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CHALLENGE TITLE	
A3: Energy Efficiency and Monitoring in Transport and Pumping Systems	
MACRO-AREA	
Water	
PROBLEM/GAP	
The transport of water and tailings over long distances and geographical heights consumes a considerable fraction of the total energy of a mining operation. Current pumping systems face hydraulic transients, cavitation, and accelerated wear due to variability in flow rates and water quality, which increases maintenance costs and reduces asset availability.	
CHALLENGE DESCRIPTION	
The challenge seeks to develop and validate technological solutions that improve the energy efficiency and reliability of water and tailings transport and pumping systems in mining. Innovations in hydraulic design, pumping technologies, control systems, and predictive monitoring that reduce energy consumption per unit of water transported and increase asset availability are prioritized. Solutions must be evaluated under representative operating conditions, considering their impact on operational cost reduction, equipment lifespan, and system stability.	
GENERAL OBJECTIVE	
To develop and validate technological solutions that improve the energy efficiency and reliability of water and tailings pumping systems in mining.	
SPECIFIC OBJECTIVES	
1.	Reduce specific energy consumption.
2.	Increase asset availability while maintaining required flow and head.
3.	Implement predictive monitoring and hydraulic optimization of transport networks.
4.	Validate high-efficiency and high-reliability pumping systems.
EXPECTED RESULTS	
1. Quantitative diagnosis of energy consumption and main causes of failures in representative pumping lines, with documented baseline. 2. Obtaining validated failure rates through a pilot operated under real conditions, with energy balance and performance report. 3. Standardized and transferable best practices for the operation, monitoring, and maintenance of pumping systems in high-altitude mining. 4. Real-time diagnostic prototype that detects cavitation, leaks, or premature wear before a failure occurs.	
SCOPE	
Includes: • Diagnostic assessment for existing pumping systems (hydraulic, energy, operational, and energy recovery). • Design and operation of a pilot on a real pumping line, validating selected technological solutions.	

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- Integration of digitalization and predictive monitoring tools into the pilot.
- Conceptual scaling to full operation and training program for operators and technical teams.

Excludes:

- Massive replacement of existing pumping infrastructure.
- Complete redesign of pumping networks or associated civil works.

KEY PERFORMANCE INDICATORS (KPIs)	
1.	Specific pumping energy consumption (kWh/m³ transported).
2.	Operational availability of pumping assets (%).
3.	Mean time between failures (MTBF) (hours).
4.	Annual operational cost of the evaluated system — OPEX (USD/year).
5.	Reduction of overpressure events or hydraulic transients (%).
6.	Response time of the predictive monitoring system to anomalies (minutes).
7.	Reduction in corrective maintenance costs compared to baseline (USD/year).
8.	Accuracy of the hydraulic model or digital twin compared to real measurements (% error).
9.	Percentage of operational time of the pumping network (%).

DESIRABLE CONTRIBUTION TO ITL CAPACITY BUILDING

- Hydraulic laboratory with capacity for characterizing pumping equipment and plotting performance curves, available as a service for partners and manufacturers. (High)
- Digital twin models of pumping systems developed and validated, replicable in different mining site configurations. (Very High)
- Predictive monitoring capacity installed at ITL, as a basis for offering diagnostic and operational optimization services to the sector. (Yes)
- Development of predictive maintenance protocols, available as a service for the regional mining industry. (Yes)

INDUSTRY AFFECTED BY THE CHALLENGE

Metallic/Non-metallic Mining, Sanitation Companies, Desalination Operators.