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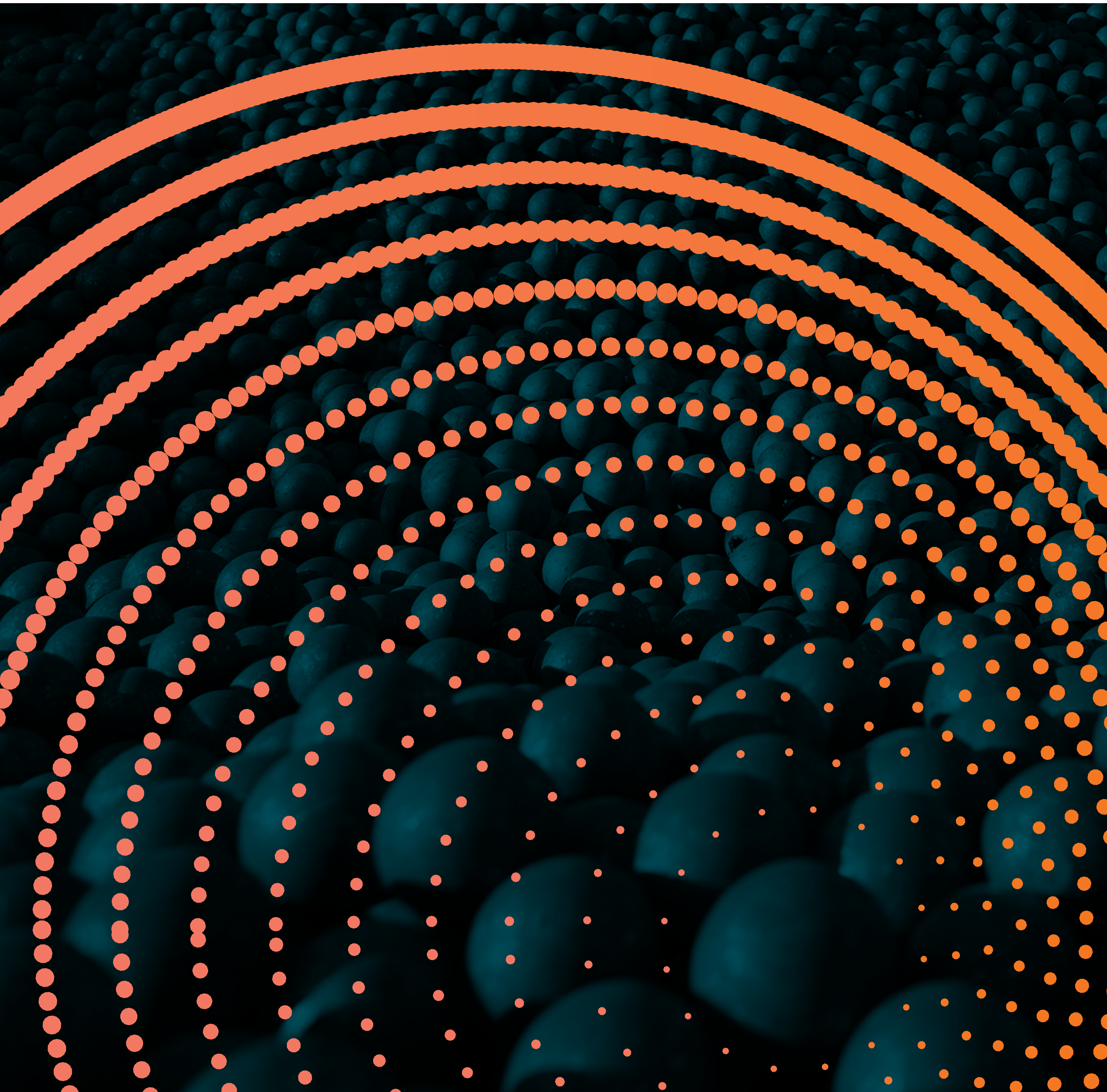
Accelerated Ramp-up and Sustained Throughput Improvement with MillROC Support

Case Study: Cowal Gold Operations

Milling



Executive Summary

A case study in accelerated ramp-up and sustained throughput improvement with MillROC support.

Post-reline ramp-up of semi-autogenous grinding (SAG) mills represents a critical phase in comminution circuit performance, yet it is frequently under-optimised due to conservative operating practices. At Cowal Gold Operations, standard restart procedures prioritised liner protection through reduced ball charge and cautious control strategies, resulting in extended ramp-up periods and delayed recovery of steady-state throughput.

Following a major shutdown and relining event in 2025, a structured optimisation program was implemented to improve ramp-up efficiency without increasing operational risk. The approach incorporated controlled ball charge increases, disciplined adjustment of mill load and real-time monitoring of internal mill dynamics using MillROC and MillSlicer technologies.

The results demonstrated that ramp-up duration could be reduced from approximately six weeks to four weeks, while achieving improved throughput, increased power utilisation and enhanced operational stability. Importantly, these gains were achieved without evidence of accelerated liner wear or increased risk of damage.

This case study highlights the value of a data-driven and systematic approach to ramp-up optimisation, demonstrating that significant production benefits can be realised without compromising equipment integrity.

Results

- Ramp-up duration was cut from six weeks to four weeks.
- Throughput increased ~14% (893 t/h to 1,019 t/h).
- SAG mill power rose from 10,600 kW to 11,150 kW.
- Ball charge increased from 11.0% to 12.2%.
- No abnormal liner damage detected throughout.

Key Takeaways

- A data-driven ramp-up strategy delivers significant production gains without compromising equipment integrity.
- Adjusting only one variable at a time, with stabilisation periods, ensures controlled and repeatable performance improvements.
- Real-time monitoring tools (MillROC and MillSlicer) are critical for safely increasing operating intensity post-reline.
- Conservative restart practices, while mitigating mechanical risk, carry a measurable economic cost in lost gold production.
- Improving ramp-up efficiency represents a high-value opportunity for operational optimisation.

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Introduction

Cowal Gold Operations, located in New South Wales, Australia, operates a large-scale gold processing facility with a conventional comminution circuit consisting of primary crushing followed by semi-autogenous grinding (SAG) and ball milling. The circuit is configured to process a blend of open pit and underground ores and feeds downstream flotation and leaching processes.

Due to the relatively coarse grind size requirement of approximately 180–200 µm, the processing plant is not highly sensitive to grind size variations. Instead, plant performance is strongly dependent on maximising throughput through efficient utilisation of installed milling capacity.

A challenge at Cowal has been the optimisation of SAG mill performance following relining events. During these periods, conservative operating strategies are typically employed to minimise the risk of liner damage. While such strategies are effective in mitigating mechanical risk, they can result in sub-optimal breakage conditions, reduced power draw, and extended ramp-up periods.

Lost throughput during ramp-up directly translates to reduced gold production and economic loss. As a result, improving ramp-up efficiency represents a high-value opportunity for operational optimisation.

Following a major shutdown and relining campaign in March–April 2025, an initiative was undertaken to implement a structured, data-driven ramp-up strategy aimed at accelerating recovery to steady-state performance while maintaining liner integrity.

Circuit description

The Cowal comminution circuit consists of a conventional SABC circuit with three primary stages:

- Primary crushing.
- Semi-autogenous grinding (SAG).
- Ball milling and classification.

The SAG mill is the primary determinant of plant throughput.

Operating philosophy

Mill speed and slurry density are adjusted and optimised during operation and ramp up. The circuit is designed to operate at a coarse grind target of 180–200 μm. Under these conditions, throughput maximisation is achieved through maintaining optimal breakage efficiency within the SAG mill.

Pre-reline baseline performance

Prior to shutdown, the circuit was operating under stable conditions as summarised in Table 1.

Parameter	Unit	Value
SAG Feed Rate	t/h	1077
SAG Power	kW	10,600
SAG Speed	% Nc	75
Ball Charge	%	11.0
Total Load	%	24.0

Table 1: Pre-reline operating conditions.

These conditions provided a stable operating baseline and served as the reference point for evaluating post-reline performance improvements.

Post-reline operating environment

Following the relining event, several factors influenced the performance of the grinding circuit during the ramp-up period.

Ore characteristics

A significant change in feed composition was observed post-reline, including:

- increased proportion of underground ore
- reduced availability of softer oxide material
- overall increase in ore competency.

These changes resulted in more challenging breakage conditions and increased demand on mill energy.

Operational constraints

The ramp-up phase was further impacted by several operational constraints:

- Decrease in ball charge heading into shutdown in preparation for the reline.
- Feed instability due to intermittent crusher availability.
- Presence of tramp steel from underground sources.
- Feeder blockages and transient operational disturbances.

Impact on performance

These combined factors resulted in:

- reduced impact intensity within the mill
- inadequate steel-to-rock interaction
- lower effective utilisation of installed power
- reduced throughput and efficiency.

These conditions highlighted the need for a structured approach to ramp-up optimisation.

Optimisation approach

The optimisation strategy was developed to systematically improve SAG mill performance while balancing competing operational objectives.

Key trade-offs

The ramp-up strategy required careful balancing of three key factors:

1. Maximising throughput through increased mill power draw.
2. Maintaining effective breakage conditions through appropriate steel charge.
3. Protecting newly installed liners from excessive impact.

Target operating conditions

Based on historical performance and operational constraints, target conditions were defined as:

Parameter	Target
SAG Power	~11,500 kW
Ball Charge	~13%
Total Load	~25%

Table 2: Defined target conditions.

These targets represented achievable conditions that would maximise performance while maintaining acceptable operating risk.

Ramp-up methodology

A structured and disciplined methodology was implemented to achieve controlled and repeatable improvements.

Operating philosophy

The ramp-up procedure followed several key principles:

- Adjust only one operating variable at a time.
- Allow sufficient time for system stabilisation.
- Avoid introducing multiple simultaneous changes.

Controlled variables

The primary variables adjusted during ramp-up were:

- Ball charge (via controlled steel addition).
- Mill load (through adjustment of weight setpoints).

These variables were selected based on their direct influence on breakage efficiency and power draw.

Process monitoring and analytics

The optimisation program relied heavily on advanced monitoring tools to provide visibility into internal mill behaviour.

MillROC

MillROC provided:

- real-time monitoring of key process variables
- centralised data visualisation
- trend analysis of load, power and throughput.

MillSlicer

MillSlicer enabled detailed analysis of:

- conditions in which slurry pooling was suspected to be more prevalent with certain parameters
- distribution of liner strikes
- charge behaviour dynamics.

This information was critical for ensuring that increased operating intensity did not result in excessive liner stress.

Ball charge estimation

Ball charge was tracked using:

- power-based estimation models
- steel consumption rates.

This allowed for accurate and proactive control of charge levels.

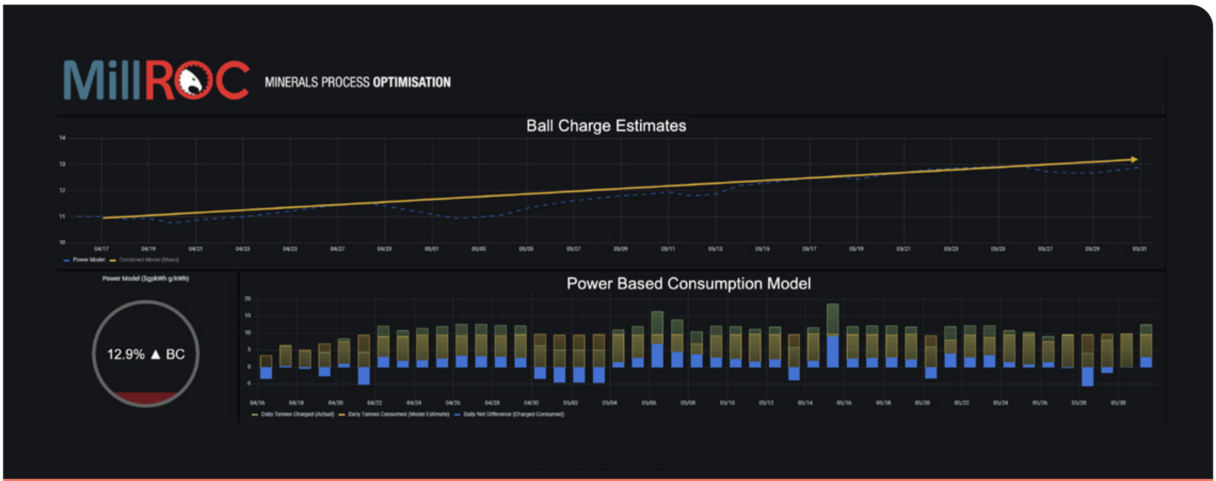

Figure 1: MillROC ball charge tracking.

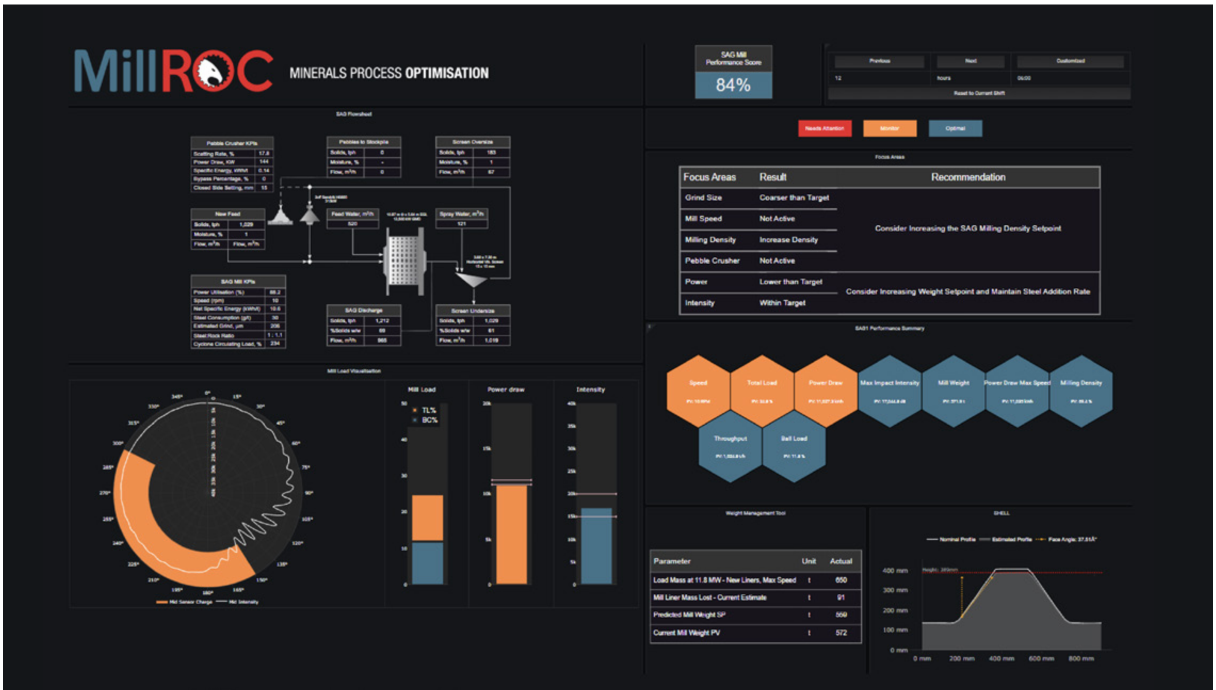

Figure 2: Monitoring progress using MillROC.

Results and discussion

Ramp-up performance

Progressive increases in ball charge and mill load resulted in measurable improvements over the first four weeks post-reline.

Parameter	Week 1	Week 4
Feed Rate	893 t/h	1019 t/h
SAG Power	10,600 kW	11,150 kW
Ball Charge	11.0%	12.2%
Total Load	23.0%	24.0%

Table 3: Ramp-up performance.

Throughput improvement

Throughput increased by approximately 14% during the ramp-up period. This improvement was driven primarily by:

- increased power utilisation
- improved impact efficiency
- enhanced steel-to-rock interaction.

Energy efficiency

The increase in SAG power resulted in:

- improved energy transfer to the ore
- higher breakage rates
- more efficient comminution.

Operational stability

The structured ramp-up approach resulted in:

- reduced fluctuations in mill load
- improved control response
- more stable circuit operation.

Liner protection

Despite increased operating intensity:

- no abnormal liner damage was detected
- impact levels remained within acceptable limits
- monitoring enabled proactive intervention where required.

Continuous improvement

The results demonstrate that ramp-up optimisation is an ongoing process. Further opportunities for improvement include:

- refinement of operating parameters for different ore types
- integration of ore competency data into control strategies
- continued use of advanced analytics tools
- ongoing collaboration between operational and technical teams.

Summary of benefits

Production

- Faster recovery to steady-state operation.
- Increased throughput during ramp-up.

Efficiency

- Improved utilisation of installed power.
- Enhanced comminution performance.

Risk management

- Maintained liner integrity.
- Controlled operating conditions.

Operational capability

- Improved process understanding.
- Increased operator confidence.

Conclusions

This case study demonstrates that post-reline ramp-up can be significantly improved through a structured, data-driven approach.

Key outcomes include:

- reduction in ramp-up duration from approximately six weeks to four weeks
- increased throughput and power utilisation
- improved operational stability
- effective management of liner wear risk.

The results confirm that controlled optimisation of ball charge, supported by real-time monitoring and disciplined operating practices, provides a practical and effective pathway to improving SAG mill performance.

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References

Vu, H.K. (2025). *Post-reline SAG mill optimisation: A case study in ramp-up efficiency.*

Cowal Gold Operations internal data.

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A tega company

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