From: Rushing, Kelly [mailto:Kelly_Rushing@fmi.com] **On Behalf Of** Caylor, John
Sent: Monday, December 13, 2010 4:24 PM
To: zzMSHA-Standards - Comments to Fed Reg Group
Cc: Caylor, John; Johndrow, Tamara
Subject: RIN 1219-AB70: Freeport-McMoRan Comments

Please see attached cover letter and Freeport-McMoRan's comments regarding RIN 1219-AB70

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December 10, 2010

Ms. Patricia W. Silvey
Director, Office of Standards, Regulations, and Variances
Department of Labor
Mine Safety and Health Administration
Room 631, 1100 Wilson Boulevard, Room 2350
Arlington, VA 22209-3939

Re: RIN: 1219-AB70
Title: Metal and Nonmetal Dams

Dear Ms. Silvey:

The Mine Safety and Health Administration (MSHA) is reviewing standards for dams at metal and nonmetal mining operations. In advance of promulgating new regulations, MSHA is asking interested parties to comment on specific questions to do with dam design, construction and operations.

As stated in the Advanced Notice of Proposed Rulemaking, mining operations regularly find it necessary to construct dams to dispose of large volumes of mine waste from ore processing operations, or to provide water supply, sediment control, or water treatment. The stated objective by MSHA for these additional Metal and Nonmetal standards is to outline means for ensuring safety is manifest in dam design, construction, operation and maintenance.

Freeport-McMoRan Copper &Gold Inc. (Freeport) respectfully submits the following comments for consideration by MSHA in the proposed regulatory effort and standards.

Freeport is committed to safe dam operations. The potential impacts of a failure including compromising the safety of personnel, loss of life, environmental consequences, loss of operations, and other liabilities are strong incentives to build and operate in a safe manner. The "top-down and bottom-up" program utilized by Freeport currently fulfills this commitment to safe dam operations by ensuring that each dam is constructed with an in-depth understanding of site specific conditions and the application of best engineering practices, which are the foundation for safe operations. Freeport currently constructs and operates "state-of-the-practice" dams which meet or exceed local/state and federal regulatory requirements. Most of the dams at the Freeport mining operations are tailings dams. Tailings dams share many common engineering attributes with water retention earth structures (embankment dams) but there are major distinguishing differences. Water retention dams are constructed over a short period of

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time prior to their operation. Tailings dams are typically constructed over the operating life of the storage facility with continuous or intermittent raises of the containment structure. Tailings dams, also known as Tailings Storage Facilities (TSFs), usually have design, capital construction, and ongoing operational construction phases that span decades.

Freeport's comments and observations hereby submitted for consideration primarily address TSF, along with the expectation that subsequent rulemaking will need to integrate with MSHA's existing regulatory framework under 30 CFR Parts 56 and 57. The comments are presented using the questionnaire based format of MSHA's Advanced Notice of Proposed Rulemaking.

Sincerely,

John R. Caylor
Vice President, Corporate Occupational Health & Safety

RESPONSE TO QUESTIONS

DEPARTMENT OF LABOR — MINE SAFETY AND HEALTH ADMINISTRATION
30 CFR PARTS 56 AND 57
RIN 1219-AB70

METAL AND NONMETAL DAMS

GENERAL QUESTIONS

QUESTION 1: MSHA is seeking information concerning current dam safety practices at metal and nonmetal mines.

QUESTION 1a. What measures do mine operators currently take to design, construct, operate, and maintain safe and effective dams?

RESPONSE: Water dams are designed and constructed in a short time period while they may operate for many years. Tailings dams, also known as Tailings Storage Facilities (TSFs), usually have design, capital starter dam construction, and ongoing or intermittent operational construction dam raises that span decades. This response focuses on TSFs due to their complexities and interpretation of MSHA's focus with 30 CFR Parts 56 and 57.

Freeport-McMoRan Copper & Gold Inc. (Freeport) is committed to safe dam operations. The potential impacts of a failure including compromising the safety of personnel, loss of life, environmental consequences, loss of operations, and other liabilities are strong incentives to build and operate in a safe manner. A "top-down and bottom-up" program creates understanding of risks and thus ownership of safe operations. Executive management consistently voices and provides economic support. Thus, Freeport currently constructs and operates "state-of-the-practice" dams which meet or exceed local/state and federal regulatory requirements.

Many existing Freeport dams were built decades ago when the state-of-the-practice was different from today's state-of-the-practice. In previous decades the best practice was to maximize drainage in the dam and impoundment for optimal dam stability. The seepage is then collected in seepage ponds or reclaim wells downstream of the dam. In cases where dams were constructed prior to current best practices for design documentation, an Owner's Engineer regularly inspects the dam for stability and dam safety, and follow-up analyses are completed as required by the engineer. Engineering inspections, analyses, and designs (geotechnical, water management, tailings management) meet or exceed standards by utilizing engineering firms who are familiar with the data collection, evaluation, design, construction, and operation of tailings storage facilities. These designs are reviewed by either an internal tailings review team or an external tailings review board. Construction is monitored by trained quality control and assurance inspectors with testing completed per design specifications along with design engineer regular visits (or residency). Follow-up field and laboratory investigations coupled with instrumentation data and engineering analyses are completed periodically through the operating life, as deemed necessary by an Owner's Engineer or an Engineer-of-Record and/or any state or national requirements.

QUESTION 1b. What measures do mine operators currently take to safely abandon their dams?

RESPONSE: The evaluation process follows that described above in that the evaluation, design, and construction, if applicable at the time of construction, are followed. If an operator wishes to close an inactive tailings storage facility that was designed prior to the current state-of-the-practice or where closure design criteria differ from operational design criteria, an investigation is completed to evaluate the geotechnical integrity of the facility and a surface water hydrologic evaluation is completed to verify that this facility can store or bypass the design storm. Closure strategies are consistent with permit requirements or stipulated state regulations and can vary from facility to facility, based on state requirements. Water management designs should be incorporated for the face of the dam and may include capping of the facility to reduce infiltration and seepage.

QUESTION 1c. For mine operators with dams, please provide your experiences.

RESPONSE: Freeport has a corporately sponsored Tailings Stewardship Program that is specifically designed to provide oversight of TSFs. Freeport utilizes the practices noted in 1a and 1b consistently in the operation of its TSFs. The objectives of the Tailings Stewardship Program include:

- Performing regular thorough inspections and following-up regularly with operations to advance completion of recommended actions
- Implementing the appropriate engineering evaluations and applying suitable factors of safety and redundancies
- Providing training and education to raise awareness and encourage proactive implementation of best practices amongst Freeport TSF/mill operators, supervisors and engineers
- Identifying best practices and creating a communication avenue for mine site operations teams to share best practices amongst each other

QUESTION 2: MSHA is required to inspect every mine in its entirety, which includes dams of all sizes and hazard potential. A common approach for dam safety is to have tiered requirements based on a dam's size and hazard potential. How should MSHA determine safety requirements based on a dam's size and hazard potential? Please include specific recommendations and explain your reasoning.

RESPONSE: Dam size and hazard potential requirements should be consistent with current state-of-the-practice. Criteria established for water dams by the U.S. Army Corps of Engineers (USACE) are broadly applied throughout state and federal agencies, which identify the embankment height, storage volume and hazard potential as criteria for establishing dam classification. Other federal and state agencies may have existing technical and regulatory criteria in place that address hazards, pre-constriction permitting requirements, such as those established under the so called dredge and fill or Section 404 permitting requirements under the Clean Water Act. It is recommended that MSHA reference the well-established state and federal regulations for water dams.

Water dam criteria are often applicable to tailings dams, but not always and should be reviewed by a professional engineer. Tailings dams are regulated less consistently across states. Thus MSHA should first consider the state regulations that apply. Regulations may be supplemented with international guidance documents such as those published by International Committee of Large Dams (ICOLD), Mining Association of Canada, and Canadian Dam Association Safety Guidelines.

QUESTION 3: What non-Federal authority regulates the safety of dams at metal and nonmetal mines in your state, territory, or local jurisdiction? Please discuss the specific requirements, including the principles that they address. If possible, please provide information about relevant non-federal dam safety requirements through a hyperlink or other means.

RESPONSE: The non-Federal authorities that regulate the safety of dams at our mines are listed below. Applicable regulatory requirements for states in which Freeport operates TSFs are attached as an appendix to this document. Websites with their specific requirements and criteria are also provided below.

Dam Safety Agencies

State	Agency	Website
Arizona	Arizona Department of Environmental Quality (Tailings Storage Facilities – Dam Design, Operation, Closure, and Groundwater)	www.adeq.state.az.us
	Arizona Department of Water Resources (Water Storage Facilities)	www.azwater.gov/azdwr
Colorado	Division of Reclamation, Mining and Safety (Dam Design, Operation, and Closure)	www.mining.state.co.us
	Office of State Engineer Division of Water Resources (Water Storage Facilities)	www.water.state.co.us
New Mexico	New Mexico Bureau of Dam Safety Office of the State Engineer (Design, Construction, Operations)	www.ose.state.nm.us
	New Mexico Environment Department (Groundwater, Closure)	www.nmenv.state.nm.us

Activities that commonly fall under state jurisdictions include:

- environmental permitting of a new or existing dam
- construction of a new dam
- enlargement of an existing dam
- modification, alteration, or repair of an existing dam
- formal closure (abandonment), removal, or breaching of an existing dam
- inspection of dams (regular interval varies by state)

Tailings dams may be delisted from agency jurisdiction after formal closure in some states.
QUESTION 4a: What records should be kept of activities related to the safety of dams? Please be specific and include your rationale.

RESPONSE: TSFs are often operated for a number of decades. Good record keeping is essential in maintaining continuity for dam safety activities and site-specific lessons provided by past experience. Records related to the design, construction, and operation of Freeport's tailings dams generally include:

- General project information, including regional vicinity maps showing the project location and the upstream and downstream drainage areas, design report and/or geotechnical analyses, as-built drawings, and photographs of the dam and impoundment
- Hydrologic and hydraulic information, including drainage area and basin characteristics, site rainfall, storage volume, surcharge capacity for floods, rate of tailings inflow, elevation of maximum design pool, and freeboard height
- Properties of embankment materials, including results of field and laboratory tests, and design material properties
- Design assumptions and analyses, including hydrologic and hydraulic analyses, and stability and stress analyses
- Instrumentation measurements and/or engineer's regular instrumentation data review report; instrumentation may include any or all of movement monuments, piezometers, inclinometers, weirs, etc. installed to monitor stability of the dam
- Submittals to state regulatory agencies and approvals

QUESTION 4b: What records should be provided to miners if hazardous conditions are found?

RESPONSE: The examination of the workplace recordkeeping requirements covered in 30 CFR 56.18002 are more than sufficient to satisfy recordkeeping requirements for the discovery of hazardous conditions and would not become overly burdensome on operators of TSFs and water dams.

DESIGN AND CONSTRUCTION OF DAMS

MSHA's existing standards do not include specific requirements for design of dams. MSHA found that inadequate design contributed to some of the metal and nonmetal dam failures. In responding to the following questions, please discuss how any requirements should vary according to the size or hazard potential of a dam, and why.

QUESTION 5: How should mine operators assure that dams are safely and effectively designed? Please suggest requirements that MSHA should consider for safe design of dams. Please be specific and include your rationale.

RESPONSE: Safe operation of TSFs should follow the current state-of-the-practice. Selection of appropriate design criteria, and adherence to those criteria during initial construction and operational construction should form the basis of assuring the dams are safe. There are numerous guidelines to consider which depend upon the type of TSF construction and its operational conditions due to unique conditions at each storage facility: topography, geology, seismicity, hydrology, tailings properties, etc. Mine operators should utilize a team of professional engineers and scientists who collectively have expertise and experience in each area of the design, as well as in construction inspections/guidance, operational considerations and criteria and staff training. An Owner's Engineer or Engineer-of-Record's regular inspections, a corporate inspection team, and/or an external review panel provide assurances for the mine operator that ongoing oversight of its TSFs is robust and considers historic performance of a specific TSF.

International Commission of Large Dams (ICOLD) develops technical bulletin guidelines that may be referenced during the design criteria selection phase of a project to ensure selected criteria are in alignment with international best practices. ICOLD has published eleven technical bulletins on tailings dam safety and management of tailings storage facilities. Freeport respectfully suggests that MSHA consider the guidelines in ICOLD documents as MSHA *guidelines*. Key bulletins include:

- Bulletin 74 (1989). Tailings Dam Safety – Guidelines
- Bulletin 97 (1994). Tailings Dams – Design of Drainage – Review and Recommendations
- Bulletin 101 (1995). Tailings Dams – Transport, Placement and Decantation
- Bulletin 103 (1996). Tailings Dams and Environment – Review and Recommendations
- Bulletin 104 (1996). Monitoring of Tailings Dams – Review and Recommendations
- Bulletin 106 (1996). A Guide to Tailings Dams and Impoundments – Design, Construction, Use and Rehabilitation

Other guidelines Freeport typically references include:

- International Finance Corporation (2007). Environmental, Health and Safety Guidelines for Mining
- Arizona Department of Environmental Quality (1998). Arizona Mining BADCT Guidance Manual
- New Mexico Office of the State Engineer (2005). Rules and Regulations Governing Dam Design, Construction and Dam Safety
- Colorado Mined Land Reclamation Board (2006). Mineral Rules and Regulations

Freeport examines design criteria to ensure consistency with regulations and in consideration of applicable guidelines. Freeport determines on a case-by-case basis whether a formalized risk assessment on a tailings storage facility is required to supplement its prescriptive approach to design criteria. Designs for new dams typically are accompanied by an operations and maintenance manual (O&M Manual) to explain requirements during the operational period to assure the dam continues to meet design criteria selected.

MSHA should reference state regulations to ensure alignment when considering safety of tailings dams. However, MSHA's professional engineers who review designs and operations will need to consider that most design and operating plans are very site specific and the Owner's Engineer or Engineer of Record should have the final authority on tailings dam safety.

QUESTION 6: Please suggest requirements for review of dam designs by mine operators and MSHA and include your rationale for specific recommendations and alternatives.

RESPONSE: Freeport believes that the review of the operation and safety of the tailings dams is incumbent upon the operator. Inspections completed by the mine operators and MSHA should be performed by professional engineers who are trained, experienced, and knowledgeable in the design, operation, and closure of TSFs. Given the broad scope of mine safety inspection activities, TSFs represent a highly specialized aspect in an area in which specific and relevant expertise is necessary in order to objectively and reasonably evaluate the safe operation of the facilities. Qualified personnel to perform inspections should have at least a bachelor's degree in civil/geotechnical engineering and have at least 5 to 10 years experience in the design and/or safe operation of tailings storage facilities. Background and expertise in surface water hydrology and hydraulic design is also important in design and operational review of tailings dams. These are the minimum requirements for key members of the Tailings Stewardship Program at Freeport.

QUESTION 7: With new standards, operators may need to evaluate and upgrade existing dams. Please elaborate on how the safety of existing dams should be addressed.

RESPONSE: Freeport's programs are designed so that its operations meet or exceed the current state-of-the-practice for geotechnical stability and stormwater management. The facilities are compliant with state and federal regulations and utilize international best practice. Freeport operations' level of external professional engineering and oversight along with training, operational procedures, and instrumentation monitoring by Freeport operational staff are acclaimed by outside parties for being robust. MSHA should consider mining operations' existing TSFs on a case-by-case basis regarding existing jurisdictional regulations and potential risks when reviewing design criteria and operational requirements.

QUESTION 8: MSHA's existing standards for dams at metal and nonmetal mines do not address whether a dam is constructed as designed. What measures are necessary to ensure that mine operators construct dams as designed?

RESPONSE: MSHA may wish to consider whether state regulatory requirements are being met, as well as the current state-of-the-practice construction methods and inspections to verify that TSFs are constructed according to intended designs. Some tailings dams were constructed decades ago prior to requirements for formal design reports, so documents will not be available to determine whether the dams were constructed per the design. These structures should be reviewed by a licensed professional Owner's Engineer.

MSHA's professional civil/geotechnical engineers who will inspect TSFs should be knowledgeable of TSF regulations in the states over which they inspect as well be informed on federal and international *guidelines*. State requirements typically have verification procedures which include quality control and quality assurance programs as well as continued oversight.

QUESTION 9: How should MSHA verify that dams have been constructed as designed? Please explain your rationale.

RESPONSE: Verification of a newly constructed TSF starter dam will follow requirements established in the engineering analysis and design report, drawings, and specifications. A construction report will be completed by either the Engineer-of-Record or construction engineering manager with support from the Engineer-of-Record. Operation of a TSF includes continuous raises for the life of the facility. The TSF is monitored as part of the observational approach which includes regular instrumentation readings, informal operator inspections, geotechnical data collection and engineering evaluations. Additional documents which may be available for review include operator log books, inspection reports and follow-up actions, safety incidents and follow-up actions, training program presentations and participation, and closure plans. MSHA may choose to review a number of these documents and/or participate in state engineer inspections.

OPERATION AND MAINTENANCE OF DAMS

MSHA's existing standards do not contain specific requirements addressing the operation and maintenance of dams.

QUESTION 10: What should a mine operator do to operate and maintain a safe dam? How should MSHA verify that dams are safely operated and maintained? Please be specific.

RESPONSE: Competent operations personnel should be involved in the daily operations and maintenance of the tailings facilities to monitor for conditions specific to each TSF that may adversely affect health or safety of miners and the public. A project-specific operations plan is essential. Freeport conducts continuing education and training courses with operators, supervisors, and engineers to ensure persons making the day-to-day decisions understand the

importance and requirements of safe dam construction and operation. Operator log books or suitable forms are used as appropriate to the facility to document and report the operating condition of tailings facilities. The records kept at the operation's tailings management offices, along with visual inspections, will allow MSHA to efficiently verify the dams are safely operated and maintained.

MSHA's existing standards require dams to be inspected at regular intervals if failure would create a hazard. Inspections can identify hazardous conditions, allowing a mine operator to take corrective action to prevent a failure. The Agency will be referring to two types of inspections in this document, "routine" and "detailed." Mine operators should perform frequent, routine dam inspections, which may include monitoring instrumentation, to identify unusual conditions and signs of instability. Personnel with more specialized knowledge of dam safety should conduct detailed inspections to identify less obvious problems and evaluate the safety of the dam. Detailed inspections, occurring less often, would include an examination of the dam and a review of the routine inspections and monitoring data. The Guidelines recommend that inspection personnel be qualified for their level of responsibility and trained in inspection procedures.

QUESTION 11: What measures should mine operators take to assure that dams are adequately inspected for unusual conditions and signs of instability?

RESPONSE: Trained operations staff routinely observe active TSFs on a daily basis as part of their work activities. Components that are observed and inspected on a routine basis, depending on Owner's Engineer or Engineer of Record's requirements, may include the dam embankment, tailings delivery system, deposition areas, reclaim water system, seepage collection system, and related appurtenant structures. If unusual observations are made, operations management is notified.

QUESTION 12a: How often are routine inspections of dams conducted?

RESPONSE: It depends on the operating condition of the dam. Frequency depends on recommendations by Owner's Engineer or Engineer or Record.

QUESTION 12b: How often should they be conducted?

RESPONSE: Inspections should be conducted on the frequency established by the Owner's Engineer or Engineer or Record as suitable on a case-by-case basis.

QUESTION 12c: What determines the frequency?

RESPONSE: The major discriminators on frequency would be whether the facility is active or inactive and hazard classification. Special inspections should be conducted in response to major operational changes and after storm events or earthquakes.

QUESTION 12d: Who conducts the routine inspections? Please be specific and include your rationale.

RESPONSE: Routine inspections are conducted by trained Freeport operations staff or outside consultants on a site-by-site basis.

QUESTION 13: Instruments, such as weirs, provide information on the performance of a dam. How frequently should mine operators monitor dam instrumentation? Please provide your rationale.

RESPONSE: Instrumentation should be monitored as appropriate for unique issues related to each facility. Weirs are not used frequently at Freeport's tailings storage facilities, except as an optional method for measuring flow entering a seepage collection pond. The standard tool used in Freeport TSFs to monitor stability is the piezometer well, which measures internal pore pressures in the embankment. Piezometers are monitored on a regular basis depending on whether a TSF is active or inactive and the facility condition and hazard classification. Frequency of piezometer readings is defined by the Owner's Engineer or Engineer or Record, and depends on operational activities at the facility and the sensitivity of a specific TSF to hydrology and drain-down conditions.

QUESTION 14: What information should be documented during routine dam inspections? Please provide your rationale.

RESPONSE: Information documented during the routine dam inspection, typically conducted by Freeport operators and engineers, generally includes observations of the tailings dam and impounded tailings, the current operating practices, the condition of the embankment downstream slope, the condition of the tailings beach and location of decant pond, freeboard, seepage rates, piezometer levels, any unusual conditions such as cracks or depressions, piping of fines, and erosion conditions beyond what has deemed acceptable and safe by the Owner's Engineer or Engineer of Record.

QUESTION 15a: Does a competent engineer inspect your mine's dam?

RESPONSE: Yes, competent and experienced in the design and construction of dams.

QUESTION 15b: If so, at what frequency? Please explain the rationale for these inspections and what is evaluated.

RESPONSE: Competent and experienced engineers perform at least annual detailed inspections of active tailings storage facilities and less frequent inspections of inactive tailings storage facilities (presently, detailed inspections are performed at inactive tailings storage facilities every 2-5 years depending on hazard profile). Freeport's experience shows that annual inspections are sufficient for active facilities given the level of oversight and observation provided by operators and mine site engineering staff. State regulations are followed as appropriate. See response to Question 17 for details on what is evaluated.

QUESTION 16: How often should detailed inspections be conducted? Please include your rationale.

RESPONSE: See response for Questions 15b.

QUESTION 17: What information and findings should be documented during detailed dam inspections? Please be specific and include your rationale.

RESPONSE: Conditions can change throughout the life of a tailings storage facility. These changes can affect the conditions governing the stability of the dam. A continuous program of inspection is needed from the start of construction, through the operational phase, and continuing after closure. Thorough inspections are necessary to detect adverse or unsafe conditions and to identify conditions that require special attention such as changes in operational practices.

The following information is typically reviewed during a detailed dam inspection, with key items of interest or concern being included a formal inspection report:

- Date of Observation
- Participants
- Upstream Slope
  - Deposition
  - Beach area
  - Beach erosion
  - Vegetation types and locations
  - Settlement
  - Estimated freeboard
  - Estimated beach width
  - Unusual conditions
- Crest
  - Surface cracking
  - Settlement
  - Starter dam/dike if exposed
- Downstream Slope
  - Signs of movement
  - Seepage/wet/moist areas
  - Indications of piping or sinkholes
  - Vegetation types and locations
  - Erosion
  - Burrowing animals
  - Condition of benches
  - Unusual conditions
- Decant Pond/Structures
  - Elevation
  - Flows
  - Indications of sediment in discharge
  - Any active or abandoned structural decants
- Seepage
  - Location
  - Estimated flow

Color
Clarity / Indications of sediment in discharge

- Instrumentation
  Piezometers
  Inclinometers (if required by Owner's Engineer or Engineer of Record)
  Flow measurement

QUESTION 18: How should MSHA verify that mine operators conduct routine and detailed inspections? Please explain how your suggestion would work.

RESPONSE: MSHA will best serve public safety by focusing on whether operations comply with existing state regulations and on understanding geotechnical, seismic, hydrologic, and hydraulic engineering principals. Engineering design and inspection reports are the best means to ensure the operation is complying with the state regulations. Operators also maintain a log of routine and detailed inspections on-site which could be reviewed by MSHA's licensed professional who has tailings design and operations expertise and experience to assess the completeness of the program.

QUALIFICATIONS OF PERSONNEL

A mine operator is responsible for the design, construction, operation, and maintenance of dams. For an effective dam safety program, an operator must use personnel who are knowledgeable about dam safety.

QUESTION 19a: What qualifications do mine operators currently require of persons who design, inspect, operate, and manage dams?

RESPONSE: Persons who are responsible for the design and detailed inspections of the tailings facilities are qualified engineers with geotechnical and hydrological backgrounds and are experienced in the evaluation, design, construction and operation of tailings storage facilities. Persons who are responsible for the day-to-day operations and management of the tailings facilities are typically individuals who have an understanding of the general geotechnical and hydrologic principles and are trained in the safe operation and management of tailings storage facilities.

QUESTION 19b: In what capacities are engineers used? Please be specific in your response.

RESPONSE: Freeport's mid and senior level management staff generally include individuals with engineering or technical degrees. Freeport also uses outside consultancy firms on a regular basis whose professional engineers are industry leaders in tailings dam design and construction.

QUESTION 20: The Guidelines recommend that dams be designed by competent engineers. What specific qualifications or credentials should persons who design dams possess? Please include your rationale.

RESPONSE: Design engineers and design consultants should have appropriate educational and practical experience directly applicable to tailings dam design. Minimal qualifications would include a bachelor's degree in civil engineering with a focus in geotechnical (as well as hydrologic and hydraulic engineers); experience in the evaluation, design, construction, and operation of tailings storage facilities; professional engineering license; and a portfolio of similar, successful projects.

QUESTION 21: The Guidelines recommend that a dam be constructed under the general supervision of a competent engineer knowledgeable about dam construction. What specific qualifications or credentials should a person have who verifies that a dam is being constructed as designed? Please provide your rationale.

RESPONSE: The guidelines would be similar to those described above. As a reference, similar guidelines exist for the State of New Mexico. These specific requirements for expertise in engineering design and oversight are outlined in the state regulations.

QUESTION 22: What training should personnel receive who perform frequent, routine inspections and who monitor instrumentation at dams? In your response, please suggest course content and the frequency of the training, including the rationale for your recommendations.

RESPONSE: Instrumentation and monitoring represent important tools in tailings dam safety. Freeport requires that the staff responsible for tailings dam operation receive training in dam monitoring and inspection.

A typical training program includes a discussion and practical examples of the following items.

- Tailings dam design methods
- Construction practices
- Stability issues
- Operation and inspection
- Instrumentation monitoring
- Anything specific to the particular facility they are inspecting
- Critical operational considerations

QUESTION 23: What qualifications or credentials should be required of persons who perform detailed inspections to evaluate the safety of a dam? Please be specific and include your rationale.

RESPONSE: Detailed inspections are planned and conducted under the direction of experienced engineers who are thoroughly familiar with the investigations, design, construction, and operation of the tailings storage facilities. Team members are trained to recognize and assess

signs of possible instability, distress, and abnormality and to recommend appropriate corrective actions. The team reviews instrumentation results and/or reports and issues identified by operations personnel.

ABANDONMENT OF DAMS

QUESTION 24: Some regulatory authorities require that dam owners obtain approval of a plan to cap, breach, or otherwise safely abandon dams. What actions should mine operators take to safely abandon dams? Please include specific suggestions and rationale.

RESPONSE: The closure of a tailings storage facility typically involves several regulatory agencies. Typically a closure plan is prepared to address permanent closure. The plan is prepared by a team of engineers and scientists with experience in the design and closure of tailings facilities. The plan typically addresses the following issues:

- Design criteria appropriate for closure
- Long-term stability under static and seismic conditions
- Surface water diversion and /or management (typically, tailing facilities are closed to shed un-impacted storm water)
- Control of surface erosion; creation of post-closure land use for capped surface
- Plan for long-term monitoring (including groundwater), as appropriate
- Identification of the responsible engineer to supervise construction and monitoring of the closure plan

Tailings impoundment closure is typically regulated at the state level. Closure of the facilities should be consistent with state regulations. Examples of regulation requirements include ADEQ, NMSEO, NMED, and MMD.

QUESTION 25: How can MSHA verify that a mine operator has safely abandoned a dam?

RESPONSE: MSHA can refer to the regulatory agency to confirm that the closure was completed in accordance with state regulations.

ECONOMIC IMPACT

MSHA seeks information to assist the Agency in deriving the costs and benefits of any regulatory changes for dams at metal and nonmetal mines. In answering the following questions, please indicate the dam's storage capacity, height, and hazard potential and characterize the complexity of each dam referenced. Also, please include the state where each dam is located, and the number of employees at the mine.

QUESTION 26: What are the costs of designing a new dam? Please provide details such as hours, rates of pay, job titles, and any contractual services necessary. How often is the design of an existing dam changed? What are the costs of a redesign?

RESPONSE: This question is difficult to answer given the different locations, construction/ deposition methods, and sizes of tailings storage facilities.

The general rule is the design runs between 5 and 10 percent of the initial capital construction cost of the facility. These costs include preparing plans, technical specifications, and construction cost estimates. Engineering analysis can also run between 5 and 10 percent of the initial capital cost of the facility. These costs include field and laboratory investigations; and slope stability, seepage, piping, hydrology, embankment zoning, and borrow evaluations.

Change to the design generally occurs when additional storage capacity is required due to increase in the operational life of the mine facility and the cost of redesign will vary depending on the extent of changes made to the original design.

QUESTION 27: What are the costs of constructing a dam? Please provide details based on: Size of dam; labor costs, including hours, rates of pay, job titles; costs of equipment and materials; and any contractual services necessary.

RESPONSE: Costs for constructing a starter dam for a tailings impoundment can fluctuate due to site conditions and market conditions and are highly variable. It is probably best to do a comparative evaluation with mass earthwork projects. The costs are dependent upon local labor, craft labor availability, volume and availability of materials moved, and other factors such as foundation conditions, distance to borrow sites, type and size of starter dam, which cannot be consistently implied at each site. Freeport suggests reviewing cost data provided in suitable references and databases (RSMeans, DOTs, Davis-Bacon, Equipment Watch, etc.).

QUESTION 28: Please describe the oversight you provide during dam construction to assure it complies with the design plan. How much does it cost per year per dam for oversight and quality control? What special knowledge, qualifications, or credentials do you require of those who provide oversight?

RESPONSE: The construction of the tailings dam varies based on the initial construction of the starter dam type, construction method, and pumping costs on an annual basis. The design engineer will specify a construction quality assurance program to be following during the construction of the tailings starter dam and a quality control program for the on-going tailings dam raise construction during the operational phase. It is difficult to provide an estimated cost

based on the different operating methods utilized in tailings storage facilities. The costs would be unique to the construction method, the deposition practices, and other factors.

QUESTION 29: How often do you add height to an existing dam or modify it in some other way? Who supervises the design and construction of these modifications, for example, a professional engineer, competent engineer, contractor, etc? Please be specific and provide rationale for your answer. How much does it cost? Please provide details such as labor costs, including hours, rates of pay, job titles, and costs of equipment and materials and any contractual services necessary.

RESPONSE: Tailings dams are typically constructed on a continuous basis over many years, using tailings materials for construction with minimal quantities of earthfill while conventional dams are constructed in a single stage in a short time period. Raise rates for Freeport's dams can range from about 5 to 20 feet per year.

The costs associated with dam raising and dam modifications are site and project specific. The recent design and construction costs for a 50-foot upstream raise to an existing centerline dam were about $200,000 and $7.5 million, respectively.

QUESTION 30: How much does it cost per year per dam for routine inspections? If you incur separate costs for monitoring instrumentation, how much is that cost? How often do you have a detailed inspection conducted? How much does it cost per year for these inspections?

RESPONSE: The costs associated with inspections and monitoring are site and project specific. Routine inspections can cost about $2,000 to $5,000 for a single operation and are typically done by trained Freeport staff as discussed in the earlier responses. Detailed inspections can typically cost about $20,000 to $30,000. Yearly monitoring costs can range from about $15,000 to $75,000. Frequency intervals of routine and detailed inspections were provided in earlier responses.

QUESTION 31: Does the state or local jurisdiction in which you operate require you to use a professional engineer? If so, when is a professional engineer specifically required? (If you have dams in more than one state please identify which states require a professional engineer and which do not).

RESPONSE: Professional engineers are required in all states in which Freeport operates (NM, AZ, CO) to oversee and direct the evaluation, design, and construction of the initial capital components of the tailings storage facilities. These agencies are listed in the response to Question 3. Intermittent involvement is required throughout the operational phase.

QUESTION 32: What are the costs associated with training personnel who conduct frequent, routine inspections and monitor instrumentation at dams?

RESPONSE: The costs associated with training personnel vary depending on the site conditions, the number and types of dams, and operating procedures. An 8-hour short course taught by industry leaders in tailings dams covering the basic principles of operating safe tailings dams costs approximately $8,000. Freeport's consultants spend about $10,000 to $20,000 per engineer for in-house training and on-the-job training (field investigations, laboratory testing, analyses, report writing, etc.).

QUESTION 33: What costs are involved in capping, breaching, or otherwise properly abandoning a dam? Please provide details of your experience and what was involved when you properly abandoned a dam. Describe any impact of a properly abandoned dam.

RESPONSE: The costs associated with capping, breaching, or otherwise abandoning a dam depend on the number of dams, the site location, geometry, hydrology, size of drainage area, borrow material availability, and other project-specific factors such as state regulation requirements.

QUESTION 34: What are the costs to a mine operator if a dam fails? Please characterize other impacts such as loss of life, environmental damage, etc.

RESPONSE: The costs, both clean-up and socioeconomic, to a mine operator are high if a dam fails. The dollar costs associated with tailings dam incidents can reach into the hundreds of millions of dollars including clean-up costs, property and personal liability and lost profits from operations shut down as the result of a tailings failure. The non-financial consequences of a tailings incident can be catastrophic in terms of loss of human life and environmental damage.

Question 35: *Do you have insurance against a dam failure? If so, please specify cost and coverage. Does the insurance carrier require the use of a professional engineer for specific dam activities? If a professional engineer is not required, does the insurance carrier give a discount if one is used? Does your insurance company have any other requirements related to dam safety?*

RESPONSE: FCX's general and excess liability insurance program provides coverage for third party bodily injury and property damage claims for which FCX is legally liable. This should include potential third party liability arising from a dam failure. There is no specific premium component identified for this particular coverage. Our insurers do not currently require the use of a professional engineer and there are no discounts being offered for the use of one. Our insurers are not currently mandating any specific dam safety requirements.

QUESTION 36: What quantifiable and non-quantifiable costs and benefits for the downstream community are involved when a dam is properly designed and constructed? In addition, MSHA welcomes comments on other relevant indirect costs and benefits.

RESPONSE: Non-quantifiable benefits of a properly designed and constructed TSF to the downstream community include security for the community's inhabitants, their property and their immediate environment. These benefits improve the miner's social license to operate, and minimize environmental impact. Potential quantifiable benefits include higher property values and a strong local business climate.