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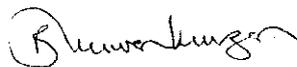
Compiled by

Functional Responsibility

Authorized by



RR Morgan
Senior Advisor FON



B van Nieuwenhuizen
Manager: North and West Cape



J Marais
Telecommunications Manager (Acting)

Date: 18/10/2016

Date: 18/10/2016

Date: 25/10/2016

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1. Introduction

The optical fibre network within the Eskom environment requires constant maintenance, repairs and inspections. To standardise and improve the level of maintenance and repairs and ensure integrity of the optical fibre network, this specification lays out the minimum requirements to ensure that training suppliers provide a standardised and focused training, specific to the Eskom optical fibre network.

2. Supporting Clauses

2.1 Scope

This specification covers the minimum requirements for training of Eskom Telecommunications technicians on optical fibre maintenance, installation and design.

2.2 Purpose

The purpose of this specification is to stipulate the minimum requirements required for fibre optic training.

2.3 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.4 Effective date

October 2016

2.5 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.5.1 Normative

[1] ISO 9001 Quality Management Systems

2.5.2 Informative

- 240-70732888: FIBRE OPTIC CABLE SYSTEM ACCEPTANCE TESTING.
- NRS 061-2:2004: Specification for Overhead Ground Wire with Optical Fibre – Part 2: Installation Guidelines
- NRS 078-2: ADSS Specification for All Dielectric Self-Supporting Fibre Optic Cable - Part 2 Installation Guideline.
- 240-42990189 - Externally attached (helically wrapped) fibre optic cable

2.6 Definitions

None.

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2.7 Abbreviations

Abbreviation	Explanation
PMD	Polarisation Mode dispersion
DWDM	Dense Wave Division Multiplexing
OADM	Optical Add-Drop Multiplexor
OTDR	Optical Time Domain Reflectometer
ADSS	All Dielectric Self Supporting
OPGW	Optical Power Ground Wire
MASS	Metallic Aerial Self Supporting

2.8 Roles and Responsibilities

Eskom Academy of Learning shall be responsible for monitoring adherence to the provisions of this document by fibre optic training suppliers.

2.9 Process for Monitoring

Implementation of this procedure will be audited periodically.

2.10 Related/Supporting Documents

None

3. Fibre Optic Training Requirements

3.1 Training Materials and Venue

Optical Fibre courses presented to Eskom Telecommunications shall cater for both theory lectures as well as practical interventions. The supplier shall provide for all lecture materials, test equipment, machinery and hardware required to provide a comprehensive course for both theory and practical. Where there is no suitable Eskom venue for the training, the supplier shall make provision for a suitable venue as well as facilities for both theory and practical interventions. The supplier shall provide Eskom with a detailed course outline so that Eskom may scrutinise the content.

The course content shall concentrate on fibre optic networks within the power utility environment, with emphasis on the impact of the electrical network on the fibre optic network (Induction, dry band arcing) as well as personal safety while working in proximity to live conductors and routine maintenance. The courses shall include an introduction to fibre optics which will include, fibre optic theory, cable preparation, practical splicing, practical OTDR measurements, fault finding, dome joint and patch panel packing. More advanced courses shall be made available for hands on stringing of specified fibre optic technologies as well as network planning and advanced measurement techniques.

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3.2 Pass Mark and Certificate

Learners attending the course shall be required to have a 100% attendance record during the course. The supplier shall provide Eskom at the end of each course, a daily attendance record of the learners.

Learners attending the course shall be required to undergo a comprehensive evaluation which is set out to thoroughly test the knowledge and practical skills gained during the course.

Learners shall be required to achieve an 80% pass mark. The completed exam results shall be made available to the Eskom training department providing the name, unique number and score achieved by each learner. The supplier shall provide on successful completion of the course a certificate of competence for each learner indicating the results for both theory and practical evaluation.

3.3 Accreditation of Supplier, Trainer as well as Course Content

The supplier shall demonstrate to Eskom that the supplier and its trainers and training content is suitably accredited according to national and/or international standards.

3.4 Course Content

The following requirements are set as the minimum content requirements for fibre optic courses. The courses shall be structured by the supplier into modules/levels so as to advance the learners knowledge from basic to advanced.

3.4.1 Fibre Optic Introduction Course

Learners with or without prior knowledge of fibre optics, will need to be fully competent with fibre optic theory, testing and splicing. The learner shall be fully competent to enter into the fibre optic maintenance environment to maintain, test and splice fibre optic cables. The learner shall be able to "pack" a dome joint and patch panel correctly. The learner shall be able to perform power and light source testing as well as OTDR testing and understand and interpret the results.

- Pre requisite course - Fundamentals of Fibre Optics (in house course)
- Optical Fibre Theory.
- Fibre Optic's vs. Copper.
- How a fibre optic cable is manufactured with respect to Materials, Doping, Cladding, Buffer – Loose tube buffer and tight buffer, Colour coding Fibres and Transport Tubes, Strengthening of the different fibre cables for their applications (Kevlar, Glass Reinforced Plastic rods etc.).
- Core and Cladding diameters, Single mode vs. Multimode and wavelengths, Water peak, non-zero dispersion shifted fibres, Dispersion shifted fibres, Dispersion compensation fibres.
- Properties of light and dispersion, Reflection, Refraction, Rayleigh Backscatter, Chromatic dispersion, Transmission differences via Laser and Led, Types of lasers, Identifying the laser types, Laser safety.

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- Differences between the types of cable and where best applied, Duct, OPGW, Wrap, ADSS, MASS, Handling and installing cables, bend radius, hauling methods, Machinery and equipment required, safety.
- Connector types as well as difference between APC and UPC and the effects of incorrect use.
- Theory of how an OTDR works, What is a dead zone, OTDR setup such as: Cable type, Site names, Dates, Setting the wavelength, Setting Pulse width, Setting the Distance range. Trace analysis such as: Identifying and understanding the different types of events, What is ghosting, Distance to events, Bi-directional testing, Saving the OTDR data. Practical fault finding using an OTDR (EXFO FTB 400) (each learner to participate individually).
- Power and light source measurement theory (Recording your reference) , Power and light source practical (each learner to participate individually).
- Theory of operation of a Fusion Splicing machine, Safety issues w.r.t eyes, ingestion etc. Fibre preparation, Cleaving, Splice protectors, Cleaning and care of the splicing machine. Fibre waste management, Practical splicing exercises (each learner to participate individually).Dome Joints theory of packing, Dome Joint packing practical (each learner to participate individually).
- Patch panel theory of packing, Patch panel packing practical (each learner to participate individually).
- Cleaning of connectors on ODF's, Patch leads and test equipment.
- Identification of installation defects on all fibre technologies
- International methods of temporary repairs.
- Enforcing installation and repair standards
- Contractor management.

3.4.2 Fibre Optic Advanced Courses

The Learner shall be able to demonstrate and perform the installation of OPGW, ADSS, and Wrapped fibre. The learner must demonstrate the use of the installation machinery required (winch and Tensioner, use of pulleys etc.), tensioning, associated safety and earthing. The learners need to be able to identify incorrect/poor installation practises, incorrect/poor installation of attachment hardware and highlight any safety issues.

- Theory of Installing of ADSS, planning, attachment hardware required, methods of installing, tensioning, safety, ADSS practical installation.
- Theory of installing OPGW, planning, attachment hardware required, method of installing, tensioning, safety, OPGW practical installation.
- Theory of installing wrapped fibre, planning, attachment hardware required, method of installing, tensioning, safety, Wrapped Fibre practical installation.
- Theory of installing duct cable, planning of manholes and ducted routes, hauling, safety during installation, safety accessing manholes post installation (gas detection, vermin etc.), Duct cable practical installation.

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3.4.3 Advanced Testing and Network Planning

The learner shall be able to design a fibre optic network route and work out the loss budget as well as determine the correct power levels required to operate across the network. The learner shall also demonstrate and understand the working of DWDM and SDH principles. The learner shall be well versed with PMD testing as well as analysing and understanding the results.

- DWDM basics, multiplexing and de-multiplexing, DWDM components and ITU standards – OADMS.
- Network planning and budget calculations.
- PMD testing and analysis.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
Joe Manyisa	NMC Manager and Eskom Telecommunications Manager (acting)
Cornelius Naidoo	Manager: CoE Design Engineering
Craig Pitt	Manager: Business Architecture
Keith Cornwall	Manager: Gauteng and North West Region
Ben van Nieuwenhuizen	Manager: Western and Northern Cape
P.M Masoka	Manager: Limpopo and Mpumalanga
Mfundiso Hina	Manager: Kwazulu Natal and Eastern Cape
Bheki Nala	Manager: National Planning
Nolan Dominique	Manager: CCSM
Mark Ganesan	Manager: SHEQS
Mlungisi Mkhwanazi	Manager: Capital Programme Management
Willie vd Vyver	Manager: Network Replacement Portfolio
J. Mmako	Field Services Manager_Fibre Optic Network

5. Revisions

Date	Rev.	Compiler	Remarks
September 2016	1	RR Morgan	Revision date changed

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6. Development Team

The following people were involved in the development of this document:

- RR Morgan
- MJ Mmako
- JE Badenhorst
- V Naidu

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