

# REINFORCEMENT LEARNING USED TO OPTIMISE PIPELINE PERFORMANCE AT 3,000M ANDEAN MOUNTAINS

## EXECUTIVE SUMMARY

Copper mining operations are energy intensive and must ensure water availability for continuous ore processing. In Chile, this is set against a context of mining sites operating in areas of scarce water resources, reducing ore grade and increasing tensions in the price and supply of electricity.

IntelliSense.io technology has been deployed at the Anglo American SAR Pipeline at Los Bronces Copper Mine, applying Machine Learning and physical models to real-time data to provide intelligent decision-making actions for the pump operations with the following expected benefits:

- 4-8% average energy savings per year.
- 25-50% decrease in the number of pump switches on and off.

## PROJECT HIGHLIGHTS

Anglo American's La Confluencia SAR Pipeline and Pumping System transports up to 800 litres of water per second over a distance of 52km with more than a 2km rise via four pumping stations. The recovered water from tailings waste is pumped back to the plant to be reused.

IntelliSense.io deployed its Industrial IoT and AI powered real-time decision analytics platform "Brains.app" and its Optimisation as a Service (OaaS) Pipeline Optimisation application at the SAR Pipeline. A sensor data lake was created by integrating real-time measurements and applied advanced algorithms to create virtual sensors. The future system performance is predicted, and real-time recommendations on optimised pumping schedules and tank levels are provided. The recommended schedules deliver significant energy efficiency and improved asset conditions while assuring a consistent volume of water delivery.

Key system components and deliveries are:

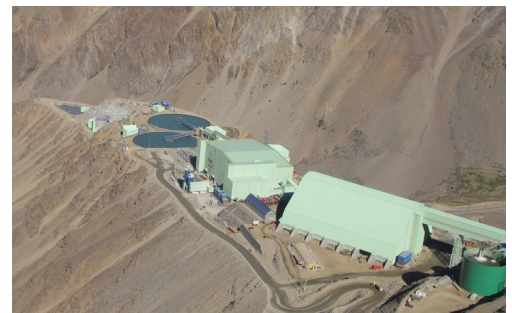
### Sensor Data Lake:

IntelliSense.io integrated real-time operational and integrity data from site systems and developed virtual flow sensors. All this information is available in a sensor data lake that enables a complete understanding of the pipeline status in real time.



*"The system is currently running successfully at the site. We are happy with the results delivered by the system to date: reduced energy consumption, provide assurance of volume of water delivery and improved pump condition."*

VP Anglo American Chile



*"The results delivered by the optimised pump schedules are encouraging and so we have asked IntelliSense.io to extend the project scope by integrating their system outputs with the control system to completely automate the SAR Pipeline operations."*

VP Anglo American Chile



**System Prediction and Simulation:**

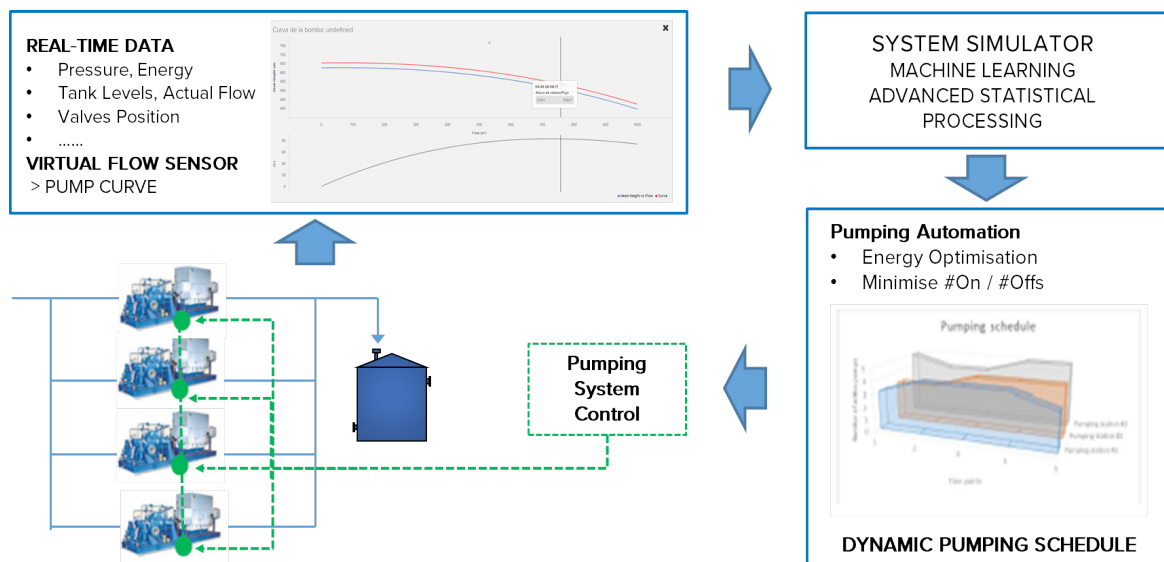
An algorithm was developed to enable the simulation of the pipeline operation in real time. By modelling the finite combination of pump station configurations against the Target Flow Rate, an optimised pumping schedule can be generated to deliver the required water through the pipeline.

**Optimisation Recommendations:**

The optimisation of the SAR Pipeline operation is achieved via delivery of a dynamic pumping schedule to the operators, increasing their productivity as time is freed up for them to dedicate to other tasks, and enhancing the efficiency of the pipeline.

**Reinforcement Learning System and Real-Time Benefit Tracking:**

Reinforcement Learning technologies, a cutting-edge branch of Machine Learning, are used for the prediction and control of the system. Software agents continuously determine the optimal behaviour to maximise the performance of the system within the specific operational context, and deliver real-time benefits tracked against the KPI baseline. The quarterly updates of the Pipeline Optimisation application guarantee the alignment with the needs of the SAR Pipeline operations.



IntelliSense.io Pipeline Optimisation Application System Architecture

**APPLICATION BENEFITS**

- The optimised SAR Pipeline pump schedule reduces the energy consumption while the system is running at full capacity. The expected 4-8% annual energy saving will increase at the same rate as site energy costs.
- Automated, dynamic pumping schedule delivers continuous optimisation and is expected to decrease the number of pumps switches on and off between 25 and 50%.
- Additional indirect benefits are generated by the reduction of the maintenance costs through reducing the number of pump switches (on/off's) and the online analysis of bearing vibration & temperature data to help operations shift towards condition based maintenance.
- Operators at the mine quickly adopted the application while praising its performance: "It does the same as me when I operate the system" (Operator 1), "The app is really useful" (Operator 2).