5.0 LOSS-REDUCTION MEASURES IN VARIOUS FEDERAL INSURANCE CONTEXTS

In Section 3 we evaluated candidate loss-reduction activities in terms of their cost-effectiveness. In Section 4 we discussed fifteen promising LRMs which could serve to define earthquake ordinances.

Our goal in this section is to determine how LRMs may be incorporated into a federal earthquake insurance program. In achieving this goal, we define only general types of federal earthquake insurance constructs. Fuller definition and evaluation of possible constructs is beyond the project scope. Similarly, in order to show that it is feasible to incorporate LRMs into federal earthquake insurance involvements, it is necessary only to indicate some of the ways in which these LRMs may be so incorporated. Although we indicate that some federal earthquake insurance constructs would be incompatible with the LRMs proposed here, an administrator of a federal earthquake insurance involvement may devise ways other than are illustrated here in order to incorporate LRMs.

In Section 5.1 we present an overview of the possible roles that the federal government could play in the provision of disaster insurance and the application of loss-reduction measures.

In Section 5.2 we first discuss the status quo which involves no federal earthquake insurance program, and suggest how recent modifications and developments of disaster relief policy affect the implementation of loss-reduction measures.

In Section 5.3 we examine how the rate structure of an earthquake insurance program will affect the implementation of such LRMs as those recommended in this report.

In Section 5.4 we examine LRMs in a **primary** federal earthquake insurance context. We consider two general types of primary programs: (1) purchase of federal earthquake insurance made possible by federal agreements with local (or state) governments and (2) purchase of earthquake insurance without requiring such agreements. We assume that this earthquake insurance may be available only to some segment of the population (e.g., the residential section) and that private insurance markets will cover remaining segments.

In Section 5.5 we examine LRMs in a secondary federal earthquake insurance context.

Sections 4, 5.2, and 5.3, provide coherent programmatic directions for implementing LRMs into a federal insurance program. In general,

(1) existing contingent federal liabilities, themselves created to meet genuine state and local needs, justify increased federal influence over seismic construction and land-use planning processes, and

(2) in primary and secondary federal earthquake insurance programs, some of this influence can be effected through rate-making and/or pricing which ensures that buildings in higher risk categories are rated in accordance with their risks or that insurance availability is conditional only on LRM implementation and/or enforcement of earthquake ordinances. As previously explained, these ordinances do not place significant burdens on state or local governments in lower seismic zones, especially zones 0 and 1. Furthermore, public and selected private nonprofit buildings may be required to purchase earthquake insurance.

The loss-reduction programs outlined here emphasize reductions in expected long-term earthquake losses; they do not (and could not) include mechanisms to reduce significantly large-scale earthquake losses in the very near term. We address the issue of near-term losses only briefly in Section 5.1, where we indicate schematically how a federal earthquake insurance involvement with a mitigation element can assist in controlling losses from potential near-term large-scale earthquake disasters. We do not examine whether or not such an involvement yields the best or optimal system; however, a federal earthquake insurance and/or reinsurance system with a loss-reduction component can address both short-term and long-term losses associated with earthquakes.

5.1 Possible Federal Involvement in Earthquake Disaster Insurance

One principal reason for federal involvement in an earthquake insurance program is to protect the integrity of the United States economy. In this regard, we are referring to an expected catastrophic earthquake resulting in losses that could exceed fifty billion dollars. Another major objective is to reduce expected property and injury/life losses through the application of LRMs which can be implemented through an insurance mechanism.

Federal Insurance as Buffer

The functional role of federal insurance mechanisms and LRMs are illustrated in Figure 5-1. Federal involvement would serve as one component in a buffer zone of private and public entities which can take steps to reduce negative social, political, and economic impacts of a catastrophic earthquake. Within the buffer zone, state and local governments may require LRMs such as building codes to reduce structural damage, may provide self-insurance against future disasters, or may provide disaster relief. Private insurance companies may issue disaster policies to protect structures. The federal government may seek to

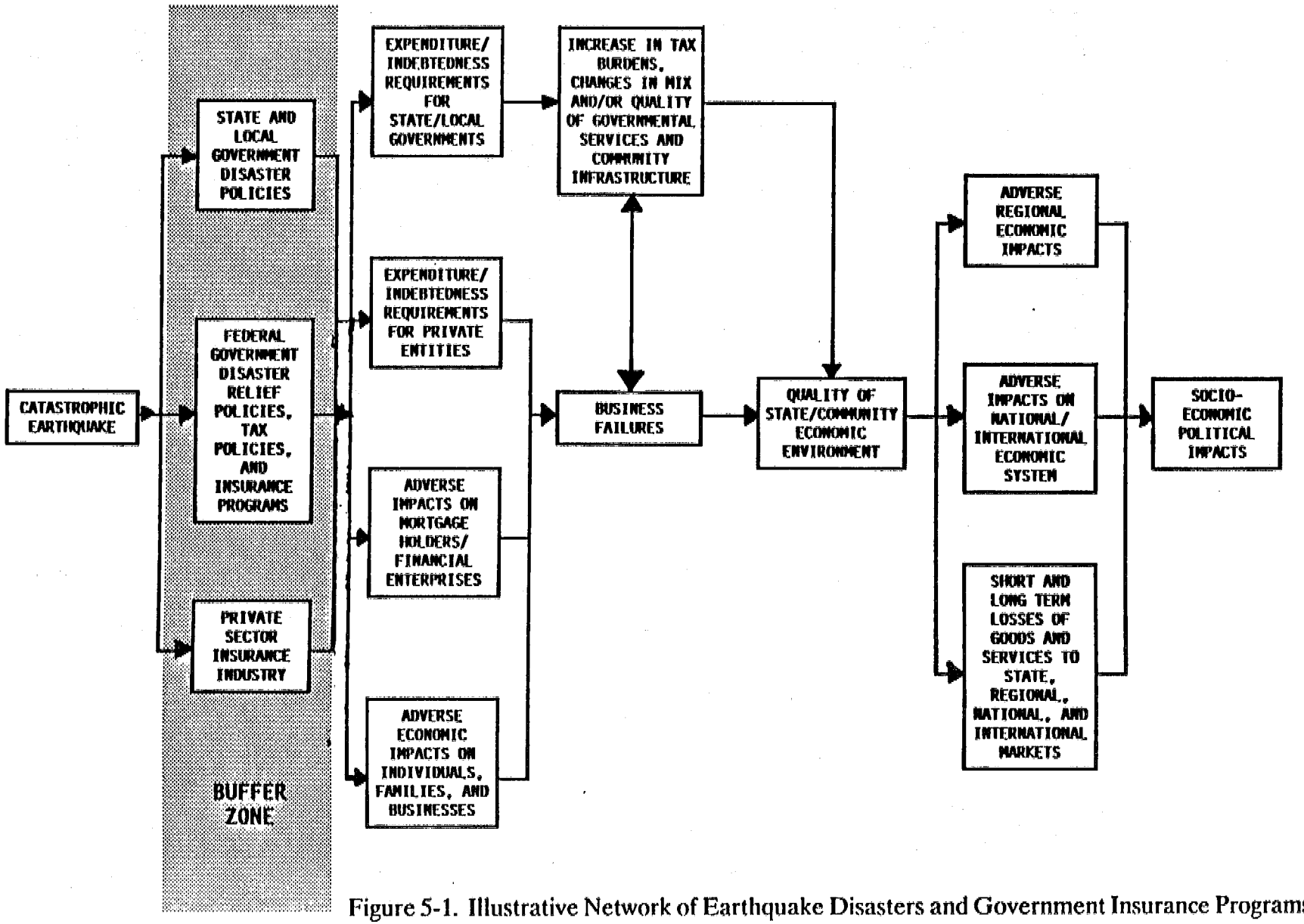

Figure 5-1. Illustrative Network of Earthquake Disasters and Government Insurance Programs

achieve LRMs through improved landuse and building practices and may provide insurance or disaster relief. Depending on the aggregate insurance coverage provided and disaster relief allowed, there will be inversely corresponding effects on the socio-political-economic system.

If there is insufficient insurance coverage and/or limited disaster relief, then the economy will be adversely impacted. State and local governments, private entities, financial institutions, or individuals may suffer severe primary losses, which in turn lead to business failures and long-term losses of goods and services throughout the system. Through a domino or ripple effect, secondary or higher order losses may equal or exceed primary losses.

It is common to think of insurance as a transfer mechanism which shifts risk from one party to another and of LRMs as a mechanism to reduce the risk to both the insured and the insurer. In the case of catastrophic disasters, insurance has the additional role of reducing the risk of financial crisis or collapse throughout the United States, because it reduces adverse primary impacts and thus buffers the system against secondary disruptions.

Possible Roles

There are at least **three roles** which the federal government could play in an earthquake insurance program. The first role is that of a **primary** insurer providing first-loss coverage through a government insurance policy. In Figure 5-2, this function is represented by box 4. This role could be accomplished in a manner similar to the National Flood Insurance Program or may take an alternative form. When the federal government works in cooperation with the private insurance industry (Figure 5-2, box 5) to issue policies and collect premiums, the linkage between the two entities is strong.

The second role which could be taken by the federal government is as a **reinsurer**, providing insurance coverage to the industry who compose the primary insurers (Figure 5-2, box 7). Again, the alliance of federal and private insurance shown in boxes 8 and 9 represents the combined effect of providing insurance coverage.

The third role would be for the federal government to provide a **combination of primary insurance and reinsurance**. How extensive federal involvement might be would be determined after evaluating the capabilities of private insurers and the necessary amount of insurance needed to protect against severe socio-political-economic impacts.

In the case of public and private nonprofit properties currently covered by the Stafford Act, the federal government currently can be perceived as being a co-insurer with the state government and private nonprofit organizations when a Presidential disaster declaration is

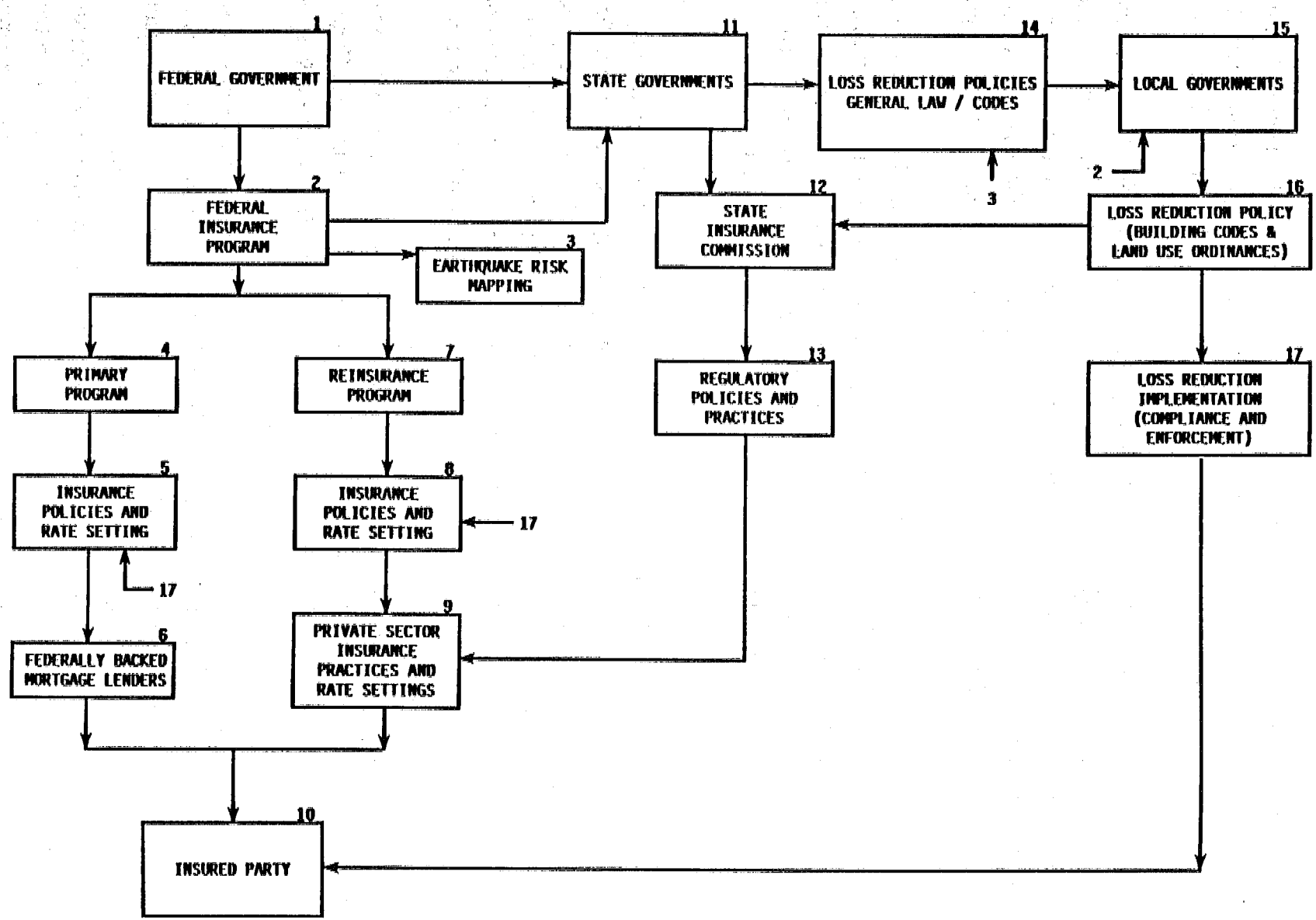

Figure 5-2. Intergovernmental-Insurance System

made. In Figure 5-1, this relationship is identified by the line connecting the federal and state boxes in the buffer zone.

In addition to providing insurance, federal involvement in requiring the implementation of LRMs would provide a means of risk reduction and thereby buffer adverse impacts in the society. While it has been demonstrated earlier in this report (Sections 3 and 4) that LRMs may be cost-effective and reduce risk, the enforcement of LRMs by local communities is not simple to achieve.

Complexity of the Relationship between Federal, State and Local Governments and the Insurance System

In order to view the role of federal insurance and LRM implementation from the proper perspective, it is important to understand the complex relationship between an intergovernmental regulatory system and an insurance market system. (See Figure 5-2.) The **intergovernmental regulatory system** is grounded in politics, and its purpose is ultimately to produce rules, regulations, and ordinances which benefit society -- in this case those mechanisms that reduce the risk of loss of property to earthquakes.

The intergovernmental aspects of this system are based on a constitutional form of government in which the federal government adopts laws that transcend state rule where most rights, including generally landuse and the development and construction of property, are guaranteed. Therefore, in its hierarchical relationship with states, the federal government may mandate rules or laws which are consistent with the constitutional system or may provide incentives to the states and/or local governments through the use of such instruments as grants-in-aid, loans, and sanctions, such as withholding or other forms of federal financial assistance.

Local governments, however, function at the pleasure of the states; therefore, the states may directly mandate that local governments engage in certain regulatory activities, or the states may pass through a federal requirement. The states may also provide incentives (such as cost-sharing) to accomplish the adoption and implementation of certain loss-reduction measures. It is important to note that the states can act directly without federal prompting. (E.g., in the case of California, the state legislature enacted the Field Act which gave the state authority over the design and construction of schools.) In spite of this ability of the state to require mitigation, as illustrated in Figure 5-2, **local governments retain, for the vast majority of buildings, primary responsibility for the adoption and implementation of loss-reduction measures for earthquakes by insuring compliance and enforcement.**

With respect to the **insurance market**, should the federal government decide to engage in the business of providing insurance, it may take on the role of a primary insurer or the role of a reinsurer. In either role, the federal government would be participating in the insurance market system, and thus would be working in cooperation with the insurance industry. In the case where the federal government provides primary insurance, it would have full control over the requiring of LRMs and the setting of rates.

In the case of reinsurance, the federal government would set rates for the sale of reinsurance to private sector companies, and those rates would be passed through to the insured parties. The federal government's relationship with reinsured parties would be largely contractual. The primary contractual relationships would be between the federal government and insurance companies, on the one hand, and the insurance companies and the insured parties, on the other hand. Effecting the implementation of LRMs through a reinsurance program would be more difficult, since federal relationships with state and local governments and with the insured are less direct than in a primary program.

In order to achieve the implementation of loss-reduction measures through the reinsurance program, the federal government would have to either mandate action or provide incentives to the states such that appropriate LRMs are adopted and implemented at the local level and then require that insured parties comply with the LRMs as implemented by local government. This compliance can be either mandated by the federal government through its ability to withhold insurance coverage or encouraged through an insurance rate-setting structure.

In effect, implementation of loss-reduction measures through an insurance program would be accomplished at the state level through a regulatory process on the part of the state through its insurance commission. The insurance commissioner of each state operates under the rules of the state, but establishes the specific set of regulations which govern the operation of the private sector insurance companies within the state. Therefore, the federal government could provide incentives to the state to require the private sector insurance industry to comply with incorporating loss-reduction requirements into the insurance market system.

In summary, it is important to understand that **the incorporation of loss-reduction measures in a national insurance program requires integration of a complex intergovernmental political system with an equally complex governmental insurance and market system.** The federal government has the ability to withhold insurance and to use the rate structure to enforce the adoption of certain LRMs; however, should local governments and/or states

refuse to comply, the whole notion of having a federal insurance program to reduce the risk to the economic system of the United States fails. As a result, the federal government must work in both directions; it needs to work through the intergovernmental system as well as through the insurance market system to achieve the ends of incorporating loss-reduction measures which reduce the risk of loss and also providing insurance which reduces the risk of severe economic downturn in the event of a catastrophic earthquake. Thus, the federal government can and must use direct and indirect measures to achieve the adoption and enforcement of LRMs by local governments in high risk earthquake zones. This is a complex task, reflecting the characteristics of the political structure that we live and operate under.

Additional Challenges to Insurance and LRM Implementation

To achieve local compliance and establish a workable system, it is important initially that the adoption of loss-reduction measures be broadly accepted as necessary and desirable and as relatively noncontroversial. Even LRMs such as the requirement that minimum building codes be implemented within the various risk zones in the United States have met with strong challenges. Unfortunately, the challenges to incorporating LRMs involve additional issues and requirements which extend beyond these initial levels.

For adoption, compliance, and enforcement to take place there must exist sufficient constituency support, inside advocates, sufficient community resources, necessary technical skills, and jurisdictional acceptance (Alesch and Petak, 1986; Mittler, 1989; and Petak, 1984). In general, the smaller the jurisdiction, the greater the probability that one or more of these requirements will not be met (Mittler, 1989). In smaller communities, technical abilities are scarce, fiscal capacity is low, tax effort is minimal, data to make accurate decisions is limited and the resources to generate sufficient amounts of data is low, organized constituencies (political interest groups) are unlikely, and the political dynamics of the community would largely be conservative in approaching implementation of LRMs. When a community is uninformed it is unable to attack a problem knowledgably and find worthwhile solutions, so it uses this lack of information as an excuse for inaction.

With respect to landuse practices, it has historically been difficult for the federal government to engage in regulating activities. There have been numerous attempts under laws established by the Environmental Protection Agency and the NFIP to engage in activities seen by many as national landuse planning. Project participants expressed extremely diverse opinions on the success of these programs. For both building and landuse planning acts, some project participants have questioned whether or not the federal government has a legitimate role to play. (See our response in Section 5.2.) Thus, the application of broad

landuse control measures is controversial although we have some reasonably successful examples in the form of coastal zone management and floodplain and wetlands protection acts.

In the area of building codes, the United States operates with three generally accepted model codes which are applied in different regions of the country. They are not equal in their consideration of seismic design and construction. The seismic provisions for new buildings, prepared by the Building Seismic Safety Council under contract to FEMA, are gaining acceptance in BOCA and SBC as well as in ASCE standards.

Whatever the benefit to be gained by implementing earthquake-related damage-resistant measures in building construction and the rehabilitation of existing buildings and by the application of landuse measures, it must be large enough to be of significance in terms of the definition of catastrophe that we are concerned with when we talk about a national governmentally-sponsored insurance program. By our earlier discussion, we noted that the immediate aim of such a program is to protect the viability of the U.S. economic system in the event of a catastrophic earthquake. Therefore, at a federal level, catastrophe occurs when the state and local governments are unable to meet the demands brought about by the disaster event, in which case the U. S. economic system might be seriously harmed. The benefit, then, of LRMs is in reducing the consequences of that event and other events in terms of dollar loss.

In the very near term, the LRMs proposed here may not reduce the catastrophic loss potential enough to turn it into a noncatastrophe. LRMs are important because, in the long term, they may result in significantly reducing the probability of building collapse, mortality and morbidity and loss of personal property which could contribute significantly in terms of the ability to recover from a catastrophe, and they may assure that the level of potential losses associated with earthquakes does not increase significantly as the built environment changes and grows.

5.2 Status Quo Policy and its Implications for the Implementation of LRMs and the Purchase of Earthquake Insurance

In Section 1 we explained that current earthquake loss-prevention programs are fragmentary owing to the locus of control, various sources of building codes, lack of economies of scale (capital and skilled labor), the sporadic timing of earthquake policy development, insurance system considerations, the public "spillover" benefits of privately undertaken LRMs, and disaster relief system considerations. Specifically, we concluded that current federal and

state disaster relief policies, viewed here only from the narrow perspective of their implications for loss-prevention programs

- o create contingent federal liabilities in the event of a presidential declaration of disaster (see Appendix C),
- o create inequities in federal funding through these liabilities (see Petak and Atkisson, 1982), and
- o create strong financial disincentives for state and local governments to engage in pre-disaster earthquake loss-reduction projects for publicly owned buildings (see Appendix D).

In this subsection, we discuss the possible implementation of LRMs within the limitations of status quo programs. For purposes of this discussion, the status quo is viewed as a collection of policy instruments currently available to implement LRMs. We provide a brief discussion of the current role of lending institutions in requiring earthquake insurance purchase. We then emphasize current disaster relief assistance and hazard mitigation policy as defined in the 1988 Stafford Act. Appendix D supplements this section with an illustration of stakeholder considerations for seismic retrofit of public buildings.

The Role of Lenders in the Status Quo with Respect to LRMs and Insurance Purchase Requirements

Studies by Brown and Weston (1980) and by Brown and Gerhart (1989) concluded:

- o that the property/casualty insurance industry would not aggressively market earthquake insurance voluntarily;
- o that the industry could be induced to provide widespread protection against earthquake damage by mortgage-finance industry demands that security property be protected by earthquake insurance;
- o that legislatively imposed requirements for such coverage can be an effective stimulus as A.B. 2865 demonstrated in California [though as Brown and Schiller pointed out (1979), legislatively mandated coverage may be vulnerable to constitutional challenge];
- o and that inherent in the implementation of any scheme for inducing widespread earthquake insurance coverage were risks of antitrust violation, especially with respect to insurers, although under the guidance of qualified counsel such risks could be identified and circumvented.

In California, judicial intervention (the Garvey case, overturned on appeal) extending the doctrine of "concurrent causation" stimulated counteractive legislation (A.B. 2865) which required all property/casualty underwriters doing business in the state to make a one-

time offer to policyholders to sell them an earthquake endorsement. These offers resulted in a doubling, to about 20%, of California homeowners who were insured against earthquake. Arguably, the typical 10% deductible clause and the premium cost discouraged wider acceptance.

During the 1980s, there was general acceptance of the strong probability that a major earthquake would strike California within 20 to 30 years. The mortgage-finance industry's general response to any earthquake-related threat to the value of its security interest in mortgaged property was to ignore the prospect. Not even proximity to Alquist-Priolo "special studies zones" generated selectivity in evaluating loan applications.

The secondary mortgage-finance market, in those instances where it evidenced any concern, generally preferred direct purchase of portfolio protection to the alternative of requiring earthquake insurance as a condition of residential mortgage loans, even though such a requirement could have been imposed selectively, state by state, through a minor modification to standard-form Federal National Mortgage Administration (FNMA)/Federal Home Loan Mortgage Corporation loan documents. Loan originators, with a very few exceptions, ignored the opportunity to require earthquake coverage and registered strong opposition to tentative suggestions by FNMA that it might consider requiring primary lenders to include earthquake coverage for any loans assigned to the secondary market. Central to that resistance was the recognition that the cost of such additional insurance coverage could be a significant factor in the competition for borrower-customers in the absence of a demand universally imposed on all loan agreements. Since not all loans are sold into the secondary market, such universality could not be achieved. Geographical dispersion of security properties was also presumed to diminish portfolio risks of some but not all lenders, as was the incidence of wood frame shake-resistant residential structures.

In effect, within the status quo, lending institutions are not currently in a position to enforce LRMs. As suggested in Section 4, lenders would benefit from major program modifications that require LRMs and/or effect increased earthquake insurance purchase. Such program modifications would be needed for lending institutions to play a major role in implementing earthquake loss-reduction measures.

Implications of the Stafford Act for Loss Prevention

The Stafford Act offers a number of means to encourage and support loss-reduction efforts. Specifically, the Stafford Act

- requires that currently "applicable codes, specifications, and standards" be used in federally assisted repairs or replacements (sections 406 and 409),
- provides monies to support additional loss-prevention programs (section 404),
- strongly suggests that a loss-prevention element become a significant feature of pre-disaster earthquake planning (sections 404 and 409),
- may be interpreted to suggest that subsidies to state and local governments may be warranted to induce cost-effective LRMs for public buildings (see Appendix D), and
- conditionally requires earthquake insurance purchase for public and private nonprofit buildings repaired, restored, reconstructed, or replaced with the assistance of federal disaster relief funds (section 311).

Hence, for damaged public and private nonprofit buildings, seismic replacement and retrofit can be required given adequate current codes, specifications, and standards. In effecting LRMs in this context, it is important that adequate codes, specifications, and standards be defined. In addition, with state insurance regulator certification, insurance purchase can be required for repaired or replaced buildings so that a large share of the contingent Federal liabilities for these buildings can be transferred to state and local governments (FEMA, March 1989, p. 11639). Issues pertaining to the certification by the state insurance regulator have not been addressed in this project.

LRM Implementation within Status Quo Policy as Defined by the Stafford Act

The types of loss-reduction efforts referenced in the Stafford Act accord with the types of LRMs that we have been examining in this project. These types include

- structural hazard control or protection projects,
- construction activities that will result in protection from hazards,
- retrofitting of facilities,
- acquisition of hazardous properties or relocation of facilities to less hazardous sites,
- development of state or local mitigation standards (See for instance, supporting elements B3, B4, B5, in Table 4-4; supporting elements L7, L8, L9 in Table 4-2; loss-reduction measures in Tables 4-1 and 4-3.), and
- development of comprehensive hazard mitigation programs with implementation as an essential component. (FEMA, May, 1989)

The process of identifying, evaluating, prioritizing, and monitoring these risk-reduction measures, as suggested by the Stafford Act, may be encapsulated as follows (see FEMA, Sept. 1989, p. 37957; FEMA, March, 1989, pp. 11649-53; FEMA, May, 1989):

- Prior to the disaster, the state can develop a hazard mitigation plan, while the Federal government assists with model standards, codes, and specifications.

- After the disaster, the state evaluates the hazards and prepares a new hazard mitigation plan, updates the existing mitigation plan so that it identifies and prioritizes LRMs for the state, as primary grantee under section 404, and for potential subgrantees (restricted in the FEMA, May, 1989 memorandum to state agencies, municipalities, certain private nonprofit organizations, and Indian tribes).

- The federal government approves or declines project(s) and/or findings and/or makes suggestions as to the state hazard mitigation plan.

- Once the plan is approved, the state monitors implementation of LRMs after the plan.

Criteria for inclusion of LRMs in the state hazard mitigation plan include

- a cost-effectiveness test, which involves a 10 percent discount rate (FEMA, May, 1989, p. 14; OMB, 1972), and

- determination of "best fit" in overall state or governmental risk reduction plan, and/or

- determination that the consequences of not undertaking the LRM are severely detrimental, and/or

- determination that the LRMs have the greatest potential impact on reducing future disaster losses. (FEMA, May, 1989).

The overall linkage between section 404 of the Stafford Act and LRMs proposed in this project suggests clarification of two elements of section 404:

- the 10 percent standard for a discount rate to be used in determining "cost-effectiveness" and

- the legally allowable and politically feasible scope of the types of building usages to which section 404 can be applied.

If the 10 percent standard is used, and dominates all other criteria for identification and selection of LRMs, then many of the LRMs identified in Tables 4-3 and especially those in Table 4-1 will probably fail to be deemed "cost-effective." In this case, <u>as a rule</u>, only those LRMs passing Tier 1 criteria will likely be properly deemed "cost-effective". They include:

- use of geotechnical techniques to minimize severe liquefaction and/or subsidence hazards in seismic zone 4 for commercial and public developments, and large-scale residential tracts,

- retrofit of unbolted and/or poorly anchored wood-frame residences in seismic zone 4, and

- adoption of, compliance with, and enforcement of adequate seismic codes.

On a project-by-project basis, a number of other LRMs, such as anchoring/securing critical equipment in specific buildings, may be found to be cost-effective. If, however, the 10 percent rule is one of the criteria to be weighed, and life-safety and long-term disaster reduction considerations are given significant weight, then Tables 4-1 through 4-4 are helpful in considering LRMs to be used along with their supporting elements.

If the scope of facilities covered under section 404 is deemed to be the same as the scope of facilities covered under section 406, then only those LRMs apply that pertain to publicly owned (and in special cases, private nonprofit) buildings. These include applicable portions of all landuse LRMs in Table 4-1 and applicable portions of B1, B2, B4, B5, B6 and B7 in Table 4-3, along with requisite supporting elements.

Obstacles to Implementation within the Framework of the Status Quo

We have interpreted the Stafford Act as implying that:

- Hazard mitigation planning processes, both before and after earthquake disasters, can be augmented to include cost-effective LRMs and/or earthquake ordinances (and also supporting elements as defined in Section 4).
- Federal funding assistance for repair or replacement of damaged public and selected private nonprofit buildings can include monies that recipients can use to meet current seismic standards.
- There is an urgency to define standards and measures for seismic repair of existing buildings as a basis for clarifying "applicable codes, specifications, and standards" to be used in federally assisted repairs.
- Monies may be provided for developing risk-reduction programs after an earthquake. The earthquake ordinances proposed in Section 4 suggest general LRMs for the implementation of such programs.
- Projects federally financed for repairs should be required to purchase earthquake insurance.

In effect, the 1988 Stafford Act modified previous disaster relief programs to encourage loss-reduction activities in post-earthquake circumstances. Pre-earthquake hazard mitigation planning should now benefit from the expertise of those in earthquake building and landuse disciplines. Hazard mitigation policies and programs developed after earthquakes should reflect loss-reduction elements such as those defined in Section 4.

In spite of these positive implications of the Stafford Act, because the federal government pays at least 75 percent of the cost of post-earthquake recovery, federal disaster relief inherently discourages property loss-reduction programs for state and local and selected

private nonprofit buildings. As previous sections and many project participants have affirmed, the minimum 75 percent recipient cost share remains a formidable obstacle to the implementation of LRMs for public buildings not yet affected by an earthquake disaster (see Appendix D). With the post-disaster orientation of current policies, risk managers of public and selected private nonprofit buildings have in effect free "coinsurance" policies (with the Federal Treasury serving as a retrocessional reserve fund -- one paid by future taxpayers after the damage has occurred). Yet cost-effective LRMs for public and private nonprofit buildings benefit the public in a great many ways. Lives can be saved, injuries can be reduced, and governmental and educational downtime can be minimized. Public buildings could serve as models for seismic design rather than as examples of poor construction and ill-considered retrofit. This general approach is consistent with Executive Order 12699 of January 5, 1990, which applies similar reasoning to all new construction of buildings to be leased for federal uses or purchased or constructed with federal funding assistance.

From a general liability standpoint, the federal government has a clear interest in state and local programs that affect potential earthquake losses, including those pertaining to development, adoption, and implementation of seismic loss-reduction measures, including landuse and building practices. These controls were constructed in the federal system owing to genuine needs at state and local levels for federal disaster assistance. We must conclude that current federal controls over earthquake losses are inadequate relative to contingent federal liabilities incurred. This suggests that stronger (i.e., commensurate) controls are needed over these federal liabilities, whether they be through subsidies, altered tax deduction policies, or federal earthquake insurance involvement.

Summary

Section 406 of the Stafford Act may serve as a useful hazard reduction tool for publicly owned and private nonprofit buildings damaged by an earthquake in a Presidentially declared disaster. Continuing development of standards, specifications, and codes, especially for buildings and sites in seismic zones 3 and 4 for retrofits, and seismic zones 2 and 3 for new construction, are essential to sound public policy. The requirement in section 311 of state insurance regulator certification for earthquake insurance availability, adequacy, and necessity greatly qualifies possible assistance in relieving federal liabilities for these damaged buildings, once they are retrofitted, relocated, or replaced in accordance with adequate standards. Earthquake insurance purchase can limit future disaster assistance to portions of the population who are not or should not have been insured.

Section 404 promises to encourage earthquake risk reduction efforts, especially if life-safety and other community criteria are weighed heavily and public programs to assist residential/commercial/industrial loss-reduction measures are encouraged or allowed. However, in the face of funding restrictions after a major disaster, and in face of pressures to confine loss-reduction projects to public buildings and selected private nonprofit buildings, section 404 may in practice be more restrictive and require considerable judgment. LRMs proposed in Tables 4-1 and 4-3 serve as useful guides to community-based programs and LRMs that passed at Tier 1 suggest the sorts of projects that will likely be cost-effective.

The Stafford Act also modifies the way in which pre-disaster planning can and should occur. Pre-disaster planning should now contain a very strong loss-prevention element so that post-disaster recovery activities can benefit from this element. Otherwise, post-disaster implementation of section 404 will have the extreme disadvantage of requiring hasty reports which are not supported by prior activities. (See Spangle, 1987.) Tables 4-1 through 4-4 provide guidelines for activities that should be undertaken prior to disasters. Monies currently earmarked under the Stafford Act for pre-disaster planning appear to be inadequate for the professional labor required to engage in loss-prevention planning and execution. Moreover, since this planning and execution requires consideration of many stakeholders, relative autonomy of functions from existing agencies may be needed so that monies used for loss-prevention are not spent on other activities, or overwhelmed by the powers of other state and local agencies.

The presence of a large federal cost share for public and nonprofit buildings damaged by disasters has many implications. For example, even with the Stafford Act, federal controls over loss-prevention activities are not commensurate with potential federal liabilities incurred. These potential liabilities apply not only to public and selected private nonprofit buildings but to homeowners, small businesses (through the SBA loan program), and to mortgages generally (through federally backed mortgage programs). Liabilities with respect to health, life, safety, and environmental matters also exist. As a consequence of these existing potential liabilities, the federal government has a clear interest in such activities as

- the state and local governmental adoption of, enforcement of, and compliance with building codes,
- life, safety, and welfare issues,
- mortgage-default issues, and
- low-income housing issues.

Unfortunately, current federal disaster assistance policy tools provide inadequate means to achieve broad scale implementation of LRMs because they are mandated only in localities declared federal disaster areas by the President. Instead of being proactive and supporting the implementation of LRMs prior to earthquake events, the current disaster policy is reactive and triggered by unusual events. The Stafford Act, therefore, is not by itself a policy that is capable of preparing the entire United States for a catastrophic earthquake.

The principal goal of current disaster policy is to ensure that economic stability be restored in the affected disaster region. While necessary to support recovery efforts, the current policy has no provisions to address primary and secondary effects in areas other than Presidentially declared disaster areas. Thus, by itself, current policy is insufficient to deal with the full impacts of single disasters.

As currently written, the Stafford Act mandates that communities affected by disasters employ loss-reduction measures to reduce the risk from future disasters. These measures are not standardized; they are location-specific. In addition, they are politically negotiated by state and federal officials rather than designed by mitigation specialists, and then they are amassed in a Hazard Mitigation Plan early in the recovery process rather than well-formulated prior to the disaster.

In order to protect the United States from a catastrophic earthquake, the current disaster policy is clearly insufficient. What is needed is a mechanism which prepares the country for disasters and guarantees that excessive loss of life and injury and severe economic downturn are avoided.

Because federal controls over these existing concerns are not commensurate with liabilities potentially incurred, significant program alterations could be made in order to strengthen these controls. In Sections 5.3 and 5.4 we shall examine how major program interventions involving federal earthquake insurance may augment these controls. However, at present and barring significant federal legislation to augment these controls (such as through altered taxation deduction policy), **we suggest that a program of federal subsidies to public and selected private nonprofit entities, including universities, be initiated to undertake cost-effective LRMs as a means to reduce these potential federal statutory liabilities.**

5.3 Insurance Rates and Loss-Reduction Measures

Before considering how LRMs might be incorporated into the two major types of federal earthquake insurance program constructs (primary or secondary insurance), we must look at one major incorporation issue -- how the rate structure of any earthquake insurance program will affect the implementation of such LRMs as those proposed in this report. The

compatibility of the LRMs proposed here with federal earthquake insurance involvement may largely depend on how rates are differentiated on the basis of such key factors as seismic hazards and building vulnerabilities. Consistent with the use of partially risk-based rates as a public policy instrument would be the decision to permit federal earthquake insurance for all properties on the condition that cost-effective LRMs be undertaken. Hence, a major issue facing the administration of a federal earthquake insurance program will be the degree to which the rate structure supports and sustains cost-effective LRMs. Considerations of how this major issue fits into primary and secondary federal earthquake insurance involvements are discussed in Sections 5.4 and 5.5.

In a review of the fifteen LRMs proposed, one finds the following factors emphasized:

- seismic zone designations (0, 1, 2, 3, and 4), with special emphasis on higher risk zones,
- current model seismic codes as indicators of building performance in earthquakes,
- potentially hazardous buildings in seismic zone 4,
- one- and two-family wood frame dwellings in seismic zones 3 and especially 4, and
- severe liquefaction, landslide, subsidence, surface fault zones, and high shaking amplification sites in seismic zones 3 and 4.

Because this report emphasizes community-based LRMs, these factors are not rare. (See Section 3.2.) These factors do not as a result reflect the full range of scientific and engineering considerations that **could** be examined in an **extremely thorough** seismic analysis of an individual building. As indicated in Eguchi et al. (1989), costs of very detailed investigations have rapidly diminishing returns with respect to rate development for all but very expensive properties, properties with large numbers of occupants, very high potential business interruption costs, or critical community functions. As a consequence, **a fully risk-based rating system -- one that satisfies the highest level of scientific and engineering precision and thoroughness available for all buildings -- would be prohibitive in cost**. The partially risk-based rating system implied in this report lies between the two extremes -- a fully risk-based system with cost-prohibitive underwriting expenses and a flat or relatively flat rating system with extremely low underwriting costs. Only the above factors are of concern in the partially risk-based system recommended.

For this reason, we shall speak of various partially risk-based rating systems -- as opposed to flat rates. Rates may be flat relative to some factors but not to others, and the factors of interest in this report are those reflected in the LRMs proposed.

There are several important reasons for considering some risk factors in the rating structure. Summarily, these reasons are that:

1. For the most cost-effective LRMs, all other things being equal, actuarially risk-based rates are adequate economic inducements for undertaking the LRMs.

2. Even if all things are not equal, flat rates with respect to parameters reflected in LRMs can be counterproductive to efforts to implement these LRMs.

3. In at least some cases costs of incorporating partially risk based rates are characteristic of current prudent underwriting.

4. In a federal earthquake insurance involvement severe administrative problems can be avoided if mapping for LRMs converges as much as is feasible with mapping for insurance rates.

The following discussion illustrates the first three reasons with respect to the very simple building parameters ("highly damageable" versus other) and seismic zones parameters (especially seismic zone 4) reflected in the building practice LRMs. The fourth reason has been discussed already in Section 2.

Economic Inducements

The economic inducement for implementing LRMs can be seen first in the wide variations of risk levels and rates reflected in some current rating systems and secondly as reflected in our socioeconomic analysis of the LRMs themselves. The fact that rates currently are not perceived as providing incentives to LRMs reflects primarily the extreme business cycles that earthquake insurance undergoes (as discussed in Section 1.2 and in Cheney and Whiteman, 1987). During soft markets, actual rates may be extremely competitive. As the market hardens, rate increases may occur even for parties who undertake LRMs. The hardened market -- resulting from limited reinsurance availability and higher reinsurance prices -- makes rates even less sensitive to LRMs undertaken.

For commercial structures no dispute exists over the wide variations in earthquake insurance rates currently applied to diverse building vulnerability classes. According to Steinbrugge (1982, p. 372), rates across building classes vary more than tenfold. (Rates for class 1C and 2A buildings are approximately 10 percent of rates for class 5C buildings.) Rates across residential building classes vary to a slightly lesser extent. To indicate the significant spread of risk among various building categories (all other factors being equal), we

have developed an analysis described in the footnote below.[1] Appendix B contains adequate materials for a preliminary actuarial analysis of potential rate differentials, as illustrated in Appendix C and also with finer detail in terms of general procedures outlined in the footnote below.

For **residential construction**, our socioeconomic analysis suggests that there is sufficient spread of risk for differentiation of rates by class of construction -- especially in higher seismic zones. Use of the best class of construction as a means of determining rates would imply a subsidy situation for those types of structures expected to contribute significantly to expected future losses. In some cases, cost-effective retrofits for these structures are available.

Risk-Based Rates as Incentives

Given the extreme differences in risks for various building classes, differences sufficient to make LRMs cost-effective, then all other things being equal, actuarially sound rates are sufficient economic inducements for undertaking LRMs. With actuarially sound rates, the difference in risks between the status quo and the implementation of the LRM is magnified in rates through the use of a loading factor. This loading factor, a multiplier, represents minimal administrative costs including overhead marketing, claims adjustment, underwriting costs and fees, if any, plus costs to cover catastrophic factors (see Section 2). Since costs for

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1. For residential construction and for illustrative purposes, we have modified SEISRISK-III (Bender and Perkins, 1987) in order to provide comparative annualized average loss for various types of residential construction. A composite attenuation function developed by N. Donovan was used along with soil factors derived from Evernden (1985) and with intensity conversion factors derived from Trifunac (1976). Residential loss algorithms used in this project are summarized in Appendix B of this report. Of chief interest are those average annual losses derived for

- unanchored and unreinforced wood frame dwellings,
- anchored and reinforced wood frame dwellings,
- low-rise unreinforced masonry dwellings, and
- residential construction without specific seismic design (seismic zone 0 or 1)

We find that throughout California, average annual losses for unanchored and unreinforced dwellings exceed those for anchored and reinforced dwellings by a factor of almost three. Average annual losses for unreinforced masonry units exceed those for anchored and reinforced wood frame dwellings by a factor of approximately seven. Using Wiggins' (1986) algorithms, we find that average annual losses for residential construction with no special seismic design exceed those for residential construction designed to UBC seismic code 3 standards by a factor of almost five. These findings do not reflect differences in strong ground motions throughout California.

LRMs are unaffected by rates, then the benefits of undertaking the LRM are multiplied by this factor if these benefits are reflected in rate differentials. In other words, if the present value of the future stream of expected benefits is B, then the present value of the future stream of expected premium reductions is L x B, in which L is the loading factor exceeding unity. So, if the benefits (B) exceed the costs (C), then the premium reductions (i.e., L x B) in a risk-based system exceed the costs by an even greater margin. Hence, LRMs considered cost-effective without respect to rate differentials prove to be even more cost-effective if rates are suitably risk-based.

The above reasons apply only if "all other things are equal." As already indicated, earthquake insurance markets currently do not have sufficiently stable prices for owners to discern clearly that undertaking LRMs results in rate reductions. Also, as indicated in our socioeconomic analyses of state and local buildings, where much of the risk is assumed by the federal taxpayer, risks may be "externalized" and thus do not serve as an incentive to implementing LRMs. (See Appendix D.) Furthermore, not all benefits of LRMs accrue to building owners. Some benefits, for instance, may accrue to building tenants through resulting increased life-safety protection and less chance of prolonged business interruption losses. Other benefits, for instance, may accrue to lending institutions, through reduced likelihood of losses resulting from default. These "spillover" effects, or benefits to others, will not necessarily be reflected in actuarially sound partially risk-based rates. Another reason why partially risk-based rates do not always induce LRMs is that people do not always behave in economically rational ways, even if they have pertinent information and can interpret it correctly.

Flat Rates as Disincentives

Our second reason for strong consideration of partially risk-based rates is that even if these rates do not in all cases induce LRMs, flat rates will serve as disincentives to the implementation of LRMs, even for new developments. Flat rates provide potentially subsidized economic protection against earthquake damage. For instance, if rates are flat in California, then owners in a lower seismic zone will be subsidizing owners in high liquefaction and landslide susceptible sites along the coast and in higher seismic zones. Likewise, owners of buildings designed to current adequate code standards will be subsidizing owners of buildings that are highly damageable. In effect, flat rates would provide financial protection against earthquake-related damage whether or not seismically-responsible landuse and building practices were employed.

In a voluntary earthquake insurance program using flat rates, numerous cases of moral hazard may result. Owners of highly damageable properties, knowing that rates are subsidized, will insure; owners knowing that their rates subsidize risks assumed by others will refuse to insure. Moreover, given the protection of earthquake rates subsidized by others, those with higher risks will not be economically induced to reduce those risks. Whatever motivations exist for individuals, firms, municipalities, and states to undertake LRMs, they will not include rate reductions, and the presence of subsidized earthquake insurance will serve as a disincentive to reducing expected property damage. Benefit-cost ratios for LRMs that are otherwise favorable may become unfavorable given insurance protection provided by flat rates. (See Appendix D.)

Current Underwriting Practice

The third reason supporting the contention that partially risk-based insurance premiums are to be strongly considered is that risk-based rates are characteristic of prudent underwriting practice. Continuing the current practice of many earthquake insurers, these rates would reflect

- o seismic zone designations (or, in other terms, macroseismicity estimates of earthquake sources, their rates of seismicity and attenuation functions), and
- o building vulnerability categories (here, with a minimum distinction between highly damageable commercial and residential construction on the one hand and other construction on the other hand).

To a lesser extent some insurers currently consider

- o high site amplification, liquefaction, landslide, subsidence, and fault zones.

The feasibility of including such site hazards into earthquake insurance considerations is currently being examined in conjunction with studies under California legislation SB1885.

Additionally, the cost of differentiating structures into broad-based categories is not necessarily so great as may be presumed. Inspectors at time of sale may be able to determine whether or not dwellings are bolted to their foundations. Age of structure and type of exterior construction may also serve as proxies for rating categories. Sampling techniques can be used to assess the quality of data derived from telephone calls and other data sources. Prudent insurers writing both residential and commercial structures currently include such considerations in their underwriting practices. These considerations are important to them in order to control losses from their insured exposures. Moreover, rate credits can be con-

sidered for owners who prove, contrary to prima facie ratings, that their structures are not higher risks.

Current underwriting practice reflects both information costs and private insurance market competition costs. From a business standpoint, insurers need rate differentials at least in order to assure that lesser risks do not purchase insurance elsewhere. Insurers with fairly flat rates might be faced with worse risks at rates which do not adequately cover these risks. However, a governmental insurance program, especially if primary and mandated, may avoid such problems of adverse selection because both low and high risks are included. Also to be considered are governmental objectives including providing affordable insurance both in the short- and long-term and decreasing risks to property, persons, and financial and institutional entities. In such a monopolistic setting, where normal competitive business considerations do not apply, underwriting costs of partially risk-based rates may be erroneously conceived as additional administrative burdens -- resulting in higher overall rates -- rather than as means to achieve primary program objectives, including loss-reduction and resulting long-term reductions in rates. These considerations show that, in a fuller study of federal earthquake insurance issues, the objectives of a governmental insurance involvement need to be considered, especially if competitive market concerns are largely or fully removed.

Conclusions

In summary, administration of a federal earthquake insurance involvement will require strong consideration of the types of rates involved, and how they affect such LRMs as those proposed in this report. We maintain that a partially risk-based insurance rate-setting system, sensitive to regional seismic strong motion hazards, and, in higher seismic zones (especially 3 and 4) to differences in building vulnerabilities and site conditions is one of two major vehicles (the other being earthquake ordinances) for incorporating LRMs into a federal earthquake insurance program. To the extent that rates do not reflect the diverse types of risks reflected in the fifteen LRMs proposed here, rates will be counterproductive to the implementation of those LRMs. Perfectly flat rates -- as an extreme example -- would undercut economic arguments for undertaking LRMs, since insurance could protect economic investments in high-risk properties at rates that were subsidized by those with lower risks.

Even if partially risk-based rates do not induce LRMs, they provide at least some incentive for mitigation. For instance, if it costs $2,000 to bolt a dwelling to the foundation, then a homeowner has some incentive to mitigate if the premium is thereby reduced by over one hundred dollars a year. But, the homeowner has little or no economic incentive to do so if

premiums are the same whether or not dwellings are bolted to their foundations. In fact, flat rates could be used as a reason to oppose any public policy measures that encourage very cost-effective property loss-reduction measures, including code compliance and retrofitting. Thus, in the administration of a federal earthquake insurance involvement, one significant consideration will be the degree to which the rating system supports and sustains the LRMs proposed here.

These reasons thus provide extremely powerful considerations for partially risk-based rates in order to incorporate LRMs into a federal earthquake insurance program. The administrative ease of having partially risk-based rating maps that coincide with LRM maps greatly contrasts to the administrative difficulties of extreme differences between these rating and LRM maps. This project supports only modest underwriting costs to incorporate partially risk-based rates. The misconception that the costs for developing risk-based rates will be a burden on a primary mandated (i.e., monopolistic) federal earthquake insurance program needs to be further examined in a fuller study addressing the feasibility and program objectives of federal earthquake insurance. In estimating the cost-effectiveness of a federal earthquake insurance involvement, benefits of loss-reduction must also be included.

5.4 Loss-Reduction Measures in a Primary Federal Earthquake Insurance Program

This subsection includes a general discussion of those aspects of a primary insurance program that are pertinent to LRMs. We deal principally with logical features of a primary program and in no way define precise details of that program.

Potentially Increased Federal Liabilities and Rate Considerations

If the federal government undertakes a primary earthquake insurance program with respect to some or all classes of private owners and tenants, potential short-term federal liabilities will be increased. **To offset both short- and long-term potential liabilities,** premium payments could be used to develop a pre-disaster reserve fund. Also, programs that induce loss reduction (as for public and selected nonprofit buildings) could potentially reduce these liabilities. Deductibles may be increased or limits of liability may be decreased. For instance, if there is strong desire for low deductible levels, then premiums must be increased, or some other mechanism (e.g., subsidies) must be employed to cover potential increased federal liabilities.

General mechanisms for **decreasing earthquake insurance rates** (i.e., making them more affordable) without increasing deductible levels and without adversely affecting LRMs can include

- o long-term and uniform implementation of adequate seismic building standards,
- o long-term and uniform implementation of adequate seismic landuse and geotechnical standards and criteria,
- o developing greater geographic distribution of insured properties, and
- o pooling perils.

These mechanisms suggest

- o the long-term desirability of inducing uniform and adequate seismic construction and landuse planning/geotechnical standards and criteria,
- o the desirability of strong inducements and/or requirements to assume greater geographic spread of seismic risks, and
- o the desirability (if feasible) of integrating perils and, to the extent politically acceptable, of cross-subsidizing among perils and among geographic regions for earthquake.

Providing very affordable rates (i.e., low premiums, low deductibles, high limits of liability) is initially an attractive inducement for voluntarily assuring geographic distribution of earthquake insurance purchase. To do so, however, a program may have to be subsidized in the event of earthquake losses <u>except with respect to buildings for which contingent federal liabilities are already significant</u> (e.g., public and selected private nonprofit buildings).

In this report, we have not argued against subsidies in general, especially those that serve as investments in reducing future earthquake losses; however, subsidies for poor construction do not serve to reduce future losses and should be assumed with caution. (Early subsidized rates in the NFIP were heavily criticized as noted in Neil Fulton, 1984, Monday and Butler, 1984, and Kusler and Bloomgren, 1984.) As suggested in Section 5.3 (and with caveats for the various types of subsidy situations that can arise), providing lower rates for more damageable buildings and higher risk sites by subsidizing with rates from lower risks can be counterproductive to implementation of loss-reduction programs. Greater affordability in rates should be achieved through such risk diversification methods as pooling risks and encouraging geographic spread of coverage, which promote rather than hinder loss-reduction programs.

The apparent **tension between affordable rates and LRMs** is less dramatic than may be supposed. Nonetheless, the administrator of a primary federal earthquake insurance program will need to make difficult decisions regarding the degree to which the rate struc-

ture supports and sustains the LRMs proposed here. Even if rates are lowered in response to implementation of LRMs, they may not be perceived by consumers to be affordable, and for some low-income segments of the population, insurance purchase may be viewed as a financial hardship. As suggested in section 5.3, there will be a temptation in a non-competitive situation for administrators to reduce underwriting costs incurred in the private market setting, and so to discourage safe construction and landuse practices in order to reduce -- temporarily -- rates. The point here is that while many social, political, economic and legal considerations on rates charged may enter into administrative decisions, those decisions must not ignore the potentially deleterious effects of having lower risks subsidize higher risks, particularly those for which cost-effective LRMs are available. The administrative weaknesses of maintaining and applying radically diverse maps for LRMs and insurance rates further supports the contention that both maps should be risk-based.

General Linkages with the NFIP

Discussion of a definitive linkage between the NFIP and a primary earthquake insurance program lies beyond the scope of this project. However, the general logic and experience of the NFIP are useful in terms of implementing loss-control measures in a primary federal earthquake insurance program.

Major distinctions between flood insurance programs and potential earthquake programs derive from mapping considerations. Large-scale mapping of local areas forms the primary basis in the NFIP for flood plain management and rating programs. In contrast, macrozonation (e.g., seismic zones as illustrated in Figure 2-5) currently forms the basis for the most thoroughly developed earthquake loss-reduction programs, namely, those that deal with seismic code development, adoption, compliance, and enforcement. This distinction is reflected in the primary emphasis of this report on LRMs and rate development relative to those parameters of importance in the LRMs proposed: macrozones, seismic building vulnerability categories, and, in higher seismic hazard zones (3 and 4), local seismic hazards. Current evidence supporting the cost-effectiveness of landuse LRMs is significantly weaker than evidence supporting the cost-effectiveness of building design and construction LRMs. Hence, there is less emphasis in this project on the very large-scale maps (at scale larger than 1:24,000) that are characteristic of such detailed landuse efforts as in the NFIP.

Earthquake hazard microzonation may eventually evolve to take on a greater significance as applied and theoretical research improves our understanding of the geotechnical environment and ability to employ larger-scale mapping techniques cost-effectively. Structural engineering, geotechnical engineering, architecture, and other building construc-

tion advancements would be priorities along with risk analysis that emphasizes risk assessments and regional mapping rather than very large-scale mapping. These are the principal methods to achieving loss reduction which would be applied under a primary earthquake insurance program.

Nevertheless, the overall logic and experience of the NFIP provides a basis for understanding the sort of program that a primary federal earthquake insurance program could become and the various ways in which it may evolve. The basis for the national flood insurance program is an agreement between communities and the federal government that communities will adopt, comply with, and adequately enforce flood plain management ordinances. Noncompliance entails possible suspension from the program or rate surcharges. Participating communities who comply enable individuals or corporations whose insurable property is located within the community to purchase flood insurance. As support for this program, FEMA/FIA has mapped special flood hazard area zones at large scales and has gradually made rates less subsidized and more actuarially sound. Problems of noncompliance, although rare, have been recognized and are being addressed. (See FEMA/FIA, July 1989, p. 29668; FEMA, June 1989; and ISO, 1989.)

In the early years of the NFIP (1968-1973) even highly subsidized rates did not make flood insurance purchase attractive to property owners. Under the Flood Disaster Protection Act of 1973, purchase became required in special flood hazard zones for those property owners assisted by Federal programs or Federally supervised, regulated, or insured agencies or institutions. Hence, lending institutions were called on to require that flood insurance be purchased by their borrowers whose security consisted of building properties located in special flood hazard zones. Lenders may at their discretion require that flood insurance be purchased by borrowers with securities in properties located outside special flood hazard zones where to date approximately one-third of claims paid have occurred. Both residential and commercial property is included, but land values are not insured. (FEMA/FIA, July 1989).

The Coastal Barrier Resources Act, Public Law 97-348, prohibits the NFIP from providing flood insurance protection for structures built or substantially improved after October 1, 1968, in areas designated undeveloped coastal barriers. For these areas, as in other areas where flood insurance is unavailable, federally backed lenders may make conventional loans at their own discretion. FEMA/FIA has recognized problems of compliance of mortgage lending institutions with regulations, but continues to work on resolutions. Similar experience and progress has occurred with respect to defining limits of liability coverage -- a

problem that arose for residential condominiums initially treated as multi-unit residential buildings and more recently treated as single-family units (FEMA/FIA, July 1989).

Thus, the NFIP is working out the problems as they become apparent in the application of rules and regulations in the program. The agreement with local governments constitutes a voluntary means by which community-based standards can be implemented through local governments. Agreements with insurers in the Write-Your-Own (WYO) program suggest precedents whereby government-insurer relationships can be clarified, especially with respect to how insurers can act as agents for the federal government.

We did not assess whether or not voluntary community participation in a primary federal earthquake insurance program would provide adequate geographic spread of coverage to reduce rates significantly. However, if a primary earthquake insurance program were developed along these lines, then the LRMs proposed in Tables 4-1 and 4-3 would fit in well. Informally, these serve to define generally earthquake ordinances (earthquake resistant standards) analogous to flood plain management ordinances. So developed, earthquake LRMs have the advantage of being able to be incorporated directly into overall community programs. The ordinances as envisaged here primarily emphasize building loss-reduction practices. As microzonation practices evolve and possibly become incorporated into seismic building codes in the next decade or two, the linkage between landuse planning and building loss-reduction practices may become closer. As with the NFIP, a major federal role would involve developing earthquake insurance rates. This may eventually include very large-scale mapping, but initially would currently involve smaller scale regional mapping along with assessments of building vulnerabilities and regional seismicity. The community orientation of LRMs in Tables 4-1 and 4-3 fits well into a primary federal insurance program involving agreements between the federal government and local governments. The possibility of earthquake-induced flooding and mudslides, a topic excluded from consideration in this project, itself suggests linkages between the current NFIP and potential primary earthquake insurance involvements.

A contrasting primary program structure may be one in which the sole primary relationship is between the federal government and the insured. Such a program permits insurance companies to act as agents for federal insurance. In this type of primary earthquake insurance program, we shall assume as before that the federal government has a primary responsibility for rate-making. Since this type of program may require only an indirect relationship between the federal government and communities, no direct federal controls over LRM requirements are available. Thus, it is unlikely that LRMs will be initiated, unless they are induced by differential insurance rates or by insurance availability requirements.

A potentially expensive program, from an underwriting standpoint, would involve considerable federal guidance in determining rates for various communities so that rates would reflect risk. This would not entail federal-community agreements but could involve considerable efforts to rate buildings. One means to effect this rating system would be to presume that higher rates apply and to place the burden of proof on the buyer to substantiate any request for rate reductions/credits. A potentially less expensive alternative would be the generation of federal-community agreements acknowledging that earthquake risk-reduction ordinances (such LRMs defined in Tables 4-1 and 4-3) were in effect. These are potentially less expensive because uniformity of loss-reduction and underwriting standards could be assured.

Possible Extension of Provision (d) of Section 406 of the Stafford Act

One possible remedy for the inadequate tools currently available to control contingent federal liabilities lies in extending provision (d) of section 406 of the Stafford Act to include primary earthquake insurance. In effect, justified by the need to reduce current federal liabilities, one could require that public and selected private nonprofit buildings purchase earthquake insurance (at partially risk-based rates) as a condition of receipt of federal disaster assistance. Section 311 currently requires this earthquake insurance purchase only with state insurance regulator certification of availability, adequacy, and necessity. If this earthquake insurance purchase requirement were made conditional only on receipt of federal disaster assistance, provision (d) of section 406 then would indicate that noncompliance with insurance purchase entails that federal disaster relief is reduced by the amount of insurance proceeds that would otherwise have been covered by earthquake insurance.

This large step in a primary federal earthquake insurance program would need to be justified, as is done here, by reference to existing contingent federal liabilities and the inadequacy of current controls over these liabilities. State insurance regulators would need to be involved in discussions of such program changes. To buttress this program, we suggest as before possible federal subsidies for cost-effective seismic retrofits and other seismic program developments, including staffing assistance. Existing federal liabilities can be reduced through a program that specifically addresses potential cost-effective LRMs and supporting elements.

As Appendix D clarifies, sanctions are not the only effective means to encourage LRMs. Implementation of this program element may require additional staffing and training to assure that public and private nonprofit buildings are rated appropriately and that rate

credits are provided for suitable seismic mitigation activities. Extremely affordable rates may also be warranted but only for construction that satisfies programmatic guidance developed in Tables 4-1 and 4-3.

It is undecided here as to whether or not this extension should be part of the primary or the secondary federal earthquake insurance program. It is possible that the private insurance industry, regulated by state insurance commissions, could adequately rate these buildings and supply earthquake insurance given secondary federal insurance involvement.

Conclusions

This discussion has suggested the following general conclusions:

- Partially risk-based rates are desirable for the building usages covered in the primary program (and a strong prima facie case exists against rates for riskier buildings that are subsidized by other lesser risks -- unless undertaking LRMs is a condition for earthquake insurance purchase).

- Partially risk-based rates form a primary basis for a federal program in which insurance is provided directly to owners and tenants.

- In order to lower rates on an actuarial basis (whether through decreased premiums, decreased deductibles, or increased limits of liability), risk diversification is desirable, whether through geographic spread or through linkage with other perils (see Section 2.2).

- In order to minimize potential conflicts between LRMs proposed here and those federally supported elsewhere, and in order to use the experience of current primary federal insurance programs, there should be a linkage with the National Flood Insurance Program (NFIP). (This does not entail a single administration over the two programs, nor does it imply that the federal earthquake insurance structure should be modeled after the NFIP. However, this does entail using benefits of program experience, including legal experience, and examination of advantages and disadvantages of linking flood and earthquake perils, along with other perils, if any, for which there is market failure.)

- In the early stages of the NFIP, the subsidized rates for risky facilities were heavily criticized; and a strong case can be made that more damageable buildings and more hazardous sites for which cost-effective LRMs are possible should not be subsidized through lower rates in a federal earthquake insurance program having a loss-reduction element.

- If the primary program involves a direct optional agreement between communities and the federal government, then the LRMs proposed in Tables 4-1 and 4-3 can serve generally to define for local and state governments an "earthquake ordinance" (a set of earthquake-resistance standards) for participation in the primary program; Tables 4-2 and 4-4 define supporting elements (see caveats and additions in following discussion). Earthquake ordinances pertaining to building usages covered in the primary program

are compatible with a program involving federal agreements with state or local governments.

- If the primary program involves direct relationships between the federal government and local residents, and no agreement with the local government, then indirect means can be used to induce LRMs for public buildings, including
  - rate credits for buildings identified as not being potentially hazardous on the condition that LRMs for public buildings are implemented,
  - federal assistance to state and local LRM programs and projects, and
  - earthquake insurance purchase requirements for public and private nonprofit buildings.

- Given current contingent federal liabilities for private and nonprofit buildings, consideration should be given to extending provision (d) of section 406 of the Stafford Act (covering mandatory flood insurance purchase and commensurate decrease in federal post-disaster obligations with noncompliance) to incorporate earthquake as well as flood insurance considerations. (An analogous recommendation appears in French and Rudholm, 1990.)

Thus, a primary federal earthquake insurance program can serve as a strong policy tool to encourage LRMs for buildings covered under the program. However, a primary program by itself does not provide strong inducements for LRMs for buildings not covered. LRMs for public buildings may be induced by federal cost-sharing programs or by providing selected rate credits. Hence, inclusion of LRMs for public buildings can be justified with reference to existing contingent federal liabilities without regard to those additional liabilities incurred by federal earthquake insurance involvement.

In a primary federal earthquake program, then, an administrator has two basic possible tools for incorporating LRMs: partially risk-based rates and earthquake ordinances. An administrator may also justify LRMs for public buildings with respect to non-insurance-related existing contingent federal liabilities. Thus, it is clearly feasible to incorporate LRMs into a primary federal earthquake insurance program.

5.5 Loss-Reduction Measures in a Secondary Federal Earthquake Insurance Program

The preceding sections provide a general overview of how major federal program changes or additions can provide greater controls over LRMs. The need for greater controls over implementation of LRMs is supported by (a) existing contingent federal liabilities and (b) contingent federal liabilities that would be created under a primary program. More generally, it is in the ordinary interests of the federal government to be concerned with the national welfare, which includes the financial stability of institutions and the health and well-being of citizens.

As a consequence of existing federal liabilities, we have maintained that federal assistance for cost-effective LRMs may be suitable especially in those cases where these subsidies can help to reduce contingent federal liabilities. We have further maintained that risk-based premiums or premiums conditional on LRMs being undertaken may be desirable to support LRMs proposed in Section 4.

The challenge of incorporating LRMs into a secondary program, or a combined primary and/or secondary program, is enormous. In this subsection, we examine some features of such programs.

Key Relationships

Figure 5-3 provides a very schematic account of some key relationships within a secondary federal program. The figure is designed to address the critical question of how LRMs are to be enforced in a secondary earthquake insurance program. Key participants of interest are the federal government, insurers, the insured, state insurance regulators, lenders, and communities. We examine these various participants and their general relationships in order to understand how to incorporate LRMs into a secondary program.

Owing to the competitive nature of private financial institutions, we do not propose to use the leverage of lending institutions as a direct means to incorporate LRMs into a secondary program. As indicated in Section 5.2, federally-backed lending institutions may not be eager to require purchase of earthquake insurance. Although some lending institutions may be strongly supportive of implementation of LRMs, others may be less supportive. Hence, whereas lending institutions may be helpful in ensuring broader insurance purchases and in influencing the implementation of LRMs, we do not regard them as primary enforcers of LRMs. For similar reasons, we have not treated insurance companies as primary enforcers of LRMs even though they may lobby communities to achieve adequate or superior seismic standards. As a result of competitive pressures to avoid cases of adverse selection, private insurers may use partially risk-based rates based on available information on risks, and this may assist indirectly in encouraging LRMs. Nevertheless, business considerations including the desire for profitability will dictate the degree to which risk-based rates are used, and the practice will vary considerably among private insurers.

State insurance regulators are in a good position to begin requiring that insurance companies provide the federal government (and private reinsurers) with adequate information on which to base rates and to assess potential liabilities.

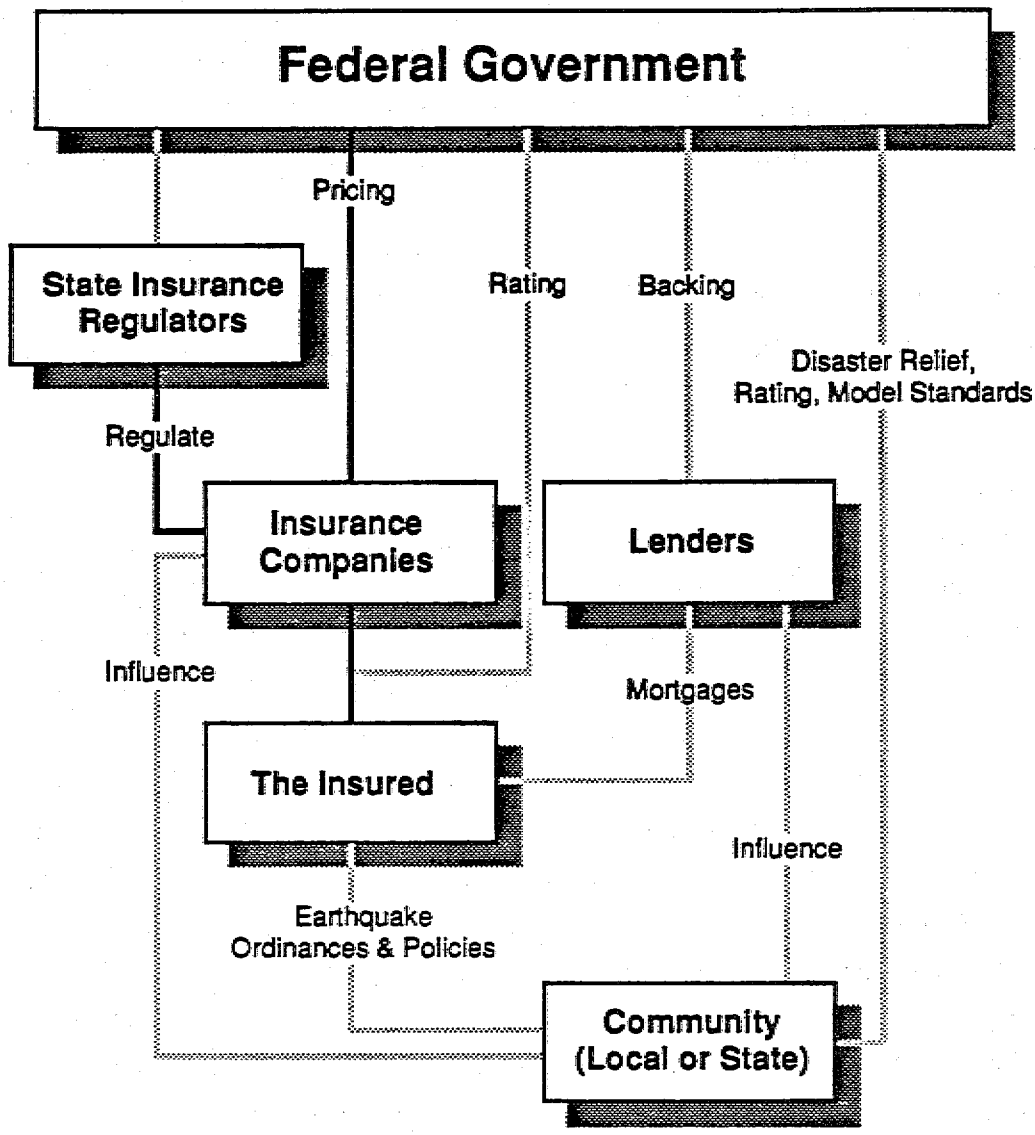

Figure 5-3. A Simplified Diagram of Probable and Possible Relationships in a Secondary Federal Insurance Program

(Shaded lines denote possible relationships.)

Pricing Mechanisms and LRMs

One way to effectuate partially risk-based rates in a secondary system is for the federal government to form cooperative relationships with state insurance regulators. Secondary earthquake insurance would be made available to various states conditional on state insurance regulator assurance that rates would be reflective of those seismic risk factors pertinent to the fifteen LRMs proposed here and discussed in Section 5.3. Hence, on this alternative, state insurance regulators would assume the responsibility for ensuring that rates are partially risk-based in the sense used throughout this project. We do not here elaborate on the pros and cons of this alternative, but merely mention it as one conceivable administrative avenue for making a secondary federal earthquake program insurance involvement compatible with the LRMs proposed.

The pricing mechanism for earthquake reinsurance is sufficiently complex and entrenched that it may require many years for this mechanism to be adjusted to ensure that LRMs are being incorporated through at least partially risk-based rates. Another administrative alternative for ensuring this incorporation would be to develop secondary prices to reflect primary risks. The justification for federal control over this secondary pricing lies in the liabilities potentially incurred by taxpayers if the federal government becomes a secondary earthquake insurer. In developing secondary prices, the administrator would need to require

- that insurance companies writing earthquake policies and desiring federal earthquake reinsurance provide exposure data as means to evaluate secondary prices, and
- that risk estimation methods such as those indicated in Section 2 (and in greater detail in Eguchi et al., 1989, and Taylor, Hayne, and Tillman, 1990) be used to develop prices for this reinsurance.

The first step would be extremely large since

(a) primary earthquake insurance portfolios may change on a day-to-day basis (so that standards for aggregating portfolio exposures would be needed);

(b) adequate exposure data, such as building structural vulnerability categories, currently are not always collected by primary insurers, especially when policies are written that cover a great many sites. Collection of these data may be regarded as a nuisance by many underwriters; and

(c) suitable analysis of these data, given private reinsurance arrangements, deductibles, and limits of liability, can be time-consuming unless simplified guidelines are provided that are nonetheless compatible with secondary pricing to reflect primary risks.

Hence, use of secondary pricing to reflect primary risks is an available tool, although difficult to implement, to assure that a secondary federal earthquake insurance involvement is compatible with the LRMs proposed here. In a fuller analysis of this second alternative, consideration should be given to the extent to which in a secondary earthquake insurance program there can be confidence that participating primary insurers, in a competitive market, will necessarily and uniformly use partially risk-based rates. The degree to which insurers will use such rates to remain competitive may bear on the degree to which raw exposure data are needed for secondary pricing.

A third alternative, once considered the most promising, would be to have the federal government develop primary rate guidelines. We regard federally prepared guidelines as a much more direct approach to inducing LRMs than attempts to affect prices only at the secondary level. Many underwriters may balk at the tedium and time required to collect and transmit this exposure data, and the timeliness of data for secondary pricing decisions may require considerable systematization of raw data. In contrast, with federally prepared guidelines, direct rates can be guided so that the total volume of sales by underwriters can provide an index of the relative risks within their portfolios and, hence, an index of the residual risks borne by the federal government as a secondary insurer.

Moreover, the federal government could provide for rates relative to community LRM standards (earthquake ordinances) that have evolved and that are in effect. Through this mechanism, greater uniformity in rate-making could be achieved, since community-level earthquake risk assessments would in the main dictate how facilities are to be rated. In addition, rate advantages could be provided for owners and tenants in communities that incorporate LRMs. Finally, the federal government could ensure that subsidized rates are not provided for potentially hazardous buildings or highly damageable structures.

This third alternative -- direct federal control over primary rates -- may receive challenges owing to state jurisdiction over insurance regulation. Hence, although initially promising, the desire not to create federal-state conflicts makes this a less attractive alternative.

A fourth alternative, possibly combined with the others, is to use the leverage of a combined primary-secondary federal earthquake insurance involvement (if this combined program exists) in order to assure that LRMs are initiated in states and municipalities for which earthquake insurance is made available. In effect, federal earthquake insurance availability would be made conditional on earthquake ordinances being implemented by

state and local governments. Analogous considerations were developed in Section 5.4 when insurance purchase requirements for public buildings were discussed. By itself, the availability of federal earthquake insurance involvement may not suffice to induce communities to adopt earthquake ordinances. If combined with other programs, such as federal assistance programs suggested in Section 5.2, then this fourth alternative may prove to be useful. Moreover, serious consideration should be given as to whether or not the secondary pricing mechanism supports and sustains the earthquake ordinances.

We have examined at least four possible ways in which secondary federal earthquake insurance involvement may be compatible with the LRMs proposed. These four ways suggest that it is feasible -- although challenging -- to incorporate LRMs into a federal earthquake insurance involvement. In all four ways, partially risk-based rates (or else rates conditional on LRMs being undertaken) are a major vehicle for supporting and sustaining the LRMs proposed here. The expression "incorporate" suggests that federal earthquake insurance involvement can be seriously inconsistent with implementation of LRMs, and that the incorporation issue partially turns on how to make fiscal incentives consistent with implementation of LRMs. The first and second alternatives, for instance, stress these financial incentives. The fourth alternative stresses direct enforcement of cost-effective LRMs at the community level.

Conclusions

In this subsection we have developed the following conclusions:

- It appears to be feasible, although extremely challenging, to incorporate LRMs into a secondary federal earthquake insurance program.

- As part of a combined primary and secondary program, if one exists, various reasons may be provided for applying LRMs to all buildings rather than merely to those buildings as covered in the primary program. Particularly, the administrator may use other contingent federal liabilities to justify extension of LRM requirements to buildings covered in a secondary program. (These may include existing liabilities or others created under a primary program.) These reasons, while not fully compelling, nonetheless should be strongly considered by program administrators.

- One very direct way to assure that rates are compatible with LRMs is for the federal government to control rate-making and conditions of insurance availability (e.g., by requiring that insurance is available on the condition that LRMs are undertaken). Although this way is clearly feasible in a primary federal earthquake insurance program, it encounters large-scale obstacles in a secondary federal earthquake program to the extent that such federal controls over direct rate-making may challenge, or appear to challenge, state controls over insurance regulation.

- One less direct way to assure that rates are consistent with LRMs is to develop prices at a secondary level to reflect primary risks. This way, although feasible, would be extremely challenging and would require changes of habits among many primary earthquake insurers.

- Another way to assure that rates are consistent with LRMs is to make insurance availability conditional on state regulation that assumes partially risk-based rates (through a cooperative arrangement with state insurance regulators so that they may assure that primary rates reflect risks). This way is mentioned here to indicate that various administrative programs may be conceivable, although not without possible problems and challenges.

Thus, as in a primary federal earthquake insurance program, the administrator of a secondary program has two vehicles for incorporation of LRMs: partially risk-based rates and earthquake ordinances. However, in a secondary federal earthquake insurance involvement, influence over requiring both LRMs and partially risk-based rates will be less direct and to that extent more challenging. The presence of private insurer competition that leads to the frequent use of partially risk-based rates in order to avoid adverse selection may mitigate some of the challenges faced by an administrator over a secondary federal earthquake insurance program.

These conclusions were arrived at through an examination of a few of the key participants and relationships within a federal program. There is no examination here of the overall political feasibility of the above conclusions or of the details of any secondary federal earthquake insurance construct. With respect to a combined primary and secondary federal earthquake insurance involvement, it follows from the foregoing conclusions that significant federal responsibility for or involvement in encouraging directly or indirectly partially risk-based rates will be a common element of both programs. As indicated previously, if the major thrust of this encouragement is to ensure that potentially hazardous or highly damageable buildings in regions of higher seismicity are not provided rates subsidized by lower risks, then the costs of underwriting these rates will not be extraordinarily high and will continue current practices of many earthquake insurers. If rates are tied to community standards that have evolved over the years (or that in many regions of the country have remained uniform), then underwriting costs will be reasonable.

5.6 Summary of Approaches to Incorporating LRMs into Various Federal Insurance Contexts

In overview, the overriding goals of a federal earthquake insurance program are:

- o to indemnify persons for their losses in the event of future earthquake disasters,
- o to reduce the tragic losses of life and increasing losses of property from earthquakes,
- o to ensure financial stability throughout the United States should a large catastrophic earthquake occur in the near term and
- o to sustain this stability through efforts which control direct expected losses and hence secondary, tertiary, and higher order losses.

The latter is the goal of this report. The costs of physically modifying the built environment in order to reduce very significant losses from a large catastrophic earthquake in the near term would be exorbitant. Hence, the LRMs recommended here reduce expected losses in the long term.

In the status quo, disaster relief policy designed to serve many social and political needs nonetheless serves as a disincentive to the implementation of loss-reduction measures for public and selected private buildings. (See Burby et al., 1990.) The significance of existing federal liabilities justifies increased federal controls along with possible cost-sharing, training, and education programs. Earthquake ordinances as defined earlier can assist in prioritizing funding under section 404 of the Stafford Act and in defining where increased controls are most useful.

With increased federal liabilities in a primary and/or secondary earthquake insurance program, we maintain that the federal government would need to have direct influence over rating at the primary level and/or pricing at the secondary level. These controls and influences are needed to assure that partially risk-based rates are employed. These partially risk-based rates are here encouraged chiefly for economic and administrative reasons, but they also offer potential life-safety and other benefits. Residents of communities that adopt earthquake ordinances can also receive rate credits in a primary earthquake insurance program.

We have addressed generally how the loss-reduction measures proposed in this report can be incorporated into a federal earthquake insurance program. Incorporation of LRMs involves two major vehicles:

(a) their use in defining earthquake ordinances for implementation at state and local levels, and

(b) the use of or encouragement of partially risk-based rates (or else availability of insurance only on the condition that LRMs are undertaken).

To facilitate incorporation, we propose federal legislation to implement loss- and hence deficit-reducing seismic mitigation programs for public and selected private nonprofit buildings. These programs would provide training, staffing, and other supporting elements needed to implement LRMs within a federal earthquake insurance program.

In a primary federal earthquake insurance involvement, both vehicles -- ordinances and partially risk-based rates -- could be used to promote LRMs. In a secondary federal earthquake insurance involvement, less direct means (including secondary pricing to reflect risks and the use of the leverage of other programs) would need to be used to incorporate LRMs.

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