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DEFINING A FEDERAL AGENDA TO ENCOURAGE STRONG STATE PROGRAMS
AND OWNER RESPONSIBILITY FOR NON-FEDERAL DAMS

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I. Introduction

It is indeed a pleasure to be here at this dam safety workshop. This is the first opportunity to my knowledge, for technical people and other experts to come face to face with non-Federal dam owners and discuss the complex problems brought on by dam failures and unsafe dams. There are many questions and there are no easy answers. However, the public challenges us all to work out a solution which is acceptable to them, is fair to owners, is sensitive to State needs, and is politically and technically feasible.

The President, in establishing the new Federal Emergency Management Agency (FEMA), delegated lead agency responsibility for coordination of efforts to promote dam safety to the FEMA Office of Mitigation and Research. One aspect of FEMA's responsibility is encouraging and facilitating long-term dam safety programs within the private sector and the States.

As Chief of FEMA's Federal Dam Safety Program, I am committed to coordinate efforts among owners, State and local officials, engineering and other technical experts, professional organizations, and Federal agencies to promote programs which reduce the threat of dam failure to populations. But without the cooperation

and self-determination by those responsible for dam safety, the program will not work and public safety will be compromised. We cannot afford to rely on quick-fix solutions, triggered by catastrophic dam failures, if we ever expect to ensure long-term effective dam safety. The Federal Departments and agencies recognized the need to make many institutional changes to ensure continuous safety from Federally-built, -assisted, or -regulated dams following an extensive review of Federal agency dam safety procedures after the failure of Teton Dam.

The Federal agencies responsible for dams also recognize that, despite the application of sound dam safety procedures, the possibility of dam failure still exists. For this reason, each Federal agency now applies contingency planning at its dams to first prevent failure, if possible, and to minimize the public impact in event of failure.

States and private dam owners must recognize, too, that their dams can fail, that high-risk situations must be identified and responsibly dealt with, and that effective emergency planning can minimize loss of lives and property when failure occurs or becomes imminent.

II. Purpose and Guiding Principles

I would like to discuss three topics today: first, to characterize the nature and extent of "unsafe" non-Federal dams in the U.S.; second, to display the relevant problems and issues for discussion; and third, to recommend direction for resolving the issues. While it is assumed that the primary responsibility for dam safety rests with the dam owner, the public demonstratively expects (and demands) government to be vigilant to unreasonable risks which endanger life and property. Here the Federal Government supports a strong State role for ensuring that dam owners maintain high safety standards. When State programs are either weak or absent, data shows that dam safety suffers. In these States, the Federal Government has

assumed a limited responsibility to reduce or eliminate imminent public threats, while encouraging States and owners to act responsibly in the future. However, the Federal Government must proceed cautiously, even in emergency situations, so that States and owners do not forever become dependent on Federal assistance and excuse themselves from accepting responsibility. FEMA is currently in the process of defining an agenda to develop a national dam safety program where: (1) the public is educated about the potential hazards from dams, (2) owners are motivated to act responsibly, (3) States can achieve strong programs for ensuring responsible owner actions, and (4) the Federal Government can be a catalyst that leads to effective local control.

III. Background

Following the failure and disastrous consequences of the Buffalo Creek, West Virginia mine refuse embankment in 1972, Congress enacted the National Dam Inspection Act (PL 92-367) of August 1972. The law authorizes the Secretary of the Army, acting through the Chief of Engineers, to carry out a National Program of Inspection of Non-Federal Dams, generally 25 feet or more in height or impounding more than 50 acre-feet of water. An inventory of about 50,000 dams was completed and reported in 1975. The national inventory revealed that about 20,000 of the 50,000 dams were located where dam failure would cause loss of life and appreciable property damage. Although the authorizing legislation provided for the inspection on non-Federal dams, funds were not provided for the inspections. In 1977 following several dam failures and national publicity given these events, interest in implementing the national inspection program increased. Congress appropriated 15 million dollars in the 1978 Public Works Appropriation Act (Pl 95-96) to initiate a four-year inspection program, authorized under PL 92-367 and to update and verify the 1975 inventory of dams.

On 2 December 1977, in the wake of the Toccoa dam failure, the President announced that he had directed the Secretary of the Army to begin, at once, a four-year inspection program of about 9,000 non-Federal dams that represent a high potential for loss of life and property if they fail. The President stressed the importance of State cooperation during the four-year inspection program. He also emphasized that the Federal inspection program would not relieve the States or dam owners of their responsibilities for public safety. The President asked the Secretary of the Army (in cooperation with the Secretaries of Interior and Agriculture and the Science Advisor to the President) to report back to him within one year on the status of the inspection effort, the development of State programs, and the need for additional actions to assure national dam safety. A first year's (FY 78) progress report on 1793 inspections was sent to the President in March 1979. The Secretary of the Army submitted recommendations for future program actions in July 1979. A second year (FY 79) progress report issued in April 1980, indicated that 4388 dams had been inspected by September 30, 1979 at a cost of nearly \$40 million, or about \$8,600 per dam.

When all the high hazard dams are inspected by the end of FY 81, the Corps inspection program is expected to stop and the States are expected to conduct their own dam safety programs. Although the inspection program has probably saved many lives by preventing potential catastrophes and has stimulated significant improvement of the States' capabilities, there is no guarantee built into the inspection program for ensuring State program longevity, effectiveness, or 100 percent participation.

IV. Nature and Extent of Problem

The Corps of Engineers, in the National Dam Inspection Program, completed 6,692 inspections through October 31, 1980 and determined that 30 percent, or 2,008 dams, were unsafe.¹ One-hundred and one, or about 5 per cent, of the unsafe dams were found to require "emergency" action and the remaining 1,907 unsafe dams represented "non-emergency" conditions, predominantly a result of functional deficiencies such as inadequate spillway capacity.

Projection of this third year inspection data indicates that, for 8,600 high hazard category dams which will be inspected under the Corps programs, about 2,580 dams are unsafe. Similarly, for the total updated October 1980 inventory of 66,158 non-Federal dams in all hazard categories about 19,800 dams may be unsafe.²

The Federal responsibility for action under the PL 92-367 Inspection Program essentially ends after the inspection and notification of the investigation results to the Governor of the State in which any unsafe dam is located. In the event that a serious problem exists, the Corps would recommend necessary emergency actions or remedial measures. The responsibility for taking measures to mitigate the risk of failure rests with the State authorities and owners.

Potentially, 19,800 non-Federal dam owners could be affected by critical inspection findings--about 5 percent requiring emergency actions. There are few technically feasible options available to the owner of an unsafe dam. And there are even fewer financially or socially acceptable options. In situations where dam

^{1/} It is noteworthy that the reported cumulative proportion of unsafe to inspected dams increased from 20 to 29 percent, between the first and second years of the inspection program and has further risen to 30 percent during the third year.

^{2/} The projection of high hazard category inspection results to all dams is considered by some to be too conservatively high, since high hazard category inspection criteria would not be applied to lower hazard classification dams. However, the addition of 1600 new dams annually, the continuous trend of dams toward a higher classification because of downstream development, growing engineering conservativeness, and many more unclassified and smaller dams not inventoried by the Corps could offset this bias.

failure is imminent and the owner does not act voluntarily, the State may use its police power or other statutory authority to take emergency action, including emptying the impoundment or breaching the dam. First-year State and owner response to serious risks found in the Corps Inspection Program was outstanding, but has since declined. Where emergency actions were recommended to eliminate the potential for immediate failure of 26 unsafe dams during the first year of the inspection program, action was taken at 25 dams. Most actions involved draining or partial draining the reservoir. In one case, where recommended emergency action was refused by the dam owner, the State initiated court proceedings to compel the owner to take appropriate measures to eliminate the hazardous condition. October 1980 Corps inspection data show that 60, or 59 percent of the 101 emergency unsafe dams have been deactivated -- emergency actions at the remaining dams are required in only a handful of States. One state, Missouri, accounts for 30 emergency unsafe dams, and has 22 still requiring remedial action. A shortcoming of the Inspection Program is that there is no public assurance that the neutralized emergency condition will remain neutralized, except where States follow up with their own effective programs.

In non-emergency cases, the owner may elect to: (1) lower or empty the reservoir, (2) repair or eliminate the structural deficiency, (3) engineer measures to prevent failure in event of various stimuli, such as overtopping from flood, (4) abandon or sell the facility, (5) do nothing at the risk of State penalties or heavy claim liabilities in event of failure, or (6) contest inspection results with independent engineering review. In most cases there is a need for preserving the impoundments for vital public water supplies or for protecting other values. Therefore, draining and abandonment may not be acceptable solutions for non-emergency situations. Selling or doing nothing only transfers responsibility for or prolongs the public risk. Making needed

and expensive repairs or modifications is apparently beyond the financial means for many dam owners, who comprise a large body of local governments, homeowner associations, public cooperatives, and other non-Federal institutions. The Corps, State governors and officials, and engineers have expressed concern that there are potential problems with respect to the ability of dam owners to obtain financial resources for remedial work on dams. The problems were underscored in a few cases when some seriously unsafe dams necessitated draining the impoundment. Letters from several State governors to the Secretary of the Army reflect non-Federal attitudes and concern over financial difficulties.

Despite the application of accepted design, construction, and maintenance standards the possibility of Federal or non-Federal dam failures still exists. The probability for failure is expectedly higher for dams which remain functionally deficient. For these reasons, States should follow the Federal lead by requiring strong contingency measures, such as emergency action plans, for high hazard dams. Development of inundation maps, warning and notification systems, and evacuation plans, represents a temporary alternative for local officials to consider for functionally deficient dams located above populated areas while States develop long-term dam safety programs and until owners take necessary mitigation actions. Sufficient technology and limited Federal financial and technical assistance are available for local and State governments to develop programs. Some States (e.g. Calif., N.C., N.Y.) are developing or have developed guidelines for preparing emergency action plans at non-Federal dams.

The safety problem is compounded by potential interruption of public water supplies in event of failure or deliberate draining, in the case of village- or city-owned impoundments. Table 1 illustrates the severity of the problem by ownership class, based on first-year (FY 78) Corps inspection program data:

<u>Class of Owner</u>	<u>No. of Unsafe Dams</u>	
Villages, towns or cities	97	
County government	16	NOTE: 43% of unsafe dams are publically owned.
State government	40	
Company or corporation	87	
Private Developers	31	
Individuals	49	
Other (Social groups, churches country clubs, etc.)	34	
TOTAL	354	(20% of all dams inspected)

TABLE 1. OWNERSHIP CLASSIFICATION OF UNSAFE NON-FEDERAL DAMS BASED ON FY 78 CORPS INSPECTION PROGRAM (1793 DAMS INSPECTED THROUGH SEPTEMBER 1978)

More recent findings, based on second-year Corps inspection data for 4388 dams, show similar trends -- 569 dams or 48 per cent of 1184 unsafe dams are publicly owned by States, cities, counties, and water districts or utilities.

Engineering and repair of existing unsafe dams are expected to be very costly, depending on the nature of the deficiency problem. Based on private discussions with engineering consultants and State program officials, known costs appear to range between a few thousand dollars for detailed engineering studies to 2.5 million dollars for major rehabilitation. Meaningful data on these potential costs and the capability of the dam owners to make needed repairs and improvements need to be developed and analyzed. Assuming an average cost range of \$50,000 to \$500,000

to repair each of the projected 19,800 unsafe dams, the total national cost for all downstream hazard categories could approach \$1.0 to \$10 billion for engineering and construction. This assumed range of repair costs appears to be reasonable, based on limited sampling of recent data from some states and private engineering consulting firms. For example, one prominent consulting engineer in the Northeast, who is significantly involved in the Phase I Federal Dam Inspection Program, estimated Phase II cost ranges to be as follows for small- or intermediate- size dams located in drainage areas less than 10 square miles:

Phase II Investigation to Provide Adequate Spillway Capacity

	<u>Cost Range</u>
Engineering	\$ 15,000-\$30,000
Construction	\$100,000-\$400,00

Phase II Investigation Including Subsurface Investigation, Material Testing, and Analysis

	<u>Cost Range</u>
Engineering	\$ 30,000-\$60,000
Construction	\$200,000-\$400,00

Table 2 provides a sample listing of Phase II engineering and construction cost estimates for seven dams, determined to be unsafe in one state.

Using a \$5 billion present worth figure, 6 percent discount rate, and 50 years amortization period, the annual cost would exceed \$300M (excluding social costs from lost services during repair and assuming that few additional unsafe dams are discovered). In some cases, the expenditures can not be justified. Because of significant variation in State dam inventories and program effectiveness, annual cost among States could be expected to differ accordingly. For example, based on 6,692 inspections and 2,008 unsafe dams to date, two States and five territories report no unsafe dams, while only three States account for 627 or 31 percent, of all unsafe dams discovered.

TABLE 2. SAMPLE COST ESTIMATION - PHASE II INVESTIGATION OF DAMS IN A NORTHEASTERN STATE

<u>Cost Estimate</u>						
<u>Dam</u>	<u>Age (Years)</u>	<u>Height (Feet)</u>	<u>Capacity (Acre-Feet)</u>	<u>Owner</u>	<u>Scope of Phase II Work</u>	<u>Engineering</u> <u>Construction</u>
A	30	93	1600	Water Authority	Investigation Stability and Foundation Grouting	\$60,000 \$ 65,000
B	64	32	66	Water Authority	Inadequate Spillway	\$30,000 \$700,000
C	64	33	180	Water Authority	Inadequate Spillway	\$30,000 \$500,000
D	70	60	370	Water Company	Investigate Underseepage; Construct a Berm	\$50,000 \$200,000
E	20	33	711	State Fish Commission	Inadequate Spillway	\$15,000 \$100,000
F	21	95	3600	Land Developer	Embankment Seepage	\$50,000 \$ 50,000
G	7	65	2000	Land Developer	Embankment Seepage	\$35,000 \$ 20,000
Average						\$39,000 \$272,000

In the current Corps Inspection Program, information on follow-on actions at unsafe dams is being tabulated, only when made available by the States, but specific information such as disposition costs and funding sources has not been requested. Consequently, incomplete information about owner follow-up actions exists and little cost data is available.

V. The Issue

Since non-Federal dam safety is considered by the Federal Government to be a responsibility of the owner, it follows that he should first seek whatever assistance is needed—technical or financial—from private, State, or other non-Federal sources, for achieving and maintaining a safe structure. Any delay in remedying safety problems identified through inspection would unnecessarily prolong or increase the risk of dam failure affecting downstream life and property and public water services. However, many private and other non-Federal owners have expressed concern and difficulty in financing the restoration of unsafe dams to a safe condition. Some States feel that the Federal Government should provide the necessary resources for fixing unsafe dams because of the Federal Inspection Program. Several responsive proposals before Congress over the last couple years clearly demonstrate the strength of this feeling for ensuring public safety.³

The issue of repairing unsafe dams and defining Federal policy toward achieving national dam safety raises the following questions:

- A. How can the Federal Government encourage others (individual owners, States or public institutions) to reduce legitimate risks of and potential losses from dam failure?

^{3/} The U.S. Congress is currently considering actions for responding to the non-Federal dam safety problem by proposing a Senate Bill (S.703), Title III - Dam Inspection and Safety Program, which would amend Public Law 92-367. The proposed Bill contains several elements for assisting States and owners, including a revolving loan fund for dam repairs.

Similarly, what should the Federal Government do to remove any impediments which constrain others from taking mitigatory actions?

B. What legal, jurisdictional, or other institutional instruments control the procedures for reducing the risk of unsafe dams? What institutional factors such as available technical/financial assistance, regulation, court orders, codes and laws, directives, training programs, etc. need to be improved? How?

C. Given the current inventory of dams and inspection results, what are the owner and State needs for ensuring effective long-term dam safety? What are the currently available Federal-State-local programs and resources for assisting non-Federal owners to upgrade the safety of their dams? For developing and implementing emergency action programs? How could these programs be modified, supplemented, or replaced to serve dam safety purposes more efficiently and effectively?

D. How should any Federal actions and/or policies for reducing public risks from potential dam failure be structured to ensure that these programs stimulate long-term and effective owner and State responsibility?

E. Should Federal interest in unsafe non-Federal dams extend beyond the following:

1. Dams constructed with Federal assistance
2. Dams on Federal lands
3. Dams classified as high hazard potential to downstream people, property and lifelines

4. Dams providing vital public services

F. What should be the Federal role for ensuring future public safety below "low hazard" category dams, where downstream development pressure could raise the hazard classification to "high" and where design standards would be more demanding?

These and other questions about non-Federal dam safety have to be answered before any Federal policy role can be decided. Although there is evidence that some owners are having difficulty financing the repair of unsafe dams, there is little data available upon which to draw meaningful conclusions or to base Federal programs and policy. Clearly, the scope and magnitude of owner difficulties need to be documented.

VI. Future Direction--Information Needs and Recommended Study Tasks

Before an appropriate Federal role in non-Federal dam safety can be established, each of the major questions associated with unsafe non-Federal dams has to be examined and resolved. This complex issue cuts across many institutions--Federal and non-Federal. It is important that all affected Federal agencies, States, owners, the engineering profession, technical organizations, professional associations, and the general public have the opportunity to participate in reviewing the issue and in helping to answer the questions raised.

FEMA is considering meeting its responsibility for coordinating a practical solution to the problem of unsafe private dams by developing and supporting programs which determine and characterize: (1) the problems encountered by States and owners in achieving national dam safety, (2) the technical and financial needs beyond the

capacity or capability of State and private entities to assimilate, and (3) possible Federal program and policy actions for filling the gaps between owner needs and available non-Federal resources. The following task areas are being considered in FEMA's National Dam Safety Program for achieving these broad objectives:

TASK A. Review unsafe dams inspected and discovered to date to establish profiles of:

- Ownership (who owns the unsafe dams?);
- History of Federal technical or financial assistance for planning or constructing owners' dams;
- Financial base of owner (is there a problem in paying repair costs?);
- Revenue sources available to dam owner for financing engineering and modifications (including loans and grants; Federal and non-Federal);
- Estimates of total repair cost (rehabilitation engineering/construction);
- Economic and social factors to be considered in maintaining each dam in a safe condition after construction;
- Probable disposition of dam and resultant social and economic impact in event adequate financial assistance is not available to remedy and unsafe dams.

TASK B. Projection of the data base established in Task A for estimating the probable number and characteristics of all unsafe dams.

- TASK C. Perform in-depth survey of existing non-Federal and Federal programs under which an owner of an unsafe dam might apply for technical and financial assistance.
- TASK D. Develop alternative types of potential loan programs, including those administered by States and their political subdivisions and direct loan programs for owners of unsafe dams.
- TASK E. Develop criteria and conditions for administering any of the proposed loan programs.

Concluding Statement

During the six-year period 1972 through 1977, six major dam failures cost the U.S. nearly 500 lives and about \$2 billion in damages. The initiation of Federal reviews and non-Federal dam inspections indicates that these losses are not acceptable to the public. While there has been marked progress made toward improving non-Federal dam safety in the U.S. over the last three years, much more remains to be done. As the Chief of Arizona's Dam Safety Program, Mr. Benson Scott, recently put it, "We can not afford to take the position that dam safety as we're engaged in now is a 'one shot' program. Dam safety has to be a long range continuing effort because the basic problems with dams are related to aging, and are also intensified with increasing population densities." The Federal Government must continue to view non-Federal dam safety as a non-Federal responsibility. At the same time, the Federal Government should recognize its own appropriate responsibility to assure public safety and welfare by assisting States and owners to help themselves.