

# OVERVIEW OF INTERNATIONAL MINE CLOSURE GUIDELINES<sup>1</sup>

Dawn H. Garcia, CPG-08313<sup>2</sup>

**Abstract.** The mining industry has learned that plans for closure of mine and plant facilities, plus post-closure use of the land, must be presented to stakeholders as part of a successful planning process and to obtain the “social license” from the community. Historic mining operations that were abandoned without closure methods that mitigated physical and environmental impacts have negatively influenced the ability of mining firms to obtain a social license. The perception that a new modern mine will create the same impacts during operation and at closure as abandoned historic operations must be overcome during the initial steps of an exploration program. The closure planning begins during project conception.

Mining companies typically conduct exploration projects in far-reaching corners of the globe, in countries with varying governmental regulations and standards for mine closure. What guidelines should be considered as basic references for a closure plan for operations in any country? In the absence of well-defined closure regulations, companies may choose to use closure guidance from international sources such as the World Bank and the International Finance Corporation, as well as prominent national and state or province specific legislation. Corporations can compare published guidance documents to develop a “baseline” list of closure elements, and subsequently use a risk-based corporate analysis to refine the closure approach.

The most elementary goal of closure is to minimize future environmental impacts from mining activities and to reduce future financial risk to the company’s shareholders. All aspects of the environment, such as soil, water, air, and communities, are considered during closure planning. National and local legislation may provide specific closure design requirements and regulatory standards for soil and groundwater. A risk-based strategy also considers the potential future risks and how much risk the company is willing to incur. Risks can be reduced by removal of impacted materials or by in-place remedial closure methods. The long-term post-closure care and maintenance, especially those associated with impacts from closed facilities, need to be considered in the closure strategy and demonstration of responsibility for a social license.

Key Words: Mine closure, mine closure regulations, guidelines for mine closure

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<sup>2</sup>Dawn H. Garcia, CPG-08313, Senior Hydrogeologist, SRK Consulting, (U.S.), Inc., Tucson, AZ 85741, dgarcia@srk.com.

## **INTRODUCTION**

The high cost of mine closure has resulted in greater corporate awareness of closure in the mine life cycle. Historic mining operations that negatively impacted the environment, resulting in contaminated surface water and groundwater, unsightly and unstable tailings with acid rock drainage, and dangerous open adits, have given the mining industry a dubious reputation. Though those examples are certainly not the conditions at closure for a current mine closed by a reputable company, the past actions of mining companies have colored the public's perception of the mining industry. The perception that a new modern mine will create the same impacts during operation and at closure as abandoned historic operations must be overcome during the initial steps of an exploration program. Companies are learning that they must plan for closure as part of the initial phases of exploration, because the communities demand that mines obtain a "social license" and because neglect of the closure costs may mean that the project will end with negative balance in profits at the project's end. The closure planning begins during project conception phase.

This paper presents an overview of requirements for mine closure in selected countries. It is not intended to be an all-inclusive document, and should not take the place of a mine's responsibility to research local, regional and national regulations that pertain to their site. The intent of the paper is to highlight best practices available to the mining industry when planning for closure and implementing closure plans, with an emphasis on the recent and pending changes in multiple countries.

## **SOCIAL LICENSE**

Investors view Bre-X as the ultimate symbol of fraud in the mining industry, whereas communities have viewed discolored flow from mine adits or tailings ponds into clear mountain streams as the ultimate symbol of neglect by the mining industry. Historic mining operations that were abandoned without closure methods that mitigated physical and environmental impacts have negatively influenced the ability of mining firms to obtain a social license.

A social license refers to the acceptance of the community to have the mine in the community. This social license is an intangible, informal approval or acceptance by the community. It is non-permanent. The company must first earn it and then continue to maintain it. Remember, the community lives with the mine forever after closure, so it is the community's legitimate right to participate in closure planning.

Within communities there are different local stakeholders that are key contacts in obtaining the social license. The company must demonstrate that it respects, listens to and understands the stakeholders. During the process of obtaining a social license, the company will be called upon to share its plan for closure and how the closure will ensure that the community will not be harmed by the mine operations, closure, or post-closure conditions. Post-closure may be a much longer period at many mines compared to the life of mine. Indeed, the social license and costs of closure should be a factor in the mine owner's decision to continue with a project. The closure planning can be a good process to bring disaffected local parties back to the table. Even when a community disagrees with a new operation, or disagrees whether to close a current operation, it can provide constructive input on closure.

Mining companies typically conduct exploration projects in far-reaching corners of the globe, in countries with varying governmental regulations and standards for mine closure. What guidelines should be considered as basic references for a closure plan for operations in any country? Some countries have established closure requirements as part of the operational permits, but most countries, especially developing countries, currently have few or no mine closure requirements. In the absence of well-defined closure regulations, companies may choose to use closure guidance from international sources such as the World Bank and the International Finance Corporation, as well as prominent national and state or province specific legislation that details the expectations of closure plans (World Bank and International Finance Corporation, 2002). Corporations can compare published guidance documents to develop a “baseline” list of closure elements, and subsequently use a risk-based corporate analysis to refine the closure approach. With a significant number of large mines facing closure in the near future, the urgency of planning for closure has prompted international companies to form closure groups that oversee multiple projects with different regulatory requirements. Table 1 lists some well-known mines that are pending closure.

The most elementary goal of closure is to minimize future environmental impacts from mining activities and to reduce future financial risk to the company’s shareholders. All aspects of the environment, such as soil, water, air, are considered during closure planning. Companies that incorporate sustainability into the project life cycle design closure into all parts of the life cycle planning. Figure 1 illustrates how closure planning is incorporated into the mine life cycle. Controlling costs is one of the advantages of incorporating closure into the mine life cycle. If the closure cost estimate is flawed during the initial mine planning phase, the final cost of closure may negate the project profit. Concurrent closure and operations also allows for the costs to be borne during operations rather than dependent on the closure provision, plus the closure cost estimate can be compared against actual project costs. Additional benefits of concurrent closure have been stated by others (United Nations, 2005) with an emphasis that it makes business sense.

A risk-based strategy also considers the potential future risks and how much risk the company is willing to incur. Risks can be reduced by removal of impacted materials or by in-place remedial closure methods. The long-term post-closure care and maintenance, especially those associated with impacts from closed facilities, need to be considered in the closure strategy and demonstration of responsibility for a social license. National and local legislation may provide specific closure design requirements and regulatory standards for soil and groundwater.

A variety of closure guidelines are discussed below. As mentioned previously, this review is not complete. Every mine owner has the responsibility to be aware of the specific regulations that pertain to their operations. This overview can be useful in finding the current “best practices” standards and providing a start in developing a risk-based closure plan protocol.

## **INTERNATIONAL GUIDELINES**

There are no regulatory agencies that are international, but financial institutions have emphasized the importance of closure for socially conscious and fiscally safe banking purposes. There are voluntary programs that financial institutions can adopt to manage environmental and

social risk in their project finance transactions. These voluntary programs can be especially pertinent for a lender that uses the project revenues both as the source of repayment and as security for the exposure. This type of financing is usually for large, complex and expensive installations, such as mines.

Sixty financial institutions have adopted the Equator Principles (EPs), which require that the financial institution assess and manage social and environmental risk as part of the project financing ([www.equator-principles.com](http://www.equator-principles.com)). Adherence to the EPs requires that the borrower conduct a social and environmental assessment process to address the relevant social and environmental impacts and to identify risks to the proposed project. The EPs do not cover the technical aspects of due diligence.

The World Bank provides financial and technical assistance to developing countries around the world by offering low-interest loans, interest-free credit and grants to developing countries for education, health, infrastructure, communications and many other purposes. It is composed of two development institutions owned by 185 member countries—the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The IBRD focuses on middle income and creditworthy poor countries, while IDA focuses on the poorest countries in the world.

The International Finance Corporation (IFC), the private sector arm of the World Bank Group, has a Sustainability Web Portal (<http://www.ifc.org/sustainability>) in response to growing stakeholder interest. IFC uses environmental and social screening criteria to categorize the magnitude of social and environmental impacts. These categories are Category A (projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented); Category B (projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures); and Category C (projects with minimal or no social or environmental impacts).

## **NATIONAL GUIDELINES**

### **NORTH AMERICA**

Closure guidelines exist for Canada, Mexico, and the United States. The USA and Canada have a similar approach to mine reclamation in that the legislation is found in multiple legislative acts that govern mining (making it sometimes a complicated regulatory framework), plus there are strong enforcement and financial assurance components. Both countries have national environmental laws, plus province or state-specific requirements. The USA has a specific national regulation that excludes tailings materials from being handled as hazardous waste (Bevill amendment to the Resource Conservation and Recovery Act). The Bevill amendment does not exclude tailings impoundments from other environmental regulations, such as those governing environmental impacts to groundwater from mining facilities. Mexico does not have detailed reclamation legislation, but has national environmental laws and is currently developing more specific mine closure requirements. For example, guidance for the constructions, operation and closure of tailings impoundments was included in a national regulation promulgated in 2003 (NOM-141-SEMARNAT-2003).

**USA.** There are multiple federal environmental laws, plus state and local regulations, that are related to mine closure. Most states with mining activities have state-specific laws as well as regulations with technical requirements and guidance documents for closure. Arizona, for example, has two regulatory agencies that oversee closure plans and closure activities: the Arizona Department of Environmental Quality (ADEQ) and the State Mine Inspector's Office. ADEQ is responsible for the oversight of impacts to the environment (soil, water, air), whereas the State Mine Inspector's Office is responsible for the physical safety of the site (such as stability of closed tailings impoundments and underground shafts). Detailed assessments of conditions during operations and the predicted post-closure conditions are required for a closure permit. Closure plans are required as part of the approval to operate and include estimates of closure costs as well as a financial assurance.

Closure planning includes the following components, summarized here for brevity:

- Site information, such as topography, property lines, structures, and facilities
- A description of closure procedures, including an analysis of alternative measures
- Site-specific and regional hydrologic and geologic characteristics
- Detailed closure methods for each facility
- Groundwater model demonstrating that future impacts to water quality from facilities that will continue to discharge (such as drainage from unlined impoundments) will not be above regulatory levels
- Financial assurance that the company is fiscally sound to complete the closure
- Demonstration that the company (or its subcontractors) have the technical ability to complete closure

Closure approval will be based on conditions after closure and the plans for long-term monitoring:

- As-builts of closed facilities that will remain (such as the heap leach and tailings impoundments)
- Assessment of soil conditions after closure
- Monitoring plan for physical inspections of closed facilities that will remain and sampling for groundwater quality
- Contingency plan for discharges above approved levels, groundwater quality degradation, or physical damage to closed facilities
- Recordkeeping and reporting schedule
- Future updates of the groundwater model

**Canada.** The Government of Canada and the territorial governments oversee mine closure and have multiple regulatory programs in place. Important federal environmental acts related to mine closure include the Canadian Environmental Protection Act, Fisheries Act, and Canadian Environmental Assessment Act.

## **SOUTH AMERICA**

Legal frameworks for managing mine reclamation in South America are established in Argentina, Bolivia, Colombia, Ecuador, Brazil, Chile, and Peru at a minimum. As recently as June 2008 Ecuador has enacted new regulations for mining that requires that a management plan

be developed to address water treatment, revegetation, handling of wastes, and management of fauna and flora. Local government and community representation is required. Though there are not regulations for every country in Latin American and South America, both Chile and Peru have been leaders in the mining industry and their closure laws are discussed below.

**Chile.** Chile's mining regulations include closure requirements and provide general guidelines for closure. This legislation is the "Reglamento de Seguridad Minera" (December 2002). Chile does not currently have detailed legislation that provides closure guidelines. The law established a deadline of February of 2009 for all current mining operations to submit a closure plan to the authorities. New projects should present a closure plan in the Environmental Impact Study for project permitting.

There is a closure law that was proposed several years ago, but is still pending approval. The closure law includes requirements for technical workplans, public disclosure, and provision for financial assurance.

**Peru.** Peru has detailed closure legislation outlined in its law governing mine closure (Ley No. 28090, Ley que regula el cierre de minas, published October 14, 2003). The deadline for Closure Plan submittal was 2006. The law requires that the closure plan include the reclamation methods, closure cost estimate, methods of control and verification, closure and post-closure plans, and financial assurance. The Peruvian Ministry of Energy and Mines published a guide for preparation of mine closure plans in 2006 (Perú, Ministerio de Energía y Minas, Guía para la elaboración de planes de cierre de minas, April 2006). The Ministry of Energy and Mines publishes the most recent versions of the regulations and other pending laws on their website ([www.minem.gob.pe](http://www.minem.gob.pe)).

## **EUROPE**

Closure aspects for mining facilities in Europe are closely linked with the conditions of planning permission for the mine. Closure of waste disposal facilities is covered by the European Union (EU) Mining Waste Directive (EU, Directive 2006/21/EC, 2006). This includes requirements for the establishment of a closure plan for the waste facilities (Article 12) and allocation of a financial bond to cover the estimated costs of closure and rehabilitation (Article 14). A partnership of international organizations prepared a closure guideline for South-eastern and Eastern Europe, Central Asia and Caucasus as part of its mission to advance and protect peace and the environment (United Nations et al, 2005). The document makes a particular point of the economic development of nations in central and eastern Europe being linked to ongoing and new mining efforts. A primary objective of the document is to provide guidance for either re-opening the mine or redeveloping the site for other economic uses. Historic mines are being revisited in many countries as commodity prices increase and mining technology improves (or in some cases, the political stability of the area allows for private investment).

## **MINE CLOSURE GUIDELINE DEVELOPMENT**

As awareness of the need for closure regulation has increased, more countries are in the process of developing legislation and policies. Examples of pending guidelines in Mexico and Chile were already presented. Another example is work conducted in Romania to develop a set

of guidelines for closure of the country's tailings dams due to safety concerns. Mines in Romania are the property of the government. In 1999 the World Bank funded the "Mine Closure and Social Mitigation" project to work with the Romanian government to close several mines in the country in a social and environment sustainable manner. Since there were no regulations to clarify procedures for the physical closure of the mines, one of the goals of the World Bank project was to create a set of environment regulation/procedures for the mining sector in Romania. SRK became part of the project in 2006 when we worked as part of a field survey team, with the Romanian National Agency for Mineral Resources.

The current level of foreign investment in mining interests in other countries is influencing the way closure is approached as mining companies apply more stringent closure policies from their home countries to sites in developing countries and as the investors demand that sustainability issues be incorporated into all projects, despite a lack of local policy.

## **CONCLUSIONS**

Companies that wish to apply the most stringent practices in mine closure procedures can benefit by reviewing the closure laws and regulations that are used by other governmental agencies, as well as proposed legislation. Although closure regulations are not equal in all countries, the trend is for increased regulation of closure by governmental and lending agencies.

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**Table 1.** Examples of mines pending closure (World Bank and International Finance Corporation, 2002).

Country	Site Location	Mineral	Sponsor	Lifespan	Employment
Argentina	Cerro Vanguardia	Gold, Silver	AngloGold (46.25%), Perez Compac (46.25%), Santa Cruz Province (7.5%)	2010	469
Brazil	Serra Grande	Gold	AngloGold (50%); TVX Gold Inc. (50%)	2008	640
Brazil	Crixas	Gold	AngloGold (50%), TVX Newmont (50%)	2009	N/A
Chile	Agua de la Falda	Gold	Barrick Gold Corp.	2002	N/A
Chile	El Indio	Gold, Copper	Barrick Gold Corp.	2002	N/A
Chile	La Coipa	Gold, Silver	Placer Dome (50%), TVX Normandy Americas Inc. (50%)	2008	440
Chile	Michilla	Copper	Antofagasta (74%), Chilean Investors (26%)	2007	463
Chile	Quebrada Blanca	Copper	Aur Resources (76.5%), Pudahuel and ENAMI (13.5%)	2012	N/A
Mali	Sadiola	Gold	AngloGold (38%), IAMGOLD (38%), GOM (18%), IFC (6%)	2008	820
Mali	Morila	Gold	AngloGold (38%), Randgold Resources (40%), GOM (20%)	2009	770
Mali	Yatela	Gold	AngloGold (40%), IAMGOLD (40%), GOM (20%)	2007	N/A
Mexico	Cerro San Pedro	Gold	Glamis Gold Ltd. (50%), Metallica Resources Inc. (50%)	2008	N/A
Namibia	Namdeb	Diamonds	DeBeers	2010	N/A
PNG	Porgera	Gold	Placer Dome (50%), Aurion Gold Ltd. (25%), Orogen Minerals Ltd. (20%), the Enga Provincial gov't and landowners (5%)	2012	2,000
PNG	Ok Tedi	Copper, Gold	BHP Minerals Holdings Pty Ltd. (52%), the State (20%), Inmet Mining Corporation (18%), Mineral Resources Ok Tedi No.2 Limited (10%)	2011	2,300
South Africa	Savuka	Gold	AngloGold Limited (100%)	soon	3,680
South Africa	Great Noligwa	Gold	AngloGold Limited (100%)	2009	9,650
South Africa	Namaqualand	Diamonds	DeBeers	2010	2,181
South Africa	Tau Lekoa	Gold	AngloGold Limited (100%)	2008	3,600
South Africa	Tau Tona	Gold	AngloGold Limited (100%)	2011	5,260
South Africa	Tshepong	Gold	AngloGold Limited (100%)	2012	3,870

**Table 2.** Mine life cycle (Peru Ministerio de Energía y Minas, 2006).

<b>Life Cycle Stage</b>	<b>1</b>	<b>2</b>		<b>3</b>	<b>4</b>	<b>5</b>	
<b>Stage Description and Estimated Duration</b>	Exploration  1-10 years	Site Characterization and Mine Planning  1-3 years		Construction  1-3 years	Operation  2-100 years  On-going reclamation Care and Maintenance	Site Closure  1-5 years	Post Closure  In perpetuity
<b>Management Decision</b>	Project Go/No Go Decision	Project Go/No Go Decision					
<b>Required Submittals</b>	Closure Plan for Exploration Project	Baseline Environmental Assessment		Environmental monitoring/on-going reclamation			
		Environmental Impact Statement (EIS)  (include conceptual closure plan)	Closure Plan  (include closure cost estimate and financial assurance)	Closure Plan Updates  Typically 3 years after approval, followed by 5-year updates or when conditions change. Include revised cost estimate.			
<b>Permits</b>	Exploration	Approval of EIS	Approval of Closure Plan				Closure Approval