

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

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Abstract

Successful mine closure or reclamation processes have various definitions in jurisdictions around the world. Setting criteria for a successful mine closure is required to measure progress towards achieving the objectives of closure. The majority of existing guidelines are based on processes – methods and procedures and techniques – the ‘means’ rather than the ‘ends’. Current debate argues that identification of end-use is good practice in mine closure methodology, seeking outcomes such as future use, performance and function. This paper examines aspects of these ‘good’ mine closure practices, identifying the objectives and criteria in the jurisdictions of Western Australia, Canada (BC), Chile and South Africa.

This paper then goes on to contrast these aspects with what is currently found in former Soviet Union (FSU) countries of Russia, Kazakhstan and Kyrgyzstan. It is apparent that these FSU countries have much to do to achieve good mine closure practices. The paper concludes with descriptions of planned future development of policies and trends in the FSU arena that could move towards targeting similar good practices.

1. Introduction

Mining is a finite economic activity that provides socio-economic benefits to communities, shareholders and owners. Mining contributes to businesses, education, infrastructure and other forms of capital that improve economic development. However, mining is often viewed as having a negative environmental impact and to which can result in significant financial liability for the host country. The associated infrastructure and pollution from mining activities have the potential to affect the health of ecosystems and reduce their ability to provide the goods and services necessary for human and environmental well-being (Rajaram, 2005).

Over recent decades, the topic of mine reclamation has become increasingly intertwined with the sustainability of mining itself within a number of jurisdictions. As an activity, post-mine reclamation has emerged as a critical component of the mining lifecycle not only for minimising the impacts of mining on the environment and protecting the environmental services that local communities often depend upon, but also for helping mining companies secure the social license they need to operate (Slocombe 2012).

Mine closure and reclamation is a subject of vital interest to many other stakeholders, including environmentalists, regulators, investors, mine employees and affected communities. The mine closure legislation of countries such as Canada, the United States and Australia has been developing for the past 30 years and can be considered, in these various forms, to be examples of international good practice.

Although mining has in the past been a big part of the Soviet Union economic imperative, since the collapse of the Soviet Union in 1991, in the now-termed countries of the former Soviet Union (FSU), mine closure design, planning and practice by and large remain a novel and undeveloped concept. Yet mining activity in the FSU is of global significance (USGS 2012a). For example, the world’s biggest gold mine, Muruntau, is in Uzbekistan, and the world’s largest producer of uranium is Kazakhstan. Further, Russia and Kazakhstan are major producers of bauxite, chromite, copper, iron, lead, manganese, and zinc ores in global term (USGS 2012a).

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

To assist in understanding why the nations of the FSU pay scant attention to mine closure, a brief contextual historical perspective may help.

Mining enterprises in the Soviet Union were controlled (as with all industrial activity) through central command, achieving annual target mine outputs of the central planning organ in the Soviet Union — the Gosplan (State Planning Committee). As Stalin put it: ‘plans are not forecasts, but instructions’ (Ellman 1979).

The Gosplan would supervise planning committees in the relevant ministries (Ministry of Energy for Coal, Oil and Gas Production, and the Ministry of Industry for most solid minerals) in Moscow, who would produce annual target mine outputs for mining enterprises.

The enterprise managers would then respond with a request for resources needed to achieve the targets, and, to a lesser or greater extent, these resources (equipment, manpower, energy, and infrastructure) would be provided from the central industrial resource pool. Successful achievement of targets would normally result in reward to the enterprise in the form of increased salaries and access to consumer goods. Failure to achieve would incur punishment in some form. In the planning process, the concept of closing the mining enterprise was not considered as it did not contribute any obvious economic benefit to the central plan. Unproductive mines would simply be abandoned, and the mine community moved on to another venture. The minerals and mining legislation in the majority of FSU countries has not changed significantly since the days of the Soviet Union, and the state usually monitors the mines’ production outputs and resource depletion on a state ‘reserve balance’. Some reforms are being considered, but generally, as a consequence, the region is faced with the challenge of balancing competitiveness in terms of investment attraction while requiring and ensuring compliance with good environmental and sustainable development practice in mine closure required by most financial institutes and investors.

This paper presents a broad overview of the mine closure requirements in Canada, Western Australia, Chile and South Africa and compares those practices with mine closure requirements in FSU countries. The focus of this paper is on mine closure objectives and criteria in each of these countries.

2. Mine closure legal framework in Australia, Canada, Chile and South Africa

For comparative analysis of mine closure regulations in FSU countries, four countries were identified that represent jurisdictions with varying approaches enacted to ensure long-term compliance by mine owners and operators to mine closure obligations. For each chosen jurisdiction, mine closure, reclamation requirements, and financial assurance for each case are described. A comparison of mine closure regulations is summarised in Table 1.

2.1 Australia (Western Australia)

The Department of Mines and Petroleum (DMP) is responsible for ensuring that Western Australia’s resources sector is developed and managed responsibly and sustainably for the benefit of all Western Australians. The Environmental Protection Authority (EPA) formally assesses mine closure under Part IV of the EP Act, where mining projects are not subject to the Mining Act such as pre-1899 title or minerals-to-owner tenure, or where the EPA considers that there is a significant impact or risk and identifies

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

Rehabilitation and Closure as a preliminary Key Integrating Factor of a proposal (Department of Mines and Petroleum 2015).

DMP and the EPA jointly released version 1 of the Guidelines for Preparing Mine Closure Plans (MCPs) in 2011. The Guidelines were updated in May 2015 (Department of Mines and Petroleum 2015). Under these Guidelines, all new and existing mining operations' Mining Proposal applications must contain a Mine Closure Plan prepared in accordance with the Guidelines. The Guidelines set out the structure and content of a Mine Closure Plan. The Plan should include a legal obligations register which identifies closure obligations and commitments under state and federal legislation, as well as individual tenement conditions (Barton 2013).

The MCP Guidelines state that the DMP's principal closure objectives are for rehabilitated mines to be (physically) safe to humans and animals, (geo-technically) stable, (geo-chemically) non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use. The EPA's objective for rehabilitation and decommissioning is to ensure that premises are decommissioned and rehabilitated in an ecologically sustainable manner (EPA 2015).

The post-mining land use(s) and closure objectives are necessary to provide the basis for developing completion criteria. Objectives in the Mine Closure Plan must be developed based on the proposed post-mining land use(s) and be as specific as possible to provide a clear indication to Government and the community on what the proponent commits to achieve at closure.

In the Guidelines, DMP and the EPA require identification of completion criteria that will demonstrate that the closure objectives have been met in the Mine Closure Plan. The completion criteria should follow S.M.A.R.T. principle (specific, measurable, achievable, relevant and time-bound). The completion criteria should include performance indicators to demonstrate that rehabilitation trends are following the predicted performance, particularly where mathematical modelling is utilised to predict any long-term environmental impact (usually 300 years or longer).

According to the Guidelines, the objective of financial provisions for closure is to ensure that adequate funds are available at the time of closure and that the community is not left with an unmanageable liability. Cost of closure has to be calculated as early as possible and must be regularly reviewed to reflect changing circumstances and levels of risk. The process and methodology for financial provisioning has to be transparent and verifiable. The mine owner has to make adequate provisions in corporate accounts for mine closure costs.

Beyond financial provisioning The Mining Rehabilitation Fund Act enacted in 2012 creates the framework for Mining Rehabilitation Fund (MRF) which is a pooled fund contributed to by holders of most tenements under the Mining Act (Department for Mines and Petroleum 2015). The purpose of the Fund is to secure long-term funding for the State to rehabilitate abandoned mine sites and other land affected by mining operations where the mine operator does not fulfil its mine rehabilitation and closure obligations.

The levy will be calculated as 1 per cent of the total mine closure cost per annum (as an estimated figure). Contributions to the MRF are separate from the internal accounting provisions for closure and rehabilitation and should not be used to offset the costs for rehabilitation (Department for Mines and Petroleum 2015).

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

2.2 Canada (British Columbia)

Under Canada's constitution, environmental regulation is shared between the federal government and the 10 provinces and three territories (here referred to collectively as 'provinces'). Where there is a direct conflict between federal and provincial environmental statutes in relation to the same matter, federal law prevails, but such conflicts are rare, and overlapping requirements are common. Municipalities also play a growing role (Saxe & Campbell 2015). Under a federal Supreme Court ruling, aboriginal communities that have traditionally used the affected lands have the right to be meaningfully consulted on the development and closure of mines. Provincial governments have the responsibility, on behalf of the public, to provide and enforce efficient and effective legislation with respect to the development of mineral resources and management of wastes on Canadian lands (Siwik, 2015). British Columbia was one of the first jurisdictions in Canada to enact mine reclamation legislation and the first to extend this policy to exploration sites (BC TRCR, c. 2010). British Columbia's reclamation laws have the objective of ensuring that, once operations cease, mine site lands are returned to a useful and productive state (McLaren, 2008).

Environmental assessment (EA) is required for any major mining project in British Columbia. The EA process must include a conceptual-level decommissioning and reclamation plan. The plan should describe, among other details, the long-term objectives for future use of the property following decommissioning, e.g. end land use objectives. According to McLaren (2008), finding the right balance between provision of conceptual level information during the EA review and more detailed information during subsequent *Mines Act* permitting is often a challenge during the EA process as some participants in the review process seek greater detail and/or assurances on reclamation and closure activities.

The *Mines Act* and the accompanying Health, Safety and Reclamation Code for Mines in British Columbia (the Code) regulate provisions for minimising the health, safety and environmental risks related to mining activities. A mine must apply for, and obtain, a permit from the Chief Inspector of Mines under *Mines Act* prior to mining or significant ground disturbance. This permit approves the mine plan, the program for the protection of land and watercourses, and the reclamation program that contains conditions for reclamation. The Code specifies requirements for final conceptual reclamation program, as follows:

- Be prepared taking into consideration the health and safety of the public and persons involved in the work.
- Be designed so as to make it as practicable as possible in the future to mine zones affected by the plan.
- Be designed to protect the land and watercourses.

The physical and chemical design stability requirements for the major impoundments and waste rock landforms are outlined in guidelines such as Canadian Dam Association, Dam Safety Guidelines, Interim Guidelines of the British Columbia Mine Waste Rock Pile Research Committee, and Guidelines for Metal Leaching and Acid Rock Drainage at mine sites in British Columbia.

In British Columbia permittees are required to estimate the total expected costs of outstanding reclamation obligations over the planned life of the mine. The Mines and Mineral Resources Division (MMD) of the Ministry of Energy and Mines seeks to provide reasonable assurance that the Province will not have to contribute to the costs of reclamation if a mining company defaults on its reclamation obligations (Province of British Columbia c. 2015). As a condition of *Mines Act* permits, the permittee must post financial security in an amount and form acceptable to the Chief Inspector of Mines. The assessment of financial security is done

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

on a site-specific basis. The Mines Inspectorate accepts the following forms of reclamation security: cash, certified cheques, bank drafts, term deposits (i.e. GICs), Government of Canada bonds and irrevocable standby letters of credit (ISLOCs).

2.3 Chile

In an overview of mine closure regulations development, Sanzana et al. (2015) note that, in 1994, an environmental impact assessment (EIA) obligation was introduced, and while closure was not specifically addressed, the EIA for new mining projects was expected to include the closure phase. According to Sanzana et al. (2015) the next milestone in mine closure regulation was an introduction of updated EIA regulations (Law 19.300) in 2002. For the very first time, this regulation established a requirement that all mining operations must present closure plans to the National Mining and Geology Service (Servicio Nacional de Geología y Minería, or Sernageomin). Existing mines were required to ensure that they had filed closure plans with the relevant authorities by 2009.

The focus of closure plans in 2009 was on physical stability of remnant mine wastes, and health and safety issues. Notably, environmental impact issues were not covered as they were considered to be outside of the jurisdiction of Sernageomin, and there was no requirement to assess or indicate the cost of implementing closure measures (Sanzana et al. 2015).

In November 2012, new Chilean law 20.511 was introduced that required mining companies to establish financial assurance or guaranties to the state that were intended to ensure complete and timely compliance with closure obligations, as described by this law. This law obligates all mining companies with an extraction level or ore benefit that exceeds 10,000 tons per month to present a closure plan for approval to the mining authority. The plan should address all closure work, requirements, and activities made to prevent, minimise, or take control of environmental hazards, risks, and possible negative effects associated with the chemical and physical stability of the mine site (Brokering Abogados c.2015).

The mining company has to elaborate a cost estimate for all closure work, requirements, and activities of the mine to establish financial guarantees for approval by Sernageomin and the Chilean Securities and Insurance Supervisor (Olivari, 2014).

2.4 South Africa

The *Mineral and Petroleum Resources Development Act* (MPRDA) makes provision for equitable access to and sustainable development of South Africa's mineral and petroleum resources. In order to obtain legislative closure for mining in terms of the MPRDA, a closure certificate must be issued by the Department of Mineral Resources (DMR). DMR is a department of national government of South Africa which regulates mining industry.

The *National Environmental Management Act* (NEMA) establishes a set of principles that govern environmental management, which all state authorities have to consider when exercising their powers. NEMA states that 'every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring'. If such degradation/pollution cannot be prevented, then appropriate measures must be taken to minimise or rectify such pollution.

In October 2014, new regulations under NEMA – '*Regulations pertaining to the financial provision for the rehabilitation, closure and post-closure of prospecting, exploration, mining or production operation*' governing closure and financial assurances were issued in South Africa. Regulations specify the minimum content of the annual rehabilitation plan and for a final rehabilitation, decommissioning and mine closure plan.

The annual rehabilitation plan must contain information that defines concurrent rehabilitation activities for the forthcoming 12 months and how these relate to the operations closure vision and what closure objectives and criteria are being achieved through the implementation of the plan.

The annual rehabilitation plan must contain:

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

- The pertinent closure objectives and performance targets that will be addressed in the forthcoming year.
- A description of the relevant closure design criteria adopted in the annual rehabilitation activities and the expected final land use once all rehabilitation activities are complete for the activity or aspect.

Based on the regulation, the final rehabilitation, decommissioning and closure plan forms a component of the environmental management program and will be subjected the same requirements of the environmental management program with regards to opportunities for stakeholder review and comment.

The plan must include details of design principles including: Closure vision and objectives. The objectives must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations.

Additionally, as part of the organisational capacity that will be put in place to implement the plan, details on relinquishment criteria for each activity or infrastructure in relation to environmental aspects must be provided with auditable indicators.

Regulations also require ‘financial provision for the rehabilitation and management of negative environmental impacts from prospecting, exploration, mining or production operations to the satisfaction of the Minister responsible for mineral resources’.

Financial provision has to be provided by one or a combination of the following methods:

- A contribution to a trust fund established in terms of applicable legislation.
- A financial guarantee from a bank registered in terms of the Banks Act, 1990 (Act No. 94 of 1990) or from a financial institution registered by the Financial Services Board.
- A deposit into an account specified by the Minister responsible for mineral resources.

Adequacy of the sum of the financial provisions has to be assessed on the annual base.

3. Mine closure legal framework in former Soviet Union countries

The Soviet Union possessed some of the world’s largest reserves of hydrocarbons and minerals. With the breakup of the Union in 1991, the former Soviet republics now exercise sovereign control over their resources and related industries (Dorian et al. 1993).

After the Soviet Union breakup, the subsequent independent FSU republics started to develop legislation regulating mining industry and environmental protection. A review of the mine closure legislation in Russia, Kazakhstan and Kyrgyzstan demonstrates that the separate jurisdictions actually have many similarities, but each country has its own variations and challenges. Both Russia and Kyrgyzstan have mining legacies that were listed on Blacksmith Institute’s top ten toxic threats. Most notably, in Kyrgyzstan, the abandoned Mailuu-Suu processing complex, home to a former uranium processing plant, is now in a situation where heavy metals and radionuclides from 23 nearby uncontrolled tailings dumps have migrated into the town’s decrepit water system (Blacksmith Institute 2014).

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

This and many similar legacy issues pose a tangible, documented and serious threat to the health and safety of the population (Waggitt 2008), yet there is no legislation in place to engender and enforce legacy mine site restitution.

One common aspect of existing relevant legislation pertaining to mine closure and reclamation in the FSU countries is the application to technical and biological reclamation. In Russia, Kazakhstan and Kyrgyzstan mine closure is referred to as 'liquidation' and mining is referred to as 'subsoil use'.

3.1 Russia

Federal law on subsoil use (a direct translation from Russian to English essentially meaning Mining Law) requires initial closure and reclamation requirements and a schedule to be included within a mining licence. A detailed closure and rehabilitation plan is prepared about one year before closure, but with no clear legislative deadline, the local authorities may require the detailed closure plan at the design stage (Vershina, 2003).

Based on the law, the mine closure/liquidation objective is ensuring public health and safety and environmental protection. The mine closure is considered complete with an act of acceptance signed by competent authority.

Federal law on environmental protection requires developing and implementing measures to restore the natural environment when decommissioning buildings, structures and other objects. The mine operator is responsible for financing of the decommissioning and rehabilitation works. In the case of production sharing agreement, liquidation is carried out at the expense of investor's created liquidation fund. The fund's size, order of formation and use are determined by a production sharing agreement in accordance with the legislation of the Russian Federation. However, requirements on magnitude, frequency of payments and disbursement mechanisms of the liquidation fund are vague.

Instruction on closure work order of hazardous production objects related to mining is a most comprehensive document on mine decommissioning and closure that sets technical requirements. According to instructions for mining companies and design institutions, the measures accounted for in the mine closure project shall ensure the following:

- Geotechnical stability of mine workings.
- Prevention of pollution of subsoil resources and water bodies.
- Closure of subsidence zones, fractures and fencing of the unsafe areas.
- Rehabilitation of disturbed lands.
- Prevention of people and animal access to mine workings.
- Extinguishing of existing subsurface fires.
- Prevention of hazardous geotechnical processes (such as landslides).

A set of state standards (Russian - *gosudarstvennyy standart* - "GOST"s) define requirements for reclamation process and end land-use. GOSTs were issued in 1980 by the government of the Soviet Union as part of its national standardisation strategy and their requirements are partially duplicated in the documents described above.

According to the GOSTs, rehabilitation consists of two stages – technical and biological. The technical stage may include levelling, re-profiling, scraping, storage and placement of the fertile soil and growth media, construction of diversion channels, and disposal of toxic wastes as well as other measures. The biological stage includes fertilising, seeding and planting of trees if required by the intended post-mining land use. The

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

post-mining land use is identified in accordance with GOST 17.5.1.02-85 '*Nature protection. Lands. Classification of disturbed lands to be recultivated*'.

GOST 17.5.304-83 states that disturbed land must be preferably reclaimed to agricultural land. If the reclamation of land for agricultural purposes is not practical, afforestation to increase forest resources, improve environment or protect land from erosion is allowed. If necessary, a company can create recreational areas and nature reserves.

There are no requirements for demolishing buildings or structures. In practice, they remain in situ, supposedly for future use (Vershina 2003). This in reality leaves the abandoned buildings open to unregulated salvage activity. Usually the buildings have not been decommissioned thoroughly and consequently they add to the potential to impact upon the environment over time.

3.2 Kazakhstan

The principal legislative act governing mine closure activities in Republic of Kazakhstan is the *Law on Subsoil and Subsoil Use*, introduced in 2010, with the latest amendments added in 2015. Based on this law, the President of Kazakhstan approves the liquidation and conservation rules of the subsoil use objectives. These rules determine the order of liquidation and conservation of subsoil use objectives.

Mine closure within the Kazakhstan context relates to: a) liquidation or conservation of the site, which involves ensuring the structures on site are physically secure (prevention of collapsing, ground subsidence, landslide and flooding) upon returning the land to the State; and b) reclamation of land affected by mining operations (pollution remediation and re-vegetation). These are treated separately in terms of the law. Upon termination of the subsoil use operations or the depletion of mineral resources, a subsoil user shall immediately proceed to work on the liquidation or conservation of the subsoil use objectives.

The prescribed rules for liquidation procedures include measures to restore the land occupied by mining facilities to a condition suitable for future use. The procedural rules are to ensure the following:

- The safety of people during liquidation or conservation process.
- That civil structures located within the mining complex are protected from hazardous events such as landslides, flooding, and subsidence of soil.
- Compliance with environmental and sanitary requirements, which include the development of an environmental impact assessment (EIA) for liquidation and conservation stage. The EIA is subject to approval by state ecological and sanitary and epidemiological expertise.
- Compliance with industrial safety requirements, including development and registration of the declaration of industrial safety in the manner prescribed by regulations.
- Potential environmental impacts from closure are mitigated.

Guidelines on the development of land reclamation projects are based on the Land Code. The guidance details the development of land reclamation projects, which are aimed at reclaiming the disturbed soil cover as a result of construction activities, geological exploration, and during operational stage of the mine. Mine closure/liquidation is financed by a liquidation fund, which has to be formed by a mine operator. The annual contributions to the liquidation fund should be no less than 1% of the annual amount of operational costs. The details of the liquidation fund formation should be listed in the mining (subsoil user) contract. A 'Liquidation fund' was introduced in a new edition of *Law on Subsoil and Subsoil Use* in 2004. It should be noted that, in 2014, a new requirement was added that requires mining companies to cover a full cost of mine closure in case of liquidation fund insufficiency. This latest requirement creates a significant financial risk for the mining companies. Practical experience in Kazakhstan shows that typically a liquidation fund covers 10% of actual mine closure requirements.

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

Mine closure requirements are defined in the mine closure plan that is developed for each mine. Most of the current operating mines have a projected mine life of twenty years or more. Without instigating adequate financial provisions for closure, Kazakhstan might face serious environmental, social and economic problems from current mining activity in the future.

Reclamation and mine closure/liquidation is regulated by two different legal documents: the Law on Subsoil and Subsoil Use and the Land Code. The financing of the reclamation and mine closure is regulated separately. It is not the effective unified approach as seen in Western Australia and British Columbia, Canada. The implementation of the reclamation and mine closure/liquidation is regulated by different authorities. Figure 1 demonstrates two alternative ways a mining operator can approach mine closure/liquidation and reclamation processes in Kazakhstan.

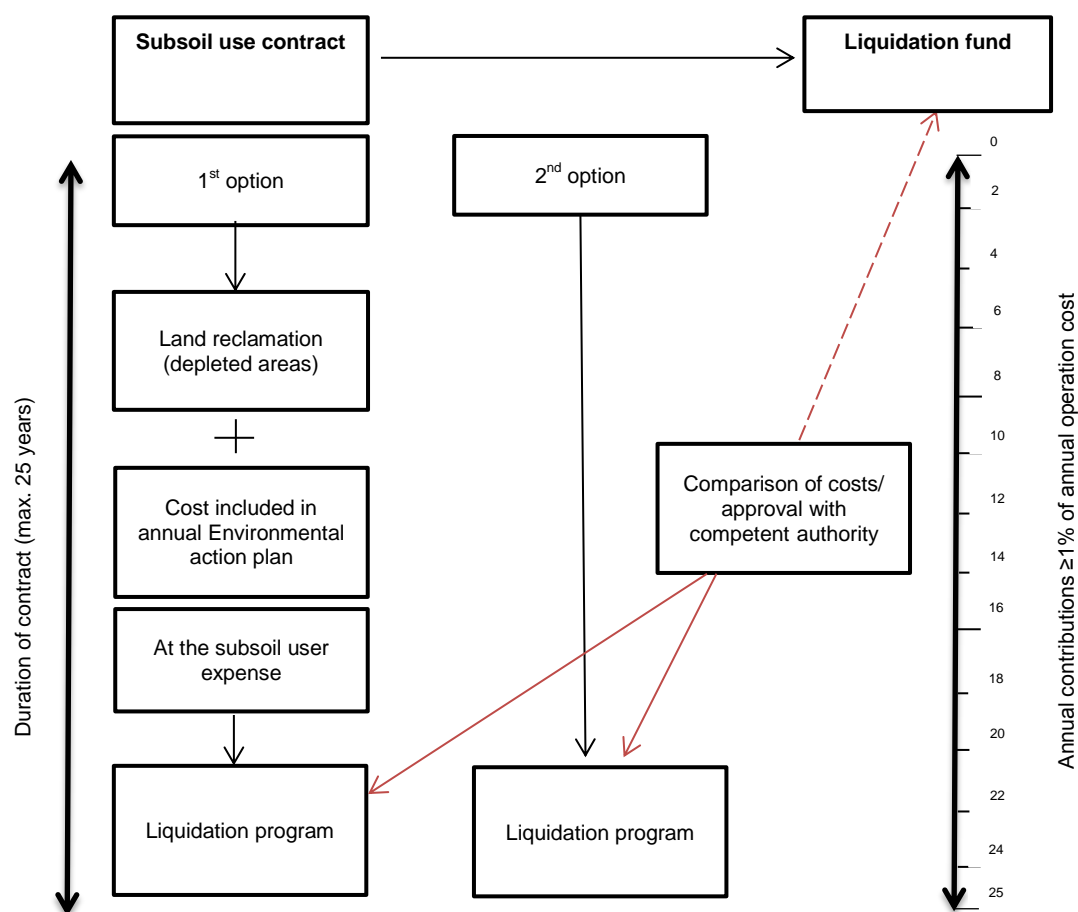


Figure 1 Schematic of a mine closure and reclamation process in Kazakhstan

3.3 Kyrgyzstan

The present day mining industry in Kyrgyzstan is dominated by one mining project, Kumtor. The mine contributes 65 per cent of the production of the Kyrgyz mining industry and is a substantial source of taxes, social fund payments, local procurement and employment (Bogdetsky & Novikov 2012). The Canada based company Centerra owns and operates the Kumtor gold mine through its wholly owned subsidiary Kumtor Gold Company (KGC). The mining elevation is at about 4,460 metres making Kumtor one of the highest

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

altitude mines in the world. As part of the routine mining activity, KGC is required to mine glacial ice which encroaches on the open pit.

The primary law governing mining activities in the Kyrgyz Republic is the Law “On Subsoil” (mining law). First introduced in 1997, amendments in 2012 were intended to modify and reduce the “command and control” involvement of the Government over the mining sector that had been inherited through persistence of Soviet-era laws (Honkonen 2012).

The Subsoil Law regulates mine closure, relinquishment and reclamation in Kyrgyzstan; but there are no guidelines, definitions or instructions on what actually constitutes mine closure. The closure objective, according to the Subsoil Law, is health and safety of the public.

The main objective of reclamation is conservation of natural balance, recultivation and improvement of land capacity that can be used for agriculture, forestry and other land uses. As in Russia and Kazakhstan, reclamation consists of two stages – technical and biological.

The reclamation criteria differ based on final land use: agriculture, forestry, water body, or fishery. The reclamation process is financed by a reclamation fund. The fund must be formed by the mining operator and monthly contributions have to be made to the fund. However, the law does not categorise the size or mechanism of the fund’s disbursements.

Gullette and Kalybekova (2014) state that there is another significant concern that may be contributing to some people’s fears: there has never been a successful closure of a mine in Kyrgyzstan. As mentioned earlier, abandoned uranium tailing sites are a testament to the environmental pollution of poorly controlled mining activities and the failure to securely store mine wastes.

4. Comparative analysis of mine closure regulations

Table 1 provides comparison of mine closure and reclamation objectives, mine closure and reclamation criteria, and financial assurance. Similar patterns in mine closure and reclamation objectives are observed in Western Australia, Canada, and Chile. Physical and chemical stability are one of the repeated objectives along with public health and safety.

The FSU countries all have public health and safety as an objective; however, this objective is not clearly defined. Geochemical and physical stability are not identified as an objective. A relinquishment criterion in FSU countries is a signed document ‘Act of acceptance’ by competent authorities. Without clear indication of objectives and criteria, the consequence being that poor mine closure can be deemed as a fulfilled obligation by regulatory authorities. Additionally, it creates corruption opportunities for unscrupulous mine owners. Financial assurance in Western Australia, British Columbia, Chile and South Africa cover full cost of mine closure. Different financial instruments are used to ensure that cost of the mine closure will be adequately provided for.

A liquidation/reclamation fund in the FSU countries was introduced over the past 10 years. However, in practice, the provision is inadequate and it does not protect the state or communities from possible environmental risk associated with poor or non-existent mine closure action. It also creates financial risk for responsible mining companies who could be obliged to provide top-up financing for effective mine closure action where liquidation funds are not sufficient.

In Russia and Kyrgyzstan the methods for calculating the required amount and frequency of payments are not provided in the legislation. Even though Kazakhstan does provide both the method of calculating liquidation fund payments and the frequency of payment, practical experience shows that the fund usually does not cover the full costs associated with effective mine closure.

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

Table 1 Comparison of the mine closure regulations

Countries	Mine closure and reclamation objectives	Financial assurance
Australia (WA)	<p>(Physically) safe to humans and animals, (geotechnically) stable, (geochemically) non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use.</p> <p>Ensure that premises are decommissioned and rehabilitated in an ecologically sustainable manner.</p>	<p>The Mining Rehabilitation Fund (MRF) is a pooled fund contributed to by Western Australian mining operators. Money in the fund will be used for rehabilitation where the tenement holder/operator fails to meet rehabilitation obligations and every other effort has been used to recover funds from the operator.</p> <p>The levy will be calculated as 1% of the total mine closure cost per annum (as an estimated figure). Performance bonds.</p>
Canada (BC)	<p>Health and safety of public.</p> <p>Future land-use and land capability objectives.</p> <p>Reclamation objective involves, among other things, ensuring there are stable landforms, an appropriate mix of vegetation and stable growth rates and a suitable combination of terrestrial and aquatic wildlife habitat components.</p>	<p>Permittee must post financial security in an amount and form acceptable to the Chief Inspector of Mines. This security is held by the government until the Chief Inspector is satisfied that all reclamation requirements for the operation have been fulfilled. Chief Inspector accepts the following forms of reclamation security: cash, certified cheques, bank drafts, term deposits (i.e. GICs), Government of Canada bonds and irrevocable standby letters of credit (ISLOCs).</p>
Chile	<p>Physical and chemical stability.</p> <p>Public health and safety.</p>	<p>Financial guarantee instruments:</p> <ul style="list-style-type: none"> • Certificate of cash deposit, bank guarantee, certificate of cash deposit with a term of no longer than 360 days, or standby letter of credit. • Fixed-rent instruments. • Other instruments, such as ore sale contract cession, pledge on export returns, corporate guarantee (Olivari, 2014).
South Africa	<p>The objectives must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations.</p>	<p>Financial provision has to be provided by one or a combination of the following payment methods:</p> <ul style="list-style-type: none"> • A contribution to a trust fund established in terms of applicable legislation. • A financial guarantee from a bank registered in terms of the <i>Banks Act, 1990</i> (Act No. 94 of 1990) or from a financial institution registered by the Financial Services Board. • A deposit into an account specified by the Minister responsible for mineral resources.
Russia	<p>Public health and safety.</p>	<p>Liquidation fund in case of production sharing agreement only – calculation instructions are not provided.</p>

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

Countries	Mine closure and reclamation objectives	Financial assurance
Kazakhstan	Restore the land to a condition suitable for future use, public health and safety.	Liquidation fund (annual contributions of 1% operating expenses).
Kyrgyzstan	Public health and safety. End land use.	Reclamation fund. Fund formation and calculation instructions are not provided.

5. Future development and trends

Current challenges in the mining industry including economic slowdown, political instability, and currency depreciation can create opportunities for FSU countries. Attracting investors in a highly competitive environment is one of the priorities for the region. Reforming legislation to further develop mine closure regulations and financial assurance will give mining companies protection from possible future environmental liabilities and incentive to invest in FSU region.

Financial institutions such as the World Bank and European Bank for Reconstruction and Development require adherence to their environmental standards that are stricter than environmental standards in FSU countries. The pressure to improve and develop better standards from financial institutions, investors and communities could well become a motivation for FSU countries to improve mine closure regulations. Recently, the Government of Kazakhstan has chosen to reform its current mining legislation by adapting Australian mining legislation. Although the scope does not include mine closure and reclamation as yet, it could be seen as a positive trend for sustainable mining practice in Kazakhstan.

While there are opportunities for future development of mine closure regulations, one of the challenges is that political policy and establishment sentiment still adhere to Soviet-style processes in most territories of the FSU. This tends to be less apparent in countries where there have been several changes of leadership since independence, and where leadership has adopted more open and 'international' style administrative and legal practices. This is a general comment, and it remains the case that mine closure practice is low on most nations' priority lists. It is likely that meaningful changes in the rest of the FSU will not be far off once one of the countries in the region will demonstrate adoption of successful legal reforms.

6. Conclusion

Whilst the FSU states have globally significant mining industries, the concept of sustainable mine closure is not currently a recognised requirement by the states' jurisdictions. This is not to say that some reforms are being considered, and this is mostly driven by pressure to compete on the world stage for internationally sourced, and responsible, financing for minerals exploitation. What is certain in the present situation is that there are no FSU State obligations and mechanisms intended to prevent a continuation of abandoned and hazardous legacy mine sites.

The FSU region can take advantage of tried and tested models of regulatory success, and lessons learned in other jurisdictions, namely South Africa, Canada, Australia and Chile.

The greatest challenge for the FSU regulatory bodies is to move from their customarily highly prescriptive approach inherited from the days of the Soviet culture of central command planning, to a more realistic approach that requires demonstrable engineered mine closure designs appropriate to individual situations. This approach is the one that underpins the regulations of what are considered the more advanced

A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

jurisdictions noted above. Having appropriate financial assurance mechanisms in place that are fair and manageable by the miner, but are also contributing to a sustainable post-mining environment, should be a fundamental principle in reforming legislation. Legacy issues in the FSU remain to be addressed by the governments involved. The most serious and urgent cases are now coming under action programmes funded by external donors. Ignoring the long-term environmental and social issues from numerous legacy sites will not serve the aspirations of those FSU nations whose national vision is to take their place in the upper echelon of developed nations.

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A comparative study of regulatory approaches to mine closure with a special emphasis on the current situation in the former Soviet Union

Z Faizuldayeva

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