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From: Dan Buxton, P.E.
1942 Hiway H
Farmington, MO 63640

MSHA should consider regulating impoundments with a similar approach to the pressure vessel inspection protocol.

MSHA currently regulates pressure vessels by this method:
30 CFR § 56.13015
Inspection of compressed-air receivers and other unfired pressure vessels.
(a) Compressed-air receivers and other unfired pressure vessels shall be inspected by inspectors holding a valid National Board Commission and in accordance with the applicable chapters of the National Board Inspection Code, a Manual for Boiler and Pressure Vessel Inspectors, 1979. This code is incorporated by reference and made a part of this standard. It may be examined at any Metal and Nonmetal Mine Safety and Health District Office of the Mine Safety and Health Administration, and may be obtained from the publisher, the National Board of Boiler and Pressure Vessel Inspector, 1055 Crupper Avenue, Columbus, Ohio 43229.
(b) Records of inspections shall be kept in accordance with requirements of the National Board Inspection Code, and the records shall be made available to the Secretary or his authorized representative.

A resolution to this issue could be:
Inspection of retaining dams.
(a) Retaining dams and impoundments shall be inspected by inspectors holding a valid professional engineering license in the state in which the structure is located and in accordance with the applicable rules and regulations of the state or local dam safety authority.
(b) Records of inspections shall be kept in accordance with requirements of the state or local dam safety authority, and the records shall be made available to the Secretary or his authorized representative.

Comments and answers to detailed questions:

1. Currently mine operators acquire services of competent engineering firms who assign experienced professional engineers to design safe and effective dams. Construction is monitored by the designer and the owners' engineer. Operation and maintenance is done under the supervision of a licensed professional engineer. This company continues to inspect dams that are no longer used at an operating location. The state of Missouri does not allow for abandoning of dams unless they are breached to eliminate ability to impound water. In most cases this is impractical in the case of tailings dams.

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2. MSHA should use the classification system used by the state of Missouri which classifies dams as Class I (which contains 10 or more permanent dwellings or any public building), Class II (which contains 1 to 9 permanent dwellings), or Class III (which is everything else). Safety requirements should be tiered to the class of dam and also to its size. Missouri uses a 35 ft height to separate dams that should be regulated and those that need not. Most if not all tailings dams in this area will fall into the regulated category because of their height greater than 35 ft.

3. The Missouri Dam Safety Program regulates the safety of dams at the mines in Missouri. The state of Missouri maintains a chief engineer and a staff of professional engineers to inspect and approve operation and modification to all regulated dams. They address crest elevation, dam configuration, maximum water surface, geologic exploration, geotechnical investigation, settlement and seepage analysis, seismic analysis, hydrologic and hydraulic analysis, flood routing, spillway capacity, operation and maintenance, etc. Full information can be found at http://www.dnr.mo.gov/env/wrc/damsft/damsfthp.htm.

4. Records should be kept of all designs, construction, major maintenance, inspections, permits, deficiencies and resolutions. Records should be available to all miners on request. If hazardous conditions are found, miners should be alerted to any and all potential dangers.

5. Mine operators can assure that dams are safely designed by using experienced competent professional engineering services. Missouri has a comprehensive list of "requirements", (spillway size based on PMF, seismic analysis requirements, etc.) located on web site above. However, a MSHA specific requirement should be flexible because of the many factors that go into a dam design based on things such as climate in the region, seismic activity in the region, materials available for construction in the region, etc. The most important requirement it to have the dams designed and monitored by experienced competent professional engineers familiar with the region that the dam is located in. MSHA should require the owner to meet all criteria specified in the state dam safety law as enforced by the state dam regulatory body. Criteria for design is in the rules and regulations. Requirements must be met before permission to construct is granted by a construction permit. The design is reviewed and approved by a competent professional engineer employed by the state regulatory agency. The dam is designed by a professional and reviewed and approved by a professional. If impoundments do not fall under state jurisdiction, an inspection by an experienced professional engineer should be acceptable to MSHA.

6. Review of dam designs by mine operators is part of the construction process. Review by MSHA should not be necessary if the design is done by experienced competent professional engineers and approval is granted by the state regulatory authority using experienced competent professional engineers. MSHA should be

satisfied with documents showing the dam was designed by professional engineers, then reviewed and approved by another professional engineer.

7. Safety of existing dams can be ascertained by inspection and analysis by experienced professional engineers, either independent contractor or state regulatory personnel. If the state has a program to regulate dams by a permitting process, this should be sufficient to satisfy MSHA requirements. A state permit signed and sealed by the states' professional engineer should provide sufficient documentation to MSHA. (This is similar in nature to a non destructive hoist rope test, where a certificate is produced to satisfy the requirement that the test be done and the hoist rope certified as being acceptable for use). The state has a permitting process to address "upgrades" in a reasonable time frame.

8. The state permitting process ensures that operators construct dams as designed by requiring competent professional engineers to submit documentation of that fact. Approval by state professional engineers and issuance of a state permit satisfies the MSHA requirement. The state will not issue an operating permit unless they have determined that the dam has been constructed as designed.

9. MSHA can verify that dams have been constructed as designed by viewing a copy of the permit issued by the state.

10. To operate and maintain a safe dam, the operator should perform regular routine inspections and have competent experienced professional engineers inspect at regular intervals. Any deficiencies found should be addressed as soon as reasonably possible. MSHA can verify that dams are safely operated and maintained by requesting a copy of the operating permit from the state. They can also request reports from the professional engineer who regularly inspects the dam. If there are deficiencies in operation or maintenance, they will be noted and the state permit will be withheld. Permits are reviewed regularly and have expiration dates. MSHA inspectors can request to see the current operating permit and verify that the permit is valid and has not expired.

11. Mine operators should require that trained personnel regularly inspect the condition of the dam. An experienced professional engineer should regularly inspect the dam and produce a report on its condition.

12. Routine inspections are conducted weekly, which is sufficient in most cases. Trained operators conduct these inspections. (MSHA requires mine shaft inspection weekly, this is similar)

13. Dam instrumentation should be monitored on a quarterly basis, or more often if unstable conditions warrant. (MSHA non destructive testing of hoist ropes is required semi annually, and has been found adequate).

14. During routine inspection, look for signs of sloughing, sliding, or subsidence on embankments and adjacent areas, look for erosion on embankments, spillways, and adjacent areas, look for obstructions in spillways, observe seepage and monitor for cloudy or muddy water.

15. A competent experienced professional engineer inspects all tailings dams on a quarterly basis. Visual inspections of dam, embankments, adjacent areas, spillways, water levels, seepage, etc. Data records include piezometer levels, lake level, rainfall levels, seepage quantities, tailings deposition volumes, etc. General condition of the impoundment and action items needed.

16. Detailed inspection should be quarterly and in concert with the permitting inspection which varies from 2-5 yr intervals in the state of Missouri based on downstream environment zoning. It is also done whenever a deficiency is observed in the structure. The state permit requires immediate notification of the state Chief Engineer of any "conditions relating to the structural stability of and seepage through the dam discovered during the term of the permit". Upon this notification, state professional dam engineers will make an on site inspection to determine actions to address the situation.

17. Documentation of the detailed inspection should include: condition of vegetation, seepage, spillway condition, embankment condition, reservoir area, drain valves or gates, spillway outlet channels, embankment drain outlets, condition of riprap armoring, determination of downstream classification, evaluation of dam elevation and water level (verification of design freeboard), general condition of structures,

18. Documentation should be provided to the MSHA representative during his inspection. (Weekly inspections are similar to pre shift area inspection). Quarterly detailed inspections have a report that can be viewed. (Similar to hoist rope inspections)

19. Operators require competent trained professional engineers to design and inspect dams. Operators require operation personnel trained to safely operate and manage the dam. Any questionable issues with the dam are to be referred to the professional engineer.

20. Credentials for the dam designer are that he must be a licensed professional engineer in the state. He must have experience in the design and construction of dams. This is the highest qualification that should be required.

21. The construction verification should be by a competent professional engineer licensed in the state who is experienced in the design and construction of dams. The obtaining of a license requires an engineering degree, technical training, work experience, recommendation by other professionals, and a rigorous written examination. This license is subject to renewal and revocation if there is evidence

of unethical or unprofessional conduct. A state licensed professional engineer is the best measure of an acceptable qualification for this work.

22. Training for routine inspections should be done by a formal training source such as (an MSHA training video as used in the coal mining industry), an information booklet, or training by an MSHA certified trainer. Course content should include seepage, spillway, erosion, slippage, sloughing, sinkholes. Other good sources can be found at Missouri Dam Safety homepage: http://www.dnr.mo.gov/env/wrc/damsft/damsfthp.htm

23. Only competent experienced licensed professional engineers should perform detailed inspections to determine the safety of a dam. They are the highest qualified and best resource available to MSHA and industry to perform this task.

24. Before mine operators cap, breach, or otherwise modify dams, a design provided by a competent experienced licensed professional engineer must be submitted and approved by the state professional dam safety engineers. If abandoning the dam, the design should address all issues of future operation and maintenance and provide for a plan that shows no maintenance will be needed in the future to control water levels, erosion, vegetation growth, seepage, etc.

25. A written plan by a competent experienced licensed professional engineer and approved by the state professional dam safety engineers for any dam to be "abandoned".

26. Geological studies, geotechnical studies, design engineering, testing services, excavation methods, spillways, slopes, drainage, materials of construction, all contribute to the cost of designing a new dam. Costs are infinitely variable based on site specific needs. No two dams are ever the same. Designs for existing dams are changed when there is a deficiency or a need to change the configuration of the operating features. An increase or decrease in capacity requirements could also trigger a change in design. Costs can range from the thousands to hundreds of thousands or more.

27. Contractor costs include site supervision, labor, materials, testing, enviriomental controls, safety, and equipment to excavate and place materials in position based on design. Costs can range from thousands to millions.

28. Regular site inspections at important stages are made to assure compliance with design. An important stage could be daily, weekly, or monthly based on the individual project. Testing by outside vendors (e.g. compaction testing, surveying, etc) is done at important stages. Costs vary for all dams based on size, design parameters, difficulty of construction, etc.

29. Modification to existing dams may occur every 7 years , 10 years, 12 years, or longer. The owner supervises the selection of an independent consultant to do the

professional engineering design of raising heights or other modifications. The state of Missouri requires a design and construction permit for all of these modifications. The design must be sealed by a competent licensed professional engineer licensed in the state of Missouri. Costs vary based on the size and intricacy of the modification.

30. Routine inspections are done by operating personnel on their regular shifts. No attempt is made to track that cost. Monitoring of piezometers requires approximately 3 hours per dam, per quarter. Monitoring of seepage is done on a regular shift. Detailed inspections are performed by the owners professional engineer and can account for 8 hours to inspect and another 8 hours to produce a report. Additional detailed inspections for permitting are provided free of charge by the state dam safety engineers as part of their permitting process. These are done on 2,3 or 5 year intervals based on downstream environmental class. A detailed inspection by an outside consultant can cost $3-10 thousand dollars.

31. The state of Missouri does require a professional engineer to seal any design document sent to them. A status report can be sent by the owner.

32. Costs are minimal for training personnel for routine inspection. It is normally included with other operational training as "part of the job".

33. Costs to cap, breach, or abandon a dam are variable based on size, construction method, watershed, etc. This owner has not abandoned any dams. Costs could range from $10's of thousands to millions.

34. Costs of a dam failure include loss of production, environmental cost of cleanup, private and public property damage, cost of reconstruction, loss of life, etc. Costs could be from thousands to millions.

35. Information on insurance coverage is not available.

36. A properly designed and monitored dam will create no risk to the community, and sometimes the lake generated is perceived as a benefit to the sportsman.

    The dams at the Doe Run Company are designed, constructed, operated, and maintained to accepted dam safety standards. The state of Missouri does an excellent job of monitoring these dams to insure that all state rules and regulations are complied with. The existence of a state regulatory agency and its' approval to operate a dam should be sufficient to satisfy MSHA as to its safety. Copies of the state permits made available to MSHA should be a reasonable verification of the safety of the dam. In a state where permitting is not the method, or for those unregulated impoundments that MSHA may feel should be regulated, a document from an experienced licensed professional engineer that states that the dam "has no observable defects and its' design is consistent with good engineering practices" should be sufficient also.