "NORMAL" DISASTER VS. THE CATASTROPHE

There is incongruity between acknowledging that a maximum credible disaster—a disaster taking thousands of lives and running into tens of billions of dollars—implies major discontinuity, and the desire within Government to maintain a comfortable sense of continuity of institutions. It would be worthwhile to identify a threshold of disaster at which point the normal operating laws, rules, and regulations of society would need to be suspended during some extended recovery period. This concept would go well beyond martial law and suggests that debts, insurance, bank payments, commercial obligations, and so on might be handled in a unique way. Postwar Europe's recovery provides a possible model. Such a strategy might address many of the difficulties associated with major disaster (or its prediction) that could disrupt the whole U.S. or a regional economy.

This conflict between the necessity for saving lives and restoring the economic balance of the country (or a region) by such drastic measures on the one hand, and the constitutional questions raised by such solutions on the other, requires careful analysis and anticipatory planning.

Questions

1. Does the plan face the reality of identifying a level of disaster so severe that the normal operating laws, rules, and regulations of society would need to be temporarily suspended or drastically modified during a long recovery period?
2. Within the framework of a major/maximum credible disaster, could one anticipate that fire might be particularly dominant? To what extent is dealing with fire integrated into the plan and to what extent is special foreign experience or historical American experience being utilized?
3. In a major holocaust will there be special need for rubble removal equipment? Where are these needs being considered ?

ISSUE 13
INTERAGENCY CONFLICTS: NEW VS. EXISTING AGENCIES

Public Law 95-124 provides for leadership to coordinate the efforts of the many agencies. Most States already have agencies responsible for emergency preparedness, environmental concerns, and geological matters, and these have ties with Federal agencies with implementation responsibilities.

Shall each agency take responsibility for managing its own programs and coordinating with other agencies, or shall they assume responsibility for creating one body with representatives from each agency? This question can be raised at all levels of government. On the one hand, agencies generally resent outside direction. Yet, few agencies can boast a good track record of cooperation with other groups in the absence of a central coordinating entity. Interagency committees are often unwidely creatures, however, and as a rule are not as efficient or effective as a single agency.

It is inevitable that there will be interstate conflicts where laws and procedural regular ions are concerned. The resolution of this conflict is closely tied to the basic approach of the plan; is it to be from above or broadly based on the expressed needs of the affected parties?

Interaction among the several State agencies and among State, local, and regional bodies ranges from cooperation to competition so intense that it impedes effective action. It may be that the only solution in some States will be to consolidate all earthquake planning functions into one new agency. In others, varying degrees of consolidation and coordination will be required. In still other States, effective interagency programs may already be functioning.

Existing agencies at both Federal and State levels have the advantage of experience and personnel familiar with problems and procedures. On the other hand, bureaucracies tend to become overcommitted to their own sets of regulations and priorities. The implementation plan must balance these conditions in order for the legislation to be effective.

Questions

1. Does the plan make use of existing agencies, programs, and systems or does it call for the establishment of new ones?
2. How is the plan related to the President's Reorganization Plan for disaster preparedness and response?
3. How will the coordination affect more than information exchange and achieve real integrated action ?
4. Does the plan provide for resolution of interagency conflicts over procedures to coordinate work efforts?
5. Is the plan sufficiently flexible so that these conflicts can be resolved in the manner best suited to each level of government or to each local area?
6. Does the plan provide constraints necessary to achieve an appropriate balance of power among agencies?
7. Does the plan provide for effective criteria for deciding when new agencies or coordinating bodies are necessary to surmount interagency or interlevel conflicts? Are there effective mechanisms for their creation ?
8. Does the plan call for resolution of statutory conflicts among States by imposition of new Federal laws or regulations?
9. Does the plan encourage voluntary resolution of legal conflicts by the States themselves?
10. Does the plan allow for model State laws or guidelines that States may use to resolve interstate conflicts in disaster planning and rehabilitation ?
11. What new legal or equity issues will arise under the plan ? How is this determined? How will they be resolved?
12. Seismology is a concern of the Department of Defense, particularly through its network for nuclear test detection. To what extent will such test information be made available under the new plan?

ISSUE 14
URGENCY OF NEED VS. LIMITED CAPABILITIES

It is often widely believed that brief, all-out efforts can solve major problems or accomplish great feats. Unfortnuately this is rarely justified by events.

The question of how much effort is enough must be resolved. The tendency to meet the most immediate needs and to go no further than an agencies feels required to go leads to focus on a short-term partial solutions ("satisficinig"). This undercuts more effective, long-term measures.

If the implementation plan is to succeed, it must balance aims and intent on the one hand, and specific plans to put those aims to work on the other.

The final philosophical conflict for examination is the tension between the strict interpretation of the Act and the freedom to interpret its intent and purpose even when the latter facets are not spelled out in the original legislation.

Congress and the President will need to be apprised from time to time, certainly at the end of the initial appropriation period, if not sooner, of the success or failure of the plan.

If the plan is succeeding, then some measure of its success must be made visible and available. If the plan is not working, it must be recast or abandoned.

Questions

1. With or without a major earthquake, can hazards reduction be evaluated?
2. What does "hazards reduction" mean when interpreted as explicit agency objectives?
3. Does the plan provide a mechanism for continuing assessment of its effectiveness?
4. What are the measures of the plan's effectiveness?
5. How will nonquantitative measures of success be used in evaluation?
6. What is a reasonable schedule of accomplishments?

7. How does the plan encourage finding *the* best solutions possible, consistent with the state-of-the-art, and reasonable, fiscal constraints ?

8. Does the plan discourage intensive effort, restricting time and money to temporary or "band aid" approaches to earthquake problems?

9. Does the plan encourage speed at the expense of thoroughness?

10. Does the plan favor a rigid, narrow, conservative interpretation of the letter of the Act and its own specifications? Does the plan allow for a generous or common sense interpretation of the Act and flexibility in its own requirements?

11. Has the plan examined the ability and willingness of the agencies charged with carrying out the plan? How are the nonresearch aspects of the plan to be funded? Are there political conflicts of interest that will impair the plan's functioning? Do the advocates of the plan have constituencies both within government and without who are powerful enough to successfully support the execution of the plan's objectives and programs?

12. Does the **plan** tend to *self-destruct* after the initial appropriation period, or does it contain provisions for the gradual phasing in and out of specially funded programs or projects?

13. Does the plan contain mechanisms for the establishment of ongoing programs?

14. Does the plan anticipate and provide for the gradual turnover of any successful Federal projects to the appropriate State or local agency or jurisdiction?