Eskom	Report	Technology

Title: **PHILIPPI SUBSTATION 132 KV CABLE SYSTEMS FROM TRFR 3 TO 132 KV GIS**

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Compiled by	Functional Responsibility	Authorized by
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PCM Reference: **Support to the Grid and OU**

SCOT Study Committee Number/Name: **Cable Systems and Metal Enclosed Switchgear SC**

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Executive Summary

Report number (WPhi12P01-SE-D87) describes the project design for the extension of Philippi Transmission station to 3 x 500 MVA 400/132 kV. It will be required to install 132 kV cable system from the transformer to 132 kV GIS at Philippi substation. The estimated cable route length is 100 m from the transformer to the GIS.

A total of 300 m (3X100 m) cable drum will be required for this project. The scope entails the complete cable system works from the transformer outdoor cable terminations to the GIS cable terminations in the Transmission substation HV yard as outlined on the latest revision of drawing WPhi12P01-SE-D6.

The ampacity calculations shall take this into consideration to establish the point of highest de-rating based on the principles of the percentage of cable installed above ground level for the specified installation conditions.

1. Introduction

This document was compiled to provide the design and minimum technical requirements for the use of a HV cable system for the connection of the new 500 MVA 400 / 132 kV transformer to be installed at Philippi substation.

2. Supporting clauses

2.1 Scope

Group Technology HV Plant was requested to specify the minimum technical requirements for the 132 kV cable systems to be installed at Philippi substation for the new 500 MVA 400/132 kV transformer project.

2.1.1 Purpose

This document specifies the requirements for the design, manufacture, factory sample and routine testing, factory acceptance testing, supply, trenching, installation, after installation testing and commissioning, operational manual, maintenance manual and training of the 132 kV cable system for the connection of the new 500 MVA 400/132 kV transformer bay to the 132 kV GIS at Philippi substation.

Figure 1 shows the single line diagram for the Philippi Substation and the proposed cable route.

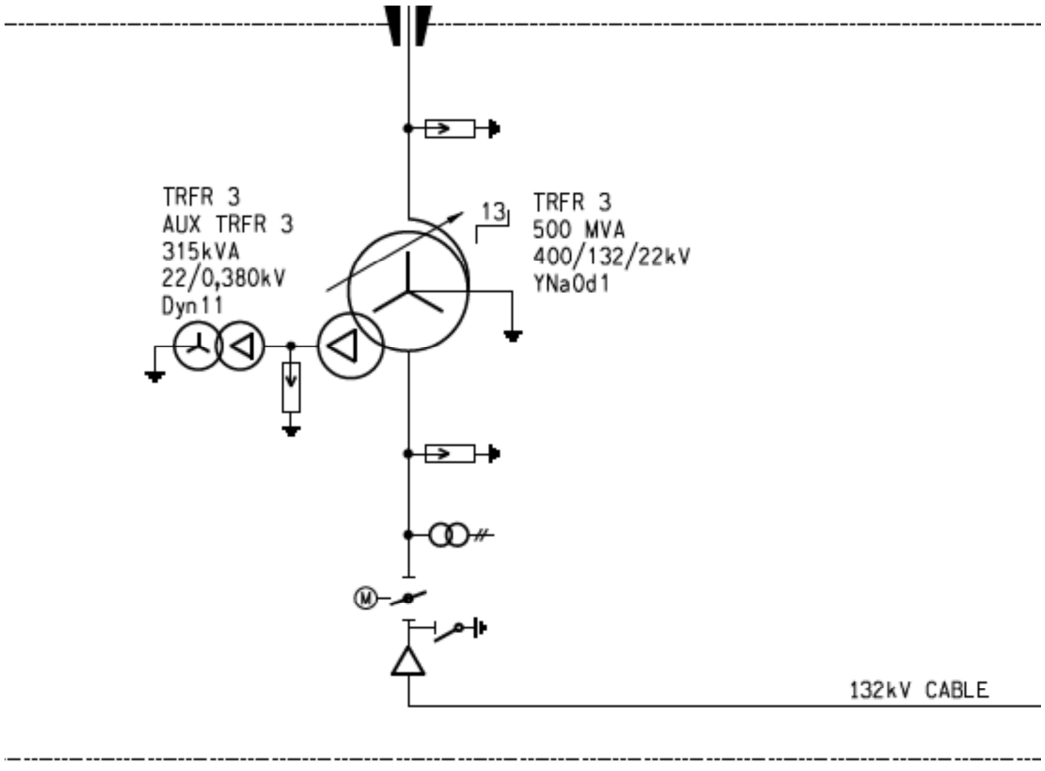

Figure 1: Philippi Trfr Nr 3: 500 MVA 400/132kV from drawing number WPhi12P01-SE-D6

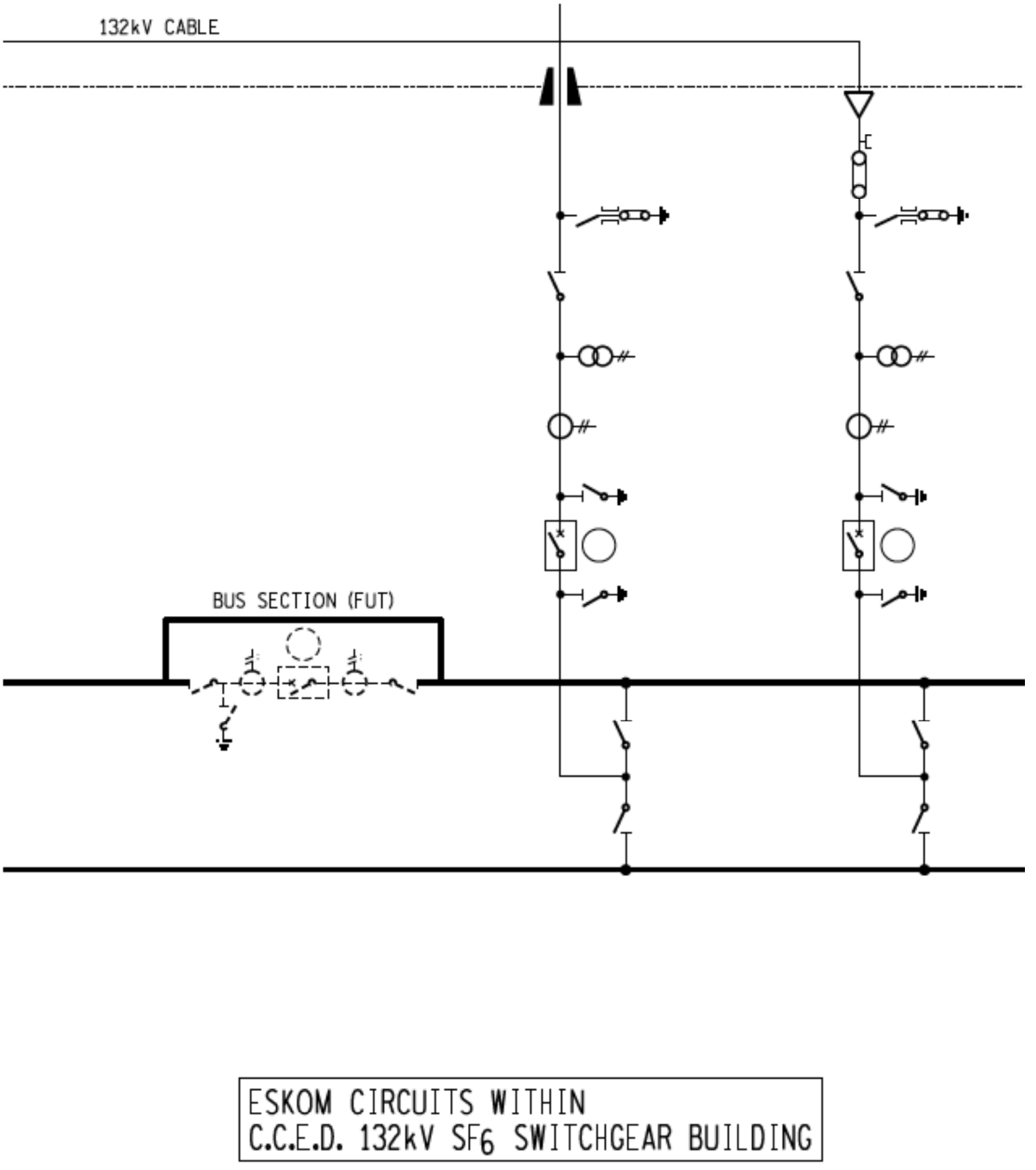

Figure 2: Philippi 132 kV GIS from drawing number WPhi12P01-SE-D6

2.1.2 Applicability

This document shall apply for Eskom Holdings Limited, Transmission division 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] ISO 9001: Quality Management Systems.

[2] SANS 60840: Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test methods and requirements.

[3] NRS 077: XLPE-insulated cables and accessories for systems with nominal voltages of 44 kV, 66 kV, 88 kV and 132 kV.

[4] 240-56030640: General Information and requirements for high-voltage cable systems.

[5] 240-56030625: Specification for XLPE-insulated power cables and accessories for systems with nominal voltages of 44 kV to 132 kV.

[6] D-DT 8075: Buyer's guide for bonding leads.

[7] WPhi12P01-SE-D87: Detail Design Report: City of Cape Town Strengthening – Philippi Substation Extension.

[8] WPhi12P01-SE-D6: Philippi Station Electric Diagram

2.2.2 Informative

[9] 32-9: Definition of Eskom documents.

[10] 32-644: Eskom documentation management standard.

[11] 474-65: Operating manual of the Steering Committee of Technologies (SCOT).

2.3 Definitions

2.3.1 General

Definition	Description
Cable system	Cable with installed accessories (i.e. joints if applicable, terminations, earthing and bonding system)

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
DCR	Dynamic Cable Rating
DTS	Distributed Temperature Sensing
SVL	Surge Voltage Limiter
XLPE	Cross Linked Polyethylene

2.5 Roles and responsibilities

All Eskom employees and/or appointed bodies involved in the procurement of the 132 kV cable systems shall ensure that the project deliverable meets the requirements of this specification.

All manufacturers, suppliers and contractors of the 132 kV cable systems to Eskom must be conversant with the requirements of this standard, and shall comply with the requirements. Suppliers shall ensure that they obtain clarity where required and obtain all supporting information or documents necessary to comply with this document.

2.6 Process for monitoring

The 132 kV cable systems acceptances shall be based on a fully compliant submission of documents and the factory testing of the 132kV cable system.

The 132 kV cable systems project acceptances shall be based on full compliance to this document.

2.7 Related/supporting documents

Refer to clause/ section 2.2.

3. The 132 kV Cable systems requirements

The cable system design, manufacture, factory sample and routine testing, factory acceptance testing, supply, trenching, installation, after installation testing and commissioning, operational manual, maintenance manual, and training shall be performed in accordance with the latest revision of the following documents:

- 240-56030640: General Information and requirements for ac high-voltage, ac extra high-voltage and dc cable system,
- 240-56030625: Specification for XLPE-insulated power cables and accessories for systems with nominal voltages of 44 kV to 132 kV,
- NRS077: XLPE-insulated cables and accessories for systems with nominal voltages of 44 kV, 66 kV, 88 kV and 132 kV, and
- SANS 60840: Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) — Test methods and requirements.
- The cable, joints and terminations offered shall be type tested as a cable system in accordance with SANS 60840 (clause 12).

Where any conflicting information is stated, this document will take precedence.

3.1 The 132 kV cable system requirements for Philippi substation

The cable system supplier is required to sufficiently optimise the cable systems design, manufacture, factory sample and routine testing, factory acceptance testing, supply, trenching, installation, after installation testing and commissioning, operational manual, maintenance manual and training for the prevailing conditions and constraints that may arise from on-site conditions or specified in this document. All cable and accessories details, raw material information, datasheets, drawings, preliminary routing and configurations, trench designs, racking designs, applicable calculations with assumptions and results, test plans, quality inspection test plans and any other requirements contained in this specification shall be included in the cable systems suppliers design package and properly cross referenced in schedule B.

The 132 kV cable system to be installed at Philippi substation shall be designed to comply with the following minimum criteria:

a) A design, bill of material and costing model for the 132 kV cable system shall be submitted.

b) A minimum cable system design life of 40 years. Cable systems suppliers shall submit test data and applicable calculations supporting the system design life criteria, considering thermal, electrical and mechanical ageing of the cable system, i.e. both the cable and the cable accessories.

c) The cable system shall meet the specified maximum continuous current rating at a daily load factor of 1 (100%) for the Eskom defined maximum continuous current temperature limit of 70 ℃. A continuous current load rating of I = 2187 A (500 MVA / (1.73 * 132 kV)) is required for this installation.

d) The emergency current ratings at 90 ℃ and 105 ° C conductor temperature, four hour, two hour and one hour shall also be calculated.

e) The maximum three phase fault level requirement is 40 kA for 1 second and the maximum single phase to earth fault level requirement is 40 kA for 1 second.

f) Calculation of the ampacity (rating) shall show all the rating factors that were considered. The applicable ambient temperature ranges is stated in schedule A. Step by step hand or detailed excel spread sheet calculations shall be submitted for both an ambient temperature of 45 ℃ and soil temperature of 30 ℃, and an ambient temperature of 35 ℃ and soil temperature of 25 ℃.

g) The following design options need to be submitted by the cable supplier to meet the load requirements as specified in clause 3.1.3.

   1) Offer 1: A design for an optimised aluminium conductor size to meet the current rating requirement for a flat formation, single end point bonded system, and

   2) Offer 2: A design for an optimised copper conductor size to meet the current rating requirement for a flat formation, single end point bonded system.

h) The cable system design shall be optimised to prevent using any cable joints.

i) Single end point bonded methods shall be used to minimise sheath currents and maintain sheath voltages within acceptable limits.

j) The open circuited sheath standing voltage shall not exceed 65 V.

k) The SVL shall be adequately rated to withstand transient over voltages induced during fault currents, switching and lightning events.

l) Step by step hand or excel spread sheet calculations shall be submitted to show the calculated sheath standing voltage for steady state and transient currents, and for the SVL rating selected.

m) The cable system supplier and installation contractor shall be responsible for surveying the final cable route in accordance with the preliminary routing information provided.

n) The cable length shall make provision for snaking of the cable along its route, and passage of the cable through the termination support structures and at the termination ends.

o) The cable system design shall make provision for all trenching, steel support frames, termination support structures, termination foundations, termination cleats, cable racking and wooden cable clamps in accordance with the expected thermal mechanical behaviour of the cable. All preliminary and final drawings, appropriately referenced, related to these items shall be provided with the Tender.

p) The fibre optic ducts for protection shall be installed.

q) A method statement and procedure for the execution of the cable and accessories design, manufacturing and installation shall be provided covering the following minimum aspects:

   1) The manufacturing plant location and manufacturing method statement for the type tested cable systems and all applicable components.

   2) The project reference list of type tested 132 kV cable systems supplied over the last 5 years for equivalent or larger conductor size cable systems to verify manufacturing and installation capability.

3) Project team and roles: Experience and certification of jointers and installation teams must be provided. If applicable subcontractor evaluated results and experience with regard to the service offered need to be submitted as part of the tender for Eskom review. Organograms for all relevant project teams and roles to be submitted.

4) Final site and route surveying.

5) Final design, design review and engineering phase time allowance after contract award.

6) In process inspections at the cable and accessories manufacturing plants.

7) Quality inspection test plans and factory acceptance tests for the cable and all cable accessories at the manufacturing plants.

8) Site Preparation and/or Establishment.

9) Erection of steel bracing, supporting structures and installation of foundations (civil works).

10) Cable trenching, racking and installation design and on site quality inspection plans.

11) Jointing/Splicing (if applicable) installation instructions and on site quality inspection plans.

12) Sheath bonding arrangement, bonding lead, link disconnecting boxes, SVLs: design, manufacturing, quality inspection test plan, installation, on site testing and commissioning.

13) Cable installation method statement and on site quality inspection plans.

14) Outdoor cable terminations installation instructions, method statement and on site quality inspection plans.

15) GIS cable terminations installation instructions, method statement and on site quality inspection plans

16) After installation testing and commissioning testing method statements and on site quality inspection plans.

17) Operation and maintenance manuals for the installed cable systems.

18) Project Plan indicating time frames of all related activities.

r) A proposal for the training of Eskom personnel locally shall be offered pertaining to the following:

1) Installation

2) Operation

3) Maintenance

s) Technical evaluation reports for any nominated sub-contractor to perform work on the cable system.

t) A 10 year system guarantee will be required for the cable system supplied, installed and commissioned.

3.2 The cable system route reference description

The 132 kV cable system will be required to be installed as per figure 1 from the 132 kV transformer outdoor terminations (see latest revision of drawing WPhi12P01-SE-D6) to the 132 kV GIS cable terminations at Philippi Substation. The cable route length for the commercial tender enquiry and technical evaluation purpose will be approximately 100 m long. After awarding of the tender it is required that the exact route and trench length be measured on-site and the cable trench length, order length, installation length and bill of quantity costs be adjusted to this measured and agreed length during the design and engineering phase.

3.3 The cable system after installation testing

The Contractor shall conduct the following after installation tests. These tests shall comply with clause 15 of SANS 60840 respectively. These proposals inclusive of method statements with pass/fail criteria shall be provided with the tender.

a) Jacket/over sheath integrity test.

b) AC voltage withstand utilising a series resonant test set with test level at 1.7 U_0 for 60 minutes per phase.

c) Partial discharge (PD) measurement. PD test methods, detection systems as well as pass/fail criteria to be provided for Eskom review.

d) Bonding lead current and sheath standing voltage measurements.

e) Sheath-bonding verification.

f) Contact resistances for earth and bonding connections.

Positive and zero sequence impedance measurements.

All test, measurement data and results performed after installation shall be provided to Eskom in a final report for Eskom review and compliance acceptance.

3.4 Risks identified for Philippi 132 kV cable system project

Electrical clearances and safe working clearances need to be considered for the cable terminations to cater for the cable system installation and commissioning testing that will be performed on site.

3.5 Strategic spares for Philippi 132 kV cable system

The following spares shall be procured and be kept by the Grid as part of strategic spares.

a) Due to the cable route length: no cable joints shall be kept as spares. In an event of a fault: the faulted cable (phase) shall be replaced from the outdoor termination to the GIS termination.

b) 3 X outdoor cable terminations,

c) 1 X three-way link disconnecting box (i.e. 3 line and 1 earth),

d) 1 X three-way link disconnecting box with SVL surge arresters (i.e. 3 line onto SVL arresters and 1 earth),

e) 3 X SVL arrestors.

f) 100 m, 132 kV XLPE cable in accordance with the offered cable size and conductor material.

g) 100 m, Link disconnecting bonding leads or ECC (D-DT 8075).

3.6 Conclusion

This report is effective to recommend and specify a cable system solution to connect the 500 MVA 400/132 kV transformer to the 132 kV GIS cable termination. The cable system supplier and installation company to complete the Annex A technical schedule B as part of the tender returnable.

The technical evaluation criteria for this project are specified in Annex B, C, and D.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Bheki Ntshangase	Senior Manager – HV Plant Engineering

Name and surname	Designation
Lester Geldenhuis	Chief Engineer – Tx WC Grid
Percy Seboco	Senior Technologist – Substation Design COE
Rodger Peense	Middle Manager: HV Plant Western Cape Grid

5. Revisions

Date	Rev	Compiler	Remarks
June 2020	1	Q Khumalo	New document.

6. Development team

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

- Queeneth Khumalo: Chief Engineer HV Plant, Group Technology

7. Acknowledgements

Not applicable.

Annex A – Schedules A and B in accordance with NRS 077 for the 132 kV Aries substation cable system project

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and particulars of equipment to be supplied (to be completed by tenderer)

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
1	4.1	a) altitude	m	Up to 1800	xxxxxxxx
2		b) ambient air temperature	°C	–5 °C to 50 °C (average of 35 °C and 45 °C)	xxxxxxxx
3		c) soil temperature	°C	0 °C to 35 °C (average of 25 °C and 30 °C)	xxxxxxxx
4		d) soil thermal resistivity (minimum requirement for imported soil)	K·m/W	1,2	xxxxxxxx
5		e) depth of burial	m	1,2	xxxxxxxx
6		f) configuration		Flat (Min 2D spacing)	_____
7		g) special bonding applied (i.e. end-point, double end-point or cross-bonded)?		Yes, single end point bonded	xxxxxxxx
8		h) lightning ground flash density		severe (14 flashes/km^2/year	xxxxxxxx
9		i) solar radiation	W/m^2	1 000 to 1 250	xxxxxxxx
10		j) ultraviolet radiation		High	xxxxxxxx
11		k) relative humidity		10 % to 95 %;	xxxxxxxx
12		m) wind pressure and seismic		Not exceeding 700 Pa (equivalent to 34 m/s) and 0.3g	xxxxxxxx
13		n) pollution severity defined by IEC 60815: "Very heavy"		Very heavy (31 mm/KV required as a minimum)	_____
14					
15		o) maximum conductor operating temperature	°C	70°C (@ 500 MVA)	xxxxxxxx
16	4.2.2	Cable or accessory operating voltage (or both)	kV	132kV	xxxxxxxx
17	4.2.3	Rated voltage of accessories		145kV	_____
18	4.3.1.2	Conductor cross-sectional area and	mm^2	See clause 3.1	_____
19		Load current (@ 70^{o}C)	A	2187 A (500 MVA)	_____
20		(100 % load factor; thermally independent circuit)		xxxxxxxx	
21		110% for 4 hours		xxxxxxxx	_____
22		120% for 2 hours		xxxxxxxx	_____
23		130% for 1 hour		xxxxxxxx	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
24		90°C		xxxxxxxx	_____
25		105°C		xxxxxxxx	_____
26	4.3.1.3	Symmetrical short-circuit fault level	kA	40	_____
27	4.3.1.3	Fault level duration (if not 1s)	s	1	xxxxxxxx
28	4.3.1.4	Type of conductor required		Cu or Al	_____
29	4.3.3.2	Nominal thickness of insulation	mm	xxxxxxxx	_____
30	4.3.3.2	Actual conductor screen radial stress at U_0	kV/mm	≤ 8,0	_____
31	4.3.3.2	Actual core screen radial stress at U_0	kV/mm	≤ 4,0	_____
32	4.3.6.1	Metallic sheath: seamless corrugated aluminium		Seamless corrugated aluminium	xxxxxxxx
33	4.3.6.2.2 **OR** 4.3.6.3.2	Earth fault level	kA	40	xxxxxxxx
34		Fault level duration (if not 1s)	s	1	xxxxxxxx
35	4.3.6.2.3	Nominal thickness of aluminium sheath	mm	xxxxxxxx	_____
36	4.3.7.2	Details of water barriers offered		xxxxxxxx	_____
37	4.3.8.5	Conductive coating applied		Graphite or alternative	
38					----------
39	4.4.1.1	Details of the cable to be jointed		xxxxxxxx	_____
40		Size of conductor to be jointed	mm^2		xxxxxxxx
41	4.4.1.1(f)	Bonding lead lug fixing hole if not M12	mm^2	M12	Xxxxxxxx
42	4.4.1.1(f)	Type of bonding lead (single core/concentric)		Single core	xxxxxxxx
43	4.4.1.1(f)	Diameter of bonding lead	mm	See clause 3.1	_____
44	4.4.1.1(g)	Additional requirements		Cu or Al conductor	xxxxxxxx
45	4.4.1.2	Required type and number of joints for			
46		a) straight joints (for spares purpose). Note: the joints will be purchases as part of maintenance spares by the GRID.		None	xxxxxxxx
47		b) sheath-interrupting joints		None	xxxxxxxx
48	4.4.1.3	Details of joints offered		Nene	xxxxxxxx
49	4.4.1.4	Specialized tools required for jointing		Supply to Eskom	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
		or terminating a cable			
50	4.4.1.5	Specify method used to connect the conductors		xxxxxxxx	_____
51	4.4.2.1	Details of the cable to be terminated		See clause 3.1g) in this document	_____
52	4.4.2.1	Size of conductor to be terminated	mm^2	See clause 3.1g) in this document	_____
53	4.4.2.2	Details of cable end support structure		DDT5271& DDT5272	xxxxxxxx
54	4.4.2.3	Pollution Application ("very heavy")		Very heavy (31 mm/kV required as a minimum)	xxxxxxxx
55	4.4.2.4 **OR** 4.4.2.7	Insulator material type		Composite	xxxxxxxx
56	4.4.2.8	Insulator material offered		xxxxxxxx	_____
57	4.4.2.8	Measured creepage distance	mm	xxxxxxxx	_____
58	4.4.2.9 **OR** 4.4.2.8 **OR** 4.4.3.3	Bonding lead lug fixing hole if not M12		M12	xxxxxxxx
59	4.4.2.11 **OR** 4.4.2.8 **OR** 4.4.3.3	Bonding lead cross-sectional area for termination	mm^2	See clause 3.1 above	xxxxxxxx
60	4.4.2.12	Diameter of vertical stem for self-supporting type terminations	mm	To be provided	_____
61	4.4.2.13	Details of current-carrying connector for non-self-supporting type terminations		N/A	Xxxxxxxx
62	4.4.2.14	Required number of outdoor terminations		3	_____
63	4.4.2.15	Details of terminations offered		Xxxxxxxx	_____
64	4.4.2.16	Specialized tools required for terminating		Xxxxxxxx	_____
65	4.4.2.17	Mounting PCD for self-supporting termination		Xxxxxxxx	_____
66	4.4.3.1	Materials required for SF_6/oil termination		Xxxxxxxx	_____
67	4.4.3.1	SF6/oil terminations shall be of the plug-in type A dry-type in accordance with SANS 62271-209.		Xxxxxxxx	_____
68	4.4.3.1	The base of the termination shall		Yes	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
		make provision for the connection of a bonding lead with cross-sectional area as stated in clause 3.1.			
68	4.4.3.1	The insulating barrier between the bonding lead and the termination base plate is designed for a 60 s d.c. dry withstand voltage of 10 kV?		Yes	_____
69	4.4.3.1	Required number of GIS terminations		3	_____
70	4.4.4.1	Sheath bonding arrangement required for either		Single end point	_____
		a) single end-point bonded system, or			
		b) cross-bonded system, or			
		c) solid-bonded system or			
		d) combinations of the above			
71	4.4.4.1(c)	Number of major sections if cross-bonded		N/A	N/A
72	4.4.4.2	Type and number of link disconnecting boxes required for			
73		a) one-way (i.e. 1 line and 1 earth),		N/A	N/A
74		b) one-way with SVL surge arresters (i.e. 1 line onto SVL arrester and 1 earth),		N/A	N/A
75		c) three-way (i.e. 3 line and 1 earth),		1	_____
76		d) six-way (i.e. 6 line and 1 earth),		N/A	N/A
77		e) three-way with SVL surge arresters (i.e. 3 line onto SVL arresters and 1 earth),		1 and the 3 SVLs included	_____
78		f) six-way cross-bonded with SVL surge arresters (i.e. 6 line cross-bonded onto SVL arresters and 1 earth).		N/A	N/A
79		g) six-way with 6 SVL surge arresters (i.e. 6 line onto SVL arresters and 1 earth)		N/A	N/A
80		h) six-way with 3 SVL surge arresters (i.e. 6 line with 3 line onto SVL arresters and 3 line and 1 earth)		N/A	N/A
81	4.4.4.3	Type of link boxes required		Kiosk or structure	_____
82	4.4.4.3	Material of link boxes		Stainless steel	xxxxxxxx
83	4.4.4.3	Suitability for mounting in a manhole		N/A	xxxxxxxx
84	4.4.4.6	Details of link boxes offered		xxxxxxxx	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
85	4.4.4.7	Maximum TOV that the SVL surge arresters will be subjected to.		To be provided	_____
86	4.4.4.8	Details of SVL surge arresters offered		xxxxxxxx	_____
87	4.4.5.2	Bonding lead design parameters		To be provided	_____
88	4.4.5.3	Bonding lead cross-sectional area offered	mm^2	xxxxxxxx	_____
89	4.4.5.4	Required length of bonding leads			
91		a) the single-core bonding lead	m	200	_____
92		b) the concentric bonding lead	m	N/A	N/A
93	4.4.5.5	Thickness of bonding lead insulation:			
94		a) single-core	mm	xxxxxxxx	_____
95		b) concentric inner	mm	xxxxxxxx	_____
96		c) concentric outer	mm	xxxxxxxx	_____
97	4.4.5.5	Overall diameter		xxxxxxxx	_____
98	6.2.1	Length of cable required per drum	m	300	_____
99	6.2.1	Number of drums required		1	_____
100	6.2.3	Method of wood treatment (if applicable)		xxxxxxxx	_____
101	6.2.5	Details of pulling eye offered		xxxxxxxx	_____
102	6.2.5	Maximum permissible pulling tension	kN	xxxxxxxx	_____
103	6.2.6	Cable drum material		xxxxxxxx	_____
104	7.1.1	Additional information required:			
105		a) rated voltage	kV	xxxxxxxx	_____
106		b) nominal diameter of conductor	mm	xxxxxxxx	_____
107		c) nominal thickness of conductor screen	mm	xxxxxxxx	_____
108		d) nominal thickness of core screen	mm	xxxxxxxx	_____
109		e) nominal overall diameter of cable	mm	xxxxxxxx	_____
110		f) mass of cable	kg/m	xxxxxxxx	_____
111		g) d.c. resistance of conductor at 20 ^oC	Ω/κμ	xxxxxxxx	_____
112		h) a.c. resistance of conductor at 90 ^oC	Ω/κμ	xxxxxxxx	_____
113		i) a.c. resistance of sheath with conductor at 90 ^oC	Ω/κμ	xxxxxxxx	_____
114		j) reactance per phase	Ω/κμ	xxxxxxxx	_____
115		k) capacitance per phase	nF/km	xxxxxxxx	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
116		l) zero sequence impedance	Ω/κμ	xxxxxxxx	_____
117		m) zero sequence capacitance	nF/km	xxxxxxxx	_____
118		n) rated continuous current at			
119		• 70ºC conductor temperature	A	xxxxxxxx	_____
120		• 90ºC conductor temperature	A	xxxxxxxx	_____
121		• 105ºC conductor temperature	A	xxxxxxxx	_____
122		o) rated symmetrical fault withstand current	kA·s	xxxxxxxx	_____
123		p) rated earth fault withstand current	kA·s	xxxxxxxx	_____
124		q) conductor temperature at specified load	^{o}C	xxxxxxxx	_____
125		r) conductor temperature after symmetrical fault (1 s) assuming operation at specified load prior to fault	^{o}C	xxxxxxxx	_____
126		s) sheath temperature after earth fault	^{o}C	xxxxxxxx	_____
127		(1 s) assuming operation at specified load prior to fault			
128		t) conductor losses at maximum conductor operating temperature	kW/km	xxxxxxxx	_____
129		u) type test reports for the cables offered or for similar cables previously tested		xxxxxxxx	_____
130		v) dimensioned drawing of the cable cross-section		xxxxxxxx	_____
131		w) minimum installation bending radius	m	xxxxxxxx	_____
132		x) emergency current rating (IEC 60853-2)	A	Xxxxxxxx	_____
133		y) cyclic current rating in accordance with IEC 60853-2	A	xxxxxxxx	_____
134		z) Load profile		100% continuous, 110% 4 hours, 120% 2 hours and 130% 1 hours	xxxxxxxx
135	7.1.2	Additional information required:		xxxxxxxx	_____
136		a) dimensioned drawing of joints offered		xxxxxxxx	_____
137		b) MCOV characteristic curves		xxxxxxxx	_____
138		c) installation instruction for joints		xxxxxxxx	_____

Item Nr	Sub clause in NRS077	Description	Units	Schedule A	Schedule B
		offered			
139		d) type test reports for accessories offered		xxxxxxxx	_____
140		e) details of training offered		xxxxxxxx	_____
141		Additional information required:		xxxxxxxx	_____
142		a) dimensioned drawing of terminations offered		xxxxxxxx	_____
143		c) installation instruction for terminations offered		xxxxxxxx	_____
144		d) type test reports for terminations offered or similar terminations		xxxxxxxx	_____
145		e) details of training offered		xxxxxxxx	_____
146	7.1.2	Dimensioned drawings of link disconnecting boxes offered		xxxxxxxx	_____
147	7.1.2	Special tools required		xxxxxxxx	_____
148	7.1.3	Accessory information indicated on drawings supplied with tender documentation	Yes/no	xxxxxxxx	_____

Annex B – Technical evaluation criteria for the 132 kV Philippi substation cable systems project

1) Scope

This document covers the criteria for the evaluation of the 132 kV Philippi substation cable systems project to install the 132 kV cable system within Eskom Holdings SOC (Ltd). The document addresses the standard documented technical evaluation criteria to be used when evaluating the tender submissions for the 132 kV Philippi substation cable system project in line with the Eskom Holdings SOC (Ltd) requirements and it is applicable to all the technical evaluations for the related tender submissions.

2) Requirements

The technical evaluation criteria is specific for each part of the 132 kV cable system design, manufacture, factory sample and routine testing, factory acceptance testing, supply delivery and, trenching, installation, after installation testing and commissioning, operational manual, maintenance manual, and training. The evaluation methodology will include two main parts, namely the documentation evaluation and the factory assessment for the cable and accessories offered.

2.1 Documentation Evaluation

The documentation evaluation exercise is performed by the Eskom evaluating representatives. This initial part of the evaluation starts when submissions are opened and assessed for the first time. The submitted documents will be evaluated against the evaluation criteria as stated in Annexures C and D.

During the documentation evaluation; a fully compliant type tested and pre-qualification tested 132 kV cable systems in accordance with NRS 077 and SANS 60840 will be required. Failure to submit and comply with the type test requirements specified in these documents will lead to immediate disqualification.

The documentation evaluations are meant for establishing if all the key tender deliverables are met. The documentation evaluation will consist of two sections: Mandatory Technical Evaluation Criteria deliverables and Qualitative Technical Evaluation Criteria. The Mandatory Technical Evaluation Criteria constitute a total of 80% of the total Technical Evaluation Criteria score, while the Qualitative Technical Evaluation Criteria constitute 20% of the technical evaluation score.

The tender submission must meet all the Mandatory Technical Evaluation Criteria. Failure to meet all the mandatory requirements will result to a score of 0% of the 80% (listed above); thus a tenderer can only obtain 0%, or 80% and nothing in between for Mandatory Technical Evaluation Criteria. The Qualitative Technical Evaluation Criteria will constitute 20% towards the total project evaluation score. Equation 1 shows how the technical evaluation score will be calculated.

Technical evaluation score = 80% (Mandatory Technical Evaluation Criteria) + 20% (Qualitative Technical Evaluation Criteria) (1)

NOTE: Any technical evaluation score below 100% for Qualitative requirements will need to be addressed as part of possible contract award discussions.

2.2 Evaluation at factory

The factory evaluations will only be performed on the submissions that have met all the Mandatory Technical Evaluation Criteria requirements as stated in Annex C. Eskom Commercial shall make the arrangements for factory visits and ensure the technical representatives are invited on time.

At the factory, the Eskom evaluating representative(s) conducts the evaluation through the use of checklists. The checklists are used to verify factory capability and manufacturing method compliance to the type tested and pre-qualification tested cable system offered.

The factory evaluation will consists of the cable manufacturing plant evaluation (i.e design capability, type tested compounds and extrusion lines, manufacturing plant, processes, sample and routine testing, etc) and the cable accessories manufacturing plant evaluation (i.e. design capability, type tested compounds and manufacturing equipment, manufacturing plant, processes, sample and routine testing, etc).

The following areas shall be assessed during the manufacturing evaluation:

a) Machinery capability.

b) Plant setup.

c) Raw material and compounds type tested.

d) Extrusion lines type tested.

e) Production process and critical check points.

f) Design and software design capability.

g) Material handling and storage.

h) Testing facilities including certification and calibration of testing equipment.

i) Sample testing.

j) Routine testing procedures.

k) Packaging of materials.

At the end of the factory evaluation, the Eskom evaluating representative(s) list all the deviations and identified risks if any. The Tenderer and their OEM will be given an opportunity during possible contract negotiations to confirm that they will meet the Eskom requirements as part of possible contract award.

Annex C – Mandatory Technical Evaluation Criteria for Philippi 132 kV cable System Project

Table C.1: Mandatory Technical Evaluation Criteria

Item	Criteria	Clause (240-84027577	Acceptance: Yes/ No
1.	Is a cover letter indicating location and physical address of manufacturing facility which will be used to manufacture and supply for Eskom requirements submitted? Note: Eskom will only evaluate these facilities and they will be the only qualifying facilities from which the Supplier will supply?	3	
2.	Are English copies of the cable system type test reports in accordance with SANS/IEC60840 submitted?	3	
3.	Has all type testing been performed at an accredited test facility?	3	
4.	Are the submitted type test reports compliant in accordance with SANS/IEC60840 and Eskom's requirements?	3	
5.	Is the information of the extrusion line used to manufacture the offered cable submitted? The information to include the serial number of the extrusion line and the test reports of the extrusion line. Note: Only HV cable produced using the triple head extrusion in a Continuous Vulcanising (CV) line shall be accepted.	3	
6.	Is a written confirmation that the extrusion line used to manufacture the offered cable complies with Eskom's requirements submitted? The extrusion line to comply with the following: • Dry curing extrusion, • In-production quality monitoring systems employed to monitor curing and scorching characteristics of XLPE compound as well as insulation and screen thickness, and • Clean room facility complying with the requirements of Class 1000.		
7.	Is a letter of consent submitted? **Note**: The letter of consent is to allow Eskom representative(s) to carry out factory evaluations, in process inspections, witnessing of routine tests, sample tests and Factory acceptance testing if tenderer is successful.	3	
8.	Are the factory acceptance test plans for the cable manufacturing and accessories manufacturing in English submitted?	3	
9.	Are the quality inspection test plans for the cable manufacturing and accessories manufacturing in English submitted?	3	
10.	Is factory routine tests failure rate submitted? **Note**: the factory routine failure rate to state the: number of failed cable drums routine tests, or number of cables tested per annum. Figures must be auditable for the last 2 years.		
7.	Are completed Technical Schedules submitted?	3 and Annex A	
8.	Does the completed schedule B meet Eskom schedule A requirements? (i.e. all items with value/ description on schedule A)	3 and Annex A	
9.	As specified in 240-56030640 clause 3.35. a) is a formal design report with all design drawings submitted?	3	

Item	Criteria	Clause (240-84027577	Acceptance: Yes/ No
10.	Is the single line diagram with all listed component descriptions, earthing and bonding design submitted?	3	
11.	Are the cable system design life calculations submitted?	3.1.2	
12.	Are the cable system ampacity calculations submitted? **Note:** Step by step calculations showing the equations used and assumptions (if any) to the submitted.	3.1.3 and 3.1.4	
13.	Are the sheath standing voltage calculations submitted?	3.1.8	
14.	Are the two offers submitted (i.e offer 1 and offer 2 options)?	3.1.5	
15	Is a 10 year cable system guarantee in writing based on standard Eskom operating conditions submitted?	3.1.16	
16.	Are the quality inspection plans for the cable trench, cable installation, cable termination and link disconnecting boxes in English submitted?	3	
17.	Are the installation instructions for the cable terminations and or joints (if applicable) in English submitted?	3	
18.	Are the maintenance manuals for the cable system in English submitted?	3	
19.	Is a proposal for training submitted?	3.1.14	
20.	For proof of experience in construction and installation of 132 kV cable systems; choose one of the following options: 20.1 Supply and installation history of HV XLPE cable system projects must be submitted? The history to meet the following requirements: At least five projects where HV XLPE cable for the same conductor sizes offered or bigger were supplied and installed? The above required project references shall indicate the following information: The name of the utility or customer, The size and type of the cable (i.e the voltage rating, the cable conductor size, the cable route length and number of cable circuits per project), The types and total number of cable accessories installed, The execution year. Contact details of the utility/customer representatives, their titles, addresses (work address), emails and telephone numbers should be provided. Proof of qualifications for the person who will be performing the terminating or jointing (if any) of the cable. This shall include: CV's, and cable jointing and terminating certificate (where applicable).	3	
	OR 20.2 Submit written confirmation that the installation of the cable system terminations and/or joints will be performed and supervised on site by authorised cable jointers from the cable termination and joint original manufacturer. Furthermore the following information shall be submitted. CV of the person who will be installing the terminations or the joints (if applicable). Qualifications to prove that the candidate is qualified to install the 132 kV cable termination or the joints (if applicable). This can be: joint and termination certificate for 132 kV (or above) cable systems, or authorisation for joint and termination for 132 kV cables (or above). A list of projects where the person has installed terminations or joints of the same		

Item	Criteria	Clause (240-84027577	Acceptance: Yes/ No
	voltage (132 kV) or higher. At least 3 projects. Furthermore: submit cable trenching and cable system installation history for at least 3 projects where HV XLPE Cable systems were installed.		
	Any “NO” on the above scores in Table C.1; the supplier will be disqualified.		

Annex D – Qualitative Technical Evaluation Criteria

Table D.1: Qualitative Technical Evaluation Criteria

Only submission that passed the Mandatory Technical Evaluation Criteria			
Criteria	**Scoring weight**	**Acceptance (Yes/ No)**	**Score**
Technical Schedules correctly completed?	2		
Are outdoor termination design detail drawings submitted? Drawings to show the following information: dimensions, termination construction components, raw materials specified and type tested?	2		
Are joint design detail drawings containing references to dimensions, joint construction components, raw materials specified and type tested?	0		
Are link disconnecting boxes design detail drawings containing references to dimensions, construction components and raw materials specified and type tested?	1		
Are SVL design detail drawings containing references to dimensions, construction components and raw materials specified and type tested?	1		
Are bonding lead design detail drawings containing references to dimensions, construction components, raw materials specified and type tested?	1		
Submitted cable drum packaging detail and drawings?	1		
Submitted termination packaging detail and drawings?	2		
Submitted joint packaging details and drawings?	0		
Submitted short circuit calculations?	1		
Are sheath standing voltage calculations considering parallel running cable circuit influence submitted?	2		
Are provisional structural supports, racking, clamps and/or cleats design detail drawings containing references to dimensions, construction components and raw materials specified?	1		
Are outdoor termination structural support and foundation design detail drawings containing references to dimensions, construction components and raw materials specified?	1		
Method statement for works execution and project plan 100% completed for the scope of works specified?	1		
Are the submitted project roles and teams organograms reflective for the scope of works specified?	1		
Are Type-test reports referencing the raw material type tested?	1		
Are the after installation test proposal and equipment rating considerations for on-site testing considered in the method statement?	2		
Total = /20			