



Eskom

Standard

Technology

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1. Introduction

Teleprotection systems enhance the effectiveness of protection schemes. On the other hand, defective teleprotection systems or incorrect testing and fault finding procedures, can negatively affect protection performance and system stability. It is very important that teleprotection fault finding and maintenance procedures do not pose protection performance risks.

2. Supporting clauses

2.1 Scope

This procedure is applicable to all feeders utilising Teleprotection on the Transmission (Tx) and Distribution (Dx) power networks. This is a generic procedure for Teleprotection Trip-testing and must be used with the specific manufacturer's instructions manuals for each type of Teleprotection equipment.

2.1.1 Purpose

This procedure is to ensure that the functional requirements for Teleprotection are met.

2.1.2 Applicability

This specification shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

2.2 Normative/informative references

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

2.2.1 Normative

- [1] 240-90353855 Design Standard for Teleprotection Systems.
- [2] 240-60725298 Handling of Electronic cards and Equipment Technical instructions as listed in Annex A.

2.2.2 Informative

The following documents may be referred to for information.

- [3] SLDG 9-20 Design Guide for interfacing Phase 1 and Phase 2 Protection Equipment with Teleprotection Equipment
- [4] SLDG 9-21 Design Guide for BBC ETI "HE" PLC and NSD41 Teleprotection Equipment.
- [5] SLDG 9-22 Design Guide for BBC ETI "ZA" PLC and NSD41 Teleprotection Equipment.
- [6] SLDG 9-25 Design Guide for ABB ETL PLC and NSD 50 Teleprotection Equipment.
- [7] TDG0031 Design guide for the ABB NSD70/72/D/DX radio teleprotection equipment
- [8] 1KHL015946-EN ABB Instruction Manual for the ETL540 and ETL580 PLC Equipment and the NSD550 Equipment
- [9] 1KHW002582-EN ABB Instruction Manual for the ETL600 Rel.4 Digital PLC Equipment
- [10] DIP5K/EN U/B11, Actom DIP5000 User's Manual.
- [11] 1KHW000890-EN, ABB NSD570 Teleprotection System Operating Instructions

The relevant Instruction Manuals for each specific type and model of equipment must be consulted for details not included in the above references.

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2.3 Definitions

2.3.1 General

Definition	Description
Bearer Teleprotection	Teleprotection borne over a medium other than PLC, normally broadband Radio and/or Optical fibre system.
End-to-end trip testing	Is the functional testing of Teleprotection between the terminals at either end of a line, preferably including, and initiated from, the Protection Equipment.
Protection Injection Test Equipment	Equipment used by Protection to inject currents and voltages to test primarily the protection relays or schemes.
t	Transmission time
Trip Testing	Functional testing of teleprotection to ensure that a “Trip” command originating at the relevant line protection relay is transmitted successfully and received within the specified time at the distant protection relay

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
CIS/TPIS	Carrier Isolation Switch/Teleprotection Isolation Switch
HMI	Human Machine Interface
ms	milliseconds
O.I.E	Open Isolated and Earthed
PLC	Power Line Carrier
PS	Power Supply
SLMS	Selective Level Measuring Set
TOC	Transmission Operating Control
TPE	Teleprotection Equipment

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

This document supersedes TPC41-133.

3. Requirements

3.1 Test instruments required

- a) Variable 48 – 220 Volt DC power supply, (Voltage dependant on system under test)
- b) Selective Level Meter
- c) Analogue multi-meter or digital multi-meter with bar graph display/max hold facilities to capture fast voltage or resistance changes.
- d) Hand tools

3.2 General and preliminary

- a) Teleprotection forms part of the protection scheme therefore any work done on the teleprotection system requires re-testing of the full protection scheme.
- b) A line outage is required for teleprotection trip testing which includes the breaker operation.
- c) TOC in consultation with National control, at their discretion, will generally give permission to switch feeders “OFF Carrier protection” for the purpose of fault location or repair. Risk of Trip (ROT) Procedure, from National Control, must then be read in conjunction with this procedure.
- d) Obtain permission to work from the relevant Control Centre(s), i.e. TOC and/or National or Regional Control Centre, before any work is started. When work is done under a Risk of Trip an operator must be on site to restore equipment should a trip occur.
- e) This procedure clarifies the process with the assistance of the protection department. Whenever teleprotection is tested, commissioned or wiring has been disturbed, functional testing must be conducted on an end-to-end basis in cooperation with the protection department.
- f) Exercise caution when dealing with contact wetting and command signal voltages. Human contact with these voltages may cause injury.
- g) Prevention of damage through static discharge: Staff working on teleprotection equipment shall comply with the static control measures stipulated in the Document “Handling of Electronic Cards and Equipment”, 240-60725298.
- h) Comment on non-conformity, before rectification, together with measured results after rectification, must be recorded in Annex B “Teleprotection trip testing sign off document” and distributed in accordance with section 3.4: “Records”.

3.3 Trip Testing Procedure

3.3.1 Configuration and modification checks

- a) Ensure that all appropriate modifications have been performed on the PLC/teleprotection equipment as per the Technical Instructions listed in Annex A.
- b) Ensure that interfaces are appropriately programmed for the protection scheme in use. To fully understand the schemes, the protection department and the DC key diagrams for the scheme should be consulted. Further details of programming options for interfacing various teleprotection equipment to the different protection philosophies may be found in the standard, 240-90353855, ‘Design Standard for Teleprotection Systems’.

3.3.2 Trip testing

- a) Trip testing can only be performed when the line has been isolated and the line Isolators are open. The interface between the protection and the teleprotection equipment will be fully tested.
- b) Ensure that the teleprotection isolation switch or carrier isolation switch is in the “on” position at both ends before doing end-to-end trip testing.

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- c) Initiation of send commands and monitoring of receive commands can either be performed by the Teleprotection or the Protection department personnel.
- d) The later models of Teleprotection and PLC equipment display the transmission time from the HMIs.
- e) Modern protection schemes under certain conditions (e.g. Breaker open) “echo” the received carrier command back to the originating end. In addition, modern protection injection test equipment can measure this “echo” time, or even unidirectional transmission time through the HMI. With the assistance of protection staff meaningful end-to-end transmission times can be measured. It must be borne in mind however that components within the protection equipment will add delays to the maximum time.
- f) **At the conclusion of work, restore all conditions to normal and contact the control centre.**

3.4 Records

- a) Complete “Teleprotection trip testing sign off document”, a sample of which is listed in Annex D.
- b) Distribute copies as follows.
- c) Regional or Secondary Plant Manager.
- d) Tx/Dx/Eng./Power Telecomms/Operational support
- e) Local Maintenance Copy.
- f) Site Copy.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Lenah Mothata	Senior Manager – Grids
Barry Clayton	Chief Engineer – Secondary Plant, Works Planning and Centralized Services
Sikelela Mkhabela	Senior Manager – DX
Prudence Madiba	Senior Manager – GX
Isabel Fick	Senior Manager – Eskom Telecommunications
Maureen Mokone	Senior Manager – GIT (Acting)
Botse Sikhwitshi	Senior Manager – Group Security Senior Manager (Acting)

5. Revisions

Date	Rev	Compiler	Remarks
March 2020	2	M Mokou	Revise and reformat/template change from rev 1 to rev 2
April 2015	1	J. Schutte	Revise and reformat/template change to SCOT. Document number changed to 240-91461878
Oct 2005		P. Lubbe	New document.
Oct 2002	1	P. Lubbe	Title amended. Sections 1., 2., 3., 4., 6 and annexes added. Extensive content revisions.

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Date	Rev	Compiler	Remarks
March 2020	2	M Mokou	Revise and reformat/template change from rev 1 to rev 2
Oct 2001	0	P. Lubbe	Previously compiled as TTLPV0006. Original document no: TPR0133

6. Development team

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

- T. Gosai
- A. Pereira

7. Acknowledgements

Not applicable.

Annex A – Technical Instructions Associated with various Powerline Carriers

BBC/ABB

201. NSD41/45 G3FG mod. For Slyp Slcn.
202. NSD41/45 G3FC modifications
203. NSD41/45 G3FB modification.
204. NSD41/45 G3FG component replacement instruction.
205. ETI P3EF missing trip modification.
206. ETI/NSD41 “Hard” TPS RX Alarm (wiring & O3EI mod)
207. ETI Carrier combiner drawings modification.
208. ETI O3FL modification.
209. ETI P3EF slave modification.
210. ETI “E” relay drop off modification (O3EI, B5EL &P9CA modifications) TM10267. NSD 70 Teleprotection Alarm Modification (ABB Powertech) TM10268. ETL/NSD50 Alarm separation modification Instructions

MISCELLANEOUS

601. Equipment panel and 19” rack “anti-static” earth points

Annex B – Teleprotection Trip Testing sign off document

	<p align="center">Teleprotection Trip Testing Sign-Off Document</p>	<p align="center">Reference Annex A</p>	<p align="center">Rev 1</p>
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Station: _____ Distant Station: _____ Region: _____

Date: ____/____/____ Project/ Job/ WO number _____

1 Functional test (End-to-End Trip test) successful? (Y/ N/ n/a)

1.1 Main 1 Permissive[] Direct Transfer Trip[] Directional E/F []
 1.2 Main 2 Permissive[] Direct Transfer Trip[] Directional E/F []

Comments: _____

2 Teleprotection transmission time (only record if available from HMI or protection injection test set)

2.1 Transmission time: from HMI (ETL500/600, DIP5000, NSD570 and later only)

M1____ ms TPE Type _____ **M2**____ ms. TPE Type _____

2.2 If other transmission times are available (e.g. Protection)

M1____ ms TPE Type _____ **M2**____ ms. TPE Type _____

Comments: _____

Test and inspection performed by:
 (POWER TELECOMMS PERSONNEL)

End to End trip testing performed by:
 (PROTECTION PERSONNEL)

 Signature

 Signature

 Print name

 Print Name

Annex C – Teleprotection Interface Standards

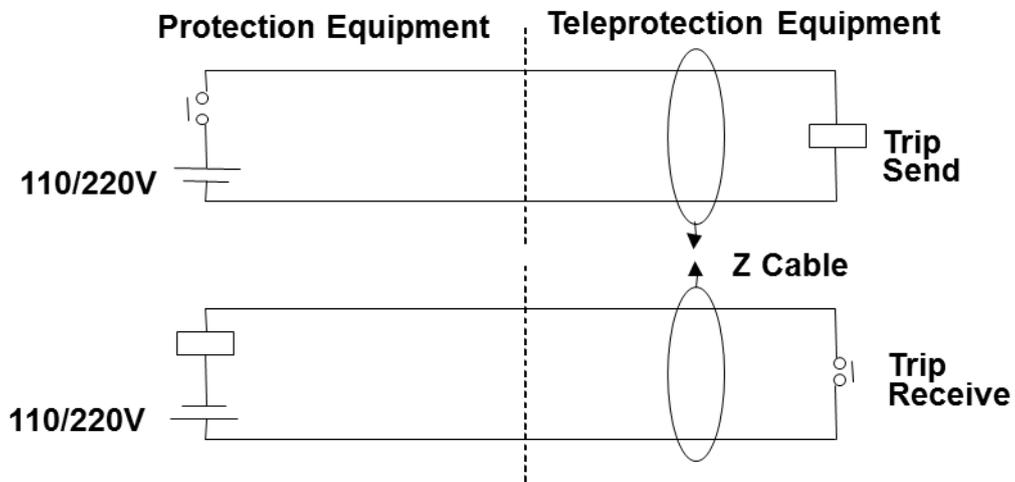


Figure C.1: System A

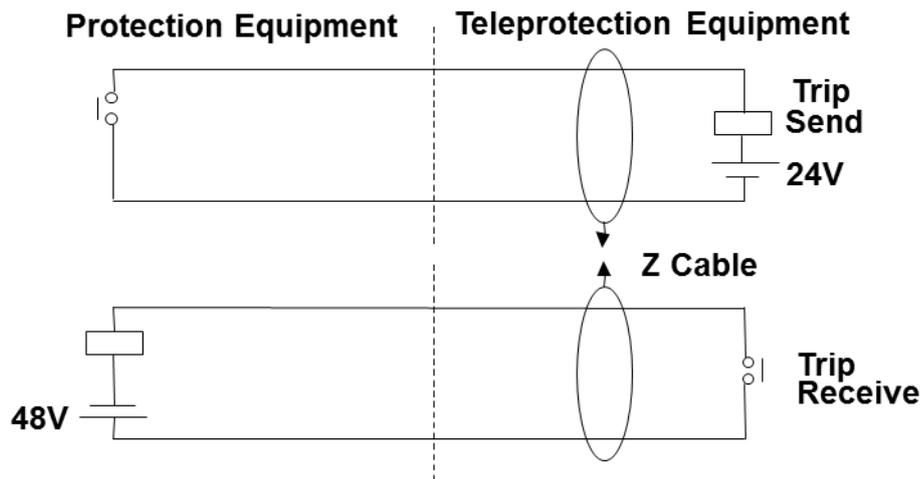


Figure C.2: System B

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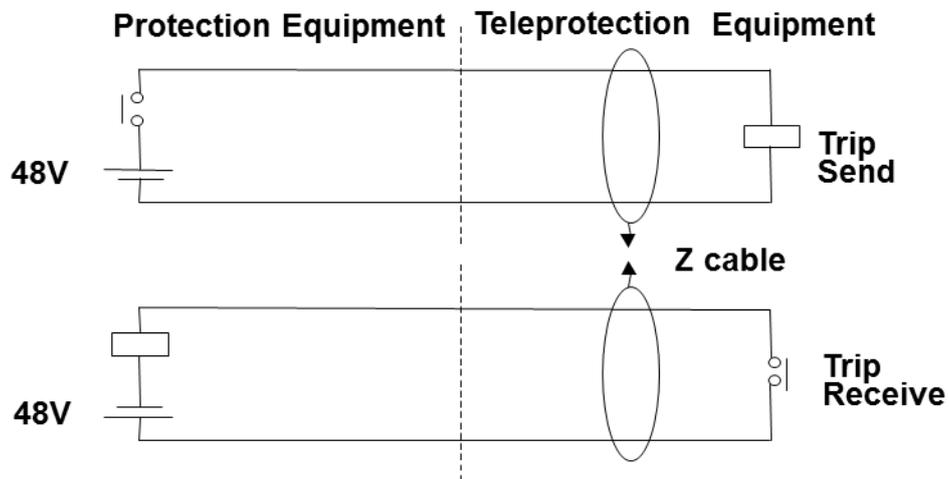


Figure C.3: System C