

**A BRIEF SUMMARY OF
EARTHQUAKE SAFETY IN UTAH
AND
ABBREVIATED RECOMMENDATIONS
FOR RISK REDUCTION**

**SEISMIC SAFETY
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Prepared By
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STATE OF UTAH

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INTRODUCTION

This report provides a summary of findings and recommendations by the Seismic Safety Advisory Council regarding earthquake safety in Utah. The purposes of the summary report are to indicate the results of earthquake safety studies by the Advisory Council since 1977, and to provide a synopsis of general findings and recommendations made by the Seismic Safety Advisory Council.

The Seismic Safety Advisory Council was established by Legislative Act in 1977 (Section 63-34a, UCA, 1953) and charged to recommend a consistent public policy framework for earthquake hazards reduction in Utah. The Advisory Council presents this final report in fulfillment of the provisions of the legislation.

In this summary report we limit our comments mostly to general findings regarding earthquake safety conditions in the State. The report also indicates specific actions that the Seismic Safety Advisory Council believes would remove deficiencies in current practices that cause unnecessary earthquake risk to life and property.

This summary report begins with a brief statement on earthquake risk that highlights the most important findings on earthquake safety pertinent to Utah conditions. This is followed with a list of abbreviated recommendations by the Advisory Council which would enhance Utah's ability to cope with damaging earthquakes and would lead to expected reduced losses--both to life and property. The Summary report concludes with discussion of several earthquake safety issues and problems pertinent to Utah. Conditions which the recommended actions are intended to satisfy are briefly described; ways for correcting deficiencies are suggested; and administrative and legislative actions leading to improved earthquake safety practices are outlined.

The information presented in this summary report is drawn from detailed technical reports prepared by the Advisory Council staff. The need for succinctness herein precludes complete treatment of each topic, and so simplifications of complex conditions are made that sometimes may be inadequate for the reader to evaluate fully without additional information. Those readers interested in more information on any particular topic should refer to the detailed technical reports. At the end of this summary report we have included a listing of the technical reports prepared by the Advisory Council that address topics in greater depth and that are only briefly described here.

EARTHQUAKE RISKS AND MAJOR RECOMMENDATIONS

PURPOSE OF THE REPORT

This summary report outlines the principal elements of a comprehensive earthquake safety policy for the State of Utah. It contains the essential findings and recommendations pertaining to earthquake safety in Utah. It presents the essential elements of the Advisory Council's response to a legislative charge established in 1977 to provide recommendations for a consistent policy framework for seismic safety in Utah, to recommend programs to reduce earthquake hazards, and to suggest goals and priorities for earthquake hazards reduction.

UTAH'S EARTHQUAKE ENVIRONMENT AND HAZARDS

Earthquakes in Utah are an historical fact. Since settlement of the State in the mid-nineteenth century, a continuous history of earthquakes has been observed. The historical record supplemented with more recent geologic evidence forms the basis of earthquake risk assessments and risk reduction recommendations that are made. These data reveal that severe and damaging earthquakes are expected in Utah in future years, although one can only estimate their locations and strengths. Utah's settlement pattern has an unusual correlation with the region of greatest earthquake activity, and more than 80 percent of the State's population and development lie within a zone that defines the region of greatest earthquake hazard.

The damaging effects of earthquakes, and thus their threat to life and property, impact principally upon the built environment--the works of man. The concerns of earthquake safety therefore are focused upon where we build and what we build. Utility systems, roads, and dams, as well as buildings, are among the facilities that could be detrimentally affected. These types of facilities are the subjects of studies and associated hazards reduction recommendations by the Seismic Safety Advisory Council.

EARTHQUAKE SAFETY DEFICIENCIES

Facilities in Utah of the types indicated above are expected to be damaged by future earthquakes. Estimates of the extent of damage, the causes, and the impacts form the basis of risk assignments that are only briefly described here. Property losses assuredly will result from these earthquakes; the extent of resulting life loss and injury will depend upon unpredictable factors of earthquake strength, location, and quality of construction of facilities.

Earthquake resistance traditionally has not been considered in facilities designed and constructed in Utah. Older facilities generally are vulnerable to earthquake forces, as are many facilities constructed as recently as the 1970's. Standards for construction that include earthquake safety provisions continue to be ignored or rejected, even today.

Deficiencies of two types are implied in the above comments. The first deficiency concerns the need for broader consideration of earthquake safety in new facilities so that the inventory of unsafe or marginally safe facilities is not enlarged as the State grows. The second deficiency is the degree and nature of earthquake risks in existing buildings, utility systems, dams, etc.

The two types of deficiencies described above have different remedies. The first deficiency results from lack of standards, guidelines, and adequate procedures in the planning and review of new facilities. The second deficiency, a result of past decisions, can be remedied only within the facilities themselves through some sort of abatement effort. Our recommendations address both types of deficiencies and their possible remedies.

COST CONSIDERATIONS

Earthquake hazards in Utah pose an unavoidable cost. Hazards mitigation entails a cost just as does a decision to do nothing about the problem. The cost of mitigation occurs in the construction of stronger facilities. The cost of doing nothing looms in the future when the inevitable earthquakes occur and cause losses.

Both sorts of costs can be effectively managed, but neither can be eliminated. Management of the cost of mitigation requires that prudent policies be promulgated involving standards and procedures in design and construction of buildings and other facilities, policies that everyone should be required to follow. Management of the cost of earthquake damage to existing facilities entails carefully drafted policies of selective hazards abatement, dealing first with conditions of highest hazard.

Policies recommended by the Seismic Safety Advisory Council are developed using benefit/cost analyses from which the most cost-effective remedies are selected. Detailed risk assessments of existing facilities reveal that earthquake hazards abatement is cost-effective only for special situations in Utah. These situations require greater discussion than can be provided in this summary, and the reader is referred to the detailed studies for specific cases.

ABBREVIATED RECOMMENDATIONS

As the foundations of a comprehensive and coordinated earthquake safety program for Utah, the Seismic Safety Advisory Council makes the following general recommendations. These general recommendation statements are expanded in other reports which contain specific recommended actions. The recommendations briefly stated below are more completely described later in this report.

Recommendations:

1. Adopt legislation requiring compliance with earthquake safety provisions of the building code.
2. Amend planning statutes to provide explicit authority for local governments to plan for earthquake safety.

3. Accelerate the State seismic risk mapping program to achieve completed mapping of the major risk areas within five years.
4. Adopt legislation requiring that siting evaluations of geologic hazards be made for all public-use facilities.
5. Enforce earthquake safety code provisions in facilities under State jurisdiction.
6. Establish seismic standards and review procedures for dams and reservoirs.
7. Strengthen licensing laws for architects and engineers to improve professional accountability.
8. Assist local governments to strengthen building code enforcement practices.
9. Promulgate and enforce standards concerning the earthquake resistance of public utility systems.
10. Promulgate guidelines and procedures within the Department of Health to reduce the earthquake risk to water supply and waste disposal systems.
11. Utilize regulatory authorities now available to ensure that new schools and health-care facilities meet appropriate earthquake safety standards.
12. Undertake a program of selective retrofit or replacement of high-hazard facilities that are essential in our communities or that have large occupancies of people.
13. Encourage local governments to safeguard fire equipment from operational dysfunction due to earthquakes through assistance from the State Fire Marshall's office.
14. Develop and implement abatement programs leading to eventual elimination of existing high-hazard, publicly occupied facilities.
15. Identify and correct conditions in water supply systems that are vulnerable to earthquake damage.
16. Provide secure and reliable communications systems for post-earthquake response and recovery activities.
17. Establish a strong-motion instrumentation program to obtain needed information about earthquake-induced ground motions in Utah soils.
18. Establish an earthquake safety office for the purpose of providing overall coordination and direction for earthquake safety in Utah.

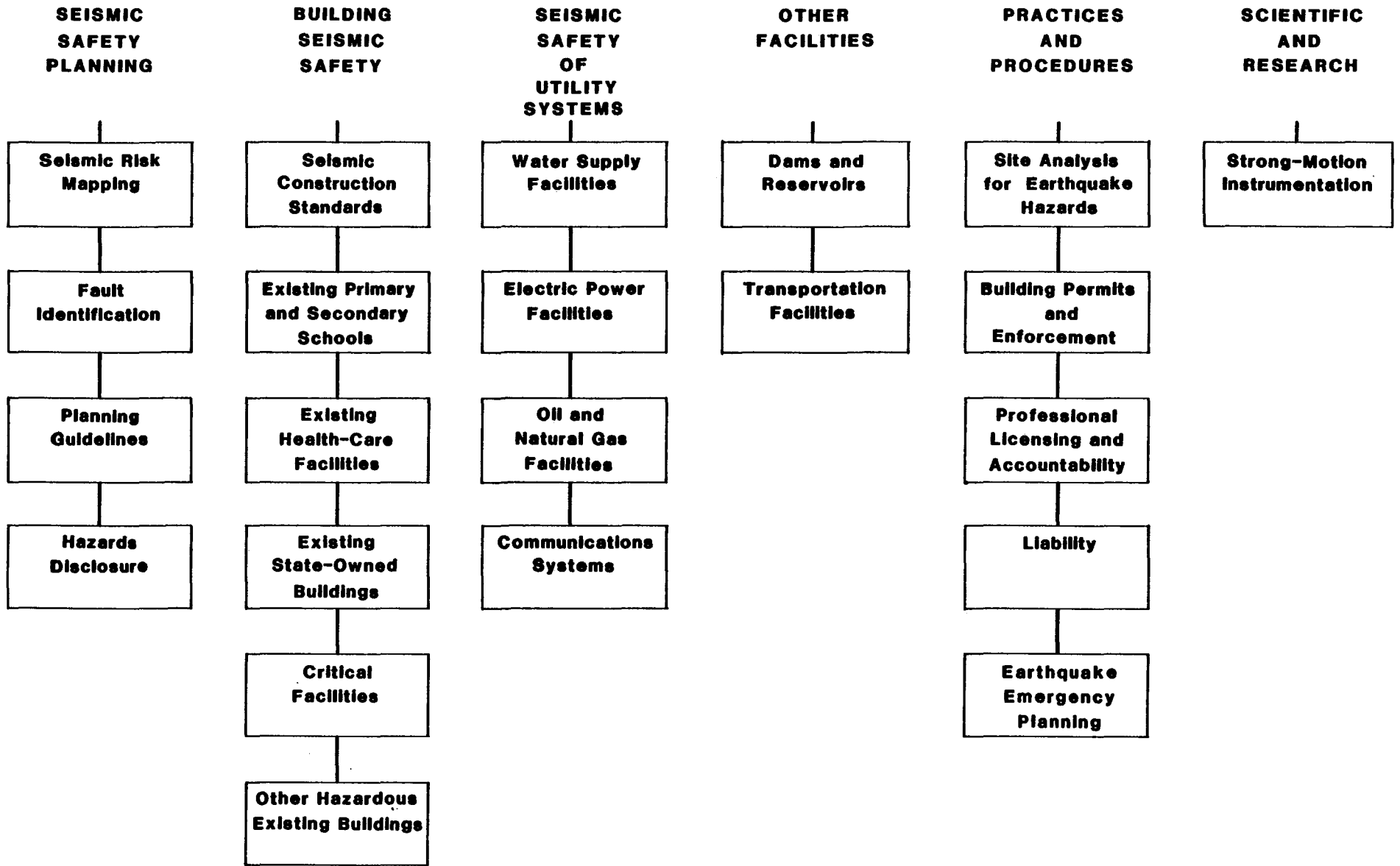
SUMMARY OF STUDY SUBJECTS AND PRODUCTS

Seismic Safety Advisory Council -- July, 1977 to May, 1981

LIABILITIES ANALYSIS	Liability statutes reviewed; no recommendations.
STRONG-MOTION INSTRUMENTATION	Final report completed with recommendations.
BUILDING CODES AND ENFORCEMENT	Contract report on earthquake safety cost completed in 1978. Workshop presented in 1978. Legislation recommended in 1979 and 1980. Seismic zone map prepared for Utah.
SEISMIC RISK MAPPING	Contract report on mapping guidelines completed in 1978. Program expansion recommended in 1979. Map of Utah faults distributed in 1980.
SEISMIC SAFETY PLANNING ELEMENTS	Recommendations completed in 1979. Planning guidelines prepared and distributed in 1980. Seminar presented in 1980. Legislation recommended in 1980.
PROFESSIONAL EDUCATION AND LICENSING	Curriculum suggestions sent to universities in 1978. Licensing recommendations made in 1980. Strengthened procedures of State Department of Registration regarding monitoring of licensed professionals are recommended.
SCHOOL FACILITIES	Final report completed with recommendations. Legislation recommended in 1980.
DAM SAFETY AND SITING	Final report completed with recommendations.
PUBLIC UTILITIES FACILITIES	Report on water supply systems completed. Report on electric power systems completed. Report on oil and gas systems completed. Report on communications systems completed. Recommendations for all are completed. Seminar on water supply systems presented in 1979.
HAZARDOUS BUILDINGS	Contract report on program options completed in 1979.
HOSPITAL FACILITIES	Final report completed with recommendations.
STATE FACILITIES	Final report completed with recommendations.
PRIORITY-USE FACILITIES	Final report completed with recommendations.
TRANSPORTATION FACILITIES	Contract report completed in 1980. Final report with recommendations completed.
FEDERAL FACILITIES	Procedures reviewed, no recommendations.
PUBLIC EDUCATION	Descriptive brochure about SSAC printed and distributed. Attorney General's opinion on planning authority of cities and counties obtained in 1978. Newspaper and TV interviews. Presentations to school administrators, State agencies, professional engineers. Technical papers and presentations to professional committees -- national and State.
STATE AGENCY PREPAREDNESS PLANNING	Agency reports assembled and reviewed. Report with recommendations completed.
LOCAL PREPAREDNESS PLANNING	Recommendations included in general report on emergency management planning.
HAZARDS ALERTS AND PREDICTION	Federal initiatives and procedures reviewed, no recommendations.
EMERGENCY MEDICAL SERVICES PLANNING	Recommendations included in general report on emergency management planning.
EQUIPMENT MOBILIZATION	Recommendations included in general report on emergency management planning.
LAW AND ORDER PLANNING	Recommendations included in general report on emergency management planning.

Figure 1

A TOPICAL LISTING OF SEISMIC SAFETY STUDIES AND RECOMMENDATIONS



RECOMMENDED ADMINISTRATIVE AND LEGISLATIVE ACTIONS
FOR IMPROVED EARTHQUAKE SAFETY

MEETING THE NEEDS IN TWO WAYS

Many different agencies and levels of government have significant responsibilities in matters that affect earthquake safety. These responsibilities derive in part from statutory obligations, in part from local ordinances, and in part from an implicit general obligation upon government to safeguard public life, safety, and welfare.

Enhancement of the State's earthquake safety posture will come about primarily as a result of collective actions among many agencies and levels of government. Both administrative and legislative participation are required to accomplish all of the needed actions.

Many earthquake safety needs may be met through actions or authorities granted under existing Utah statutes, but some new legislation also is needed. Study findings are that significant forward strides in earthquake safety are possible simply by utilizing fully those existing statutory authorities. Such actions we have called administrative actions.

Success in utilizing administrative remedies to improve the State's earthquake safety situation is largely dependent upon the degree of commitment and effectiveness of administration. In this regard, we believe that administrative commitment and effectiveness can be raised to higher levels in Utah. We also believe that many earthquake safety goals can be reached through programs of information dissemination and assistance rather than through legislative mandates.

Legislation for earthquake safety has been viewed by the Seismic Safety Advisory Council as a remedy of last resort. Legislation therefore has been recommended only where existing statutory authority may be missing or where administrative actions have been demonstrated to be ineffective. The amount of needed legislation therefore is not large.

Perhaps the most needed earthquake safety action in Utah is endorsement of a goal to seek an appropriate and affordable level of earthquake protection. There are indications that a visible State commitment to such a goal would produce significant forward movement in earthquake safety among local governments and the private sector. The mere presence of the Seismic Safety Advisory Council during the past several years has demonstrated that there is broad-based concern for earthquake safety in Utah which needs only to be nurtured. This is a role that only the State can fulfill, and so the Advisory Council strongly recommends that an earthquake safety office be established in order to provide continuing State coordination, information, and presence.

FOUNDATIONS FOR AN EARTHQUAKE SAFETY PROGRAM

The foundations of a comprehensive and coordinated earthquake safety

program for Utah are contained in 18 general recommendations dealing with five principal issues. These issues are stated next along with the associated recommendations. In this report, the recommendations are stated in general terms in order that the principal thrust of each may be set forth in policy terms. More specific recommendations dealing with specific problems or observed earthquake safety deficiencies are found in the technical reports prepared by the Advisory Council.

The point again is emphasized that earthquake safety is a broad subject that reaches many agencies and levels of government and that requires equally wide ranging treatment. Accordingly, recommended policies are neither simple to state nor, even when properly described, simple to grasp. The Advisory Council therefore urges careful reading of the abbreviated statements and recommendations that follow, so that initial perceptions by the reader do not obscure fundamental points.

Issue No. 1

A general policy for designing and constructing new buildings, utilities systems, and other facilities to resist earthquake forces likely in Utah is, by far, the most needed, most effective risk reduction measure, and the most cost-effective action, that can be taken in Utah. This recommended action is really a test of State will to face the earthquake safety issue; since the needed standards and practices already are known and their effectiveness has been adequately documented.

RECOMMENDATION 1. The State should adopt legislation requiring that all buildings and other facilities open to use by the public be designed and constructed in full compliance with earthquake safety standards adopted by the State.

Issue No. 2

Planning decisions involving the use of land have significant long-term implications for earthquake safety. Such decisions can be made intelligently only when the earthquake hazards, such as fault zones, unstable soils, and liquefiable soils, are known, mapped, and the data are used in reviews of planning proposals made by developers. Since planning is a power granted by the State to local governments, the State should make every possible effort to ensure that the planning authority so granted allows and encourages local application of earthquake safety practices. Further, the State should provide assistance to planning agencies of local governments in instances when the necessary level of technical expertise may not be otherwise available to them.

RECOMMENDATION 2. Existing statutes in the Utah Code pertaining to the planning authority of cities and towns and counties should be amended to include explicit reference to earthquake safety as a permitted activity under the enabling statement.

RECOMMENDATION 3. The State seismic risk mapping program, presently administered by the Utah Geological and Mineral Survey, should be accelerated so that needed earthquake hazards information is made available to local governments within the next five-year period.

RECOMMENDATION 4. As a means of avoiding unnecessary and costly risk to life and property, the State should adopt legislation requiring that siting evaluations of geologic hazards be prepared in advance of the construction of facilities used by the public.

Issue No. 3

Procedures by which earthquake safety policies may be administered are equally as important as the policies themselves. Some procedures that are followed in the design, review, and construction of facilities are ineffective in ensuring that earthquake safety is adequately considered, even when statutes and adopted rules or ordinances imply otherwise. A serious consequence is that public users of facilities incorrectly believe that earthquake safety is routinely included. The State has a responsibility to provide leadership to ensure that authorized administrative procedures are fully and competently carried out.

The following recommendations address specific program areas where administrative control should be strengthened as a means to enhance the State's earthquake safety posture.

RECOMMENDATION 5. The State should insist upon full enforcement of earthquake safety code provisions in facilities under State jurisdiction, including schools, State-owned buildings, and health-care facilities.

RECOMMENDATION 6. Seismic standards and review procedures for dam and reservoir construction should be promulgated.

RECOMMENDATION 7. Established procedures for administering licensing laws for architects and engineers should be modified to strengthen those portions dealing with professional accountability.

RECOMMENDATION 8. Guidelines should be established and assistance should be made available to local governments for strengthening enforcement of regulations and codes governing construction, including compliance with State laws regarding licensed professional services. (Strengthened enforcement here means more thorough, more competent enforcement of reasonable standards that have been accepted.)

RECOMMENDATION 9. The Public Service Commission should promulgate and enforce standards of earthquake safety performance for utility systems it regulates in the public interest.

RECOMMENDATION 10. Guidelines and procedures should be established by the Department of Health pertaining to earthquake risk reduction for water supply and waste disposal systems, and assistance should be provided to local governments in applying the guidelines.

Issue No. 4

Special attention to earthquake safety is needed for facilities whose

continued operation is critical immediately after an earthquake or whose failure could cause significant numbers of injuries and possibly deaths. Hospitals, fire stations, and communications systems are the more important among critical facilities. Schools, high-rise buildings, and large assembly buildings are examples of high-exposure facilities. These types of facilities merit thorough consideration of earthquake safety and full compliance with earthquake safety standards. Existing and new facilities are of equal importance, and both should be addressed.

RECOMMENDATION 11. Regulatory authorities now granted to State agencies concerning oversight of school buildings and health-care facilities should be fully utilized to ensure that new buildings are planned and built in accordance with appropriate earthquake safety standards.

RECOMMENDATION 12. Programs should be established leading to retrofit or replacement of high-hazard critical and large-occupancy facilities. (Specific recommendations call for selective retrofit or replacement, as determined from high earthquake risk indicators, and phased over several years. This strategy is the most cost-effective.)

RECOMMENDATION 13. The State Fire Marshall's Office should assist local governments to safeguard fire equipment from earthquake damage in order to ensure that fire fighting capability remains functional after an earthquake.

RECOMMENDATION 14. Local governments should develop and implement abatement programs leading to eventual elimination of conditions in publicly occupied facilities that may be vulnerable to earthquake damage affecting life safety.

RECOMMENDATION 15. Operators of public water supply systems should undertake comprehensive review of their systems for the purpose of identifying and then eliminating conditions that are vulnerable to earthquake damage and that might disrupt service.

RECOMMENDATION 16. Communication systems--both facilities and equipment--should be safeguarded from earthquake damage or loss; back-up communications capability should be provided; and greater attention should be given to integrated or cross-linked communications capability.

Issue No. 5

Neither the state of knowledge of seismicity nor effective utilization of present earthquake knowledge are at a state of completion in Utah. Only through concerted and continuing attention can long-term progress be made toward higher levels of earthquake safety. Continuing efforts are needed both in research that advances applications technology and in coordination of programs that utilize present knowledge. The State has a responsibility to identify and support further scientific exploration when the interests of its citizens are directly served. It has an even greater responsibility

to provide the framework within which earthquake safety policies may be recommended and coordinated. In conjunction with these goals, the following recommendations are made.

RECOMMENDATION 17. A strong-motion instrumentation program should be established for the purpose of obtaining needed scientific information about earthquake-induced ground motions in soil structures unique to Utah.

RECOMMENDATION 18. An earthquake safety office should be established in the Office of the State Planning Coordinator for the purpose of coordinating established earthquake safety policies, setting earthquake safety goals and priorities, monitoring progress of earthquake safety programs, and gathering and disseminating earthquake safety information to the public and to other governmental units.

REPORTS AND PUBLICATIONS BY THE SEISMIC SAFETY ADVISORY COUNCIL

- USSAC-01 Purposes and Activities of the Utah Seismic Safety Advisory Council; Undated pamphlet.
- USSAC-02 Activities Report for the Period July 1977-June 1978; 1978.
- USSAC-03 Seismic Zones For Construction in Utah; September, 1979.
- USSAC-04 Seismic Zone Map of Utah; January, 1980.
- USSAC-05 Seismic Risk Assessment of Utah Primary and Secondary Schools and Recommendations for Risk Reduction; December 1979.
- USSAC-06 Seismic Risk Assessment of Utah Health-Care Facilities and Recommendations for Risk Reduction; December, 1979.
- USSAC-07 Seismic Hazards and Geologic Hazards Related to Comprehensive Planning in Utah: Guidelines for Preparation of a Seismic Safety Element of the Comprehensive Plan; April, 1980.
- USSAC-08 Seismic Safety Considerations for Dams and Reservoirs in Utah; April, 1980.
- USSAC-09 Briefing Material on the Seismic Risk of Utility Lifelines in Utah; June, 1980.
- USSAC-10 Seismic Strong-Motion Instrumentation for Utah: Current Status, Needs, and Recommendations; August, 1980.
- USSAC-11 Seismic Risk Assessment of State-Owned Buildings in Utah and Recommendations for Risk Reduction; December, 1980.
- USSAC-12 Seismic Risk Assessment of Fire Stations, Police Facilities, and Other Critical Municipal Facilities in Utah and Recommendations for Risk Reduction; January, 1981.
- USSAC-13 A Report to the 44th Utah Legislature: Earthquake Safety in Utah and Recommendations for Risk Reduction; January, 1981.
- USSAC-14 Seismic Risk Assessment of Public Culinary Water Supply Systems in Utah and Recommendations for Risk Reduction; April, 1981.
- USSAC-15 Seismic Risk Assessment of Electric Power Systems in Utah and Recommendations for Risk Reduction; April, 1981.
- USSAC-16 Seismic Risk Assessment of Oil and Natural Gas Systems in Utah and Recommendations for Risk Reduction; May, 1981.

REPORTS AND PUBLICATIONS BY THE SEISMIC SAFETY ADVISORY COUNCIL

(continued)

- USSAC-17 Emergency Management Planning for Earthquake Disasters
in Utah; April, 1981.
- USSAC-18 Seismic Risk Assessment of Utah Transportation Systems
and Recommendations for Risk Reduction; May, 1981.
- USSAC-19 Earthquake Safety in Utah and Recommendations for Risk
Reduction--An Information Outline for Public Hearings;
May, 1981.
- USSAC-20 Seismic Risk Assessment of Principal Communications
Systems in Utah and Recommendations for Risk Reduction;
May, 1981.
- USSAC-21 An Evaluation of the Effectiveness of School Building
Procedures in Assuring Safe Facilities and Recommendations
for Modification of Procedures; June, 1981.
- USSAC-22 A Brief Summary of Earthquake Safety in Utah and Abbreviated
Recommendations for Risk Reduction; June, 1981.