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To: Mine Safety Health Administration

From: Gonzalo Castro, PE, PhD

Re. Comments on RIN 1219-AB70
Metal and Nonmetal Dams

The comments presented herein do not intend to cover all of the issues listed in the Federal Register's announcement of August 13, 2010, but only cover issues that I am familiar with through my professional experience. As discussed in more detail below, my primary recommendations are:

- Dam owners should be required to maintain detailed records of the design and construction of their dams, including records of the tailings or other materials that are placed behind the dams.
- Dam designers should consider both drained and undrained strengths of materials that make up the dam and the materials behind the dam.

I have been involved with the design and investigation of many water retaining dams and tailings dams for coal refuse and copper, iron and uranium mill tailings. My involvement has mostly been providing consultation to owners and engineering firms on the evaluation of the stability of both conventional and tailings dams.

The safety of water retaining dams (conventional dams) will not be addressed here since there are well-recognized programs and procedures to investigate the safety of, maintain, and monitor such structures. Federal agencies such as the US Army Corps of Engineers and the Bureau of Reclamation have a long history of work on dam safety and have published extensive literature on the procedures for designing, building, maintaining and monitoring water retaining dams. What I will comment on is on the main differences in the development of safety requirements between tailings and conventional dams.

Conventional dams are designed and built mostly in one phase and the dam is a structure separate from the water being stored. In contrast most tailings dams are built in phases, often over periods of time of many years. The reason is that the investment on dam construction is spread out to coincide with mine production. In most tailings dams the material being stored is considered part of the dam, particularly for upstream construction methods. These differences between tailings and conventional dams give rise to special challenges for evaluating and ensuring the safety of tailings dams.

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The extended design and construction period means that often the engineers responsible for design and construction may be different individuals or companies for each phase, as the engineers that designed a previous phase may not be available any more. The same is true for the engineers involved in monitoring and maintenance. There are then special challenges that arise when a new engineer designs and/or builds a new phase. The new phase often involves a vertical expansion of the facility in which the new phase will be built over the existing dam. Thus in-depth knowledge of the condition of the previous structure is crucial to a safe design of the new phase.

Absent a detailed record of the existing structure design and construction, it is difficult to assess the condition of the existing structure solely on the basis of new explorations. Since the tailings themselves are part of the structure, it is not only the condition of the perimeter dikes that needs to be known but also what were the properties of the tailings that were placed behind the dikes and how they were placed. I have found in my practice that finding out about the existing conditions before designing and building a raise can be a major effort with the result involving significant uncertainties. Therefore, it is very important that the owners keep detailed records of design, construction, inspections, monitoring data (e.g. piezometers) and of the properties of the tailings being produced and stored at different times and their method of deposition.

The tailings are often hydraulically placed behind the perimeter structure and end up in a loose condition. As they are considered part of the retaining system, their shear strength needs to be carefully evaluated. In geotechnical engineering one distinguishes between drained and undrained strength. In a loose soil, the undrained strength is lower than its drained strength. It is beyond the scope of these comments to discuss this issue in detail. It suffices to state that both types of strength need to be evaluated. The geotechnical engineer must carefully consider whether undrained behavior is possible, and if so pick the undrained strength as the most critical strength for analysis of the stability of the tailings dam.