

 Eskom	Standard	Technology
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Title: **APPLICATION DESIGN
STANDARD FOR
TELEPROTECTION SYSTEMS**

Unique Identifier: **240-103057370**

Alternative Reference Number: **<n/a>**

Area of Applicability: **Engineering**

Documentation Type: **Standard**

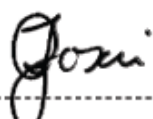
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Date: 09 December 2020

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1. Introduction

The purpose of this document is to provide an application design standard that could be used by the project engineers/ application engineers and planners to plan for teleprotection systems.

2. Supporting clauses

2.1 Scope

This document covers the most common application designs for Teleprotection systems used in Eskom.

2.1.1 Purpose

The purpose of the document is to ensure that the functional requirements for Teleprotection systems are included in the project designs.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

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] 240-46264031, Fibre-Optic Design Standard – Part 2: Substations
- [3] 240-70733995, Optical Distribution Frame/Patch Panel

2.2.2 Informative

None.

2.3 Definitions

2.3.1 General

Definition	Description
Coupling Equipment	This equipment is used for isolating and coupling Power Line Carrier signals, and is usually found in Transmission and Distribution substation yards and also in Power Station HV yards, and is connected to the High Voltage power line. The coupling equipment consists of the Line Trap and Line Matching Equipment.
dB	<p>The ratio of two powers, typically that at the output of a device/ component compared to that at the input to express the gain or loss in a component or system.</p> $X_{dB} = 10 \log_{10} \frac{P_{out}}{P_{in}}$

Definition	Description
dBm	The absolute power level of a signal (Px) expressed in relation to a signal with a power level of 1 mW . $dBm = 10 \log_{10} \frac{Px}{1mW}$ (1mW into 600 Ω produces a voltage of 0.775V and = 0dBm)
Responsible employee (person)	An employee (person) who has been authorised in writing to be responsible for ensuring that the work on electrical apparatus covered by the Operating Regulations for High Voltage Systems can be carried out safely.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
2W	2 Wire
4W	4 Wire
ADSS	All Dielectric Self Supporting
CC	Coupling Capacitor
CCU	Carrier Combining Unit
CT	Current Transformer
CVT	Capacitive Voltage Transformer
HF	High Frequency
HV	High Voltage
LES	Lines Engineering Services
LME	Line Matching Equipment
LT	Line Trap
OPGW	Optical Ground Wire
ORHVS	Operating Regulations for High Voltage Systems
PE	Project Engineer
PLC	Power Line Carrier
Rx	Receive (Receiver)
SED	Substation Electric Diagram
TPE	Teleprotection Equipment (i.e. Microwave Teleprotection)
TU	Tuning Unit
Tx	Transmit (Transmitter)

2.5 Roles and responsibilities

Not applicable.

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2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

This document should be read in conjunction with 240-90353855, "Design Standard for Teleprotection Systems".

3. General

The Project Engineers must have a relatively good understanding of Teleprotection, PLC and Fibre Optic systems to follow the requirements below.

Note: It is important to note that if the Teleprotection systems are not included in the pre CRA or CRA phase of the project, to rectify the exclusion of the Teleprotection systems would cost substantial amounts as the requirements could influence or change the Substation HV yard, HV Lines and the Protection systems designs.

3.1 Application Guideline Requirements

- 1) Need to identify the type of projects as this would affect the designs of the Teleprotection systems. The different types of projects are:
 - a) New Substation Project
 - b) Refurbishment Substation Project
 - c) Substation Extension Project (New Lines Project)
 - d) Refurbishment Lines Project (Ground Wire Replacement with OPGW)
 - e) Line rearrangement Project (Shifting of Feeder bays)
 - f) New Protection Projects
 - g) Refurbishment of problematic Protection Projects
 - h) Teleprotection and PLC Refurbishment Projects
 - i) Aerial Fibre Optic (OPGW) Replacement Projects
 - j) Line Trap Replacement Project
- 2) For the above projects, the following documents need to be requested by the Project Engineer (PE) where applicable:
 - a) Planning Report – Primary Plant Planning Department
 - b) Substation and Lines Phasing Diagram – Substations
 - c) Substation User Requirement Specification (SURS) – Substations
 - d) Lines User Requirement Specification (LURS) – LES
 - e) Voltage Unbalanced Studies – LES
 - f) Substation Electric Diagram (SED) - Substations
 - g) Substation Foundation & Trench layout diagrams (for Fibre Optic systems) – Substations.

The following items lists the information and check lists required to ensure that all the areas for the Teleprotection systems are covered.

- a) Discuss with protection what protection schemes are being planned.
- b) Check with Eskom Telecommunications what telecommunication mediums are available or being planned. Check if the existing or planned telecommunications mediums will satisfy the protection requirements.

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- c) Check the requirements for Teleprotection systems.
- d) If a fibre optic cable is being planned, check the fibre optic design details and the possible date when installation will take place.
- e) For other telecommunications requirements, invite Eskom Telecoms to the project meetings to discuss their own technology.
- f) The document 240-90353855, "Design Standard for Teleprotection Systems" details the following:
 - 1) Teleprotection Philosophy for Transmission and Distribution.
 - 2) PLC design consideration.
 - 3) Line Trap phase allocation and lists the Line Parameters table to be completed by LES.
 - 4) Frequency allocation and lists the Parameters table to be completed by the PEs.
 - 5) Stand-alone teleprotection unit design consideration.
 - 6) Teleprotection – Protection contact base interface.
 - 7) Teleprotection interface cable.
 - 8) Current differential scheme telecommunications design.
 - 9) Matching and checking compatibility with new and existing Protection, Teleprotection and PLC equipment.
- g) Sample of the NSD 570 Proforma (Annex A) – To contact PTM&C Technology for the latest Proforma revision.
- h) Sample of the LME Proforma (Annex B) – To contact PTM&C Technology for the latest Proforma revision.
- i) Sample of the PLC ETL 6101/651 Proforma (Annex C) – To contact PTM&C Technology for the latest Proforma revision.
- j) Sample of the Line Trap Proforma – Actom (Annex D) – To contact PTM&C Technology for the latest Proforma revision.
- k) Sample of the Line Trap Proforma – High Voltage Technology (Annex E) – To contact PTM&C Technology for the latest Proforma revision.
- l) Sample of the Line Trap Proforma – Mega HVT (Annex F) – To contact PTM&C Technology for the latest Proforma revision.

From the above information and documents, a line diagram to plan for the Teleprotection and Fibre Optic System needs to be developed by the Project Engineer (PE) that encompasses the affected power network.

3.2 PLC System Requirements

3.2.1 PLC System

- a) Provide Technology with the following diagrams to determine the Line Trap positions on the phases of the line:
 - 1) Substation and Lines Phasing Diagram – Lines Engineering Services (LES)
 - 2) Voltage Unbalanced Studies – LES
 - 3) Line Parameters table from 240-90353855 - LES

Technology will perform the propagation analysis and allocate the Line Traps to the most feasible line phases.

- b) Provide Technology with the following information to allocate the PLC frequencies:
 - 1) A line diagram that displays the Teleprotection, PLC and Fibre Optic System developed by the Project Engineer (PE).
 - 2) Frequency allocation Parameters table from 240-90353855 to be completed by the PEs.
- c) If the PLC frequency cannot be allocated due to congestion, then an Artificial Busbar (additional Line Traps, CVTs, LMEs) would need to be built. Technology will be required to assist with the design and this will need consultation with Substation Engineering.
- d) To determine the type of Line Trap required for the project, the following information is required, that is Line Voltage, Line Continuous Current, Fault Current, Line Trap Inductance, Creepage (insulators) and the Blocking Band (Frequency). Generally, the Line Voltage, Line Continuous Current, Fault Current, Line Trap Inductance and Creepage (insulators) would be similar to the corresponding circuit breaker parameters in the same feeder bay and obtained from Substations.
- e) To determine whether a high pass or band pass LME is required depends on the PLC frequency allocated by Technology.

3.3 Teleprotection (Stand-alone) System Requirements

- a) Provide Technology with the following information:
 - 1) A line diagram that displays the Teleprotection, PLC and Fibre Optic System developed by the Project Engineer (PE).
- b) The line diagram will display which telecommunications medium is available for the stand-alone teleprotection unit that is either a fibre optic module or X.21 module.
- c) The stand-alone teleprotection unit address must be allocated.
- d) The signalling voltage from the protection panel must be provided to setup the stand-alone teleprotection unit correctly.

3.4 Fibre Optic System Requirements

- a) Enquire from Protection and Eskom Telecommunication what their requirements are.

Note: A new substation cannot be commissioned without telecommunications.

- b) Create a line diagram with the fibre links associated with each substation within the project. This will assist in identifying the number of fibre optic links that are available and what may be required.
- c) Ensure that you know what type of fibre optic cable is used in the link between the substations (OPGW, ADSS, ADLash™, etc).
- d) Teleprotection cannot work over ADLash™ fibre optic cables since these cable are experiencing high losses due to macrobending. Motivation should be made to replace these cables.
- e) Decide on the duct cable and patch panel requirements based on the configuration of the fibre optic link.
- f) Decide to which control room the fibre optic cable must be routed.
- g) Check if there is a requirement to connect control rooms with a fibre optic cable within the same substation area.
- h) Ensure that a fibre optic cabinet is installed in the control room for the patch panel.
- i) The PEs to provide the layout diagram and requirements for the Protection and Control fibre optic cable requirements within the substation. Technology can assist with the fibre optic cable design.

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
Mfundiso Hina	Senior Manager – Eskom Telecommunications (Acting)
Maureen Mokone	Senior Manager – GIT (Acting)
Botse Sikhwitshi	Senior Manager – Group Security Senior Manager (Acting)

5. Revisions

Date	Rev	Compiler	Remarks
Jan 2021	2	T Gosai	Required to review due to document review date. Added Proformas in Annexes.
Feb 2016	1	T Gosai	New document.

6. Development team


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

- Vanessa Naidu
- Antonio Pereira
- Riyaz Gangat
- Mimi Tshikosi

7. Acknowledgements

Not applicable.

Annex A – Sample of NSD 570 Proforma

	PTM&C Equipment Proforma		Unique Identifier	
			Record Identifier	NSD570
			Document Type	Proforma
			Revision	1
			Effective Date	01 June 2014
			Group Technology (Engineering) - PTM & C	
			Date:	
From:	PTM & C Planning & Project Support	To:	Capital Expansion Central	
Project Engineer:				
Tel:				
Scheme name:				
Project name:				
Project / CC / WBS No.:				
Region / O.U.				
Substation:				
Busbar Voltage:				
Bay:				
Station DC Voltage:				
Contract No.:	4600067973			
Supplier:	ABB (Hitachi) (Pty) Ltd			
Revision:				
Revision Control		First Issue		

Please order the Microwave Teleprotection equipment listed below:


EQUIPMENT LABEL DETAIL			This information must be included on the Purchase Order		
STATION:			DISTANT END:		
Feeder No.		HV Voltage	TPE DC Voltage		V DC
For Protection Main		Protection Panel Delivery Date:			
Item No.	SAP No.	Short Code	Description	QT	
1	0000663307	Combo 1 - TPE 48VDC/X.21	NSD570 Module Rack which includes the Base Unit with 48V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card.		
2	0000663301	Combo 2 - TPE 110VDC/X.21	NSD570 Module Rack which includes the Base Unit with 110V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card.		
3	0000663304	Combo 3 - TPE 220VDC/X.21	NSD570 Module Rack which includes the Base Unit with 220V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card.		
4	0000663309	Combo 4 - TPE 48VDC/FO 1310nm-30km	NSD570 Module Rack which includes the Base Unit with 48V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card and 1310nm SM FO Driver.		
5	0000663412	Combo 5 - TPE 110VDC/FO 1310nm-30km	NSD570 Module Rack which includes the Base Unit with 110V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card and 1310nm SM FO Driver.		
6	0000663416	Combo 6 - TPE 220VDC/FO 1310nm-30km	NSD570 Module Rack which includes the Base Unit with 220V DC Power supply, 2 x PIA, 2 x Input/Output Cards, CPU - X.21 (RS-422/V.11) Interface Card and 1310nm SM FO Driver.		

Transport/Delivery is not included in the contract. Project Manager to arrange.

	Name	Designation	Signature	Date
Compiled by:	0	PTM&C Project Engineer		
Accepted by:		Discipline Custodian		
Approved by:		PTM&C Planning & Project Support Manager		
Received by:	0	Project Manager		

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Annex B – Sample of LME Proforma

	PTM&C Equipment Proforma	Unique Identifier	240-84597622
		Record Identifier	LME
		Document Type	Proforma
		Revision	0
		Effective Date	01 July 2014
		Group Technology (Engineering) - PTM & C	
		Date:	
From:	PTM & C Planning &	To:	Capital Expansion Central
Project Engineer:		Project Manager	
Tel:		Tel:	

Scheme name:	
Project name:	
Project /CC/ WBS No.:	
Region / O.U.	
Substation:	
Busbar Voltage:	
Bay:	
Station DC Voltage:	
Contract No.:	4600064123
Supplier:	ABB (Pty) Ltd
Revision:	0
Revision Control:	0 First Issue


Please order the Line Matching Equipment listed below:

Eskom Item No.	Code	SAP Number	Description	Line Trap Blocking range kHz	QTY
10	XH	0002900	Line matching Equipment HP Filter.	101 to 500	
20	XB	0004155	Line matching Equipment BP Filter.	48 to 78kHz	
			Value		
			Coupling Capacitor ...4400.pF	70 to 156kHz	
			Lowest Carrier Frequency required: xxx kHz		
			Line Impedance: 240 Ω / 320 Ω	xxx Ω	

	Name	Designation	Signature	Date
Compiled by:		PTM&C Project Engineer		
Accepted by:		Discipline Custodian		
Approved by:		PTM&C Planning & Project Support Manager		
Received by:		Project Manager		


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Annex C – Sample of PLC Proforma

	PTM&C Equipment Proforma		Unique Identifier		240-84597622	
			Record Identifier		PLC	
			Document Type		Proforma	
			Revision		2	
			Effective Date		01 July 2014	
Group Technology (Engineering) - PTM & C						
				Date:		
From:				To:		
Project Engineer:				Project Manager		
Tel:				Tel:		
Scheme name:						
Project name:						
Project / CC / WBS No.:						
Region / O.U.:						
Substation:						
Busbar Voltage:						
Bay:						
Station DC Voltage:						
Contract No.:		4600064993				
Supplier:		ABB (Pty) Ltd				
Revision:						
Revision Control		First issue				
Please order the PowerLine Carrier equipment listed below:						
Distant end:					Line number:	
A POWERLINE CARRIER CABINET						
Cabinet Label:		TELEPROTECTION –			Quantity: 1	
Item	Material N	Item Description			Quant	
00640 KX-2	0554765	Carrier Cabinet and wiring for 1 PLC.				
00650 KX-3	0224028	Carrier Cabinet and wiring for 2 PLC.				
B CARRIER COMBINING UNIT						
00670 CCU-1	0554766	PLC Carrier Combiner for phase to phase coupling				
00680 CCU-3	0207814	PLC Carrier Combiner for three phase coupling				
C UPPER SSB POWERLINE CARRIER SET						
Frequencies						
00380 CX50-T	0224011	Power Line Carrier protection with 3 channel , 50 W 2 kHz	TX	kHz	RX	kHz
00430 CX100-T	0224017	Power Line Carrier protection with 3 channel , 100 W 2 kHz	TX	kHz	RX	kHz
Please note that it is imperative that the frequencies are indicated on the order						
D LOWER SSB POWERLINE CARRIER SET (only required if two PLC's are required)						
00380 CX50-T	0224011	Power Line Carrier protection with 3 channel , 50 W 2 kHz	TX	kHz	RX	kHz
00430 CX100-T	0224017	Power Line Carrier protection with 3 channel , 100 W 2 kHz	TX	kHz	RX	kHz
D LOOSE MODULES / UNITS						
00710	0224053	Connector, HMI Cable RS232 to USB				
Name		Designation		Signature		Date
Compiled by:		PTM&C Project Engineer				
Accepted by:		Discipline Custodian				
Approved by:		PTM&C Planning & Project Support Manager				
Received by:		Project Manager				

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Annex D – Sample of Line Trap Proforma - Actom

	PTM&C Equipment Proforma		Unique Identifier	240-84597622
			Record Identifier	TLP - FO1
			Document Type	Proforma
			Revision	1
			Effective Date	01 July 2014
			Group Technology (Engineering) - PTM & C	
			Date:	
From:	PTM & C Planning & Project Support	To:	Capital Expansion Central	
Project Engineer:		Project Manager		
Tel:		Tel:		

Scheme name:	
Project name:	
Project No.:	
Cost Centre:	
WBS/Internal Order:	
Region / O.U.	
Substation:	
Busbar Voltage:	
Bay:	
Station DC Voltage:	
Contract No.:	4600067325 (Tx) & 4600067434 (GC)
Supplier:	Actom

Please order the equipment listed below:

Line ITEM	Material No	Item Description	Blocking Band	Quantity
	4483	U4: 132 kV, 2500A, 40 kA, 0,5 mH LT – (WITHOUT PI)	48 - 78 kHz	
	4483	U4: 132 kV, 2500A, 40 kA, 0,5 mH LT – (WITHOUT PI)	70 - 156 kHz	
	4483	U4: 132 kV, 2500A, 40 kA, 0,5 mH LT – (WITHOUT PI)	101 - 500 kHz	
	0558633	S8H: 275 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558633	S8H: 275 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558633	S8H: 275 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558632	S8HH: 275 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558632	S8HH: 275 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	70 - 156 kHz	

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Line ITEM	Material No	Item Description	Blocking Band	Quantity
	0558632	S8HH: 275 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	101 - 500 kHz	
	0558631	S9H: 275 kV, 3150A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)	48 – 500 kHz	
	0558630	S9HH: 275 kV, 3150A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)	48 – 500 kHz	
	0558629	S10H: 275 kV, 4000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558629	S10H: 275 kV, 4000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558629	S10H: 275 kV, 4000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558628	S10HH: 275 kV, 4000A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558628	S10HH: 275 kV, 4000A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	70 - 156 kHz	
	0558628	S10HH: 275 kV, 4000A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	101 - 500 kHz	
	0558823	Q8H: 400 kV, 3150A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)	48 – 500 kHz	
	0558822	Q8HH: 400 kV, 3150A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)	48 – 500 kHz	
	0558627	QB1H: 765 kV, 5000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558627	QB1H: 765 kV, 5000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558627	QB1H: 765 kV, 5000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558626	QB1HH: 765 kV, 5000A, 50 kA, 0,5 mH LT – Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558626	QB1HH: 765 kV, 5000A, 50 kA, 0,5 mH LT – Extra Heavy Creep (31mm/kV)	70 - 156 kHz	
	0558626	QB1HH: 765 kV, 5000A, 50 kA, 0,5 mH LT – Extra Heavy Creep (31mm/kV)	101 - 500 kHz	
		Delivery destination:	0 Substation	*

	Name	Designation	Signature	Date
Compiled by:		PTM&C Project Engineer		
Accepted by:		Discipline Custodian		
Approved by:		PTM&C Planning & Project Support Manager		
Received by:		Project Manager		

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Annex E – Sample of Line Trap Proforma - HVT


	PTM&C Equipment Proforma			Unique Identifier		240-84597622	
				Record Identifier		TLP - FO1	
				Document Type		Proforma	
				Revision		1	
				Effective Date		01 July 2014	
			Group Technology (Engineering) - PTM & C				
					Date:		
From:	PTM & Planning Project Support	C &	To:	Capital Expansion Central			
Project Engineer:			Project Manager				
Tel:			Tel:				
Scheme name:							
Project name:							
Project No.:							
Cost Centre:							
WBS/Internal Order:							
Region / O.U.							
Substation:							
Busbar Voltage:							
Bay:							
Station DC Voltage:							
Contract No.:	4600066174 (Tx) & 4600066175 (Group Capital)						
Supplier:	High Voltage Technologies (HVT)						
Please order the equipment listed below:							

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Line ITEM	Material No	Item Description	Blocking Band	Quantity
	667708	U2: 132 kV, 2500A, 40 kA, 0,2 mH LT – (WITHOUT PI)	80 – 108 kHz	
	667708	U2: 132 kV, 2500A, 40 kA, 0,2 mH LT – (WITHOUT PI)	104 – 156 kHz	
	667708	U2: 132 kV, 2500A, 40 kA, 0,2 mH LT – (WITHOUT PI)	125 – 204 kHz	
	667708	U2: 132 kV, 2500A, 40 kA, 0,2 mH LT – (WITHOUT PI)	194 – 500 kHz	
	0558639	S3H: 275 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558639	S3H: 275 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558639	S3H: 275 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558638	S3HH: 275 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558638	S3HH: 275 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	70 - 156 kHz	
	0558638	S3HH: 275 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	101 - 500 kHz	
	0558836	Q1H: 400 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558836	Q1H: 400 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558836	Q1H: 400 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558835	Q1HH: 400 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558835	Q1HH: 400 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	70 - 156 kHz	
	0558835	Q1HH: 400 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	101 - 500 kHz	
	0558834	Q3H: 400 kV, 2500A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)	48 – 500 kHz	
	0558833	Q3HH: 400 kV, 2500A, 50 kA, 1,2 mH LT - Extra Heavy Creepe (31mm/kV)	48 – 500 kHz	
	0558832	Q6H: 400 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	48 - 78 kHz	
	0558832	Q6H: 400 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	70 - 156 kHz	
	0558832	Q6H: 400 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)	101 - 500 kHz	
	0558831	Q6HH: 400 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	48 - 78 kHz	
	0558831	Q6HH: 400 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	70 - 156 kHz	
	0558831	Q6HH: 400 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)	101 - 500 kHz	

Line ITEM	Material No	Item Description		Blocking Band	Quantity
	0558830	Q7H: 400 kV, 3150A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		48 - 78 kHz	
	0558830	Q7H: 400 kV, 3150A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		70 - 156 kHz	
	0558830	Q7H: 400 kV, 3150A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		101 - 500 kHz	
	0558826	Q7HH: 400 kV, 3150A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		48 - 78 kHz	
	0558826	Q7HH: 400 kV, 3150A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		70 - 156 kHz	
	0558826	Q7HH: 400 kV, 3150A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		101 - 500 kHz	
	0558816	Q9H: 400 kV, 3150A, 63 kA, 1,2 mH LT - Heavy Creep (25mm/kV)		48 - 500 kHz	
	0558645	Q9HH: 400 kV, 3150A, 63 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)		48 - 500 kHz	
	0558644	Q10H: 400 kV, 4000A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		48 - 78 kHz	
	0558644	Q10H: 400 kV, 4000A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		70 - 156 kHz	
	0558644	Q10H: 400 kV, 4000A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)		101 - 500 kHz	
	0558643	Q10HH: 400 kV, 4000A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		48 - 78 kHz	
	0558643	Q10HH: 400 kV, 4000A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		70 - 156 kHz	
	0558643	Q10HH: 400 kV, 4000A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)		101 - 500 kHz	
		Delivery destination:	0	Substation	*
		Name	Designation	Signature	Date
Compiled by:		0	PTM&C Project Engineer		
Accepted by:			Discipline Custodian		
Approved by:			PTM&C Planning & Project Support Manager		
Received by:		0	Project Manager		

Annex F – Sample of Line Trap Proforma – Mega HVT

	PTM&C Equipment Proforma		Unique Identifier	240-84597622
			Record Identifier	TLP - FO1
			Document Type	Proforma
			Revision	1
			Effective Date	01 July 2014
			Group Technology (Engineering) - PTM & C	
		Date:		
From:	PTM & C Planning & Project Support	To:	Capital Expansion Central	
Project Engineer:		Project Manager		
Tel:		Tel:		
Scheme name:				
Project name:				
Project No.:				
Cost Centre:				
WBS/Internal Order:				
Region / O.U.				
Substation:				
Busbar Voltage:				
Bay:				
Station DC Voltage:				
Contract No.: 4600066985				
Supplier: Mega HVT				
Please order the equipment listed below:				
Line ITEM	Material	Item Description	Blocking Bai	Quanti
	17528	U5HH: 132 kV POST INSULATORS – EXTRA HEAVY CREEPAGE (31mm/kV) - Line Traps U1 to U4		
	11055	S1H: 275 kV, 2500A, 50 kA, 0,2 mH LT - Heavy Creep (25mm/kV)	80 – 108 kHz	
	11055	S1H: 275 kV, 2500A, 50 kA, 0,2 mH LT - Heavy Creep (25mm/kV)	104 – 156 kHz	
	11055	S1H: 275 kV, 2500A, 50 kA, 0,2 mH LT - Heavy Creep (25mm/kV)	125 – 204 kHz	
	11055	S1H: 275 kV, 2500A, 50 kA, 0,2 mH LT - Heavy Creep (25mm/kV)	194 – 500 kHz	
	0558642	S1HH: 275 kV, 2500A, 50 kA, 0,2 mH LT - Extra Heavy Creep (31mm/kV)	80 – 108 kHz	
	0558642	S1HH: 275 kV, 2500A, 50 kA, 0,2 mH LT - Extra Heavy Creep (31mm/kV)	104 – 156 kHz	
	0558642	S1HH: 275 kV, 2500A, 50 kA, 0,2 mH LT - Extra Heavy Creep (31mm/kV)	125 – 204 kHz	
	0558642	S1HH: 275 kV, 2500A, 50 kA, 0,2 mH LT - Extra Heavy Creep (31mm/kV)	194 – 500 kHz	
	0558637	S5H: 275 kV, 2500A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)	48 – 500 kHz	
	0558636	S5HH: 275 kV, 2500A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)	48 – 500 kHz	
Delivery destination:		0 Substation		*
Name		Designation	Signature	Date
Compiled by:	0	PTM&C Project Engineer		
Accepted by:		Discipline Custodian		
Approved by:		PTM&C Planning & Project Support Manager		
Received by:	0	Project Manager		

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