

Availability of

DAM INSURANCE

A Report to Congress

1999

Federal Emergency Management Agency

Mitigation Directorate



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I. EXECUTIVE SUMMARY

On October 12, 1996, President Clinton signed into law the Water Resources Development Act of 1996 (Public Law 104-303). Section 215 of Public Law 104-303 established a National Dam Safety Program and named the Director of the Federal Emergency Management Agency (FEMA) as its coordinator. Section 10(a) of the law states that “Not later than 180 days after the date of the enactment of this subsection, the Director shall report to Congress on the availability of dam insurance and make recommendations concerning encouraging greater availability.” This report is in response to Section 10(a).

To assess the availability of insurance, FEMA sent a request for information to organizations with an interest in dam safety. The recipients, which were selected from across the United States, were asked to provide information about (1) sources of dam insurance; (2) availability of comprehensive insurance coverage for the dam itself; and (3) availability of liability insurance for the loss of life and property as a result of dam failure. Inquiries also were made of a sampling of hydroelectric power producers and organizations in different regions of the country.

The findings indicate that insurance is available for dams owned by state and local governments. Most government entities insure their dam facilities (and associated liabilities) using the financial resources of the government. This appears to be adequate to meet most needs resulting from dam failures. There also is no problem of availability for privately owned and operated dams used for revenue generation, such as those owned by hydroelectric power companies. Nearly all revenue-generating facilities already possess dam insurance for their facilities.

The largest number of dams, however, are small and privately-owned. For the small dam owner, insurance is not readily available. The primary barrier to the availability of insurance for this group is the lack of credible probability assessments to determine the risk of loss. Without credible probability assessments for dams, insurers are reluctant to cover risks that cannot be assessed with a reasonable degree of predictability. In turn, this leads to the insurer basing premium rates on worst-case scenarios, and the resulting inability of the small dam owner to afford insurance.

To facilitate decision-making on this issue, FEMA is working with industry, federal agencies, and the states through the Association of State Dam Safety Officials (ASDSO) to develop, collect, and analyze information on dam performance and failure rates. The primary mechanisms for data collection and analysis are the National Inventory of Dams (NID) and the National Performance of Dams Program (NPDP). This fiscal year, the U.S. Army Corps of Engineers (USACE), which manages the NID, is pursuing cooperative projects with the NPDP to improve the compatibility, accessibility, and usefulness of data collected on dam performance and failure modes and rates.

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Another activity to improve risk communication and information exchange is FEMA's investigation of the feasibility of showing dam-break inundation areas on the Flood Insurance Rate Maps (FIRMs), which are prepared by FEMA to delineate special flood hazard areas. Although there are no insurmountable technical obstacles to showing dam-break inundation zones on FIRMs, consistency in dam breach analysis methodology and selection of breach conditions will be needed if the maps are to be used for insurance purposes. FEMA will address these and other issues with interested stakeholders, including its National Dam Safety Review Board, ASDSO, the USACE, and the Association of State Floodplain Managers.

Through the Interagency Committee on Dam Safety, FEMA also will fund a workshop in fiscal year 1999 to address the state-of-the-art practice and research needs in the area of dam safety risk analysis and risk assessment.

II. INTRODUCTION

Dams are a critical part of the nation's infrastructure. Dams serve a number of purposes and provide essential benefits for our communities and industries. They make supplies of water available for irrigation, hydroelectric power, and human consumption. Dams make it possible to create popular recreational areas, stimulating state and local economies. Dams also provide the mechanism for adjusting river depth for navigation and, in some instances, for mitigating flooding from seasonal river overtopping. The purposes for which dams are used have changed over the years as our economic base has changed and our communities have grown. With these changes has come an increased need to maintain safe and reliable structures.

Dams provide benefits to society but also present risk. Dam failure is a constant concern to those responsible for dams to those downstream whose lives, property, and businesses are subject to the consequences of dam failure. A dam failure, defined as the uncontrolled release of reservoir water, may be massive, as occurred in the catastrophic 1976 Teton Dam disaster in Idaho. Failure of even a small dam releases sufficient water energy to cause great loss of life, personal injury, and property damage.

Downstream inundation of homes, farms, and businesses results not only in direct and visible destruction of and damage to buildings and farm produce but also causes enormous indirect losses. Personal income is lost when business operations are interrupted. Even when businesses can continue to operate, workers may be unable to return to work because day-care facilities are closed, roads are blocked, or bridges have collapsed. The dam owner loses revenue needed to rebuild the dam structure. Hydroelectric power plants and irrigation facilities lose the source of water for operation, and recreational facilities must close. Unemployment compensation payments increase, as do those for other services, straining community budgets that are already overloaded. Diminished personal income and losses of business revenue have wide-ranging negative effects on the local economy and on the welfare of residents.

The comprehensive costs of dam failure have never been computed accurately. Moreover, there is no generally accepted method for quantifying the value of lives in jeopardy due to dam failure. Direct costs--those due to physical damage to or loss of structures and equipment, associated loss of employment income, and the amount of disaster assistance--can be quantified. Indirect costs--those due to loss of lives and personal injuries or in loss of production and its multiplier effects, such as supply bottlenecks or reduced demand and income--are more difficult to measure but must be considered integral to dam failure as well.

Several dam failures in the 1970's generated a public policy focus on inspecting and regulating these important structures. In February 1972, a privately owned tailings (coal mine) dam failed at Buffalo Creek, West Virginia, devastating a 16-mile valley with 6,000 inhabitants. Half of the residents of the valley were left homeless and 125 people were killed. This event, and the catastrophic failure of several other dams during that same year, led Congress to enact the

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National Dam Safety Program Act of 1972 (Public Law 92-367). The primary focus of the National Dam Safety Program Act is to “reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national dam safety program to bring together the expertise and resources of the Federal and non-Federal communities in achieving national dam safety hazard reduction.”

The Act directed the Secretary of the Army, acting through the Chief of Engineers, to (1) carry out a national program of inspection of dams; and (2) complete an inventory of dams throughout the United States. Data from the first inventory, which was published in 1975, listed 47,422 non-Federal dams and 2,078 Federal dams. Initial funding under this Act allowed only for the nationwide inventory. The inspection program was not begun until another disaster occurred.

In 1976, Teton Dam failed, causing \$1 billion in property damage and leaving 11 people dead. In November 1977, Kelly Barnes Dam in Toccoa Falls, Georgia, also failed. Thirty-nine people, mostly college students, died.

In response to these events, Congress appropriated funds to update the national inventory of dams and to initiate the National Dam Inspection Program under the National Dam Safety Program Act. In May 1982, results of the inspections were presented by the U.S. Army Corps of Engineers in the *National Program of Inspections of Non-Federal Dams, A Final Report to Congress*. The latest inventory, conducted in 1995-1996, reported that there are 75,187 dams in the United States, of which 10,756 are classified as high hazard. Dams assigned a high hazard potential classification are those where failure or mis-operation will probably cause loss of life.

Chronology of Legislative Actions Applicable to Dams and Dam Safety

June 21, 1906	Dam Act of 1906
June 23, 1910	Dam Act of 1910
August 8, 1972	National Dam Safety Program Act (P.L. 92-367), amended on
	August 4, 1977 P.L. 95-91
	November 17, 1986 P.L. 99-662
	August 23, 1988 P.L. 100-448
	October 31, 1992 P.L. 102-580
	October 12, 1996 P.L. 104-303
November 17, 1986	Dam Safety Act of 1986, P.L. 99-662
October 12, 1996	Water Resources Development Act of 1996, P.L. 104-303

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The Teton Dam failure prompted President Carter to direct that federal dam safety activities be reviewed by an *ad hoc* panel of recognized experts. This panel, the *Ad Hoc* Interagency Committee on Dam Safety, issued a report in June 1979 which contained the first guidelines for federal agency dam safety. In October 1979, President Carter directed the federal agencies to implement the guidelines, report their progress, and submit recommendations to the Director of the newly formed Federal Emergency Management Agency (FEMA). Since then, FEMA has had a leading role in coordinating national dam safety.

In 1981, FEMA commissioned the National Research Council to conduct a comprehensive study of policy and technical issues related to the safety of dams. The first report, *Safety of Non-Federal Dams-A Review of the Federal Role* (1982), identified ten “imperative” needs in dam safety, one of which was to provide “federal insurance assistance, in conjunction with a benefits program, to states and dam owners who are committed to effective dam safety procedures.”

Today, the federal agencies that own and/or regulate dams conduct comprehensive safety programs for the dams under their jurisdiction. The programs are reviewed periodically and are generally regarded as effective. Most of the states also have comprehensive dam safety programs, although some are less effective than federal programs and some lack even the funds to properly supervise--much less conduct--an effective inspection program. The number of non-federal dams nevertheless has increased by 34 percent since the inventory of dams in 1975. The risk of dam failure is growing, particularly in light of 1998 data from the American Society of Civil Engineers indicating that by the year 2020, more than 85 percent of dams in the United States will be 50 years old, generally considered to be the design life of a dam.

III. NATURAL HAZARDS AND THE INSURANCE INDUSTRY

Even though dam failures can and do result in death, disability, and bodily injury, insurance against dam failure is handled in the property and casualty category by the insurance industry.

For a risk to be attractive to an insurer, *i.e.*, one that the insurer believes will be profitable to cover, it would ideally have several characteristics.

1. Events exposing the risk would have occurred and provided sufficient extant data on losses to estimate the likelihood of future, similar occurrences and the likelihood of future losses.
2. Past losses would be quantifiable.
3. The potential for catastrophic loss would not be so great as to threaten the financial stability of the underwriting company.
4. Occurrences that expose the insured risk must be accidental.

The risk of dam failure does not meet all of these characteristics. Future losses cannot be predicted adequately based on the past record; losses, particularly indirect or ripple effect losses, are not quantifiable; the scope of each event is different in terms of magnitude and impact; and external factors that affect losses, such as population density, change over time.

IV. FINDINGS ON THE AVAILABILITY OF DAM INSURANCE

Introduction

In general, ownership of dams fits into one of two categories: (1) those owned by federal or state governments, electric utilities, or cities that produce power or provide flood control, irrigation, or water supplies, or are used for navigation; and (2) those owned by small businesses that tend to be used for recreation, farming, and related purposes. The largest number of dams in the United States is in the second category. Crossovers between the two categories are common in terms of usage but not in terms of ownership characteristics.

To assess the availability of insurance, the Federal Emergency Management Agency (FEMA) sent a request to organizations across the United States with an interest in dam safety (see Attachment). Recipients were asked to provide information about (1) sources of dam insurance; (2) availability of comprehensive insurance coverage for the dam itself; and (3) availability of liability insurance for the loss of life and property as a result of dam failure. Inquiries also were made of a sampling of hydroelectric power producers and organizations in different regions of the country.

Response to Requests for Information

All of the organizations contacted (excluding insurance companies) provided non-specific information relevant to sources of dam insurance. Excerpts from commercial publications listing insurance companies and agencies for specialty lines of insurance were received from each correspondent. For example, the National Association of Insurance Companies provided excerpts from *Rough Notes Market Place*. Insurance for dams in this publication was listed under “High Technology Projects.” Excerpts from other publications included *The Insurance Almanac*, *The Insurance Marketplace*, *The Inland Marine Insurance*, and publications from specific companies such as CIGNA’s Special Risk Facilities and Fireman’s Fund Insurance Company, which writes some first party dam insurance but without third party coverage.

Comments received from industry contacts on the availability of comprehensive coverage for the dam itself and the availability of liability insurance for the loss of life and property as a result of dam failure include:

- The Institute for Business and Home Safety responded that “Dam coverages are highly specialized individual types of coverages. Dams are often part of a municipal package, another very specialized type of coverage. Some coverages insure the actual water held by the dam as property. Obviously, for some industries and municipal functions (water departments), the actual “loss” of the water or its use is of economic significance. Some coverages simply insure the dam. Since each state regulates dams individually, this adds another layer of uniqueness to the whole process.”

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- The Alliance of American Insurers responded that “most large dams are owned by public authorities: the Federal Government, states, counties, and cities. As a rule, public entities would be likely to self-insure. Other dams could be owned by private enterprises. If insurance coverage was requested by either the public or private sector, it would be at the discretion of our member insurance companies as to whether they would choose to entertain writing such an exposure. A poll of member companies would likely reveal that most would not usually write these exposures, but might do so for an individual risk.”
- The Alliance also stated that “Any insurance company willing to consider liability insurance on a dam could spend a great deal of time engineering the risk, *i. e.*, determining the structural safety of the dam, maintenance schedules, and potential liability to life and property downstream from the dam. The result of the engineering survey, along with the limits of insurance requested and several other factors, would influence the willingness of an insurance company to write the policy.”
- The National Center for Earthquake Engineering Research responded that “there are in existence very few provisions for dam insurance and only about three companies that provide insurance.” (These were the same companies from which FEMA requested information.)

Inquiries of Hydroelectric Power Producers

Information for this section of the report was provided from a sampling of dam owners in different regions of the country and organizations with an interest in the subject. Each of the companies whose owners were contacted owns a significant number of dams. Several of the owners also have invested in dams in other countries. These owners were asked to address the question of insurance for dams in light of the current privatization trend in other countries. (The type and extent of insurance coverage that is available in the United States for hydroelectric producers is illustrated in Table 1 on the next page.)

Table 1.
Summary of Insurance (Sampling) for Dams in the United States

		Insurance and Coverage ¹			
		Property		Liability	
Organization	Location (State)	Coverage (Dollars in millions)	Deductible (Dollars in millions)	Coverage (Dollars in millions)	Deductible (Dollars in millions)
Alabama Power Company	AL	400.0	2.0	225.0	2.0
Consumers Energy	MI	— ²	0.5	100.0 ³	0.5
Adirondack Hydro	NY	— ²	0.05	16.0	0.005
North American Hydro	WI	5.0	0.05	2.0	0.005
Virginia Electric Power Company	VA	400.0	.05	2.0	0.005
Southern California Edison Company	CA	— ⁴	—	— ⁵	—
PacifiCorp	OR	400.0	1.0	150.0	2.0
Niagara Mohawk Power Company	NY	350.0	1.5	175.0	1.5
Washington Water Power Company	WA	200.0	1.0	100.0	1.0
Georgia Pacific Company	GA	400.0	2.0	225.0	2.0

SOURCE: Ron Corso, Civil Engineer and Senior Client/Project Manager with Mead & Hunt, Inc.

¹Insurance coverage and deductibles are maximums based on total of all policies for each category.

²Property damage covers full replacement costs.

³Liability coverage is world-wide and also covers facilities in other countries, such as El Chacon in Argentina.

⁴Self-insured.

⁵Indicated that company has liability insurance but did not provide amount.

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The practices related to insuring dams for hydroelectric power production in the United States have changed significantly in the last few decades for two primary reasons. First, replacement costs for dams and dam-related facilities have increased to prohibitive levels for many dam owners. Add to this concern that society in general has become more litigious and it is, therefore, more likely that legal action would be taken against the dam owner in the event of dam failure. The problem is compounded by ever-increasing dollar amounts of judgments awarded to successful plaintiffs. These considerations have led dam owners to obtain insurance coverage if possible, despite its cost.

Second, the practices and policies of financial institutions have changed. To finance construction, major maintenance, or purchase of dams, financial institutions routinely require dam owners to obtain both property and liability insurance coverage. The amount of coverage and deductibles is dictated primarily by the original cost and estimated replacement value of facilities. Other factors in determining the cost of insurance and the level of deductibles are the inspection, maintenance, and monitoring practices of the dam owners.

Discussions with hydroelectric power producers revealed that insurance is readily available from a number of insurance companies, and they all have insurance to cover their dams. In cases where the amount of insurance coverage is large, a pool of several insurers covers the amount of the policy. An important determinant in the availability of insurance is whether dams generate significant income. Presumably, this is an indicator of the insured's ability to earn enough, quickly enough, to re-start the business and recover from the losses it might incur.

The type of insurance obtained is usually governed by the dam size and scope of activities of the company that owns the dam. For instance, large electric utilities that own dams with hydroelectric power plants also own other types of generating facilities. These companies usually will purchase an umbrella or all-risk insurance policy for property damage and a separate comprehensive liability policy. Smaller companies that primarily produce hydroelectric power generally have insurance policies that cover only their hydroelectric facilities, including the dams, if they have coverage at all. It should be noted that issues related to insurance for dams associated with nuclear power generation are not relevant to this report as these dams typically are insured under all-risk type coverage.

Discussion

In general, insurance is available for dams owned by state and local governments and for privately-owned and operated dams that are capable of generating significant income, such as those owned by hydroelectric power companies. As discussed above, the ability to generate significant income is an indicator of the insured's ability to re-start the business and recover from the losses. For small, privately-owned dams that do not produce hydroelectric power, such as fire and farm ponds and dams used for recreation and irrigation, there are barriers to the availability of insurance: the reluctance of insurers to cover a risk that cannot be assessed with a

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reasonable degree of predictability; the consequential need for the insurer to base premium rates on worst-case scenarios; and the inability of small dam owners to pay for insurance.

Although aspects of the consequences of dam failure can be estimated in part, the probability of failure of a particular structure is virtually impossible to assess. The basic principles for making probability assessments exist but a methodology has not been applied to dams except in isolated incidents and in very simplistic forms. A risk assessment for dam safety must incorporate probability information such as historical failure data, structural resistance loads, and geological factors. It also must allow for uncertainties about loads (including those consequential to phenomena such as earthquakes). To remain accurate over time, a probability assessment must be updated to incorporate changes in the volume and quality of information about site conditions and structural properties.

Without credible probability assessments, and lacking the tools and methodologies with which to assess accurately the risk of losses, engineers and safety officials base priorities for dam inspection, maintenance, and remedial work on approximations established through technical studies. Studies to assess risk often are incomplete and almost always controversial. Different parties (owners, downstream residents, and contractors, for example) are affected differently by the outcome of such assessments. Thus, they tend to assess costs and risks differently, and they may select different criteria on which to base decisions.

Insurance companies may not accept the results of such studies because they traditionally do not view them as credible for insurance underwriting purposes. An important reason for this is the strong tendency, not reflected in studies, for businesses and individuals considered “poor risks” by the insurers to buy insurance against natural hazards more frequently than those considered “good risks.” This seems particularly true when the hazard is defined narrowly and geographically, as in the floodplain. People living in or near a floodplain will choose to buy flood insurance, while those outside the floodplain assume they are not at risk. This human, attitudinal phenomenon, termed “adverse selection,” obviates an acceptable spread of risk, results in an inadequate premium base, and makes it difficult for insurers to offer affordable rates. Insurance against dam failures is clearly subject to adverse selection.

The small dam owner nevertheless may be required by a financial institution to purchase insurance as a condition of a loan, and the insurance company must rate the property to support this requirement. Rating is subject to the uncertainties and extreme difficulty of assessing the risk of failure of dams, and often prompts insurance companies to retain independent engineering consultants to review the overall safety of an insured dam and its maintenance and monitoring programs. Insurance companies also review reports, studies, and other information available from regulatory agencies that have dam safety jurisdiction, particularly the Federal Energy Regulatory Commission.

V. CONCLUSIONS AND RECOMMENDATIONS

The analysis of data collected for this report indicates that insurance is available for dams owned by state and local governments. Most government entities insure their dam facilities (and associated liabilities) using the financial resources of the government. This appears to be adequate to meet most needs resulting from dam failures. For this reason, the Federal Emergency Management Agency (FEMA) recommends that no action be taken to expand the availability of dam insurance to this category of dam owners.

Similarly, there is no problem of availability associated with privately owned and operated dams used for revenue generation, such as those owned by hydroelectric power companies. The analysis demonstrates that nearly all revenue-generating facilities already possess dam insurance for their facilities. This is primarily because these owners/operators have the resources to pay for dam insurance through their revenue generation activities, and have an incentive to maintain such coverage to protect their investment and minimize business disruption costs. Because dam insurance coverage is maintained on most of these facilities, FEMA believes that there is no need to expand the availability of dam insurance to this segment of dam owners and operators.

The largest number of dams, however, are small and privately-owned. For the small dam owner, insurance is not readily available. The primary barrier to the availability of insurance for this type of dam is the lack of credible probability assessments to determine the risk of loss. Without credible probability assessments for dams, insurers are reluctant to cover risks that cannot be assessed with a reasonable degree of predictability. In turn, this leads to the insurer basing premium rates on worst-case scenarios, and the resulting inability of the small dam owner to afford insurance.

To facilitate decision-making on this issue, FEMA has undertaken a number of initiatives with industry, federal agencies, and the states through the Association of State Dam Safety Officials (ASDSO) to develop, collect, and analyze information on dam performance and failure rates. The primary mechanisms for data collection and analysis are the National Inventory of Dams (NID) and the National Performance of Dams Program (NPDP). The NID is a software-based update methodology for the electronic transfer of data from government agencies on the status of dams. Since 1994, the NPDP has served as the national archive of information on dam incidents. This fiscal year, the U.S. Army Corps of Engineers (USACE), which manages the NID, is pursuing cooperative projects with the NPDP to improve the compatibility, accessibility, and usefulness of data collected on dam performance and failure modes and rates.

Another activity to improve risk communication and information exchange is FEMA's investigation of the feasibility of showing dam-break inundation areas on the Flood Insurance Rate Maps (FIRMs), which are prepared by FEMA to delineate special flood hazard areas. In *The National Dam Safety Program: Dam Inundation Mapping Pilot Study* (January 1999), the conclusion was reached that there are no insurmountable technical obstacles to showing dam-

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break inundation zones on paper FIRMs or including them as a layer in the digital map process. However, comments were received during the course of the study that consistency in dam breach analysis methodology and selection of breach conditions is needed if the maps are to be used for insurance purposes. FEMA will address these and other issues with interested stakeholders, including its National Dam Safety Review Board, ASDSO, the USACE, and the Association of State Floodplain Managers.

Through the Interagency Committee on Dam Safety, FEMA also will fund a workshop in fiscal year 1999 to address the state-of-the-art practice and research needs in the area of dam safety risk analysis and risk assessment.

REFERENCES

Federal Emergency Management Agency. National Dam Safety Program 1996 & 1997: A Progress Report, FEMA Pub No. 337, November 1998.

Federal Emergency Management Agency. Safety of Non-Federal Dams: A Review of the Federal Role, FEMA Pub No. 31, November 1982.

Federal Emergency Management Agency. Water Control Infrastructure, National Inventory of Dams, 1992.

Federal Emergency Management Agency. The National Dam Safety Program: Dam Inundation Mapping Pilot Study, January 1999.

ATTACHMENT

List of Recipients of the Requests for Information

1. The Federal Insurance Administration, which in turn queried the National Association of Insurance Commissioners
2. Association of State Dam Safety Officials
3. Institute for Business and Home Safety
4. Alliance of American Insurers
5. American Institute for Chartered Property Casualty Underwriters
6. Penn Independent Corporation
7. Casualty Underwriters, Incorporated
8. Swett & Crawford Group
9. CIGNA's Special Risk Facilities
10. Fireman's Fund Insurance Company
11. Hartford Steam Boiler Group

