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Tailings Management and New Regulatory Standards in Peru and Chile

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1. INTRODUCTION

In the Chilean case, this study aims to critically review the new regulations in comparison with the DS 248/2006 and with the global tailings standards, specifically with the International Global Tailings Management (GS) standard; in the Peruvian case, this study aims to analyze the current regulations and the Global standards to propose guidelines that contribute to the development of the terms of reference to be used for the public tender for the selection of the consultant responsible for the preparation of the new standard. This work will focus on analyzing how these new regulations incorporate two main topics: physical stability and governance. The concept of governance refers to all the company's processes, operations and support areas, procedures and practices through which matters related to tailings management issues that concern the company are decided and regulated. Good governance adds a normative or evaluative dimension to the process of governing tailings matters throughout the life cycle of your tailings deposits.

2. OBJECTIVES

1. Determine the most relevant aspects of each legal system and their specific objectives when managing a tailings deposit in all its stages, with emphasis on the regulatory aspects regarding physical stability and governance.
2. Critically evaluate the new decree DS35/2021 and decree DS 248/2006 in comparison to the ICMM global tailings management standard, in terms of physical stability and governance.
3. Critically evaluate current Peruvian regulations in comparison to the ICMM global tailings management standard, with respect to physical stability and governance.

3. SCOPE

The proposed work will be limited to a comparative analysis on two topics: physical stability and governance, of tailings regulations in both Chile and Peru in relation to the ICMM Global Tailings Management Standard.

The main regulations for this study correspond in the case of Chile to DS248/2006 and DS35/2021 (Regulations for the Approval of Design, Construction, Operation and Closure of Tailings Deposits), and in the case of Peru to RD035/1995 (Environmental Guide for the Management of Mine Tailings) and RD019-97-EM/DGAA (Environmental Guide for the Stability of Slopes of Solid Mine Waste Deposits).

4. ANALYSIS AND RESULTS

4.1 REGULATIONS AND LEGAL FRAMEWORK

The following identifies the ICMM Global Standard, which is used as the frame of reference for this study:

4.1.1. ICMM Global Standard

Following the tragic collapse of the tailings facility in Brumadinho, Brazil, on January 25, 2019.

The set of guidelines, which is the product of a public consultation, strengthens current practices in the mining industry by integrating social, environmental, technical and local economic considerations. The standard covers the entire life cycle of tailings facilities, from site selection, design and construction, through management and monitoring, to closure and post-closure.

4.1.2. Chilean Legislation

The result of these symposiums was the issuance of Decree No. 86 of the Ministry of Mining of July 31, 1970, Regulations for the construction and operation of tailings dams.

Subsequently, in 2007, the D.S. No. 248, Regulation for the Approval of Design, Construction, Operation and Closure Projects of Tailings Deposits, was published by the Ministry of Mining, repealing D.S. No. 86/1970, with the final purpose of ensuring the safety of people and the environment. The need to modernize technical regulations in relation to tailings deposits arises from the fact that in recent years the methods of disposal of these deposits changed substantially, It is for this reason that, the new DS 35/2021 establishes the elimination of any reference to such deposits or tranques in the DS 50/2015, thus eliminating the duplication of competences, and thus, provide certainty and legal certainty for obtaining the sectoral permit, thus honoring, among others, the principle of coordination.

4.1.3. Peruvian Regulations

The base document of the Peruvian regulations is the "Guide for Tailings Management" from the Mining and Metallurgical Industry. The World Bank Technical Assistance provided for the review, modernization and consolidation of environmental issues related to mining activity in Peru, with the objective of giving an overview of the planning, design, operation, maintenance and closure of tailings dams. Its purpose is that it can be used as a reference document and technical support to assist in the preparation of Environmental Impact Studies and Environmental Adjustment and Management Programs (PAMA) as required by the regulation for environmental protection in mining and metallurgical activities (DS No. 016-93-EM) and its modification (DS No. 059-93-EM).

Other standards applicable to mine tailings management include:

1. Environmental Guidance for Slope Stability of Mine Solid Waste Dumps.
2. Guide for the Design of Mining Waste Deposit Coverings
3. Guide for the Preparation of Closure Plans for Environmental Mining Liabilities
4. Environmental Guidance for the Management of Acid Mine Drainage.

4.2 PHYSICAL STABILITY

Physical stability is an aspect to be considered at all stages of the tailings impoundment: design, construction, operation and closure. The following are the topics of the global standard to be analyzed, and their respective associated principles:

THEME II: Integrated Knowledge Base

- **Principle 2:** Develop and maintain an interdisciplinary knowledge base to support tailings management throughout the tailings life cycle, including closure.
- **Principle 3:** Use the elements of the knowledge base - social, environmental, local economic and technical - to inform decisions throughout the life cycle of the tailings facility, including closure.

TOPIC III: Design, Construction, Operation and Monitoring of Tailings Facilities

- **Principle 4:** Develop plans and design criteria for the tailings facility to minimize risks for all phases of the life cycle, including closure and post-closure.
- **Principle 5:** Develop a sound design that integrates the knowledge base and minimizes the risk of failure that could affect people and the environment during all phases of the tailings facility life cycle, including closure and post-closure.
- **Principle 6:** Plan, construct and operate the tailings facility to manage risk in all phases of its life cycle, including closure and post-closure.
- **Principle 7:** Design, establish and operate risk management monitoring systems for all phases of the tailings facility life cycle, including closure.

Considering the principles associated with each of the above-mentioned topics, the following subtopics to be evaluated are established.

- Knowledge Bases (previous studies): Principle 2
- Adaptive Management (Climate Change): Principle 3
- Sound Design Criteria and Development: Principle 4 & 5
- Risk Management: Principle 6
- Instrumentation and Monitoring: Principle 7

Each principle of the Global Standard must comply with a series of requirements demanded by the Global Standard that are related to physical stability, as indicated above. Additionally, in the following table (Table 01), a comparative analysis of the Chilean and Peruvian standards under study is made, verifying compliance with each of the requirements, making a critical analysis of each subchapter or topic.

Table 01: comparative analysis of Chilean and Peruvian regulations

	CHILEAN REGULATIONS	PERUVIAN LEGISLATION
Knowledge bases miento	- (DS248) Geological, geotechnical, hydrological, hydrogeological, seismic, meteorological background information must be presented. - (DS35) Classifies by Tailings Deposit Category, material characterization, geological-geotechnical prospecting campaigns, seismic considerations, hydrological and hydrogeological design conditions. - (DS35) Tailings Deposit Rupture Study (ERD) considering credible failure mechanisms and in Article 87 instructs the owner to perform an updated Tailings Deposit Rupture Study (ERDA).	- indicates that the amount and scope of field investigations should be appropriate to the size and importance of the structure and to the complexity of the local characteristics. - The main objectives of the detailed investigations should include determining: a) the site geology of both surficial and bedrock deposits; b) the hydrogeology of the site; c) the geotechnical properties of the soil and rock strata that may affect the design of the tailings dam structure; d) the availability of suitable construction materials for dam or levee construction and impermeable liners. - It establishes that the values considered in the design must be confirmed during the execution of the work. - With respect to developing and documenting a dam breakage analysis of tailings facilities applying a methodology that considers credible failure modes
Adaptive Management tiva	- (DS248) does not directly consider climate change. - (DS248) It is the duty of the User to demonstrate to the Service that sustainable technologies will be implemented. - (DS35) does not directly consider climate change within its text.	- Peru's standards and regulations lack climate change information - The Framework Law on Climate Change N° 30754 ensures that the country is better prepared to face climate events and generate the conditions for the growth of clean and sustainable industries.
Criteria and Development of a solid design	- (DS248) does not directly consider climate change- (DS248) considers that slope stability analysis must be performed for its operation and closure stages- (DS248) does not directly consider in its text some requirements of the Global standard. - (DS35) establishes low, medium high and very high consequence levels, depending on the number of people to evacuate, disabling damage to structures, flooding area and loss or deterioration of	- The Environmental Guide to Mine and Concentrator Tailings Management has attempted to explain the issues, problems, and solutions of tailings management, initially addressing the basic principles and working its way up to the advanced technology in current use. - This Guide cannot address the specific problems and solutions at existing mines, which requires detailed investigations tailored to the unique circumstances of each case. However, existing practices provide the foundation on which tailings

	environment and ecosystems- (DS35) classification by category of tailings deposit according to consequence level and classification of size of tailings deposit- (DS35) establishes: design criteria, development of seepage analysis, minimum acceptability criteria for the evaluation of the stability of tailings in operation and closure in phase I and II. - (DS35) establishes that category 1, 2 or 3 deposits must have an engineer of record who will be responsible among others for recording all technical information and reports related to design, operation and closure. - (DS35) establishes the hydraulic considerations on water balance that will aim to maintain physical stability under any hydrological condition.	management in Peru will evolve over time to the most advanced levels of international practice, along with adaptations to meet the special challenges of tailings management in the country. - This guide does not define criteria for sound design, but only provides recommendations and references to national and international experiences.
Risk management	- (DS248) Tailings operation procedure documents must be submitted for all construction specifications and operating standards and that the project must submit all construction specifications and operating standards. - (DS35) a construction management, operation and monitoring system must be established to ensure and provide traceability of tailings and risk management of the deposits in consideration of their original design - (DS35) a construction management plan (CMP) must be submitted to ensure construction quality and compliance with the approved design - (DS35) an operation management plan (OMP) must be submitted to describe the activities, strategies and operating procedures - (DS35) instructs to submit the	- The Environmental Guide for Tailings Management does not include a risk management methodology, it only mentions some recommendations and considerations to be taken into account for external geodynamic risks, effects of the country's climate, seismic risk, environmental risks, as well as physical stability risk.

	updated construction report (CAR).	

Instrumentation and monitoring	- (DS248) establishes that control and monitoring plans must be included, and instructs the variables to be monitored and controlled by the operator. - (DS35) A Comprehensive Monitoring Plan (PMI) must be in place, and based on it, the respective updated reports must be developed with the monitoring results, verifying the defined tolerable thresholds.	- installation and monitoring of piezometers is essential. - The dam should be visually inspected daily for any signs of instability. - The guide does not mention the need or requirements to develop an instrumentation project or monitoring of tailings impoundments. There is no guide or standard that regulates the instrumentation and monitoring of tailings deposits in Peru.

4.3 MANAGEMENT AND GOVERNANCE

It has been concluded that the main causes of recent catastrophic failures of tailings impoundments are based on organizational shortcomings and with relevance in risk analysis and governance. Another important aspect found is that the deficiency does not lie in the state of knowledge, but in the effectiveness with which this knowledge is applied.
The purpose of the Tailings Governance Framework is to enable greater focus on the key management and governance elements required to avoid catastrophic failure of tailings storage facilities (TSFs). The following are the principles of the global standard to be discussed in relation to Management and Governance:

THEME IV: Management and Governance

- **Principle 8:** Establish policies, systems and accountability to support the safety and integrity of tailings facilities.
- **Principle 9:** Appoint and empower an engineer of record.
- **Principle 10:** Establish and implement levels of review as part of a sound quality and risk management system for all phases of the tailings facility life cycle, including closure.
- **Principle 11:** Develop an organizational culture that promotes learning, communication and early recognition of problems.
- **Principle 12:** Establish a process to report and address concerns and implement whistleblower protections.

Considering the principles associated with each of the above-mentioned topics, the following subtopics to be evaluated are established.

- Policies and Accountability to Support Security (Principle 8)
- Engineer of Record (Principle 9)
- Risk and Quality Management (Principle 10)
- Organizational culture, learning, communication and early problem solving (Principle 11)
- Managing Employee and Contractor Concerns (Principle 12)

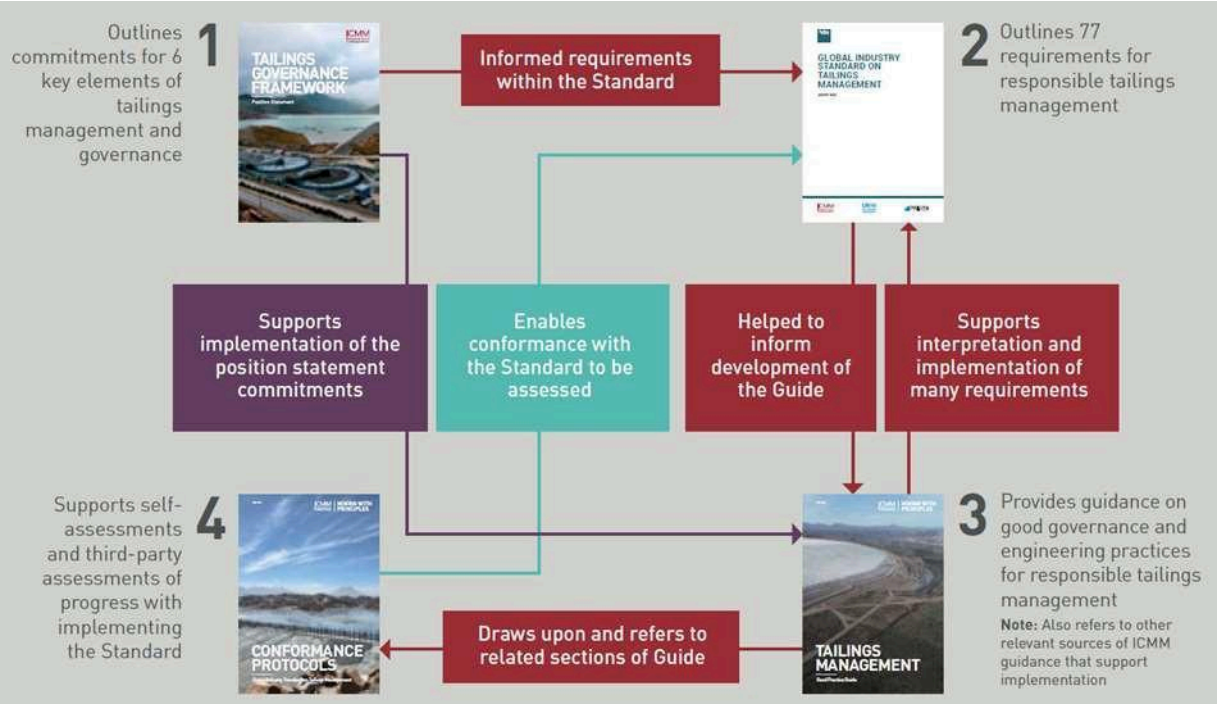
Each principle of the Global standard must comply with a series of requirements. In the following table (Table 02) a comparative analysis of the Chilean and Peruvian standards under study is made, verifying compliance with each of the requirements, and each subchapter or topic is analyzed from a critical point of view.

Table 02: Comparative analysis of Chilean and Peruvian regulations, with reference to Governance

	CHILEAN REGULATIONS	PERUVIAN LEGISLATION
Policies and accountability to support safety and security dad	-(DS248) Does not incorporate any of the requirements stated in the GS regarding policy statements and accountabilities to support the security of the deposits in terms of management and governance of the deposits. - (DS35) requires that the DR governance model be integrated with the Company's other systems, policies, practices and processes, but does not require a specific governance model structure. - (DS35) defines, in line with the GS, the figure of an "Independent Reviewer" as a Professional who carries out a review of the different aspects involved in a RD.	- The standard establishes that a report on the status of the evaluation of the physical stability of operating tailings deposits must be submitted every 2 years, independent of the risk classification of the deposit collapse.
Engineer of record	- (DS248) does not consider the figure of a Tailings Deposit Engineer of Record or any similar figure. - (DS35) requires the figure of an Engineer of Record (ERR), it does not specify that this service must be provided by an engineering firm, it focuses on professional experience. - (DS35) requires the submission and periodic updating of a Construction Management Plan (CMP), but does not require the development of an information exchange plan in the event of a change of RDI.	- The guide does not incorporate the term Engineer of Record, but mentions under Construction Monitoring, Inspection and Supervision that design and construction are processes that usually take place as the dam is raised during the life of the mine.
Risk and quality management	- (DS248) requires a risk assessment at the design stage in relation to the physical stability of reservoirs. - (DS248) does not require a dam safety review that considers an evaluation of credible failure modes, however, it does require, in the design phase, a slope stability analysis, which can be evaluated periodically.	- The Guide does not mention risk management, it only gives recommendations on some types of risks, in terms of quality it mentions that during Construction Monitoring, Inspection and Supervision - However, the Guide for the development of mine closure

	- (DS248) does not establish specifications on closure plans. - (DS35) risk assessment is incorporated into the Tailings Deposit Breakage Study studies. - (DS35) requires the IDR to review and sign each Updated Construction Report (CAR). - (DS35) and (DS248) refer to law 20,551 which regulates the closure of mining sites and facilities.	plans requires the formulation of closure plans considering the associated costs and the obligation to update the plan every 5 years to verify the implementation of the plan updates.
Organizational culture, learning, early problem communication	- (DS248) requires the implementation of personnel training programs for the safe operation of the tank and related works. DS248 makes no reference to the rest of the requirements. - (DS35) requires that a training manual be included in each Updated Construction Report (ICA), in which the instruction of the operators must be indicated and the background of the person responsible for the operation must be attached.	- The guidance is silent on developing an organizational culture that promotes learning, communication and early recognition of problems in tailings impoundment management. - focuses on the fact that tailings management should be considered as important as metal recovery.
Manage Employee and Contractor Concerns	- (DS248) does not incorporate any of the requirements outlined in the GS regarding the management of concerns of employees and contractors involved in the design, construction and operation of tailings impoundments. - (DS35) does not explicitly refer to other requirements in relation to the management of concerns or findings by employees or contractors, however, it requires the user to demonstrate that the best available national and international practices will be implemented and ensure the risk management of the facility.	- no process is in place to report and address concerns and implement whistleblower protections. - To cover all aspects of Integrated Mine Tailings Management, it is recommended that the following documents be considered: 1. Tailings Governance Framework. 2. Global Tailings Management Standard for the mining industry. 3. Good Practices Guide for Tailings Management. 4. Guidelines for compliance with Tailings Management Protocols - Figure 01 shows the basic documents for the elaboration of rules and regulations for Tailings Tailings Tailings Management.

Figure 01: Basic documents for the elaboration of rules and regulations for Tailings Management



5. CONCLUSIONS

1. In relation to physical stability in the Chilean regulations, after reviewing the old DS248 in comparison to the Global Standard, we see that DS248 is a step behind the new international standards. In addition, DS35 establishes that a construction, operation and monitoring management system must be implemented to provide traceability to tailings and risk management of the deposits, through different management plans well defined in its text.
2. In relation to physical stability in Peruvian regulations, Peru has minimum legislation to ensure minimum compliance with design criteria, such as safety factors for slope stability, management of facilities and monitoring of geotechnical instrumentation throughout the life cycle of the reservoir,
3. In relation to Tailings Repository Management and Governance in Chilean regulations, it is worth mentioning that the new DS35/2021 constitutes an important advance in this matter in comparison to the old DS248/2006 in which the issue is practically not addressed. In the new DS35/2021 the incorporation of the requirement to develop a Tailings Deposit Management System expressly considering the formulation of a governance model and the updating of the different plans contained in this one stands out. On the other hand, it also highlights the inclusion of the figure of an Engineer of Record who must have demonstrable experience in tailings deposit engineering,
4. It can be stated that Peruvian legislation does not have management and governance guidelines for mine tailings management. The Guide mentions general recommendations to achieve the objectives for tailings management, indicating that a coordinated effort is required between mine management and operations personnel, and the participation of

qualified and experienced professionals throughout the life cycle of the deposit. However, these guidelines are not sufficient to establish a Management and Governance framework as set out in the Global Standard.

5. With respect to Peruvian regulations related to Tailings Repository Management, it can be concluded that its regulations are outdated and dispersed, are more than 26 years old, do not have a single ordered text but several standards and guides, and do not include key issues such as Governance, Risk Management, Engineer of Record, Independent Review Committees, Tailings Repository Manager, among others.
6. In Peru there is no government policy for the treatment and management of mining tailings, even though it is the second largest copper producer in the world and the mining sector is responsible for 10% of GDP, 60% of exports, 16% of private investment and 19% of taxes paid by companies, according to the National Mining Society (SNMPE). Therefore, it is urgent to establish a Mining Tailings Management Policy that allows reaching the final objective of zero harm to people and the environment, and zero tolerance for human fatalities, according to the Global Standard.
7. Another important aspect of this research is that due to the lack of standards and regulations in Peru regarding tailings deposit management, transnational companies that execute and operate projects in Peru have taken the application of international standards such as CDA, ICOLD, ANCOLD and recently ICMM's IGSTM as convenient. This is required by international financial organizations such as IDB or the World Bank or to meet sustainability requirements of stock exchanges where the companies are listed.
8. An idea that emerged from this research was to create a registry of mining contractors, specialists in Tailings Deposit Operation, which can provide services like stripping, advancement or deepening of mine, in many countries such as Canada and Australia there are contractors who perform ore processing and charge per ton processed, in this case they would charge per ton of tailings disposed.
9. A special and unique administrative procedure must be established, which includes among its provisions the instances of citizen participation. In addition, it must consider the deadlines that the authority must resolve the conditions that must be met to obtain the permit and the complaint mechanisms.

6. REFERENCES

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