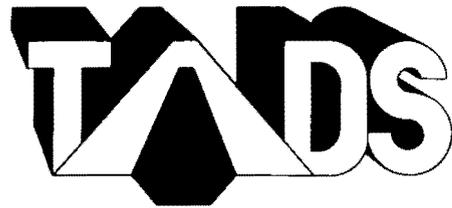


**Training
Aids for
Dam
Safety**

MODULE:

**PREPARING TO
CONDUCT A DAM
SAFETY INSPECTION**



Trainning **A**ids for **D**am **S**afety

MODULE:

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

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PREFACE

There are presently more than 80,000 dams in use across the United States. Like any engineering works, these dams require continual care and maintenance, first to ensure that they remain operational and capable of performing all intended purposes, and then to preclude endangering people and property downstream.

The safety of all dams in the United States is of considerable national, state, and local concern. Given that, the principal purpose of the TADS (Training Aids for Dam Safety) program is to enhance dam safety on a national scale. Federal agencies have responsibility for the safe operation, maintenance, and regulation of dams under their ownership or jurisdiction. The states, other public jurisdictions, and private owners have responsibility for the safety of non-Federal dams. The safety and proper custodial care of dams can be achieved only through an awareness and acceptance of owner and operator responsibility, and through the availability of competent, well-trained engineers, geologists, technicians, and operators. Such awareness and expertise are best attained and maintained through effective training in dam safety technology.

Accordingly, an ad hoc Interagency Steering Committee was established to address ways to overcome the paucity of good dam safety training materials. The committee proposed a program of self-instructional study embodying video and printed materials and having the advantages of wide availability/marketability, low per-student cost, limited or no professional trainer involvement, and a common approach to dam safety practices.

The 14 Federal agencies represented on the National Interagency Committee on Dam Safety fully endorsed the proposed TADS program and have underwritten the cost of development. They have also made available technical specialists in a variety of disciplines to help in preparing the instructional materials. The states, through the Association of State Dam Safety Officials, also resolved to support TADS development by providing technical expertise.

The dam safety instruction provided by TADS is applicable to dams of all sizes and types, and is useful to all agencies and dam owners. The guidance in dam safety practice provided by TADS is generally applicable to all situations. However, it is recognized that the degree to which the methods and principles are adopted will rest with the individual agency, dam owner, or user. The sponsoring agencies of TADS assume no responsibility for the manner in which these instructional materials are used or interpreted, or the results derived therefrom.

ACKNOWLEDGMENTS

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Association of State Dam Safety Officials
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PREPARING TO CONDUCT A DAM SAFETY INSPECTION

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MODULE INTRODUCTION

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

MODULE INTRODUCTION

OVERVIEW OF THE MODULE

In this module you will learn about the different types of dam safety inspections, and how to prepare for conducting a safety inspection. You will learn about the Dam Safety File, as well as other documents to review in order to gather information to help you develop an inspection plan. In addition, you will be provided with information on modifying or developing checklists to meet the needs of a specific inspection, and on developing a plan to conduct the inspection.

OBJECTIVES

At the completion of this module, you will be able to:

- . Describe each of the five types of inspections.
- . Explain when each type of inspection may be conducted.
- . Identify individuals who might comprise the inspection team.
- . Conduct a preliminary review of data for a dam safety inspection, and obtain information on:
 - Who owns the dam
 - Where the dam is located
 - The type of inspection to be performed
 - Features of the dam to be inspected
 - Upstream and downstream conditions that may affect the safety or operation of the dam
 - Conditions that may affect the timeframe for inspection
- . Describe the level of data review required for the different types of inspections.
- . Review data obtained from the Dam Safety File and explain how to use the data to develop specific inspection objectives.
- . Identify sources of information apart from the Dam Safety File regarding the dam and the geology of the area under and around the dam.
- . Obtain information from reviewing and evaluating available data that will aid you in identifying specific inspection concerns to investigate at the dam site.
- . Make changes to existing general checklists so they apply to the particular dam you will be inspecting.
- . Develop inspection objectives that cover all areas to be inspected.
- . Prepare an inspection plan to use as a guide on the inspection.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

MODULE INTRODUCTION

OBJECTIVES (Continued)

- . Identify features that need to have special arrangements made for their access, operation, and/or inspection.
- . Identify other areas where special arrangements must be made (e.g., special transportation).
- . Describe the personal and general equipment needed in order to properly conduct a dam safety inspection.

HOW TO USE THIS MODULE

This module is designed to be used in conjunction with other Training Aids for Dam Safety (TADS) modules. The TADS Learner's Guide lists all of the TADS modules and presents a recommended sequence for completing the modules. You may want to review the Learner's Guide before completing this module.

CONTENTS OF THIS MODULE

This module is divided into three units, followed by four appendixes:

- . **Unit I. Selecting The Type Of Inspection:** Presents information on the different types of dam safety inspections, and lists possible members of an inspection team.
- . **Unit II. Reviewing Project Records:** Provides information on gathering and using data when preparing to conduct a dam safety inspection.
- . **Unit III. Preparing A Field Inspection Plan:** Describes the two types of checklists that are generally available for conducting inspections. Unit III also describes how to develop inspection objectives, prepare an inspection plan, develop site-specific inspection checklists, and make special arrangements before conducting the inspection.
- . **Appendix A. Sample General Checklist For Embankment Dams**
- . **Appendix B. Sample General Checklist For Concrete Dams**
- . **Appendix C. Site-Specific Checklist For Thunder Mountain Dam**
- . **Appendix D. References**

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

MODULE INTRODUCTION

DESIGN OF THIS MODULE

This module is a self-paced instructional package. You may move through it as slowly or as rapidly as is comfortable for you. You may stop and review the material at any time. Since the module is designed for independent study, you may take breaks whenever you wish.

There are several components of this module that are designed to help you master the material being presented. These components include:

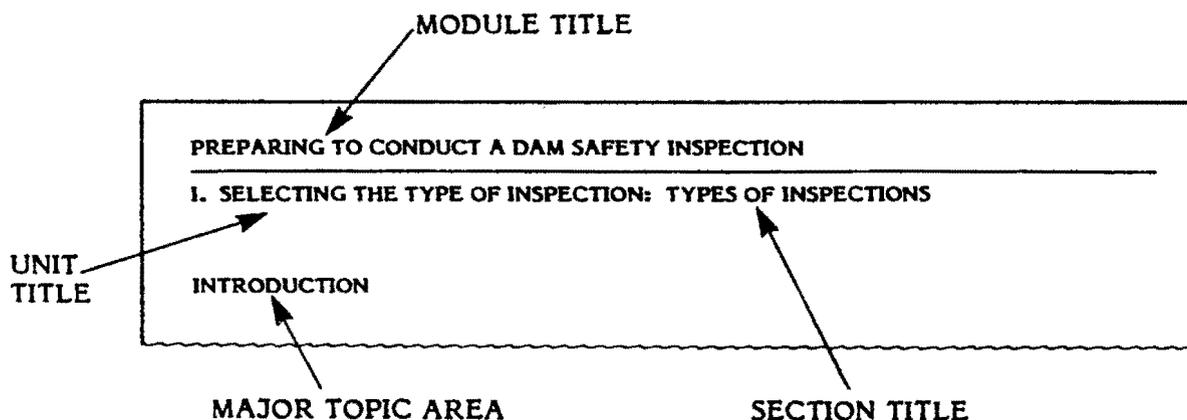
- . Text Instruction
- . Unit Exercises
- . Final Review Exercise

We will now look at how you will use each component individually.

Text Instruction

The text instruction is presented in this workbook. Always begin by reading the text instruction, since it explains how to proceed through a given block of instruction.

As you read the text instruction, you will notice that every page has a header. The header is designed to let you know where you are in the module. Let's look at how information is presented in the header.



Unit Exercises

Most units include exercises to help you determine how well you are mastering the information presented. These exercises are **not** tests and will not be used to grade you or to rate your performance. Rather, the exercises are tools to help you assess your own learning.

Instructions for completing the exercises appear at the beginning of every exercise. Answers to the exercises are presented immediately following each exercise.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

MODULE INTRODUCTION

Final Review Exercise

After reading the text instruction, you will complete a final review exercise. The final review exercise is designed to help you determine how much you have learned from the module. The final review exercise will not be used to grade you or to judge your performance.

Instructions for completing the final review exercise are presented at the beginning of the exercise. After completing the final review exercise, check your work with a supervisor or other appropriate person to help you determine if there are areas where you need additional assistance.

REQUIRED MATERIALS

To complete this module, you will need the following materials:

- . This workbook and a pencil or pen
- . Access to a Dam Safety File (for the final review exercise)

You may want to find a quiet place to work while you study these materials.

UNIT I
SELECTING THE TYPE OF INSPECTION

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: OVERVIEW

INTRODUCTION

The first unit of this module will introduce you to . . .

- . The five general types of dam safety inspections:
 - . Initial or Formal Dam Safety Inspection
 - . Periodic or Intermediate Dam Safety Inspection
 - . Routine Dam Safety Inspection
 - . Special Inspection
 - . Emergency Inspection
- . Individuals who might comprise the inspection team for each of the different inspections.

If you are new to dam safety inspections, the material in this unit will provide you with information on the different types of inspections.

If you have experience in conducting dam safety inspections, this unit will provide a review of the scope of the different types of inspections.

UNIT OBJECTIVES

After completing this unit, you will be able to . . .

- . Describe each of the five types of inspections.
- . Explain when each type of inspection may be conducted.
- . Identify individuals who might comprise the inspection team.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: TYPES OF INSPECTIONS

INTRODUCTION

The type of inspection you will be conducting will depend upon the purpose of the inspection. This section provides background information on the different types of dam safety inspections and why they are conducted. Understanding the purpose of your inspection may help you identify areas on which to focus when reviewing the Dam Safety File or other sources of information, and when conducting the visual inspection.

TYPES OF DAM SAFETY INSPECTIONS

Dam safety inspections are conducted to determine the status of a dam and its features relative to its structural and operational safety. The five general types of dam safety inspections are:

- . Initial or Formal Dam Safety Inspection
- . Periodic or Intermediate Dam Safety Inspection
- . Routine Dam Safety Inspection
- . Special Inspection
- . Emergency Inspection

Initial Or Formal Dam Safety Inspection

Initial or formal dam safety inspections include an indepth review of all pertinent data available on the dam to be inspected. Design and construction data are evaluated relative to current criteria or the state-of-the-art in order to identify:

- . Potential dam safety problems that may not be apparent from a visual inspection.
- . Areas of the dam that may require particular attention during the inspection.

After reviewing and evaluating the records, a thorough onsite inspection of all features is conducted. An attempt is made to operate all mechanical equipment through their full operating range, under as close to full design load (i.e., maximum reservoir elevation) as possible.

Periodic Or Intermediate Dam Safety Inspection

Periodic or intermediate dam safety inspections are inspections that are conducted between formal inspections. A periodic or intermediate dam safety inspection differs from a formal inspection because while all available data are reviewed (in order to become thoroughly familiar with the dam and its features), they are not compared to the current state-of-the-art. The data review focuses on the current status of the dam and its features.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: TYPES OF INSPECTIONS

Periodic Or Intermediate Dam Safety Inspection (Continued)

A comprehensive visual onsite inspection is conducted; however, all of the mechanical equipment may not be test operated during any one inspection. An alternating schedule to test operate equipment may be set up whereby certain equipment are tested during one inspection, and the remaining equipment is tested at another time or during the next scheduled inspection.

For intermediate inspections, some agencies are willing to accept documentation of operation, such as an entry in a facility log describing when the different equipment had been tested or operated. If logs are used to document equipment operation, make sure the equipment was test operated within the frequency and according to the conditions specified in the Standing Operating Procedures or the manufacturer's instructions.

Routine Dam Safety Inspection

The routine dam safety inspection is most typically conducted by field or operating personnel. The primary focus is on the current conditions of the dam and its features. Data may not be reviewed and evaluated prior to this type of inspection, depending on the inspector's familiarity with the dam and its features.

Routine dam safety inspections may be structured or unstructured. Structured routine inspections are conducted on a set schedule (e.g., weekly or monthly). Unstructured routine inspections are performed in conjunction with other routine tasks. For example, if a worker is at the toe of the dam to take a measurement from a weir, that worker may also inspect the entire toe and record any findings on a checklist or in a notebook.

Special Inspection

A special inspection is conducted when only a particular feature of a dam is to be inspected. Often, a unique opportunity exists to inspect this feature which otherwise is not easily inspected. For example, if an upstream slope will be unwatered, an inspection of that slope may be scheduled. Or, if scuba divers are needed to inspect features generally under water, that inspection may be scheduled as a special inspection.

Emergency Inspection

An emergency inspection is performed when the immediate safety of the dam is of concern, or in the event of unusual or potentially adverse conditions at the dam (e.g., during a large flood or immediately following an earthquake).

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: TYPES OF INSPECTIONS

TYPES OF RECOMMENDATIONS

For each of the different inspections, recommendations may be made for:

- **Additional Evaluation, Analysis, Investigation, Or Testing**

Recommendations for additional evaluation, analysis, investigation, or testing are made when . . .

- Following the data review and onsite inspection, the evidence regarding a potential dam safety deficiency is inconclusive.
- The area of concern is beyond the inspection team members' levels of expertise.

- **Remedial Action**

Recommendations for remedial action are made for . . .

- Operation and maintenance deficiencies that should be corrected. (Operation and maintenance recommendations are those that pertain to conditions that may shorten the service life of a structure or feature. These conditions, if left uncorrected, could eventually affect the safety of the dam.)
- Straightforward corrective measures.
- Emergency actions that should be taken (e.g., operational restrictions and/or modifications).

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: INSPECTION TEAM

INTRODUCTION

The members of an inspection team can vary in number. This section describes the areas of expertise required of individuals likely to be involved in certain types of safety inspections.

INSPECTION TEAM

The members of an inspection team will vary, depending upon the . . .

- . Requirements and the resources of the organization conducting the inspection
- . Type of inspection being performed
- . Results of the data review
- . Special requirements of the inspection

Inspection Team Members

The type of inspection to be performed will usually affect the number and required expertise of individuals who participate in the dam safety inspection. Table I-1 lists the different types of inspections and suggests members of the inspection team. These cases are ideal, and may not be realistic for some organizations.

TABLE I-1. INSPECTION TEAM MEMBERS

Type Of Inspection	Members Of The Inspection Team
Initial or Formal Dam Safety Inspection	Generally performed by a: <ul style="list-style-type: none">. Civil Engineer. Mechanical Engineer. Geologist Based on the pre-inspection data review, one or more of the following individuals may also be included: <ul style="list-style-type: none">. Geotechnical Engineer. Structural Engineer. Electrical Engineer. Hydraulic Engineer. Instrumentation Specialist
Periodic or Intermediate Dam Safety Inspection	Usually performed by a Civil Engineer, who may sometimes be accompanied by a: <ul style="list-style-type: none">. Mechanical Engineer. Geologist

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: INSPECTION TEAM

Inspection Team Members (Continued)

TABLE I-1. INSPECTION TEAM MEMBERS
(Continued)

Type Of Inspection	Members Of The Inspection Team
Periodic or Intermediate Dam Safety Inspection (Continued)	Based on the pre-inspection data review, one or more of the following individuals may also be selected: <ul style="list-style-type: none">. Geotechnical Engineer. Structural Engineer. Electrical Engineer. Hydraulic Engineer. Instrumentation Specialist
Routine Dam Safety Inspection	May be performed by one or more of the following: <ul style="list-style-type: none">. Civil Engineer. Mechanical Engineer. Technician (including various dam personnel)
Special Inspection	Based on the objectives of the inspection, one or more of the following individuals may be selected: <ul style="list-style-type: none">. Civil Engineer. Mechanical Engineer. Geologist. Geotechnical Engineer. Structural Engineer. Electrical Engineer. Hydraulic Engineer. Instrumentation Specialist
Emergency Inspection	Depending on the urgency and reason for the inspection, one or more of the following individuals may participate: <ul style="list-style-type: none">. Civil Engineer. Mechanical Engineer. Geologist. Geotechnical Engineer. Structural Engineer. Electrical Engineer. Hydraulic Engineer. Instrumentation Specialist

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: INSPECTION TEAM

Other Inspection Team Members

Other individuals may participate in the dam safety inspection. These participants will vary depending on the particular dam being inspected, the responsibilities of the dam owner, and any special inspection requirements.

The other inspection team members may include . . .

- . An owner or an owner's representative
- . Government agency representatives
- . Design and construction representatives
- . Inspection divers

Table I-2 presents other inspection team members and the reasons why they may be included in a dam safety inspection.

TABLE I-2. OTHER INSPECTION TEAM MEMBERS

Other Team Members	Reasons For Inclusion
Owner's Representative (may include): <ul style="list-style-type: none">. Dam operator. Staff or consulting engineers. Workers to accommodate special needs of the inspection team	<p>An owner or an owner's representative should be present at an inspection, regardless of who is performing the inspection or the type of inspection. The owner or owner's representative should:</p> <ul style="list-style-type: none">. Provide access to certain inspection areas, if needed.. Operate equipment.. Provide information about the dam.. Receive preliminary results of the inspection.
Government Agency Representative	<p>If a certain Government agency has financial, regulatory, or licensing responsibility for a dam, it may elect to send a representative to accompany the inspection team.</p>

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: INSPECTION TEAM

Other Inspection Team Members (Continued)

TABLE I-2. OTHER INSPECTION TEAM MEMBERS
(Continued)

Other Team Members	Reasons For Inclusion
Design And Construction Representative	<p>It may be appropriate to include a representative of the design and/or construction organization if it is separate from the owner or regulator who is performing the inspection. This may be done as a matter of:</p> <ul style="list-style-type: none">• Courtesy• Project agreement• Necessity due to a problem noted in the pre-inspection data review
Inspection Divers	<p>Various features of a dam are usually or periodically submerged. Underwater features are no less important to safety than those above the water's surface. These features generally should be inspected with the same regularity. Such areas will either have to be dewatered and inspected in-the-dry or examined by qualified inspection divers. Divers must be qualified to dive safely at hydro projects and preferably should be technically qualified to perform an inspection. If a diver is not a technically qualified inspection diver, he or she should perform the inspection under the direction of a qualified inspector.</p>

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: UNIT EXERCISE

INSTRUCTIONS: Use the information presented in this unit to answer the following questions. When you have completed all of the questions, check your answers against those presented in the answer key. The answer key can be found immediately following this exercise.

1. Write the letter of each type of dam safety inspection next to the matching description.

TYPE OF INSPECTION		DESCRIPTION
a. Routine Dam Safety Inspection	_____	A thorough inspection of all structural and geologic features. Design and construction data are compared to the current state-of-the-art.
b. Initial or Formal Dam Safety Inspection		
c. Emergency Inspection	_____	A thorough inspection of all structural and geologic features. Design and construction data are reviewed only to become familiar with the dam and its features.
d. Periodic or Intermediate Dam Safety Inspection	_____	An inspection of all structural and geologic features generally conducted by field or operating personnel as they are performing their regular or routine tasks.
e. Special Inspection	_____	An inspection conducted when a unique opportunity to inspect a certain area or feature is presented, or if specialized personnel are needed (such as inspection divers).
	_____	An inspection performed when the immediate safety of the dam is of concern, or in the event of unusual or potentially adverse conditions.

2. If a diver is not a technically qualified inspection diver, then . . .
-
-

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: UNIT EXERCISE

3. Why should a representative of the dam owner be present during an inspection?

4. Name two types of recommendations that may be made upon completion of a formal dam safety inspection.

- ---
- ---

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: UNIT EXERCISE -- ANSWER KEY

INSTRUCTIONS: Compare your answers to those given below to see how well you learned the information presented in this unit.

1. Write the letter of each type of dam safety inspection next to the matching description.

TYPE OF INSPECTION		DESCRIPTION
a. Routine Dam Safety Inspection	<u> b </u>	A thorough inspection of all structural and geologic features. Design and construction data are compared to the current state-of-the-art.
b. Initial or Formal Dam Safety Inspection	<u> d </u>	A thorough inspection of all structural and geologic features. Design and construction data are reviewed only to become familiar with the dam and its features.
c. Emergency Inspection	<u> a </u>	An inspection of all structural and geologic features generally conducted by field or operating personnel as they are performing their regular or routine tasks.
d. Periodic or Intermediate Dam Safety Inspection	<u> e </u>	An inspection conducted when a unique opportunity to inspect a certain area or feature is presented, or if specialized personnel are needed (such as inspection divers).
e. Special Inspection	<u> c </u>	An inspection performed when the immediate safety of the dam is of concern, or in the event of unusual or potentially adverse conditions.

2. If a diver is not a technically qualified inspection diver, then . . .

The diver should perform the inspection under the direction of a qualified inspector.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: UNIT EXERCISE -- ANSWER KEY

3. Why should a representative of the dam owner be present during an inspection?

To provide access to certain inspection areas if needed, to operate equipment, to provide information about the dam, and to receive preliminary results of the inspection.

4. Name two types of recommendations that may be made upon completion of a formal dam safety inspection.

- . **Additional evaluation, analysis, investigation, or testing**
- . **Remedial action**

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: SUMMARY

TYPES OF DAM SAFETY INSPECTIONS

The type of inspection you will be conducting will depend upon the purpose. The five general types of dam safety inspections are . . .

Type Of Inspection	Description
Initial or Formal Dam Safety Inspection	<p>The initial or formal dam safety inspection includes an indepth review and evaluation of all pertinent data available on the dam to be inspected. Design and construction data are evaluated against current criteria or state-of-the-art in order to identify:</p> <ul style="list-style-type: none">• Potential dam safety problems that may not be apparent from a visual inspection.• Areas of the dam that may require particular attention during the inspection. <p>After reviewing and evaluating the records, a thorough onsite inspection of all features is conducted. An attempt is made to operate all mechanical equipment through their full operating range and as close to full design load (i.e., reservoir head) as possible.</p>
Periodic or Intermediate Dam Safety Inspection	<p>Periodic or intermediate dam safety inspections are inspections that are conducted between formal inspections. A periodic or intermediate dam safety inspection differs from a formal dam safety inspection because while all available data are reviewed (in order to become thoroughly familiar with the dam and its features), they are not compared to the current state-of-the-art. The data review focuses on the current status of the dam and its features. A comprehensive visual onsite inspection is conducted; however, all of the mechanical equipment may not be operated and tested during any one inspection.</p>
Routine Dam Safety Inspection	<p>The routine dam safety inspection is most typically conducted by field or operating personnel. The primary focus is on the current conditions of the dam and its features. Data may not be reviewed and evaluated prior to this type of inspection, depending on the inspector's familiarity with the dam and its features.</p> <p>Routine dam safety inspections may be structured or unstructured. Structured routine inspections are conducted on a set schedule. Unstructured routine inspections are performed in conjunction with other routine tasks.</p>

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

I. SELECTING THE TYPE OF INSPECTION: SUMMARY

TYPES OF DAM SAFETY INSPECTIONS (Continued)

Type Of Inspection	Description
Special Inspection	A special inspection is conducted only when a particular feature is to be inspected. Often, a unique opportunity exists to inspect this feature which otherwise is not easily inspected. For example, if an upstream slope will be unwatered, an inspection of that slope may be scheduled. Or, if scuba divers are to be employed to inspect features generally under water, that portion of the inspection may be conducted as a special inspection.
Emergency Inspection	An emergency inspection is performed when the immediate safety of the dam is of concern, or in the event of unusual or potentially adverse conditions at the dam (e.g., during a large flood or immediately following an earthquake).

INSPECTION TEAM

The members of an inspection team will vary, depending upon the . . .

- . Requirements and the resources of the organization conducting the inspection
- . Type of inspection being performed
- . Results of the data review
- . Special requirements of the inspection

UNIT II
REVIEWING PROJECT RECORDS

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: OVERVIEW

INTRODUCTION

Reviewing project records provides an orientation to the type of dam to be inspected, the features of the dam, the geology of the dam site, and whether there were problems with the dam in the past. Reviewing project records before a visual inspection will help you identify conditions that may affect the safety of the dam. This unit presents information on . . .

- . Conducting a data review
- . Conducting a preliminary data review
- . Conducting a comprehensive data review
- . Sources of data
- . Reviewing and evaluating the data

UNIT OBJECTIVES

After you have completed this unit, you will be able to . . .

- . Conduct a preliminary review of data for a dam safety inspection, and obtain information on:
 - Who owns the dam
 - Where the dam is located
 - Type of inspection to be performed
 - Features of the dam to be inspected
 - Upstream and downstream conditions that may affect the safety or operation of the dam
 - Conditions that may affect the timeframe for inspection
- . Describe the level of data review required for the different types of inspections.
- . Review data obtained from the Dam Safety File and explain how to use the data to develop specific inspection objectives.
- . Identify sources of information, besides the Dam Safety File, on the dam and the geology of the area under and around the dam.
- . Obtain information from reviewing and evaluating available data that will aid you in identifying specific inspection concerns to look for at the dam site.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A DATA REVIEW

WHY REVIEW DATA?

Reviewing and evaluating data before conducting a dam safety inspection can help you conduct a more thorough and accurate inspection. Information can be gathered on:

- . The geology of the area of the dam and reservoir
- . How the dam was designed and constructed
- . What the features are and how they were designed to function
- . Conditions that might not be apparent from a visual inspection
- . Conditions noted from previous inspections

LEVEL OF DATA REVIEW

The extent of data acquisition and evaluation depends upon the type of dam safety inspection to be conducted. The amount of data available on individual dams will vary among dams. For large major structures, voluminous data may be available, whereas there may be a limited amount or no data available for older or smaller structures. Table II-1 describes the level of data acquisition and evaluation required for each type of inspection.

TABLE II-1. LEVEL OF DATA REVIEW

Type Of Inspection	Level Of Data Review
Initial or Formal Dam Safety Inspection	Requires an indepth review of all pertinent data available on the dam. Design and construction data are evaluated relative to current criteria or state-of-the-art.
Periodic or Intermediate Dam Safety Inspection	Requires an indepth review of all pertinent data available on the dam so the inspector can become thoroughly familiar with the dam and its features. However, data are not compared to the current state-of-the-art.
Routine Dam Safety Inspection	Because routine inspections are usually conducted by dam personnel, data may or may not be reviewed before a routine inspection.
Special Inspection	Data review is limited to the area or features of the dam that the special inspection will focus on. The data review will include previous inspection reports concerning the special inspection area.
Emergency Inspection	Requirements vary, depending on the nature of the emergency. A review of readily available data may be performed for an emergency inspection to help provide comprehensive field coverage under adverse conditions.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A DATA REVIEW

LEVEL OF DATA REVIEW (Continued)

The procedures for conducting a preliminary and comprehensive review of data described in this unit are typical for conducting formal or periodic (intermediate) dam safety inspections. However, for a formal inspection, the data would be compared to the current state-of-the-art, whereas it would only be used to provide information on the dam and its features for a periodic dam safety inspection.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A PRELIMINARY DATA REVIEW

WHAT IS A PRELIMINARY DATA REVIEW?

A preliminary review is an initial review of general information about the dam you will be inspecting. The information reviewed will help you to . . .

- . Select the appropriate records to review (based on features of the dam to be inspected, geologic areas, etc.).
- . Schedule the inspection (time of year for the desired operating condition, and the amount of time the inspection will take).
- . Select members of the inspection team.
- . Make arrangements for operation and inspection of certain features.

CONDUCTING A PRELIMINARY DATA REVIEW

Conducting a preliminary data review involves gathering and reviewing general information about the dam to be inspected. The preliminary review gives you an overall picture of the dam, and helps you identify areas for which further research and preparation are needed.

During the preliminary data review, you should . . .

- . Identify the owner of the dam.
- . Identify the exact location of the dam.
- . Determine the type of inspection to be performed.
- . Identify the features to be inspected.
- . Identify upstream and downstream conditions.
- . Determine the timeframe for the inspection (both time of year or season, and amount of time the inspection will take).

Identify The Owner Of The Dam

You need to identify the owner of the dam to be inspected before a search of the records can begin. The owner may be your own agency, a number of different Federal or State agencies, a municipal authority, a private individual, or a group of individuals.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A PRELIMINARY DATA REVIEW

Identify The Owner Of The Dam (Continued)

If the owner is not known, you may locate the owner by requesting a title search, or by searching . . .

- . State inventory records
- . Other agencies' files
- . A State or Federal dam safety computerized data base
- . Local government records
- . Plat books

Identify The Exact Location Of The Dam

You must identify the exact location of the dam so you can collect the appropriate maps and other information on the area. If you are an owner or regulator, this information should be available in your files. If not, you might search . . .

- . Other agencies' files
- . State inventory records
- . U.S. Department of Agriculture aerial photographs
- . U.S. Geological Survey quadrangle maps
- . State and county maps
- . Computerized data base

Determine The Type Of Inspection To Be Performed

If you are an owner or regulator of the dam to be inspected, the type of inspection should be part of any written or verbal instructions within your organization.

If you are a consultant performing the inspection, the exact requirements of the inspection should be outlined by the organization requesting the inspection.

Identify The Features Of The Dam To Be Inspected

It is necessary to identify the various features to be inspected so that adequate data can be collected on those features, and inspection plans can be made.

Information on the features of the dam may be found in your organization's files, the Dam Safety File, or as part of the owner information. If the information is unavailable, you may wish to visit the site before the inspection to identify the features.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A PRELIMINARY DATA REVIEW

Identify Upstream And Downstream Conditions

Over time, situations or conditions may be created upstream or downstream of a dam that have an effect on the dam and the reservoir. An example of an upstream condition that could affect the dam is the construction of another dam or a water conveyance system that affects the inflow of water into the reservoir. A downstream condition might be development in the flood plain that would change the dam's hazard classification. A hazard classification is a rating (e.g., low, moderate/significant, or high hazard) that is representative of the probable loss of life and property damage downstream from a dam based on the results of breaching studies of the dam, and an identification of the area downstream that would be inundated.

You should try to identify any new conditions or changes in existing conditions prior to conducting the dam safety inspection. Check the following resources for information on upstream and downstream conditions . . .

- . Quadrangle maps
- . State maps
- . Aerial photographs (if available)
- . Watershed (drainage area) maps
- . Inundation maps
- . Information from a computerized data base

Determine The Timeframe For The Inspection

There are two aspects to determining the timeframe for a dam safety inspection: the time of year (or season) in which the inspection will take place, and the time it will take to perform the actual inspection.

Time Of Year

If you are performing a dam safety inspection in which many or all of the features of the dam will be inspected, the time of year or season in which the inspection will take place can be important.

You may wish to conduct your inspection when the reservoir is at its lowest point or after a large release of water so that those features or areas of the dam that are normally under water are exposed. Also, removal from service and inspection of some features may be possible during periods of limited operational requirements.

If the inspection requires that certain features be tested or inspected as close to full design load (i.e., maximum reservoir elevation) as possible, you may wish to conduct your inspection when the dam is at its normal yearly maximum elevation. This may also allow you to inspect equipment as it operates under maximum design loading conditions.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A PRELIMINARY DATA REVIEW

Time Of Year (Continued)

If you have flexibility in choosing the time of year you will perform the dam safety inspection, you should . . .

- Determine what features will be inspected, and under what conditions.
- Talk with the dam owner or operator to determine the best time to conduct the inspection that will fulfill the conditions desired.

Time Needed To Conduct The Inspection

The amount of time the dam safety inspection will take is dependent on a number of factors, namely . . .

- The type of inspection being conducted (e.g., an initial or formal dam safety inspection will take longer than a special inspection).
- The number and complexity of appurtenances to be inspected, and whether the inspection requires you to operate them all.
- The size of the structure. If the dam is an embankment dam several miles in length and you must walk it a number of times (to inspect the upstream slope, downstream slope, and crest), it will take some time. If it is a large concrete dam, it may have miles of galleries. (The Grand Coulee Dam has over 12 miles of galleries.)
- The size of the inspection team.
- Whether the reservoir will be inspected in addition to the dam, and what method of inspection will be used.

INSPECTION TIP: After you have determined what features of the dam will be inspected as well as the general scope of the project, review the records of past inspections to get an idea of how long the inspection will take. Experience will also aid you in judging the length of inspections.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: CONDUCTING A COMPREHENSIVE DATA REVIEW

WHAT IS A COMPREHENSIVE DATA REVIEW?

After conducting a preliminary review of data to obtain general information about a dam to be inspected, a more comprehensive review covering all features of the dam must be made.

The amount of information reviewed and evaluated before the onsite inspection will determine the comprehensiveness of the inspection. Reviewing information on the dam you will be inspecting can . . .

- . Reveal potential dam safety deficiencies that may not be visible during the inspection.
- . Help you interpret conditions you may observe.
- . Help you develop an inspection plan that will ensure a thorough onsite dam safety inspection.

CONDUCTING A COMPREHENSIVE DATA REVIEW

Conducting a comprehensive data review involves gathering and reviewing all pertinent information about the dam to be inspected.

During the comprehensive data review, you should identify . . .

- . The type of dam to be inspected and its individual features.
- . The intended use of the dam and reservoir.
- . The underlying and surrounding geologic conditions.
- . Design and construction details pertinent to the safety of the dam.
- . Conditions that might, at some point, affect the structural integrity of the dam (e.g., fault zones, lack of drainage features, alkali-aggregate reactive concrete, increasing seepage, etc.).
- . Past problems with the performance or operation of the dam or any of its features that need to be addressed during the inspection.
- . Past problems with the underlying foundation or abutments (either during construction or operation) that need to be addressed during the inspection.

If you are conducting a formal dam safety inspection, design and construction details should be compared to current criteria or state-of-the-art to determine whether materials or procedures used at the time the dam was constructed pose a threat to the safety of the dam when compared to current standards.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: SOURCES OF DATA

DAM SAFETY FILE

A Dam Safety File is essentially a compilation of all information pertinent to a specific dam. A thorough assessment of dam safety cannot be made without ready access to this information. Each organization has its own guidelines concerning the structure of the Dam Safety File. Some organizations establish a separate Dam Safety File, while others use a compilation of existing project files.

CONTENTS OF THE DAM SAFETY FILE

The goal of the Dam Safety File is to provide ready access to information that can be used to help you . . .

- . Prepare for conducting a dam safety inspection.
- . Evaluate the observations made during an onsite inspection.
- . Have pertinent information available in case of an emergency or serious problem.

Table II-2 lists the information that may be included in a Dam Safety File.

TABLE II-2. INFORMATION THAT MAY BE INCLUDED IN A DAM SAFETY FILE

Information Category	Typical Items That May Be Included
Background Information	<ul style="list-style-type: none">. Statistical Summary. Aerial Photographs Of The Dam. Historical Events (during construction and operation). Facility Emergency Preparedness Information. Correspondence
Geologic Information	<ul style="list-style-type: none">. Regional Information. Site Information. Seismicity. Correspondence
Hydrologic Information	<ul style="list-style-type: none">. Design Flood. Current Inflow Design Flood. Correspondence
Reservoir Information	<ul style="list-style-type: none">. Restrictions. Operation. Deficiencies (e.g., landslides, etc.). Reservoir Evaluation Records. Correspondence

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: SOURCES OF DATA

CONTENTS OF THE DAM SAFETY FILE (Continued)

TABLE II-2. INFORMATION THAT MAY BE INCLUDED IN A DAM SAFETY FILE
(Continued)

Information Category	Typical Items That May Be Included
Foundation Information	<ul style="list-style-type: none">. Description. Design and Analyses. Treatments. Construction Records, Changes, And Modifications. Instrumentation. Deficiencies (e.g., seepage, etc.). Correspondence
Dam Structure	<ul style="list-style-type: none">. Description. Design And Analyses. Construction Materials. Construction Records, Changes, And Modifications. Instrumentation. Deficiencies (e.g., cracking, etc.). Correspondence
Other Features	<ul style="list-style-type: none">. Description
Spillways	<ul style="list-style-type: none">. Design and Analyses
Outlet Works	<ul style="list-style-type: none">. Construction Records, Changes, And Modifications
Mechanical Systems	<ul style="list-style-type: none">. Reservoir Drawdown Capability. Restrictions. Operation. Deficiencies. Correspondence
Reports	<ul style="list-style-type: none">. Previous Inspection Reports. Special Studies. Instrumentation Data. Operation And Maintenance Reports
Drawings	<ul style="list-style-type: none">. Design, As-Built, And Modification Drawings Of Major Structures And Features. Topographic Maps

If a Dam Safety File does not exist for the project you will be inspecting, one should be developed from the information gathered for the data review, and from the inspection report developed after the inspection is completed. Refer to the TADS module entitled Documenting And Reporting Findings From A Dam Safety Inspection for information on developing a Dam Safety File.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: SOURCES OF DATA

OTHER SOURCES OF INFORMATION

In addition to the Dam Safety File, there are other sources of information from which you can review data. These sources may be used to supplement data found in the Dam Safety File, or in the event a Dam Safety File does not exist for the dam to be inspected. These sources include . . .

- . The dam owner's records
- . Files from other organizations or agencies
- . Federal agencies responsible for resource management
- . Private engineering firms
- . Federal and State governments
- . Universities
- . Correspondence and legal documents
- . Maps and photographs
- . Previous owner's records (if the dam was previously owned)

Interviews with people knowledgeable in the geology, design, construction, and/or operation of the dam will also be helpful. Individuals you may wish to interview include . . .

- . The dam owner
- . The dam operator
- . The owner's engineer
- . Project personnel
- . Engineers or other persons involved in the construction of the dam
- . Adjacent property owners
- . County extension service personnel

The dam operator or other project personnel may have information about problems or conditions that might not be evident during a visual inspection. Individuals involved in the construction of the dam may have information about its construction, the local geology, and other important topics. County extension service personnel may be able to provide information regarding the geology of the area and problems with the geology.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

INTRODUCTION

A complete review and evaluation of the data regarding a specific dam should cover each of nine general categories of information. These categories are:

- . Site conditions (geologic)
- . Hydrology
- . Design documents
- . Construction records
- . Operation and maintenance records
- . Facility emergency preparedness
- . Instrumentation records
- . Past inspection reports
- . Maps and photographs

The Dam Safety File may contain much of this information, or this information may be obtained by researching other sources. These categories of information are described below, and examples of how the information might be used when preparing for a dam safety inspection are provided.

SITE CONDITIONS (GEOLOGIC)

During the pre-design phase of a dam construction project, numerous site investigations are conducted, and the results of those investigations are recorded. A review of data available on the site conditions will allow you to become familiar with the . . .

- . Regional and site geology, including characteristics of foundation rock and soil
- . Geologic features of the dam foundation, abutments, and reservoir rim
- . Relationship of the geologic features to the components of the dam

Evaluate the information to identify . . .

- ✓ If there are potential problematic materials in the foundation, abutment, or reservoir rim
- ✓ Areas of potential slides
- ✓ Areas susceptible to:
 - . Seepage or piping
 - . Erosion
 - . Subsidence or settlement (especially differential settlement)
 - . Liquefaction
 - . Uplift pressures
- ✓ Anything unique to the site to be inspected

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

SITE CONDITIONS (GEOLOGIC) (Continued)

Records of site investigations may be found in the Dam Safety File. However, in the event that data on site conditions are not available, geologic information may be found by reviewing . . .

- . Local and regional geologic maps, plans, and sections
- . Soil survey reports
- . Geological literature
- . Well logs
- . Aerial photographs of the site and vicinity
- . Topographic maps
- . Foundation treatment records
- . Materials test records (soil, rock, water)
- . Interviews with individuals knowledgeable about the area of the dam site

Further information on site geology can be found in the TADS module entitled Inspection Of The Foundation, Abutments, And Reservoir Rim.

HYDROLOGY

Hydrologic information is used to design the capacities of the outlet works and spillways, and to determine how much freeboard is needed. Logging and other land usage will affect runoff. Rainfall and runoff are considered when designing the hydrologic capacity of the dam.

Over time, there may be changes that will affect hydrologic conditions. These changes could affect the amount of water entering the reservoir. If you are conducting a formal or periodic inspection, you will look at how the hydrologic design was developed. If the information is dated, you may recommend that a hydrologist look at the data and methodology used to determine if changes need to be made based upon current criteria for determining hydrologic design.

During your visual inspection, you should see if there have been changes in the upstream area that would impact the hydrologic design for the dam.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

DESIGN DOCUMENTS

Design documents may include the original design of the dam and all appurtenant structures, as well as any changes made to the design to accommodate site conditions. Reviewing design documents will allow you to become familiar with . . .

- . The type and quality of data available at the time the dam was designed.
- . How the dam was intended to be operated.
- . Decisions made that may have influenced the design.
- . Which analyses were performed and the methodologies used.
- . Areas where the underlying foundation and abutments might affect the stability of the dam.
- . The type and configuration of dam constructed at the site and why it was selected.
- . The types and location of instrumentation and why they were installed.

Evaluate the design documents to . . .

- ✓ Identify areas to emphasize during the inspection.
- ✓ Determine performance that is not in accordance with design data.

Design documents may be found in the Dam Safety File, with the dam owner, or with the contractor responsible for constructing the dam. Design documents typically will include . . .

- . Preliminary design reports
- . Construction considerations
- . Design summaries and drawings
- . Final design reports
- . Designer's operating criteria
- . Analyses

You may learn more about design in the TADS component entitled "Data Review, Investigation And Analysis, And Remedial Action For Dam Safety."

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

CONSTRUCTION RECORDS

Construction records may include every item of documentation of the construction phase from the inspector's daily reports to as-built drawings. Reviewing construction records will allow you to become familiar with . . .

- . Site conditions encountered during construction (types of foundation materials and groundwater conditions).
- . The types and quality of materials used to construct the dam.
- . Construction techniques and tests of placed material used to construct the dam.
- . Problems encountered during excavation and construction and how they were resolved.
- . Foundation treatment methods, including excavation of unsuitable material, surface treatment of the exposed foundation, grout takes, and drainage techniques.
- . Field changes that were necessary to treat unforeseen conditions, and what those conditions were.
- . The methods of installation of instruments.
- . The installation of electrical systems and mechanical equipment that could affect the safe operation of the dam.
- . As-built drawings of the dam and its various features.

Evaluate the construction records to . . .

- ✓ Identify potential sources of weakness in the foundation, embankment, and/or structural elements of the dam.
- ✓ Determine if design assumptions are compatible with actual conditions.
- ✓ Identify indications of gradual deterioration or weakening of the structure or foundation.
- ✓ Determine if the features of the dam are functioning as intended.

 **INSPECTION TIP:** As-built drawings of the dam and its features may be reduced and taken with you on your inspection for reference, and for accurately documenting problem areas.

Construction records may be found in the Dam Safety File, with the dam owner, or with the contractor who constructed the dam.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

OPERATION AND MAINTENANCE RECORDS

Operation and maintenance records document the ongoing operation and maintenance of a dam. Reviewing operation and maintenance records will provide you with information on . . .

- . The operational history of the dam (reservoir elevations over time, gate operations, etc.).
- . Repairs and minor modifications made to the dam.
- . The intended and actual operational capabilities of outlet works, gates and valves, spillways, gallery drains, and other features.
- . The configuration and capabilities of electrical and mechanical equipment required to operate the different mechanical features.

Evaluate operation and maintenance records to determine . . .

- ✓ The extent to which operating and testing of dam components or features will be necessary based on past performance or maintenance problems.
- ✓ When to schedule the inspection (e.g., low reservoir, high reservoir, which appurtenances will be accessible, etc.).

Operation and maintenance records may be found in the reports section of the Dam Safety File, or with the organization responsible for operation and maintenance. Operation and maintenance records may include records of repair and minor modifications, as well as logs and manuals that are kept at the site or project office.

FACILITY EMERGENCY PREPAREDNESS

A review of existing data should include information on facility emergency preparedness, including the site conditions and procedures and emergency preparedness equipment. This information may be contained in the Standing Operating Procedures and the Emergency Action Plan for the dam. You should review the information on facility emergency preparedness to . . .

- ✓ Become familiar with the facility's site conditions and procedures.
 - . **Downstream Hazard Classification:** Review the downstream hazard classification. Each agency, owner, or regulatory authority may have its own system for rating the hazard potential of dams. If possible, you should identify the following:
 - ✓ Whether the dam has a hazard classification and, if so, how the classification was determined.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

FACILITY EMERGENCY PREPAREDNESS (Continued)

- ✓ If the dam has not been classified, determine what information about the usage of the area downstream of the dam is currently available.
 - . **Access:** Identify how the site would be reached in case of emergency. Determine if these roads will provide adequate access for dam personnel, equipment, and materials under adverse conditions.
 - . **Security:** Determine what security system is used to prevent trespassers from gaining access to, and operating or damaging the dam's electrical and mechanical equipment.
 - . **Standing Operating Procedures:** Review the procedures for normal operation. Comprehensive Standing Operating Procedures will ensure that:
 - ✓ A dam and its components will be operated according to design intent. Misoperation could itself create an emergency or dam safety problem.
 - ✓ Operating instructions are available for authorized persons unfamiliar with the facility who may have to operate equipment when the regular operator is absent.
- Assess whether these procedures are clear, complete, and up-to-date.
- . **Emergency Action Plan:** Review the procedures used for notification of the responsible owner or agency personnel of an emergency and for warning communities affected by a potential dam failure. Assess whether these procedures are clear, complete, and up-to-date.
- ✓ Identify the emergency preparedness equipment used at the facility, including ...
 - . **Communication Systems:** The available communication systems must be adequate during adverse situations to serve the needs of persons or organizations responsible for emergency operations. Assess whether the communication systems are adequate.
 - . **Warning Systems:** Dams may have electrical/mechanical devices to alert onsite or remote personnel of adverse conditions. However, dam attendance is the major means of warning for most sites. Assess whether the warning system used is adequate.

Continued ...

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

FACILITY EMERGENCY PREPAREDNESS (Continued)

- **Auxiliary Power Systems:** In the event of failure of the primary power system, auxiliary power (which could be a manual operation) must be available to operate mechanical equipment and lighting and communication equipment, if necessary. Assess whether the auxiliary power systems are adequate.
- **Remote Operation Systems/Equipment:** Remote operation is the ability to operate equipment, such as gates, from a location other than the dam site. Assess whether the remote operation capability is adequate.
- **Reservoir Drawdown Capability:** During an emergency at a dam, the time required to lower the reservoir to a safe level often becomes extremely important. Identify the reservoir drawdown capability and assess whether it is adequate.

The TADS module entitled Evaluation Of Facility Emergency Preparedness provides detailed information on assessing facility emergency preparedness.

INSTRUMENTATION RECORDS

Various instruments used at a dam provide information on the dam's response to stresses and pressures, and provide hydrological information. Reviewing instrumentation records will provide you with information on . . .

- The different instruments installed at the dam to be inspected.
- Instrument readings for each of the instruments installed.
- The analyses and interpretation of structural performance.
- Projections of future performance of the dam based on the record of instrument readings.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

INSTRUMENTATION RECORDS (Continued)

Evaluate instrumentation records to . . .

- ✓ Identify the different instruments installed at the dam, such as:
 - Uplift pressure measuring devices
 - Internal stress measuring devices
 - Crack monitoring devices
 - Piezometers
 - Settlement points
- ✓ Determine the location of each of the instruments.
- ✓ Identify instrument readings or trends that were considered to reflect unusual behavior or potential problems with the feature being monitored so you can pay particular attention to that feature.
- ✓ Identify data readings that are out of range, indicating either that an instrument should be checked to determine if it is functioning properly, or that a data reading was taken incorrectly. Checking the instrument may or may not be done by you as an inspector.

Data on instrumentation may be found in the Dam Safety File or logged and maintained at the dam site. Raw data on instrument logs will have to be reduced or plotted to show trends and comparisons. In some organizations, the inspector will reduce the data; in others, it will be done by someone else. Regardless of who reduces the raw data, it is the inspector who must interpret the data and combine that interpretation with the visual findings.

PAST INSPECTION REPORTS

A review of past inspection reports will be helpful in evaluating existing conditions at the dam. Reviewing past inspection reports will enable you to become familiar with . . .

- Any problems or concerns that have been identified previously.
- The condition of the dam and appurtenances at earlier points in time, allowing you to track the progression of previously identified concerns. Just as important, past reports give you a frame of reference for any new concerns that you identify (i.e., you know how long they could have taken in developing, or if they have always existed in the manner in which you are seeing them).
- Conclusions regarding the safety of the dam.
- Specific dam safety recommendations and the status of these recommendations.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: REVIEWING AND EVALUATING THE DATA

PAST INSPECTION REPORTS (Continued)

Evaluate past inspection reports to . . .

- ✓ Identify changes in deficiencies discovered in previous inspections.
- ✓ Identify repairs or modifications that may not have been inspected since they were made.

Past inspection reports may be found in the reports section of the Dam Safety File, with the dam owner, or at the dam site.

MAPS AND PHOTOGRAPHS

Maps and photographs of the vicinity of the dam can provide information on the topography of the region, as well as on the geologic conditions of the vicinity. If site conditions were not explored by drilling and sampling before the dam was constructed, you can examine the following different types of maps to get an idea of the type of foundation upon which the dam is constructed:

- . Topographic maps of the upstream drainage basin and the drainage downstream of the dam to the next major watercourse.
- . Road maps of the vicinity and locality of the dam site.

Inundation maps can help you to assess the hazard classification. Mineral extraction maps will help you locate areas of potential subsidence or sinkholes.

Construction photographs may enable you to evaluate the construction of the dam. If other construction information is unavailable, you may be able to determine how well the dam was constructed and to subsequently explain some of the observations made during your onsite inspection.

Old photographs can be used to identify such things as the kinds of equipment used to construct the dam or the condition of the foundation prior to receiving the dam structure. This type of information provides valuable clues to the dam's integrity. Two examples of the many clues that old construction photographs may provide are as follows . . .

- . A photograph revealing untreated open-jointed rock beneath the dam may explain seepage conditions you later observed during your onsite inspection.
- . A photograph showing excessively thick lifts of embankment fill placed with lightweight or inappropriate (by today's standards) equipment may explain the crest settlement you later observed on the dam.

Photographs taken over the life of the dam provide a chronological record of the changes that have occurred.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: UNIT EXERCISE

INSTRUCTIONS: Use the information presented in this unit to answer the following questions. When you have completed all of the questions, check your answers against those presented in the answer key. The answer key can be found immediately following this exercise.

1. What is the benefit of conducting a preliminary review of a dam before inspecting the dam?

2. List three types of information you would be likely to find in the Dam Safety File.

- ---
- ---
- ---

3. How would as-built drawings of the dam structure be helpful in conducting a dam safety inspection?

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: UNIT EXERCISE

4. You have been assigned to inspect a dam located in the state of Washington. Listed below are four areas in which you wish to obtain information about the dam. Write down the category (or categories) of information within the Dam Safety File where you could find data on . . .

a. Site Conditions

b. Instrumentation

c. Inflow Design Flood

d. Design and Analyses

5. How may a review of operation and maintenance records help you prepare to conduct a dam safety inspection?

6. How may the results of past inspection reports help you prepare to conduct a dam safety inspection?

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: UNIT EXERCISE -- ANSWER KEY

INSTRUCTIONS: Compare your answers to those given below to see how well you learned the information presented in this unit.

1. What is the benefit of conducting a preliminary review of a dam before inspecting the dam?

The preliminary review gives you an overall picture of the dam, and helps you identify areas for which further research and preparation are needed.

2. List three types of information you would be likely to find in the Dam Safety File.

Any three of the following:

- Background information on the dam
- Geologic information
- Hydrologic information
- Reservoir information
- Foundation information
- Information on the dam structure
- Information on other features, such as spillways, outlet works, etc.
- Reports
- Drawings

3. How would as-built drawings of the dam structure be helpful in conducting a dam safety inspection?

As-built drawings can be reduced and taken along on the inspection to provide orientation to the dam, and to note areas of deficiencies found during the inspection.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: UNIT EXERCISE -- ANSWER KEY

4. You have been assigned to inspect a dam located in the state of Washington. Listed below are four areas in which you wish to obtain information about the dam. Write down the category (or categories) of information within the Dam Safety File where you could find data on . . .

a. Site Conditions

Geologic information

b. Instrumentation

**Foundation information
Information on the dam structure
Reports**

c. Inflow Design Flood

Hydrologic information

d. Design and Analyses

**Information on the dam structure
Foundation information
Information on other features, such as spillways, outlet works, etc.**

5. How may a review of operation and maintenance records help you prepare to conduct a dam safety inspection?

Reviewing operation and maintenance records may help you to determine the extent to which operating and testing dam components will be necessary, based on past performance or maintenance problems. Operation and maintenance records can also help you decide when to schedule the inspection, since they contain information on reservoir levels, the accessibility of appurtenances, etc.

6. How may the results of past inspection reports help you prepare to conduct a dam safety inspection?

Past inspection reports may be used to identify modifications, rehabilitation, and/or problems that may have occurred during the life of the dam. Identifying these conditions will enable you to note particular areas to look during the onsite inspection.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: SUMMARY

REVIEWING PROJECT RECORDS

This unit presented information on reviewing project records and using information gathered to help plan a dam safety inspection. The basic steps involve . . .

STEP	DESCRIPTION
1	<p>Conducting A Preliminary Review</p> <p>When conducting a preliminary review, you will review general information about the dam to be inspected, and identify . . .</p> <ul style="list-style-type: none">✓ The owner of the dam✓ The exact location of the dam✓ The type of inspection to be performed✓ What features of the dam need to be inspected✓ If there are upstream or downstream conditions that might affect the dam or reservoir✓ The best time to schedule the inspection
2	<p>Reviewing The Dam Safety File</p> <p>The Dam Safety File provides ready access to information that you can use to . . .</p> <ul style="list-style-type: none">✓ Prepare to conduct the dam safety inspection✓ Analyze the observations made during an onsite inspection✓ Deal with any emergencies that may arise
3	<p>Examine Other Sources Of Information</p> <p>Identify and review other sources of information that may be used to supplement information in the Dam Safety File. You can also use this information in the event a Dam Safety File does not exist for a project.</p>

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

II. REVIEWING PROJECT RECORDS: SUMMARY

REVIEWING PROJECT RECORDS (Continued)

STEP	DESCRIPTION
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4	Reviewing And Evaluating Data
---	--------------------------------------

After sources of data have been identified, you should review information on the dam concerning the . . .

- ✓ Site conditions (geologic)
- ✓ Hydrology
- ✓ Design documents
- ✓ Construction records
- ✓ Operation and maintenance records
- ✓ Facility emergency preparedness
- ✓ Instrumentation records
- ✓ Past inspection reports
- ✓ Maps and photographs

Evaluating this information will help you identify areas of design and construction that may contribute to certain deficiencies; foundation and abutment conditions susceptible to seepage, piping, and erosion; and areas of previously noted deficiencies to inspect again.

UNIT III

PREPARING A FIELD INSPECTION PLAN

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: OVERVIEW

INTRODUCTION

Preparation of a detailed field inspection plan will help ensure the thorough inspection of all project features, known problem areas, and areas of potential problems. In addition, a field inspection plan will help you identify and plan for special logistics, access, or equipment requirements. This unit provides background information on developing a plan for conducting a dam safety inspection, including . . .

- . Developing an inspection outline or checklist
- . Developing inspection objectives
- . Preparing an inspection plan
- . Making special arrangements
- . Personal preparations
- . General safety issues

UNIT OBJECTIVES

After completing this unit, you will be able to . . .

- . Make changes to existing general checklists so they apply to the particular dam you will be inspecting.
- . Develop inspection objectives that cover all areas to be inspected.
- . Prepare an inspection plan to use as a guide on the inspection.
- . Identify features that need to have special arrangements made for their access, operation, and/or inspection.
- . Identify other areas where special arrangements must be made (e.g., special transportation).
- . Describe the personal and general equipment needed in order to properly conduct the dam safety inspection.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: THE INSPECTION OUTLINE

INSPECTION CHECKLISTS

An outline of the inspection plan may take the form of a checklist or a list of specific requirements of the type of inspection to be performed. Many agencies or organizations use checklists when conducting dam safety inspections.

The two types of checklists that may be used for dam safety inspections are . . .

- . General
- . Site-specific

If you are new to dam safety inspection, it is important to keep in mind that there may be areas in which the checklist, no matter how detailed, is lacking. Using a checklist as a "reminder" of areas to inspect in addition to always being alert for other things that may indicate problems will help you to perform a more complete onsite inspection. As a general rule, reliance on a checklist diminishes with the experience of the inspector.

Checklists are also useful tools in developing the final inspection report. In some organizations, for routine or even periodic inspections the checklist may be used as the final report.

General Checklist

General checklists only list the features "typical" of the type of dam being inspected. A general checklist can be used to assure coverage of most project features. However, this type of checklist will not identify specific project features. Appendix B presents a general checklist for inspecting embankment or concrete dams

Site-Specific Checklist

Site-specific checklists address the specific dam being inspected and its features. Site-specific checklists may already exist for some facilities. These lists should be updated if the dam has been modified or rehabilitated.

If you plan on using existing checklists during the inspection, they should be adapted or supplemented to . . .

- . Account for the type of inspection
- . Address up-to-date features
- . Include specific inspection objectives

Site-specific checklists that have been adapted to the inspection will help assure complete inspection coverage. Appendix C presents an example of a site-specific checklist.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: INSPECTION OBJECTIVES

INTRODUCTION

The type of inspection to be conducted will determine your inspection objectives. In general, all features of the dam or reservoir that affect dam safety should be examined for . . .

- . Indications of distress
- . Unusual or adverse behavior
- . Equipment malfunctions
- . Overall condition

DEVELOPING INSPECTION OBJECTIVES

A thorough review of the dam safety file will provide you with much of the information you will need to develop your inspection objectives. In addition, interviews with the dam operator or other personnel associated with the operation of the dam are valuable. Because of their daily association with the dam, they may be able to provide information on problems that may not be immediately obvious.

A list of specific inspection objectives can be used in conjunction with a general or site-specific checklist.

When developing your inspection objectives, make sure the following considerations are included:

- . Inherent weaknesses based on the type of dam and its features.
- . Outmoded design or construction practices that may have been used.
- . Foundation weaknesses.
- . Unusual or adverse conditions (e.g., large floods, earthquakes, etc.).
- . Reported problems with equipment, such as malfunctions.
- . Project structures that have recently sustained unusual loading conditions.
- . Operational or inspection objectives not covered in previous inspections.
- . Overall condition. (A satisfactory condition reported in an earlier inspection will help you assess whether there has been any change, or if "it's always been that way.")

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: THE INSPECTION PLAN

PREPARING AN INSPECTION PLAN

Once you have determined the focus of the inspection and have gathered and reviewed the necessary data, the next step is to develop your inspection plan. An inspection plan is basically an extension of a site-specific checklist and the inspection objectives. The inspection plan should address the . . .

- . Type of inspection to be performed
- . Order of the inspection
- . Equipment to be operated and the extent of operation planned
- . Special equipment needs or special arrangements (made in advance)

The inspection plan may be presented in the form of an inspection itinerary, and taken along on your inspection as a guide. It can be amended, if necessary, during the onsite inspection. You should give a copy of the inspection plan or itinerary to the dam operator or other personnel at the dam.

If you examine the sample site-specific checklist, you will note that provisions are made at the beginning of the list for other information necessary to the inspection plan, such as . . .

- . A description of the dam and other pertinent data
- . A plan and section of the dam and spillway
- . A list of individuals performing the inspection
- . Information on emergency preparedness

Type Of Inspection

When preparing an inspection plan, it is important to address the type of inspection to be performed. Preparations and procedures for conducting a formal dam safety inspection are more extensive than those required to conduct a periodic, routine, or special inspection.

For example, if you are reviewing instrumentation data for a formal or intermediate inspection, you need to review what the different types of instruments are, their location, and what they indicate about performance. This information will then be used to determine areas that may exhibit abnormal behavior. However, if a specific feature of the dam is to be inspected and a special inspection is required, only preliminary information on the dam and detailed information on the specific feature to be inspected will be reviewed.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: THE INSPECTION PLAN

Order Of Inspection

The actual inspection will normally consist of interviews with the dam owner or operating personnel, a visual inspection of the dam and all appurtenant structures, and observation of the watershed and downstream areas. However, the manner in which the inspection proceeds will depend upon . . .

- . Purpose of the inspection (type)
- . Configuration of the facility
- . Operational considerations
- . Weather conditions
- . Ground cover or other obstructions blocking inspection areas
- . Personnel safety considerations

Equipment Operation

If equipment or features of the dam are to be operated as part of the inspection, you should make arrangements for this in advance of the inspection.

The length of time needed to inspect and operate each piece of equipment or feature should be estimated and included in your inspection plan. When estimating time, take into consideration . . .

- . Purpose of the inspection
- . Extent of operation
- . The complexity and condition of the equipment or feature to be inspected
- . Restrictions on operations (if any)
- . Level of effort involved in any special inspection requirements

A review of reports from past inspections found in the Dam Safety File, and input from field representatives, will help you plan for inspecting and operating equipment and estimate the time needed for these activities.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: THE INSPECTION PLAN

Special Equipment Needs

After you determine what areas of the dam and reservoir will be inspected, you should make a list of your equipment needs other than the standard personal equipment. Some examples of special equipment would be:

- . Extension ladders, hydraulic lifts, or other equipment needed to gain access to high places.
- . Ropes and harnesses for tying off while working around steep, high, slippery, or otherwise precarious areas.
- . Air monitoring devices for entering conduits or shafts that have explosive or poisonous gases or insufficient oxygen.
- . Underwater video equipment and remotely operated vehicles, or inspection divers for inspecting inaccessible areas under water.

Once you have determined what your equipment needs are . . .

- ✓ Check with your organization to see what equipment they have available.
- ✓ Check with the dam owner or operator to see what equipment is available at the dam.
- ✓ Make arrangements with a rental company, contractor, or other source to obtain equipment that is not available through your organization or at the dam site.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SPECIAL ARRANGEMENTS

MAKING SPECIAL ARRANGEMENTS

This section focuses on the areas of an inspection that may require making special arrangements prior to the date of your inspection. Making advance arrangements will help ensure that there are no delays or problems in the overall inspection process.

Special arrangements may have to be made for . . .

- . Access provisions
- . Special transportation
- . Aerial or underwater inspections
- . Equipment operation provisions

Access Provisions

If you have identified specific features that require access or special provisions and equipment, including equipment needed for personnel safety, you should arrange for these as early as possible. You will need to make special provisions for . . .

- . Obtaining keys for locked areas
- . Obtaining ladders, ropes, boat bosun's chair, crane
- . Changing discharge in conduits
- . Draining penstocks and outlet works
- . Removal of manhole covers
- . Dewatering of basins
- . Installation of bulkheads
- . Obtaining remote equipment for inspecting confined areas

Certain provisions, such as dewatering basins or draining outlet works, conduits, and penstocks, may require more than a day to perform, depending on the arrangements that dam personnel might have to make. That is why it is important to determine ahead of time which features you need to inspect, and give advance notice to dam personnel.

Additional time requirements resulting from these activities must be addressed in the inspection plan.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SPECIAL ARRANGEMENTS

Special Transportation

At times, special transportation may be necessary in order to access an area of the dam or reservoir. Special transportation may include . . .

- . Horses
- . Boats
- . Four-wheel-drive vehicles
- . Aircraft

Arrangements for special transportation should be made early in the inspection process, and the time requirements noted on the inspection plan.

Aerial Or Underwater Inspections

If a helicopter or airplane is needed to view or photograph certain features of the dam or reservoir, arrangements must be made ahead of time and these activities accounted for in the inspection plan.

A diver may be required to perform underwater inspections of features such as stilling basins, intakes, or the upstream face of a concrete dam. Arrangements should be made for the diver ahead of time to ensure that the diver is available when the underwater features must be inspected.

It is important to select a diver who is knowledgeable in hydraulic structures to conduct underwater inspections. Divers not familiar with dams can become disoriented, or may not correctly interpret what they see. Also, divers as well as inspectors should be aware of dangers related to hydrofacilities, especially near intake structures. Design drawings can be helpful in aiding diver orientation, and you may wish to discuss these with the diver prior to the inspection. However, because underwater inspections generally are performed as a special inspection, you may not have this opportunity. In that case, other personnel should brief the diver prior to the inspection.

Underwater inspections are also done using remotely operated vehicles equipped with video cameras. These are particularly useful for areas either inaccessible or too dangerous for divers.

Equipment Operation Provisions

As a rule, equipment should only be operated by dam personnel. Therefore, before conducting the inspection, make arrangements to have one or more dam personnel accompany the inspection team to operate any equipment or features to be inspected.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: PERSONAL PREPARATION

INTRODUCTION

This section outlines the types of personal preparations that must be made before the inspection takes place. Also, items of personal equipment and inspection equipment will be described.

TRAVEL ITINERARY

If the dam you are inspecting is not within driving distance, or the inspection will last more than a day, arrangements for transportation and lodging must be made. If other members of the inspection team need transportation and lodging arrangements, determine if they will be made by the individual or by your organization. Then follow up to ensure that everyone will be at the site when needed.

EQUIPMENT

The purpose of a dam safety inspection is to gather and record facts that may have an impact on the safety of the dam. Use the SMPL (pronounced "Simple") rule for all recordings:

- S** Sketch the deficiency and note its important characteristics.
- M** Measure the deficiency.
- P** Photograph the deficiency or describe its characteristics in writing.
- L** Locate the deficiency relative to some standard reference point.

Equipment needed to use the SMPL method for recording deficiencies is as follows:

TO . . .	USE A . . .
S Sketch	Notebook or drawings
M Measure	Ruler or tape measure
P Photograph	Camera with wide-angle and telephoto lenses, as appropriate
L Locate	As-built drawings

 **INSPECTION TIP:** One method of noting the location of a deficiency is to bring a reduced set of the as-built drawings and mark the exact location of the deficiency on the drawings.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: PERSONAL PREPARATION

EQUIPMENT (Continued)

Items of personal equipment include . . .

- . Back or fanny pack
- . Clipboard
- . Field notebooks
- . Camera harness
- . Pencils
- . Hand-held tape recorder
- . Pocket ruler
- . Foul-weather gear
- . Safety gear
- . Pocket knife

General equipment and the purpose for including the equipment in a dam safety inspection are listed in Table III-1.

TABLE III-1. GENERAL EQUIPMENT

Type	Purpose
Hand level	Checking elevations and heights (approximate)
Inclinometer	Measuring the degree of slopes
Measuring tapes (6-, 25-, and 100-foot tapes)	Measuring dimensions of features or abnormalities and location relative to a known reference
Rock hammer	Sounding concrete or rock to check quality and checking for pipe corrosion
Shovel	Clearing drains and exposing covered appurtenances
Lights	Looking into conduits, galleries, or other darkened areas
Probe (rod)	Probing wet, soft areas, sinkholes, and voids
Bucket and timer	Measuring seepage and other flow rates
Bonker	Sounding concrete for voids
Knife or machete	Scraping rock or soil and clearing brush
Sounding lines or tapes	Measuring water depths in standpipes or foundation drains
Binoculars	Viewing inaccessible structures and areas

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: PERSONAL PREPARATION

EQUIPMENT (Continued)

TABLE III-1. GENERAL EQUIPMENT (Continued)

Type	Purpose
Camera (wide-angle and telephoto lenses are particularly helpful)	Making photographic records
Water sample containers (jars)	Obtaining water samples
Hand auger	Obtaining subsurface soil samples
Sample bags	Obtaining soil or rock samples
Miscellaneous surveying equipment:	Performing various measurements
Philadelphia or fiberglass surveying rod	Checking elevations and heights
Level and tripod	Checking elevations and heights

For more detailed and comprehensive inspections, some of the items presented in Table III-2 may be needed.

TABLE III-2. SPECIALIZED EQUIPMENT

Type	Purpose
Plumb bob	Checking alignment
Flow meter	Measuring flow velocity and quantity
Piezometer gauge	Reading piezometers
Remotely operated vehicle with video camera	Inspecting pipes/conduits and conducting under-water inspections

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: PERSONAL PREPARATION

EQUIPMENT (Continued)

**TABLE III-2. SPECIALIZED EQUIPMENT
(Continued)**

Type	Purpose
Videotape camera and recorder	Recording general inspection findings, discharge in the spillway(s), and equipment operation
Two-way radios	Communicating during the inspection
Pre-cut V-notch weirs	Measuring seepage
Large pipe wrench	Removing caps from piezometers

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SAFETY ISSUES

INTRODUCTION

This section describes only basic safety issues related to conducting dam safety inspections. Issues specific to a particular aspect of inspection will be discussed in the module addressing that aspect.

SAFETY EQUIPMENT

Proper clothing for the season and the job should be worn. You need to stay dry and warm if the weather is cold. You will need safety boots (steel-toed, lug-soled, high-top recommended) and rubber outerwear for entering wet conduits or tunnels. If you are entering a conduit or tunnel, you should have gloves and coveralls, plus a hard hat to protect your head. Ear protection will be required for inspection of dams having powerplants or other noisy equipment.

You should never go out in the field without a first aid kit. Rattlesnake chaps may also be a good idea, depending on the area. Also, if a team member is allergic to spider bites or bee stings, the antidote should be carried in the first aid kit.

Persons conducting part of the inspection around a drop-off or steep incline should be tied off with the proper equipment to prevent them from falling.

Persons performing inspection tasks in areas of deep water or from a boat should wear life jackets at all times.

AIR QUALITY CONCERNS

When inspecting a shaft, tunnel, or conduit, if fans are available, they should be used for air supply and circulation and started sufficiently ahead of entering the space. If fans are not available or not operable, the air quality should be checked before entering the questionable air space. Because toxic or explosive gas may be present from adjacent bedrock, as well as combustible dust, a qualified person using the appropriate instruments should determine the presence and concentrations of oxygen, toxic vapors and gases, and/or flammable vapors and gases. A candle should **never** be used to determine the presence of vapors or gases because of the danger of explosion.

REMOTE LOCATIONS

Someone besides the inspection team should know the inspection itinerary. If the team doesn't return when expected, someone will know to check on them.

In hot weather in arid regions, the inspection team should take drinking water along. If the weather is or could become cold, emergency blankets, etc. should be stowed in the vehicle.

Allow enough time to travel to a remote site and complete the inspection before dark.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SAFETY ISSUES

PHYSICAL FITNESS CONCERNS

Because conducting a dam safety inspection can be rigorous, persons on the inspection team should be in good physical shape. Also, remember to account for altitude changes. Someone from a lower elevation who is visiting a site high in the mountains will tend to be breathless, and should not do as much as he or she is accustomed to doing.

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: UNIT EXERCISE

INSTRUCTIONS: Use the information presented in this unit to answer the following questions. When you have completed all of the questions, check your answers against those presented in the answer key. The answer key can be found immediately following this exercise.

1. List three areas to address when adapting a general or site-specific checklist for use during a particular dam safety inspection.

- _____
- _____
- _____

2. In general, all features of a dam or reservoir that affect dam safety should be examined for . . . (List two)

- _____
- _____

3. Which of the following is **NOT** considered when developing inspection objectives?

- Project features or structures that have sustained recent, unusual loading conditions
- Expertise of members of the inspection team
- Operational or inspection objectives not covered in previous inspections
- Reported problems or equipment malfunctions

4. List three areas to address when developing your inspection plan.

- _____
- _____
- _____

5. There is no established order in which to conduct a dam safety inspection; the order is determined based on the type of inspection and other factors.

- True False

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: UNIT EXERCISE

6. When estimating the amount of time needed to conduct a safety inspection, it is important to take into consideration the amount of time needed to operate each of the features to be inspected.

True

False

7. List three areas where special arrangements may have to be made.

- _____
- _____
- _____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: UNIT EXERCISE -- ANSWER KEY

INSTRUCTIONS: Compare your answers to those given below to see how well you learned the information presented in this unit.

1. List three areas to address when adapting a general or site-specific checklist for use during a particular dam safety inspection.
 - . **Type of inspection**
 - . **Up-to-date features**
 - . **Specific inspection objectives**

2. In general, all features of a dam or reservoir that affect dam safety should be examined for . . . (List two)

Any two of the following:

 - . **Indications of distress**
 - . **Unusual or adverse behavior**
 - . **Equipment malfunctions**
 - . **Overall condition**

3. Which of the following is **NOT** considered when developing inspection objectives?
 - Project features or structures that have sustained recent, unusual loading conditions
 - Expertise of members of the inspection team**
 - Operational or inspection objectives not covered in previous inspections
 - Reported problems or equipment malfunctions

4. List three areas to address when developing your inspection plan.

Any three of the following:

 - . **Type of inspection to be performed**
 - . **Order of the inspection**
 - . **Equipment to be operated**
 - . **Special equipment needs or special arrangements**

5. There is no established order in which to conduct a dam safety inspection; the order is determined based on the type of inspection and other factors.
 - True**
 - False**

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: UNIT EXERCISE -- ANSWER KEY

6. When estimating the amount of time needed to conduct a safety inspection, it is important to take into consideration the amount of time needed to operate each of the features to be inspected.

True

False

7. List three areas where special arrangements may have to be made.

Any three of the following:

- . Access to certain features or areas of inspection
- . Transportation needed to inspect certain areas of the dam or reservoir
- . Aerial or underwater inspections
- . Equipment operation provisions

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SUMMARY

INSPECTION CHECKLISTS

This unit described the two types of checklists:

- . The **general checklist** only lists the features "typical" of the type of dam being inspected. This type of checklist does not address specific project features.
- . The **site-specific checklist** addresses only the dam, the features of the dam, and other areas specific to a particular site.

When adapting a checklist to meet the requirements of the inspection to be conducted, be sure to . . .

- . Account for the type of inspection
- . Address up-to-date features
- . Include specific inspection objectives

INSPECTION OBJECTIVES

Developing inspection objectives was also discussed. Inspection objectives can be developed after reviewing the Dam Safety Files and other related materials. When developing inspection objectives, be sure to consider . . .

- . Inherent weaknesses based on the type of dam and its features.
- . Outmoded design or construction practices that may have been used.
- . Foundation weaknesses.
- . Unusual or adverse conditions (e.g., large floods, earthquakes, etc.).
- . Reported problems with equipment, such as malfunctions.
- . Project structures that have recently sustained unusual loading conditions.
- . Operational or inspection objectives not covered in previous inspections.
- . Overall condition. (A satisfactory condition reported in an earlier inspection will help you assess whether there has been any change, or if "it's always been that way.")

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SUMMARY

INSPECTION PLAN

An inspection plan is basically an extension of a site-specific checklist. Make sure your plan addresses the . . .

- . Type of inspection to be performed
- . Order of the inspection
- . Equipment to be operated (and special arrangements needed to schedule the operation)
- . Special equipment needs

MAKING SPECIAL ARRANGEMENTS

Guidelines for making special arrangements were also presented in this unit. Some areas of an inspection require that arrangements be made in advance of the arrival of the inspection team. These arrangements include . . .

- . Access provisions
- . Special transportation
- . Aerial or underwater inspections
- . Equipment operation provisions

You should remember to give the dam owner, operator, or other appropriate dam personnel enough time to make their arrangements. Some procedures, such as dewatering basins or draining penstocks, require a day or more to perform.

PERSONAL PREPARATION

The areas of personal preparation covered in this unit included . . .

- . Making travel arrangements (if the dam to be inspected is not within driving distance)
- . Gathering personal equipment items
- . Gathering general equipment for conducting the inspection

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

III. PREPARING A FIELD INSPECTION PLAN: SUMMARY

GENERAL SAFETY ISSUES

Only general safety issues were presented in this unit. The issues covered include . . .

- . Proper clothing
- . Safety equipment
- . Air quality concerns
- . Remote locations
- . Physical fitness concerns

Other areas of safety specific to certain inspection activities or certain areas of the dam or reservoir will be covered in their appropriate modules.

FINAL REVIEW EXERCISE

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

FINAL REVIEW EXERCISE

INSTRUCTIONS: To complete this exercise, you need a Dam Safety File for an embankment dam or concrete dam. Using the Dam Safety File along with the Sample General Checklist for Embankment or Concrete Dams (Appendix B), complete the steps described below.

- STEP 1:** Pretend you will be conducting a formal dam safety inspection. Using the sample General Checklist (Appendix B), adapt the checklist so that it applies specifically to the dam described in your Dam Safety File (i.e., make the General Checklist a Site-Specific one).
- STEP 2:** Identify areas where information is missing from the Dam Safety File (if any), and where you would go to get that information.
- STEP 3:** Identify and list areas where special arrangements and equipment will need to be made.
- STEP 4:** Describe what equipment you will take and why.
- STEP 5:** Describe how you will go about making special arrangements and the timeframe for making them.
- STEP 6:** Develop an inspection itinerary for inspecting those areas of the dam covered in the checklist developed in STEP 1.
- STEP 7:** Meet with your supervisor or some other appropriate person and go over your specific inspection concerns and itinerary. Ask this individual to help you identify your strengths and weaknesses concerning developing an inspection plan.

APPENDIX A:

GLOSSARY

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

GLOSSARY

ABUTMENTS - Those portions of the valley sides to which the ends of the dam join, and also those portions beyond the dam that might present seepage or stability problems.

APPURTENANT STRUCTURES - Auxiliary features of a dam that are necessary to the operation of the dam project. These may include spillways, outlet works, gates and valves, powerplants, tunnels, and switchyards.

AS-BUILT DRAWINGS - Plans or drawings portraying the actual dimensions and conditions of a dam and appurtenant structures as they were built. As-built drawings document construction changes to the original design due to field conditions and material availability.

BONKER - A hardwood dowel with a metal tip used to sound for voids under concrete.

BULKHEAD - An upright partition or retaining wall built to resist pressure or shut off water.

COMPREHENSIVE DATA REVIEW - Gathering and reviewing all pertinent information about the dam to be inspected. This review should identify: the type of dam and its individual features; the intended use of the dam and reservoir; pertinent geologic conditions; pertinent design and construction details; conditions pertinent to structural integrity; past performance or operational problems; and past foundation or abutment problems.

DAM FAILURE - The uncontrolled release of impounded water. There are varying degrees of failure--any malfunction or abnormality outside the design assumptions and parameters that adversely affects a dam's primary function of impounding water is properly considered a failure. Small failures are, however, normally correctable.

DAM SAFETY FILE - A compilation of all information pertinent to safety at a specific dam. A separate Dam Safety File may exist; however, some organizations consider a compilation of existing project files to be the Dam Safety File.

DESIGN WATER LEVEL - The maximum water elevation, including the flood surcharge, that a dam is designed to withstand.

DEWATERING OF BASINS - Lowering or removing of water within the basins.

EMBANKMENT DAM - Any dam constructed of excavated natural materials or industrial waste materials. (Includes both earthfill and rockfill dams.)

EMERGENCY ACTION PLAN (EAP) - A plan designed to alleviate hazards or reduce damages that may be caused by flooding due to dam failure or unusually high flow through the spillway system. An EAP contains procedures to be followed in the event of structural malfunctions or the occurrence of a natural event that approaches or exceeds the design limits of the dam.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

GLOSSARY

EMERGENCY INSPECTION - A type of dam safety inspection performed when the immediate safety of the dam is of concern, or in the event of unusual or potentially adverse conditions.

FACILITY EMERGENCY PREPAREDNESS - The relative ability of a facility to respond effectively to emergencies such as flooding due to dam failure or unusually high flows through the spillway system.

FORMAL DAM SAFETY INSPECTION - A thorough inspection of all structural, mechanical, and geologic features of a dam. Design and construction data are compared to the current state-of-the-art. Follows same procedures as those of an Initial Dam Safety Inspection.

FREEBOARD - The vertical distance between a stated water level and the top of a dam or spillway crest.

FULL DESIGN LOAD - Maximum reservoir elevation or amount of water that can be accommodated.

GENERAL INSPECTION CHECKLIST - A general outline of a safety inspection plan that is designed to assure coverage of most typical project features.

HAZARD CLASSIFICATION - a rating (e.g., low, moderate/significant, or high hazard) that is representative of the probable loss of life and property damage downstream from a dam based on the results of breaching studies of the dam, and an identification of the area downstream that would be inundated.

INCLINOMETER (INCLINOMETER) - An instrument usually consisting of a metal or plastic tube inserted in a drill hole and a sensitized monitor either lowered into the tube or fixed within the tube. This monitor measures (at different points) the tube's inclination to the vertical. The device may be used to measure slope or settlement.

INITIAL DAM SAFETY INSPECTION - Same as Formal Dam Safety Inspection, completed for the first time at a dam.

INSPECTION OBJECTIVES - A list of specific goals and tasks that will be addressed at a dam safety inspection.

INSPECTION PLAN - A set course of action to be followed during a dam safety inspection. The plan should specify: the type of inspection to be performed; the order of the inspection events; the equipment to be operated and the extent of operation planned; and special equipment needs or special arrangements.

INTERMEDIATE DAM SAFETY INSPECTION - A thorough inspection of all structural and geologic features of a dam. Design and construction data are reviewed only to become familiar with the dam and its features. Also known as Periodic Dam Safety Inspection.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

GLOSSARY

INUNDATION MAP - A map showing areas that would be affected by flooding such as uncontrolled release of a dam's reservoir or passage of the design flood through the spillway.

LIQUEFACTION - a) The process whereby soil behaves as a viscous liquid. b) A condition whereby soil undergoes continued deformation at a constant low residual stress or with low residual resistance, due to the buildup and maintenance of high-pore water pressures, which reduces the effective confining pressure to a very low value. Pore pressure buildup leading to liquefaction may be due either to static or cyclic stress applications. The possibility of its occurrence will depend on the void ratio or relative density of a cohesionless soil and the confining pressure.

MINERAL EXTRACTION MAP - A map that identifies where minerals have been extracted (e.g., through mining activities). Such maps can be used in dam safety inspections as one source to help locate areas of potential subsidence or sinkholes.

OUTLET - An opening through which water can be discharged.

OUTLET WORKS - A system of dam components that regulates or releases water impounded by a dam. Components of an outlet works include an entrance channel, intake structure, conduit, gate or valve housing, energy dissipators, and return channel.

PENSTOCK - A pipeline or pressure conduit leading from a headrace or reservoir to power-producing turbines. Because of the possibility of sudden load changes, a penstock is designed to withstand pressure surges.

PERIODIC DAM SAFETY INSPECTION - Same as Intermediate Dam Safety Inspection.

PIEZOMETER - An instrument used for measuring water pressure within soil, rock, or concrete.

PIPING - The progressive internal erosion of embankment or foundation material.

PRELIMINARY DATA REVIEW - Gathering and reviewing general information about the dam to be inspected, to give you an overall picture of the dam and to help you identify areas needing further research and preparation.

RESERVOIR DRAWDOWN CAPABILITY - An estimate of the time needed to fully or partially drain a reservoir.

ROUTINE DAM SAFETY INSPECTION - An inspection of all structural and geologic features of a dam, generally conducted by field or operating personnel as they are performing their regular or routine tasks.

SEEPAGE - The movement of water that may take place through embankment dam materials, foundations, or abutments.

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

GLOSSARY

SINKHOLE - A depression resulting from loss of material underlying the surface.

SITE-SPECIFIC INSPECTION CHECKLIST - An outline of a safety inspection plan that is specially designed to address the specific dam being inspected and its features.

SPECIAL INSPECTION - A dam safety inspection conducted when a unique opportunity to inspect a certain area or feature is presented, or if specialized personnel are needed (e.g., inspection divers).

SPILLWAY - A structure over or through which flood flows are discharged. If the rate of flow is controlled by mechanical means, such as gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

STANDING OPERATING PROCEDURES (SOP) - Written guidelines to be followed for normal and emergency operation of the components of a dam.

SUBSIDENCE - Flattening out or sinking.

TOPOGRAPHIC MAP - A detailed graphic delineation of natural and man-made features of a region with particular emphasis on relative position and elevation.

WEIR - A structure of given shape and dimensions built across a stream or channel to control or measure flow quantities.

APPENDIX B:

**SAMPLE GENERAL CHECKLIST FOR
EMBANKMENT OR CONCRETE DAMS**

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

CONTENTS

SECTION	<u>Page</u>
Operational Status At Time Of Inspection	B-2
Inspection Team	B-2
Standing Operating Procedures (SOP)	B-2
Embankment Dam	B-5
Note: This section should be completed only when inspecting an embankment dam.	
Concrete Dam	B-8
Note: This section should be completed only when inspecting a concrete dam.	
Spillway	B-10
Outlet Works	B-15
Power Features	B-19
Note: This section should be completed only if the power features relate to the safe operation or structural integrity of the dam.	
Geology	B-20

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

DAM: _____
PROJECT: _____
REGION: _____

Date of Inspection

____ / ____ / ____

Structure Completed

____ / ____ / ____

Operational Status at Time of Inspection

Reservoir Water Surface-Elevation _____ ft
Reservoir Storage _____ acre-feet
Top of Active Conservation-Elevation _____ ft
Maximum Reservoir Water Surface-Elevation _____ ft
Releases
 Spillway _____ ft³/s
 Outlet Works _____ ft³/s
 Canal _____ ft³/s
 Power Plant _____ ft³/s

Inspection Team

<u>Name</u>	<u>Title</u>	<u>Affiliation</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

STANDING OPERATING PROCEDURES (SOP)

General

Issue or revision date _____
Is copy at dam current? _____
Are instructions adequate? _____
Are instructions understood? _____
Any changes needed? _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

STANDING OPERATING PROCEDURES (SOP) (Continued)

Emergency Preparedness

Hazard Classification

Classification _____

Basis _____

Communications

Type

Normal _____

Standby _____

Adequacy _____

Operating Procedures

Adequacy _____

Capability of Personnel _____

Auxiliary Power

Description _____

Test During Examination _____

Condition _____

Adequacy _____

Remote Control

Description _____

Test During Examination _____

Condition _____

Adequacy _____

Site Access

Description _____

Adequacy Under Adverse Conditions _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

STANDING OPERATING PROCEDURES (SOP) (Continued)

Site Security

Description _____

Condition _____

Restricted Areas _____

Adequacy _____

Warning System

Description _____

Test During Examination _____

Condition _____

Adequacy _____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

EMBANKMENT DAM

This section should be completed only when inspecting an embankment dam.

Upstream Slope

- Slope Protection _____
- Erosion-Beaching _____
- Vegetative Growth _____
- Settlement _____
- Debris _____
- Burrows Or Burrowing Animals _____
- Unusual Conditions _____

Downstream Slope

- Signs of Movement _____
- Seepage or Wet Areas _____
- Vegetative Growth _____
- Unusual Conditions _____
- Channelization _____
- Condition of Slope Protection _____
- Burrows or Burrowing Animals _____

Abutments

- Seepage _____
- Cracks, Joints, and Bedding Planes _____
- Channelization _____
- Slides _____
- Vegetation _____
- Signs of Movement _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

EMBANKMENT DAM (Continued)

This section should be completed only when inspecting an embankment dam.

Crest

- Surface Cracking _____
- Durability _____
- Settlement _____
- Lateral Movement (alignment) _____
- Camber _____

Seepage And Drainage Summation

- Location(s) _____
- Estimated Flow(s) _____
- Color (staining) _____
- Erosion of Outfall _____
- Toe Drain and Relief Wells _____

Measurement

- Method _____
- Amount _____
- Change in Flow _____
- Clearness of Flow _____
 - Color _____
 - Fines _____
 - Condition of Measurement _____
 - Devices _____
 - Records _____

Instrumentation

- Piezometer Well _____
 - Well _____
 - Frostfloor _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

CONCRETE DAM

This section should be completed only when inspecting a concrete dam.

Upstream Face	_____
Downstream Face	_____
General Condition	_____
Seepage	_____
Crest	_____
Offsets	_____
Roadway	_____
Walks	_____
Parapet Wall	_____
Lighting, etc.	_____
Galleries	_____
Concrete	_____
Metalwork	_____
Electrical	_____
Ventilator	_____
Seepage	_____
Drains and Drainage (all drains should be open)	_____
Frequency of Cleaning or Probing	_____
Foundation Tunnels	_____
General	_____
Seepage	_____
Instrumentation	_____
Reservoir-Level Gage	_____
Structural	_____
Seepage	_____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

CONCRETE DAM (Continued)

This section should be completed only when inspecting a concrete dam.

Instrumentation (Continued)

Ice-Prevention System

Other

**Foundation At Downstream
Toe Of Dam**

Leakage Around Dam

Location

Amount

Measurement Methods

Other

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

SPILLWAY

Entrance Channel

Vegetation (e.g., trees, etc.)

Debris

Slides Above Channel

Channel Side Slope Stability

Log Boom

Slope Protection

Open Channel Control Section

Floor

Surface Condition

General Condition of Concrete

Cracks or Areas of Distress

Signs of Movement

Settlement

Joints

Cracks

Crest

Surface Condition

General Condition of Concrete

Cracks or Areas of Distress

Signs of Movement

Walls

Surface Condition

General Condition of Concrete

Movement (offsets)

Cracks or Areas of Distress

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

SPILLWAY (Continued)

Open Channel Control Section (Continued)

Walls (Continued)

Settlement

Joints

Drains

Backfill

Gates

Description

General Condition

Protective Coating

Leakage (closed)

Exercising Frequency

Operation of Gates at Time
of Inspection

Controls For Gates

Mechanical

Hoists

Wire Ropes

Protective Coating

Electrical

Remote Control

Power Supply

Standby Power

Operation Instructions

Weather Doors

General Condition

Protective Coating

Exercising Frequency

Operation at Time of Inspection

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

SPILLWAY (Continued)

Chute Or Tunnel (Continued)

Floor

Surface Condition

General Condition of Concrete

Movement

Settlement

Joints

Drains

Cracks

Drainage Gallery

General Condition of Concrete

Movement (misalignment of gallery)

Cracks

Drains

Amount of Flow

Location of Seeping Drains

Ventilation

Lighting

Stilling Basin

Debris in Basin

Walls

Surface Condition

General Condition of Concrete

Movement (offsets)

Settlement

Joints

Cracks or Areas of Distress

Condition of Backfill

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

SPILLWAY (Continued)

Stilling Basin (Continued)

Floor (if visible)

Surface Condition

Condition of Concrete

Cracks or Areas of Distress

Movement

Joints

Erosion

Sill

Return Channel

Slope Protection (e.g., riprap)

Stability of Side Slopes

Vegetation or Other Obstructions

Other

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

OUTLET WORKS

Intake Structure (if visible)

Trashracks

Trashrack Concrete Structure

Intake Structure Bulkhead

General Condition

Protective Coating

Seals

Entrance Transitions and Upstream Conduit

Upstream Gate (Emergency/Guard Gate)

Gate Housing

General Condition

Protective Coating

Leakage

Metalwork (air vent, bonnet cover,
gate stems, watertight access
door)

Security

Gate (dimensions)

General Condition

Protective Coating

Cavitation

Leakage (closed)

Exercising Frequency

Operation at Time of Inspection

Control System

Mechanical

Electrical

Remote Control

Auxiliary Power

Operating Instructions

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

OUTLET WORKS (Continued)

Upstream Gate (Emergency/Guard Gate) (Continued)

Gate Hoist Shelter House

General Condition _____

Reservoir-Level Gage _____

Control Gate Or Valve (Repeat For Each Gate Or Valve)

Gate or Valve Housing

General Condition _____

Security _____

Gate(s)

General Condition _____

Protective Coating _____

Cavitation _____

Leakage (closed) _____

Exercising Frequency _____

Operation of Gates at Time
of Inspection _____

Valve(s)

General Condition _____

Protective Coating _____

Cavitation _____

Leakage (closed) _____

Creep _____

Exercising Frequency _____

Operation of Valves at Time of
Inspection _____

Weather Barrier

General Condition _____

Protective Coating _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

OUTLET WORKS (Continued)

Weather Barrier (Continued)

Exercising Frequency

Operation at Time of
Inspection

Control

Downstream Conduit

Metalwork (dimensions)

General Condition

Protective Coatings

Cavitation

Concrete

General Condition

Leakage

Ventilation

Lighting

Access Structure Or Gate Shaft

Concrete

Metalworks

Ventilation

Lighting

Leakage

Control System For Gates and Valves

Mechanical

Electrical

Operating Instructions

Stilling Basin

Debris in Basin

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

OUTLET WORKS (Continued)

Stilling Basin (Continued)

Walls

- Surface Condition _____
- General Condition of Concrete _____
- Movement (offsets) _____
- Settlement _____
- Joints _____
- Cracks or Areas of Distress _____
- Condition of Backfill _____

Floor (if visible)

- Surface Condition _____
- Condition of Concrete _____
- Cracks or Areas of Distress _____
- Movement _____
- Joints _____
- Erosion _____

Return Channel

- Slope Protection (e.g., riprap) _____
- Stability of Side Slopes _____
- Vegetation or Other Obstructions _____

Other

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

POWER FEATURES

This section should be completed only if the power features relate to the safe operation or structural integrity of the dam.

Intake Structure	_____
Trashrack	_____
Bulkhead Gate	_____
Intake Gates	_____
Intake Gate Hoist	_____
Gantry Crane	_____
Mechanical	_____
Electrical	_____
Paint	_____
Operating Instructions	_____
Operation During Inspection	_____
Storage Area	_____
Penstock	_____
Powerplant Structure	_____
Ceilings	_____
Deck	_____
Walls	_____
Substructure	_____
Tailrace	_____
Draft Tube Closure Structure	_____
Draft Tube Bulkhead	_____
Gantry Crane	_____
Other	_____
_____	_____
_____	_____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

GEOLOGY

Site Geology

Dam

Spillway

Outlet Works

Abutments

Left

Right

Reservoir

Seepage

Dam Site

Toe And Abutments

Downstream Channel

Other

Physical Features

Faulting

Clay Seams

Depressions

Sinkholes

Bedding Planes

Shear Seams

Other

Seismicity

Surface Rupture

Ground Tilting

Settlement

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SAMPLE GENERAL CHECKLIST FOR EMBANKMENT OR CONCRETE DAMS

GEOLOGY (Continued)

Landslides

Reservoir

Dam Site

Downstream Channel

Other

APPENDIX C:
SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

**THUNDER MOUNTAIN DAM
GREAT RIVER PROJECT
LOWER COLORADO REGION**

Date of Inspection

____ / ____ / ____

Description and Pertinent Data

Structure complete: 1930
Type: Concrete Thin-Arch
Structural height: 207 ft
Crest length: 1260 ft
Crest elev: 1530 msl

Spillway: 9-27' x 23' Radial Gates
Spillway Crest Elev.: 1506.0 msl
Spillway Design Flow: 140000 cfs
Elevation Top of Parapet: 1535 msl

River Outlets and Capacities:

- A. Power Penstocks: 1-13.5' dia. penstock to unit #1.
Capacity Unit No. 1: 1795 cfs. at elevation 1522
- B. Low-head Outlets: 1-84" dia. penstock with 84" butterfly valve on downstream end. Outlet normally only used for releases of 1100 cfs or less. Capacity at 1475 is 1375 cfs.

Plugged and Abandoned Outlets:

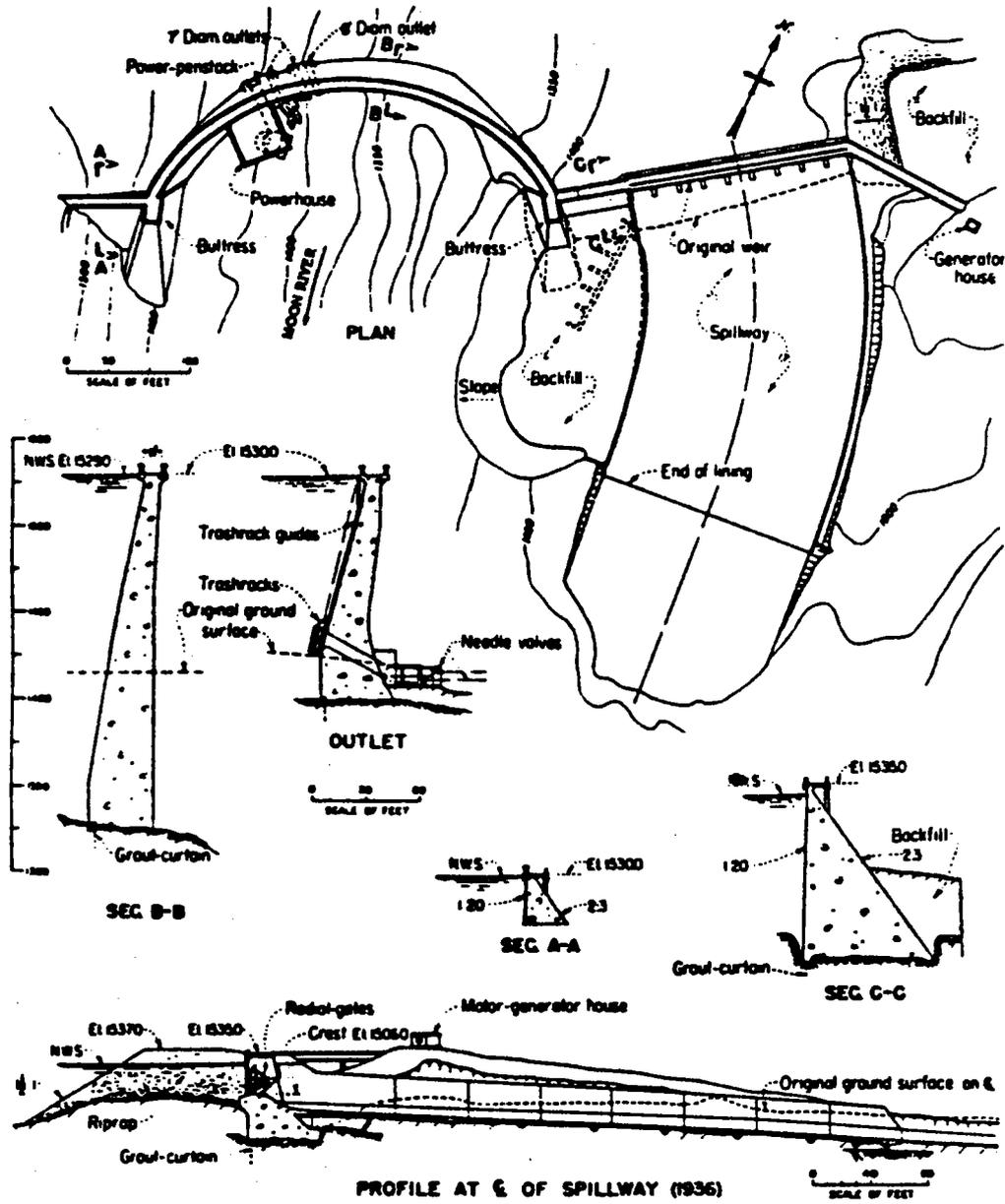
- A. 1-96" steel pipe with a semipermanent concrete bulkhead on upstream end and a steel bulkhead on downstream end.
- B. 1-84" steel pipe with a bifurcation and 2-54" needle valves have semipermanent concrete bulkhead on upstream end.

Operational Status at Time of Inspection

Reservoir Water Surface Elevation _____
Reservoir Storage _____
Releases _____
Spillway _____
Generator _____
84" Butterfly _____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM



Plan and Sections

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

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II. Standing Operating Procedures (SOP) and Emergency Preparedness	C-4
III. Structural Checklist	C-5
Dam	C-5
Related Features	C-8
Spillway	C-8
Powerhouse	C-10
IV. Mechanical Checklist	C-11
V. Electrical Checklist	C-13
VI. Communications Checklist	C-13

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

I. INSPECTION TEAM

Name **Title** **Affiliation**

II. STANDING OPERATING PROCEDURES (SOP) AND EMERGENCY PREPAREDNESS

SOP

1. Issue or revision date ____ / ____ / ____
2. Is copy at dam current? _____
3. Are instructions adequate? _____
4. Are instructions understood? _____
5. Any changes required? _____
6. Comments _____

Emergency Preparedness

1. Communications (see Communications List)
 - a. Normal _____
 - b. Standby _____
 - c. Emergency _____
2. Warning Systems

3. Emergency Power (east or left side)
 - a. Test during inspection _____
 - b. Condition _____
 - c. Adequacy _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Emergency Preparedness (Continued)

- 4. Auxiliary Power (Communications Equipment)
 - a. Test during inspection _____
 - b. Condition _____
 - c. Adequacy _____
- 5. Site Access
 - a. Adequacy under adverse conditions _____
- 6. Site Security

III. STRUCTURAL CHECKLIST

Dam

- 1. Upstream Face
 - a. General Condition _____
 - b. Cracking _____
 - c. Spalling _____
 - d. Offsets _____
 - e. Vegetation _____
- 2. Crest
 - a. General Condition _____
 - b. Cracking _____
 - c. Spalling _____
 - d. Offsets _____
 - e. Vegetation _____
 - f. Road Surface _____
 - g. Parapet Walls _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Dam (Continued)

- 2. Crest (Continued)
 - h. Guardrails _____
 - i. Drains _____
 - j. Safety Features _____
- 3. Log Boom
 - a. General condition _____
 - b. Logs _____
 - c. Wire Cable _____
 - d. Anchors _____
 - e. Warning Signals _____
- 4. Instrumentation
 - a. Structural _____
 - b. Seepage _____
 - (1) Left Thrust Block _____
 - (2) Right Abutment (Upper) _____
 - (3) Right Abutment (Lower) _____
- 5. Downstream Face
 - a. General Condition _____
 - b. Cracking _____
 - c. Spalling _____
 - d. Offsets _____
 - e. Vegetation _____
 - f. Seepage _____
- 6. Foundation
 - a. General Condition _____
 - b. Movement _____
 - c. Vegetation _____
 - d. Seepage _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Dam (Continued)

7. Left and Right Abutment

- a. General Condition _____
- b. Movement _____
- c. Vegetation _____
- d. Seepage _____

8. Right Gravity Section

- a. General Condition _____
- b. Cracking _____
- c. Spalling _____
- d. Offsets _____
- e. Vegetation _____
- f. Seepage _____

9. Left Gravity Section

- a. General Condition _____
- b. Cracking _____
- c. Spalling _____
- d. Offsets _____
- e. Vegetation _____
- f. Seepage _____

10. Left Wing Dam

- a. General Condition _____
- b. Cracking _____
- c. Spalling _____
- d. Offsets _____
- e. Vegetation _____
- f. Seepage _____

Related Features

1. Reservoir

- a. Reservoir Level Gage _____
- b. Landslides _____
- c. Warning Signs _____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Related Features

- 1. Reservoir
 - a. Reservoir Level Gage _____
 - b. Landslides _____
 - c. Warning Signs _____
- 2. Downstream Channel
 - a. Vegetation _____
 - b. Seepage _____
 - c. Erosion _____
 - d. Access Roads _____
 - e. Channel Deposits _____
 - f. Slope Stability _____

Spillway

- 1. Upstream Approach Channel
 - a. General Condition _____
 - b. Pier Nosings _____
 - c. Channel Depressions _____
 - d. Debris _____
- 2. Chute
 - a. Debris _____
 - b. Vegetation _____
 - c. Piers
 - (1) Surface Condition _____
 - (2) Movement _____
 - (3) Joints _____
 - (4) Cracks _____
 - (5) Seepage _____
 - d. Training Walls
 - (1) Surface Condition _____
 - (2) Movement _____
 - (3) Cracks _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Spillway (Continued)

2. Chute (Continued)

d. Training Walls (Continued)

(4) Joints _____

(5) Seepage _____

(6) Anchors _____

e. Floor

(1) General Concrete Condition _____

(2) Surface Condition _____

(3) Cracks _____

(4) Joints _____

(5) Seepage (Drains) _____

(6) Spalling _____

(7) Splitter Pier _____

f. Gabion Wall

(1) General Condition _____

(2) Fencing _____

(3) Rock _____

(4) Anchors _____

g. Outfall Channel

(1) General Concrete Condition _____

(2) Surface Condition _____

(3) Cracks _____

(4) Joints _____

(5) Seepage (Drains) _____

(6) Spalling _____

(7) Erosion _____

3. Emergency Generator Room

a. Windows _____

b. Roof _____

c. Walls _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Spillway (Continued)

3. Emergency Generator Room (Continued)

- d. Floor _____
- e. Doors _____
- f. Vents _____
- g. Drains (Roof and Floor) _____
- h. Lighting _____
- i. Operating Instructions for Generator and Gates _____
- j. Access _____
- k. Security _____

Powerhouse

1. Main Level

- a. Walls _____
- b. Floor _____
- c. Doors _____
- d. Drains _____
- e. Lighting _____
- f. Windows _____
- g. Access _____

2. Upper Levels

- a. Walls _____
- b. Floor _____
- c. Doors _____
- d. Stairways _____
- e. Roof _____
- f. Drains _____
- g. Lighting _____
- h. Windows _____

3. Lower Levels

- a. Stairways _____
- b. Walkways _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Powerhouse (Continued)

3. Lower Levels (Continued)

- c. Catwalks _____
- d. Drains _____
- e. Concrete Columns _____

IV. MECHANICAL CHECKLIST

1. 13.5' Penstock (To turbine)

- a. General Condition _____
- b. Coating _____
- c. Metal Condition _____

2. Turbine Stop Valve

- a. General Condition _____
- b. Internal Coating _____
- c. Operator _____
- d. Seals _____
- e. Lubrication _____

3. Upstream Metalwork

- a. General Condition _____
- b. Guiderails _____
- c. Bulkhead _____
- d. Trashrack _____

4. 7' Penstock (w/two Needle Valves)

- a. General Condition _____
- b. Coating _____
- c. Metal Condition _____
- d. Plug Condition _____

5. Needle Valves (54")

- a. General Condition _____
- b. Internal Condition _____
- c. Operator _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

IV. MECHANICAL CHECKLIST (Continued)

- 5. Needle Valves (54") (Continued)
 - d. Seals _____
 - e. Lubrication _____
- 6. Upstream Metalwork
 - a. General Condition _____
 - b. Guiderails _____
 - c. Bulkhead _____
 - d. Trashrack _____
- 7. 7' Penstock (w/Butterfly Valve)
 - a. General Condition _____
 - b. Coating _____
 - c. Metal Condition _____
 - d. Bulkhead Condition _____
- 8. Butterfly Valve
 - a. General Condition _____
 - b. Internal Condition _____
 - c. Operator _____
 - d. Seals _____
 - e. Lubrication _____
- 9. Upstream Metalwork
 - a. General Condition _____
 - b. Guiderails _____
 - c. Bulkhead _____
 - d. Trashrack _____
- 10. 8' Penstock
 - a. General Condition _____
 - b. Coating _____
 - c. Metal Condition _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

V. ELECTRICAL CHECKLIST

Crest Of Dam: Spillway/Generator Room

1. Conduit System _____
2. Grounding System _____
3. Lighting System _____
4. Controls _____
5. Wiring _____
6. Generator and Batteries _____
7. Panels _____
8. Other (Clean, Paint, Etc.) _____

Base Of Dam: Powerhouse

1. Conduit System _____
2. Grounding System _____
3. Lighting System _____
4. Controls _____
5. Wiring _____
6. Generator and Batteries _____
7. Panels _____
8. Other (Clean, Paint, Etc.) _____

VI. COMMUNICATIONS CHECKLIST

COMMUNICATIONS SYSTEMS (Drawing A-75-26)

Microwave Building

1. General Condition _____
2. Alarms _____
3. Telephone _____
4. Other _____

Control Room

1. General Condition _____
2. Radio Console _____
3. Handie-Talkie _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Control Room (Continued)

- 4. PABX Console _____
- 5. Telephones _____
- 6. Connection Blocks _____
- 7. Conduit and Cabling _____
- 8. Other _____

Powerhouse

- 1. General Condition _____
- 2. Telephones _____
- 3. Bells _____
- 4. Connection Blocks _____
- 5. Conduit and Cabling _____
- 6. Other _____

Relay Room

- 1. General Condition _____
- 2. HT Radio _____
- 3. VHF Radio _____
- 4. Telephone _____
- 5. Bell _____
- 6. Connection Blocks _____
- 7. Conduit and Cabling _____
- 8. Other _____

Crest Of Dam

- 1. General Condition _____
- 2. Telephones _____
- 3. Connection Blocks _____
- 4. Conduit and Cabling _____
- 5. Other _____

Continued . . .

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

Generator House

1. General Condition _____
2. Telephones _____
3. Connection Blocks _____
4. Conduit and Cabling _____
5. Other _____

Stilling Well

1. General Condition _____
2. Telephone _____
3. Horn _____
4. Connection Blocks _____
5. Conduit and Cabling _____
6. Other _____

Spillway

1. General Condition _____
2. Radio Remote _____
3. Telephone _____
4. Bell _____
5. Connection Blocks _____
6. Conduit and Cabling _____
7. Other _____

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

SITE-SPECIFIC CHECKLIST FOR THUNDER MOUNTAIN DAM

IV. MECHANICAL CHECKLIST (Continued)

- 11. Downstream Bulkhead
 - a. General Condition _____
 - b. Coating _____
 - c. Metal Condition _____
 - d. Nuts and Bolts _____
 - 12. Upstream Metalwork
 - a. General Condition _____
 - b. Guiderails _____
 - c. Bulkhead _____
 - d. Trashrack _____
 - 13. Spillway Gates
 - a. General Condition _____
 - b. Coating _____
 - c. Seals _____
 - d. Structural Members _____
 - e. Operating Mechanisms _____
 - f. Lifting Cables and Fittings _____
 - 14. Motor Generators
 - a. General Condition _____
 - b. Fuel Supply _____
 - c. Lubrication _____
 - d. Batteries _____
-

APPENDIX D
REFERENCES

PREPARING TO CONDUCT A DAM SAFETY INSPECTION

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