

US EPA ARCHIVE DOCUMENT

COMMENTS

Comments received for CHA Draft Report (*December 22, 2009*, CHA Project No. 20085.1010.1510) for the Assessment of Dam Safety of Coal Combustion Surface Impoundments American Electric Power – Muskingum River Power Station, Waterford, OH. Comments include;

- EPA comments - None;
- OH DNR comments received on January 5, 2010 and January 28, 2010; and
- American Electric Power comments received on January 21, 2010.

FW Comments on Draft Reports AEP's Big Sandy Conesville Muskingum
From: Harris IV, Warren
Sent: Wednesday, February 03, 2010 2:21 PM
To: Everleth, Jennifer; Adnams, Katy
Subject: FW: Comments on Draft Reports: AEP's Big Sandy, Conesville, Muskingum

Attachments: Comments on Big Sandy.doc; State Comments on Ash Pond inspections Located within Kentucky.doc; Comments on Conesville.doc; Ohio State Comments on Draft Reports.pdf; Comments on Muskingum.doc; AEP Comments on Draft Report - Muskingum River Plant.pdf

-----Original Message-----

From: Kohler, James@epamail.epa.gov [mailto:Kohler, James@epamail.epa.gov]
Sent: Wednesday, February 03, 2010 11:00 AM
To: dennis.a.miller@mco.com; Hargraves, Malcolm; Harris IV, Warren
Cc: Hoffman, Stephen@epamail.epa.gov
Subject: Comments on Draft Reports: AEP's Big Sandy, Conesville, Muskingum

Dennis/CHA:

EPA/state/company comments are attached, please address as appropriate. As before: we will be including these comments as a separate document and posting to the web along with the draft and final reports.

Please note: changes do not need to be made to your recommendations or any other parts of the report based on these comments unless you feel the additional information provided in the comments warrants a change.

If there is any question about how to address a comment, please inform Steve and myself and we can discuss.

Thank you!

Jim

(See attached file: Comments on Big Sandy.doc)(See attached file: State Comments on Ash Pond inspections Located within Kentucky.doc)(See attached file: Comments on Conesville.doc)(See attached file: Ohio State Comments on Draft Reports.pdf)(See attached file: Comments on Muskingum.doc)(See attached file: AEP Comments on Draft Report - Muskingum River Plant.pdf)

Jim Kohler, P. E.
Environmental Engineer
LT, U. S. Public Health Service
U. S. Environmental Protection Agency
Office of Resource Conservation and Recovery
Phone: 703-347-8953
Fax: 703-308-0514

Final Report
Assessment of Dam Safety of Coal Combustion Surface Impoundments
American Electric Power – Muskingum River Power Plant
Waterford, OH

Comments Received from the EPA
In Response to CHA Draft Report dated December 22, 2009
None Received

CHA Project No. 20085.1010.1510

Comments

EPA HQ – None.

EPA Region – None.

State -

From: "Brian Queen" <brian.queen@epa.state.oh.us>
To: James Kohler/DC/USEPA/US@EPA
Cc: "Craig Butler" <Craig.Butler@epa.state.oh.us>, "Dan Harris" <dan.harris@epa.state.oh.us>, "Dave Chenault" <dave.chenault@epa.state.oh.us>, "Dave Schuetz" <dave.schuetz@epa.state.oh.us>, "George Elmaraghy" <George.Elmaraghy@epa.state.oh.us>, "Jeff Hines" <Jeff.Hines@epa.state.oh.us>, "Jim Sferra" <jim.sferra@epa.state.oh.us>, "Jim Simpson" <Jim.Simpson@epa.state.oh.us>, "Jon Bernstein" <Jon.Bernstein@epa.state.oh.us>, "Pam Allen" <pam.allen@epa.state.oh.us>, "Paul Novak" <Paul.Novak@epa.state.oh.us>, "Rich Fox" <rich.fox@epa.state.oh.us>
Date: 01/05/2010 10:41 AM
Subject: Draft Coal Ash Impoundment Assessment Reports

Dear Mr. Kohler

Thank you for providing Ohio EPA the opportunity to review the Draft Coal Ash Impoundment Assessment Reports. We appreciate you keeping us involved in this process. If US EPA decides to issue press releases for these facilities we would appreciate seeing them before they're released as you did for AEP Philip Sporn.

The reports' descriptions of the facilities field evaluations and the assessments of the loading conditions appear to be accurate for all six facilities and we have no comments at this time.

Thanks

Brian Queen
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brian.queen@epa.state.oh.us

Also: See letter dated January 28, 2010 (comments from Ohio State Dam Safety Engineering Program).

Company – See comment document dated January 21, 2010.

Final Report
Assessment of Dam Safety of Coal Combustion Surface Impoundments
American Electric Power – Muskingum River Power Plant
Waterford, OH

Comments Received from OH DNR
In Response to CHA Draft Report dated December 22, 2009
Email dated January 5, 2010 and
Letter dated January 28, 2010

CHA Project No. 20085.1010.1510



Comments

EPA HQ – None.

EPA Region – None.

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Also: See letter dated January 28, 2010 (comments from Ohio State Dam Safety Engineering Program).

Company – See comment document dated January 21, 2010.



Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR

SEAN D. LOGAN, DIRECTOR

David Hanselmann • Chief

Division of Soil & Water Resources

January 28, 2010

Jim Kohler, P.E.
Environmental Engineer
LT, U.S. Public Health Service
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
(Letter provided by email)

RE: Assessment of Dam Safety Coal Combustion Surface Impoundments Draft Reports for Conesville Generation Station, Muskingum River Power Plant, JM Stuart Station, W.C. Beckjord Station, Miami Fort Generating Station, and Kyger Creek Power Station

Dear Mr. Kohler:

Thank you for the opportunity to join Clough, Harbour, & Associates (CHA) on their inspections of the dams at the power stations referenced above and to provide comments on the draft report. The reports were very thorough in the areas of dam safety that were reviewed. Although some typographical errors were noted, they have not been listed in this letter and it is expected that they will be recognized and corrected during CHA's final revisions to the reports. The comments provided below are in reference to more general concepts for the evaluations.

Hydrologic and Hydraulic Design – General

Section 3.2 of each report provides an evaluation of hydrologic and hydraulic design of each impoundment. The reports refer to Ohio Administrative Code (OAC) Rules for design flood and freeboard. The Dam Safety Engineering Program interprets these rules as follows. For a Class II upground reservoir with at least half of its impoundment as open water, the structure can inherently store the 50% probable maximum flood, and the appropriate evaluation considers overfilling prevention (OAC Rule 1501:21-13-03) and available freeboard (OAC Rule 1501:21-13-07). Also, the required freeboard is not added to pool elevation during the design flood – it is based on the maximum operating level.

1501:21-13-03 (D) Every upground reservoir shall have an overflow or other device to preclude overfilling the reservoir during normal filling operations. Local watershed drainage into the reservoir must also be included in the design of the overflow device if applicable.

1501:21-13-07 Sufficient freeboard shall be provided to prevent overtopping of the top of the dam due to passage of the design flood and other factors including, but not limited to, ice and wave action. The chief may approve a lower freeboard requirement if the dam is armored against overtopping erosion.

(A) For class I and class II dams that are upground reservoirs, the minimum elevation of the top of the dam shall be at least five feet higher than the elevation of the designed maximum operating pool level unless otherwise approved by the chief.

Structural Stability and Adequacy - General

Section 3.3 of each report provides an evaluation of structural stability and adequacy. The reports refer to Table 3-1 of the US Army Corps of Engineer's Engineering Manual 1110-2-1902. A copy of a portion of this section from the Miami Fort Generating Station report has been included for reference as well as a copy of Table 3-1 from the manual.

In performing a review of the structural adequacy and stability of Ash Pond A and Ash Pond B, CHA has compared the computed factor of safety provided in the original design documents for the ash ponds with minimum required factors of safety as outlined by the U.S. Army Corps of Engineers in EM 1110-2-1902, Table 3-1. The guidance values for minimum factor of safety are provided in Table 3.

Table 4 - Minimum Safety Factors Required

Load Case	Required Minimum Factor of Safety
Steady State Conditions at Present Pool or Maximum Storage Pool Elevation	1.5
Rapid Draw-Down Conditions from Present Pool Elevation	1.3
Maximum Surge Pool (Flood) Condition	1.4
Seismic Conditions from Present Pool Elevation	1.0
Liquefaction	1.3

From the Miami Fort Generating Station report

EM 1110-2-1902
 31 Oct 03

**Table 3-1
 Minimum Required Factors of Safety: New Earth and Rock-Fill Dams**

Analysis Condition ¹	Required Minimum Factor of Safety	Slope
End-of-Construction (including staged construction) ²	1.3	Upstream and Downstream
Long-term (Steady seepage, maximum storage pool, spillway crest or top of gates)	1.5	Downstream
Maximum surcharge pool ³	1.4	Downstream
Rapid drawdown	1.1-1.3 ^{4,5}	Upstream

¹ For earthquake loading, see ER 1110-2-1806 for guidance. An Engineer Circular, "Dynamic Analysis of Embankment Dams," is still in preparation.
² For embankments over 50 feet high on soft foundations and for embankments that will be subjected to pool loading during construction, a higher minimum end-of-construction factor of safety may be appropriate.
³ Pool thrust from maximum surcharge level. Pore pressures are usually taken as those developed under steady-state seepage at maximum storage pool. However, for pervious foundations with no positive cutoff steady-state seepage may develop under maximum surcharge pool.
⁴ Factor of safety (FS) to be used with improved method of analysis described in Appendix G.
⁵ FS = 1.1 applies to drawdown from maximum surcharge pool; FS = 1.3 applies to drawdown from maximum storage pool.
 For dams used in pump storage schemes or similar applications where rapid drawdown is a routine operating condition, higher factors of safety, e.g., 1.4-1.5, are appropriate. If consequences of an upstream failure are great, such as blockage of the outlet works resulting in a potential catastrophic failure, higher factors of safety should be considered.

From the Engineering Manual

The analysis condition for end-of-construction has been eliminated from the tables in CHA reports, which is appropriate considering the age of these structures. However, CHA has included analysis conditions for seismic and liquefaction, which are not specifically addressed in Table 3-1. Table 3-1 does refer to ER 1110-2-1806; this document provides guidance but does not note specific factors of safety. The appropriate references for these factors of safety should

be noted. In addition, it is important to note that the table is intended for new construction, and the manual provides allowances for reducing the factors of safety for dams that have been in operation for long periods of time.

c. Factors of safety. Acceptable values of factors of safety for existing dams may be less than those for design of new dams, considering the benefits of being able to observe the actual performance of the embankment over a period of time. In selecting appropriate factors of safety for existing dam slopes, the considerations discussed in Section 3-1 should be taken into account. The factor of safety required will have an effect on determining whether or not remediation of the dam slope is necessary. Reliability analysis techniques can be used to provide additional insight into appropriate factors of safety and the necessity for remediation.

In particular, the slope stability analysis for the Muskingum River Units 1-4 Bottom Ash Pond included four scenarios that have factors of safety below 1.5 but above 1.42. Considering the age of the structure, the current and historic operation of the impoundment as a pumped-storage facility with a static pool, and the location of the failure planes with respect to releasing the impoundment, further discussion for considering these factors of safety acceptable should be provided.

Muskingum River Power Plant Report

Section 4.2 should include monitoring the seeps at the downstream toe of Muskingum River Lower Fly Ash Dam.

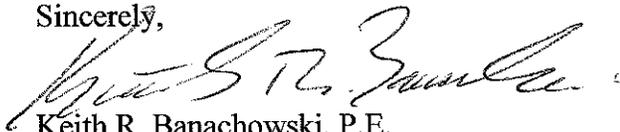
W.C. Beckjord Station

According to the as-built plans for Beckjord Ash Pond C Extension Dam and field investigation, the 30-inch-diameter concrete pipe that connects to Ash Pond C has not been plugged. However, the overflow pipe in the southwest corner that consists of a 54-inch-diameter CMP riser and 36-inch-diameter Corban reinforced fiberglass pressure pipe has been plugged with concrete.

Table 2 should be corrected to include a normal pool elevation of 518.0 for Beckjord Ash Pond C Extension Dam.

The Division of Soil & Water Resources looks forward to continuing cooperation with US Environmental Protection Agency in investigating and improving the conditions of coal ash impoundments. Please contact me at 614/265-6738 if you have any questions.

Sincerely,



Keith R. Banachowski, P.E.
Program Manager
Dam Safety Engineering Program
Division of Soil & Water Resources

Final Report
Assessment of Dam Safety of Coal Combustion Surface Impoundments
American Electric Power – Muskingum River Power Plant
Waterford, OH

**Comments Received from American Electric Power
In Response to CHA Draft Report dated December 22, 2009**
Comments Received January 21, 2010

CHA Project No. 20085.1010.1510

Comments

EPA HQ – None.

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Also: See letter dated January 28, 2010 (comments from Ohio State Dam Safety Engineering Program).

Company – See comment document dated January 21, 2010.



Comments on Draft Dam Assessment Report – Muskingum River

- January 21, 2010 -

AEP has reviewed the recommendations provided by CHA as part of their assessment of the ash impoundment facilities at the Muskingum River Plant and would like to offer the following comments. AEP's comments are denoted in *italic* print following each section listed.

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

4.1.1 Acknowledgement of the Upper Fly Ash Reservoir Dams Conditions

I acknowledge that the Upper Fly Ash Reservoir Mill Stone Creek, No-Name Creek, Wing, Spillway and Freeboard Dams, referenced herein, were personally inspected by me and were found to be in the following condition: **Satisfactory**. This indicates that there is no existing or potential safety deficiencies recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) and that minor maintenance items may be required.

No comments.

4.1.2 Acknowledgement of the Middle and Lower Fly Ash Reservoir Dams Conditions

I acknowledge that the Middle Fly Ash Reservoir Dam, the Middle Fly Ash Reservoir Spillway Dam and the Lower Fly Ash Dam, referenced herein, were personally inspected by me and were found to be in the following condition: **Fair**. This indicates acceptable performance is expected under required loading conditions in accordance with applicable safety regulatory criteria; however some additional analyses should be performed and documented to verify that these criteria are met.

No comments.

4.1.2 Acknowledgement of the Units 1-4 Bottom Ash Pond Dike Conditions

I acknowledge that the Units 1-4 Bottom Ash Pond dikes, referenced herein, were personally inspected by me and were found to be in the following condition: **Poor**. A management unit found to be in poor condition is defined as one in which a safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. Poor also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

AEP believes that the items outlined for maintenance work and the analytical assessment of the facility presented in this draft report, and items reported by independent consultants, do not demonstrate that there are safety deficiencies with the structure or that remedial action is necessary.

AEP agrees that improvements to the natural riverbank along the east embankment would improve the overall condition of the facility. Improvements have already been completed in a critical section and additional improvements will be implemented in other sections of the riverbank as required.

The improvements would increase the factors of safety for the existing dike from the current calculated range (1.42-1.47) to above the recommended value of 1.5 for new dams as defined in Section 3.2, Table 3-1 of the USACOE Engineering Manual 110-2-1902 (CHA's Table 6). Section 3.3 of the manual also provides guidance related to the stability evaluation of existing dams and embankments. This Section states that computed factors of safety less than the preferred values for new dams may be acceptable based on past performance and current condition of the dam. A copy is included in our response to section 4.8, below.

The calculated factors of safety for the Unit 1-4 Bottom Ash Pond East Dike should be acceptable considering that the facility was built in the 1950's; the operating pool level has remained relatively constant for the past several years; and the only change to the loading condition is from the transient changes in water level during rainfall events. Over the past 20 years, there have not been any conditions at the facility that have resulted in any type of slope failure or other damage that would impact the structural integrity of the dikes. The dike has and is continuing to function as designed in its current condition.

The recent analysis and inspections by AEP's consultant indicate acceptable performance of the facility for credible existing and expected loading conditions. AEP Engineers, independent consultants and the Ohio DNR Dam Safety Section consider the facility to be, at least, in FAIR condition. Such conditions have been documented since

repairs to the East dike were constructed in 1988. In consideration of the above comments, AEP respectfully requests that the US EPA consultant re-evaluate the overall condition rating.

In the sections below, CHA presents recommendations for maintenance and further studies to bring these facilities into satisfactory condition. CHA also recommends that the recommendations presented in BBCM's March 12, 2009 inspection report and ODNR's November 3, 2008 Dam Safety Inspection Reports be addressed.

Routine maintenance items are continuously addressed in accordance with AEP's Dam and Dike Inspection and Maintenance Program (DIMP).

4.2 Monitoring of Seeps

No comments.

4.3 Repair of Erosion

No comments

4.4 Repair of Rodent Burrows

No comments

4.5 Additional Stability Analyses – Upper Fly Ash Reservoir

CHA recommends that rapid drawdown analyses be performed for the current conditions and for the final raised embankment condition at the Upper Fly Ash Reservoir. While CHA understand that rapid drawdown via pumping or other discharge methods may be undesirable for a waste disposal impoundment, CHA suggests that in the event of an emergency at the facility, rapid drawdown may be more desirable to reduce hydrostatic pressures on the dam, thereby preventing a more catastrophic collapse. There have also been documented case histories where other types of failure (such as a gate failure) have resulted in rapid drawdown conditions developing which have led to a domino effect and made the situation worse. For these reasons, CHA recommends that a rapid drawdown analysis be performed.

AEP operates the Upper Fly Ash Reservoir such that a small pool of water is created around the discharge structure. The discharge structure is a vertical riser that is offset from the slope of the embankment. The operations of the facility create a fly ash buttress

against the upstream slope of the embankments at or near the water level surface. During any type of rapid drawdown condition, the embankment will be buttressed by this fly ash. AEP believes that this will prevent any type of slope failure of the embankment due to a rapid drawdown scenario.

4.6 Additional Stability Analyses – Middle Fly Ash Reservoir

No comments

4.7 Additional Stability Analyses – Lower Fly Ash Reservoir

No comments

4.8 Stability of the Units 1-4 Bottom Ash Pond East Dike

The stability analyses conducted by BBCM (outlined in Section 3.3.4) indicated that at four cross sections examined through the active pond east embankments the factors of safety relative to those recommended by the USACOE were found to be inadequate. The principal reason for this is unsatisfactory condition is the proximity of the east embankment to the eroding Muskingum Riverbank. BBCM suggested that a revetment would significantly increase the factor of safety against failure of the east embankment. Factors of safety were computed for a section of the northern slope which was repaired in such a manner. The factors of safety met the minimum recommended factors of safety provided by the USACOS (outlined in Table 6). CHA recommends that AEP make similar improvements to the east dike where inadequate factors of safety were indicated to stabilize the embankment.

Some of the computed factors of safety (1.42 – 1.47) presented in the BBCM report are slightly less (0.03-0.07) than the current recommended values for new dams (1.5) as defined in Section 3.2, Table 3-1 of the USACOE Engineering Manual 110-2-1902 (CHA's Table 6). Section 3.3 of the manual also provides guidance related to the stability evaluation of existing dams and embankments. This Section states that computed factors of safety less than the preferred values for new dams may be acceptable based on past performance and current condition of the dam. These two sections are included below for reference.

The calculated factors of safety for the Unit 1-4 Bottom Ash Pond East Dike should be acceptable considering that the facility was built in the 1950's; the operating pool level has remained relatively constant for the past several years; and the only change to the loading condition is from the transient changes in water level during rainfall events. Over the past 20 years, there have not been any conditions at the facility that have resulted in any type of slope failure or other damage that would impact the structural integrity of the dikes.

**Table 3-1
Minimum Required Factors of Safety: New Earth and Rock-Fill Dams**

Analysis Condition ¹	Required Minimum Factor of Safety	Slope
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² For embankments over 50 feet high on soft foundations and for embankments that will be subjected to pool loading during construction, a higher minimum end-of-construction factor of safety may be appropriate.

³ Pool thrust from maximum surcharge level. Pore pressures are usually taken as those developed under steady-state seepage at maximum storage pool. However, for pervious foundations with no positive cutoff steady-state seepage may develop under maximum surcharge pool.

⁴ Factor of safety (FS) to be used with improved method of analysis described in Appendix G.

⁵ FS = 1.1 applies to drawdown from maximum surcharge pool; FS = 1.3 applies to drawdown from maximum storage pool.

For dams used in pump storage schemes or similar applications where rapid drawdown is a routine operating condition, higher factors of safety, e.g., 1.4-1.5, are appropriate. If consequences of an upstream failure are great, such as blockage of the outlet works resulting in a potential catastrophic failure, higher factors of safety should be considered.

(1) During construction of embankments, materials should be examined to ensure that they are consistent with the materials on which the design was based. Records of compaction, moisture, and density for fill materials should be compared with the compaction conditions on which the undrained shear strengths used in stability analyses were based.

(2) Particular attention should be given to determining if field compaction moisture contents of cohesive materials are significantly higher or dry unit weights are significantly lower than values on which design strengths were based. If so, undrained (UU, Q) shear strengths may be lower than the values used for design, and end-of-construction stability should be reevaluated. Undisturbed samples of cohesive materials should be taken during construction and unconsolidated-undrained (UU, Q) tests should be performed to verify end-of-construction stability.

d. Pore water pressure. Seepage analyses (flow nets or numerical analyses) should be performed to estimate pore water pressures for use in long-term stability computations. During operation of the reservoir, especially during initial filling and as each new record pool is experienced, an appropriate monitoring and evaluation program must be carried out. This is imperative to identify unexpected seepage conditions, abnormally high piezometric levels, and unexpected deformations or rates of deformations. As the reservoir is brought up and as higher pools are experienced, trends of piezometric levels versus reservoir stage can be used to project piezometric levels for maximum storage and maximum surcharge pool levels. This allows comparison of anticipated actual performance to the piezometric levels assumed during original design studies and analysis. These projections provide a firm basis to assess the stability of the downstream slope of the dam for future maximum loading conditions. If this process indicates that pore water pressures will be higher than those used in design stability analyses, additional analyses should be performed to verify long-term stability.

e. Loads on slopes. Loads imposed on slopes, such as those resulting from structures, vehicles, stored materials, etc. should be accounted for in stability analyses.

3-2. New Embankment Dams

a. Earth and rock-fill dams. Minimum required factors of safety for design of new earth and rock-fill dams are given in Table 3-1. Criteria and procedures for conducting each analysis condition are found in Chapter 2 and the appendices. The factors of safety in Table 3-1 are based on USACE practice, which includes established methodology with regard to subsurface investigations, drilling and sampling, laboratory testing, field testing, and data interpretation.

b. Embankment cofferdams. Cofferdams are usually temporary structures, but may also be incorporated into a final earth dam cross section. For temporary structures, stability computations only must be performed when the consequences of failure are serious. For cofferdams that become part of the final cross section of a new embankment dam, stability computations should be performed in the same manner as for new embankment dams.

3-3. Existing Embankment Dams

a. Need for reevaluation of stability. While the purpose of this manual is to provide guidance for correct use of analysis procedures, the use of slope stability analysis must be held in proper perspective. There is danger in relying too heavily on slope stability analyses for existing dams. Appropriate emphasis must be placed on the often difficult task of establishing the true nature of the behavior of the dam through field investigations and research into the historical design, construction records, and observed performance of the embankment. In many instances monitoring and evaluation of instrumentation are the keys to meaningful assessment of stability. Nevertheless, stability analyses do provide a useful tool for assessing the stability of existing dams. Stability analyses are essential for evaluating remedial measures that involve changes in dam cross sections.

(1) New stability analysis may be necessary for existing dams, particularly for older structures that did not have full advantage of modern state-of-the-art design methods. Where stability is in question, stability should be reevaluated using analysis procedures such as Spencer's method, which satisfy all conditions of equilibrium.

(2) With the force equilibrium procedures used for design analyses of many older dams, the calculated factor of safety is affected by the assumed side force inclination. The calculated factor of safety from these procedures may be in error, too high or too low, depending upon the assumptions made.

b. Analysis conditions. It is not necessary to analyze end-of-construction stability for existing dams unless the cross section is modified. Long-term stability under steady-state seepage conditions (maximum storage pool and maximum surcharge pool), and rapid drawdown should be evaluated if the analyses performed for design appear questionable. The potential for slides in the embankment or abutment slope that could block the outlet works should also be evaluated. Guidance for earthquake loading is provided in ER 1110-2-1806, and an Engineer Circular, "Dynamic Analysis of Embankment Dams," is in draft form.

c. Factors of safety. Acceptable values of factors of safety for existing dams may be less than those for design of new dams, considering the benefits of being able to observe the actual performance of the embankment over a period of time. In selecting appropriate factors of safety for existing dam slopes, the considerations discussed in Section 3-1 should be taken into account. The factor of safety required will have an effect on determining whether or not remediation of the dam slope is necessary. Reliability analysis techniques can be used to provide additional insight into appropriate factors of safety and the necessity for remediation.

4.9 Trees and Stumps

No comments

4.10 Establishing Vegetation

No comments

4.11 Monitoring of Middle Fly Ash Reservoir Principal Spillway

No comments

4.12 Repair of Damaged Instrumentation

No comments

4.13 Routine Observations, Data Collection and Documentation

No comments