

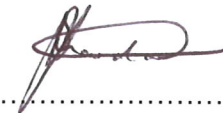
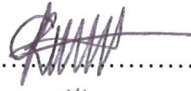



A division of Transnet limited

RAIL NETWORK

SPECIFICATION

REQUIREMENTS FOR INFRARED THERMOGRAPHIC SCANNING OF OVERHEAD TRACK EQUIPMENT.

| | | | |
|--------------|--|--------------|--|
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| | | | Date: <u>31 May</u> 2017 |

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Rail Network Technical

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A division of Transnet limited

RAIL NETWORK

TECHNICAL SPECIFICATION

REQUIREMENTS FOR INFRARED THERMOGRAPHIC SCANNING OF OVERHEAD TRACK EQUIPMENT.

This specification covers the requirements for infrared thermal scanning of 3kV DC, 11kV AC, 25kV AC and 50kV AC railway electrification equipment, the processing of the data and presentation of results for the purpose of preventative and corrective maintenance.

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1.0 SCOPE

This specification covers the technical requirements for infrared thermographic scanning of overhead railway electrification equipment, the pantograph contact wire interaction, processing of data and the presentation of the reports for the purpose of Condition Monitoring as the basis of Preventive Maintenance on 3kV DC, 25kV AC and 50kV AC overhead traction equipment and 6.6/11kV Power Line Equipment of Transnet Freight Rail.

2.0 GENERAL REQUIREMENTS

- 2.1 Transnet Freight Rail requires condition assessment information of the current carrying performance of its overhead traction equipment. The Contractor shall provide a condition assessment service comprising the following functions:
- (a) Infrared recording survey for overhead infrastructure from a moving train consisting of electrical locomotives and wagons loaded to the maximum allowable ton/axle for the section.
 - (b) Pre- and post-processing and submission of exception reports in hard copy and electronic format.
 - (c) Provide all the necessary report review graphical analysis application software which has the functionality to review moving and stationary recorded images and to edit and create fault reports.
- 2.2 The Contractor shall use infrared imaging sensors to detect thermal radiation signatures associated with electrical infrastructure component deterioration relative to a reference temperature of electrification infrastructure equipment, to predict and identify impending and developing failures.
- 2.3 The contractor shall use infrared imaging sensors to detect thermal radiation signatures associated with the pantograph-contact wire severe interactions (impacts).
- 2.4 Scanning shall be done at night to eliminate as far as possible the effect of equipment heating due to solar radiation.

3.0 DEFINITIONS

- (a) TFR - Transnet Freight Rail
- (b) OHTE – Overhead Track Equipment
- (c) Reference Temperature - the temperature against which “overheating” components are compared, a calculated weighted average temperature at multiple reference temperature sampling points of the running conductor – and/or the component to which the overheating component is electrically/mechanically connected, considering similar components as that affected in general reference to predict and prevent infrastructure failure.
- (d) “Hotspot” - An OHTE Component thermal radiation signature defect as associated with the levels of OHTE electrical infrastructure component deterioration of electrification infrastructure equipment which shall be reported whenever the temperature of the component is $\geq 5^{\circ}\text{C}$ above that of the associated Reference Temperature.
- (e) IRT – Infra red thermography

- (f) Exceptions – An abnormality measured/recorded with a thermal imaging camera that can result in failure of infrastructure.
- (g) Thermographer Level 1 – A person certified in terms of a recognised industry standard, who is qualified to gather high-quality data through thermographic scanning and sort the data based on pass/fail criteria.
- (h) Thermographer Level 2 – A person certified in terms of a recognised industry standard, who is qualified to set up and calibrate thermographic equipment, interpret data, create reports and supervise Level 1 Thermographers.

4.0 SERVICE CONDITIONS

The infrared scanning shall be done under the following conditions:

- Altitude : 0 - 1800m above sea level.
- Ambient temperature : -10 °C to +45 °C.
- Real feel / wind temp. : 15 to + 60
- Relative humidity : 10% to 90%.
- Lightning conditions : 11 flashes per square km per annum.

5.0 TECHNICAL REQUIREMENTS

5.1 GENERAL EQUIPMENT REQUIREMENTS

The following equipment will be required to provide the full service:

- 5.1.1 Infrared imaging sensors, 640 X 480 pixel resolution, lens angle between 45 and 60 degrees, mounted on the locomotive in a position providing the area required for the OHTS and the other for the pantograph - contact wire interaction.
- 5.1.2 Recording equipment - Processor which performs the recording of continuous imaging stream at a minimum rate of 10 frames per second and which sorts the data for identification efficient recovery per section that is defined by kilometre section beacons.
- 5.1.3 A DC battery based power supply capable of operating all the equipment for a minimum of 10 hours. No power will be sourced from the locomotive.
- 5.1.4 Processors and software capable to interrogate recorded data and prepare exception reports.
- 5.2 Software and memory devices are to be made available to Transnet Freight Rail Engineering staff to interrogate the scanned recordings and reports as further described herein.

5.3 SPECIFIC EQUIPMENT REQUIREMENTS.

- 5.3.1 Equipment installations shall not exceed the footplate restrictions.
- 5.3.2 The On-Board recording unit on the locomotive
Image recording equipment shall be provided - Infrared sensors / recording device / power supply / software / etc.
- 5.3.3 The single sensor system must record images of :-
 - (a) the rear view infrastructure
 - (b) the Pantograph contact wire interaction

- (c) all the relevant look-up data for the optimized moving image format data.

5.3.4 Infrared imaging sensor specification:

- (a) Operating/Spectral range: Long wave (7 - 14µm)
- (b) Minimum Resolution: 680 x 480
- (c) Accuracy: $\pm 2^{\circ}\text{C}$ or $\pm 2\%$ of reading
- (d) Emissivity correction: Variable from 0.01 to 1.0
- (e) Ambient / Atmosphere transmission correction: Automatic
- (f) Reflected temperature correction: Automatic
- (g) Thermal sensitivity/ NETD: $<0.05^{\circ}\text{C}$ @ $+ 30^{\circ}\text{C}$ / 50mK
- (h) Frame Rate: 100 Hz / minimum recording speed 10 frames per second.
- (i) Spatial Resolution / FOV: 45° - 60°
- (j) Focus: Automatic

5.3.5 Recording equipment

- (a) When the system is set up in the locomotive cabin, clutter in the cabin such as cables must be limited and installations must comply with the footplate regulations.
- (b) Power supply to the recording equipment and any associated equipment shall be completely independent from the locomotive with an operational endurance exceeding 10 hours and has to be isolated from the locomotive.
- (c) The GPS system tracking functions must exceed 7 satellite signals on average.
- (d) Display functions must include a monitor for the Transnet Infrastructure representative / observer.
- (e) The recording functionality for stop, start and pause must be automated.

5.3.6 The Viewer Unit

- (a) A Software Application shall be made available to the client for the purpose of end user review of all or a part of the thermal recording of the section or report.
- (b) The viewer application software will be used by Rail Network engineering staff and installed on computers at multiple locations at the depot concerned.
- (c) The software shall comply with the security and other requirements set by Transnet's ICT Department. Approval by ICT must be obtained.

5.3.7 Basic features for viewing/reviewing of the thermal recording/reports are to include the following functionalities:

- (a) Quick view slider , play forward , play backward , image stream frame-by-frame, still image, auto temperature range pan view, manual temperature range pan view, colour and grayscale palette toggle.
- (b) Search functions by frame, GPS co-ordinates, Mast pole, incident identifier and temperature highlighter,
- (c) Simultaneous geo-referenced interpolation viewer (eg. Google Earth) with flagged representation of the incidents/faults data must be provided.

- (d) A functionality to review detected faults frame by frame, with the functionality to reselect affected infrastructure by severity, fault temperature and base reference temperature as well as an annotation function for labeling of components.
- (e) A Report Management which is to include review functionality for the classified faults so that it can be edited if the need arises for the change in Category / priority actions. It should also be able to selectively generate Excel spreadsheets, PDF copies, Statistics, GPS information and image and create AVI files. Search function options must be made available.
- (f) The electronic report format of the thermal defects must have a direct link to the thermal recorded images. The information format / architecture must not be database driven. The application must be Windows 7 based.
- 5.4 The viewer system must be made available to run on any Rail Network stand-alone or network computer connected on the Transnet Freight Rail information technology platform.
- 5.5 All the captured thermal recording data must be made available on a portable device.
- 5.6 All the recorded data must be stored for a minimum of 1 year or as agreed to during repetitive surveys.
- 5.7 The “Hotspot” faults are to be categorised according to a 5 level index system as stated below:

Hotspot Classification Threshold Table

The classifications indicated in the following table must be used to indicate severity of exceptions:

| Fault Level | Fault Category | Relative Temperature Classification °C | Colour Code | Repair Response Priority |
|-------------|--------------------|--|-------------|--------------------------|
| 5 | Critical Fault | ≥48 | | Critical |
| 4 | Emergency Fault | 37 to 47 | | Emergency |
| 3 | Urgent Fault | 32 to 36 | | Urgent |
| 2 | Corrective Fault | 27 to 31 | | Short term |
| 1 | Preventative Fault | 5 to 26 | | Medium term |

Note: Level 5 fault classification is the highest priority corrective action.

- 5.8 Hotspot temperature range classifications must be structured according to the thermal radiation signatures associated with the OHTE levels of electrical infrastructure component deterioration and must be differentiated between the component relative temperatures in relation to the reference temperature.
- 5.9 A Pantograph interaction defect shall be reported whenever there's a flash/arc due to the following:
- hard striking point of the pantograph interacting with the OHTE components or when interfacing with the contact wire.
 - overheating contact wire or pantograph due to “no-stagger” of the contact wire.
 - any excessive arcing / flashing due to interaction abnormalities.
- All pantograph interaction defects will be classified as critical priority faults.

- 5.10 For the purpose of OHTe IRT scanning of the overhead track equipment, the thermal imaging equipment shall be mounted in a position so as to capture “hotspots” and pantograph – contact wire defects.
- 5.11 The thermal recording equipment shall be capable of reliable operation under the electrically and electromagnetic noisy environment and the mechanical vibration normally associated with electric railway traction locomotives pulling loaded wagons.
- 5.12 Scanning will be undertaken at night, normally 1 hour after sunset up to 1 hour before sunrise.
- 5.13 Only under exceptional appropriate atmospheric conditions such as low cloud base, cool evening temperatures, low atmospheric thermal radiation (i.e. no direct sunlight) it can be agreed by the Thermographer, who has to ensure report consistency and reliability and the Transnet Freight Rail Representative that scanning can take place.
- 5.14 All defect reports must be made available so that it can be easily downloaded to portable devices such as a hand held GPS unit and other mobile devices (e.g. Smartphones, Tablets, etc.). This is to ensure flexible efficiency in locating the defects.
- 5.15 The system should use IRT recording software to record continuous IRT floating data and save it to an on-board data memory device while capturing all the required related data such as continuous GPS positioning.
- 5.16 The GPS coordinates must be provided in two formats:
 - 5.16.1 Decimal Degrees: DDD.DDDDD° - Latitude and Longitude for Iamm system.
 - 5.16.2 Degrees Decimal Minutes: DDD° MM.MMM' - 'S' and 'E' for normal hand held GPS devices.

6.0 REPORT REQUIREMENTS

6.1 GENERAL

This section describes the format in which the defects which are identified are in the format of reports as required by Transnet Freight Rail for purposes of post analysis, verifications, corrective actions and locations of the defects.

6.2 TRANSNET FREIGHT RAIL INFORMATION REQUIREMENTS

- 6.2.1 It is a requirement that all initial data processing is computer or software automated so as to avoid human error or oversight. The process should include quality control methodology and protocols to eliminate false reporting. The original data properties should remain evident for the use of end user.
- 6.2.2 In addition to kilometric beacons with deviations of long and short km-references, masts are numbered sequentially with reference to the kilometric beacon positions, e.g. “23/14” will be the mast number for the 14th mast between km-23 and km-24 beacons.
- 6.2.3 Transnet Freight Rail shall provide the Contractor with the basic information of the mast locations by soft copy format.
- 6.2.4 The contractor shall provide proof of data utilization integrity and technical capability to integrate the data for the mast locations. (be able to do a demonstration application).
- 6.2.5 Transnet Freight Rail does not guarantee the suitability or integrity of the data provided.

- 6.2.6 Any information provided and utilised may only be distributed in a secure encrypted format and may not form part of a commercial reseller product.
- 6.2.7 All spread sheets to be in EXCEL format and no merged cells are allowed.

6.3 FORMAT OF REPORTS

- 6.3.1 The information shall be supplied in three media formats namely hard copy A4 size, compact disc and portable storage device.

- 6.3.2 Hard Copy - Executive Report must consist of the following:

- (a) a post-processed printout report on all Critical and Emergency defects on completion of a depot's area that provides a purified version as to the probable component that is the source of the "hot-spot" as identified,
- (b) a post-processed printout report on completion of a depot's area that provides a purified version on all pantograph interaction arcing / flashes / thermal defects as identified,
- (c) the report cover page displaying depot name, survey date and release date and line name / reference,
- (d) report interpretation guidelines,
- (e) a control Excel database of all fault categories in the format required,
- (f) copy of the site diary,
- (g) Quality Line Index (QLI) calculations defined as for "Hotspots" and Pantograph interaction defects per km per section,

- 6.3.3 Compact Disc and Digital Video Disc format's shall consist of the following:

- (a) contain all of the above including EXCEL spreadsheets (no merged cells allowed),
- (b) PDF printable documents of all 5 of the category fault classifications,
- (c) PDF printable documents of all pantograph interaction defects,
- (d) the electronic image files (JPEG and MPEG/AVI format) of all "hotspot" and pantograph interaction arcing / flashes / thermal discharges for each defect detected a 6 second image sequence file on CD shall be provided, starting 4 seconds before- and ending 2 seconds after the defect.

- 6.3.4 Mobile Portable storage device shall contain:

- (a) all the required information as stated in in 6.3.1 (a) and (b) above,
- (b) the complete thermal recording for the depot for the purpose of reviewing, report management, etc.

6.4 DATA VERIFICATION

- 6.4.1 Transnet may require a verification of the data before acceptance and these details will be described in the project specification.
- 6.4.2 Transnet Freight Rail may prior to payment, sample and perform field verification audit according to technical standards with regards to the faults reported on the physical defect location confirmation (positioning) and the data format compliance.

7.0 PERSONNEL REQUIREMENTS**7.1 QUALIFICATIONS, ROLES AND RESPONSIBILITIES**

- 7.1.1 The thermographic survey shall be conducted by a minimum Level 1 Thermographer or higher. The Contractor shall indicate on the report the ID of the Thermographer responsible for the scanning and the post processing. The Contractor shall provide certified copies of the Thermographer's certification.
- 7.1.2 The Thermographer conducting the survey shall have a valid Category C (Green License) prior to commencement of the Project. This training for the License shall be obtained from Transnet's School of Rail, and the Category C (Green License) through examination by the Examining officer on the respective region. The Contractor shall be responsible for all costs associated with obtaining the License.
- 7.1.3 The pre- and post-processing shall be conducted by minimum Level 2 Thermographer or higher.
- 7.1.4 The Thermographer(s) shall have sufficient knowledge of the components, construction and theory of electrical systems to understand observations.

8.0 TENDER PROCEDURE

- 8.1 The Tenders shall be submitted in accordance with Transnet's tendering method as stated in the Project Specification.
- 8.2 A fully functional system must be available immediately on acceptance of the offer.
- 8.3 No product or prototype testing of any system will be allowed.
- 8.4 The Tenderers may be required to demonstrate the system which they have to offer prior to being awarded the scanning campaign.
- 8.5 The Tenderers must submit all traceable work references or experience related to thermography.
- 8.6 The Tenderers must submit proof of qualification for all their Thermographers who will be conducting the Works as per this Specification.
- 8.7 The Tenderer is required to submit a clause by clause compliance statement with their offer.

9.0 ANNEXURES FORMING PART OF THIS SPECIFICATION.

- Annexure 1: INFORMATION REQUIRED IN DATABASE FORMAT
- Annexure 2: FORMAT FOR HARD COPY EXCEL HOTSPOT REPORT-1
- Annexure 3: FORMAT FOR HARD COPY EXCEL INTERACTION REPORT- 2.
- Annexure 4: FORMAT FOR THERMAL HOTSPOT REPORT 1
- Annexure 5: FORMAT FOR THERMAL INTERACTION REPORT 2
- Annexure 6: STANDARD DESCRIPTIONS OF COMPONENTS.

END

ANNEXURE 1. INFORMATION REQUIRED IN DATABASE FORMAT

Microsoft Excel file format for viewing with Microsoft Office software, and for importing into IAMM viewer:

| <i>Parameter</i> | <i>Format, e.g.</i> |
|------------------------------|----------------------------|
| Record no. | 0001 |
| Date | 2004-03-12 |
| Scan no. | 1 |
| FIN YEAR | 14/15 |
| REGION | Central |
| BUSINESS UNIT | CAB |
| DEPOT | Ladysmith |
| GPS Latitude | -27.33911629 |
| GPS Longitude | 29.84803401 |
| GPS Altitude | 1707.22 |
| Section ID | E1H13VC |
| Line code | C02 – L028 |
| Section description Node 1 | Newcastle |
| Section description Node 2 | Ladysmith |
| Mast location (before fault) | 45/2 |
| Mast location (after fault) | 45/3 |
| Line (up/down/yard) | Up |
| Timer display | 01:24:34 |
| Kilometer | 45 |
| Meter | 0.0102 |
| Linked bitmap | LDS_0034 .JPEG |
| Linked video clip | LDS_0034 .MPEG |
| Infra red Defect Type | OHTE / Pantograph |
| Defective component | Catenarysplice / arcing |
| Relative temperature | 16°C |
| Fault temperature | 36°C |

ANNEXURE 2. FORMAT OF HARD COPY EXCEL REPORT-1 – INFRA RED HOTSPOT DEFECTS

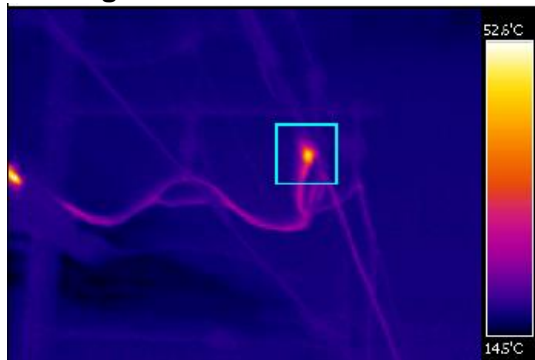
| DEPOT:VRYHEID VRYHEID TO ERMELO LINE 2 | | HOTSPOT DEFECTS 10 JUNE 2014 | | | |
|---|-----------------------|---|--|---|---|
| RECORD DATA | RECORD No. | 1 | 2 | 3 | 4 |
| | DATE | 2014/06/09 | 2014/06/09 | 2014/07/18 | 2014/07/18 |
| | SCAN No. | 1 | 1 | 1 | 1 |
| | FIN YEAR | 14/15 | 14/15 | 14/15 | 14/15 |
| | REGION | Eastern | Eastern | Eastern | Eastern |
| | BUSINESS UNIT | COAL | COAL | COAL | COAL |
| | DEPOT | Vryheid | Vryheid | Vryheid | Vryheid |
| | RECORD NO. | VHD-EMO-2_0001_00000 | VHD-EMO-2_0001_00000 | VHD-EML-L2_0001_00000 | VHD-EML-L2_0014_00002 |
| DDD° MM.MMM" | LATITUDE | S27°45.87098 | S27°45.998736 | S27°46.110643 | S26°34.437541 |
| | LONGITUDE | E030°50.773463 | E030°50.778342 | E030°50.776301 | E030°1.640368 |
| DDD.D DDDD° | LATITUDE | -27.76451634 | -27.7666456 | -27.76851072 | -26.57395902 |
| | LONGITUDE | 30.84622438 | 30.84630571 | 30.84627169 | 30.02733947 |
| | ALTITUDE | 1146 | 1140 | 1139 | 1702 |
| SECTION LOCATION | LINE NAME | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 |
| | SECTION ID (Database) | R05A (NEW) No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R05A No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R05A (NEW) No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R03A (NEW) No1 ERMELO - PIET RETIEF |
| | LINE CODE (Database) | CO5-L208 | 508 | 208 | 204 |
| | LINE FROM | Vryheid | Vryheid | Vryheid | Vryheid |
| | LINE TO | Ermelo | Ermelo | Ermelo | Ermelo |
| | LINE(Up/Down/Yard) | Up Vryheid Depot | Up Vryheid Depot | Up Vryheid Depot | Up Vryheid Depot |
| FAULT DATA | MAST LOC. BEFORE | 0/14 (Distance: 4.54m Bearing: 319.6deg) | 0/19 (Distance: 11.12m Bearing: 353.15deg) | 0/23 (Distance: 37.56m Bearing: 358.95deg) | 0/26 (Distance: 9.32m Bearing: 12.68deg) |
| | MAST LOC. AFTER | 0/15 (Distance: 38m Bearing: 180.16deg) | 0/20 (Distance: 51.41m Bearing: 179.59deg) | 1/1 (Distance: 4.44m Bearing: 167.79deg) | 0/26 (Distance: 0.64m Bearing: 188.84deg) |
| | LINKED BITMAP | VHD-EMO-2_0001_00000.bmp | VHD-EMO-2_0001_00000.bmp | VHD-EML-L2_0001_00000.bmp | VHD-EML-L2_0014_00002.bmp |
| | LINKED VIDEOCLIP | VHD-EMO-2_0001_00000.avi | VHD-EMO-2_0001_00000.avi | VHD-EML-L2_0001_00000.avi | VHD-EML-L2_0014_00002.avi |
| | COMPONENT | C Jumper | | | FCC Jumper |
| | CATEGORY | D / Minor CF | D / Minor CF | D / Minor CF | B / Critical CF |
| | Temp of Fault | 22.1 | 16.38 | 21.27 | 45.26 |
| | Reference Temp | 17.19 | 11.68 | 13.04 | 3.86 |

**ANNEXURE 3. FORMAT OF HARD COPY EXCEL REPORT-2 – INFRA RED
PANTOGRAPH INTERACTION DEFECTS**

| DEPOT:VRYHEID VRYHEID TO ERMELO LINE 2 | | PANTOGRAPH / CONTACT WIRE INTERACTION DEFECTS 10 JUNE 2014 | | | |
|---|-----------------------|---|--|--|---|
| RECORD DATA | RECORD No. | 1 | 2 | 3 | 4 |
| | DATE | 2014/06/09 | 2014/06/09 | 2014/07/18 | 2014/07/18 |
| | SCAN No. | 1 | 1 | 1 | 1 |
| | FIN YEAR | 14/15 | 14/15 | 14/15 | 14/15 |
| | REGION | Eastern | Eastern | Eastern | Eastern |
| | BUSINESS UNIT | COAL | COAL | COAL | COAL |
| | DEPOT | Vryheid | Vryheid | Vryheid | Vryheid |
| | RECORD NO. | VHD-EMO- 2_0001_00000 | VHD-EMO- 2_0001_00000 | VHD-EML- L2_0001_00000 | VHD-EML- L2_0014_00002 |
| DDD° MM.MMM' | LATITUDE | S27'45.87098 | S27'45.998736 | S27'46.110643 | S26'34.437541 |
| | LONGITUDE | E030'50.773463 | E030'50.778342 | E030'50.776301 | E030'1.640368 |
| DDD.D DDDD° | LATITUDE | -27.76451634 | -27.7666456 | -27.76851072 | -26.57395902 |
| | LONGITUDE | 30.84622438 | 30.84630571 | 30.84627169 | 30.02733947 |
| | ALTITUDE | 1146 | 1140 | 1139 | 1702 |
| SECTION LOCATION | LINE NAME | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 | Vryheid 2 Ermelo L2 |
| | SECTION ID (Database) | R05A (NEW) No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R05A No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R05A (NEW) No1 VRYHEID OOS - NHLAZATSHE (Excl.) | R03A (NEW) No1 ERMELO - PIET RETIEF |
| | LINE CODE (Database) | CO5-L208 | 508 | 208 | 204 |
| | LINE FROM | Vryheid | Vryheid | Vryheid | Vryheid |
| | LINE TO | Ermelo | Ermelo | Ermelo | Ermelo |
| | LINE(Up/Down/Yard) | Up Vryheid Depot | Up Vryheid Depot | Up Vryheid Depot | Up Vryheid Depot |
| FAULT DATA | MAST LOC. BEFORE | 0/14 (Distance: 4.54m Bearing: 319.6deg) | 0/19 (Distance: 11.12m Bearing: 353.15deg) | 0/23 (Distance: 37.56m Bearing: 358.95deg) | 0/26 (Distance: 9.32m Bearing: 12.68deg) |
| | MAST LOC. AFTER | 0/15 (Distance: 38m Bearing: 180.16deg) | 0/20 (Distance: 51.41m Bearing: 179.59deg) | 1/1 (Distance: 4.44m Bearing: 167.79deg) | 0/26 (Distance: 0.64m Bearing: 188.84deg) |
| | LINKED BITMAP | VHD-EMO- 2_0001_00000.bmp | VHD-EMO- 2_0001_00000.b mp | VHD-EML- L2_0001_00000.b mp | VHD-EML- L2_0014_00002.bmp |
| | LINKED VIDEOCLIP | VHD-EMO- 2_0001_00000.avi | VHD-EMO- 2_0001_00000.avi | VHD-EML- L2_0001_00000.avi | VHD-EML- L2_0014_00002.avi |
| | COMPONENT | Section Insulator | Contact Splice | Neutral Section | Overlap |
| | Temp of Fault | 22.1 | 16.38 | 21.27 | 45.26 |
| | Reference Temp | 17.19 | 11.68 | 13.04 | 3.86 |

ANNEXURE 4. FORMAT OF HARD COPY REPORT-1 OHTE HOTSPOT DEFECT

Images of the overhead wires must be combined in a graphic picture, and the location text superimposed on the graphic. The file must be in the JPEG format. An example of the graphic format is provided as guideline:

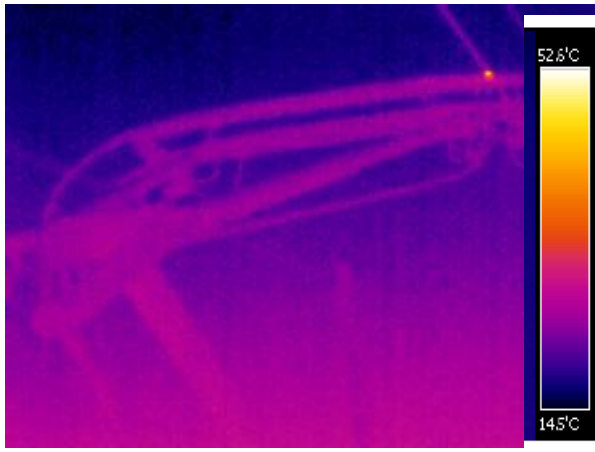
Thermal image**NOTES / ACTIONS**

| | | |
|---|-------------------------|-------------------|
| DATE | | 2009/03/18 |
| REPORT NO. | | DBN_0013 |
| GPS CO-ORDINATES | LATITUDE | S-29,522230 |
| | LONGITUDE | E31,182785 |
| | ALTITUDE | 30 |
| IAMM CO-ORDINATES Decimal degrees | LATITUDE | -29,652301 |
| | LONGITUDE | 31,485671 |
| SECTION DESCRIPTION | LINE NAME | Durban To Stanger |
| | LINE FROM Node 1 | Durban |
| | LINE TO Node 2 | Stanger |
| | LINE TYPE | DC / AC |
| MAST LOC. BEFORE | | 45/2 |
| MAST LOC. AFTER | | 45/3 |
| LINKED BITMAP | | DBN_0013 |
| LINKED VIDEO CLIP | | DBN_0013 |
| COMPONENT | | FCC JUMPER |
| CATEGORY | | 5 |
| LINE (Up/ Down/Yard) | | UP |
| Temp. of Fault (°C) | | 56.9 |
| ReferenceTemp. (°C) | | 20.9 |
| <u>Repairs Undertaken:</u> | | |
| | | |
| | | |
| | | |
| Name: _____ Signature: _____ Date: _____ | | |

ANNEXURE 5. FORMAT OF HARD COPY REPORT-2 - PANTOGRAPH ARCING

Thermal image

NOTES / ACTIONS



| | | |
|--------------------------------------|------------------|-------------------|
| DATE | | 2009/03/18 |
| REPORT NO. | | DBN_0013 |
| GPS CO-ORDINATES | LATITUDE | S-29,522230 |
| | LONGITUDE | E31,182785 |
| | ALTITUDE | 30 |
| IAMM CO-ORDINATES Decimal degrees | LATITUDE | -29,652301 |
| | LONGITUDE | 31,485671 |
| SECTION DESCRIPTION | LINE NAME | Durban To Stanger |
| | LINE FROM Node 1 | Durban |
| | LINE TO Node 2 | Stanger |
| | LINE TYPE | DC / AC |
| MAST LOC. BEFORE | | 45/2 |
| MAST LOC. AFTER | | 45/3 |
| LINKED BITMAP | | DBN_0013 |
| LINKED VIDEO CLIP | | DBN_0013 |
| COMPONENT | | Pantograph flash |
| LINE (Up/ Down/Yard) | | UP |
| Temp. of Fault (°C) | | 56.9 |
| ReferenceTemp. (°C) | | 20.9 |
| <u>Repairs Undertaken:</u> | | |
| | | |
| | | |
| | | |
| Name: _____ | Signature: _____ | Date: _____ |

ANNEXURE 6. STANDARD DESCRIPTIONS OF COMPONENTS

The standard defect descriptions are to be used for compatibility with the IAMM system and have a standard word length with underscore characters for word breaks. No other description may be used. Pick-list compiling is recommended. The information is available to the successful tenderer in electronic format from Transnet Freight Rail.

- 1 Bond_Mast_Rail_Mast_side
- 2 Bond_Mast_Rail_Rail_side
- 3 Bond_Rail_continuity
- 4 Booster_wire_clamp
- 5 Clamp_FCC catenary_side
- 6 Clamp_Catenary_Suspension
- 7 Clamp_Contact
- 8 Clamp_Earth_wire
- 9 Clamp_FCC_contact_side
- 10 Clamp_FCC_feeder_side
- 11 Clamp_Feeder_Suspension
- 12 Distribution_switch_contacts
- 13 Distribution_line_clamp
- 14 Distribution_line_insulator
- 15 Dropper
- 16 Insulator_Cross_Span
- 17 Insulator_Feeder
- 18 Insulator_Strain
- 19 Insulator_Strutt
- 20 Insulator_Suspension
- 21 Insulator_Top
- 22 Jumper_FCC
- 23 Jumper_Contact_Contact
- 24 Jumper_Track_switch
- 25 Multiple_components
- 26 Phase_break
- 27 Pantograph bounce
- 28 Pantograph flash
- 29 Section_insulator
- 30 Splice_Contact
- 31 Splice_Feeder
- 32 Track_switch_contacts
33. Uncertain_Investigate futher

END