SPECIFICATION FOR OPTICAL FIBRE TESTING EQUIPMENT

1. OPTICAL TIME-DOMAIN REFLECTOMETER (OTDR)
2. POWER METER, LASER SOURCE
3. VISUAL FAULT LOCATOR
4. TALK-SET
5. OPTICAL ATTENUATOR

SPC-00033
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I DOCUMENT AUTHORISATION

FUNCTION	NAME	TITLE & DIVISION	SIGNATURE	DATE
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II DISTRIBUTION

Once updated, a copy of the latest revision will be published in the document management system in use. E-mail to this effect will be sent to the relevant personnel or heads of department.

III DOCUMENT CHANGE HISTORY

ISSUE NO.	DATE ISSUED	ISSUED BY	HISTORY DESCRIPTION
2.00	June 2001	BG Nel	Converted to ISO standard
3.00	October 2006	BG Nel	Minor changes
4.00	June 2010	BG Nel	Adapted for updated OTDR test requirements incl. Test wavelengths, software changes and latest specifications.

IV CHANGES SINCE LAST REVISION

CLAUSE	DESCRIPTION
Various Clauses	Adapted for the latest generation of OTDRs. Replace all Transnet with Transnet Freight Rail
Clause x.xx	
Clause x.xx	
Clause x.xx	
Clause x.xx	
Add new clause:	
x.xx	
x.xx	

V ABBREVIATIONS, ACRONYMS AND DEFINITIONS

ABBREVIATIONS AND ACRONYMS	DESCRIPTION
AC	Alternating Current
DC	Direct Current
DWDM	Dense Wavelength Division Multiplexing
CWDM	Course Wavelength Division Multiplexing
EMC	Electromagnetic Compatibility
GPS	Global Positioning System
LC	Inductor – Capacitor Circuit (L is the symbol for Inductance and C for capacitance)
OTDR	Optical Time-Domain Reflectometer
PC	Personal Computer
PCB	Printed Circuit Board
ORL	Optical Return Loss
nm	Nano Meter
km	Kilo Meter
cm	Centimeter
m	Meter
dB	Decibel
CFR	Code of Federal Regulations
ns	Nano Seconds
µs	Micro Seconds

DEFINITIONS	DESCRIPTION
None	

VI RELEVANT DOCUMENTATION

APPLICABLE

DOCUMENT NO.	DESCRIPTION	LOCATION
SCED-89	The number has changed to SPC-00033	Document Control Centre

1. GENERAL

1.1 Scope

1.1.1 This specification covers the requirement for various optical instruments.

1.1.2 The instruments must be portable, robust and simple to operate and be ideally suited for South African climatic conditions.

1.1.3 This specification replaces Specifications No. SCED-77, SCED-79, SCED-89 and SPC-00033 before October 2006 and is adapted for the latest OTDR optical specifications and test wavelengths.

1.2 Compliance

1.2.1 Tenderers must indicate clause by clause how their offer complies or differ from this specification with reference to substantiating documented proof.

1.2.1.1 A statement to the effect that the equipment is in accordance with this specification is not acceptable.

1.2.1.2 Substantive or documented proof must be supplied for each point with reference to where it can be verified.

1.2.1.3 Failure to supply detail substantive proof / information on compliance, non-compliance / partial compliance points will cause disqualification from this tender.

1.2.2 Tenderers must submit their main offer that is fully compliant in terms of this technical specification.

1.2.3 Alternative Offers

1.2.3.1 Offers, which include minor deviations from this specification can be offered as alternative offer and must be marked / indicated as alternative offer.

1.2.3.2 Alternative not technical compliant tenders units might be considered at the sole discretion of Transnet Freight Rail only if it's marked as alternative / non-compliant offer.

1.2.4 Documentary proof must be submitted with the tender submission authorising the bidder to tender on the manufacturer's behalf.

1.3 Composition

1.3.1 This document consists of three sections:

- Section 1 – Information relevant / applicable to all equipment offered.
- Section 2 – Technical Specifications for Optical Time Domain Reflectometer (OTDR).
- Section 3:
  - (a) Optical Talk-set (Communications device)
  - (b) Visual Fault Locator
  - (c) Optical Power Meter
  - (d) Laser Source

1.3.2 A combined "all in one" unit with these functions can be offered as alternative to the abovementioned products as separate units.

1.3.3 The Tendered must specify and explain interoperability with current fibre test instruments used in Transnet Freight Rail.

1.3.3.1 OTDR (Software Analysis).

1.3.3.2 Optical Talk sets, integrated power meters and laser sources.

1.3.4 The Tenderer should highlight all automated features of equipment offered and explain possible advantages of equipment combinations offered.

1.3.5 The equipment shall preferably be modular to accommodate a variety of plug-in options to extend the functions or features of the equipment and allow future field upgrades.

1.3.6 Tenderers shall outline the concept of modularity and expandability in terms of hardware and software of the equipment offered.

1.3.7 Tenderers must submit detailed descriptive literature, illustrations and specifications together with sufficient information to demonstrate how the equipment offered will meet the requirements of Transnet Freight Rail.

1.3.8 Tenderers must indicate and offer future upgrade possibilities for the test unit and elaborate on all the options / modules available on the test unit for future test requirements like DWDM, CWDM, SDH /OTN, Ethernet and fibre certification (PMD, CD and OLTS).

1.3.9 Tenderers must give full details of the software capabilities to analyse existing OTDR trace data, currently available in SOR and TRC format.

1.4 Standard Products and Options

1.4.1 It is the intention of Transnet Freight Rail to use, as far as possible, standard products to facilitate extensions and upgrading using standard products, thus reducing customisation cost and to facilitate maintenance and the holding of spare parts.

1.4.2 The Tenderer shall indicate which parts of the systems offered are standard products (equipment and software), and which require special design for this contract.

1.4.3 In the case of non-standard items, a breakdown of the cost of customisation of such items shall be given in the price schedules.

1.5 Software

1.5.1 The equipment, software input and output interfaces shall be compatible with PC based systems to facilitate interconnection, networking, downloading and post processing of data offline on Windows 2000, Windows XP and Windows 7 type operating systems.

1.5.2 It shall be capable of accurate fibre fault location as well as splice loss and reflectance measurements with the minimum keystrokes by the operator.

1.5.3 All functions shall be menu driven with help functions available.

1.5.4 All upgrades or revisions of the software, to overcome shortcomings and limitations, identified by the supplier, or by Transnet Freight Rail, in accordance with this specification shall be provided to Transnet Freight Rail when they become available. The cost of these upgrades shall be considered part of the original product price.

1.5.5 New versions of software that offer additional functionality and enhanced capabilities shall be offered to Transnet Freight Rail when available.

1.5.6 Installation procedures shall be supplied with each software upgrade or release. Specialised support shall be available whilst loading of software is being performed. Initial installation of the software shall be performed by the supplier in conjunction with Transnet Freight Rail. Training shall be provided by the supplier to enable Transnet Freight Rail to load any further additional software.

1.5.7 Tenderers must indicate the procedure and cost of adapting to future hardware and software upgrades or extensions.

1.5.8 Bi-directional trace analysis shall be possible on the OTDR without the use of any external device or computer.

1.5.9 Bi-directional trace analysis shall be possible on an external computer, without the use of the OTDR mainframe.

1.6 Physical and Electrical Requirement

1.6.1 Mechanical Design

1.6.1.1 The equipment shall be of a robust and water proof design, GR196 CORE Compliant.

1.6.1.2 The equipment shall be compact and light-weight not exceeding 4kg (mainframe and modules).
(Tenderers to specify dimensions and weight (Including batteries and any possible external adapters and or battery packs)

1.6.1.3 The equipment shall be software upgradable ensuring cost effectiveness and possible expansion

1.6.1.4 Tenderers must supply a full list of additional possible future upgrades or modules available for current and/or future technologies. (Focus on SDH, Ethernet and dispersion testing).

1.6.1.5 The mechanical modules and printed board assemblies shall be easily accessible and easy to change for repair.

1.6.1.6 All external metal surfaces shall be suitable protected from corrosion.

1.6.1.7 All equipment and sub-assemblies shall be labelled in English for easy and logical identification.

1.6.2 Components

1.6.2.1 All components or, where applicable, sub-units shall be suitable designated on the PCB, chassis or framework or by suitable designation on lay-out diagrams.

1.6.2.2 Adequate margins shall be observed in the ratings of all electronic components to be used, in order to ensure good reliability in operation.

1.6.2.3 For PC boards, the laminated material shall preferably be epoxy glass filament. The patterns shall be adequately protected against corrosion. Unprotected copper conductors may not occur.

1.7 Surge Protection

All equipment which is mains operated shall be fitted with the necessary surge protection as required for lightning protection, suppression of mains-borne surges or interference, safety of personnel and suppression of radio frequency interference.

1.8 Power Supply

1.8.1 It shall be possible to operate the equipment from the following power source :

1.8.1.1 A nominal 230 volt AC power source.

1.8.1.2 Internal Li-Ion rechargeable batteries, 8 hour of operation as per Bellcore TR-NWT-001138. Preference will be given to units capable of >8 hour of operation from a single set of internal batteries under general testing conditions with OTDR.

1.8.1.3 An external 11 to 16 volt DC supply (optional).

1.8.2 The Tenderer must provide full details of the power consumption and voltage tolerances of all equipment offered, as well as the operating time available during battery operation. Full details of the battery type and expected lifetime or number of charge / discharge cycles shall be given in the Tender.

1.8.3 The Tenderer must indicate whether it is possible to easily exchange the battery in the field. The Tenderer may offer, as an option, spare rechargeable batteries and a separate battery charger.

1.8.4 The unit shall display the battery condition and remaining operating time at all times.

1.8.5 Suitable power cords must be supplied with the equipment. The mains power cord shall be not less than 1,5 m in length and shall be fitted with the standard 15 ampere three-pin plug used in South Africa. If the external DC supply option is offered, a 3 m DC cable fitted with crocodile clips suitable for connection to a car battery shall be supplied.

1.8.6 All DC inputs shall be reverse voltage protected.

1.9 Environmental Conditions

1.9.1 The equipment must operate without loss of performance within a temperature range of -5°C and +50°C and relative humidity levels between 10% and 80%.

1.9.2 The equipment must be capable of operating on a 24 hour basis under the above environmental conditions.

1.9.3 The Tenderer must verify and confirm that this equipment will be able to function according to all required provisions in this Specification in the environment provided, and must provide in the Tender full details of the environmental operating limits of the equipment.

1.9.4 The equipment must be capable of operating in conditions of severe dust and shall therefore be suitably sealed.

1.9.5 The equipment shall be sealed against moisture and water splashes.

1.9.6 The Tenderer must specify the standard of environmental compliance.

1.10 Electromagnetic Compatibility (EMC)

1.10.1 The Tenderer shall provide full details of the EMC standards applicable to this equipment and shall provide proof of compliance to the EMC standards.

1.10.2 Safe operation of the equipment under all conditions is critical to Transnet Freight Rail, failing to supply EMC certificate for any unit offered will lead to tender disqualification.

1.11 Transport Case

1.11.1 The equipment shall be supplied complete with a rugged transport case to protect the equipment against transport hazards such as shock, dust and moisture.

1.11.2 Details and prices of alternative case options shall be supplied in the offer.

1.11.3 The case shall accommodate all accessories and test cables required to perform measurements in the field.

1.12 Documentation

1.12.1 Documentation structure

The documentation to be provided with the equipment shall be structured as follows:

A list of all documents supplied with the equipment

1.12.1.1 Operation manuals describing all operational features and activities, as well as all maintenance activities required on a regular basis or in case of failures.

1.12.1.2 Software documents, where applicable.

1.12.1.3 Test manuals for testing of installed functions, where applicable.

1.12.2 Operation and maintenance manuals

The operation and maintenance manuals shall give a description of the equipment and the facilities offered with sufficient information for the following :

1.12.2.1 Operation of each function of the equipment.

1.12.2.2 Fault locating to enable faults to be cleared.

1.12.2.3 Handling of data.

1.12.2.4 Handling of measuring facilities.

1.12.2.5 Description of periodic routine maintenance, where applicable.

1.12.3 A card shall preferably be provided containing abbreviating operating instructions.

2. TECHNICAL SPECIFICATION: OTDR TEST EQUIPMENT

2.1 Functional Requirements

2.1.1 This specification covers the Transnet Freight Rail requirement for the following OTDR configurations.

2.1.1.1 1310 & 1550nm
2.1.1.2 1310/1550 and 1625nm
2.1.1.3 1310/133/1550 and 1625nm
2.1.1.4 1550 and 1625nm

Note; Compliance certificate must be supplied for each OTDR module configuration offered as per 2.1.1. (2.1.1.1 to 2.1.1.4)

2.1.2 The specifications listed are the minimum technical requirement / specification for any OTDR module / configuration required.

2.1.3 The Tender will be adjudicated primarily in respect of ease of operation, optical performance, event detection, dynamic range, dead zone, software and price.

2.1.4 The following automated test shall be provided as standard:

2.1.4.1 Determine and display the length of fibre tested.

2.1.4.2 Identify fibre breaks, splices or irregularities and determine the distances in metres from the test point to the respective splices and irregularities.

2.1.4.3 Determine the event losses using the least-squares method.

2.1.5 Distance and loss measurements shall be made using at least two movable markers. The following results shall be displayed automatically:

2.1.5.1 Distance from the beginning of the trace to the first marker in metres.

2.1.5.2 Distance between the markers in metres.

2.1.5.3 The absolute loss of the fibre between the markers in dB.

2.1.5.4 The loss of the fibre between the markers in dB/km using the least-squares method.

2.1.5.5 Software must be capable of detecting possible false events like echoes, merged events and Micro / macro bending.

2.1.6 Splice loss measurements shall be made by positioning the marker at the beginning edge of an event on the horizontal trace. The OTDR shall then perform the spice loss measurement automatically.

2.1.7 The OTDR shall be capable of combining results from two traces, acquired from both ends of a fibre span, to determine the resultant attenuation per event/irregularity (bi-directional analysis).

2.2 Optical Specification

2.2.1 The OTDR shall comply to the following as per the configurations set out in section 2.1.1.

2.2.1.1 1310 ± 20nm
2.2.1.2 1383 ± 2nm
2.2.1.3 1550 ± 20nm
2.2.1.4 1625 ± 10nm

2.2.2 The fibre type shall be 9/125 µm single mode fibre (G.652a, b, c, d, G.655 and G.657).

2.2.3 The OTDR equipment shall have a universal / interchangeable optical connector of the type E2000/APC.

2.2.4 The refractive index shall be adjustable in the range 1,400 to 1,599.

2.2.5 All equipment shall conform to Safety Classification CFR 21 class 1.

2.2.6 The OTDR shall be capable of operating in the continuous wave mode for all wavelengths as set out in 2.2.1

(This must be included as standard on the OTDR.

2.2.7 It shall be possible to modulate the continuous wavelength as described in 2.2.6 for detection purposes.

2.3 Measurement Parameters

2.3.1 The dynamic range shall be at least

2.3.1.1 32 dB (for 1310 nm and 1550 nm) using a 10 µs pulse.

2.3.1.2 36dB (for 1310/1383/1550 and 1625nm) using a 10µs pulse.

2.3.2 It shall be possible to zoom in on any section of the trace and start measurement at a point on the trace.

2.3.3 It shall be possible to display both the full trace and the zoomed trace simultaneously on the screen.

2.3.4 The OTDR shall have variable pulse width settings within a range of at least 5 ns to 20 µs.

2.3.5 Linearity shall be 0.03dB/dB or better

2.3.6 Loss measurement threshold shall be 0.01dB with a minimum resolution of 0.001 dB.

2.3.7 The event dead zone on all the OTDR modules required as per section 2.1.1 shall not exceed 1 metre.

2.3.8 The loss measurement dead zone shall be less than 5 metres on all the OTDR modules required as per section 2.1.1.

2.3.9 Sampling resolution shall be 4 cm or better on short range and shall not exceed 5m on the longest pulse / range setting.

2.3.10 Field trial test: Transnet Freight Rail will conduct a field trial test. The tenderer will supply the applicable OTDR for this purpose. The test will be conducted on an existing single mode optical fibre section of 120 km. Units will be evaluated against the manufacturer's technical specification and ability to detect events over the fibre section being tested as well as software and ease of use.

2.4 Software / Hardware Requirements

2.4.1 The OTDR shall be equipped with a large, high contrast backlit colour display. Tenderers shall provide details of the display size, type and visibility in direct sunlight conditions.

2.4.2 The display shall enable viewing under all lighting conditions including direct sunlight).

2.4.3 All measurements and test results shall be displayed digitally on the screen.

2.4.4 The trace on the display shall be displayed in amplitude (dB) versus distance (km).

2.4.5 Data point sampling shall be > 120 000 data points on the horizontal axis with a linearity 0.03dB/dB or better for the vertical axis, to form a continuous trace and to enable accurate distance and loss measurements in both the normal and zoom modes (Tenderer to provide information on the exact amount of sampling points per range and distance accurate per range.)

2.4.6 It shall be possible to connect the OTDR directly to a computer via USB port to down load, upload traces and upgrade the mainframe software.

2.4.7 The tenderer must advise what other additional type connection i.e. Wi-Fi, Bluetooth or LAN (RJ45) is available for file transfer and connection to the company network.

2.4.8 The tenderer must offer additional type connection: USB-A (Main) USB-B (remote) RJ-45 LAN 10/100, Compact Flash and integrated Fibre Inspection probe.

2.4.9 Tenderers shall offer storage of at least 10 000 traces on an internal hard disc drive in addition to possible / alternative external the storage devices.

2.4.10 It shall be possible to superimpose > 10 traces and compare an active trace being measured with any stored trace on the OTDR.

2.4.11 Hardware and software interfaces shall be provided to download all traces and stored results to a personal computer (PC) for storage and/or post-processing.

2.4.12 Post-processing software shall be provided to enable all measurements available on the OTDR to be performed on the stored data, both on the OTDR system and also on the off-line PC. Offline software must be supplied that runs on any PC based computer with a Microsoft operating system, i.e. WinCE, XP, Windows 2000, VISTA and Windows7.

2.4.13 The OTDR shall be capable of producing a hardcopy of traces and test results on a plotter and/or printer. The Tenderer shall indicate which plotter and printers his system is capable of supporting and which interfaces are provided.

2.4.14 Tenderers should indicate the possibilities for accessing information on the OTDR via a remote connection. Special emphasis on remote operation of the OTDR is required.

2.4.15 It shall be possible to add details such as project information, titles, cable data, geographic data, operator information and comments to any stored trace or measurement result using an integrated keyboard or an external keyboard on the OTDR.

2.4.16 Bi-directional trace analysis shall be possible on the OTDR without the use of any external device or computer.

2.4.17 The unit shall provide an indication or warning in case of a failed or dirty front panel optical connector.

2.4.18 Post processing Offline trace analyzing software shall be supplied with each OTDR. The following features shall be possible from an Windows compatible PC to analyze and evaluate all stored results.

2.4.18.1 Re-analyse OTDR trace to verify compliance to Transnet Freight Rail limits, and to show all events detected by the OTDR.

2.4.18.2 Show all events on the trace, including user-deleted events after post process analysis. (Critical Requirement)

2.4.18.3 Super-impose multiple > 24 stored waveforms.

2.4.18.4 Zoom in on any part of the stored trace and perform manual loss measurements.

2.4.18.5 Perform splice and fibre loss measurements.

2.4.18.6 Make distance measurements.

2.4.18.7 Perform bi-directional trace measurements, to compensate for different indexes of refraction in a spliced cable.

2.4.18.8 Insert events and comments, GPS co-ordinates on any event and or part of the trace for future reference purposes.

2.4.18.9 The field for adding events and or comments shall be at least 50 characters long.

2.4.18.10 Tenderers shall specify the capability of the software (on line and/or off line) to evaluate/interpret trace's from other vendors and/or manufacturer's of OTDR's.

2.5 Optional Equipment

2.5.1 Visible Light Source

2.5.1.1 Tenderers shall offer an optional visible light source to be integrated into the OTDR module or mainframe, with a minimum output of –1 dBm at 650nm ± 10nm.

2.5.1.2 The output of the visible light source must be Class 2, eye safe compliant.

2.5.1.3 The Tenderer may offer optional features, equipment or accessories, in which case he shall supply a complete list of all items offered, and the price of each item.

2.5.1.4 The function of each optional item shall be fully described in the offer.

2.5.2 Optical Power Metr

2.5.2.1 Tenderers shall offer an optional Optical Power meter option integrated into the mainframe with

2.5.2.1.1 Automatic offset nulling

2.5.2.1.2 Tone detection (270 and 2kHz)

2.5.2.2 Optical Power meter Adapter must be user interchangeable E2000 APC, ST, LC/PC and LC/APC.

2.5.2.3 Minimum Optical Power Range -60dBm to +26dBm

2.5.2.4 Maximum Measurement Uncertainty of ± 5% ± 0.5nW

2.5.2.5 Calibrated wavelengths 850, 1300, 1310, 1383, 1550 and 1625nm

3. TECHNICAL SPECIFICATION: PLUG-IN MODULES

3.1 Scope

3.1.1 Tenderers shall offer these items as separate units, but may, as an additional alternative, offer two or more of these functions combined into one unit.

3.1.2 This specification covers the requirements for optical plug-in modules in addition to the OTDR modules.

3.1.3 As a minimum requirement, the following test units are required:

3.1.3.1 Optical power meter.

3.1.3.2 Optical source.

3.1.3.3 Optical attenuator.

3.1.3.4 Optical Talkset.

3.1.4 Tenderers may optionally offer return loss measurements, a visual light source and a talk set as part of the above unit(s).

3.1.5 All equipment shall be rugged, compact and shall preferably be plug-in modules.

3.1.6 All equipment shall have exchangeable optical connectors of the type E2000/APC. Tenderers shall indicate whether this requirement can be met, and the range of connectors available.

3.2 Optical Power Level Meter

3.2.1 The power meter shall operate in the range of 850 to 1550 nm with calibrated wavelengths of 850 nm, 1310 nm and 1550 nm, optional 1383 and 1625nm.

3.2.2 The optical power meter shall have a sensitivity range of +10 dBm to -68 dBm or greater.

3.2.3 The accuracy shall be better than ±0,2 dB .

3.2.4 The resolution shall be better than 0,01 dB .

3.2.5 Measuring results shall be displayed in dBm, dB and watt.

3.3 Optical Source

3.3.1 The optical source shall operate at wavelengths of 1310 and 1550 nm, with the option of additional 850, 1300 and 1625nm outputs.

3.3.2 The continuous wave output power shall be not less than –4 dBm at 1310 nm and 1550 nm into 9/125 µm fibre.

3.3.3 The output stability shall be better than 0,1 dB over an 8 hour period.

3.3.4 The spectral width shall be less than 5 nm.

3.4 Optical Attenuator

3.4.1 The optical attenuator shall be suitable for use on single-mode 9/125 µm fibre.

3.4.2 The attenuator shall operate in the range of 1260 m to 1625nm with calibrated wavelengths of 1310 nm, 1550 nm and 1625.

3.4.3 The attenuation shall be variable in the range 3 to 60 dB with a display resolution of better than 0,05 dB.

3.4.4 The linearity shall be better than ±0,2 dB.

3.4.5 The optical signal path shall remain uninterrupted during attenuator setting changes.

3.5 Optical Talk Set

3.5.1 The optical talk set module shall enable full duplex voice communication over one single mode fibre (9/125 µm) fibre. Tenderers should indicate the modularity of this option on the product offered and the compatibility with current fibre Talksets in use by Transnet Freight Rail.

3.5.2 It shall be possible to use the talk set while OTDR testing and or Loss Testing is in progress.

3.5.3 The talk set shall operate at the 1550 nm wavelength over 9/125 µm single mode fibre cable.

3.5.4 The dynamic range of the talk set shall be greater than 48 dB.

3.5.5 In addition to the integrated talk set, Tenderers shall offer a compact talk set to serve as the remote unit for voice communications. This separate talk shall have the same technical specifications and must be compatible with the integrated talk set.

3.5.6 Tender must indicate compatibility with current units used by Transnet as well as interoperability with other units available.

3.6 **Optional Equipment and Features**

3.6.1 The Tenderer may offer optional features, equipment or accessories, in which case he shall supply a complete list of all items offered, and the price of each item.

3.6.2 The function of each optional item shall be fully described in the offer.

3.6.3 Tenderers may offer an optical return loss feature as part of the above mentioned equipment.

4. TRAINING

4.1 An integrated program of formal classroom training and practical hands-on instructions shall be provided to Transnet Freight Rail's personnel on the operation and maintenance of the equipment.

4.2 **Training Objectives**

4.2.1 The training program is intended to accomplish the following fundamental objectives:

To perform all operational functions provided by the offered equipment:

4.2.1.1 To perform all operational functions provided by the offered equipment :

a) To enable Transnet Freight Rail's personnel to operate the equipment properly, and to perform all measurement and testing tasks required to maintain the equipment in proper operating conditions.

b) To enable Transnet Freight Rail's personnel to undertake any reconfiguration or software upgrades in future.

4.2.1.2 Training program

a) To achieve these objectives the Tenderer shall propose a training program, preferably at Transnet Freight Rail's premises.

b) All training courses shall be conducted in the English language.

c) Training materials and manuals shall be provided to the trainees.

d) The Tenderer shall submit the detailed training program he intends to provide, indicating also the duration of each training module.

4.2.1.3 The cost of training shall include the travelling and subsistence allowances of the instructor.

5. REPAIR, AFTER SALES SERVICES AND SPARE PARTS

5.1 The Tenderer shall provide repair services for any faulty equipment at the request of Transnet Freight Rail.

5.2 The Tenderer shall state the expected turn-around time for repairing all faulty equipment.

5.3 The Tenderer shall make available to Transnet Freight Rail at no cost, swop-out units in the case of units being faulty during the warranty period. Tenders shall indicate the spares and swop-out units that are kept in South Africa.

5.4 The Tenderer shall provided full maintenance support in case of faults occurring up to the expiry of the guarantee period. The cost of this support shall be included in the price of the equipment and software offered.

5.5 After sales support expertise shall be available to assist in the following tasks (details of the support offered shall be given in the offer):

5.5.1 Hardware and software upgrades.

5.5.2 Handling of trouble reports.

5.5.3 Requirements for new functions within the equipment.

5.5.4 Assistance to the operation and maintenance staff in unusual fault situations.

5.6 The Tenderer shall indicate whether a remote diagnostics facility from the supplier's premises via a dial-up modem facility is available for the software-based equipment.

5.7 The Tenderer shall supply Transnet Freight Rail the names and contact details of at least 10 persons that can verify the Tenderers performance in maintaining current OTDR's supplied to the South African industry. This will also be used too verify current customer base. Transnet Freight Rail reserves the right to contact the people to verify the supplier's record and performance.

5.8 The Tenderer shall give full details of all support staff, with the focus on their fibre optic knowledge and years experience in the fibre industry and training records / certificates.

5.9 The Tenderer must guarantee at least 12 hour per day support in South Africa, to facilitate with problem solving, assistance and fault finding.

5.10 The tenderer must give details of local support and their training as well as what the cost would be for 24 hour local support.

END OF DOCUMENT