Amandelbult Complex
Scraper winch proximity detection

15 September 2022

Thomas Conolly

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- Project status, challenges and the way forward

System overview & background

Concept Overview | Explainer Video

SWPD | Why?

AngloAmerican

PLATINUM

AMANDELBULT COMPLEX

SAFETY INNOVATION

SCRAPER WINCH PROXIMITY DETECTION

In our quest to achieve Zero Harm, Amandelbult Complex continues to re-imagine mining to improve people's lives.

#BurningAmbition

TO BE THE WORLD'S MOST VALUED MINING COMPANY BY 2025

DEAN PELSER #BurningAmbition CHALLENGE

SHE CATEGORY - WINNER 1ST PLACE

BUILDING ON SUCCESS... Senior asset manager Thomas Conolly (right), reliability engineer Ryno Strydom (second from right), with Amandelbult Complex senior general manager Patrick Morutlwa (second from left), and team members Jaundre de Beer and Paul Coetzee (previously from Amandelbult Complex). The team received first place at the Dean Pelser Burning Ambition awards, in the safety, health and environment category for their winch proximity detection project.

ELIMINATION OF FATALITIES

HARD AT WORK... Dishaba Mine's automatic winch installation, where the winch proximity detection prototype will first be trialled.

Both Tumela and Dishaba Mines perform conventional breast stoping and currently use scraper winches to clean faces and gullies. The scraper winch is widely used in underground mining operations to move ore from mining stopes and gullies to the ore-passes.

Due to the nature of these installations, winches remain a critical safety concern and one of the main 'killers' in the mining industry as a whole.

In their submission for the Dean Pelser Burning Ambition awards, a team from Amandelbult Complex developed a concept which makes use of the missing person locator (MPL) technology and WPD's currently installed signalling device to automatically stop the winch should a person enter the path of the scraper.

This project, which is currently still in concept phase, seeks to provide a fail-to-safe way of operating our scraper winches and in so doing eliminate fatalities associated with scraper winches, from our operations and the mining industry as a whole.

The project team is currently in the process of setting up a surface trial, to test and refine the concept prototype at the automatic winch trial site at Dishaba Lower.

Real Mining. Real People. Real Difference.

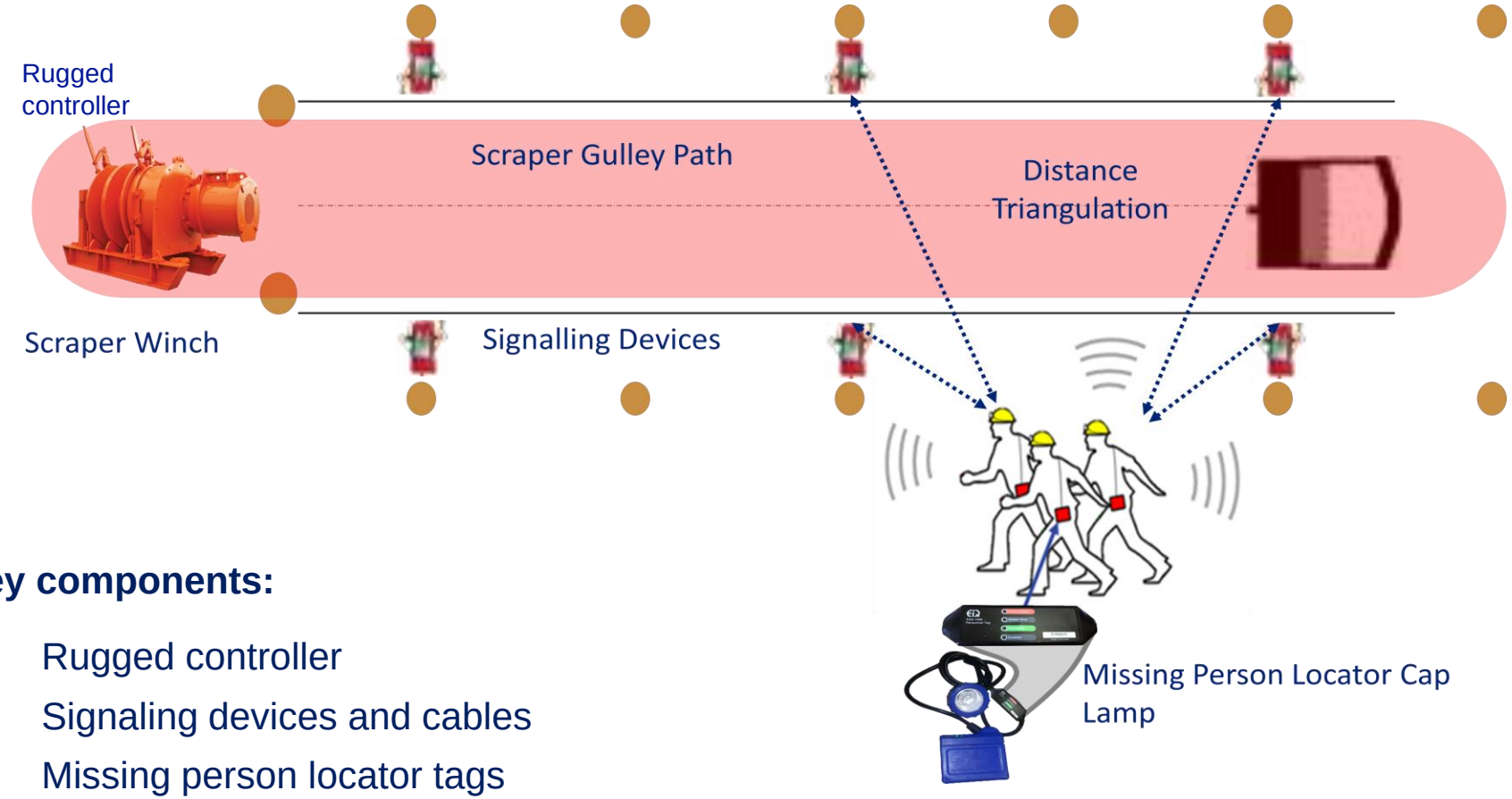
Why implement SWPD?

- 3 Winch fatalities since 2016
- Numerous winch related incidents
- >60% of incidents due to personnel interacting with the moving parts of the scraper winch

Process Risk Review

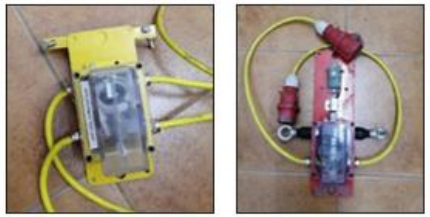
- Full system engineering review
- Third-party system review
- HAZOP studies
- Fault Tree Analyses
- Various trial phases
- AAP Invesco Process Risk Review
- Independent Process Risk Review with a focus on the following key areas:
  - Safety and fatalities
  - Maintenance requirements
  - Sustainability
  - Operational readiness
  - Process complexity
- Business Process Mapping
- Tie-ins with various modernization initiatives

System Overview

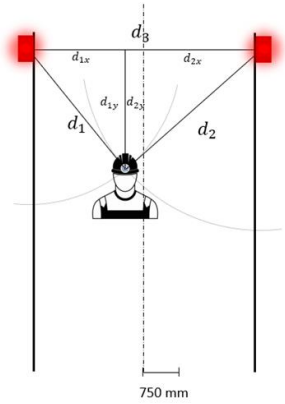


Missing Person Locator

Winch Signalling System



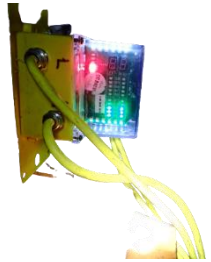
Triangulation



Key components:

- Rugged controller
- Signaling devices and cables
- Missing person locator tags

System Components

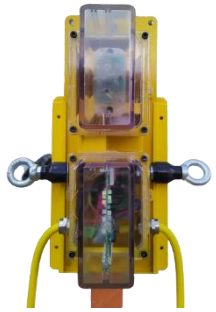


Rugged controller (RC):

Interprets signals from SD regarding RFID proximity to implement the proper response.

Roof mounted plate (RMP):

Used to mount SD's to the HW. Appropriate when there is no available backplate mounting position.



Signalling device (SD):

Uses RFID to determine personnel proximity to predetermined danger zones.

In pairs (along gullies) SD's create a 0.75m danger zone from the centre of the gully.
As standalone devices, SD's produce a 8m radius danger zone.

Back plate (BP):

Preferred mounting method. Used to mount on grout packs, stick support and pillars.

Cables:

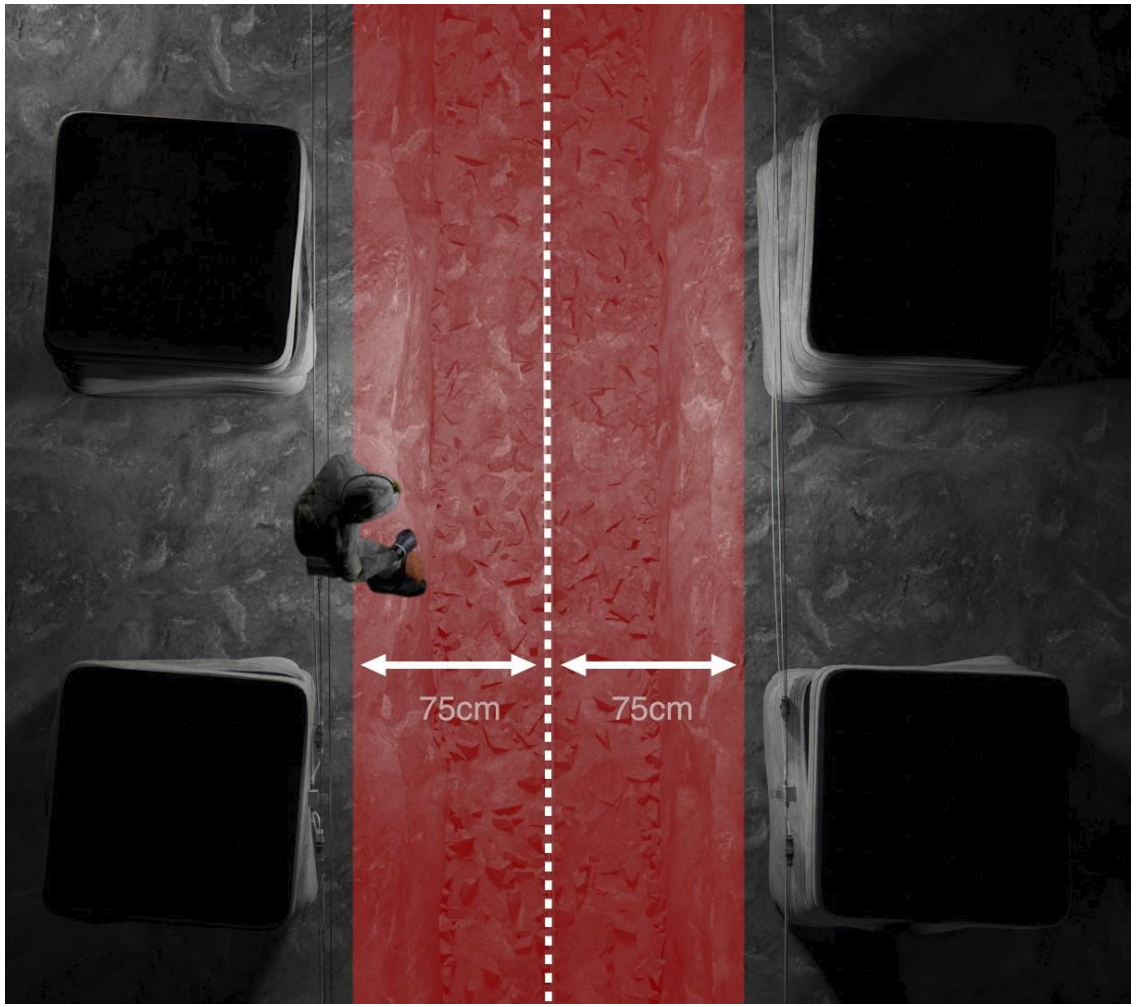
5m and 16m lengths. Powers and relays signals between winch nodes.

End-plug:

Used to reset SWPD systems in the case of alterations to system configuration. *(Important engineering and stope servicemen use)*

System Operation | Gullies

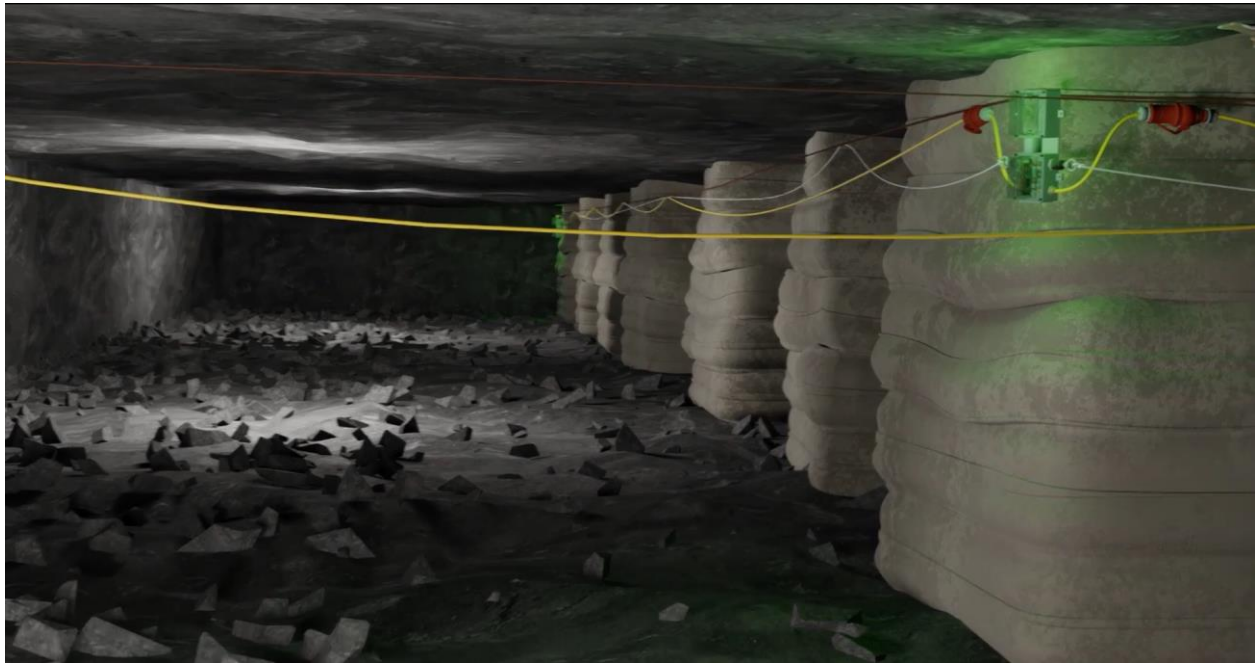
- A proximity zone is created 75 cm from the centre of the gully
- If a person enters the gully, the winch will be tripped.
- The rugged controller shows the scraper winch operator where proximity is detected
- The winch can be started again once the proximity detection has cleared the danger zone

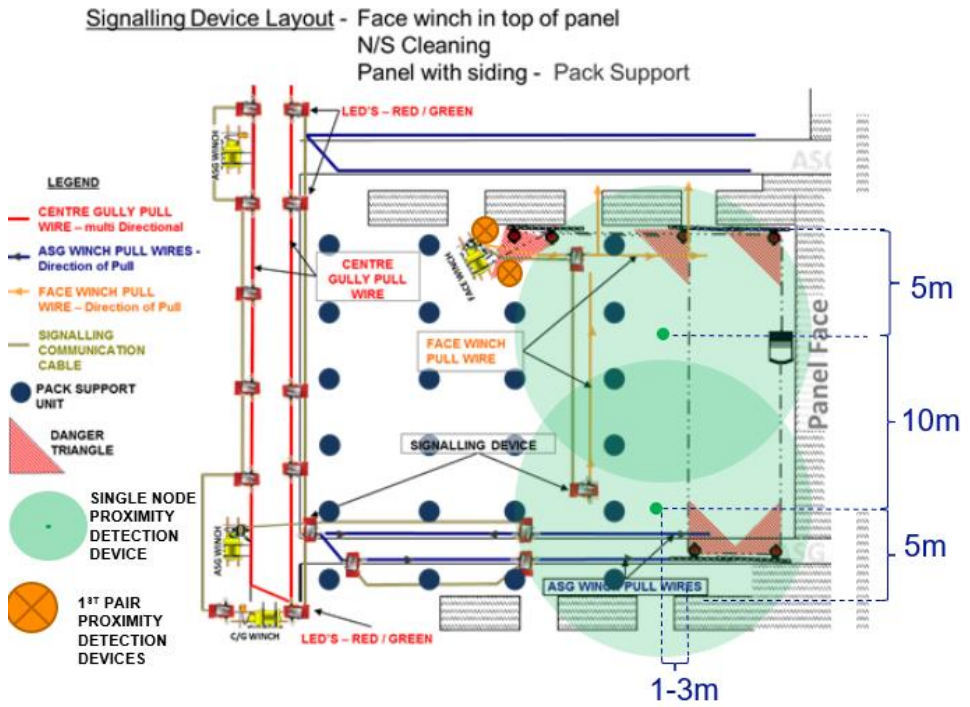


Intended to be a ***LAST LINE OF DEFENCE***

All other Winch Signalling functionality remains in place, and persons are expected to interact with winches in the same manner as before.

System Operation | Face winch





A proximity zone is created with a radius of 8m from each single node signaling device

If a person enters the danger radius, the winch will be tripped.

The rugged controller shows the scraper winch operator where proximity is detected

The winch can be started again once the proximity detection has cleared the danger zone

Project cost

High-level Project Cost

SWPD System Cost vs. Legacy Signalling System Cost:

4.9 x equivalent cost per gully metre

Legacy Signalling system

Distance (m)		40
SD's required		2
Cables required (5m)		1
Cables required (40m)		1
Price of RC	R	4,212.00
Price of SD	R	1,964.00
Price of cable (5m)	R	480.00
Price of cable (40m)	R	1,310.00
Cost of RC over distance	R	4,212.00
Cost of SD over distance	R	3,928.00
Cost of cabling over distance	R	1,790.00
Equivalent cost over distance	R	9,930.00
Equivalent cost per metre	R	248.25

SWPD

Distance (m)		40
SD's required		8
Cables required (5m)		2
Cables required (16m)		6
Price of RC	R	4,195.00
Price of SD	R	4,595.00
Price of cable (5m)	R	486.00
Price of cable (16m)	R	1,050.00
Cost of RC over distance	R	4,195.00
Cost of SD over distance	R	37,466.92
Cost of cabling over distance	R	7,433.54
Equivalent cost over distance	R	49,095.46
Equivalent cost per metre	R	1,227.39

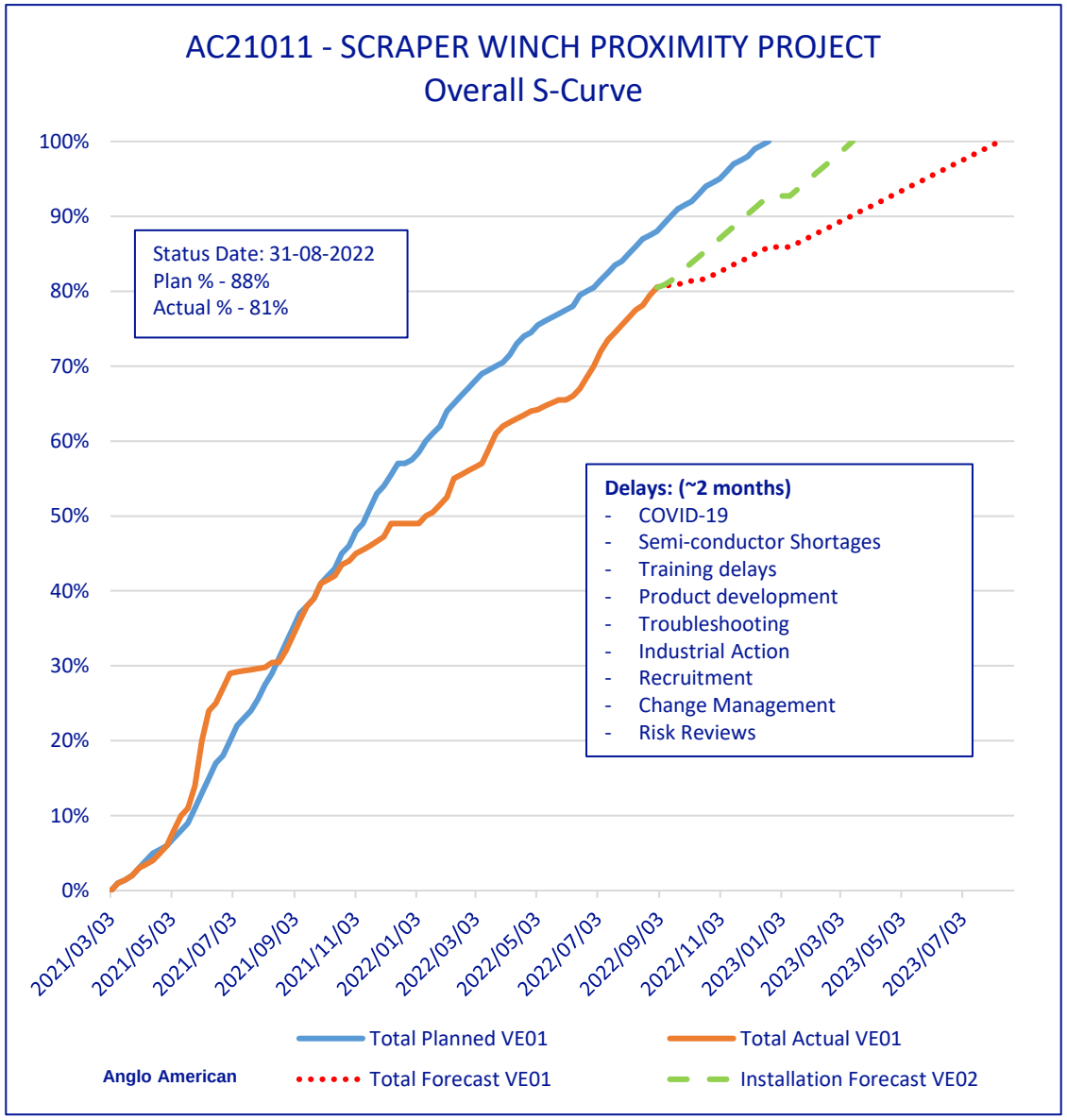
Roll-out Project Cost:

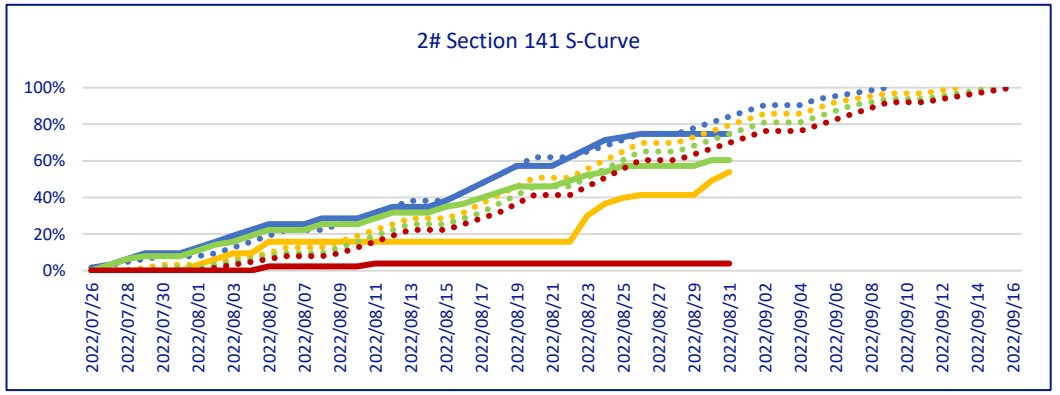
- 2019 Initial estimate ~ R40m
- 2021 Original budget ~ R62m
- **2022 Cashflow forecast ~ R80m**

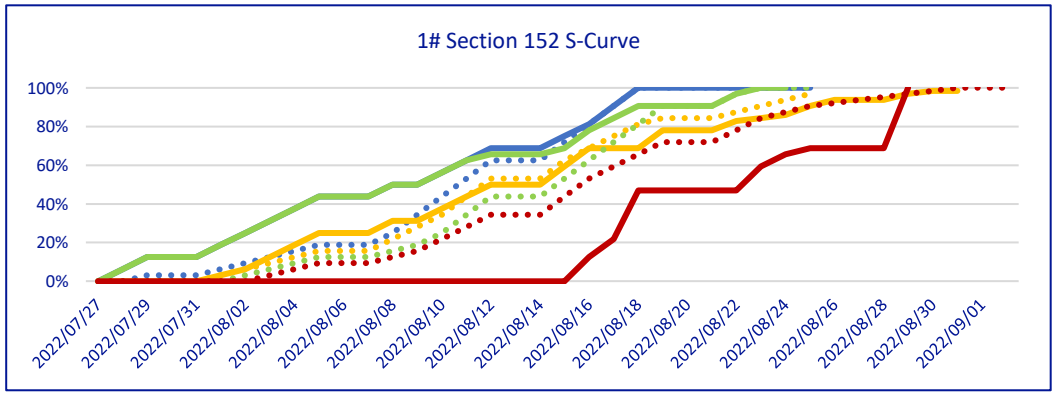
Conceptual system layout

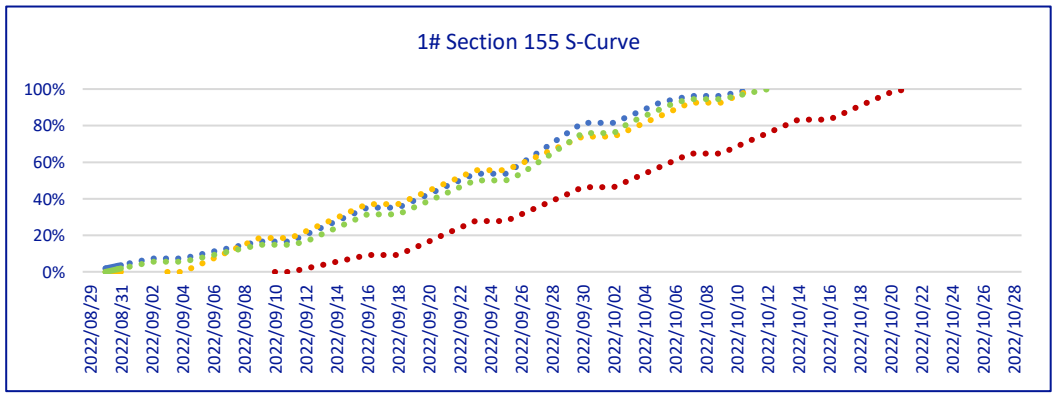
Project schedule

Roll-out Journey









Actual / Planned RAG status

Material Transport:

178/421

Training:

41%

Installation:

178/421

Commissioning:

143/421

Material flow Plan %
Training Plan %
Installations Plan %
PF6 Commissioning Plan %
Material flow Actual %
Training Actual %
Installations Actual %
PF6 Commissioning Actual %

Project status, challenges and the way forward

Project status | Operational readiness

Overall status:

Current headwinds:

- **Training on critical path**
  - Members not being paraded
  - Paraded members not arriving for training

- Little buy-in from teams

- Engineers training
- Handover procedure
- Operational stock required but not readily available

- Operational teams disabling system

Mitigation:

- **Bi-weekly meetings** (PM, SM, MO and engineering)

- Engagement with influential stakeholders
- Training planning and extra training material drafted for engineering personnel
- Handover procedure process flow drafted.
- Stock application approved. Procurement underway.
- Surveys conducted; instruction issued.

Current Constraints

Handover scheduling:

- Accurate scheduling required.
- Onus on project engineers and DMRT installation team to schedule installation.
- Onus on engineers to make sure that they are available to sign off.

Fault finding:

- System more complicated than previous “robot” system.
- In-depth system knowledge required
- Limited OEM support available

Training:

- Teams often not available for scheduled training.
- Engineering teams not comfortable with fault finding yet.

Handover process:

- Inspection job cards still based on old system.
- Responsibility of system maintenance shifted to engineering personnel
- Preliminary process flow available

Roll-out

- Urgent buy-in required by mining
- Engineering personnel competency required.

The Way Forward

Training:

- Engineering personnel to be trained with additional technical material.
- Operational teams training underground at their workplaces.

Handover process:

- Handover process to be followed by production, engineering and installation teams (PF-6 and job cards).
- Communication between project team and engineering team is NB for proper scheduling.

Installation:

- Stope servicemen to accompany installation team for coaching.
- Stope servicemen to receive regular coaching at mock ups.
- SLA now in place with OEM for technical support.

Communication:

- Bi-weekly operations meeting to be attended by section engineers.
- Initiation meeting with all engineering stake holders to discuss:
  - Project status
  - Responsibilities
  - Project handover

Sustainability | Technical Improvements

Continual:
- Installation evaluation and feedback.
- Alternative product investigations

Current product

1. Adapt circuit board to increase power supply to EIQ node

Currently being implemented

2. Auto-recover from PF

3. 99 second countdown for configuration at power up.

4. Constant configuration comms sent to nodes

5. Remove rugged controller memory function

6. Remove maximum and minimum spacing constraints

7. Change compensation method

Rev 1

1-2 months for implementation at 8/51

8. Remove constant health checks

9. Simplify fault finding signals

10. Build dedicated diagnostics device

11. Drastically change SWPD RC appearance

12. Connection break to give warning, not winch trip.

Initial prestart check by winch operator walk through **(probable phase 2 product)**

Longer term (3 months +) requiring further investigation

13. Remove the need for primary and secondary nodes

14. Clearly indicate when first pair units are operating as single node

15. Implement time limit on repairs (e.g. 1 shift)

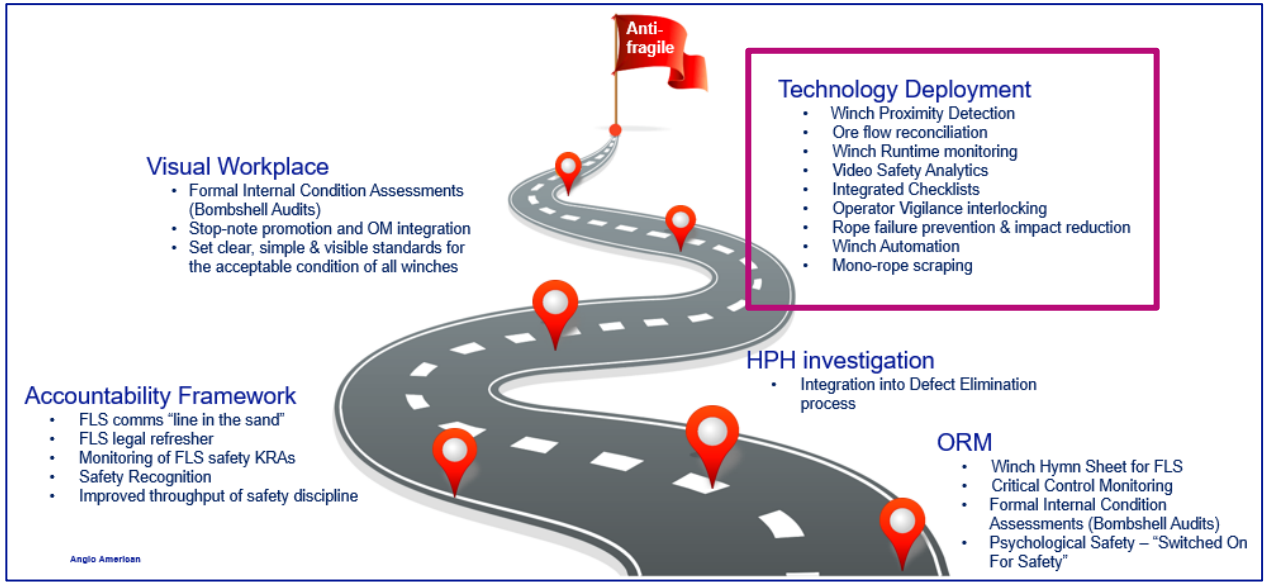
16. Increase ruggedness and SD shape changes

17. Data logging

Rev 2

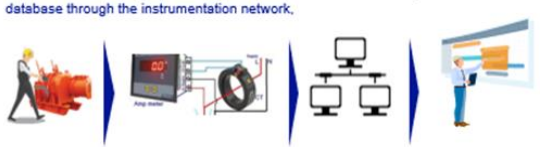
Hand-held diagnostics device

Future of Winches | EOR Roadmap



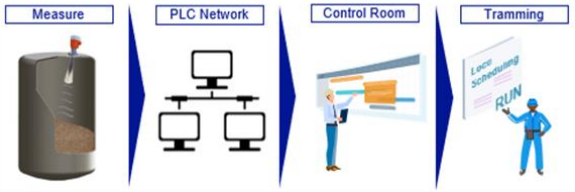
Online Winch Runtime Monitoring

Proposed Solution:
Winch run monitoring can be included in the roll-out of the Real-time Boxfront level monitoring initiative – the PLC placed at the cross-cut to monitor the box level, can be used to monitor a CT per winch, which transmits the current draw per winch to a database through the instrumentation network.



Real-time Boxfront Level Monitoring

Proposed Solution:
Implement measurement instrumentation for Stope Box Ore-passes using infrared level sensors, to monitor levels in ore-pass and allow for improved throughput and reduced gulley choking.



Video Safety Analytics

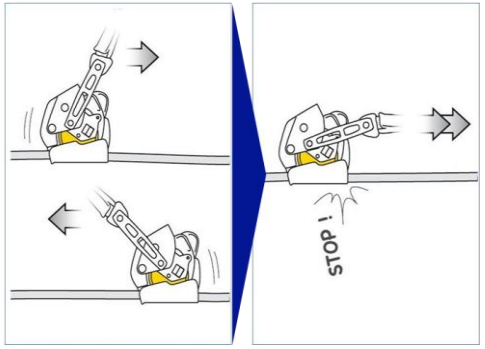
Proposed Solution:
Implementation of video analytics to monitor for water in hoppers, to identify areas where poor water control may be present.

Integrated Checklists

Proposed Solution:
Implementation of digital checklist screen, linked through the winch starter, allowing for improved 'Go/No-Go' enforcement and accessible pre-use checklist data access.

Rope Failure Arresting

Proposed Solution:
Trial and Implementation of rope arrestors, to reduce the impact of winch rope failures. Activated by acceleration of the rope through the arrestor during rope failure. Existing technology that could be trialed and implemented for winch applications.



Rope Coiling Device

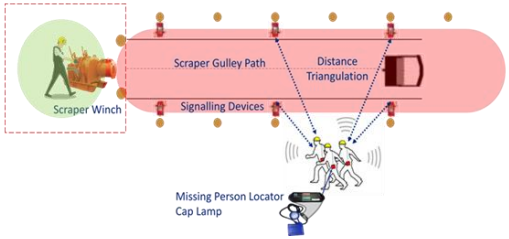
Proposed Solution:
Investigation and implementation of rope guide devices on winches, to allow for improved coiling on the winch drum, to improve rope life through reduced kinking and crushing.

Winch Operator Barricade

Proposed Solution:
Investigation and implementation of barricading screen to separate winch operator from moving parts of winch installation, and to protect against whiplashing rope, should rope failure occur.

Operator Vigilance Interlocking

Proposed Solution:
Trial and roll-out of operator vigilance monitoring on winches to prevent operators leaving their winch idling whilst working in front of winch



Thank you

Acknowledgements:

- **Amandelbult AS&R Team** – Original product design, development & testing
- **DMR Tech** – Winch Signalling OEM
- **EiQ** – MPL OEM
- **Collaborit** – Roll-out EPCM, on-going development & testing
- **Anglo American Risk Department** – Change Management & Risk Reviews
- **STS** – Explainer video development
- **Amandelbult Production & Engineering teams** – On-going support for the initiative