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Technical specification:

Medium voltage cables, 12-24 kV

Revision History
Changes include, but is not limited to, the revision history in the table below.

Ver. No.	Modifications (short description)	Updated by	Date
1	New document ID. New document template Shall-requirements clarified with identification numbers. *2 Content extent and Target Group* Removed *3 Roles and Responsibilities* Removed *4 Information Classification* Removed *3 Terms and definitions* New chapter *4 Cable types* Text clarified *5 Standards* Text clarified *"Or equivalent"* New section *5 General* *System description* Text clarified *System category* New section *Installation methods* Text clarified *Installation in water* Text clarified *Warrantee* New section *Acceptance* New section *7 Electrical design* Renamed *8 Non-electrical design* Renamed *Metallic screen (general)* Text clarified	David Söderberg Erdal	2020-04-15

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	Metallic screen, cables for overhead line use Renamed, text clarified *Shore D hardness of outer sheath* New section. New shore *D* requirements. *7 Testing* *Prequalification testing* renamed to *Initial sample inspection.* *Initial sample inspection* Renamed, text clarified End caps added for cable samples. Display samples (exhibition samples) added. *8 Non-electrical design* *Water blocking* Text clarified *11 Sealing and packing* *End caps* Additional requirements added. *12 Documentation* *Test protocols* New requirements *13 Changes* New chapter		

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1 Purpose

The purpose of this document is to be used as technical specification for 12 and 24 kV cables within Vattenfall Eldistribution AB.

2 Introduction

This technical specification is based on SS 4241416 (HD 620) and SS4241419 (HD 605). The specification can be made binding by the purchaser and will then specify the requirements which together with applicable standards are valid for design, construction and testing.

This document has been approved as suitable support for purchase within framework agreements and for prequalification of cables.

3 Terms and definitions

Al	Aluminum
Cu	Copper
HD	Harmonized document issued by the European Committee for Electrotechnical Standardization (CENELEC)
Vattenfall	Vattenfall Eldistribution AB
PE	Polyethylene
Petersén coil	Inductance(s) part of the system earthing creating a resonance earthing system. Initially disclosed in patents DE304234 and US 1537371A.
Supplier	Cable supplier
XLPE	Cross-linked polyethylene

4 Cable types

All cable types according to SS 4241416 (or equivalent) and applies for 12 and 24 kV.

Single core cables	Number of cores and cross sections for single core cables shall (S4.1) be: - 1 x 630 mm^2
Three core cables	Number of cores and cross sections for three core cables shall be (S4.2): - 3 x 50 mm^2 - 3 x 95 mm^2 - 3 x 150 mm^2 - 3 x 240 mm^2 - 3 x 300 mm^2
Three core cables, for overhead line use	Number of cores and cross sections for three core cables for overhead line use shall (S4.3) be: - 3 x 50 mm^2 - 3 x 70 mm^2 - 3 x 95 mm^2

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5 Standards

All cables shall (S5.1) be designed, constructed and tested based on the following standards or equivalent (latest versions including amendments applies).

SS 4241416 Power cables – XLPE-insulated cables of rated voltages 7/12 kV to 21/36kV – Specifications for design and testing

SS 42414419 *Power cables – Test methods*

"Or equivalent"

Public procurement regulations require that references to a national standard implementing a European standard must be followed by the words "or equivalent".

The Supplier shall (S5.2) confirm however the referenced standards are followed or if other equivalent standards are followed.

6 General

System description

Vattenfall's 11-22 kV networks are generally designed as reactance grounded systems with a central Petersén coil and/or decentralized Petersén coils consisting of distribution transformers with built-in neutral point reactors and shunt reactor with Petersén coil functionality.

System category

Cables shall (S.6.1) be designed and constructed for system category B according to SS 4241416 (or equivalent).

Installation methods

All cables shall (S6.2) be designed and constructed for:

a) Indoor installation[1]
b) Laying in trench
c) Pulling into pipes
d) Ploughing
e) Installation in water

In addition to above, cables for overhead line use shall (6.3) be designed and constructed for:

f) Overhead installation

[1] This requirements applies for indoor installation in general and is not related to the cables' reaction to fire.

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Cable laying and installation	Cables shall (S6.4) be designed and constructed in order to be installed according to *Recommendation for cable laying and installation* in SS 4241416 (or equivalent). Cables with conductor areas ≤ 240 mm^2 shall (S6.5) be suitable for ploughing. The Supplier shall (S6.6) describe the cables' properties related to ploughing.
Installation temperature	Minimum installation temperature shall (6.7) not exceed values below: -10 °C under normal conditions of care. -20 °C with special care in handling and with only moderate bending radius.
Installation in water	Cables shall (S6.8) be designed and constructed for installation down to 30 meters depth. This includes, but is not limited to handling longitudinal forces during such installation. Installation of cables in water at this depth exceeds the testing requirements for longitudinal water tightness according to SS 4241419 (or equivalent). The Supplier will not be held responsible for longitudinal water tightness for cables installed in such ways that the water gauge exceeds the testing conditions set out for the longitudinal water tightness according to SS 4241419 (or equivalent).
Drums and logistics	The Supplier shall (S6.9) provide information of type of drums and logistics solution.
Heat treatment of wooden packaging	Wooden packaging, such as drums, shall (S6.10) be approved and marked according to the ISPM 15 standard[2] if the cable and/or packaging are imported from outside the European Union.
European directives and regulations	Cables shall (S6.11) fulfill all applicable European directives and regulations. This include, but is not limited to: - Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)3
Warrantee	The demanded warrantee time is specified separately.
Acceptance	Acceptance of test protocol, other technical documents and changes shall (S6.12) be in written form. Passive acceptance, i.e. stating that acceptance is granted automatically after a certain time period unless claims or comments are provided within that time period is not allowed.

[2] International Standards For Phytosanitary Measures No. 15 (ISPM 15) issued by the International Plant Protection Convention (IPPC)

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7 Electrical design

Charging capacitance	Nominal and maximum capacitance shall (S7.1) be calculated.
Zero sequence impedance	Zero sequence impedance shall (S7.2) be calculated or measured.

8 Non-electrical design

Conductor material	The conductor material shall (S8.1) be Al.
Conductor design	Conductors shall (S8.2) be of type: - Round stranded compacted. Conductors shall (S8.3) be without welding points. Single wires may be welded.
Insulation material	The insulation material shall (S8.4) be triple extruded XLPE, dry cured.
Insulation screen	The semi-conducting insulations screen shall (S8.5) be strippable or bonded.
Water blocking	Cables shall (S8.6) be: - Cables to be installed in ground and water: Totally water blocked (longitudinal and radial) - Cables for overhead installation: Longitudinal water blocking of conductors. Cables for overhead installation should be radially water blocked. The Supplier shall (S8.7) describe the water blocking (water tightness) design. Including but not limited to swelling powder, helically or longitudinally metal foil.
Metallic screen (general)	All cables shall (S8.8) have a metallic screen of Cu or corrosion protected Al. Example of corrosion protected Al include, but is not limited to: - Copper-clad Al - Al embedded in semi-conductive material. Water blocking foil in not seen as corrosion protection from this perspective.

[3] REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

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	The screen wires shall (S8.9) be applied in any of the following ways: a) Wires helically applied around the cable cores. b) Wires helically applied around the cable cores with the wires embedded in semi-conducting material. c) Wires applied along each cable core. The wires may be applied in a bed of semi-conducting material. Technical properties of the corrosion protection shall (S8.10) be described by relevant documentation.
Metallic screen, cables for overhead line use	The metallic screen for cables for overhead line use shall (S8.11) consist of: a) Wires helically applied around the cable cores, or b) Woven metallic band
Metallic screen, cross-section area	The Supplier shall (S8.12) describe how the metallic screen cross-section area is calculated.
Rip cord	Cables shall (S8.13) be equipped with rip cord.
Outer sheath	The outer sheath should be designed and constructed to provide a good mechanical protection for the cable. The outer sheath shall (S8.14) be constructed as: a) Homogenous layer of PE, or b) Multi-layer PE In case of multilayer outer sheath, the inner layer might be foamed.
Shore *D* hardness of outer sheath	For cables with an outer sheath consisting of a homogenous layer of PE, the shore *D* hardness shall (S8.15) be ≥ 55. For cables with an outer sheath consisting of a multi-layer PE, the shore *D* hardness shall (S8.16) be: - For complete cable: ≥ 50 - For test on outermost material only: ≥ 60
Maximum bending moment of complete cable	Maximum bending moment (M_{max}) for cables with conductor cross-section areas of ≤ 240 mm^2 shall (S8.17) be ≤ 500 Nm for the first bending.

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9 Testing

Testing shall (S9.1) be conducted according to SS 4241416 (or equivalent) if not otherwise stated.

Initial sample inspection	The initial sample inspection aims to gain general understanding of the supplier's product quality. The initial sample inspection is part of the prequalification process. The supplier shall (S9.2) deliver the following free of charge: - Two cable samples cut into 1 meter long sections. (not opened) with end caps on one cable sample. - Display samples (exhibition samples), i.e. opened cable samples. - Data sheet for actual cable including: a) Dimensions of conductor and insulating materials. b) Electrical data. Initial sample inspection include, but is not limited to: - Visual inspection. - Measurement of conductor and insulation thickness. - Stripping of insulation, semi conducting layers and sheath.
Routine, sample and type test	Routine tests, sample tests and type tests shall (S9.3) be according to SS 4241416 (or equivalent) and SS 4241419 (or equivalent).
Zero sequence impedance	Zero sequence impedance shall (S9.4) be calculated for each cable type. Alternatively, the zero sequence impedance can be measured.
Bending test for complete cables	Bending test shall (S9.5) be conducted according to SS 4241419 (or equivalent), section 2.4.24 *Test method for measurement of rigidity of polymeric cables*.

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Shore *D* hardness	Shore *D* hardness shall (S9.6) be measured according to method A in SS 4241419 (or equivalent), section 2.2.1 *Measurement of Shore D hardness of PE sheath*.

10 Marking

General	Marking of cables shall (S10.1) be durable. Marking of cables shall not (S10.2) decrease the mechanical properties of the cable.
Indication of origin	Indication of origin shall (S10.3) be marked on outer sheath using indenting or embossing. Identification thread inside the cable is not accepted.
Meter marking	Meter marking shall (S10.4) be made on outer sheath using printing, indenting or embossing.

11 Sealing and packing

End caps	Cables shall (S11.1) be equipped with end caps in order to prevent water penetration. End caps shall (S11.2) be of type cold shrink, hot shrink or equivalent. (Tape only, is not accepted.) The Supplier shall (S11.3) submit data sheet or other relevant documentation for end caps.

12 Documentation

Language	All documentation shall (S12.1) be in Swedish or English.
Data sheets	Extended data sheets shall (S12.2) be submitted for prequalification and in tender. Extended data sheets shall (S12.3) include information related to: - Three dimensional drawing of the cable - Rated voltage - Conductor type - Conductor screen - Insulation - Insulation screen - Metallic screen - Water blocking (tightness) - Outer sheath - Outer diameter - Weight - Minimum bending radius

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- Maximum pulling force
- Resistance
- Inductance
- Capacitance
- Charging capacitance (zero sequence capacitance)
- Charging current
- Zero sequence impedance
- Maximum short circuit current (1 s) for conductors
- Maximum short circuit current (1 s) for screen
- Minimum temperature for installation
- Information regarding contacting and joints
- Fire protection class
- Standard drum type
- Cable length per drum

Test protocols	Prequalification: Test protocols shall be (S12.4) submitted for all cable types for which prequalification is applied for. Tender: Test protocols shall be (S12.5) submitted for all cable types offered. The following test protocols shall (S12.6) be submitted for each cable type (prequalification and tender): - Type test protocol (electrical and non-electrical) - Bending test protocol - Shore *D* hardness test protocol Test protocols submitted for prequalification or in tender shall (S12.7) not be older than 5 years.
Material safety data sheet	A material safety data sheet shall (S12.8) be submitted together with tender for each cable type. The material data sheet shall (S12.9) be structured according to REACH (16 sections).
Additional documentation	Additional documentation can be requested during pre-qualification and/or tendering.

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13 Changes

Continuous improvements are usually beneficial for all parties. However, changes include risks and Vattenfall seeks close cooperation related to all types of changes.

The supplier's duty to provide information on changes	Prequalified Suppliers shall (S13.1) inform Vattenfall of changes affecting shall-requirements in this document.
Approval for changes	Changes affecting shall-requirements in this document affects prequalification status and shall (S13.2) be evaluated and approved by Vattenfall before deliveries are allowed for installation in Vattenfall's distribution network.
Renewed type testing	Type test shall (13.3) be renewed for all changes that will affect the results of previous type test. The renewed type test shall (S13.4) be carried out free of charge to Vattenfall.

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