



FEMA

JUN 1 - 2009

To: Leeds, NRC

Richard W. Borchardt
Executive Director for Operations
United States Nuclear
Regulatory Commission
Washington, DC 20555

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Shoop, OEDO

Dear Mr. Borchardt:

The Dam Safety Act of 2006 (Public Law 109-460) requires the Department of Homeland Security, Federal Emergency Management Agency (FEMA) to submit a biennial report to the Congress that describes the status of the National Dam Safety Program, the progress achieved by the Federal agencies implementing the *Federal Guidelines for Dam Safety* during the period covered by the biennial report, and the progress achieved by States participating in the Program.

Enclosed for your reference is a copy of the biennial report for Fiscal Year (FY) 2006 and FY 2007. This biennial report describes achievements in meeting the objectives of Public Law 109-460. The final chapter of the report includes recommendations for strengthening the National Dam Safety Program and realizing the larger goal of reducing the risk posed by dams and keeping the American public safe from dam failure. The contributions of the United States Nuclear Regulatory Commission (NRC) to this goal and to the enclosed report are greatly appreciated.

If you have any questions regarding the biennial report, please have a member of your staff contact Frederick Sharrocks, National Dam Safety Program Manager, by electronic mail at frederick.sharrocks@dhs.gov.

Sincerely,

Deborah S. Ingram
Acting Deputy Assistant Administrator
for Mitigation
Mitigation Directorate

Enclosure

cc: George Wilson, NRC



Dam Safety in the United States

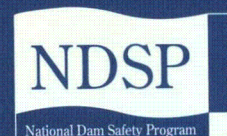
A Progress Report on the National Dam Safety Program

Fiscal Years 2006 and 2007

FEMA P-759 / February 2009



FEMA



Cover photo courtesy:
Folsom Dam, CA
Bureau of Reclamation

Preface

Dams are a vital part of our Nation's infrastructure, providing economic, environmental, and social benefits, including hydroelectric power, river navigation, water supply, wildlife habitat, waste management, flood control, and recreation. The benefits of dams, however, are countered by the risks they can present. In the event of a dam failure, the potential energy of the water stored behind even a small dam is capable of causing loss of life, significant property damage, and an extended period of denial of the services dams provide.

For almost 30 years, reducing the risk of dam failure has been the cornerstone and driving force of the National Dam Safety Program. The purpose of the National Dam Safety Program, as expressed in Section 215 of the Water Resources Development Act of 1996 (Public Law 104-303), 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." Central to the safety mission of the Program is ensuring that the public and property owners downstream of potentially deficient dams be informed of the risk from dam failure.

The objectives of the National Dam Safety Program are to:

- ensure that new and existing dams are safe through the development of technologically and economically feasible programs and procedures for national dam safety hazard reduction;

- encourage acceptable engineering policies and procedures to be used for dam site investigation, design, construction, operation and maintenance, and emergency preparedness;
- encourage the establishment and implementation of effective dam safety programs in each state based on state standards;
- develop and encourage public awareness projects to increase public acceptance and support of state dam safety programs;
- develop technical assistance materials for federal and state dam safety programs;
- develop mechanisms with which to provide federal technical assistance for dam safety to the non-federal sector; and
- develop technical assistance materials, seminars, and guidelines to improve security for dams in the United States.

This report to Congress describes the achievements of the states, the federal agencies, and their partners in Fiscal Year (FY) 2006 and FY 2007 in meeting these objectives and reducing losses from dam failure nationwide. The final chapter of this report includes recommendations for strengthening the National Dam Safety Program and objectives for the Program in FY 2008 and FY 2009 to realize the larger goal of keeping the American public safe from dam failure.

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Stonewall Jackson Lake and Dam, WV. Photo courtesy U.S. Army Corps of Engineers.

Executive Summary

This biennial report on the National Dam Safety Program for Fiscal Year (FY) 2006 and FY 2007 is submitted to Congress by the Federal Emergency Management Agency (FEMA).

Public Law 109-460, which reauthorized the National Dam Safety Program through FY 2011, continues all of the programs established by Section 215 of the Water Resources Development Act of 1996 (Public Law 104-303) and the 2002 reauthorization (Public Law 107-310) that have been serving to increase the safety of the Nation's dams. These programs include grants to the states for the improvement of state dam safety programs; training for state dam safety staff and inspectors; a program of technical and archival research; and funding to the U.S. Army Corps of Engineers for maintaining and updating the National Inventory of Dams. The Act of 2006 also continued the role of the National Dam Safety Review Board, which advises the Administrator of FEMA on national policy issues affecting dam safety. Chapter 2 of this report provides an overview of the requirements of the Dam Safety Act of 2006 and the leadership and management structure of the National Dam Safety Program.

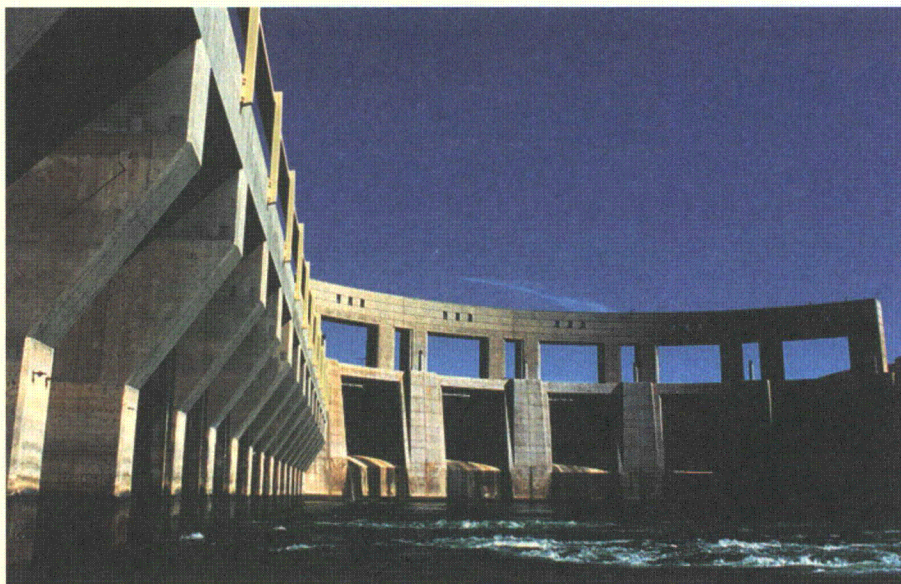
Since the National Dam Safety Program was first authorized more than 10 years ago, there have been improvements in the safety of many of our Nation's dams that are a result of National Dam Safety Program funding for state assistance, training, and research. Several dam incidents and failures over the past 2 years, however, have fixed national attention on the state of the overall dam infrastructure. Data indicate that the state of dam disrepair in the United States is now approaching a critical stage, with the number of dams identified as deficient (unsafe) increasing at a faster rate than dams being repaired. This report discusses the issues facing national dam safety and proposed solutions to these issues.

The data from the states for FY 2006 and FY 2007 present a complex portrait of dam safety today, revealing encouraging trends yet also continuing to give cause for concern because so much remains to be accomplished. In many ways, the data presented in Chapter 3 on the identification of deficient dams, implementation of emergency action plans for high-hazard potential dams, and dam inspections, mirror what is occurring in state dam safety programs across the United States: despite insufficient resources to address an increasingly aging and hazardous dam

infrastructure, state dam safety programs are nonetheless improving their ability to address these challenges.

For their part, the federal agencies that participate in the National Dam Safety Program and serve as members of the Interagency Committee on Dam Safety continue to implement the *Federal Guidelines for Dam Safety*, sharing resources and expertise whenever possible to further national dam safety. Although the Federal Government owns or regulates only about 5 percent of the dams in the United States, many of these dams are significant in terms of size, function, benefit to the public, and their hazard potential. Chapter 4 of this report describes the progress of the federal agencies in FY 2006 and FY 2007 and issues that the agencies continue to face in the operation and maintenance of their dams.

The majority of funding under the Dam Safety Act of 2006 is designated for state assistance. The Act also provides funds for the training of state dam safety staff and inspectors and for a program of technical and archival research, including the development of data collection tools for the continued monitoring of the safety of dams in the United States. Accomplishments in these areas during the reporting period are described in Chapter 5. Chapter 6 includes recommended changes for the National Dam Safety Program in FY 2008 and FY 2009 to realize the larger goal of keeping the American public safe from dam failure.



Parker Dam, AZ. Photo courtesy Bureau of Reclamation.

Introduction

This biennial report on the National Dam Safety Program for Fiscal Year (FY) 2006 and FY 2007 is submitted to Congress by the Federal Emergency Management Agency (FEMA). Section 215 of the Water Resources Development Act of 1996 (Public Law 104-303) states that the Director (now Administrator) of FEMA will submit a biennial report that describes the status of the National Dam Safety Program, the progress achieved by the federal agencies during the 2 preceding fiscal years in implementing the *Federal Guidelines for Dam Safety*, and the progress achieved by the states participating in the Program. The biennial report also is to include recommendations for legislative and other action that the Administrator considers necessary.

This biennial report, similar to previous reports, discusses many of the successes in national dam safety over the past 2 years. Unlike previous reports, this biennial report also focuses in greater depth on what must be accomplished over the short- and long-term to protect the American public from dam failure, including legislative changes to be implemented in the next reauthorization of the National Dam Safety Program.

Two major disasters during this reporting period refocused national attention on the state of our critical infrastructure

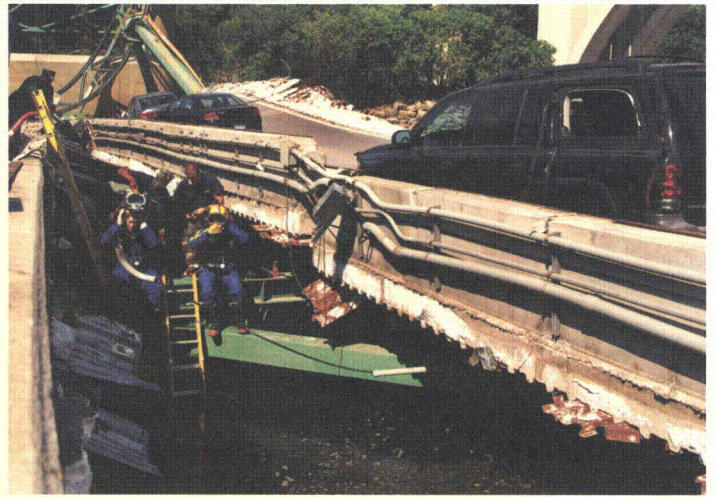
and raised questions on the safety of dams nationwide. On March 14, 2006, a century-old earthen dam on the Kaloko Reservoir on the island of Kauai, Hawaii, burst without warning shortly before 7:30 a.m. The flood from the dam failure raced downhill toward the town of Kilauea, with a wall of water reported to be between 20 to 70 feet high and 200 feet wide. The flood killed seven people, including a toddler and a pregnant woman, and swept several homes off their foundations. More recently, the 40-year-old I-35W bridge over the Mississippi River in Minnesota failed during rush hour, killing 13 people. Both of these disasters occurred without warning.

Data indicate that the state of dam disrepair in the United States is now approaching a critical stage, with the number of dams identified as deficient (unsafe) increasing at a faster rate than dams being repaired. There are more than 10,800 dams across the United States classified as high-hazard potential, meaning that they could cause loss of life if they fail. Of these dams, approximately 1,300 have been identified as deficient. The *American Society of Civil Engineers (ASCE) 2005 Report Card for America's Infrastructure*, which grades the Nation's infrastructure on a regular basis, gave dams a grade of "D."

During this reporting period, the caretakers of our Nation's dams, the owners, the regulators, emergency managers, and numerous other stakeholders, continued to make progress in areas critical to the safe operation and maintenance of dams. For example, data provided to the U.S. Army Corps of Engineers Dam Safety Program Management Tools (DSPMT) indicate that the number of Emergency Action Plans for state-regulated high-hazard potential dams has increased from 32 percent in 1999, the first full year of National Dam Safety Program funding, to 51 percent in 2006. Data from the DSPMT also indicates that the states are continuing to increase their inspections of dams. This data is particularly impressive given that the average dam inspector in the United States is responsible for more than 400 dams (the Association of State Dam Safety Officials recommends that each inspector be responsible for less than 50 dams). It is a continuing tribute to the dedication and hard work of these caretakers that there has not been greater loss of life and damage to property and the environment from a dam failure during this reporting period.

While the data reveal encouraging trends in many areas, the larger picture of dam safety remains problematic at best. FEMA, as the lead agency for the National Dam Safety Program, strongly believes that the most important message to be taken away from this report is the following: many Americans are living below structurally deficient high-hazard potential dams; they are unaware of the risk; there is no plan in place to evacuate them to safety in the event of a failure; or there is a plan in place but they are not aware of it. There is an immediate need to address these issues.

The following sections of this report provide a background on the National Dam Safety Program, describe the progress of states and federal agencies participating in the Program, and describe accomplishments realized in the past 2 years in the Program areas of research, training, and data collection and analysis. The final section of this report discusses specific recommendations to help ensure that no loss of life occurs from a dam failure over the course of the next reporting period.



Minneapolis, MN, Aug. 07, 2007 - Navy divers from Naval Amphibious Base Little Creek, Va., prepare to enter the water at the site of the I-35 bridge collapse over the Mississippi River. Photo courtesy U.S. Navy, Mass Communication Specialist Seaman Joshua Adam Nuzzo.



Anzalduas Dam, TX. Photo courtesy International Boundary & Water Commission.

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The National Dam Safety Program

Water is one of the most powerful natural forces to shape the American landscape and one of our most precious resources. To ensure the continued benefits from our rivers, dams and other water control structures have been built to manage water and keep rivers in their channels.

Collectively, American rivers are the most closely controlled hydrological system of its size in the world. Today, dams are a critical and vital part of the American infrastructure.

For almost 30 years, reducing the risk of dam failures has been the cornerstone of the National Dam Safety Program. In the 1970's, a series of catastrophic dam failures was the driving force behind federal and state initiatives leading to the creation of a national program to ensure the safety of America's dams. On February 26, 1972, a tailings dam owned by the Buffalo Mining Company in Buffalo Creek, West Virginia, failed, devastating a 16-mile valley with 6,000 inhabitants. In a matter of minutes, 125 people were killed, 1,100 people were injured, and over 3,000 were left homeless. On June 5, 1976, Teton Dam, a 123-meter high earthfill dam on the Teton River in Idaho, failed, causing \$1 billion in damage and leaving 11 dead. Over 4,000 homes and over 4,000 farm buildings were destroyed as a result of the Teton Dam failure. In November 1977, Kelly Barnes Dam in Georgia failed, killing 39 people, most of them

college students. According to statistics from the Association of State Dam Safety Officials (ASDSO), there were 28 dam failures in the United States from 1874 to 1979, resulting in 3,424 deaths.

Congress first authorized the National Dam Safety Program in 1996.¹ The passage of the 1996 Act reflected the culmination of years of collaborative effort on the part of many in the dam safety community to codify the National Dam Safety Program. Since then, Congress has reauthorized the Program twice, most recently in 2006 (Public Law 109-460).

The Dam Safety Act of 2006

On December 22, 2006, the Dam Safety Act of 2006 (Public Law 109-460) was signed into law. Public Law 109-460, which reauthorized the National Dam Safety Program through Fiscal Year (FY) 2011, continues all of the programs established by the 1996 Act and the 2002 reauthorization that have been serving to increase the safety of the Nation's dams. These programs include grants to the states for the improvement of state dam safety programs; training for

¹ Executive Order 12148, which created FEMA, also provided that the Director of FEMA would coordinate all federal efforts in dam safety.

state dam safety staff and inspectors; a program of technical and archival research; and funding to the U.S. Army Corps of Engineers for maintaining and updating the National Inventory of Dams (NID). The Act of 2006 also continued the role of the National Dam Safety Review Board, one of whose functions is to provide the Administrator of the Federal Emergency Management Agency (FEMA) with advice on national policy issues affecting dam safety.

Leadership and Management of the National Dam Safety Program

Federal Emergency Management Agency

Dam safety is not solely a federal, state, or local issue. The safety of a dam can affect persons and property across local, state, and even national borders. An incident in one area can affect commerce, navigation, and power generation and distribution, or it can cause severe damage in another area. As a result, there is a reasonable federal role to coordinate federal, state, and local efforts to provide dam safety to citizens.

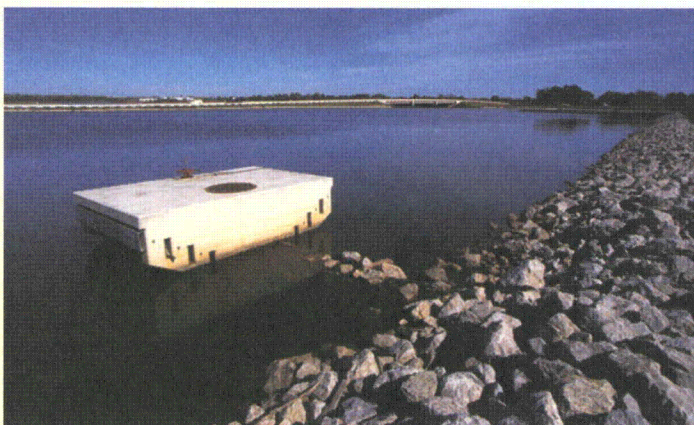
Under the leadership of FEMA, the states, federal agencies, professional organizations, and others are working in collaboration to encourage individual and community responsibility for dam safety.

Two federal organizations that play an important role in guiding the direction of the National Dam Safety Program are the National Dam Safety Review Board (Review Board) and the Interagency Committee on Dam Safety (ICODS), both of which are chaired by FEMA.

National Dam Safety Review Board

Authorized under Public Law 104-303, Public Law 107-310, and now Public Law 109-460, the Review Board provides the Administrator of FEMA with advice in setting national dam safety priorities and considers the implications of national policy issues affecting dam safety. The Review Board also helps oversee the development and support of state dam safety programs by reviewing state progress toward meeting all of the criteria listed in Public Law 104-303, assisting FEMA in the review of state dam safety programs, and establishing the reasonable costs of implementing a state dam safety program.

The membership of the Review Board includes the representative from FEMA (the Chair of the Board); representatives from four federal agencies that serve on ICODS; five members selected by the Administrator of FEMA from among dam safety officials of the states; and one member selected by the Administrator of FEMA to represent the private sector.



This step baffle trash rack on the spillway inlet of Boomer Lake prevents floating debris from plugging the inlet by forcing the water to enter upwards through baffles. Water entering the trash rack flows through the principal spillway conduit to the stream channel downstream of the dam. Photo courtesy USDA, ARS, Scott Bauer.

The primary mechanism for planning and implementing the majority of work conducted under the National Dam Safety Program are the Work Groups that operate under the Review Board. The three standing Work Groups are the Dam Safety Research Work Group, the Dam Safety Training Work Group, and the Work Group on the NID. To address specific projects or requirements, the Review Board establishes Task Groups and Steering Committees.

Interagency Committee on Dam Safety

ICODS, which was established in 1980 and meets quarterly, encourages the establishment and maintenance of effective federal programs, policies, and guidelines to enhance dam safety, and serves as the permanent forum for the coordination of federal activities in dam safety. ICODS, which was formally established by Public Law 104-303 in 1996, is composed of representatives from all the federal agencies that build, own, operate, or regulate dams.

ICODS Agencies

- U.S. Department of Agriculture
- Department of Defense
- Department of Energy
- Department of the Interior
- Department of Labor, Mine Safety and Health Administration
- Department of Homeland Security, Federal Emergency Management Agency
- Federal Energy Regulatory Commission
- Department of State, International Boundary and Water Commission (U.S. Section)
- Nuclear Regulatory Commission
- Tennessee Valley Authority

Non-Governmental Organizations

A number of non-governmental organizations, companies, universities, and individuals are involved in dam safety. Engineering consulting firms design, oversee construction and rehabilitation, and at times inspect dams for owners or regulators. Those in academia conduct research and teach the next generation of dam safety engineers. All are active stakeholders in the dam safety community.

The leading advocate for state dam safety programs is ASDSO. Founded in 1984, ASDSO is a national non-profit organization of more than 2,400 state, federal, and local dam safety professionals and private sector individuals dedicated to improving dam safety through research, education, and communications. ASDSO represents the dam safety programs of the states with the goal of saving lives, preventing damage to property, and maintaining the benefits of dams by preventing dam failures. ASDSO was very active in FY 2006 and 2007 with activities undertaken on behalf of the states and with initiatives funded under the National Dam Safety Program.

Another pre-eminent professional organization is the United States Society on Dams (USSD). The USSD, which was established in the early 1930's, focuses on dams and water resources development. USSD represents the United States as one of the 82 member countries of the International Commission on Large Dams and has served as the private sector member of the Review Board since its establishment in 1998.

National and International Organizations

- American Consulting Engineers Council
- American Public Works Association
- American Society of Civil Engineers
- Associated General Contractors of America, Inc.
- Association of State Floodplain Managers
- Earthquake Engineering Research Institute
- Electric Power Research Institute
- International Association of Emergency Managers
- National Association of Counties
- National Conference of State Legislatures
- National Emergency Management Association
- National Hazards Research and Applications Information Center
- National Society of Professional Engineers
- National Watershed Coalition
- Portland Cement Association

The Dam Safety Act of 2006

Purpose

The purpose of the National Dam Safety Program 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.”

Objectives

The objectives of the National Dam Safety Program are to:

- ensure that new and existing dams are safe through the development of technologically and economically feasible programs and procedures for national dam safety hazard reduction;
- encourage acceptable engineering policies and procedures to be used for dam site investigation, design, construction, operation and maintenance, and emergency preparedness;
- encourage the establishment and implementation of effective dam safety programs in each state based on state standards;
- develop and encourage public awareness projects to increase public acceptance and support of state dam safety programs;
- develop technical assistance materials for federal and state dam safety programs;
- develop mechanisms with which to provide federal technical assistance for dam safety to the non-federal sector; and
- develop technical assistance materials, seminars, and guidelines to improve security for dams in the United States.

Initiatives

FEMA carries out a number of initiatives, summarized below, in its leadership of the National Dam Safety Program:

- Establish a National Dam Safety Review Board to monitor the safety of dams in the United States, to monitor state implementation of the National Dam Safety Program, and to advise FEMA on implementation of the National Dam Safety Program.
- Exercise leadership by chairing the Interagency Committee on Dam Safety to coordinate federal efforts in dam safety.
- Transfer knowledge and technical information among the federal and state sectors.
- Provide for the education of the general public, state and local officials, and private industry on the hazards of dam failure and related matters.
- Provide funding to the states to establish and maintain dam safety programs through a grant assistance program.
- Provide training for state dam safety staff and inspectors.
- Establish a program of technical and archival research to develop:
 - improved techniques, historical experience, and equipment for rapid and effective dam construction, rehabilitation, and inspection;
 - devices for the continued monitoring of the safety of dams;
 - the maintenance of information resources systems needed to support managing the safety of dams; and
 - initiatives to guide the formulation of effective public policy and advance improvements in dam safety engineering, security, and management.
- Report to Congress (biennially) on the status of the National Dam Safety Program, the progress achieved by federal agencies during the 2 preceding fiscal years in implementing the *Federal Guidelines for Dam Safety*, and the progress achieved in dam safety by states participating in the Program.



June 2006, Lake Needwood in Maryland has risen to 25 feet above normal.
Photo courtesy of FEMA.

State Dam Safety

Overview

The importance of the funding provided to participating states under the National Dam Safety Program cannot be overstated. The states, which regulate 86 percent of the approximately 83,000 dams listed in the National Inventory of Dams (NID), are responsible for assuring the safety of these dams (see the next Chapter for a definition of the dams included in the NID). Figure 1 shows the distribution of state-regulated dams across the United States.

According to reports submitted by the 50 state dam safety programs, the number of deficient dams has risen by 85 percent (from 1,818 to 3,361) since 1998. This increase dwarfs the modest gains in the number of state-regulated dams undergoing repairs. Most of these deficient dams (70 percent) are classified as high- or significant-hazard potential, meaning that loss of life or significant property damage is expected in the event of dam failure.

There also is concern over the significant increase in the number of high-hazard potential dams nationwide whose failure would cause loss of life. Since 1998, the number of state-regulated high-hazard potential dams has increased from 9,175 to 9,849 (see Figure 2). This increase is

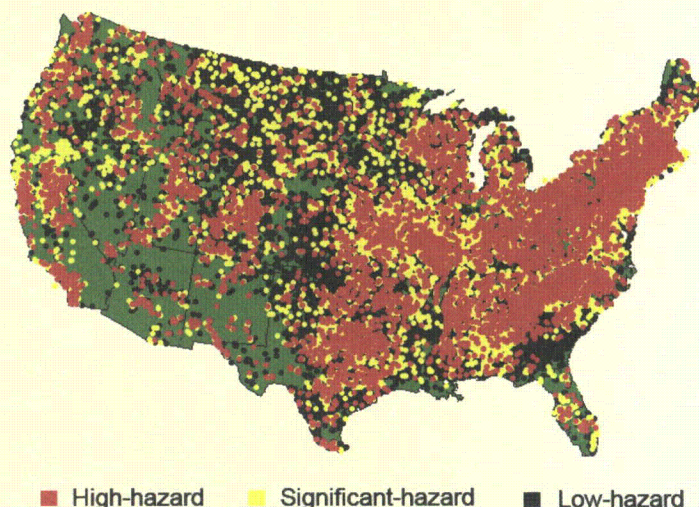


Figure 1: State-Regulated Dams in the United States

Source: NID/DSPMT

primarily caused by increased development downstream of existing dams. While the majority of these dams meet safety standards, their potential to cause loss of life demands stringent oversight, an often overwhelming challenge for state dam safety programs. For example, New York oversees the safety of 1,906 dams with only 8 full-

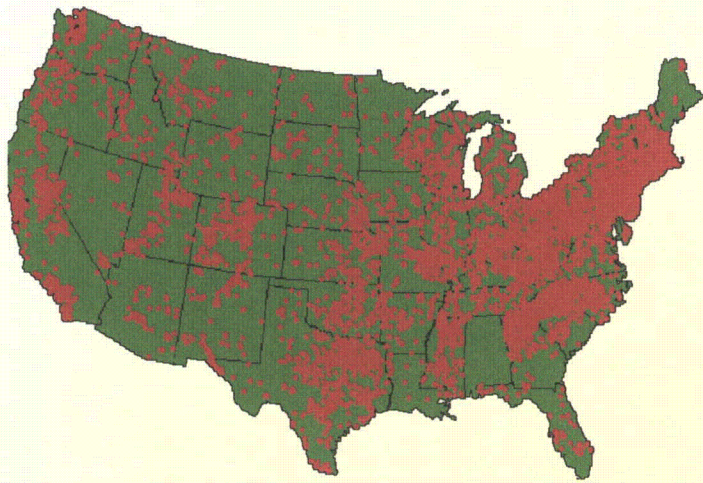
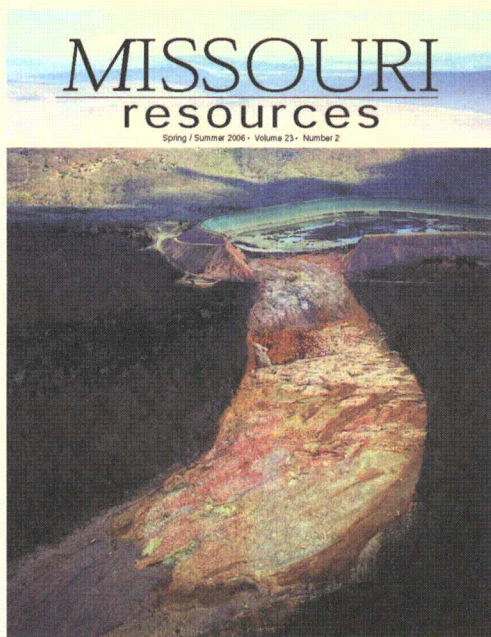


Figure 2: State-Regulated High-Hazard Potential Dams (9,849 Dams)

Source: NID/DSPMT

time employees. Maine has 1 dam inspector responsible for more than 800 dams. In Texas, 7 employees are responsible for approximately 7,000 dams.

Since the National Dam Safety Program was first authorized more than 10 years ago, there have been significant improvements in the safety of many of our Nation's dams that are a direct result of National Dam Safety Program funding for state assistance, training, and research. However, several dam incidents and failures over the past 2 years have again fixed national attention on the state of the overall dam infrastructure and illustrate the need for greater resources for state programs. In October 2005, the downtown area of Taunton, Massachusetts, was evacuated



Cover of the Missouri Resources magazine featuring an article about the Taum Sauk Reservoir failure. Image Courtesy of Missouri Department of Natural Resources.

because of fears that the 173-year-old Whittenton Pond Dam on the Mill River would fail. In December 2005, the Taum Sauk Dam in Missouri failed, releasing a billion gallons of water in 12 minutes and sending a 20-foot crest of water down the Black River. In March 2006, the century-old earthen dam on the Kaloko Reservoir on the island of Kauai, Hawaii, burst without warning, killing seven people. In July 2006, the Lake Needwood Dam in Rockville, Maryland, developed severe leakage as the lake rose 23 feet above normal pool. About 2,200 people were evacuated from their homes.

The data for Fiscal Year (FY) 2006 and FY 2007 that are discussed below present a complex portrait of the state of dam safety today. The data reveal encouraging trends yet also continue to give cause for concern because so much remains to be accomplished. In many ways, the data mirror what is occurring in state dam safety programs across the United States: despite insufficient resources to address an increasingly aging and hazardous dam infrastructure, state dam safety programs are nonetheless consistently improving their ability to address these challenges.

The State Assistance Program

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With the exception of Alabama, all of the states and Puerto Rico have regulatory programs in place for dam safety and participate in the National Dam Safety Program. A goal of the National Dam Safety Program is for Alabama to enact legislation so that it can participate, and bring the number of participating States to 50. Although the programs vary in the scope of their authority, program activities typically provide for the safety evaluation of existing dams, review of plans and specifications for dam construction and major repairs, periodic inspections of construction on new and existing dams, and review and approval of Emergency Action Plans (EAP's).

The state assistance component of the National Dam Safety Program is intended to help states bring the necessary resources to bear on inspection, classification, and emergency planning for dam safety. The nature of this program allows the states to identify their own priorities where dams are concerned and to take appropriate action according to available resources.

For a state to be eligible for assistance under the National Dam Safety Program, the state dam safety program must be working toward meeting the following criteria:

- The authority to review and approve plans and specifications to construct, enlarge, modify, remove, and abandon dams;

- The authority to perform periodic inspections during dam construction to ensure compliance with approved plans and specifications;
- A requirement that state approval be given on completion of dam construction and before operation of the dam;
- The authority to require or perform the inspection at least once every 5 years of all dams and reservoirs that would pose a significant threat to human life and property in case of failure to determine the continued safety of the dams and reservoirs, and a procedure for more detailed and frequent safety inspections;
- A requirement that all inspections be performed under the supervision of a state-registered professional engineer with experience in dam design and construction;
- The authority to issue notices, when appropriate, to require owners of dams to perform necessary maintenance or remedial work, revise operating procedures, or take other actions, including breaching dams when necessary;
- Regulations for carrying out the legislation of the state;
- The provision for necessary funds to ensure timely repairs or other changes to or removal of a dam to protect human life and property, and if the owner of the dam does not take the action described above, to take appropriate action as expeditiously as possible;
- A system of emergency procedures to be used if a dam fails or if the failure of a dam is imminent; and
- An identification of each dam whose failure could be reasonably expected to endanger human life, the maximum area that could be flooded if the dam failed, and public facilities that would be affected by the flooding.

For a state to qualify for assistance, state appropriations must be budgeted to carry out the legislation of the state. Figure 3 below shows the status of state compliance in 2007 with the Association of State Dam Safety Officials (ASDSO) Model State Dam Safety Program, FEMA 316. Green indicates that the state has all of the characteristics of the model program; blue indicates that the state has most

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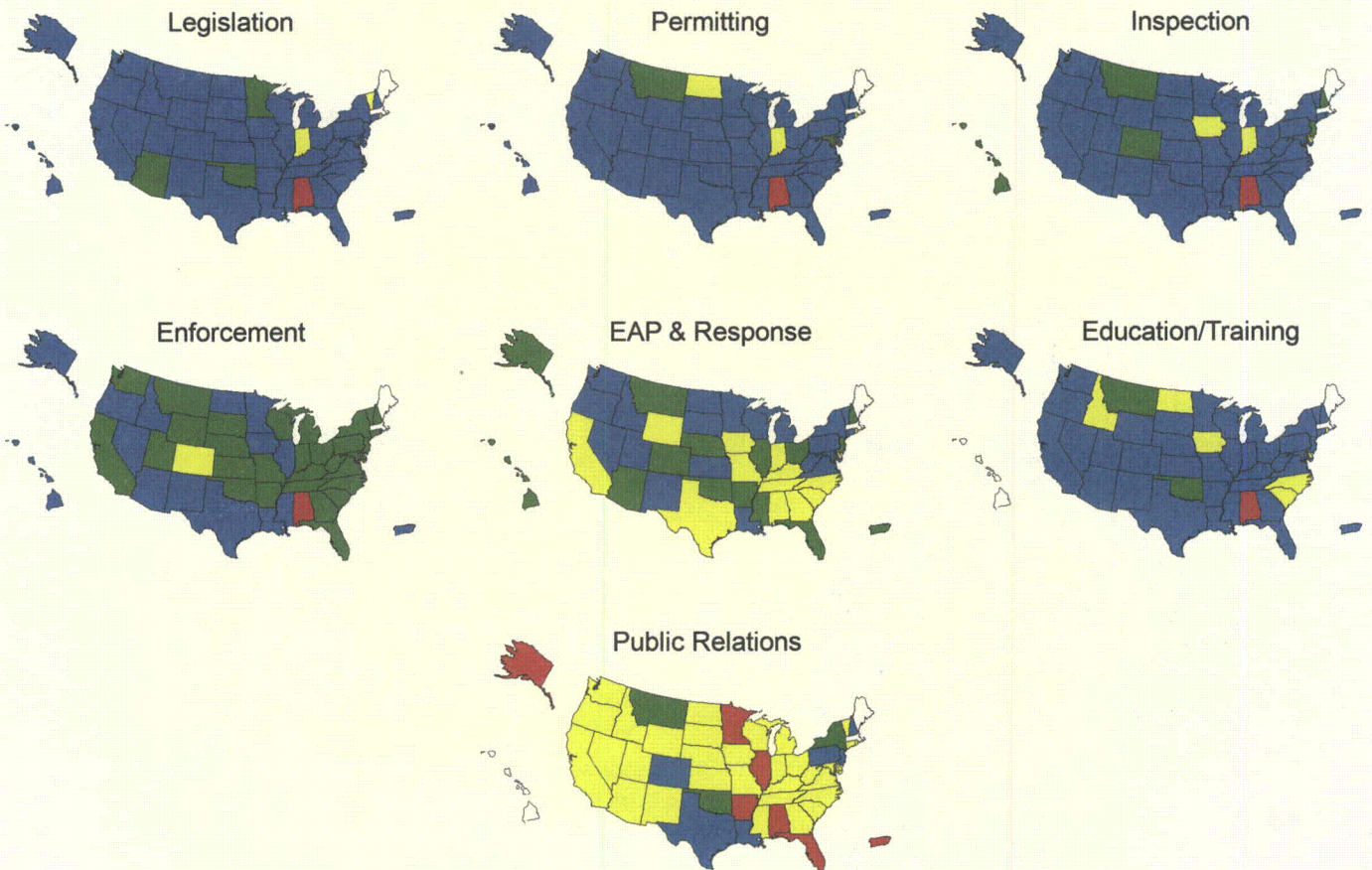


Figure 3: Summary of State Compliance with ASDSO Model State Dam Safety Program Requirements

Source: NID/DSPMT

(more than one-half) of the characteristics; yellow indicates that it has some (less than one-half) of the characteristics; red indicates that the state has no characteristics of the model program; and white indicates that the state did not respond to any of the questions. The greatest degree of compliance is in the area of enforcement and the least degree of compliance is in the area of public relations.

The combined FY 2006 and 2007 awards, which are based on the total number of all dams (low-, significant-, and high-hazard potential) the state reports to the NID, ranged from \$44,915 for Puerto Rico (reporting 33 dams in FY 2006 and 35 dams in FY 2007) to \$471,235 for Texas (reporting 7,029 dams in FY 2006 and 6,912 dams in FY 2007). The average annual state grant award was approximately \$65,000.

State Assistance in FY 2006 and 2007

Table 1 below lists the state assistance grant amounts (combined) allocated by the Federal Emergency Management Agency (FEMA) for FY 2006 and 2007. For both fiscal years, FEMA awarded approximately \$6.4 million in grant funds to the 49 states and Puerto Rico that participate in the National Dam Safety Program. Annual state funding has remained at approximately \$3.2 million since FY 2003, and has actually decreased since FY 2002.

State Performance in FY 2006 and 2007

In 2005, the National Dam Safety Review Board (Review Board) established performance measures for the National Dam Safety Program that are focused on reducing loss of life and property damage from dam failures. The performance measures include the identification of deficient dams, the number of dam inspections, and the number of EAP's for high-hazard potential dams. These performance measures have been incorporated into the

Table 1: State Assistance in FY 2006 and FY 2007

State	FY 2006/2007 Awards (in combined \$)	State	FY 2006/2007 Awards (in combined \$)
Alabama*	0	Nebraska	178,315
Alaska**	23,814	Nevada	70,082
Arizona	58,652	New Hampshire	82,234
Arkansas	112,784	New Jersey	92,387
California	119,139	New Mexico	64,013
Colorado	145,015	New York	159,300
Connecticut	85,935	North Carolina	205,867
Delaware	45,100	North Dakota	91,702
Florida	88,973	Ohio	136,986
Georgia	282,460	Oklahoma	327,367
Hawaii	50,628	Oregon	94,902
Idaho	64,217	Pennsylvania	124,282
Illinois	126,243	Puerto Rico	44,915
Indiana	100,074	Rhode Island	54,044
Iowa	242,709	South Carolina	184,244
Kansas	389,420	South Dakota	185,774
Kentucky	100,118	Tennessee	80,296
Louisiana	70,282	Texas	471,235
Maine	58,858	Utah	87,388
Maryland	61,869	Vermont	64,559
Massachusetts	133,071	Virginia	126,776
Michigan	92,987	Washington	84,391
Minnesota	97,871	West Virginia	69,882
Mississippi	249,604	Wisconsin	101,762
Missouri	82,227	Wyoming	127,971
Montana	203,532		

*Alabama does not participate because it does not have a legislatively mandated state dam safety program.

**Alaska did not request its FY 2007 grant. The funds were divided equally between Illinois, Oregon, and New Hampshire.

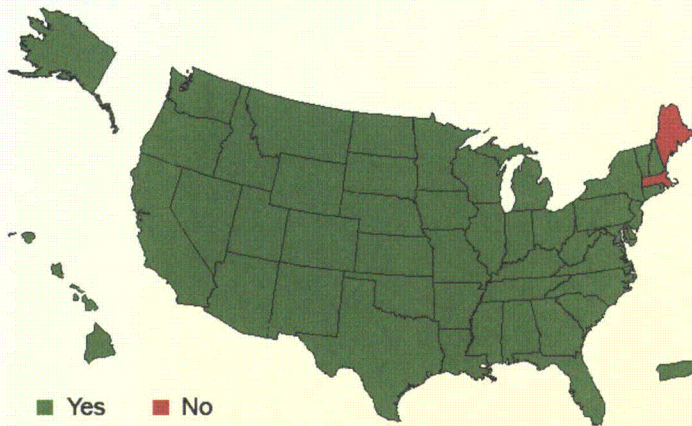


Figure 4: States Providing Performance Data to the DSPMT in 2007

Source: NID/DSPMT

Strategic Plan for the National Dam Safety Program and are being tracked by the Dam Safety Program Management Tools (DSPMT). The DSPMT, which is updated and maintained by the U.S. Army Corps of Engineers (Corps), is funded in part by the National Dam Safety Program as the tool for tracking the progress of states participating in the National Dam Safety Program. Figure 4 shows the states providing performance data to the DSPMT in 2007.

14

Dams in Need of Remediation

FY 1998 and 1999 was the first period for which the states provided FEMA with data on remediation needs; the number of dam inspections conducted each year; and the status of dams with EAP's by hazard potential classification. Figure 5 shows the number of state-regulated high-hazard potential dams in need

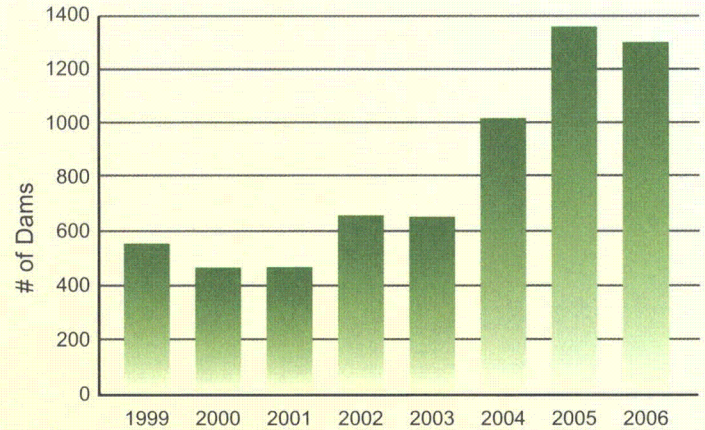


Figure 5: State-Regulated High-Hazard Potential Dams in Need of Remediation: 1999-2006

Source: NID/DSPMT

of remediation for the period 1999-2006. Figure 6 shows past and projected numbers of state-regulated high-hazard potential dams in need of remediation.

As illustrated by Figure 5, the number of dams in the United States identified to be in need of remediation is increasing exponentially as a result of a combination of factors, including more dams in the inventory, more inspections being performed, better inspections, better reporting of inspection results, aging infrastructure, and increased remediation backlog.

The number of dams being remediated each year is significantly less than the number of dams identified to be in need of remediation. This is illustrated in Figure 7, where the percentage of remediated state-regulated high-

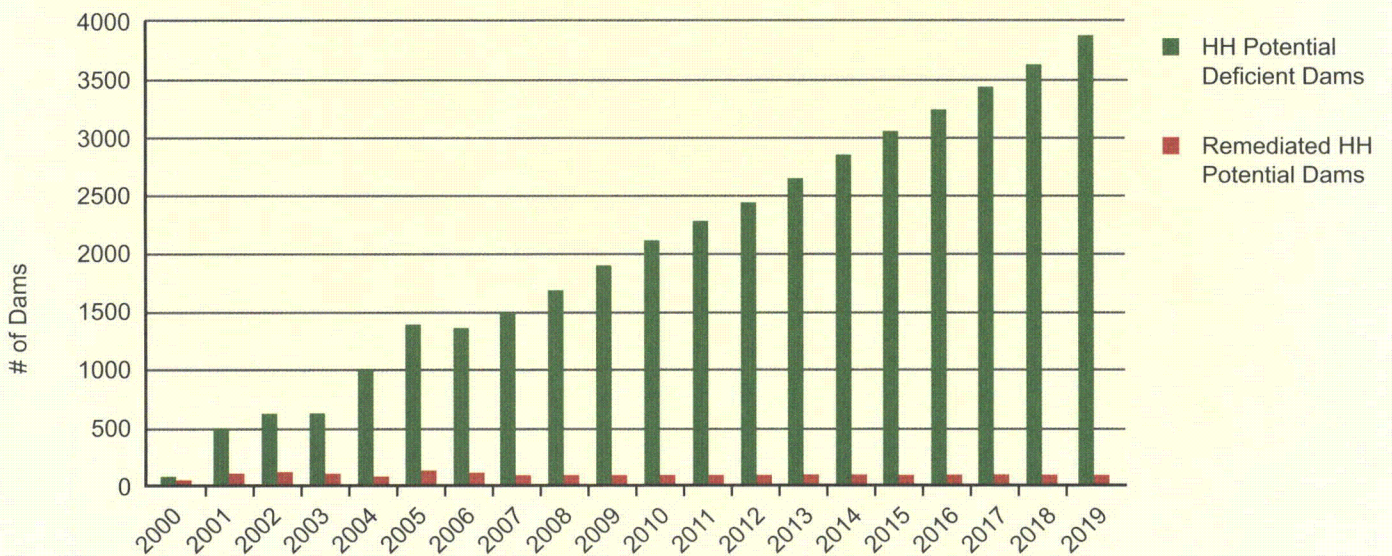


Figure 6: Past/Projected Number of State-Regulated High-Hazard Potential Dams in Need of Remediation: 2000-2019

Source: NID/DSPMT

hazard potential dams has actually decreased from approximately 30 percent of those identified to be in need of remediation in 2000 to 10 percent of those identified to be in need of remediation in 2005.

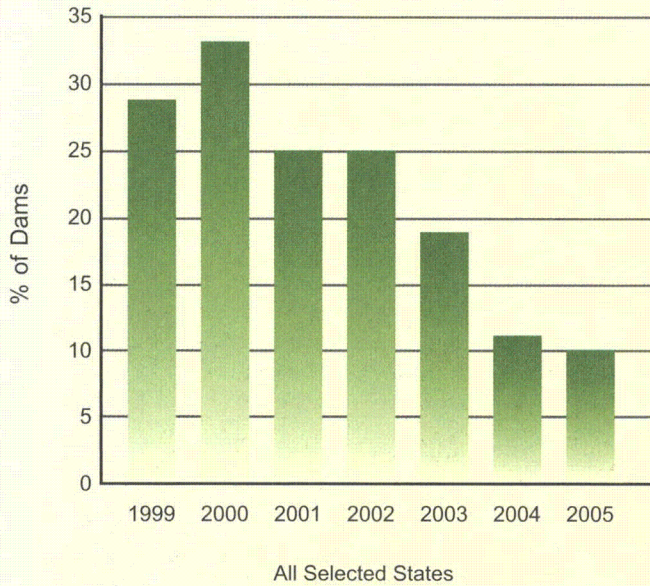


Figure 7: State-Regulated High-Hazard Potential Dams in Need of Remediation Which Were Remediated: 1998-2005

Source: NID/DSPMT

Dam Inspections

The number of inspections of state-regulated high-hazard potential dams increased from the last reporting period, to approximately 6,300, and has increased dramatically since data was first collected for 1998-1999 (see Figure 8), following the trend in the number of high-hazard potential dams. As the number of high-hazard potential dams has increased, so has the number of inspections being performed. The data provided by the states on their mandated inspection frequencies and the number of inspections actually being performed indicate that the states are currently performing the required number of inspections. Improvement in this area will be possible only by encouraging increases in mandated inspection intervals, as shown in Figure 9.

Figure 10 provides a summary of expectations on the number of inspections of state-regulated high-hazard potential dams, reflecting a target of close to 10,000 inspections, based upon an ideal target of annual inspections for high-hazard potential dams (as specified in the ASDSO Model State Dam Safety Program).

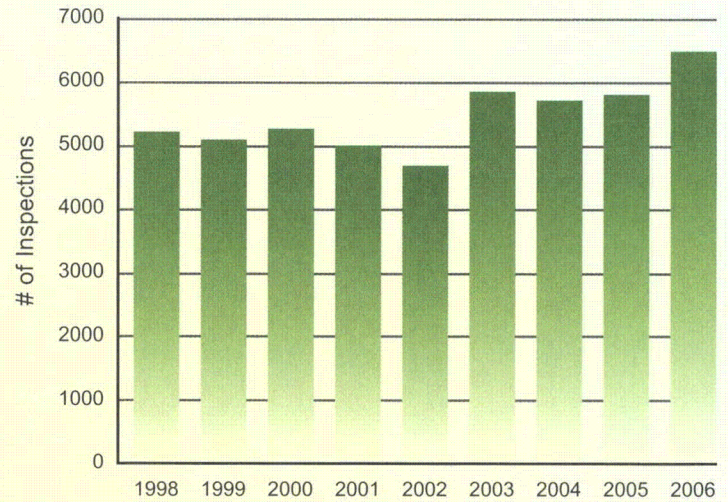


Figure 8: Inspections of State-Regulated High-Hazard Potential Dams

Source: NID/DSPMT

Emergency Action Plans

An EAP is one of the primary safeguards against the loss of life and property damage that can result from the failure of a high-hazard potential dam. Since the establishment of the National Dam Safety Program in 1979, both the state and federal sectors have made significant progress in increasing the number of state-regulated high-hazard potential dams with EAP's. The dam safety community recognizes, however, that much more must be done to reach the goal established in January 2006 by the National Dam Safety Review Board: achieve 100 percent compliance for EAP's for high-hazard potential dams.

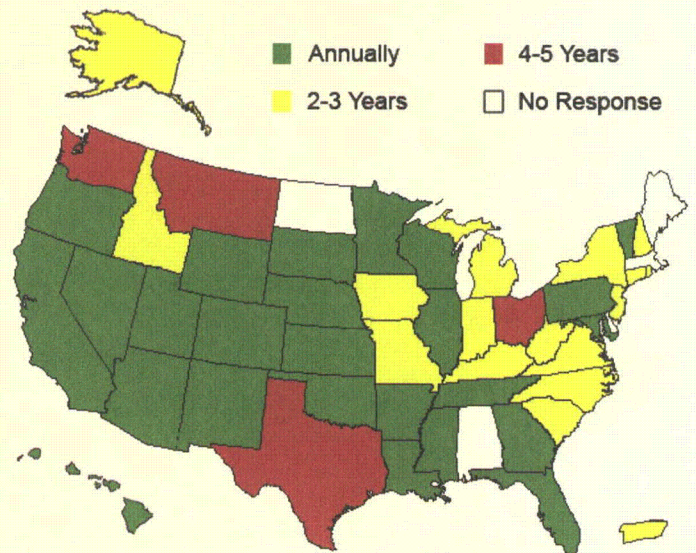
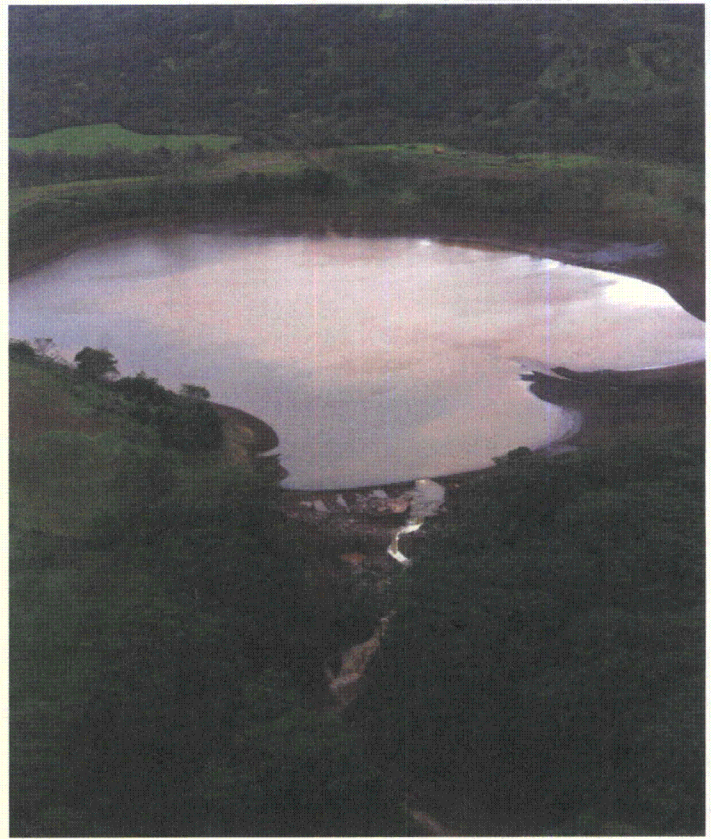


Figure 9: Inspection Intervals for State-Regulated High-Hazard Potential Dams

Source: NID/DSPMT

When the Review Board met in October 2005, the losses from Hurricane Katrina had just exposed significant failures in the Nation's emergency planning and response system. The failure of the emergency management system to respond quickly and effectively to the disaster brought to the forefront the need for all hazard areas, including dam safety, to refocus their attention on this critical requirement. For the dam infrastructure, the need for emergency action planning is heightened by the aging of dams in the United States.

To address these issues, the Review Board established the Task Group on Emergency Action Planning and Response in January 2006. In September 2006, the Task Group completed *Emergency Action Planning for State-Regulated High-Hazard Potential Dams: Findings, Recommendations, and Strategies*. This document, which was approved by the Review Board in October 2006, served as the basis for the Task Group Action Plan for future initiatives in emergency action planning. The top priority identified in the Action Plan is the development of an outreach and marketing campaign to promote the implementation of EAP's for state-regulated high-hazard potential dams.



The breach on the 400 million gallon Kaloko Reservoir on Kauai's North Shore, HI. Image Courtesy of Bruce Asato, The Honolulu Advertiser.

16 Each annual reporting period, the states have reported increases in the number of state-regulated high-hazard potential dams with an EAP (see Figure 11). Figure 12 shows the location of state-regulated high-hazard potential dams across the United States with an EAP.

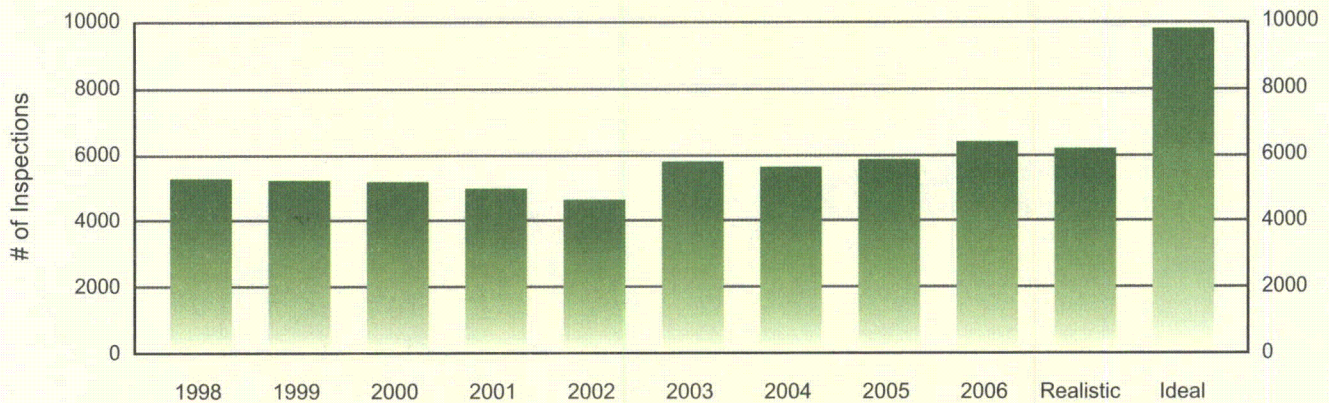


Figure 10: Summary Expectations on Number of Inspections of State-Regulated High-Hazard Potential Dams

Source: NID/DSPMT

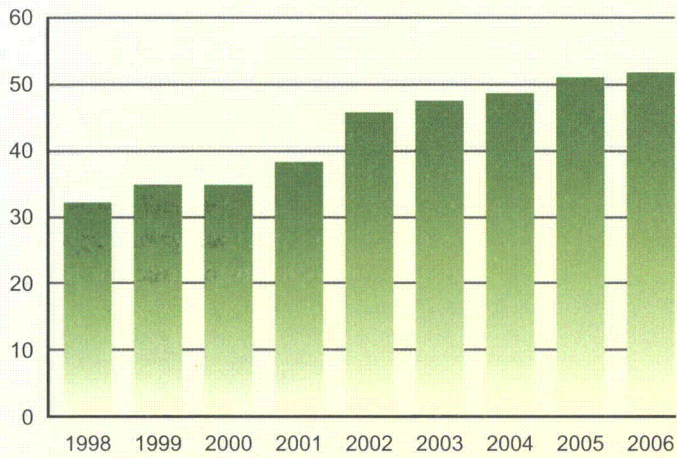


Figure 11: EAP Completion Percentage for State-Regulated High-Hazard Potential Dams

Source: NID/DSPMT

Today, approximately one-half of all state-regulated high-hazard potential dams have an EAP. The current EAP completion percentage is obtained by dividing the current number of state-regulated high-hazard potential classification dams with an EAP (4,845 dams) by the total number of state-regulated high-hazard potential classification dams (9,525 dams), which equals approximately 51 percent (see Table 2 and Figure 13). Data from the DSPMT indicate that state-regulated high-hazard potential dams which do not require EAP's (3,051) are not a significant contributor to the number of dams without EAP's (see Figure 15). The largest contributor to dams without EAP's is simply state-regulated dams for which an EAP has not been prepared. The most significant return on

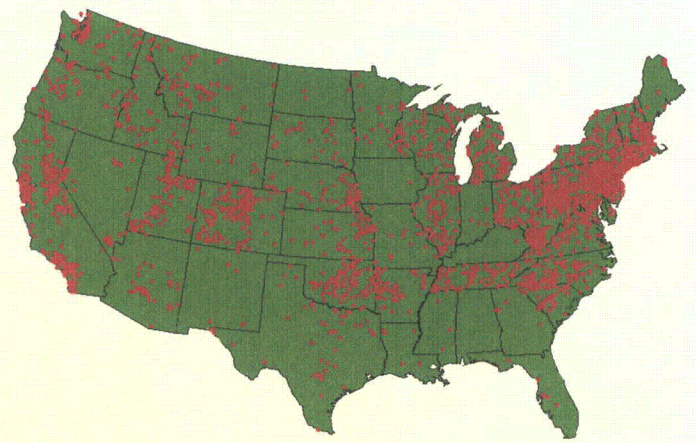


Figure 12: State-Regulated High-Hazard Potential Dams with an EAP

Source: NID/DSPMT

investment for EAP preparation would be in those states shown in Figure 14 that have dense concentrations of red dam locations. This will result in an EAP completion percentage of approximately 69 percent.

Table 3 in Appendix B shows the summary status of state dam safety programs for the year ending in 2006.

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The United States suffered large and tragic dam failures in the 1970's that focused the Nation on the need for dam safety and prompted Congress to pass national dam safety legislation. Recent dam failures continue to demonstrate the enormous potential damages that dam failures can produce. Dam failures do not respect state boundaries, as a dam

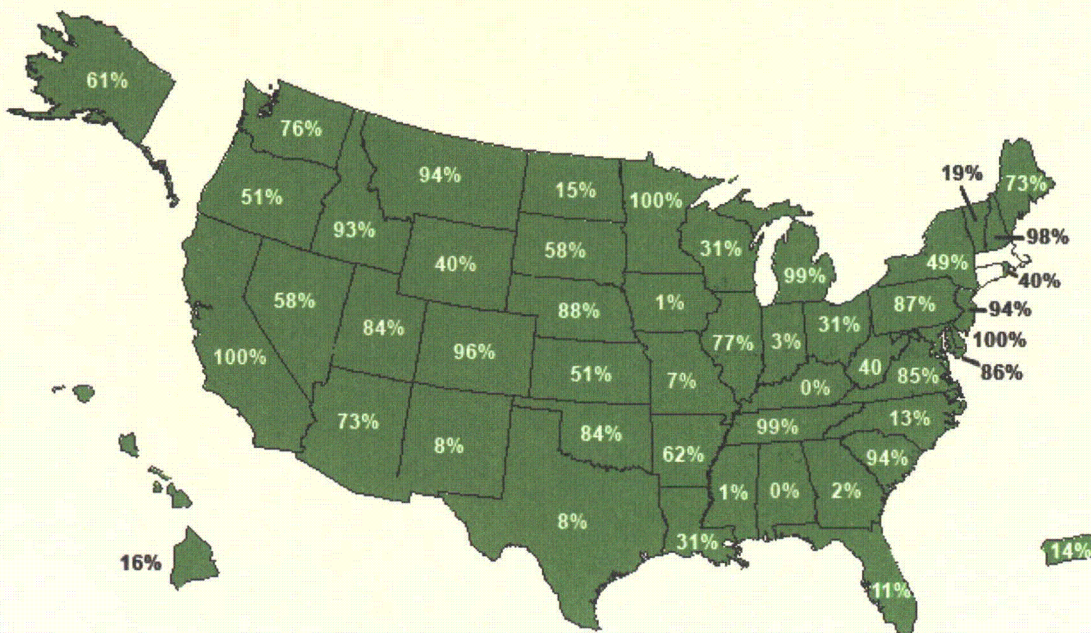


Figure 13: Percentage of State Regulated High-Hazard Potential Dams with an EAP

Source: NID/DSPMT

Table 2: State-Regulated High-Hazard Potential Dams with an EAP

State	Authority to Require EAP?	# NID High-Hazard Potential (HHP) Dams	# NID HHP Dams with EAP	% of HHP Dams with EAP
Mississippi	Yes	294	4	1.4
New Mexico	Yes	166	14	8.4
Florida	Yes	70	8	11.4
Puerto Rico	Yes	34	5	14.7
Hawaii	Yes	74	12	16.2
Massachusetts	Yes	296	75	25.3
Louisiana	Yes	16	5	31.3
Wisconsin	Yes	192	61	31.8
Ohio	Yes	412	131	31.8
West Virginia	Yes	366	148	40.4
New York	Yes	369	182	49.3
Oregon	Yes	114	59	51.8
Kansas	Yes	160	83	51.9
Nevada	Yes	131	77	58.8
Alaska	Yes	18	11	61.1
Arkansas	Yes	144	90	62.5
Connecticut	Yes	218	155	71.1
Arizona	Yes	93	68	73.1
Maine	Yes	19	14	73.7
Washington	Yes	147	113	76.9
Illinois	Yes	185	143	77.3
Oklahoma	Yes	166	140	84.3
Maryland	Yes	66	57	86.4
Pennsylvania	Yes	781	681	87.2
Nebraska	Yes	116	103	88.8
Idaho	Yes	76	71	93.4
Montana	Yes	102	96	94.1
New Jersey	Yes	200	189	94.5
Colorado	Yes	312	301	96.5
New Hampshire	Yes	75	74	98.7
Michigan	Yes	135	134	99.3
Minnesota	Yes	34	34	100.0
Alabama	No	0	0	0.0
Kentucky	No	252	0	0.0
Iowa	No	78	1	1.3
Georgia	No	405	10	2.5
Indiana	No	254	8	3.1
Missouri	No	245	19	7.8
Texas	No	817	69	8.4
North Carolina	No	999	134	13.4
North Dakota	No	19	3	15.8
Vermont	No	51	10	19.6
Rhode Island	No	15	6	40.0
Wyoming	No	71	29	40.8
South Dakota	No	51	30	58.8
Utah	No	217	183	84.3
Virginia	No	138	118	85.5
South Carolina	No	158	149	94.3
Tennessee	No	149	148	99.3
Delaware	No	9	9	100.0
California	No	340	340	100.0

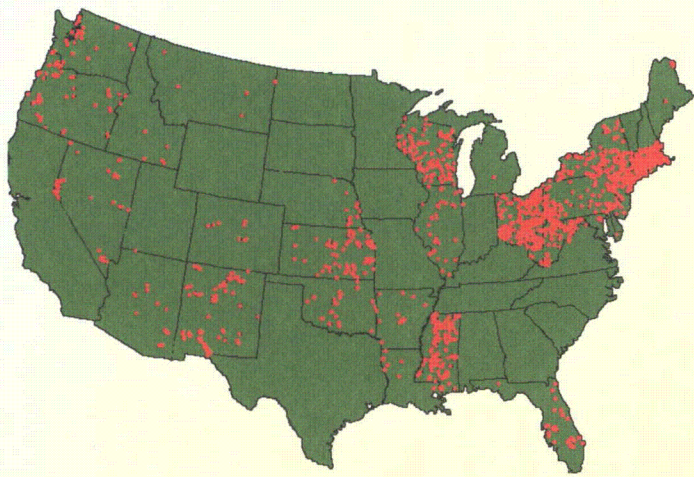


Figure 14: State-Regulated High-Hazard Dams without an EAP (EAP Required by Law)

Source: NID/DSPMT

failure in one state may cause loss of life and property damage in an adjacent state. Including recovery costs from the President's disaster relief fund and the Flood Insurance Program, the cost of one small dam failure can easily exceed the annual costs of a fully funded National Dam Safety Program.

Annual state assistance under the National Dam Safety Program has remained at approximately \$3.2 million since FY 2003, and has actually decreased since FY 2002. The states, which regulate the majority of dams in the Nation, face significant challenges resulting from limited staff and

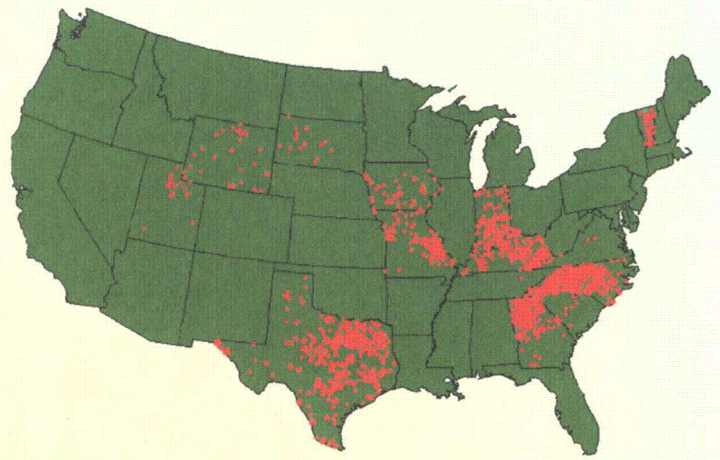


Figure 15: State-Regulated High-Hazard Dams without an EAP (EAP Not Required by Law)

Source: NID/DSPMT

funding. The states must hire more dam safety inspectors, conduct more emergency planning for dams, and perform more enforcement of deficient structures.

It is a reasonable expectation of every American to be protected from preventable disasters such as dam failures. The National Dam Safety Program is a valuable, modest program and a prudent investment in public safety. Full funding of the National Dam Safety Program is an investment in public safety that will be repaid many times over in fewer dam failures, reduced federal expenditures for dam failure recovery and, most importantly, fewer lives lost.

Federal Agency Programs

Overview

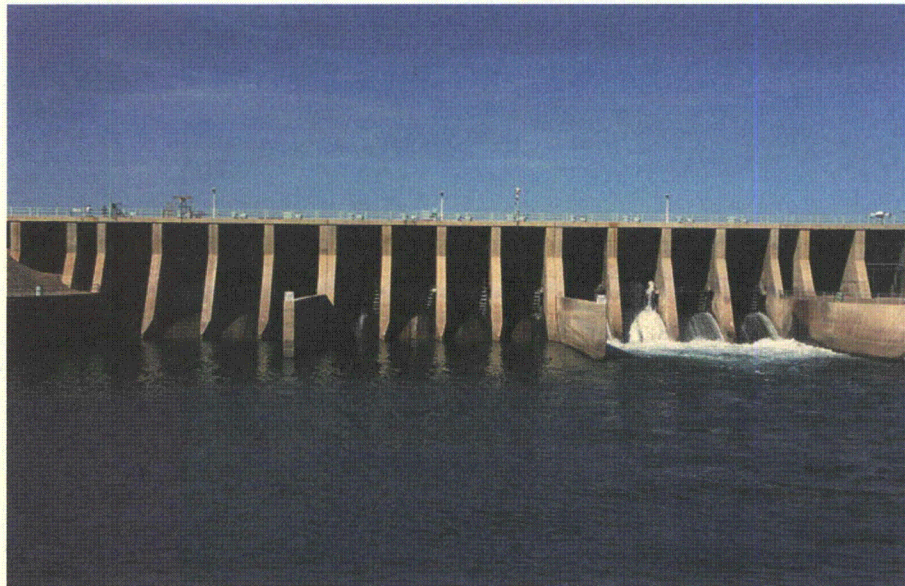
Although the Federal Government owns or regulates only about 5 percent of the dams in the United States, many of these dams are significant in terms of size, function, benefit to the public, and their hazard potential (see Figure 16).

The October 4, 1979, Presidential memorandum that directed federal agencies responsible for dams to adopt and implement the *Federal Guidelines for Dam Safety (Guidelines)* also directed the heads of these agencies to submit progress reports to the Director of the Federal Emergency Management Agency (FEMA). Since that initial report in 1980, the Director (now Administrator) of FEMA has solicited follow-up progress reports from the agencies at 2-year intervals. Below is a description of federal agency responsibilities for dam safety.

Federal Agency Responsibilities

U.S. Department of Agriculture

The U.S. Department of Agriculture (USDA) is a major planner, designer, financier, constructor, owner, or regulator of more than one-third of all the dams in the United States



Imperial Dam, AZ. Photo courtesy Bureau of Reclamation.

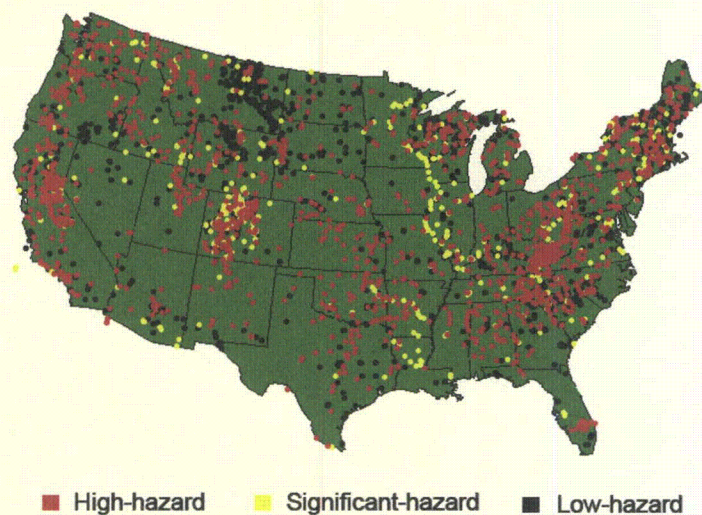


Figure 16: Dams Provided to the NID by the Federal Agencies (5,895 Dams)

Source: NID/DSPMT

included in the National Inventory of Dams (NID). USDA dams provide livestock water, municipal water and wastewater, electric power, flood protection, irrigation, fish and wildlife habitat, recreation, sediment detention, and manure storage and treatment. Six USDA agencies are involved with dams.

Agricultural Research Service (ARS) conducts internationally recognized research in hydrologic, hydraulic, erosion, and sedimentation processes applicable to dams. ARS owns and operates only one NID-size dam at one ARS research facility, and it may be decommissioned in the near future. ARS utilizes Natural Resources Conservation Service (NRCS) engineering assistance for the inspection and maintenance of the dam.

Farm Services Agency (FSA) provides financial assistance for dams through loans, loan guarantees, and grants to farmers and ranchers for land and water resource conservation or natural disaster recovery. FSA financial assistance is limited and typically provides only a small portion of the cost of small dams.

U.S. Forest Service (FS) manages more than 192 million acres of public lands in 44 states on national forests and grasslands. The FS designs, finances, constructs, owns, operates, maintains, and regulates dams in conjunction with the management of national forests and grasslands. FS owns 546 NID-sized dams and administers permits for 1,212 privately-owned NID-sized dams. For the permitted dams, the dam owner designs, constructs, and operates the dam, and FS reviews and approves activities related to the safety of the dam.

Natural Resources Conservation Service (NRCS) designs, finances, and constructs dams under its technical and financial assistance programs for individuals, groups, organizations, and governmental units for water storage, sediment detention, and flood protection. NRCS does not own, operate, maintain, or regulate any dams, except for one dam located on a NRCS Plant Materials Center. NRCS has provided technical assistance for almost 27,000 NID-sized dams and financial assistance for over 11,000 of these dams (see Figure 17).

Rural Housing Service (RHS) finances dams through loans, loan guarantees, and grants to public entities, local organizations, and non-profit corporations for rural community facilities. RHS does not design, construct, own, or operate dams. Less than 30 NID-size dams are financed under this program.

Rural Utilities Service (RUS) finances dams through loans and loan guarantees under its Electric Program to cooperative associations, public bodies, and other utilities in rural areas for hydroelectric and thermal electric power plants. RUS also finances dams through loans, loan guarantees, and grants to rural communities under its Water and Waste Program for water and

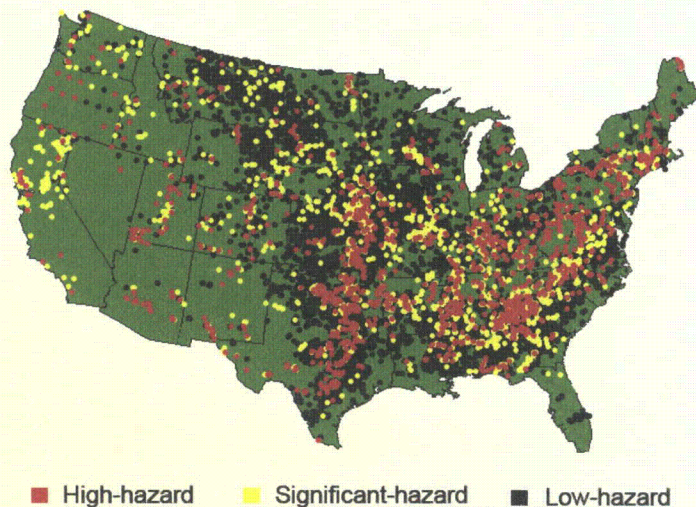


Figure 17: Dams Reported to the NID by the USDA/NRCS (26,822 Dams)

Source: NID/DSPMT

wastewater facilities. Less than 60 NID-sized dams are financed under former or current programs.

All projects financed by the Electric Program are inspected periodically. If maintenance is required, it is made known to the borrowers. All borrowers have Emergency Action Plans (EAP's) in place and are required to evaluate those EAP's annually. The evaluation includes actual or simulated drills.

In May 2005, RUS Water and Waste Program began requiring all borrowers to develop Volunteer Assessments and Emergency Response Plans for systems they financed. The State office is responsible for ensuring that Water and Waste borrowers comply with this requirement.

Department of Defense

The Department of Defense (DoD) is involved extensively with dams as a permitter, owner, manager, planner, designer, constructor, and financier. There are four DoD agencies responsible for, or involved with, dams.

Department of the Air Force (Air Force) is responsible for dams located on Air Force bases in the continental United States. The Air Force, which has jurisdiction over 23 dams, is requesting approval to remove 2 dams from its inventory: Reclamation Dam Edwards Air Force Base and Stables Dry Dam.

Department of the Army (Army) is responsible for dams that are on Army installations or controlled by Army installations. The Army has jurisdiction over 213 dams.

Department of the Navy (Navy) has dam safety responsibility for dams located on Navy bases. There are 31 candidate dams under Navy jurisdiction for safety inspections.

U.S. Army Corps of Engineers (Corps) has a diverse inventory of more than 600 dams. The dams provide a variety of project purposes, including navigation, flood control, water supply, irrigation, hydropower, recreation, environmental, and combinations of these purposes. Corps dams vary in age from over 100 years to less than 10 years. Most have not been filled to their maximum design event.



Seven Oaks Dam, CA. Photo courtesy U.S. Army Corps of Engineers.

Department of Energy

The Department of Energy (DOE) owns and has jurisdiction of 15 dams at 3 sites.

Department of the Interior

As the Nation's principal conservation agency, the Department of the Interior (DOI) is responsible for most of the U.S.-owned public lands and natural resources. Through its Bureaus, DOI is responsible for the planning, design, construction, operation, and maintenance of nearly 2,000 dams.

Bureau of Indian Affairs (BIA) has 859 dams on Indian reservations, 126 of which are classified as high- and significant-hazard potential. DOI BIA maintains overall Safety of Dams (SOD) program responsibility and works with Indian Tribes and Tribal Nations to operate and maintain these dams. During the reporting period, three dams were reclassified as high- or significant-hazard potential and two dams were reclassified as low-hazard potential.

Bureau of Land Management (BLM) is responsible for DOI BLM-owned dams on public lands in 11 Western States, including Alaska. DOI BLM has 590 dams, 8 classified as high-hazard potential and 1 classified as significant-hazard potential. In addition, 315 private/permitted dams reside on DOI BLM-administered lands.

Bureau of Reclamation (Reclamation) is a federal water resource management and development bureau authorized to operate in 17 Western States. The DOI Reclamation inventory consists of 479 dams and dikes located throughout the West. Approximately one-half of these are more than 50 years-old and about 90 percent were built before the adoption of many of the state-of-the-art design and construction practices used today.

U.S. Fish and Wildlife (FWS) operates facilities associated with fish and wildlife conservation and wildlife dependent recreation. DOI FWS dams and water control structures are located on National Wildlife Refuges, waterfowl production areas, and National Fish Hatcheries. DOI FWS has 193 dams, 15 of which are classified as high-hazard potential and 18 as significant-hazard potential.

National Park Service (NPS) is charged with minimizing the risk posed by dams and water impoundment structures to DOI NPS natural and cultural resources, facilities, personnel, and visitors. While direct responsibility for the safety of all Park facilities rests with the individual DOI NPS superintendents, the SOD Program is responsible for enabling and facilitating implementation of departmental manual guidance on dam safety. The DOI NPS has direct ownership of 16 high-hazard, 33 significant-hazard, and 453 low-hazard potential dams (not counting water impoundment structures other than dams). During the last 2 years, 27 new structures have been added, 5 structures reclassified, and 2 structures deactivated.

Office of Surface Mining (OSM) oversees dams under its authority as federal regulators under the Surface Mining Control and Reclamation Act of 1977. DOI OSM does not own any dams. DOI OSM oversees 73 dams, 8 of which are classified as high-hazard potential and 12 of which are classified as significant-hazard potential.

U.S. Geological Survey (USGS) owns and maintains one high-hazard potential embankment dam.

Department of Labor, Mine Safety and Health Administration

The Department of Labor responsibility for dam safety is vested in the Mine Safety and Health Administration (MSHA), which receives its authority and responsibility for regulating safety and health-related aspects of the miners' working environment from the Federal Mine Safety and Health Act of 1977 (30 U.S.C. 801). The Act requires the Secretary of Labor to develop and promulgate improved mandatory health or safety standards to protect the health and safety of the Nation's coal miners or other miners. The Act specifically includes "impoundments, retention dams, and tailing ponds" as part of a "coal or other mine." MSHA reports 650 dams under Coal Mine Safety and Health, a decrease of 84 dams from the previous report. The number of dams reported at Metal and Nonmetal mines is 1,604, more than twice the number reported in Fiscal Year (FY) 2004 and 2005. This significant change results from the increased emphasis that MSHA has placed on dam safety.

Department of State, International Boundary and Water Commission

The Department of State responsibility for dam safety is vested in the International Boundary and Water Commission (IBWC). The IBWC, which is composed of a U.S. Section (USIBWC) and a Mexican Section, is charged with carrying out the provisions of a number of treaties between the United States and Mexico. Among its responsibilities, IBWC has jurisdiction over two large international storage dams and four small diversion dams on the Rio Grande and Colorado Rivers. The USIBWC also is responsible for the maintenance of the American Dam and five sediment and flood control dams owned by the Caballo Soil and Water Conservation District, which is not fully international in nature.

Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is authorized by the Federal Power Act to issue licenses to individuals, corporations, states, and municipalities to construct, operate, and maintain dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary for the development of non-federal hydroelectric projects on (1) navigable streams; (2) public lands of the United States; (3) at any Government dam; and (4) on streams over which the Congress has jurisdiction under the Commerce Clause of the U.S. Constitution. As of September 30, 2007, there were 2,528 dams under FERC jurisdiction.

Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) has regulatory authority over one uranium mill tailings dam; storage water pond dams at in-situ leach mining facilities; and dams integral to the operation of licensed facilities or the possession and use of licensed material that pose a radiological safety-related hazard should they fail. Exceptions in the third category are dams that are submerged in other impoundments or dams regulated by other federal agencies, e.g., the Corps, FERC, or the Tennessee Valley Authority (TVA). The NRC regulates 9 low-hazard potential dams.

Tennessee Valley Authority

The TVA is authorized by the TVA Act of 1933 to approve plans for the construction, operation, and maintenance of all structures affecting flood control, navigation, or public lands or reservations in the Tennessee River System. TVA is responsible for the planning, design, construction, operation, and maintenance of 49 dams.

Federal Agency Activities in FY 2006 and 2007

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In June 1979, the *ad hoc* interagency committee on dam safety issued the first guidelines for federal agency dam owners. The Guidelines have withstood the test of time. Since their publication, all of the federal agencies responsible for dams have implemented their provisions, sharing resources whenever possible to achieve results in dam safety and developing strategies to address diminishing resources and decreases in staffing levels. Some of the federal agencies also maintain comprehensive research and development and training programs. Below is a description of federal agency activities in FY 2006 and 2007 in some of the areas covered by the Guidelines. Table 4 in Appendix C, Summary Status of Dams for Federal Agencies, provides data on the number of dams owned, operated, or regulated by each agency.

Organization, Administration, and Staffing

Serious challenges continue to face the Corps' dam safety organization and the dam safety community in the United States. During this reporting period, several Districts and Divisions lost experienced dam safety engineers and technicians from attrition. Continued attrition and retirements in the next 3 to 5 years will seriously affect the Corps' ability to adequately staff dam safety offices in several locations. To combat the loss of expertise, the Corps has continued a number of initiatives, including a proactive

dam safety program that provides a variety of analysis and rehabilitation design and construction opportunities for its professionals and extensive training and research and development programs.

Although attrition has contributed to a slight reduction in staffing, TVA continues to maintain an adequate staff of experienced dam safety engineers. TVA has implemented an Engineering Graduate Progression Program to ensure that dam safety engineers develop a broad base of technical capability and experience. This program is helping to develop the necessary experience for entry-level engineers to become senior-level dam safety engineers.

The management for the NRC dam safety program has been relocated from the Office of Nuclear Material Safety and Safeguards to the Division of Engineering in the Office of Nuclear Reaction Regulation. The program is implemented through an organization focused on the NRC Dam Safety Officer. None of the personnel associated with the program are employed full-time.

The MSHA impoundment safety program involves the 11 districts of Coal Mine Safety and Health, the 6 districts of Metal and Nonmetal Mine Safety and Health, the Mine Waste and Geotechnical Engineering Division within the Pittsburgh Safety and Health Technology Center of Technical Support, and the National Mine Health and Safety Academy. MSHA reports minor changes in staffing since the last reporting period.

The USIBWC and the Mexican Section of the IBWC are headed by an Engineer-Commissioner. Each Section also has Principal Engineers and a staff of engineers and technicians to carry out the work assigned by the treaties. The USIBWC, which is headquartered in El Paso, Texas, administers its dam safety program with one Principal Engineer (Operations), one Dam Safety Officer located at the IBWC Headquarters, and five field office project managers.

FERC technical staff is adequate and competent in hydrology, hydraulics, civil engineering, geology, engineering geology, field investigations and inspections, and geotechnical and structural design. When the need for additional expertise arises, FERC employs qualified outside consultants to provide an independent assessment or to supplement staff expertise. During the past 2 years, staffing in the FERC Dam Safety Program was increased to effectively address workloads and to continue enhancing the FERC program. As of September 30, 2007, there were 124 technical and support personnel assigned to the FERC Dam Safety Program, an increase of 4 personnel since the last reporting period.

In the category of state dam safety organization and staff, the DOI BLM reports that 36 percent of the respondents noted adequacy in this area, a decrease of 10 percent from FY 2004 and 2005. Alternately, 64 percent of the respondents expressed concern about their staffing levels and noted that additional full-time equivalents (FTE's) are needed (an increase of 10 percent from FY 2004 and 2005). In the category of impact of personnel changes, 91 percent indicated impacts or potential future impacts from personnel changes between the previous and current reporting periods. The impacts are primarily related to concerns with personnel shortages. DOI BLM will develop a national strategy to mitigate or eliminate deficiencies in staffing. Overall, DOI BLM reports positive strides in improving its dam safety program over the past 4 years.

DOI NPS initiated a comprehensive review of the business practices and guidance documents used for the SOD program. This review reached a first milestone with the approval of new business practices to more fully comply with the *Guidelines*. These business practices will be the basis for an estimated 5-year duration plan designed to improve efficiency, raise awareness, and reduce risks by bringing all noted safety program shortfalls into full compliance with the *Guidelines* and DOI Departmental Manual part 753. The program will be shifting to a risk-based approach.

DOI Reclamation reports that it has excellent management and technical staff resources to accomplish its dam safety activities. DOI Reclamation has implemented a workforce capability planning process that uses a strategic planning approach to match staff resources with future program needs. DOI Reclamation staff decreased from 5,900 employees in May 2005 to 5,647 employees in June 2007.

The number of engineers and engineering technicians in NRCS has declined over most of the past decade, but has increased over the past several years to address new agency programs and authorities, including small watershed dam rehabilitation. NRCS established a National Design, Construction and Soil Mechanics Center in 2000, and this staff has become a significant internal source of dam expertise. The total number of engineers and engineering technicians working in NRCS has been constant the last 2 years.

Independent Reviews

TVA's Hydro Review Board performs independent reviews when emergent conditions or situations warrant special attention. For example, as the result of the Taum Sauk dam failure, TVA reviewed the overflow protection scheme at its Raccoon Mountain Pumped Storage Plant and identified deficiencies in the automatic shutdown systems. The Board reviewed the corrective measures and determined that TVA's upgraded controls are acceptable.

DOE has established a Memorandum of Agreement with FERC to perform independent reviews of various aspects of DOE's dam operations. Private consultant services are commissioned as needed. Independent inspections by consultants other than FERC are performed every 5 years.

Over the last 2 years, coal companies have submitted to MSHA over 850 plans and other submittals related to dams. This total includes design plans for dam construction and annual certification reports, as well as programs for dam inspection and for dealing with potentially hazardous conditions. Dam construction plans are submitted for building new dams, although the majority of the plans are for increasing the size of existing dams to increase their capacity to store tailings or mine waste.

All significant actions involving design, construction, and operation of Corps' dam projects are required by regulation to receive an internal independent technical review. The review scope is based on the complexity and life safety criticality of the project. Independent technical review is conducted at the District level for design, construction, and operation, along with periodic inspection reports.

Independent design reviews were conducted on several DOI FWS design projects (Old Timbers Dam, Visitors Center Dam, Devil's Kitchen Dam, Martin Lake Dam, and Martin East Dam). Two major construction projects are currently ongoing and will be completed by the end of FY 2007 (Little White River Dam and Muskrat Dam).

Dam Inventories

Since its last submission, the Corps has adopted the Dam Safety Program Management Tools (DSPMT) software to maintain and collect dam inventory information. There have been no changes in its dam inventory.

The number of dams reported at Metal and Nonmetal mines is 1,604, more than twice the dams reported in FY 2004 and 2005. MSHA has made an effort to locate and document previously unreported dams. For example, compared to the number of dams reported at the end of 2005, the number of high-, significant-, and low-hazard potential sites reported at Metal and Nonmetal mines at the end of 2006 had increased by 54, 74, and 343, respectively. The Metal and Nonmetal Districts are continuing their efforts to ensure that MSHA's database more accurately reflects the number of dams at metal and nonmetal mines.

Approximately four to six DOI BIA dams are reclassified from low- to high- or significant-hazard each year. The DOI BIA has about one-fourth of all significant- or high-hazard dams within DOI. During this reporting period, three dams were classified as high- or significant-hazard and two dams were reclassified as low-hazard.

DOI FWS anticipates that the risk assessment of all of its 33 high- and significant-hazard dams will be completed by the end of 2007. This will enable DOI FWS to consider risk in assessing Safety Evaluation of Existing Dams (SEED) inspection frequencies, as well as directing engineering analyses toward specific failure modes with greater risk indices.

DOI Reclamation currently has 479 dams and dikes, including 375 high- or significant-hazard structures located at 249 different project facilities. Eight dams, dikes, and/or facilities were added to the DOI Reclamation Dam Safety Program inventory during the reporting period.

During the last 2 years, DOI NPS reports that 27 new structures were added to its inventory of dams, 5 structures were reclassified, 2 structures were deactivated, 2 structures were renovated/rehabilitated, and 1 structure has undergone mitigation for leakage.

RHS maintains limited records on projects in its portfolio, including projects involving dams. Currently, 25 dams are in the portfolio, and only 1 new dam project was added during this reporting period. NRCS includes the RHS dams in its inventory.

A nationwide update of data in the NRCS dam inventory was completed in March 2006. Several NRCS states reported collaborating closely with state dam safety agency counterparts to rectify data discrepancies between NRCS and state datasets. All current data on NRCS-assisted, NID-size dams were submitted to the Corps during the NID 2006 data call. The NRCS completed the transfer to the current software of the data that had not been transferred during the restructuring of the database in 1993 and 1998. This data will be made available to the states.

A USDA Office of Inspector General (OIG) audit of security following the September 11 attacks included an assessment of NRCS activities with dams. NRCS agreed with OIG to complete the hazard classification update of all NRCS-assisted project dams that permanently store water for water supply or irrigation by October 2004, and all remaining NRCS-assisted project dams by March 2006. NRCS has added a data field for the date of latest hazard classification verification to the NRCS dam inventory to measure completion of this work.

The current FS dam inventory contains 546 FS-owned dams. There are 1,212 non-FS-owned dams on National Forest Lands, including private structures (Special Use) and those owned and operated by other governmental agencies. With the rapidly escalating development of downstream land zones, the number of situations demanding elevation of hazard rating is becoming a serious problem, especially in the Western States. Many hazard ratings are changing from low to high every year.

Inspection Programs

According to data submitted to the NID, approximately 94 percent of the federal high-hazard potential dams have been inspected within the past 5 years (see Figure 18).

The Corps conducted 254 inspections in FY 2006 and 2007. In-house teams of District professionals representing technical specialty areas relevant to the project's design and construction conducted 99.6 percent of the inspections. At this time, no major staffing inadequacies threaten the inspection program, although the Corps notes that it is increasingly difficult to properly staff inspections with experienced dam safety personnel, especially at smaller districts. In these cases, resource sharing among districts helps minimize these challenges. In addition, a number of young engineers are included on the inspection teams for training purposes.

The Army reports that 117 dams were inspected in FY 2006 and 2007. The Army notes that the most important issue related to inspections is obtaining the funding to conduct the inspections, and that most inspection results indicate that dams do not meet current criteria and will need additional work to meet current criteria. Other problems associated with inspections include staffing (quality, experience, training, and the number of inspectors) and critical findings of the inspection (deficient dams and conditions and improper classifications).

DOE's agreement with FERC provides for periodic inspections by FERC of all dams and other water impoundment structures. FERC inspections are performed annually on high- or significant-hazard dams and every other year on low-hazard dams.

TVA conducted 375 dam safety inspections, a decrease from the previous reporting period due to the combining

of mechanical and electrical inspections. There was no reduction in the scope of detailed inspections. Both scheduled and special dam safety inspections are conducted by trained, in-house mechanical, electrical, and civil engineers and technicians.

Dams under MSHA's jurisdiction are inspected for hazardous conditions as part of a complete mine inspection. Underground mines are inspected four times each year and surface facilities are inspected twice each year. MSHA employs over 1,100 mine inspectors. Inspectors performed 3,128 dam inspections at coal mining operations. The number of metal/nonmetal mine tailings dam inspections performed by District personnel during the reporting period was 3,698. Citations are issued to mining companies, as appropriate, for not complying with their approved plans and corrective actions on the part of the mining company are necessary to terminate any citation. In October 2007, MSHA released an updated Coal Mine Impoundment Inspection Handbook, which provides guidance to Coal Mine Safety and Health inspectors on the proper inspection techniques for dams.

Using Technical Advisors from the Corps, the IBWC conducted 5-year inspections of American and Morelos Dams in 2006. In 2007, 5-year inspections of Amistad, Falcon, Anzalduas, and Retamal Dams were conducted using Corps Technical Advisors. International Dam is scheduled to be inspected by both the U.S. and Mexican Sections in 2008. The 5-year inspection report for Amistad Dam concluded that the dam is potentially deficient and that the entire dam foundation is in need of further evaluation and study due to project experiences with upstream sinkhole formation on the Mexican side. In FY 2008, IBWC will hire geotechnical consultants to begin further evaluation and study of the entire dam foundation.

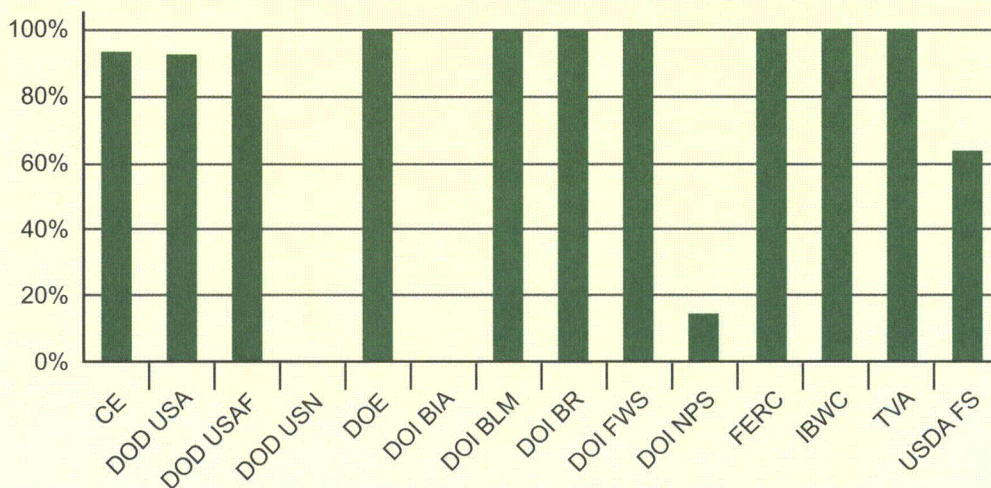


Figure 18: Federal Agency High-Hazard Potential Dams Inspection Intervals: Percentage of Dams Inspected 2000-2006

Source: NID/DSPMT

FERC staff independently reviewed the safety and adequacy of 366 dams and completed 10,093 engineering evaluations, investigations, and studies, with 1,372 in progress at the end of the period. Construction plans and specifications are also reviewed by staff for all licensed projects. FERC conducted 345 construction inspections. In addition, FERC staff completed 3,287 intermediate dam safety inspections and independent consultants performed 352 formal inspections. FERC also conducted 299 inspections of dams where specific problems occurred that related to design changes required by unanticipated field conditions encountered during construction; poor maintenance caused concern for project safety or environmental noncompliance; and special remedial actions were necessary to ensure the continued structural integrity of a project and compliance with license requirements and exemption conditions. These inspections are considered special inspections, as defined by the *Guidelines*.

NRC continues to use the technical assistance of FERC to assist with dam safety inspections at NRC licensee facilities. Seven dam safety inspections were conducted at nuclear-powered electric generating facilities. The inspection teams identified no deficient dams or improper classification.

DOI BIA performs some informal (annual) inspections internally. DOI Reclamation, under contract to the DOI BIA, performs intermediate and formal examinations. There were 46 formal examinations, 30 intermediate examinations, and 197 special (annual) examinations performed within the DOI BIA SOD Program. Annual inspections are completed on all high- and significant-hazard dams in the program that do not have a formal or intermediate inspection scheduled during the year.

DOI BLM performed 183 condition assessments and 12 technical inspections. Condition assessments for low-hazard potential dams are performed on a 5-year cycle. Condition assessments and/or inspections of high-hazard potential and significant-hazard potential dams are performed on an annual basis.

DOI FWS completed 88 formal SEED dam inspections in FY 2006 and 2007. These include 63 low-hazard, 13 significant-hazard, and 11 high-hazard dams. Formal inspections on all high- and significant-hazard dams are now being conducted every 3 years.

DOI Reclamation annually reviews each facility that includes a high- or significant-hazard dam. DOI Reclamation performed 292 inspections in FY 2006 and 288 inspections in FY 2007.

NRCS policy is to encourage state agencies to assume responsibility for routine inspection of existing NRCS-assisted dams. NRCS provides technical assistance for

routine inspections as resources permit and as requested by the dam owner. NRCS-assisted dams are inspected by hundreds of different organizations, ranging from state agencies conducting formal inspections, local project sponsors conducting intermediate inspections, or walkover Operation & Maintenance (O&M) inspections by non-engineers. NRCS does not maintain national data on numbers or types of dam inspections conducted on each NRCS-assisted dam each year. The data provided in Appendix C represent the best estimates by NRCS state staff.

Inspections of FS-owned dams are completed by qualified FS engineering staff. Based on annual inspection schedules, it is estimated that FS dam safety engineers conducted more than 550 inspections during the reporting period. Inspection schedules are all high-hazard dams annually; one-third of all significant-hazard dams annually; and one-fifth of all low-hazard dams annually. The new FS dam safety manual will change the frequency of low-hazard dam inspections to once every 7 years. The others will remain fixed. In response to a recent OIG Audit, the FS is working diligently to eliminate the inspection backlogs, prepare EAP's, and correct analytical maintenance deficiencies, as well as annual special use permit inspections and permit administration.

Dam Safety Rehabilitation Programs

FERC completed 44 dam safety modifications. There are 74 dam safety modifications ongoing or under review.

The Corps expended more than \$100 million on ordinary maintenance work. With the inclusion of the emergency repairs at Fern Ridge Dam, the Corps expended approximately \$70 million on emergency repairs. The Major Rehabilitation Program allows accomplishment of significant, costly, one-time structural rehabilitation or major replacement work (less costly repairs related to dam safety are accomplished under the normal O&M program). The work under this program restores the project to its original condition to serve as originally intended. In FY 2006-2007, the Corps expended more than \$216 million on 10 major rehabilitation projects. The Dam Safety Assurance Program provides for modification of completed dams that are potential safety hazards in light of present-day engineering standards and knowledge. This program provides for upgrading of project features related to dam safety, to permit the project to function effectively as originally intended. In FY 2006-2007, the Corps expended approximately \$211 million on Dam Safety Assurance Program projects.

Since the last report, DOI BIA reports four dams in the process of modification construction, one dam that has been decommissioned, two that have completed modifications, and five dams that are under design.

The DOI BLM expended over \$2.1 million on its safety rehabilitation program. Work included repairing spillways, installation of a chimney drain, emergency repairs, draining and breaching a dam, access roads construction and improvement, seepage analysis, and mitigation work to meet the Safety of Dams/Safety Evaluation of Existing Dams (SEED) report recommendations (included raising the embankment height and installing outlet works). DOI Reclamation had five modifications with risk reduction actions completed or scheduled for completion, five modifications underway, and two modifications planned to start.

For project dams, NRCS was authorized under the Small Watershed Amendments of 2000 (P.L. 106-472) to provide technical and financial assistance for rehabilitation. NRCS estimates the overall rehabilitation needs on NRCS-assisted project dams to be approximately \$550 million. Most of the initial implementation effort has been to communicate this new authority to eligible dam owners, receive and process applications for assistance, rank applications with a risk-based profiling system, assess individual dam rehabilitation needs, develop watershed work plans, and begin the design process. Additional projects are in the planning and design phases or are waiting for funding. Several hundred new applications from local dam owners are pending.

Management Effectiveness Reviews

In May 2007, three independent dam safety consultants performed an assessment of TVA's Dam Safety Program. The primary purpose of the assessment was to provide a perspective on how the organizational and functional components of TVA's Dam Safety Program comply with the Guidelines. Program enhancements to improve effectiveness and efficiency are being developed based on the consultants' recommendations.

Administrative Information Bulletin, AIB A05-06, dated April 28, 2005, was issued to clarify MSHA's dam safety structure and define the roles of the Dam Safety Officer and others within the program. The Dam Safety Officer reports directly to MSHA Headquarters. As required by the Bulletin, MSHA has begun to prepare an annual dam safety assessment report for the Assistant Secretary for Mine Safety and Health.

The FERC Division of Dam Safety and Inspections (D2SI) conducted a Summary Management Review, as mandated by the Federal Managers' Financial Integrity Act. On July 18, 2007, an Assurance Memorandum was forwarded to the Chairman of FERC through the Director, Office of Energy Projects, attesting that the D2SI was able to meet their management goals and objectives, there were no obstacles or funding shortfalls impacting the ability to

accomplish its mission, and there were no problems requiring the attention of higher management.

A DOE/Inspector General audit also was conducted of the FERC Dam Safety and Security Program. The December 18, 2006 report stated that the key information and actions for FERC jurisdictional hydropower projects were generally accurate and complete. The report did find that improvements could be made in the effectiveness of the security inspections, analysis, and review activities. In response to the recommendations, FERC has made adjustments to the FERC Dam Security Program.

A comprehensive evaluation of the DOI BIA Safety of Dams program was completed by the DOI Dam Safety peer review team in FY 2002. Significant progress has been made on all 12 recommendations. Although the recommendations require ongoing efforts and updates, the process to accomplish this has been institutionalized in the SOD program management and in the SOD program handbook.

The DOI BLM underwent a comprehensive evaluation in October 2002 of its Safety of Dams program by the DOI Reclamation Peer Review Team. Significant progress has been made on all five recommendations in the Peer Review's March 2003 report. Although four recommendations require ongoing efforts and updates, the process to accomplish these efforts has been implemented via the "Bureau of Land Management – National Management Strategy for Dam Safety."

The National Research Council (NRC) assisted DOI Reclamation in determining the appropriate organizational, management, and resource configurations to meet its construction mission and related infrastructure management responsibilities. In response to the NRC report, DOI Reclamation published in February 2006 the "Managing for Excellence Action Plan," which outlines a process and timeframe for identifying and addressing the specific 21st century challenges to fulfill its mission.

DOI Reclamation continued the annual reviews of an Independent Review Panel to provide an ongoing evaluation of DOI Reclamation's Dam Safety Program, with the goal of continuous improvement. The DOI Reclamation Dam Safety Officer provided programmatic oversight of dam safety activities. The FY 2006 and 2007 reports conclude that the DOI Reclamation Dam Safety Program is comprehensive and well-organized, and is being carried out diligently by staff. Numerous reviews by the Washington and Regional Offices took place as needed. In all cases, corrections to practices were made to address recommendations.

The OIG Infrastructure Maintenance Audit of 2006 gave FS several mandates for what were perceived to be dam safety

procedural deficiencies. Progress is being made to comply with the main elements: the need for a current dam safety manual (in formal final review process as of June 2007) and computer monitoring fixtures (underway in January 2007).

Dam Safety Training

The Corps offers an extensive training program. The training program, for engineers and dam operation and maintenance personnel, consists of seminars and conferences, formal classroom training, and periodic on-site training. Site training is designed to acquaint project personnel with basic engineering considerations relating to major structures, including site-specific considerations, with procedures for surveillance, monitoring, reporting of potential problems, and emergency operations. O&M personnel are retrained periodically, at a maximum interval of 4 years. New project personnel are immediately scheduled for dam safety training. No training deficiencies were identified during this reporting period.

The main thrust of TVA's training continues to be in-house training courses, supplemented by external conferences and workshops. Technically qualified project personnel are trained in inspection procedures, problem detection, evaluation, and appropriate remedial (emergency and non-emergency) measures. TVA also conducts Dam Safety Awareness and Emergency Preparedness training programs, including both classroom and hands-on instruction. This training is required for hydro operations, site maintenance, security, resource (property) management, inspection/instrumentation, and other staff that could be involved in a dam safety event or work at or visit a dam site.

Since 1982, MSHA has organized and presented an annual training seminar that serves as the primary dam safety training tool for District Impoundment Specialists. Training is provided on how to inspect dams, recognition of hazardous conditions, proper methods of dam construction, and technical design issues. MSHA held its 2006 and 2007 Dam Safety Seminars at the National Mine Health and Safety Academy in Beckley, West Virginia. Newly hired MSHA Mine Inspectors also attend a training program that covers all aspects of a mine inspector's job. During this reporting period, 17 dam-safety training sessions were attended by 235 new Coal Mine Inspectors and 6 sessions were attended by 83 new Metal and Nonmetal Mine Inspectors.

At FERC, the proper mix of training is emphasized for the development of staff, and emphasis is placed on individual development plans. Internal staff training courses during the reporting period included two workshops on Unifying Dam Safety and Security and a Pumped Storage Workshop, which was held immediately after the Taum Sauk breach. Several initiatives preceded and followed the Pumped

Storage Workshop, including a technical workshop for all FERC pump storage operators, the Corps, DOI Reclamation, and TVA to develop guidelines for the operation, instrumentation and monitoring, and inspection of pump storage projects.

DOI BLM reports a 97.7 percent increase in formal training hours for dam safety. Although training increased significantly over the past 2 years, there is concern about the decline in training budgets to keep DOI BLM engineering staff fully educated.

DOI Reclamation continues to perform, support, and participate in a variety of dam safety-related training. DOI Reclamation actively participates in professional societies such as the Association of State Dam Safety Officials (ASDSO), the United States Society on Dams, and the American Society of Civil Engineers. The DOI held annual DOI Dam Safety Coordinators Meetings in May 2006 and April 2007. Representatives from the DOI Bureaus, various Tribes, the Corps, and ASDSO attended both meetings. DOI Reclamation also sponsored week-long SEED seminars in May 2006 and 2007.

DOI Reclamation has found it efficient and effective to hold a series of workshops and conferences to train employees and water district personnel to ensure high quality and consistency in the program activities. Annual Facility Review Workshops for inspection personnel were held to discuss and exchange procedural, program, and technical issues regarding dam reviews and field examinations. Dam operators' training is provided to project operating personnel every 3 years. On-site training is performed to ensure that operating procedures and emergency action planning are fully understood by operating personnel. Training is also performed when there is a change in personnel or a major improvement to facility operation and maintenance. Instrumentation specialists also attend this training to ensure that dam operators are familiar with the specific performance monitoring requirements of dams. Water management workshops were held in February 2006 and 2007. As part of these training sessions, project operating personnel were provided technical information and procedures related to structural reliability.

The NRCS Design Center conducted several workshops on roller-compacted concrete, geotechnical engineering for rehabilitating structures, and on SITES (dam hydrologic and hydraulic design software) that were attended by NRCS and non-NRCS participants. NRCS engineers also participated in national, regional, and local training sessions, workshops, and conferences. Participation has increased significantly over the past few years.

Dam Failures and Remedial Actions

The Army reports that the Fort AP Hill Lonesome Gulch Water Control Structure (WCS) failed in 2007 and was replaced by a culvert system set at normal creek elevation. Lonesome Gulch WCS may be removed from the Army inventory in 2009.

TVA reports only one incident. In August 2006, a barge pulled too far into TVA's Wilson Dam Main Lock while traveling upstream. As the water in the chamber was raised, the nose of the barge started to lift the gate. Once the upstream seal of the gate was breached, the flow of water into the chamber was uncontrolled. The barge was trapped under the lift gate, and the gate was lifted out of the guide slot on one side of the lock. The gate was stabilized with temporary supports, a floating caisson was installed upstream of the lift gate to isolate the chamber, and the water in the chamber was slowly lowered. This freed the barge so it could be removed from the chamber. The lift gate was removed from the lock and transported off-site for repair. TVA also is monitoring the condition of Bear Creek Dam in Alabama. To limit seepage and reduce potential damage to the dam, TVA is operating the reservoir at a below-normal headwater elevation. A draft Environmental Impact Statement, issued in May 2007, recommends repairing the dam to operate as it was originally designed.

MSHA reported 11 incidents involving impoundments and tailings structures on mining property. Seven incidents occurred at coal mines and four at metal/nonmetal operations. Once MSHA becomes aware of an incident, an investigation is conducted to identify hazardous conditions, determine the probable cause of the occurrence, and ensure that appropriate steps are taken by the mine operator to resolve the issue. The mining company is responsible for investigating the problem, engaging consulting engineers, if needed, and implementing corrective measures, subject to MSHA concurrence. No injuries or significant downstream property damage occurred in any of the incidents.

There were 20 incidents at dams under FERC jurisdiction. All but two of the incidents were minor, and resulted primarily from operational failures of project facilities such as penstocks or gates. These minor incidents did not cause significant damage. The significant incidents were the Taum Sauk Upper Reservoir dam break and the Swinging Bridge project. Major remedial work continued at four sites of earlier incidents.

There were 12 dam incidents at DOI BIA dams. Incidents included four flooding events, seven seepage-related events, and one finding of significant deterioration of outlet works conduits.

DOI BLM had one dam failure. New Mexico's Palomas Dam was overtopped during a heavy rainstorm, resulting in a

breach of the structure. The repair project was submitted for inclusion in the 5-Year Plan for Deferred Maintenance. At present, New Mexico is waiting for funding to begin redesign and construction.

No dam failures occurred at DOI Reclamation dams. Significant dam incidents occurred at A.V. Watkins Dam in Utah; Clear Creek Dam in Washington; Deer Flat Dam in Idaho; and Enders Dam in Nebraska. DOI Reclamation has taken remedial action in response to the incidents or is monitoring the conditions until long-term solutions are implemented.

Emergency Action Planning

The federal agencies are doing a good job with EAP completion for high-hazard potential dams. Of the 963 federally-owned dams listed with a high-hazard potential, 96 percent have an EAP.

The FERC EAP program is used as a model worldwide and was the first to be fully developed for dam owners. All FERC-regulated dams have an EAP. Through its actions, FERC hopes to strengthen other federal and state programs, assist emergency response agencies, and ultimately improve EAP's nationwide.

FERC last issued revised EAP guidelines in November 1998. These guidelines were revised to promote national consistency with the *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*, FEMA 64. All dam owners are required to have EAP documents that follow the established federal and FERC format. In April 2007, FERC issued a draft revision to its EAP Guidelines for public comment. The draft revisions include additional guidance on document submittals, exercises, and inundation maps. The revised Guidelines should be finalized by the end of 2007.

Each year, FERC-regulated dam owners are required to meet face-to-face with primary emergency management agencies to discuss their projects, the EAP, and emergency procedures. These meetings are referred to as orientation seminars. All dam owners also annually test the state of training and readiness of key personnel responsible for actions during an emergency to ensure that they know and understand the procedures and actions required during an emergency. These annual drills are very important to determine the adequacy of how the dam owner will handle an emergency. However, the drills effectiveness is limited because there is no active participation by emergency preparedness agencies.

There are three higher-level exercises: tabletop, functional, and full-scale. These three exercises include representatives from the dam owner, as well as all agencies involved with

responding to an emergency at the dam. FERC recommends a tabletop exercise be performed before a functional or full-scale exercise. Tabletop exercises allow all parties to discuss their roles during an emergency, ask questions, and suggest changes to emergency procedures.

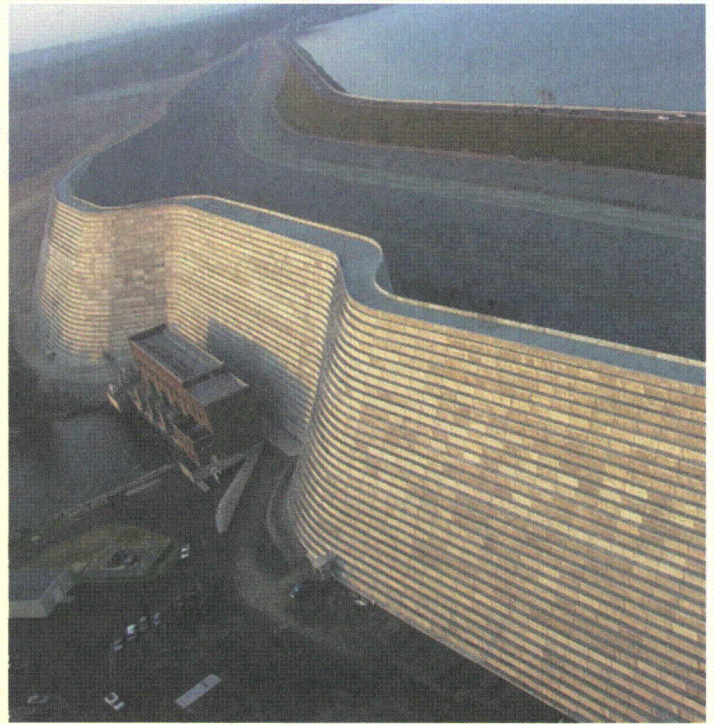
A full-scale exercise of a simulated emergency is considered the ideal approach to evaluate every participant's knowledge and understanding of an EAP. A full-scale exercise can be a true test of the total emergency management system and exhibit the effectiveness of a specific EAP because people and resources are mobilized similar to what would occur during an actual emergency. This has been demonstrated by periodic full-scale exercises for the Santee-Cooper Project, FERC No. 199, located near Charleston, South Carolina. However, there are practical considerations that show that full-scale exercises may not be feasible in all cases.

Because more in-depth testing of an EAP is essential for all participants, FERC requires dam owners to conduct functional exercises (comprehensive exercises without field mobilization of personnel and resources). Functional exercises include representatives from the dam owner and all emergency preparedness agencies to test the EAP under stressful, timed conditions. The exercise evaluates the effectiveness of the notification plan, inundation maps, and actions that local agencies take after they are notified that an emergency is occurring at a dam. After the exercise, an oral evaluation is held to discuss possible changes to the EAP for improved emergency response.

Under the FERC EAP exercise program, at least one functional exercise is conducted in each river basin where there is a FERC-regulated project during a 5-year period. The 5-year cycle is repeated in each basin with a different dam and EAP selected for a functional exercise. This schedule is meant to maintain the state of readiness of the local and state officials through the cooperation and assistance of the dam owners. In this manner, changes in personnel or improvements to the EAP can be identified and will ensure that the EAP will be kept up-to-date.

When a dam is found to require remediation or undergo difficult construction activities, the owner may be required to perform a tabletop or functional exercise of its EAP to determine if any additional requirements are needed with emergency procedures during construction. Such aspects as additional coordination and associated activities, additional instrumentation (sirens and other monitoring techniques), and frequency of inspections should be considered. An interim (construction) EAP may be required, based upon the urgency of the situation.

FERC encourages dam owners to develop EAP exercises that include active participation by upstream and downstream



Saluda Dam, SC. Photo courtesy FERC.

dam owners. Both FERC-regulated dams and non-FERC regulated dams would be included. This widened approach for coordination optimizes the time and effort required by the local response agencies and encourages many non-FERC regulated dam owners to participate in an EAP exercise for the first time. This effort also includes coordination with the National Emergency Management Association, Association of State Flood Plain Managers, State Emergency Management Agencies, the National Weather Service (NWS), and others.

FERC encourages dam owners to coordinate with and include the NWS in their EAP's. By working together, dam owners and the NWS exchange valuable information during flood events. This information exchange provides valuable data to the NWS for use in their flood forecasting models. Using actual data improves the forecasting ability of the NWS in developing warnings to communities. Dam owners also benefit from this partnership by utilizing the capabilities of the NWS to broadcast flood warnings downstream of their dams.

FERC continues to make special efforts to increase the spirit of cooperation and coordination between dam owners and the local response agencies associated with their EAP's. The exchange of information among emergency response agencies and dam owners has resulted in an improved understanding of the needs and responsibilities of each participant. It also provides a chance for the participants to meet face-to-face and provides local agencies a better understanding of the technical aspects of the EAP.

FERC held two EAP training courses in FY 2006, one of which was for the Corps' Northwest Division, and two training courses in FY 2007. These courses were open to all, including dam owners not under FERC's jurisdiction and emergency response personnel.

Dam safety emergency exercises were conducted at a number of Corps dams to test Flood Emergency Action Plans (FEAP's). The exercises simulated a dam failure or a condition that could lead to a failure if appropriate actions were not taken. FEAP's also were tested at a number of other dams by actual extreme flood events. Several smaller-scale emergency exercises were held with other agencies. Notification lists are periodically updated and verified. State and local emergency action personnel, as well as other federal agencies, are often invited to participate in the Corps' dam safety emergency exercises. As part of the Dam Safety Program, Districts are also encouraged to share ideas with state officials and extend invitations to state dam safety officials and local engineering students to attend periodic inspections.

32 Although the Corps has initiated or completed all of the FEAP's, local communities responsible for the evacuation plans have not. To date, the Corps is aware of approximately 70 projects where local evacuation plans have been completed by the local entities. The Corps' Districts continue to encourage local entities to develop their portion of the dam safety plans. Districts are being asked to increase their public awareness programs and perform follow-up visits to local communities to obtain the status of evacuation plans. At a minimum, letters are written periodically to each community stressing importance of developing the EAP.

The Army reports an ongoing effort to create or update EAP's for all high- and significant-hazard dams. At present, 4 high-hazard potential dams (out of 35) and 6 significant-hazard potential dams (out of 22) do not have EAP's.

EAP's have been developed and are maintained for all TVA dams. The EAP notification directory, including key personnel and contact numbers, is updated semi-annually. TVA is currently implementing the National Incident Management System (NIMS). NIMS will be fully integrated in the TVA emergency response plans, procedures, and exercises. Exercise program activities completed during the reporting period included a joint program with the Corps' Nashville District. The exercises were conducted in May and June 2007 at each of the TVA dams with a navigation lock and involved staff from TVA, the Corps, the U.S. Coast Guard, and state and local emergency management agencies.

TVA emergency preparedness staff has maintained close working relationships with the Franklin County, Alabama

and Fannin County, Georgia emergency management agencies due to the ongoing Bear Creek Dam project and the Blue Ridge Dam project modifications, respectively. The Bear Creek Dam efforts included providing emergency management and flood warning information for development of an Environmental Impact Statement on the project and attending a local public meeting. Staff also met with the new Tishomingo County, Mississippi emergency management agency director on the Bear Creek project to discuss notification procedures and review the Bear Creek EAP. The efforts at Blue Ridge Dam included briefings with the local emergency management agency and the public, as well as installing high water warning systems downstream of the dam.

The USIBWC has an EAP for each of its large storage dams (Amistad and Falcon), as well as for Anzalduas and Retamal International Diversion Dams. In FY 2006, a series of four International Sister Cities Exchange Workshops were held at Amistad Dam, Falcon Dam, Mercedes Texas, and Nuevo Laredo, Tamaliupas, Mexico. The workshops were attended by civil and political authorities from the United States and Mexico. Because of internal training requirements, participation was restricted to IBWC, U.S. and Mexico, and the NWS. Flood Emergency Workshops also are held annually with participation of both Sections of the IBWC, U.S. and Mexico, and the NWS.

The DOI BIA has 98 dams with EAP's. The number of dams requiring EAP's continues to increase as dams are reclassified from low- to high- or significant-hazard. Early warning systems (EWS) are in place for 78 dams. The DOI BIA emergency management program consists of the installation of EWS at each dam, ultimately tying all the EWS's into the 24/7 National Monitoring Center (NMC), and preparation and exercising of the EAP's. The 24/7 NMC will provide 24/7 emergency monitoring of DOI BIA high- and significant-hazard dams. Out of the 126 DOI BIA dams, 90 will have EWS's by the end of FY 2007 and 66 are currently being monitored at the 24/7 NMC.

The DOI BLM has eight high-hazard potential dams. Of these dams, three had approved EAP's in FY 2006-2007. At the conclusion of FY 2007, the remaining five dams were in the process of having their EAP's completed.

DOI NPS has 16 high- and 33 significant-hazard dams requiring an EAP. All 16 high-hazard dams have EAP's, although only 4 are up-to-date. Of the 33 significant-hazard dams, 25 have EAP's, with 8 reported as up-to-date. In 2007, DOI NPS initiated a new Dam Safety Program Business Plan that includes funds for improving DOI NPS Emergency Action Planning and increased coordination between the Dam Safety Program, Emergency Planning Elements, and Operational Personnel. Deficiencies in EAP's

have been given a high priority for resolution and pilot projects to resolve them are now underway.

The DOI FWS Dam Safety Officer conducts EAP exercises once every 6 years at all high- and significant-hazard dams during the full SEED inspection. These are typically tabletop exercises including all of the agencies, DOI FWS field station staff, and emergency management representatives with a major role in the surveillance, notification, or evacuation responsibilities established in the EAP. On the alternate 3-year cycle, DOI FWS conducts a limited tabletop EAP exercise during the Intermediate SEED inspection. State and local governments have attended and participated in periodic tests of EAP's and receive and maintain copies of EAP's. The DOI FWS conducted 15 EAP exercises in FY 2006 and 2007.

All of DOI Reclamation high- and significant-hazard facilities have EAP's. EAP's are annually updated and exercised every 3 years, according to DOI Reclamation directives. State and local government officials, emergency management personnel, and law enforcement agencies are encouraged to participate.

NRCS has no authority to require the development of EAP's on existing dams, but has current policy to require development of plans before construction is initiated on new or rehabilitated dams. More EAP's are implemented by the owners of NRCS-assisted dams every year. However, recent inventory data still shows that more than 1,000 NRCS-assisted, high-hazard potential dams do not have EAP's. NRCS has completed an agreement with ASDSO to collaboratively develop a sample EAP for small embankment dams. Information on the sample EAP, which will be incorporated as an amendment to the NRCS National Operation and Maintenance Manual, was presented in a technical session at the 2007 ASDSO conference.

NRCS continues to assist dam owners in developing EAP's. For example, Oklahoma NRCS, in cooperation with Oklahoma Conservation Commission, is working with local sponsors to meet a goal of current EAP's for all high-hazard watershed dams by the end of 2007. North Carolina reported assisting dam owners to develop 14 new EAP's (4 are under development). Several states reported that letters were written to local sponsors outlining the need for the development of EAP's.

Every dam at a coal mine dam under MSHA jurisdiction has a hazardous condition identification and warning program. Of the impoundments with high- or significant-hazard potential, approximately 30 percent have an EAP that includes the downstream area (beyond mine property) that may be affected in the event of a failure. These EAP's are typically required by the state agency responsible for dam safety.

Research and Development and Special Initiatives

The Corps is incorporating risk concepts into dam safety management, routine activities, and programming decisions. Initiatives include developing new policy based on risk concepts, a new, more detailed methodology, and a plan to communicate the strategies. The incorporation of risk into the Corps' Program is being accomplished in three phases: Phase I, Screening for Portfolio Risk Analysis (SPRA); Phase II, Portfolio Risk Assessment methodology; and Phase III, Site Specific Risk Assessments. In 2007, the Corps continued Phase I work initiated in 2005 to prioritize dam safety deficiencies on a nationwide basis. In FY 2006 and 2007, Corps Divisions were asked to identify the next 10 percent of their projects with the perceived highest risk when considering performance and consequences of failure. From this list, 143 projects (118 dams and 25 navigation projects) were evaluated. The evaluations were performed by three multi-discipline cadres using the same SPRA tool developed for the FY 2005 assessments. The Corps considers that the incorporation of risk concepts in its dam safety program has moved the program ahead during the last 2 years. This progress can be seen in the funding provided for dam safety modification studies and in the increase in the number of dam safety modifications under construction.

TVA participates with other agencies and utilities and supports several research programs which have the potential to enhance TVA's dam safety program. TVA continues to operate earthquake strong motion recorders at certain dams. In 2006, strong motion instruments were added at Fontana and Blue Ridge Dams. Since the program began in 1993, 51 records of local and regional earthquakes have been obtained by the strong motion instrumentation.

The presence of unmapped or inaccurately mapped mine workings in the vicinity of a dam can jeopardize its safety. As a result of incidents such as the Quecreek Mine accident, where unknown workings were mined into, Congress appropriated funds to MSHA for digitizing mine maps and for funding projects to develop and demonstrate geophysical technology for the detection of underground mine voids. MSHA provided funds for geophysical demonstration projects and funds were distributed to states for digitizing mine maps. These projects will help improve the safety of dams and impoundments in areas that are undermined. The results of the projects will be disseminated to the mining industry in a CD that will contain the final reports and findings for each project. The results will make mine operators and the engineering community aware of the various methods that can be used for locating mine voids and the applicability and limitations of the methods.

MSHA also is updating the "Engineering and Design Manual: Coal Refuse Disposal Facilities." This manual was originally published in 1975, following the failure of a coal waste dam at Buffalo Creek, West Virginia. The revised manual will address areas not covered by the original manual, such as seismic stability and break-through potential, and will include the information learned over the past 30 years about dams built for coal waste disposal. When completed in FY 2008, the manual will provide a valuable reference for the design and construction of safe dams for mine operators, designers, and regulatory agencies.

DOI BIA is developing a new SOD policy to use risk-based screening to prioritize construction projects. DOI BIA has established a task group to consult with Indian Tribes on implementing the risk-based screening. This new policy will improve the DOI BIA capability to prioritize dam safety activities and resources and identify structures that represent the greatest risk to the public.

DOI NPS has completed a full review of its Dam Safety Program. New business practices have been established and planning for the implementation is now underway. One area of special note will be the prioritization of dam safety projects based on risk. This year, DOI NPS piloted a risk-based failure mode probability analysis as part of its regular formal inspection schedule. This will allow DOI NPS to better focus limited resources for dam safety.

DOI OSM funds applied science studies on various topics, such as slope stability, impoundment safety, and other related engineering areas that may impact dams directly. OSM also is funding underground mine mapping projects to identify dams that may have been undermined.

DOI Reclamation manages a dam safety Technology Development Program in the disciplines of Geotechnical, Seismology/Geophysics, Hydrology, Paleohydrology, and Concrete Dams. During this reporting period, DOI Reclamation led interagency efforts to develop expert-level documents on piping along conduits through dams, geotextiles, and plastic pipes design.

DOI Reclamation continues to emphasize the use of risk analysis in its evaluation processes. Collaboration with the Canadian Electric Association, especially British Columbia Hydro, and Australian interests continues as the agency further develops and refines risk analysis approaches. DOI Reclamation also is collaborating with the Corps on the program to implement risk-based methods in dam safety decision-making. DOI Reclamation implemented several procedures to improve and standardize risk-based decision making techniques. DOI Reclamation standardized a graph to visually display and compare risk data for its facilities. A new process to document risk-based technical findings and

decisions and new procedures to assess performance monitoring programs in a risk-based context were also developed. DOI Reclamation continues to refine its Dam Safety Risk Analysis Methodology, a working guideline on risk analysis methods and associated appendices that define procedures for estimating risk.

The latest ARS-developed earth spillway erosion model has been incorporated into existing NRCS SITES design software. The current version of SITES, dated 2007, can be used to develop inflow hydrographs by NRCS curve number procedures, compute spillway system hydraulics, calculate peak reservoir elevations, and determine ultimate spillway headcut advance for a single dam site or multiple sites in series. Various versions of SITES have been distributed and presented at many recent ASDSO conferences.

FERC has an ongoing program that develops and continually updates Engineering Guidelines. Although FERC Guidelines are primarily intended for internal use, FERC has made them available to licensees, exemptees, applicants, federal and state agencies, engineering consultants, and the general public. The Engineering Guidelines were made available online in FY 2001 and are being used by other regulatory entities.

The chapters of the Engineering Guidelines published to date cover topics such as inflow design floods, gravity dam stability, embankment dam stability, EAP's, foundations of dams and appurtenant structures, probable maximum floods, construction quality control, instrumentation and monitoring, potential failure modes, other dams, and arch dams. New chapters under preparation include Chapter 13, Earthquake Ground Motions, a draft of which is posted on the FERC website. The chapter is targeted for completion in 2007. The Water Conveyance Facilities chapter is being redrafted to emphasize operation, maintenance, and inspection. FERC also is revising and updating Chapter 4, Embankment Dams, Chapter 6, Emergency Action Plans, and the Surveillance Monitoring Plan.

State Dam Safety Agency Involvement

Corps Districts invite state dam safety officials to participate in formal periodic inspections. Typically, state representatives attend one or more inspections per district each year. District dam safety personnel have responded to state requests for assistance during emergencies and other requests for technical assistance. The impact of a dam break for non-federal dams located upstream of present Corps dams is included in the FEAP for that dam. The Corps and ASDSO also have a partnership agreement to encourage continuing dialogue at the national and state levels on issues of importance to dam safety and the Nation; promote professional and ethical dam safety engineering practices; improve national security for all vulnerable dams

by sharing expertise and experience; and increase diversity in the dam safety engineering profession.

MSHA cooperates with state agencies by exchanging information where there is common jurisdiction, conducting joint inspections, and meeting to discuss common issues. This cooperation has been formalized in some areas with an official Memorandum of Understanding (MOU).

The Federal Government has a unique relationship with the Indian Tribes through the DOI BIA. In general, states do not have any authority over Indian reservations without the individual Tribes giving specific authority. The DOI BIA has full responsibility for implementing the SOD Program on Indian reservations. States are included when appropriate and in consultation with the Tribes involved. For example, Parmelee Dam, located on the Rosebud Indian Reservation, has a state highway located on the crest of the dam embankment. The DOI BIA has an agreement in place with South Dakota Department of Transportation for the State Highway Department to maintain the road surface and for DOI BIA to maintain the dam.

DOI Reclamation continues to maintain strong working relationships with state dam safety agencies. DOI Reclamation has MOU's with each of the 17 Western States where Reclamation has facilities. Meetings between DOI Reclamation and the states are generally conducted annually. State representatives may also participate with DOI Reclamation staff on dam safety inspections and on specific issues associated with individual structures.

Public Concerns

In response to public concerns, TVA is installing automatic warning systems to alert the public to possible hazards both upstream and downstream of its dams. Spillway warning signs with strobe lights and turbine warning systems with audible alarms and strobe lights are being installed at all main-river and selected tributary dams. In addition, signage is being upgraded at all dams. Automatic warning systems were installed at four dams during the current reporting period. To date, systems have been installed at 13 dams.

Issues of public concern regarding FERC dams focused on the Taum Sauk remediation, Swinging Bridge Dam remediation, the completion of the seismic remediation at Saluda Dam, and the continued remedial work at Swift No. 2, Marquette No. 3, Silver Lake, and Raeford. In all cases, FERC staff was prompt and responsive in disseminating information to the public. In addition, there were some inquiries and complaints received from the public following natural flood events involving FERC dams. In

most cases, the public was interested in whether the dam contributed to the downstream or upstream flood levels experienced during the flooding.

It is MSHA's practice to participate in meetings with the mining companies, consulting engineers, and public interest groups to explain MSHA impoundment approval procedures, discuss and address concerns, and receive comments from all participants. Dams at coal mines in West Virginia and Kentucky have been the subject of attention and concern for local residents. In one case, the plan is to raise the dam to an unprecedented height for a coal waste disposal dam (in the range of 900 feet). In two other cases, the concern stems from the dams being located upstream of elementary schools. In one case, a small slide occurred on the dam due to hillside seepage and a drain was installed to correct the condition. In the other case, a Freedom of Information Act request was received and fulfilled. With the correction of the seepage problem, no serious deficiencies have been found with these dams.



Morelos Dam, TX. Photo courtesy International Boundary & Water Commission.

National Dam Safety Program Activities

The two preceding chapters of this biennial report described the accomplishments of the state and federal dam sectors and some of the challenges they face. The Dam Safety Act of 2006 also provides funds for the training of state dam safety staff and inspectors and for a program of technical and archival research, including the development of data collection tools for the continued monitoring of the safety of dams in the United States. Accomplishments in these areas during the reporting period are described below.

Training

Since the inception of the National Dam Safety Program in 1979, the Federal Emergency Management Agency (FEMA) has supported a strong, collaborative training program for dam safety professionals and dam owners. With the training funds provided under the Dam Safety Act of 2006 (Public Law 109-460), FEMA has continued to expand existing training programs, begun new initiatives to keep pace with evolving technology, and enhanced the sharing of expertise between the federal and state sectors. In Fiscal Year (FY) 2006 and FY 2007, more than 3,000 stakeholders were trained at dam safety workshops, seminars, and courses across the United States. In FY 2008 and FY 2009, FEMA

and its partners will continue to develop and promote training that furthers one of the five goals for the National Dam Safety Program: to develop a workforce of engineers, scientists, technologists, and well-prepared citizens.

The training activities conducted under the National Dam Safety Program fall under one of three components: national training initiatives, most of which are conducted at FEMA's Emergency Management Institute (EMI); regional technical training that is conducted by the Association of State Dam Safety Officials (ASDSO); and local training through direct assistance to the states and self-paced training.

National Training Initiatives

A major training initiative is the National Dam Safety Program Technical Workshop Series. The idea for a series of technical workshops originated with the Interagency Committee on Dam Safety (ICODS) in 1992. The goal then, as it is now, was to invite recognized authorities in the engineering field to discuss analysis techniques, construction methods, and other issues that can increase the expertise and information available to all of the engineers in the dam safety community.

For the first few years of the Technical Workshop Series, the majority of attendees were representatives from federal agencies. With the passage of the National Dam Safety Act of 1996, FEMA was able to make the Workshop Series more national in scope, and more inclusive of state and local dam safety personnel and the private sector. Over the years, the Technical Workshops have hosted a pre-eminent roster of speakers. For the last 8 years, training funds have been set aside for state dam safety officials to attend the Workshops. To date, 14 Technical Workshops have been held.

In February 2006, Technical Seminar #13, *Implementation of Remedial Measures*, was held at FEMA's EMI. Approximately 200 participants from the states, academia, federal agencies, and private sector organizations attended this Seminar. In February 2007, Technical Seminar No. 14, *Earth Embankment Dams*, was held at EMI. About 165 state and federal dam safety officials attended the course. Of the attendees at Technical Seminar #14, 41 percent had 5 years or less of experience and 14 percent had less than 1 year of experience. Technical Seminar No. 15, *Lessons Learned from Dam Failures and Incidents*, will be held at EMI in February 2008.

HEC-RAS is the U.S. Army Corps of Engineers (Corps) Hydrologic Engineering Center (HEC) River Analysis System (RAS). The HEC-RAS software analyzes networks of natural and man-made channels and computes water surface profiles based on steady one-dimensional flow hydraulics. The HEC-HMS is the HEC Hydrologic Modeling System (HMS), designed to simulate the precipitation runoff processes of dendrite watershed systems. Hands-on computer training in both HEC-RAS and HEC-HMS has been a priority for state training. Each year, the National Dam Safety Program supports a HEC-RAS course and a HEC-HMS course for approximately 25-30 students at EMI. A Beginning HEC-HMS course was held at EMI in May 2006 and in January 2007 and an Advanced HEC-RAS course was held at EMI in January 2006 and May 2007.

ASDSO Regional Technical Training

As part of its educational mission, ASDSO administers a regional technical training program funded by the National Dam Safety Program. The program offers participants in-depth study in specific dam-related topics. Basic and advanced-level courses are offered each year on topics selected from the ASDSO Program of Study. The basic courses are geared for dam safety regulators, engineers, dam owners and operators, and others with 5 years or less of experience in dam safety. Advanced courses are designed to address the needs of dam safety officials and engineers with at least 5 years of experience. In some cases, prerequisite courses are recommended. Most of the courses last two to four days and are rotated to different geographic regions over a 1- to 2-year period.

In FY 2006 and 2007, ASDSO held the following regional technical seminars:

- 2005 Northeast Regional Course on Hydraulics of Spillways, Princeton, New Jersey, November 2005
- 2005 Southeast Regional Course on Hydraulics of Spillways, Charlotte, North Carolina, December 2005
- 2006 West Regional Course on Hydraulics of Spillways, Las Vegas, Nevada, January-February 2006
- 2006 Midwest Course on Safety Evaluation of Existing Dams, Indianapolis, Indiana, April 2006
- 2006 Northeast Regional Course on Interactive Preparedness: Emergency Action Planning for Dam Safety, Newark, Delaware, November 2006
- 2006 Southeast Regional Course on Interactive Preparedness: Emergency Action Planning for Dam Safety, Jacksonville, Florida, December 2006
- 2007 West Regional Course on Safety Evaluation of Existing Dams, Tempe, Arizona, February 2007
- 2007 Midwest Regional Course on Hydraulics of Spillways, Milwaukee, Wisconsin, March 2007

Each year, in addition to its regional technical training, ASDSO sponsors Advanced Technical Seminars and an annual conference that provides extensive training for attendees. In FY 2006, ASDSO conducted an *Advanced Course on Dam Failure Analysis*, which was presented in Salt Lake City, Utah in October 2005, in Burlington, Vermont in July 2005, and in Portland, Oregon in October 2006. In July 2007, an *Advanced Course on Slope Stability for Embankment Dams* was held in Rolla, Missouri. This course also was offered in October 2007 in Denver, Colorado. The 2006 and 2007 ASDSO Annual Conferences were held in Boston, Massachusetts and Austin, Texas.

Local and Self-Paced Training

Training funds for state dam safety officials have been a mainstay of the National Dam Safety Program. Each year, an amount is provided directly to state officials to cover the costs of attending technical training identified by the individual states. This flexibility allows the states to focus their training on their specific needs.

One of the most successful training initiatives for state and federal dam safety officials is the Training Aids for Dam Safety (TADS) program, which consists of 21 modules (workbooks and videos) covering topics from inspection to

evaluation to emergency planning. The TADS program consists of three parts: (1) the inspection component, in which state regulators are taught how to conduct a dam safety inspection; (2) the awareness component, which emphasizes dam safety mitigation; and (3) the analysis component, in which state regulators are taught how to analyze dam safety data.

In FY 2005, the Corps began scanning the TADS modules and the ICODS Dam Safety Video Series for placement on the Corps Learning Network website at <http://usaceln.org/technical>. This effort was completed in FY 2006. In the summer 2007, FEMA completed the digitization of the 21 TADS workbooks and videos into DVD format. The TADS DVD will be published and distributed in FY 2008.

Research

Research is critical to the Nation's agenda for dam safety. Research funding under the National Dam Safety Program has addressed a cross-section of issues and needs in FY 2006 and FY 2007, all in support of ultimately making dams in the United States safer.

In April 1999, the first full year of National Dam Safety Program funding, the ICODS Research Subcommittee, now the National Dam Safety Review Board (Review Board) Dam Safety Research Work Group, identified 17 broad area topics related to the research needs of the dam safety community. Research funds were subsequently allocated to hold workshops in nine of the priority areas. Based on the results from the workshops, research topics were proposed and pursued. Several topics have progressed to products of use to the dam safety community, such as technical manuals and guidelines. Products produced during this reporting period with research funds include the *Final Report on Coordination and Cooperation with the European Union on Embankment Failure Analysis*, FEMA 602D, and the update to the *ASDSO Model State Dam Safety Program*, FEMA 316. Two additional products that will be published in FY 2008 are the *Technical Manual: Plastic Pipe Used in Embankment Dams*, Bureau of Reclamation (Reclamation) and *Technical Report: Use of Geotextiles in Embankment Dams*, Reclamation.

In July 2007, the Review Board authorized the release of a new risk categorization tool developed with research funding. This product is an Excel-spreadsheet-based tool intended to provide a simplified, risk-based vehicle for completing screening level evaluations that can be used for



From an observation platform overlooking a test dam, hydraulic engineer Greg Hanson records the test for use in computer modeling. Photo courtesy of USDA, ARS, Stephen Ausmus.

initial prioritization of dam safety concerns in a portfolio of dams. Pre-release versions of the tool are available from the ASDSO web site (www.damsafety.org). The official release versions of the tool and the user manual will be available from the FEMA web site (www.fema.gov) in FY 2008.

There also were a number of ongoing initiatives continued under the direction of the Research Work Group in FY 2006 and FY 2007. To establish an effective and efficient research program, the ICODS Research Subcommittee recommended that all relevant research data be collected and compiled on the history of dam safety engineering in the major technical areas. To address this need, ASDSO developed a comprehensive *Bibliography of Dam Safety Practices* using its national networking capabilities. The effort, which began in 1999, continues today. The *Bibliography* is updated on a weekly basis and is fully searchable online at ASDSO's web site.

Other ongoing research projects scheduled for completion during the next reporting period include the following:

- Best Operation & Maintenance (O&M) Practices for Gates (Corps)
- Best Practices for the Design and Construction of Outlet Works Dissipaters (Reclamation)
- Indirect Means for Assessing Conditions within Embankment Dams (Corps)
- Preparation of Guidance for Best Practices for Monitoring, Measurement, and Evaluation of Seepage through and beneath Embankment Dams (Corps)
- Preparation of Guidance for Design and Installation of Granular Filters within Embankment Dams (Corps)
- Improvement of Regression Equations for Analysis of Embankment Dam Breaching (Colorado State University)

Research priorities for FY 2008 include outreach to the states to promote emergency action planning for high-hazard potential dams; overtopping protection for earth embankments; hydraulic design criteria for embankment stepped spillways; and historical, regional databases of storms and floods.

Information Technology

Information needs for dam safety extend from those in Congress who set national priorities and allocate fiscal resources to those of the dam owner and engineer involved in inspections, operations and maintenance, dam safety modifications, and other day-to-day activities of

maintaining safe, economically viable facilities and environmentally responsible structures. A primary objective of FEMA in its leadership of the National Dam Safety Program is to identify, develop, and enhance technology-based tools that can help educate the public and assist decision-makers.

National Inventory of Dams

Congress authorized the Corps to inventory dams in the United States with the National Dam Inspection Act (Public Law 92-367) of 1972. The NID was first published in 1975, and has been periodically updated since. The Water Resources Development Act of 1986 (Public Law 99-662) authorized the Corps to maintain and periodically publish an updated NID, and the Dam Safety Act of 2006 re-authorized periodic updates and provided a continued funding mechanism.

The NID is a computerized database of dams in the United States used to track information on our water control infrastructure, land use management, flood plain management, risk management, and emergency action planning. The NID, which is maintained and published by the Corps with information from all 50 states, Puerto Rico, and 16 federal agencies, is a dynamic on-line database with scheduled periodic updates and interim updates (as *improved data is received from participants*). The NID also includes Internet-based tools to query the data, and features a Geographic Interface System that allows for the display and analysis of data. Access to the NID is available at <http://www.tec.army.mil/nid/> for government users and <http://www.tec.army.mil/nidpublic> for all others.

The current NID contains data on approximately 83,000 dams throughout the United States that are more than 25 feet high, hold more than 50 acre-feet of water, or are considered a significant hazard if they fail. The NID web site enables query of dams, including dam name, height, type, purpose, year of construction, and owner, with query results shown on a screen or available in a downloadable file. Users can also display dams on a map of the United States that includes features such as state, county, congressional boundaries, waterways, and major cities.

The Review Board Work Group on the NID, which is chaired by the Corps, provides guidance and recommendations concerning the data element, format, and publication media for the NID. The Work Group provides a permanent forum for federal and state organizations to advise the Corps, via the Review Board and FEMA, on issues relating to the NID, and to make recommendations on institutional, managerial, technical, policy, and security issues that affect the NID. The Work Group on the NID also oversees activities relating to the publication and use of the NID on the Internet and other communication media.

In FY 2007, the Corps completed its most recent update to the NID. The update captures more accurate and more comprehensive data on existing dams, changes in existing dams, and new dams. For example, each dam in the NID is assigned a downstream hazard potential classification (by the appropriate regulating authority), based on the potential loss of life and damage to property should the dam fail. With the changes in demographics and post-construction land development in downstream areas, hazard potential classifications need to be updated continually to reflect the dam's current status.

As the update process continues, the quality of information at all levels in the Nation's dam safety community continues to improve. State inspections and data sharing among state and federal agencies verify or amend existing data, and identify or complete missing information. The key advantages of this methodology are that it leverages the economic advantages of a partnership effort, fosters cooperation among state and federal agencies, and strengthens government and non-government risk management and decision-making at the state, local, and national levels.

Dam Safety Program Management Tools

40 Since the authorization and implementation of the National Dam Safety Program, it has become increasingly clear that there are broad information needs required to support dam safety. These data needs include:

- Documenting the condition of the Nation's dams
- Tracking the existence and progress of dam safety programs
- Supporting dam safety professionals who are responsible for evaluating and maintaining the safety of dams in the United States

Satisfying many of these data needs is the Dam Safety Program Management Tools (DSPMT) program. The DSPMT is an information collection and management system that is controlled locally by federal and state dam safety program managers and which interacts with national external cooperative information resources for providing as-requested and periodic information on local dam safety information, program needs, and accomplishments within each organization's jurisdiction.

The purpose of the DSPMT is to provide dam safety program managers with a tool to collect unbiased data about dams and dam safety programs, check selected data for accuracy, and then utilize the data to achieve an accurate local and national inventory of dams and to help address programmatic questions such as:

- How well are our dam safety programs being implemented?
- Are we doing too much in some areas and not enough in others?
- Are we spending our scarce resources in the right places?
- Are we improving?

The DSPMT consists of a set of interactive software programs that provide a resource to the dam safety data owners, managers, and data providers. The DSPMT includes three distinct, complementary, and interoperable software programs:

- The Dam Safety Program Performance Measures (DSPPM)
- The NID Electronic Submittal Workflow
- Dam Safety Program Reporting Tools to National Oversight Organizations

Dam Safety Program Performance Measures

The performance measures, or indicators, use unbiased data to assess effectiveness of dam safety programs and organizations. Performance measures have been defined and implemented in the following seven key areas:

- 1 - Dam Safety Program Management Authorities and Practices
- 2 - Dam Safety Staff Size and Relevant Experience
- 3 - Inspections and Evaluations
- 4 - Identification and Remediation of Deficient Dams
- 5 - Project Response Preparedness
- 6 - Agency and Public Response Preparedness
- 7 - Unscheduled Dam Safety Program Actions

These broad performance measures are supported by detailed spreadsheets which are targeted at individual aspects of the performance measures. The following detailed spreadsheets are currently available within the DSPMT:

- Staffing Spreadsheet
- Deficiencies and Budgeting Prioritization Spreadsheet
- Documentation Spreadsheet

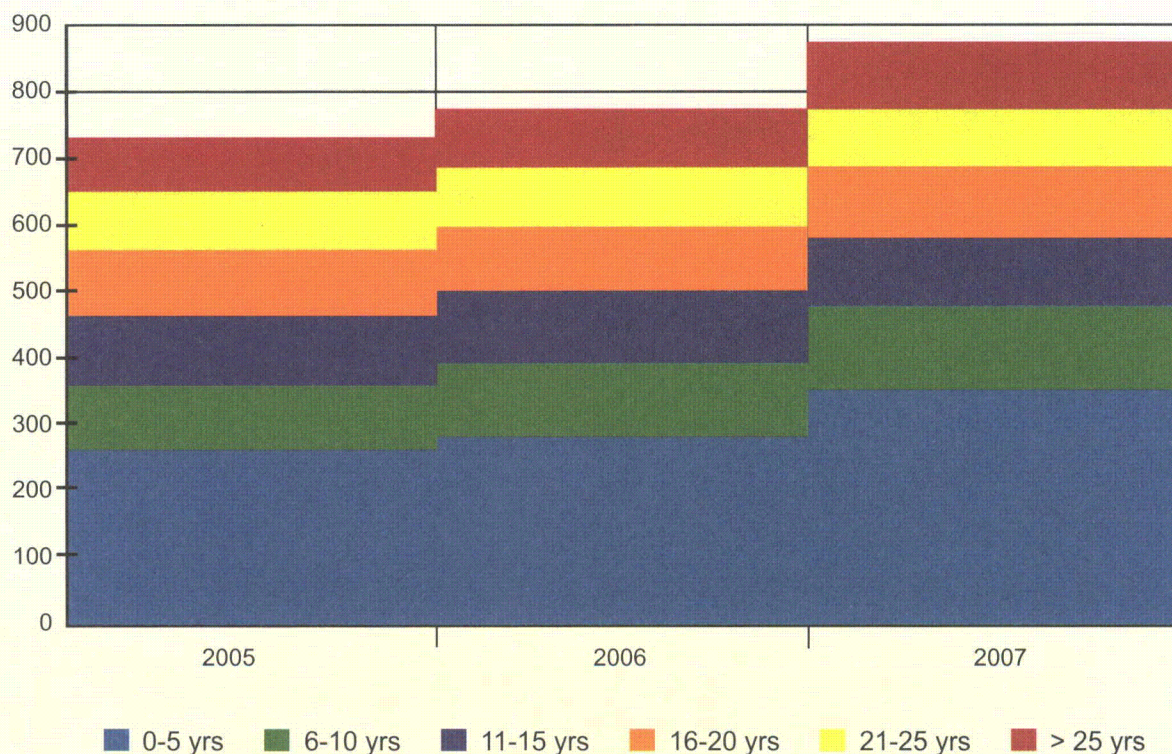


Figure 19: Available Corps Staff by years of Dam Safety Experience

Source: NID/DSPMT

These spreadsheets allow graphics to be generated that provide insight into the capabilities and challenges faced by the organization. For example, Figure 19 shows the number of available staff and associated experience levels within the Corps dam safety program since 2005.

The full database of DSPMT information for Corps Districts and Divisions was initially utilized to support and generate the FY 2004-2005 Corps biennial report to FEMA. It was updated and utilized this year to support and generate the FY 2006-2007 Corps biennial report.

Performance measure output at each level in an organization can be used individually and/or collectively to evaluate the “health and progress” of the program at that level. These same data can then be used at the next higher level to evaluate program performance or program “health and progress” on broader scales, e.g., district, division, Agency, State. The performance measures can be used by organizations such as the ASDSO, the Review Board, ICODS, and FEMA to evaluate the “health and progress” of dam safety programs on national scales. Historical data sets allow for the establishment of baselines for each organization or state from which comparisons can be made to measure degree of change or improvement and to generate timelines of data from which trends may be observed.

NID Electronic Submittal Workflow

The NID Electronic Submittal Workflow software is a natural extension of the NID and part of the DSPMT to help users provide a consistent, error-checked electronic submittal of inventory information. The NID Electronic Submittal workflow is represented in Figure 20.

By performing data submittal workflows at the state and agency level, those most familiar with the data and most qualified to make any changes, specifically the data owners, managers, and data providers, are kept in the loop by the program as it highlights areas in the data that potentially need attention, modification, or double-checking. By performing these workflows at the state and agency level, and by using the original data from the day-to-day dam inventory management tools, the data quality and accuracy of the submittal is significantly enhanced.

In 2006, the states and federal agencies were requested to provide dam inventory data to update the NID developed in spring 2007. Figure 21 shows the individual dams provided by each of the NID contributors which were included in the final NID, with high-hazard potential dams shown in red, significant-hazard potential dams shown in yellow, and low-hazard potential dams shown in black.

This data collection effort built upon the tools and experience gained during the publication of previous

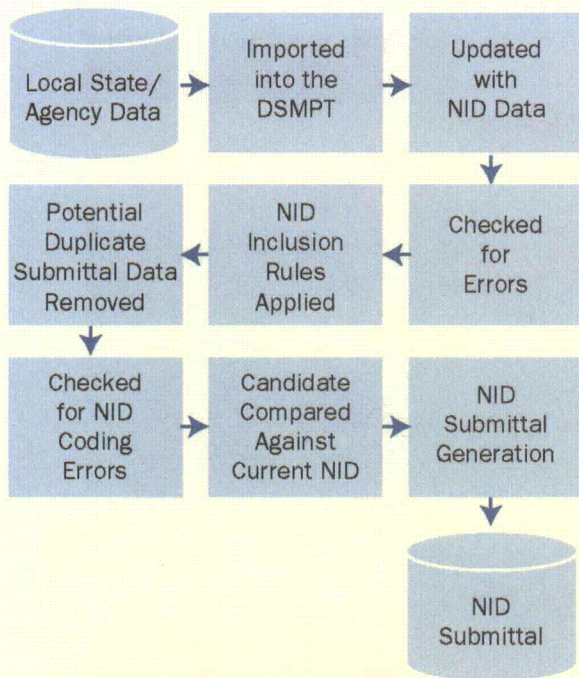


Figure 20: NID Electronic Submittal Workflow

Source: NID/DSPMT

national inventories of dams. By utilizing and applying the knowledge gained during these past duplicate resolution efforts, future efforts should be significantly reduced. The near-term goal is to be able to publish the NID every 2 years. As a result, the states and federal agencies will again be requested to provide dam inventory data in early 2008. Although not yet achieved, the long-term goal is to have a “living” NID in which electronic contributions from the states and federal agencies can be incorporated in near real-time to when they were submitted, meaning that whenever changes are made in a state or federal agency local inventory, those changes will be reflected in a current, ongoing NID within a timeframe of a few days.

Dam Safety Program Reporting Tools to National Oversight Organizations

Utilization of DSPMT data collection and reporting capabilities provides insight into the contributing organization’s dam safety program, both individually and collectively. Electronic reporting of dam safety program information is being used to help determine whether program improvements are occurring and how a program stands relative to the dam safety programs of other organizations. This can facilitate the development, documentation, and modification of practices and

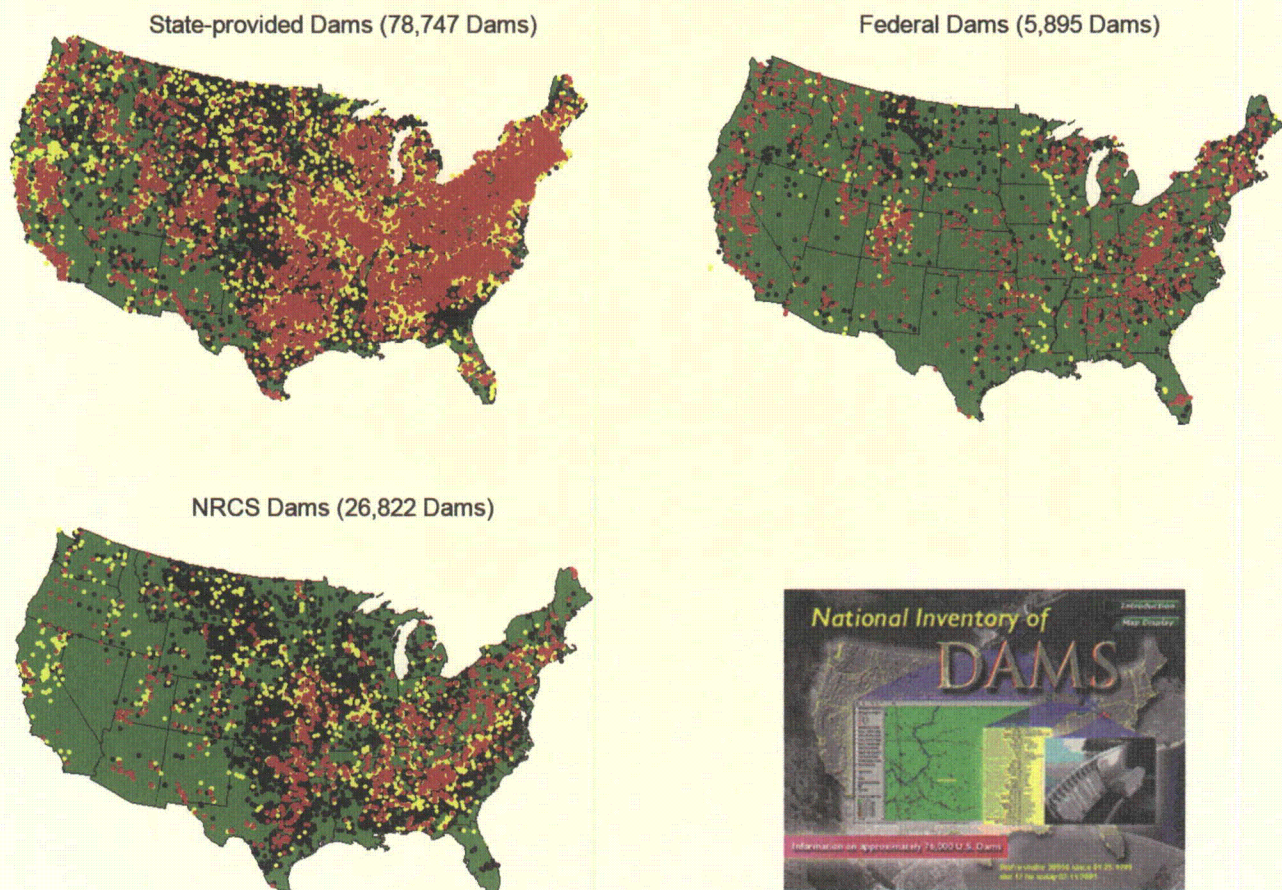


Figure 21: Dams Provided by Individual Contributors for 2007 NID

Source: NID/DSPMT

procedures by supporting performance measures which directly address all aspects of an organization's dam safety program, ranging from legislative authorities, dam safety staff size and relevant experience, the inspection program, identification of deficient dams, remediation needs and accomplishments, training, and emergency action planning and response.

An ongoing concern among the national oversight organizations has been how to continue to maintain high levels of state participation in providing requested data in an environment of ever-increasing requests for additional data. In the past, states had been asked for data to support inventory update requests from the NID, State Evaluation Criteria Report data from the Review Board, annual survey data from ASDSO, and annual dam safety program information from the Community Rating System in support of the National Flood Insurance Program. These requests for data occurred at differing times of the year and varied in terms of their complexity. The DSPMT has been modified to support a combined reporting workflow so that all of the data requests can be satisfied with an annual one-time-only electronic data report. The electronic reporting interface is enhanced by utilizing the most recently published NID for providing recommendations on responses, where possible, to the combined dam safety program questions. For example, the NID information can be used to provide data on numbers of dams, numbers of EAP's, and numbers of inspections. This should function to improve the accuracy and quality of the data being reported to the national oversight organizations.

In 2007, state program performance information was again collected from the state regulatory organizations and provided to the Review Board and ASDSO. The state program performance data has been collected from the state regulatory organizations since 1998, and enough data has been collected to observe trends in the collective national dam safety program.

Use of the DSPMT by federal agencies and the states is illustrated in Figure 22. An organization's local inventory of dams, in a variety of data formats, can be imported into the DSPMT and used as the local inventory of dams for numerous functions, including performance measure data submittals, NID data submittals, generation of the FEMA State Evaluation Criteria Report, the ASDSO annual survey, and providing incident information to the National Performance of Dams Program (NPDP).

Both federal and state dam safety programs are in need of continuous efficiency and effectiveness improvements. In addition, there is an ever-increasing need for performance-based reporting. The DSPMT provides the tools necessary for evaluating dam safety programs, for reporting

accomplishments, and for expressing program needs to others. As a working tool, it implements true one-time-only data entry, provides assistance to program managers in achieving continuous program improvement, is a self-evaluation tool and an internal and external reporting tool, and encourages results-oriented management practices. By using the DSPMT, states and federal agencies will be assured of a more consistent, error-checked submittal of inventory and performance measure information provided on a periodic or as-needed basis.

National Performance of Dams Program

The NPDP, which is headquartered at Stanford University, is a national effort to retrieve, archive, and disseminate information on dams and their performance in the United States. As part of its mission, the NPDP operates a database and library on the performance of dams to meet the needs of dam safety professionals. The NPDP, which works with professional associations and federal and state agencies, receives reports on dam incidents, i.e., events that relate to the structural and operational integrity of dams. The NPDP home page address is <http://npdp.stanford.edu/>.

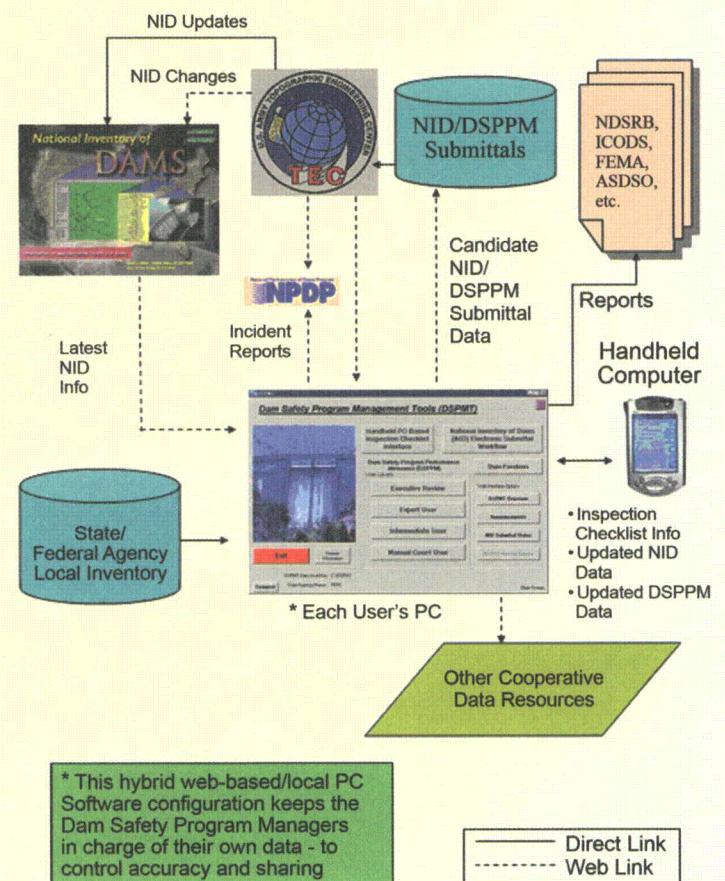
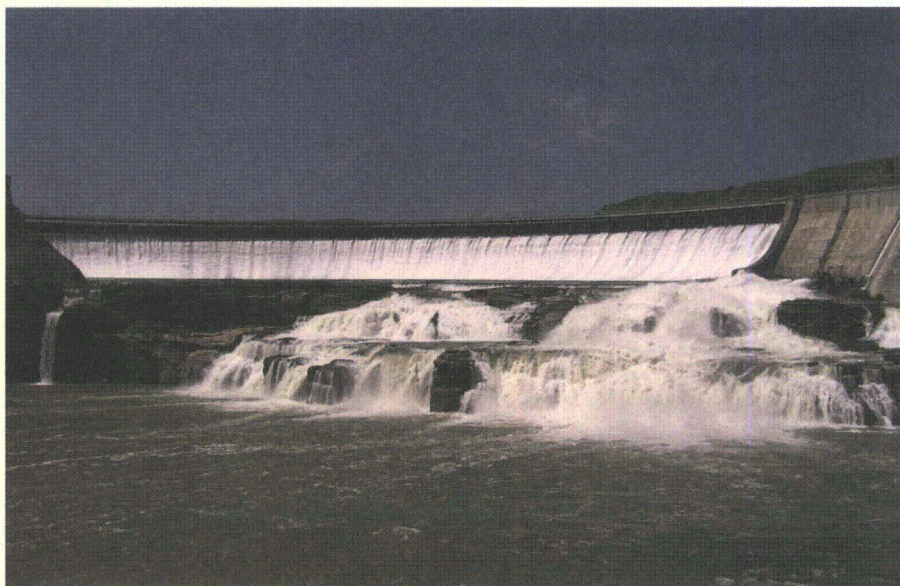


Figure 22: DSPMT Information Flow

Source: NID/DSPMT



Ryan Dam, MT. Photo courtesy FERC.

Recommendations

Section 11 of the Water Resources Development Act of 1996 (Public Law 104-303) states that the Director (now Administrator) of the Federal Emergency Management Agency (FEMA) will submit a biennial report that describes the status of the National Dam Safety Program, including progress achieved by participating states and federal agencies, and recommendations for legislative and other action that the Administrator considers necessary. Below are recommendations for the National Dam Safety Program in Fiscal Year (FY) 2008 and FY 2009 to realize the larger goal of keeping the American public safe from dam failure.

Provide the Means to Assess the Risk Associated with Dams

As discussed earlier in this report, the number of dams in the United States identified as deficient is increasing at a faster rate than dams are being repaired. The National Dam Safety Program can significantly reduce the risk to life and property from dam failures by providing state and federal dam safety officials and dam owners with the tools to identify, prioritize, and mitigate this risk. In turn,

information on the risk from dam failure must be shared with the downstream public (*see the recommendation, Increase Awareness of Dams by the Downstream Public*).

As the value and benefit of risk-informed analysis becomes more evident, there is an obvious need to share expertise, methodologies, and best practices that will enable state and federal agencies and private dam owners to implement such approaches in their programs. The National Dam Safety Program, working through the National Dam Safety Review Board (Review Board) and the Interagency Committee on Dam Safety (ICODS), will focus on this area through the following: (1) the analysis, development, and sharing of best practices in risk assessment, with the ultimate goal of ascertaining the most efficient way to address risk assessment in FY 2009; (2) the sharing of information on risk assessment tools; (3) the dissemination of tolerable risk guidelines that can be used by state, federal, and international agencies and organizations and private dam owners; and (4) the development of recommendations for research related to risk assessment that can be undertaken by federal agencies, universities, and the private sector.

Increase Awareness of Dams by the Downstream Public

Many Americans are not aware that they are living downstream of a dam, much less a deficient dam. Further, many Americans are not aware that they are living downstream of a deficient dam that does not have an Emergency Action Plan (EAP) to provide for warning and evacuation in the event the dam fails. In some cases, there is an EAP, but those living downstream are not aware of it. During the May 2006 floods in New England that breached numerous dams throughout the region, EAP's for many dams either could not be located or were out of date. In FY 2008 and FY 2009, FEMA and the Review Board will develop and implement initiatives to reach and inform the public and property owners of the existence of potentially deficient dams, ensuring that they are aware of the status of each dam.

Increase Inspections of Dams

One of the factors behind the increase in the number of dams identified as in need of remediation is the increase in inspections being performed, combined with better inspections, and better reporting of inspection results. Although the number of dam inspections conducted by the states remained fairly constant compared to the last reporting period, overall inspections have increased dramatically since data was first collected for 1998-1999. In January 2006, the Review Board approved a performance measure for the National Dam Safety Program to increase the number of high-hazard potential dams in the United States that are inspected. In FY 2008, FEMA and the Review Board will establish overall and state-based targets for this measure.

Increase the Number and Updates of Emergency Action Plans

An EAP is one of the primary safeguards against the loss of life that can result from the failure of a dam. Today, there are 9,525 state-regulated high-hazard potential dams in the United States. Of these 9,525 dams, approximately 49 percent do not have an EAP.

Since the National Dam Safety Program was established in 1979, the state and federal sectors have made significant progress in increasing the number of high-hazard potential dams with EAP's. FEMA and the dam safety community recognize, however, that much more must be done to reach the goal established in January 2006 by the Review Board: achieve 100 percent compliance for EAP's for high-hazard potential dams.

In January 2006, the Review Board convened a Task Group on Emergency Action Planning to develop recommendations for significantly increasing the number of high-hazard potential state-regulated dams with an EAP. The Task Group developed six recommendations for implementation by a cross-section of stakeholders. For each recommendation, the Task Group also developed strategies and best practices for addressing the issues affecting EAP implementation. FEMA, through the National Dam Safety Program, will pursue initiatives recommended under the EAP Action Plan.

Achieve the Participation of all States in the National Dam Safety Program

At the end of this reporting period, Alabama was the only state not participating in the National Dam Safety Program. One of the long-standing goals of the National Dam Safety Program is for the State of Alabama to enact legislation so that it can participate in the Program.

Increase the Number of Stakeholders Trained in Dam Safety

Through the efforts of the Review Board, the Association of State Dam Safety Officials (ASDSO), and the ICODS agencies, there is now a national dam safety training program in place that provides for a cycle of continuous technical training to meet the needs of the dam safety community, including government, consulting engineers, dam owners, the emergency management community, and other professionals. In FY 2006 and FY 2007, more than 3,000 stakeholders were trained at dam safety workshops, seminars, and courses across the United States. FEMA and the Review Board will continue to develop and promote training in FY 2008 and FY 2009 that furthers one of the five goals for the National Dam Safety Program: to develop a workforce of engineers, scientists, technologists, and well-prepared citizens.

Translate Research Products and Tools into Training

The majority of research projects approved for National Dam Safety Program funding generate a research product, such as a technical manual, guideline, or software tool, that is based on the priorities established in the 5-year Strategic Plan for Dam Safety Research. In FY 2006 and FY 2007, a

number of products were developed that address research priorities identified in the Strategic Plan. A goal of FEMA and the Review Board for FY 2008 and FY 2009 is to establish and implement a better cross-walk between the research products generated and the training that is offered to stakeholders in the dam safety community.

The National Inventory of Dams (NID) and the Dam Safety Program Management Tools (DSPMT) program, which have received major emphasis and funding under the National Dam Safety Program, continue to collect invaluable data on the status of dams and dam safety programs in the United States. These programs, which are operated and maintained by the Corps, are generating data for the evaluation of the “health and progress” of dam safety programs on the national scale. As in the past, the NID and the DSPMT will be important tools in the collection of data for measuring progress in dam safety during the next reporting cycle.

Continue to Achieve Cost Efficiencies

46 One of FEMA’s ongoing goals for the National Dam Safety Program, as it is for all of its programs, is to increase efficiencies in the publication and distribution of resource materials, increase the access to the resource materials, and to maintain the quality of the materials. FEMA has now implemented a web-based and CD-ROM/DVD publication and dissemination structure for the majority of its materials. The increased use of these publication technologies, which will continue in FY 2008 and FY 2009, is resulting in annual reductions each year in printing and distribution costs for National Dam Safety Program resource materials.

Appendix A: List of Acronyms

ARS	Agricultural Research Service	IBWC	International Boundary and Water Commission
ASCE	American Society of Civil Engineers	ICODS	Interagency Committee on Dam Safety
ASDSO	Association of State Dam Safety Officials	MOU	Memorandum of Understanding
BIA	Bureau of Indian Affairs	MSHA	Mine Safety and Health Administration
BLM	Bureau of Land Management	NID	National Inventory of Dams
DHS	Department of Homeland Security	NIMS	National Incident Management System
DoD	Department of Defense	NMC	National Monitoring Center
DOE	Department of Energy	NPDP	National Performance of Dams Program
DOI	Department of the Interior	NPS	National Park Service
DOL	Department of Labor	NRC	Nuclear Regulatory Commission; National Research Council
DSPMT	Dam Safety Program Management Tools	NRCS	Natural Resources Conservation Service
DSPPM	Dam Safety Program Performance Measures	NWS	National Weather Service
D2SI	FERC Division of Dam Safety and Inspections	OIG	Office of Inspector General
EAP	Emergency Action Plan	O&M	Operation & Maintenance
EMA	Emergency Management Agency	OSM	Office of Surface Mining
EMI	Emergency Management Institute	RHS	Rural Housing Service
EWS	Early Warning System	RUS	Rural Utilities Service
FEAP	Flood Emergency Action Plan	SEED	Safety Evaluation of Existing Dams
FEMA	Federal Emergency Management Agency	SOD	Safety of Dams
FERC	Federal Energy Regulatory Commission	SPRA	Screening for Portfolio Risk Assessment
FS	U.S. Forest Service	TADS	Training Aids for Dam Safety
FSA	Farm Services Agency	TVA	Tennessee Valley Authority
FTE	Full-Time Equivalent	USDA	U.S. Department of Agriculture
FWS	U.S. Fish and Wildlife Service	USGS	U.S. Geological Survey
FY	Fiscal Year	USIBWC	U.S. Section, IBWC
HEC-HMS	Corps Hydrologic Engineering Center- Hydrologic Modeling System	USSD	United States Society on Dams
HEC-RAS	Corps Hydrologic Engineering Center-River Analysis System	WCS	Water Control Structure

Appendix B: Table 3: Summary Status of State Dam Safety Programs for the Year Ending in FY 2006

State	# State Regulated NID Dams*				Total # State Regulated Dams*			
	Total	High	Sig	Low	Total	High	Sig	Low
Alabama	2219	191	438	1590	0	0	0	0
Alaska	100	25	33	42	77	18	31	28
Arizona	328	113	52	163	256	93	39	124
Arkansas	1208	162	226	820	1146	144	206	796
California	1494	461	725	308	1255	340	700	215
Colorado	1806	362	384	1060	1635	312	330	993
Connecticut	723	229	447	47	702	218	445	39
Delaware	61	9	27	25	37	9	27	1
Florida	853	110	310	433	790	70	310	410
Georgia	4814	451	82	4281	4480	405	37	4038
Hawaii	116	75	21	20	115	74	21	20
Idaho	406	108	144	154	341	76	132	133
Illinois	1463	192	331	940	1391	185	291	915
Indiana	1047	271	298	478	927	254	254	419
Iowa	3340	84	198	3058	3278	78	190	3010
Kansas	5707	187	206	5314	5673	160	206	5307
Kentucky	1057	276	234	547	947	252	219	476
Louisiana	553	18	71	464	530	16	62	452
Maine	336	57	37	242	157	19	19	119
Maryland	317	67	84	166	311	66	83	162
Michigan	983	157	167	659	832	135	146	551
Minnesota	1030	44	153	833	915	34	130	751
Mississippi	3433	306	85	3042	3411	294	82	3035
Missouri	5205	657	1045	3503	666	245	207	214
Montana	3256	203	174	2879	2607	102	130	2375
Nebraska	2284	129	216	1939	2255	116	214	1925
Nevada	461	136	106	219	442	131	106	205
New Hampshire	628	82	183	363	616	75	183	358
New Jersey	820	205	374	241	808	200	373	235
New Mexico	500	192	102	206	362	166	97	99
New York	1971	388	757	826	1906	369	742	795
North Carolina	2894	1062	669	1163	2781	999	662	1120
North Dakota	838	28	93	717	807	19	93	695
Ohio	1587	450	553	584	1517	412	550	555
Oklahoma	4701	199	93	4409	4644	166	84	4394
Oregon	897	139	188	570	821	114	175	532
Pennsylvania	1517	830	289	398	1359	781	251	327
Puerto Rico	35	34	1	0	35	34	1	0
Rhode Island	181	15	38	128	180	15	38	127
South Carolina	2419	204	490	1725	2319	158	481	1681
South Dakota	2503	88	153	2262	2351	51	144	2156
Tennessee	1164	272	346	546	628	149	205	274
Texas	6976	851	782	5343	6913	817	775	5321
Utah	858	248	327	283	784	217	321	246
Vermont	358	55	132	171	344	51	130	163
Virginia	1637	184	312	1141	1393	138	274	981
Washington	745	216	212	317	617	147	197	273
West Virginia	560	382	142	36	525	366	129	30
Wisconsin	1142	257	157	728	925	192	132	601
Wyoming	1468	95	120	1253	2349	71	1112	1166
Totals	80999	11556	12807	56636	70160	9553	11766	48841

Total	# of Inspections**			#EAP's**	
	High	Sig	Low	High	Sig
0	0	0	0	0	0
14	3	8	3	9	9
103	63	15	25	74	30
89	38	26	25	98	0
1676	570	903	203	341	720
617	247	198	172	345	332
19	3	15	1	162	125
0	0	0	0	7	0
1100	200	700	200	72	321
1439	540	0	899	14	0
135	96	22	17	64	15
171	34	61	76	93	35
153	77	37	39	170	125
278	56	67	155	6	1
83	67	11	5	0	0
117	66	49	2	139	14
278	89	90	99	6	0
150	25	48	77	21	4
78	7	14	57	23	48
121	43	29	49	58	43
220	33	32	155	80	136
54	23	21	10	23	2
102	99	3	0	44	3
177	118	40	19	25	15
25	17	3	5	95	1
585	55	92	438	116	7
257	92	65	100	94	25
151	26	41	84	89	136
181	87	50	44	202	234
180	120	26	34	13	0
425	263	113	49	212	55
1686	830	211	645	186	25
168	19	62	87	12	4
76	70	4	2	160	118
612	78	19	515	145	30
121	33	22	66	72	15
1805	1457	101	247	704	122
17	17	0	0	35	0
150	3	10	137	2	1
199	43	156	0	153	481
82	17	7	58	31	6
364	148	109	107	147	6
243	136	47	60	135	16
305	161	90	54	187	51
135	38	48	49	14	29
57	11	20	26	122	166
56	32	19	5	121	60
222	156	48	18	186	54
45	11	7	27	104	22
299	19	14	266	37	7

* Numbers extracted from 2007 NID

** Numbers extracted from 2007 State Program Performance Report (2006 reporting year)

Appendix C: Table 4: Summary Status of Dams for Federal Agencies (FY 2006–2007)

DEPT. Agency	DAM INVENTORY				PERIODIC INSPECTIONS			
	Total	Hazard Classification			Total	Since Last Report		
		High	Sig.	Low		Formal	Inter.	Spec/Const
USDA (Total)	28333	2142	2407	22333	18556	673	11284	6599
ARS	1	0	0	1	0	0	0	0
USFS	1042 ¹	51	113	878	-	-	-	-
NRCS	27211 ²	2091	2294	22333	18555 ³	673	11283	6599
RHS	25 ⁴	-	-	-	-	-	-	-
RUS	55 ⁵	-	-	-	-	-	-	-
DOD (Total)	875	495	152	226	397	335	62	0
USACE	608	453	122	33	254	214	40	0
Army	213	35	22	156	117	95	22	0
Navy	31	5	3	21	16	16	0	0
Air Force	23	2	5	16	10	10	0	0
DOE	15	2	1	12	15	15	0	0
DOI (Total)	2697	474	139	2084	1017	237	292	318
BIA	859	92	34	733	273	46	30	197
BLM	590	8	1	581	183	0	183	0
BOR ⁶	479	334	41	104	242	84	78	80
USFWS	193 ⁷	15	18	160	88	88	- ⁸	40 ⁹
NPS	502	16	33	453	19	19	0	0
OSM	73	8	12	53	210	0	0	0
USGS	1	1	0	0	2	0	1	1
FERC	2528	758	199	1571	4297	366	3287	299/345
IBWC	7	3	1	3	430¹⁰	6 ¹¹	424	0
MSHA (Total)	2254	352	222	1680	0	0	6826 ¹³	0
Coal	650	221	68	361	3128	0	3128	0
M/NM	1604	131	154	1319	3698	0	3698	0
NRC	9	0	0	9	7	7	0	0
TVA	49¹⁴	34	11	4	375¹⁵	120	245	10 ¹⁶

1 Dams owned by FS; approximately 1,330 non-FS dams are also on FS lands.

2 Dams designed and/or funded by NRCS, includes dams with unknown hazard classifications.

3 Inspections are performed by NRCS and non-NRCS organizations.

4 Dams with active loans in RHS portfolio.

5 Dams financed by RUS.

6 Reclamation also performed 174 annual site examinations in FY 2006 and an estimated 165 will be completed in FY 2007.

7 FWS has identified approximately 60 additional impoundments that are included in the NID and owned by FWS that will be inspected and added to the Bureau's dam inventory after verifying that the dams meet inventory size criteria in accordance with NDSP and Department definitions.

8 Inspections are performed by FWS station personnel on a continuing basis.

9 FWS performs quality assurance and construction administration activities on an ongoing basis for all dams and dam construction activities. FWS conducted 15 post flood inspections at Wichita Mountains WR in May 2007.

10 Amistad, Falcon, Anzalduas, and Retamal are inspected weekly. Quarterly inspections are performed at Falcon Dam.

11 Performed formal inspections at Morelos Dam and American Dam in 2006 and Amistad, Falcon, Retamal, and Anzalduas Dams in 2007.

INVESTIGATIONS & STUDIES		DAM SAFETY MODS.		DAMS WITH EAP'S	
'06-07	Active	'06-07	Active	High	Sig.
46	82	18	55	815	182
0	0	0	0	0	0
-	-	-	-	-	-
46	82	18	55	815	182
-	-	-	-	-	-
-	-	-	-	-	-
10	27	5	25	482	72
6	20	3	23	450	56
0	0	1	1	31	16
4	4	1	1	1	0
0	3	0	0	0	0
0	0	1	0	2	1
196	88	23	24	212	87
42	22	3	9	65	33
12	0	0	0	2	1
123	58	12	5	334	41
15	7	6	2	15	18
1	1	2	8	16	25
3	0	0	0	8	10
0	0	0	0	1	0
99	169	44	74	758	199
4 ¹²	0	0	0	3	1
16	0	0	0	109	21
7	0	0	0	102	2
9	0	0	0	7	19
0	0	0	0	0	0
4 ¹⁷	2	1 ¹⁸	1	34 ¹⁹	11

- 12 Performed the following studies: 1) evaluate the gates operations for Penstock Gate No. 4 for Anzalduas Dam; 2) structural analysis of spillway bridge deck for Amistad Dam; 3) technical evaluation and analysis for the dam power plants for Amistad and Falcon Dams; and 4) apron and structural analysis and evaluation for American Dam.
- 13 Inspections performed by dam-safety engineers and by mine inspectors who have been trained to recognize signs of instability and other potentially hazardous conditions.
- 14 Includes only main dam projects. Total, including associated saddle dams and dikes, is 82.
- 15 Includes Civil, Mechanical, and Electrical Inspections. Number of monthly inspections (Civil, Mechanical, and Diesel Generator) by site staff is 2696.
- 16 Ten special inspections (not periodic) performed in FY 2006-2007 are included in the total.
- 17 The four studies include Wilson Main Lock Gate Block (active); Bear Creek Dam Seepage (active); Chickamauga Dam Spillway AAR; and Fontana Dam AAR.
- 18 Blue Ridge Dam penstock repair, intake tower, and embankment seismic strengthening.
- 19 Saddle dams and dikes are included in main dam EAP's.



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