Anglo Platinum Amandelbult

Loco Safety

27 July 2006

Scope

- Background
- Description of Recent Incident at Amandelbult
- Illustration in Plan View of the Incident
- Simulation of Incident
- Contributing factors
- Legal and DME Requirements
- Current Situation
- Proposed Solutions
- Technical Information by A&R Engineering
- Questions

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Background

- DME statistics:
  - Tramming incidents second highest frequency in the industry;
  - Second to Fall of ground.
- Fatality at Amandelbult on 22 February 2006:
  - In depth investigation as to reasons for incidents;
- Workshop was held:
  - Manager Engineer;
  - Resident Engineers and Engineers;
  - Safety Officers and Safety Representatives;
  - Tramming Mine Overseers and Shift Supervisors;
  - Loco Drivers.

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Casualty Classification by Commodity – May 2006

	Department of Minerals and Energy				
	Casualty Classification by Commodity				
	From 2006/05/01 to 2006/05/31				
Code	**Classification Discription**	**Injured**	**Killed**	**Disabled**	**Accidents**
	Commodity: GOLD				
1	FALL OF GROUND	60	6	0	66
2	MACHINERY	8	0	0	8
3	TRANSPORTATION AND MINING	30	0	0	30
4	GENERAL	84	0	0	73
	COMMODITY TOTAL	**182**	**6**	**0**	**177**

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Casualty Classification by Commodity – May 2006

	Commodity: COAL	Injured	Killed	Disabled	Accidents
1	FALL OF GROUND	2	0	0	2
3	TRANSPORTATION AND MINING	6	1	0	7
4	GENERAL	15	0	0	15
6	ELECTRICITY (Not causing fire)	1	0	0	1
13	MISCELLANEOUS (specify)	1	1	0	2
	COMMODITY TOTAL	**25**	**2**	**0**	**27**

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Casualty Classification by Commodity – May 2006

	Commodity: PLATINUM GROUP METALS	Injured	Killed	Disabled	Accidents
1	FALL OF GROUND	27	1	0	28
2	MACHINERY	6	0	0	6
3	TRANSPORTATION AND MINING	31	0	0	31
4	GENERAL	54	0	0	49
13	MISCELLANEOUS (specify)	3	1	0	4
	COMMODITY TOTAL	**121**	**2**	**0**	**118**

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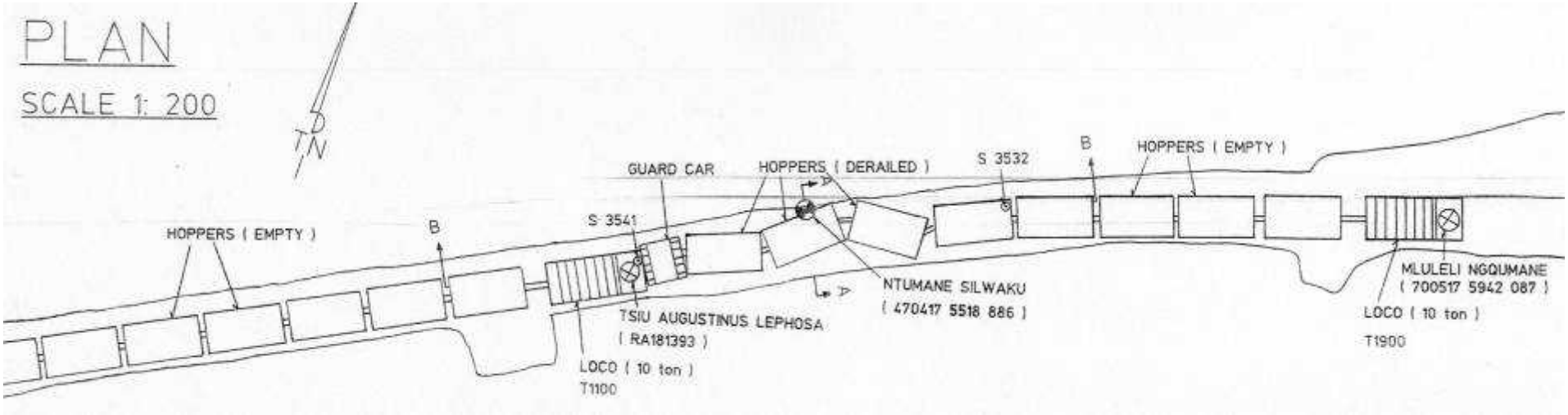
Plan of the accident



Description of Incident

- Incident involved 3 locomotives.
- Loco A:
  - Traveling towards the workings
  - Empty hoppers
- Loco B:
  - Traveling towards the tips
  - Full span of hoppers
  - Right of way
- Loco C:
  - Traveling behind Loco A towards workings
  - Empty hoppers

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Description of Incident

- Loco A backed up to nearest crosscut to give right of way to the oncoming Loco B;
- Guard of Loco C did not warn his driver of the on coming loco – Loco A;
- Guard of Loco C jumped out of guard car when he realized that the two locomotives were going to collide;
- Hoppers derailed;
- Killing the guard against the side wall.

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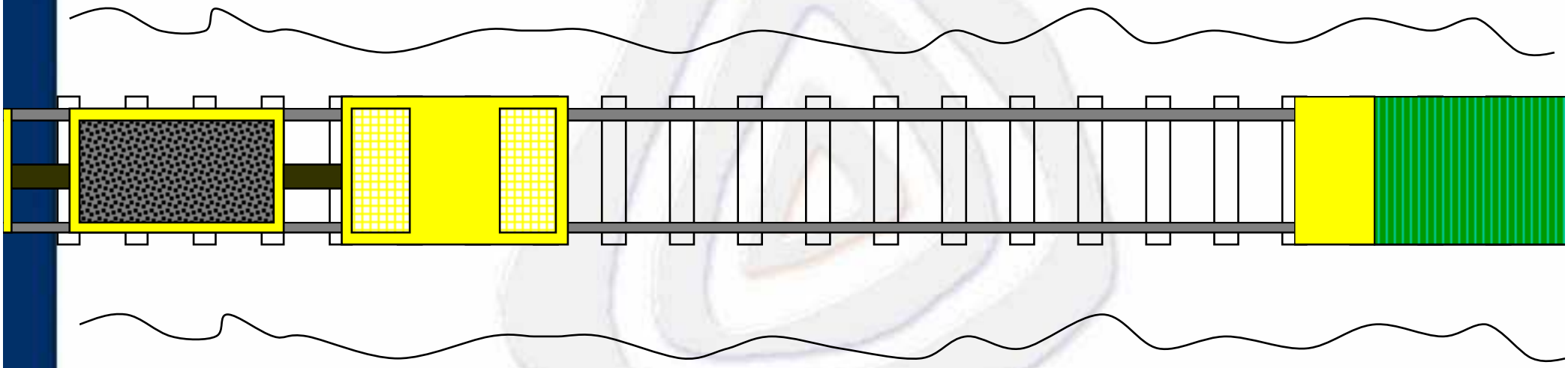
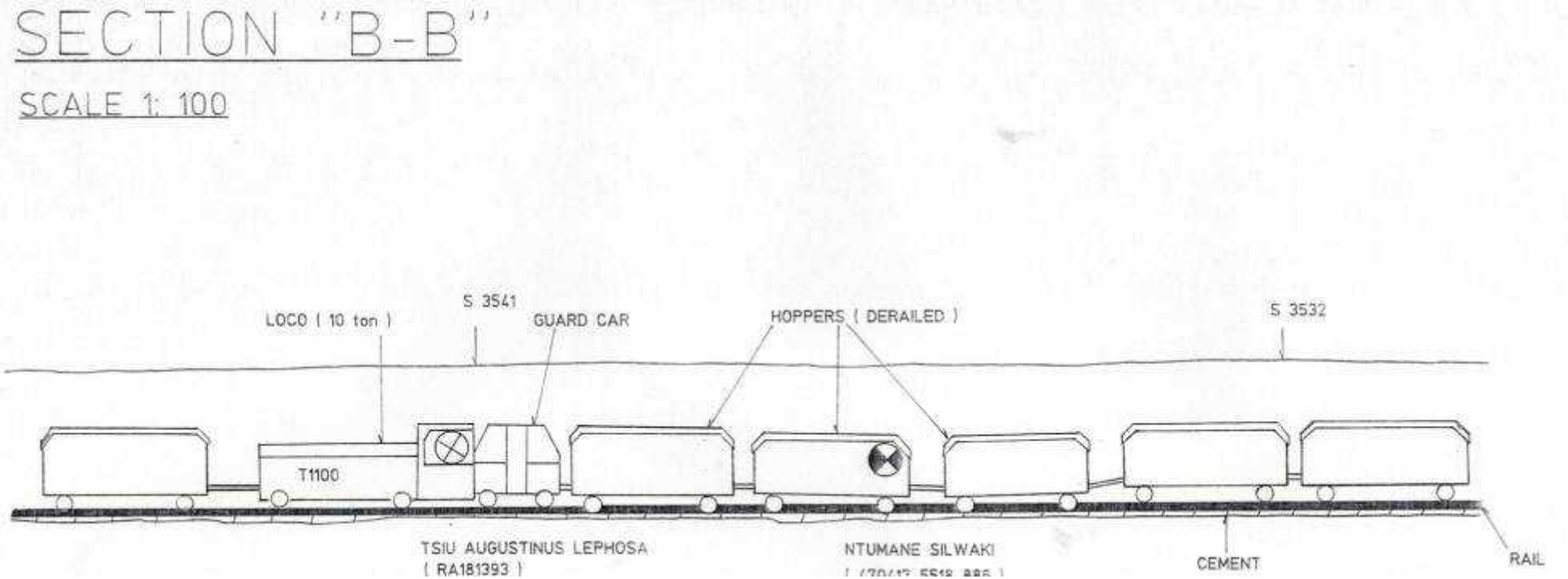
Simulation of the incident



Section view B-B (Scale1:100)



Contributing Factors

- Guard jumped out of the guard car;
- No effective communication between guard and driver;
- No early warning device between locomotives
- Guard could not stop loco from inside guard car;

Legal and DME Requirements

- **Reg. 15.3.2: Illumination of sufficient intensity to enable driver to identify dangerous conditions ahead and stop timeously. Average light intensity in direction of travel ≥ 10 lux at 20m.**
- **Reg. 18.3.3: Any person traveling in/on any self-propelled mobile machine to be safe guarded adequately to prevent accidental slipping from machine whilst in motion.**
- **Reg. 18.3.4: No person to alight from mobile machine whilst in motion.**
- SANS1809 – "Failsafe underground mine locomotive control system."
- SANS10339 – "Design, construction, maintenance and safe use of permanent underground rail track work in mines" now called: "Underground rail track work in mines."
- Guideline for Mandatory Code of Practice for Underground Railbound Transport Equipment.

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Current Situation

- Locomotives in use:
  - New Millennium Locomotives;
    - Light configuration:
      - Two white lights in direction of travel;
      - One flashing red light in opposite direction
  - Goodman Trident Locomotives.
    - **Light configuration:**
    - Two white lights in direction of travel;
    - One red light in opposite direction (Loco lamp)
- Guard car:
  - Roller coaster bars fitted;
  - Swing arm latch

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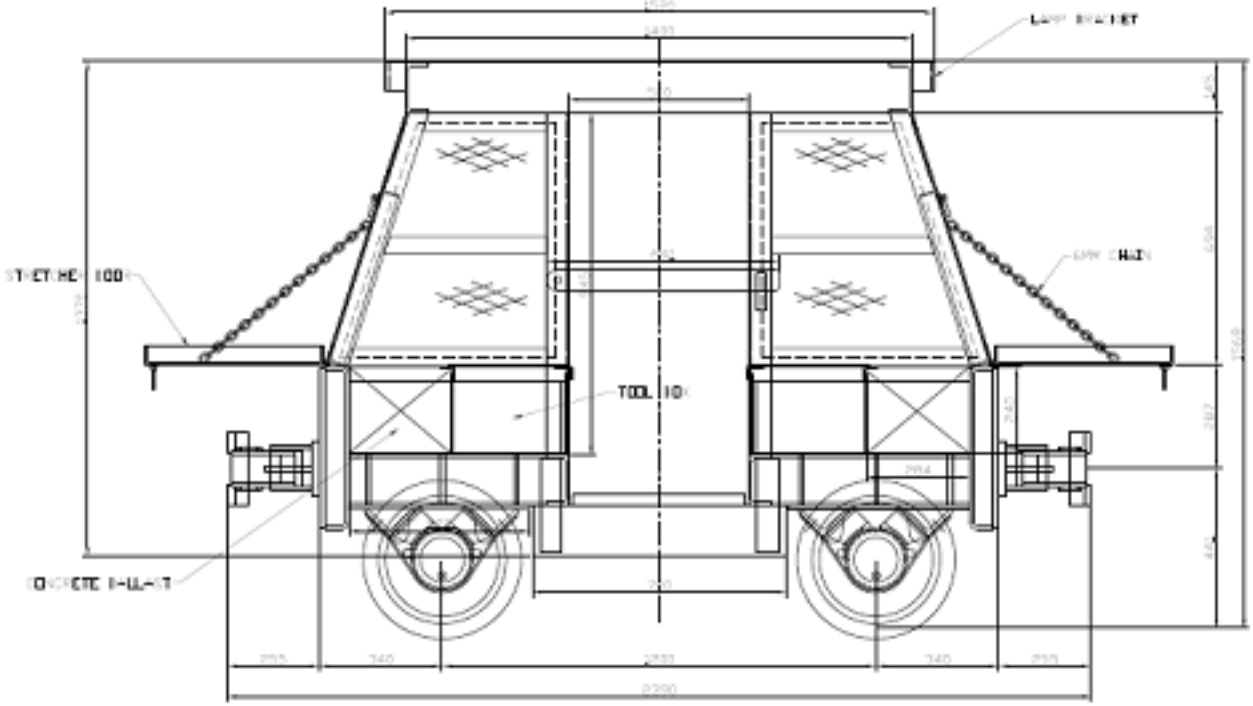

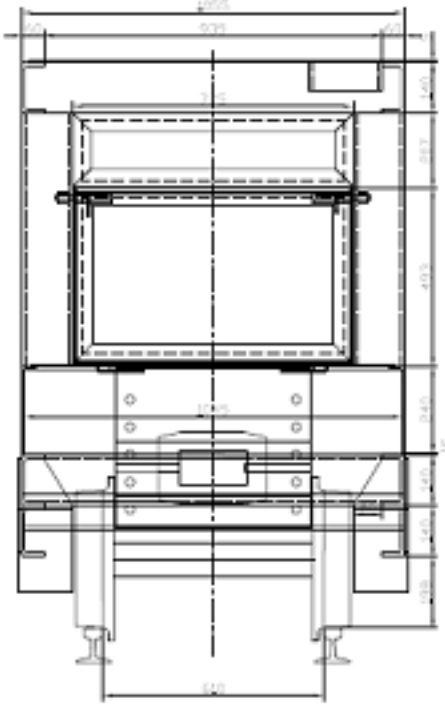

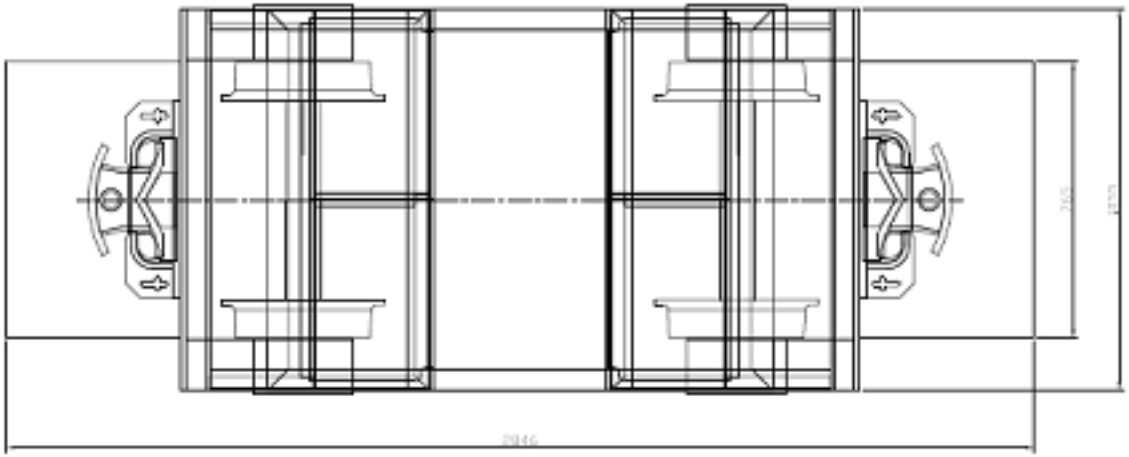

NOTE:
KUDU BUFFERS
R80 WHEELSET 15°
MASS = 1433kg

OCTA ENGINEERING KROONSTAD

APPLATS	JWRB	01/01/1998
GAURD CAR		07012A

Workshop Proposals

- Guard car safety;
  - Not robust;
  - Guards feel unsafe;
  - No effective means to prevent guard from jumping out of guard car;
- New design guard car;
- Communication between driver and guard;
- Lighting in direction of travel and stationary locos;
- Proximity Range Transponder;
  - Warning device;
  - Loco to Loco;

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Existing guard cars

- Communication between guard and driver;
- Modify existing guard car latching sliding doors;
- Light configuration;

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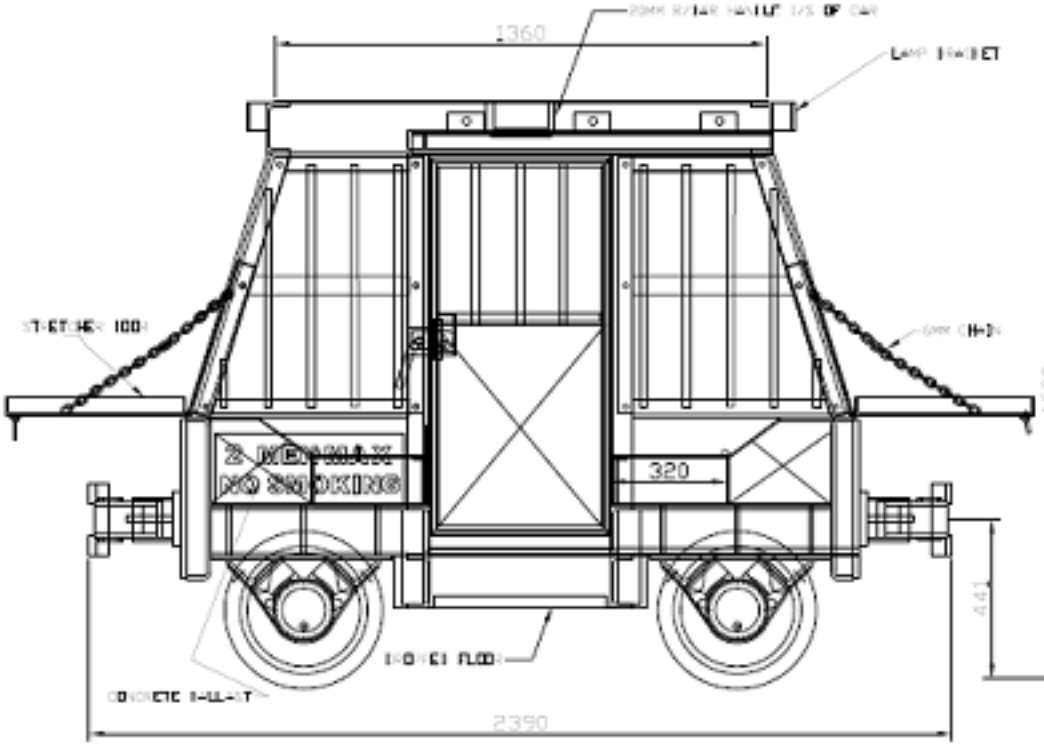

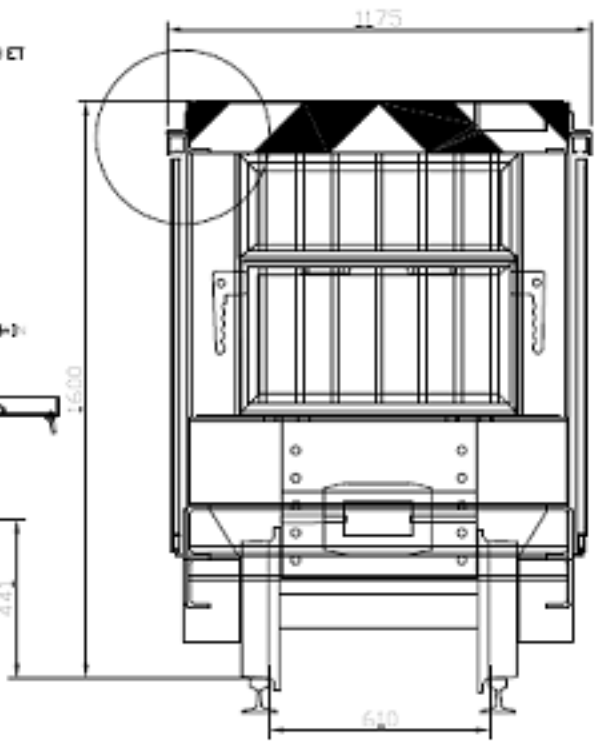

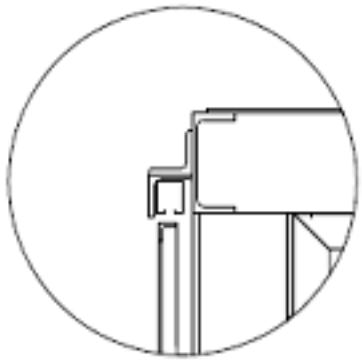

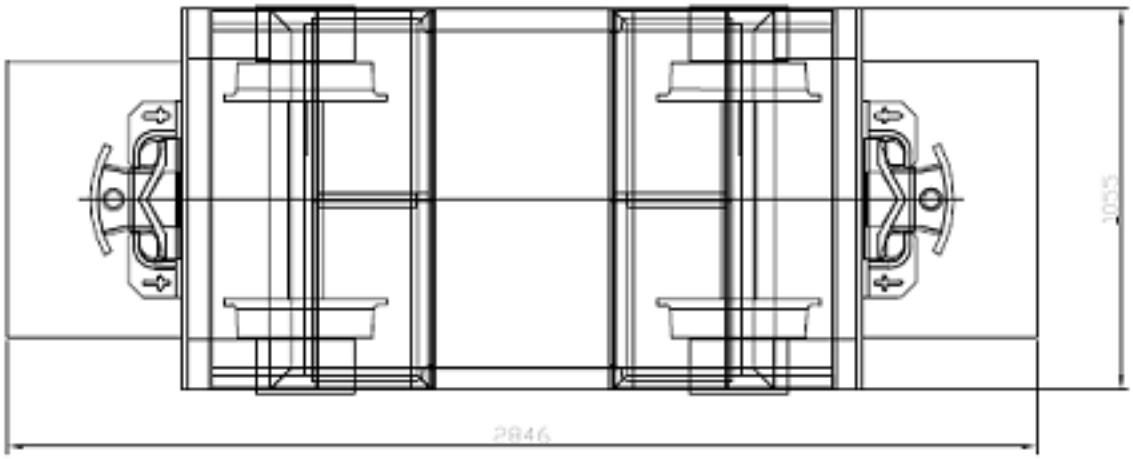

GENERAL NOTES: (U.O.N)

(1) C/W 2 SAFETY BELTS
(2) C/W CONCRETE BALLAST
(3) C/W POWER BUFFERS
(4) C/W R80 WHEEL SET 15" 610 RG
(5) C/W BOLT ON WINDOW FRAMES
(6) C/W CHEVRON PLATES ON BOTH SIDES
(7) ALL BOLTS TO BE M20 GR 8.8 HEX BOLTS
(8) 5MM BODY PLT
(9) ALL PLATE & STEELWORK TO BE GRADE 300WA
(10) ALL WELDING TO BE 6MM C.F.W
(11) TOTAL MASS = 1433KG

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AMPLATS UNION 1.6 MSH	JJVR8	01/01/1998

GUARD CAR 07012A

New design guard car – Option 1

- Goodman Trident Caboose
  - 6 seat;
  - Fitted with safety belts;
- Communication between guard and driver;
- Light configuration;
- Lockable sliding doors;

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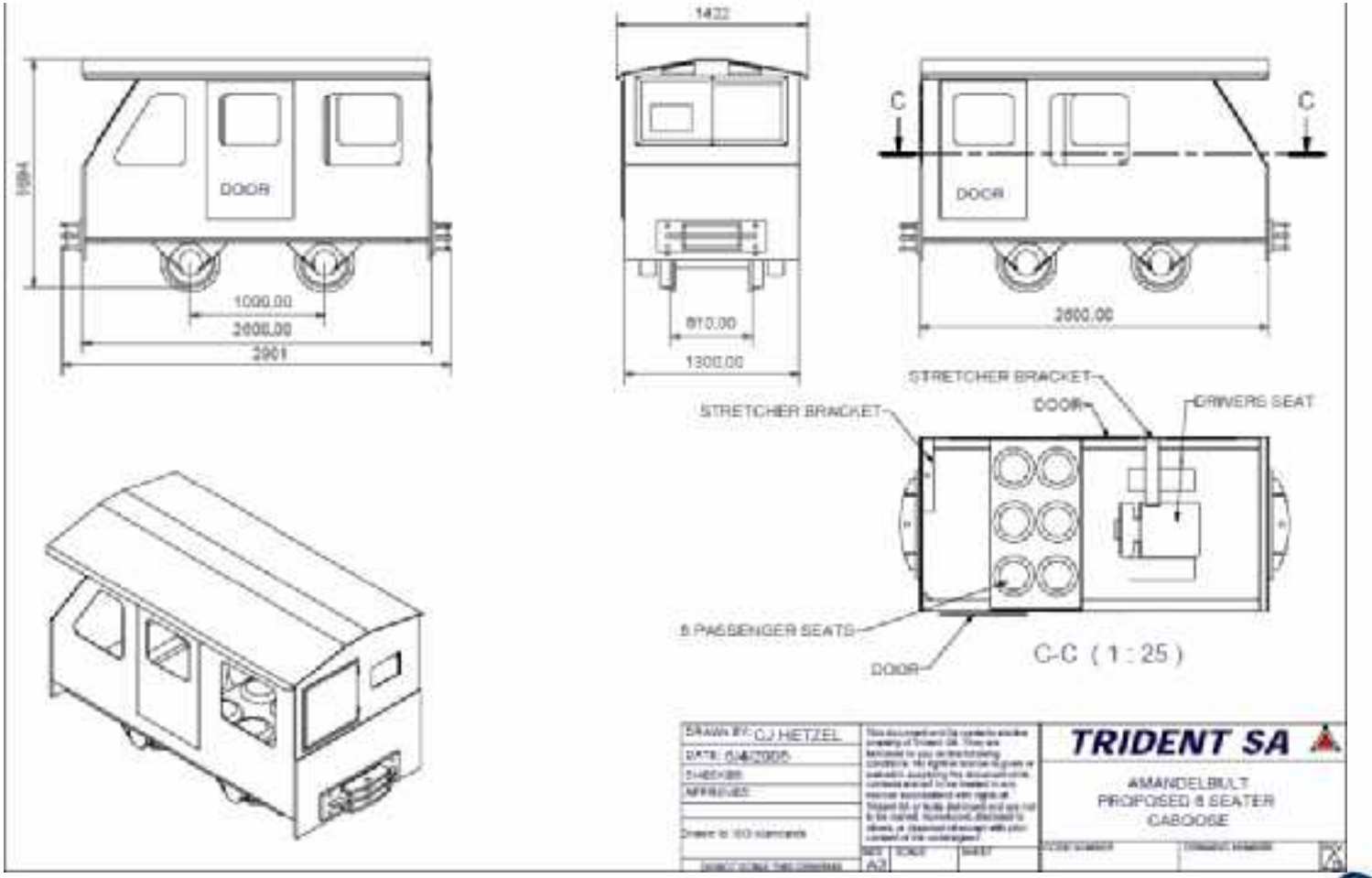
Proposed Guard Car (Caboose)



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New design guard car – Option 2

- Octa Guard car;
  - 5 seat;
  - Fitted with safety belts;
- Communication between guard and driver;
- Light configuration;
- Lockable sliding doors

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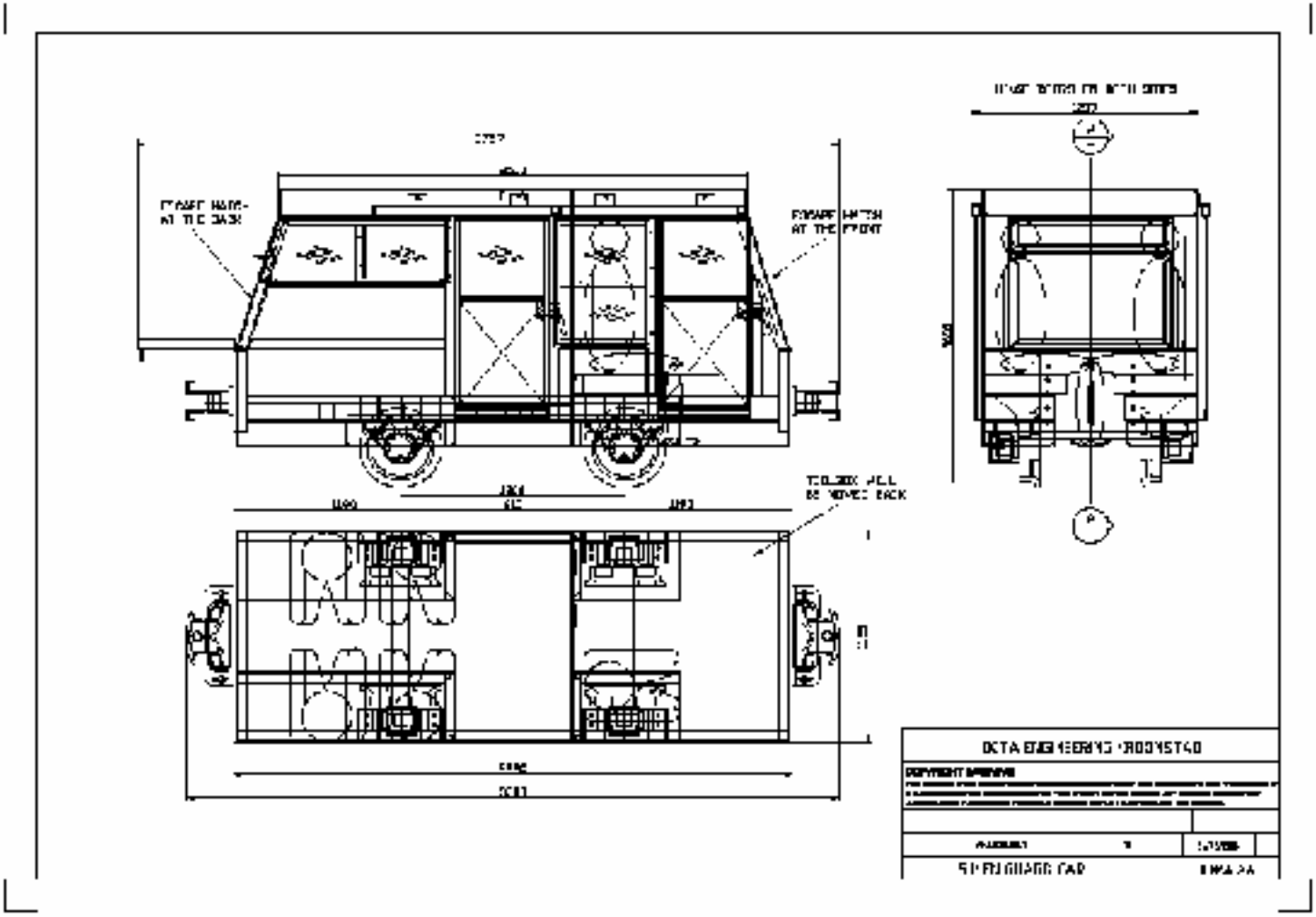
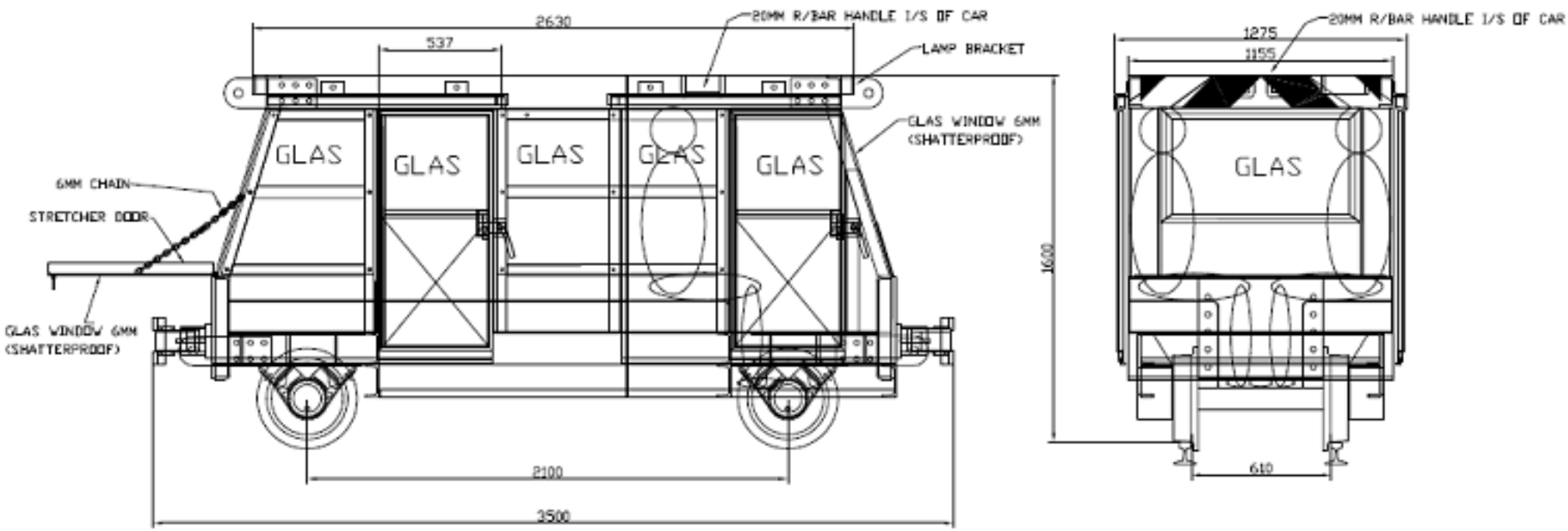
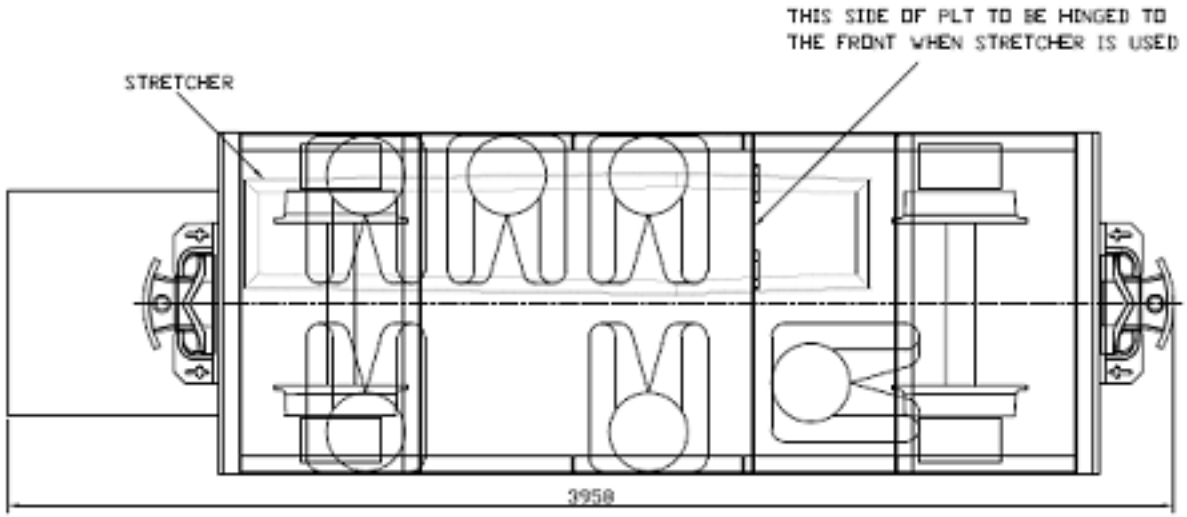
Octa Guard Car – 5 seat







GENERAL NOTES (U.O.N)

1) COMPLETE WITH KUDU BUFFERS
2) R80 WHEELSET 15" 614 RG
3) COMPLETE WITH SAFETY BELTS, 1 PER PERSON
4) SLIDING DOORS ON ONE SIDE ONLY
5) COMPLETE WITH RUBBER PADDED SEATS

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AMANDELBULT	TE	26/05/2006

8 MEN GUARD CAR 07056 BB

Light configuration

- Light configuration:
  - Two white lights in direction of travel;
  - Red light in opposite direction;
  - Flashing red in both directions when stationary;
  - LED lights:
    - 10Lux @ 20m;
    - Integrated red.

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Guard Car Equipment

- High Frequency Charger
  - Supply Voltage 110/220V AC
  - Secondary Voltage 24V DC
  - Dimensions 250x250x100mm
  - Adjustable output voltage
  - Over/under Voltage protection
  - Current protection

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Guard Car Equipment

- Battery Pack
  - 2 x 17AH 12V Maintenance Free Batteries
  - 2 x Battery Packs per Guard car
  - Weight ± 9kg's

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Guard Car Equipment

- LED Lights
  - Light Output: 10Lux at 20M
  - Operating Voltage: 24V DC
  - Operating Current 600mA
  - Each lamp has an integrated red LED cluster for reverse/stationary indication.
  - Intrinsically safe – Tested by Government Approved Inspection Authority (Explolabs)

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Guard Car Equipment

- Siren
  - 24V DC Banshee siren
  - Will operate when direction is selected, or manually from inside the guard-car or Loco.

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Proposed guard car installation

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Guard Car Equipment

- Communication Equipment
  - Fail to safe System
  - Continuously transmitting and receiving.
  - 2 x Radios (operating frequency 430mhz)
  - 1 x Loco unit 1 x Guard-car unit to facilitate the inputs and outputs.

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Proposed Loco Installation

- Proximity Range Transponder:
  - Loco to loco;
  - Early warning system of approaching locomotives;
  - Warning via siren/light;
  - Will not stop or retard the locomotive;
  - Driver to respond to warning signal.

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Proximity Range Transponder

- The system was designed specifically to enhance safety.
- The system consists of two main components i.e. Haulage unit and the Loco unit
- The operation allows for communication between the haulage unit as well as Loco to Loco
- The haulage unit is designed to be mounted upside down from the centre of the haulage using the eyelet supplied. The unit derives power from the underground lighting supply and has a backup battery to ensure at least 24 hour operation without primary power. Unscrewing the bottom cover gives access to the connections and settings.
- The Loco is installed in the Loco and communicates with the haulage and to any other Loco that has a Loco unit installed. The unit derives power from a 24V DC/DC converter.
- The current version is not a fail to safe system, but A & R is currently busy developing a system that will be fail to safe.

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Loco Unit

TECHNICAL SPECIFICATIONS

1. Power Requirements – 24Vdc 100mA
2. Relay rating – 1A at 24Vdc
3. Operating frequency 430MHz
4. Transmitter power +20Dbm

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OPERATION

- The Loco unit is continuously transmitting and “listening” for a signal.
- When a signal is detected it will activate the Loco unit and a warning device (light/siren).
- The Loco unit will stay activated until the other Loco is out of range.

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LOCO UNIT

- **The Loco Unit PRT-LOCO)**
- The wiring harness is fixed to the radio.
- No maintenance is required other than to do a functionality test on pre-described intervals
- Outside the box are two LED indicators, the RED LED will flash during transmission and the GEEEN LED will light when in range of a BEACON or other Loco unit.
- The approximate range from loco to loco can be anything from 30m to 80m depending on the rock formation. (Test to be conducted on site).

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Haulage Unit

Technical Specification

1. Power requirements 110-220v AC
2. Relay rating 1A 24Vdc
3. Operating frequency 430MHz
4. Transmitter power 0dbm, +10dbm and +20dBm

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Haulage Unit

- **Switches:**
- The left switch is the range control **HI, MID and LO**
- **HI** generates the highest output power and ensures the longest range
- **MID** Is one tenth the power of HI, and in theory should halve the distance
- **LO** Is one tenth the power of MID and again should halve the distance of MID
- Due to the nature of the environment in which the product is used, it would be impossible to predict the exact range or distance, however, the estimated range is as follows: HI – 50m to 80m, MID – 20m to 50m and LO – 5m to 20m. This specification will vary on each installation.
- The right switch is the system switch **TX-ON, OFF and TX-OFF**
- **OFF** switches the unit off but still allows the battery to charge
- **TX-ON** switches the unit on and allows the unit to transmit and receive
- **TX-OFF** switches the unit on but inhibits the beacon transmission.
- **Indications**
- IN RANGE A loco is in range
- RX A valid radio signal is being received
- TX The beacon is transmitting
- I/P The Opto input is triggered
- O/P The relay is energised
- DC The system is on
- AC The system is charging

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Proposed Guard Car

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Proposed Guard Car

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Questions ?

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