4 Shaft Rock Winder Rope Failure

Tuni Kgalhanye
Index

➢ Introduction
➢ What Happened
➢ Scene of Accident
➢ Immediate Action
➢ Investigations Findings
➢ Absence and Failed Defence
➢ Learning Points
Introduction

- Impala operations is on the western limb of the Bushveld Complex.
- Near Rustenburg in the land of Royal Bafokeng Nation.
- This operation comprises a 10-shaft mining complex and concentrating and smelting plants.
- The Merensky and UG2 reefs are mined concurrently.
- The mining method is predominantly conventional breast mining.
- It employs 27000 employees.
➢ Impala 10-shafts mining complex layout is as shown
➢ The 4 shaft in red dot
➢ 4 Shaft was started in 1969
Introduction

➢ In 1974 slimes dam adjacent to the shaft failed, 5 years after 4 shaft started operations
➢ It was restored in 8 weeks
Introduction

- 4 Shaft sections
- Vertical compartments
- Technical Information
- Unlike the vertical section Sub-incline consist of chair lift and incline rock winder
- In early 2018 production was stopped (mined out)
- Then, reclamation process was initiated

1. Counterweight
2. Cage
3. Underlay Skip
4. Overlay Skip
Specifications at the time of the accident are as follows:
- Double drum Winder
- Ward Leonard system
- 1.2MW DC motor
- Diameter drum: 3.35m
- Rope diameter: 42mm
- Rope construction: 6x29(11/12/6+3T)
- Length of wind: 460m
- Skip: 8 Ton
Introduction

➢ 4 Shaft sections
➢ Vertical compartments
➢ Unlike the vertical section
➢ In early 2018 production was stopped (mined out)
➢ Then, reclamation process was initiated

Technical Specification

1. Counterweight
2. Cage
3. Underlay Skip
4. Overlay Skip
As per regulation 16.9.2
The shaft was equipped with the following;
- Guduza System Technologies (GST) electronic monitoring system
- Mechanical Slack rope detection
- Skip stuck in tip device
4 shaft is equipped with the GST system which monitors the slack and tight rope
Slack rope alarm and trip
The slack rope override switch must be operated
§ When it is operated the winder control circuit is in enforced creep mode
§ Safety circuit unhealthy
On the 14 November 2018, 2 days prior to removing the conveyances.
At 10:13 rock winder was started
Manually operated
Four trips were done in 10 minutes.
Loading carried only on overlay
During tipping the Banksman heard rocks falling in the headgear
Then Boilermaker was called to come and inspect.
The rock winder was stopped and then Boilermaker fetched from loading box with man winder
What happened

- At 10:44, Boilermaker was brought on surface and proceeded to investigate what was reported.
- While on en-route to the tip, the overlay skip was dispatched and tipped at 10:56.
- Boilermaker observed the skip not fully closed.
- And also observed the humble hook laying flat and slack on rope.
- Boilermaker shouted to the Banksman to call the Winding Engine Driver to immediately take up the slack (it was six minutes after the skip tipped).
- A minute later (11:03), before anything was done, the skip became unstuck and fell.
- The winder rope snapped at the drum in the winder house and the skip fell down the shaft.
Scene of Accident

- Broken rope on the drum
Scene of Accident

- Observed dial indicator almost 3 turn warning
- Shock load snaps rope from 10m
Scene of Accident

➢ Piece of rope broke off and fell on the bank
Scene of Accident

➢ Piece of rope broke off and fell on the bank
Investigations Findings

➢ Damaged screen around the l coil
Investigations Findings

➢ Broken handrail around sheave
Scene of Accident

➢ Light at top of jib crane broken by the rope
Immediate Action

- Senior Management were notified
- Accident was reported at DMR and also notified of actions to be carried
- Emergency control room was established
- All 9 employees underground by the time of accident were accounted
- Shaft exam was conducted using man winder (single drum)
- Inspectors came for visit and they were taken through findings
Investigations Findings

- Damages observed on rock winder compartments buntings
- The man winder compartment buntings were not damaged
Investigations Findings

➢ Skip in the spillage bin at the bottom
➢ Found still within guides
Investigations Findings

Slack Rope Trip Flagged

Man Winder Trip Indicator Panel

Skip in tip
Total minutes
Rope Snap
Investigations Findings
# Absence and Failed Defence

<table>
<thead>
<tr>
<th>DEFENCE</th>
<th>Defence Worked?</th>
<th>COMMENTS</th>
<th>REMDIAL ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic continuous slack and tight rope monitoring system</td>
<td>✓</td>
<td>Found in order and operational</td>
<td></td>
</tr>
<tr>
<td>Mechanical slack rope in hoist room</td>
<td>✓</td>
<td>Found in order and operational</td>
<td></td>
</tr>
<tr>
<td>Skip-stuck-in-tip detection</td>
<td>×</td>
<td>Found in order and operational. However, it was observed that the skip-stuck-in-headgear detection was already cleared.</td>
<td>Ensure the position of the switch is such that it only clears when a skip is fully out of the tipping path.</td>
</tr>
<tr>
<td>Slack Rope Inter-trip</td>
<td>✓</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Slack rope condition cannot be reset unless the slack rope condition is rectified</td>
<td>✓</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Slack rope override switch on the driver desk, to take up any slack rope immediately in enforced creep</td>
<td>✓</td>
<td>Found in order</td>
<td>Investigate how the slack rope override can be improved to prevent such a long piece of rope to be paid out</td>
</tr>
</tbody>
</table>
## Absence and Failed Defence

<table>
<thead>
<tr>
<th>DEFENCE</th>
<th>Defence Worked?</th>
<th>COMMENTS</th>
<th>REMDIAL ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic continuous slack and tight rope monitoring system</td>
<td>√</td>
<td>Found in order and operational</td>
<td></td>
</tr>
<tr>
<td>Mechanical slack rope in hoist room</td>
<td>√</td>
<td>Found in order and operational</td>
<td></td>
</tr>
<tr>
<td>Skip-stuck-in-tip detection</td>
<td>×</td>
<td>Found in order and operational. However, it was observed that the skip-stuck-in-headgear detection was already cleared.</td>
<td>Ensure the position of the switch is such that it only clears when a skip is fully out of the tipping path.</td>
</tr>
<tr>
<td>Slack Rope Inter-trip</td>
<td>√</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Slack rope condition cannot be reset unless the slack rope condition is rectified</td>
<td>√</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Slack rope override switch on the driver desk, to take up any slack rope immediately in enforced creep</td>
<td>√</td>
<td>Found in order</td>
<td>Investigate how the slack rope override can be improved</td>
</tr>
</tbody>
</table>
Absence and Failed Defense

<table>
<thead>
<tr>
<th>DEFENCE</th>
<th>Defence Worked?</th>
<th>COMPLAINECE</th>
<th>REMEDIAL ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance and Audits Regulation 16.74 &amp; 16.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.41 (Cutting, recapping and testing)</td>
<td>√</td>
<td>Found within requirements</td>
<td></td>
</tr>
<tr>
<td>16.74 (Appointments and Dailies)</td>
<td>√</td>
<td>Found all in order</td>
<td></td>
</tr>
<tr>
<td>16.75.3 (Rope Exam)</td>
<td>√</td>
<td>Found in order as per interval requirements</td>
<td></td>
</tr>
<tr>
<td>Level 1 Audits</td>
<td>√</td>
<td>Found in order as per interval requirements</td>
<td></td>
</tr>
<tr>
<td>EMT</td>
<td>√</td>
<td>Found in order as per interval requirements</td>
<td></td>
</tr>
</tbody>
</table>
## Absence and Failed Defence

<table>
<thead>
<tr>
<th>WED Competence and Conduct</th>
<th>Defence Worked</th>
<th>COMPLAINECE</th>
<th>REMEDIAL ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualified</td>
<td>√</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Appointed</td>
<td>√</td>
<td>Found in order</td>
<td></td>
</tr>
<tr>
<td>Adherence to Procedures</td>
<td>×</td>
<td>Skip stuck in headgear procedure not followed.</td>
<td></td>
</tr>
</tbody>
</table>
➢ Skip stuck device must not clear when conveyance is not fully out of tipping path

➢ Override switch configuration to have directional movement
The end