# VERGABEUNTERLAGEN

2020001980

CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL - Sweden and Germany

Qualifizierungssystem (EU) (Sektorenverordnung)

Qualifizierungssystem

AUFTRAGGEBER
Vattenfall AB
Evenemangsgatan 13 C, 16956 Solna, Schweden

17.04.2020

# Inhaltsverzeichnis


Vergabeunterlagen ..... 1
Projektinformation ..... 1
Vergabeunterlagen ..... 3
Documents of the procedure - !!All documents in Excel in the Appendix!! ..... 3
General infomation (scope & process) ..... 3
Cable Prequalification System Sweden and Germany ..... 3
ANNEXES SWEDEN ..... 13
1.1 ND-Sb-00724_TS MV, 12-24 kV ..... 13
1.2 ND-Sb-00725_TS Covered con oh-l, 24 kV ..... 27
1.3 Cable factory audit - SE ..... 35
1.4 MV Cables SWEDEN - Supplier reply form ..... 38
ANNEXES GERMANY ..... 53
Prequalification System Questionaire ..... 53
2.2 GER_LV_MV_specification ENG ..... 121
2.3 GER_LV_MV_specification ENG_Supplements ..... 131
2.4 GER_TB3514_110kV-Kabelsystem_V-B1.1_Berlin_EN_akt-06.2019 ..... 133
ANNEXES for both ..... 163
3.1 Process of EU Cable Prequalification ..... 163
3.2 Concept of Quality Monitoring ..... 164
Eignungskriterien ..... 165
Anlagen ..... 167

# VERFAHRENSINFORMATIONEN
Qualifizierungssystem

Verfahren: 2020001980 - CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL - Sweden and Germany

## INFORMATIONEN ZUM PRÄQUALIFIKATIONSSYSTEM

Das EU-Prüfungssystem wurde am xx.xx.xxxx erstmals von xxxxxxxxxxxxxxx unter der EU-Supplement-Nummer xxxxxxxxxx veröffentlicht und anschließend jährlich aktualisiert.

Die Bekanntmachung dient zur Information über das Bestehen eines des Prüfungssystems (gemäß Sektorenverordnung-SektVO 2016, §37).

## INFORMATIONEN

### ALLGEMEIN

| | |
|---|---|
| Auftragsnummer | 2020001980 |
| Maßnahme | B07 - Breunung |
| Auftragsbezeichnung | CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL - Sweden and Germany |
| Auftragsbeschreibung | Pre-qualification Sweden for: Qualification for cables medium voltage (12 – 24kV), Qualification for of covered conductors for overhead lines (24 kV) and Pre-qualification Germany for: Qualification for delivery low voltage (1kV) incl. communication cable, Qualification for delivery medium voltage (10kV) and Qualification of application for the delivery and installation high ( 110 kV) |

### VERFAHREN

| | |
|---|---|
| Auftraggeber | Vattenfall AB |
| Auftraggebertyp | Sektorenauftraggeber |
| Liefer-/Ausführungsort | |
| Leistungsart | Lieferauftrag |
| Vergabeart | Qualifizierungssystem (EU) (Sektorenverordnung) |

### VERFAHRENSEIGENSCHAFTEN

Klassifizierungen

| Code | Bezeichnung |
|---|---|
| 31321100-3 | Stromfreileitungen |
| 31321210-7 | Niederspannungskabel |
| 31321220-0 | Mittelspannungskabel |
| 31321300-5 | Hochspannungskabel |
| 32521000-1 | Fernmeldekabel |

### TEILNAHMEANTRÄGE

| | |
|---|---|
| Verwendung elektronischer Mittel | Die Einreichung der Angebote/Teilnahmeanträge darf nur elektronisch erfolgen |
| URL für elektronische Teilnahmeanträge | https://portal.deutsche-e vergabe.de |

## TERMINE

### ALLGEMEIN

| | |
|---|---|
| Vorausgegangene Vorinformation | Nein |
| Besondere Dringlichkeit | Nein |

### BEKANNTMACHUNG

| | |
|---|---|
| Bekanntmachung | |
| Vorinformation | |

### TEILNAHME UND BEWERTUNG

| | |
|---|---|
| Qualifizierungsgültigkeit | Unbegrenzte Laufzeit |
| Teilnahmefrist | |

## ELEKTRONISCHE TEILNAHME

Bitte melden Sie sich auf der Bekanntmachungsplattform unter
https://portal.deutsche-e vergabe.de
mit Ihrem Benutzernamen und Ihrem Passwort an.

Sofern Sie im System noch nicht registriert sind, können Sie dies auf der Plattform vornehmen.
Die Registrierung ist kostenfrei.

Anschließend können Sie auf der Startseite bspw. nach dem Titel des Verfahrens über die Direktsuche als Suchbegriff suchen. Folgen Sie anschließend der Anleitung im System, um an dem Verfahren teilzunehmen.

## BIETERFRAGEN

Bieterfragen müssen bis spätestens Uhr eingegangen sein.
Für später eingehende Fragen wird deren Beantwortung nicht zugesichert.
Bieterfragen müssen im Fragen-/Antwortenforum des eVergabe Bieterassistenten unter https://portal.deutsche-e vergabe.de gestellt und Antworten ebenfalls dort geprüft werden. Fragen auf anderen Kommunikationswegen, wie telefonische, schriftliche oder E-Mail Anfragen werden nicht beantwortet.

**Hinweis:** Antworten auf Bieterfragen werden unmittelbar nach deren Beantwortung auch per E-Mail zugestellt, dienen aber ausschließlich der Benachrichtigung über das Vorliegen von Antworten im Fragen-/Antwortenforum. Anlagen die Antworten beigefügt wurden, werden in der E-Mail Benachrichtigung nicht mitgesendet. Daher müssen alle Antworten auf Bieterfragen im Fragen-/Antwortenforum geprüft und deren Kenntnisnahme bestätigt werden.

# CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL

## Sweden and Germany

Ref to announcement in

e-Vergabe: 2020001980

(Ver Final. 15th of April 2020)

1. Background ..... 3
2. Scope ..... 3
2.1. Vattenfall Distribution Germany ..... 3
2.2. Vattenfall Distribution Sweden ..... 4
2.1.1 Background scope of pre-qualification for Sweden ..... 4
2.1.2 Technical Prequalification ..... 4
3. Administrative procedure ..... 4
3.1. Methodology for the qualification-system ..... 4
4. PQ process ..... 5
4.1. Becoming a PQ supplier ..... 5
4.1.1. Background ..... 5
4.1.1.1. Requirements of becoming PQ ..... 5
4.1.1.2. Timeline ..... 6
4.1.1.3. The PQ process ..... 6
The PQ process (appendix 3.1) is structured as follows: ..... 6
4.2 Maintaining/upholding - or losing PQ status over time. ..... 7
5. Administrative description of the questionnaire ..... 7
6. Audit ..... 7
7. Important notice ..... 8
8. Concept Quality Monitoring (Appendix 3.2) ..... 8
8.1. Quality follow up on Vattenfall Prequalification System (PQS) for cables ..... 9
8.1.1. Quality status ..... 9
8.1.2. Quality Deviations and definitions. ..... 9
8.1.3. Supplier Quality Status (QS) levels ..... 9
9. Contact persons ..... 9
Annexes ..... 10

# 1. Background

Vattenfall AB (Vattenfall) is a leading European energy company, that for more than 100 years has electrified industries, supplied energy to people's homes and modernized our way of living through innovation and cooperation.

In order to operate this business and provide electricity to app 3,290,000 electricity network and app 6,450,000 electricity customers in: Sweden, Germany, the Netherlands, Denmark, the UK and Finland - Vattenfall Group has among other initiatives decided upon a common strategy to enable the cable supply.

Vattenfall Group´s annual spend of distribution and sub- transmission power land cables (LV, MV and HV) in total is app 500 MSEK. This is mainly covered through Framework agreements, created by public tendering.

Huge part of this volume will be also called off through Vattenfall´s own contracted contractors or bought through a technical prequalification model, where the contractors are the direct commercial part to the cable supplier(s).

Vattenfall´s annual spend of subsea power cables (MV, HVAC and HVDC) in total is approx. 470MSEK. This is mainly covered through project agreements, created by (public) tendering (depending on EU-tendering exceptions where windfarm are planned to will be build).

The spend of sub-transmission and transmission cables (land and subsea) vary, depending on the investment plans.

# 2. Scope

The scope is divide in to two parts. One for Vattenfall Distribution Germany and one or Vattenfall Distribution Sweden.

## 2.1. Vattenfall Distribution Germany

Vattenfall AB for Germany includes any and all of its subsidiaries, affiliates and other companies and business units that are part of Vattenfall group that are entitled to use this PQS.

Prequalified (PQ) status means that the supplier´s factory is entitled to receive all cable tenders/RFQ for Vattenfall AB (as long as the PQ status is uphold).

This Pre-Qualification System´s (PQS) aim is to prequalify supplier(s) to Vattenfall AB of:

- Qualification for delivery low voltage (1kV) incl. communication cable,
- Qualification for delivery medium voltage (10kV) and

- Qualification of application for the delivery and installation high ( 110 kV) with conductor material of Copper or Aluminum, all corresponding to Vattenfall´s technical specifications.

## 2.2. Vattenfall Distribution Sweden

### 2.1.1 Background scope of pre-qualification for Sweden

Vattenfall Distribution Sweden (Distribution Sweden), has over the last years consolidated the spend through frame work agreements for the supply of cables and overhead lines. Those agreements have historically been awarded to manufactures of the cable and overhead lines. The logistics services to deliver the cables to the various sites have been tendered and awarded separately with a logistical service provider (distributor).

Distribution Sweden, has decided to delegate the full responsibility to deliver cable and over-headlines to its contractors. By that Distribution Sweden will achieve a reduction of transactions and clear roles and responsibilities between Vattenfall Distribution Sweden and its contractors.

This agreement with a distributor could be used by any contractor providing that the contractor has a Distribution Sweden project id number to declare to the distributor. It will be optional for the contractor to use this agreement i.e. the contractor has its own right to establish and use other supply routes.

### 2.1.2 Technical Prequalification

The prequalification on the Swedish cables and overhead lines will be on a technical level.

The Prequalified (PQ) status means that the supplier´s factory is entitled to receive call-off orders from the distributer as long as the PQ status is uphold.

This Pre-Qualification System´s (PQS) aim is to prequalify supplier(s) to Distribution Sweden of:

- Qualification for cables medium voltage (12 – 24kV) and
- Qualification for of covered conductors for overhead lines (24 kV)

.

# 3. Administrative procedure

Only applicants with clearly provable compliance and capability can be qualified. For this reason a questionnaire has to be answered and patterns of specific cable types have to be provided by every applicant.

## 3.1. Methodology for the qualification-system

1) The Application for participation to be sent to e-Vergabe
2) The Applicant has to answer a pre-qualification questionnaire (PQQ) provided by Vattenfall.
3) Vattenfall analyses the answers in the returned questionnaire; analyzing the fulfilment of the technical specification.

4) Further documents and patterns have to be made available on request of Vattenfall.
5) Factory audit by Vattenfall, up on request.
6) Qualification decision by Vattenfall
7) Notification of qualification status will be a public information

Qualified manufactories will be admitted into a prequalification list (PQL) expressing the qualification status in respect of site of manufacturing, type of cable and to respective Vattenfall areas/ business units/ areas.

This PQL / prequalification will be:

a) basis for next Framework agreement competition for suppliers in Germany and for the Framework agreement competition for distributions in Sweden.
b) in some Vattenfall areas be provided to Vattenfall´s contactors for supply of cables
c) Basis for upcoming project related tender (only Germany).

# 4. PQ process

## 4.1. Becoming a PQ supplier

### *4.1.1.Background*

The long term target of PQS is to establish a cable supplier base that meet (and can improve):

- general and technical requirements - quality aspects;

- the foreseeable demand profile from 2019 and on and thereby increasing the focus on long term supply and quality assurance.

#### *4.1.1.1. Requirements of becoming PQ*

- Only a company that has ownership of a factory that manufacture cable can apply and be awarded PQ status.
- The process for PQ is based on individual factory audit to verify that factory/supplier meet mandatory requirements.
- If one supplier/company wants to prequalify more than one factory, each factory will have its own PQ process as described below.
- Non PQ suppliers, contrary, shall not be selected for tenders/RFQ (they can consequently not be awarded contract).
- A supplier that lose PQ status during ongoing tender(s) will accordingly be rejected from tender(s).
- If a supplier would lose PQ status during ongoing supply period, this shall be seen as "substantial breach" to prequalification terms.

<u>For Distribution Germany</u>

- A factory that is approved through the described PQ process is given PQ status for the delivery of cable to Distribution Germany
- PQ status means that factory is entitled to receive all cable tenders/RFQ to Distribution Germany (as long as PQ status is uphold).

<u>For Distribution Sweden</u>

- A factory that is approved through the described PQ process is given PQ status for the delivery of cable to by Distribution Sweden selected Distributor.
- PQ status is determined per product type, i.e. PQ is granted for a specific cable types manufactured in a specific factories.
- PQ status means that factory is entitled to receive cable tenders/RFQ from the distributor for project relating to Vattenfall Distribution Sweden (as long as PQ status is uphold).

#### *4.1.1.2. Timeline*

Vattenfall intends to implement PQS during 2019.

The PQS is released on eNotices in TED [LINk]

For Distribution Germany

Applications over the year are welcome

For Distribution Sweden

Applications over the year are welcome.

To guarantee to be qualified supplier of cables and/or over headlines in the upcoming tender for Distributors you need to send in your application latest on the 8th of May 2020.

#### *4.1.1.3. The PQ process*

The PQ process (appendix 3.1) is structured as follows:

1) The EU cable qualification system by Vattenfall published in the e-Vergabe

2) Participation contact the e-Vergabe and load up a letter of interest

3) The questionnaire is sent to supplier by Vattenfall from e-Vergabe (appendix G 2.1 and S1.4)

4) Factory/supplier fills in the questionnaires and resends to Vattenfall according to instruction from e-Vergabe.

5) Vattenfall evaluates the answers in the submitted questionnaires.

6) If Vattenfall approves the answers on questionnaires, Vattenfall could request an on-site factory audit to verify answers to questionnaires and capability to meet technical requirements as set forth in the technical specifications (appendix G 2.2. – 2.4 and S1.1-1.3).

7) For supply to Vattenfall Sweden the prequalified suppliers also need to be registered and approved in UNCE/ Sellicha for AUCS 3.7.0 Cables and Accessories, manufacturers in order to get full prequalification status.

”http://corporate.vattenfall.com/about-vattenfall/supplier-relations/supplier-registration/”

8) Based on Vattenfall approved final audit report, factory/ supplier is awarded PQ status.

9) If factory/supplier is located in "risk country", also Vattenfall approved on-site CSR audit is necessary for PQ status.

(as not static, eventual "risk country" status will be informed upon supplier application).

### 4.2 Maintaining/upholding - or losing PQ status over time.

Along with the implementation of the PQS, Vattenfall also implements a Quality Management System (QMS), also called the “Concept Quality Monitoring”.

All cable supply within the PQS will be subject to this QMS. The intention of QMS is to assure continuous improvements on the PQ supplier base. Supplier quality deviations will be measured and actions for improvement will be taken (Quality follow up).

PQ status for specific cable types are maintained as long as no changes are made that affect the type test previously evaluated in the prequalification process. Technical re-evaluation is required for such changes.

A supplier that repeatedly have quality deviations and do not improve will eventually lose its PQ status (= "stopped/red" status) i.e becomes disqualified. Also, any single major quality deviation may lead to a re-audit of factory/supplier to verify that requirements on PQ supplier are meet.

## 5. Administrative description of the questionnaire

Please answer all questions in PQ questionnaires and attach eventual requested information or documents to support the reply.

A non-compliant answer on any question means that the manufacturer cannot assure the right:

- process, or

- product, or

- service, or

- establishment/ competence, or a combination of above to deliver to / meet the requested requirements of Vattenfall.

Any non-compliant answer will therefore mean "not prequalified status".

If all answers are compliant, it means that supplier is evaluated as capable to deliver to requested requirements.

## 6. Audit

The submitted answers in the questionnaire will be verified through an on-site factory audit on questions in PQ questionnaires and technical specifications through which Vattenfall intends to finally verify if factory/supplier meet the requirements.

If factory is approved through audit, factory/supplier will be awarded PQ status. PQ means that factory/supplier is entitled to receive all tenders/RFQ for Vattenfall (as long as PQ status is uphold). PQ status will be regularly checked by:

a) continuous quality follow up and

b) re-audit of factory

Periodically re-audits can take place to verify that PQ supplier meet the updated/new requirement(s) over time.

<u>High voltage cable projects Germany:</u>

The 110kV- cable projects of Stromnetz Berlin GmbH consisting of cable production (Cu and/or Al), corresponding connection systems, assembly and cable laying at the construction site in the city of Berlin. That means, that the prequalification is covering the whole cable system, meaning cable and appropriate connection systems, as well as the manufacturing plant (see point 3.1). Furthermore the prequalification of the 110-kV-cable system is requesting a successful type test as described in the technical specification TB 3415 (Appendix G 2.4.).

In case the supplier is successfully prequalified for the copper cable system, he is allowed to offer inquired Al-cable systems as an alternative for the already qualified Cu-cable system. If the supplier is awarded a contract for the aluminum cable system as part of the invitation to tender for the framework contract, the supplier is owing a successful type test for the AL cable system. This type test need to be fulfilled latest 18 months before start the projects, otherwise the supplier had to deliver in copper and pays the additional costs.

# 7. Important notice

Vattenfall AB reserves the right to update or introduce new requirements on the factories/suppliers within the PQS.

Following an updated/new requirement the PQS will be updated with the update/new requirement; and the PQ supplier is accordingly informed.

The consequence can accordingly be that a PQ supplier cannot meet updated/new requirement; if that is the case, supplier will lose its PQ status.

# 8. Concept Quality Monitoring (Appendix 3.2)

| CONCEPT OF QUALITY MONITORING | | Quality status of supply | | | | Related infromation from Vattenfall |
|---|---|---|---|---|---|---|
| Quality criteria | Sub-Criteria | Approved | Action plan | Escalation plan | Stopped | Note: If one category (=sub criteria) gets into "red" status, the supplier will immediately lose its general PQ-status. A new application fro pre-qualification is posible. |
| Technical | Deviation to technical specification | | | | | |
| | Deviation to technical specification influencing functionality of the cable or system. | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to technical specification not influencing functionality of the cable or system. | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation during factory acceptance testing (FAT) | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to type test setup | | | | | |
| | Deviation during testing (SAT) | | | | | |
| Logistics | Late delivery according to Purchase Order/ Project Time Plan (OTD) | | | | | |
| | Incorrect handling of cables/ drums/ goods | | | | | |
| | Incorrect packaging of cables/ drums/ goods | | | | | |
| | Damaged cables/ drums/ goods | | | | | |
| Execution | Deviation to SFT (specification to tenders) - Health & Safety | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to SFT - Personnel | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to SFT - Technical requirements and general regulations | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to Documentation | | | | | Applicable only for HV & Sub Marine Cables |
| Commercial | Failures during guarantee time | | | | | |
| | Deviations in delivery statistics | | | | | |
| Other | Health & Safety Issues | | | | | |
| | Environmental Issues | | | | | |
| | Cooperation | | | | | |

## 8.1. Quality follow up on Vattenfall Prequalification System (PQS) for cables

### 8.1.1. Quality status

The PQ supplier gets a Quality Status given the number of claimed Quality Deviations and the supplier´s ability to improve and not repeat Quality Deviations

A Quality Deviation claim is based on:

1) a specific Vattenfall requirement

2) the supplier´s acceptance of claim

### 8.1.2. Quality Deviations and definitions.

QD = Quality Deviation

FAT* = (factory acceptance test) = any deviation versus specification on FAT

SAT*/RFO (site acceptance test/ ready for operation) = any deviation versus specification/ supply agreement on SAT/ RFO

OTD (on time delivery) = any delivery delay to supply agreement OTD (=reday fro operation date)

G (product guarantee) = any deviation that is related to manufacturer´s product responsibility

### 8.1.3. Supplier Quality Status (QS) levels

The suppliers quality status (QS)levels is specified below.

- approved (green or white for OTD, also means prequalified (PQ) status)

- action plan (yellow, also means prequalified (PQ) status))

- escalation plan (amber/orange, also means prequalified (PQ) status)

- stopped (red, stopped status, also means loss of prequalified (PQ) status)

Supplier QS will be measured and monitored over time - and regularly reported to PQ suppliers.

The QMS might be updated/ improved over time and this will be the announced to PQ suppliers.

If the supplier within one year after loss of PQ status can show that requirement is met, supplier will get back the approved PQ status (all else equal).

If more than one year pass from loss of PQ status, supplier will have to re-apply to become prequalified and submit full PQ process again.

# 9. Contact persons

Main contact person for this PQ-system and cable supply to Vattenfall Germany (LV, MV, HV):

Marika.breunung@vattenfall.de

Contact person for cable supply to Vattenfall Sweden/ Nordic (LV, MV):

elsie.wallin@vattenfall.com

## Annexes

1. Sweden (S)
   - 1.1 ND-Sb-00724_Technical specification Medium voltage cables, 12-24 kV
   - 1.2 ND-Sb-00725_Technical specification Covered conductors for overhead lines, 24 kV
   - 1.3 Cable factory audit requirements and process – SE
   - 1.4 MV Cables SWEDEN - Supplier reply form
2. Germany (G)
   - 2.1 Prequalification Questionnaire
   - 2.2 LV_MV_specification ENG
   - 2.3 LV_MV_specification ENG_Supplements
   - 2.4 GER_TB3514_110kV-Kabelsystem_V-B1.1_Berlin_EN_akt-06.2019
3. Sweden and Germany
   - 3.1 Process of EU Cable Prequalification
   - 3.2 Concept of Quality Monitoring

| Document Type | Document ID | Document no. | Version | C class | | Valid from |
|---|---|---|---|---|---|---|
| Spec. / Beskrivn. | ND-Sb-00724 | | 1 | C1 - Öppen information | | 2020-04-15 |
| | | | Replaces | | No. App. | Org. Owner of Doc. |
| | | | ND-G-00006 | | 0 | DS-UG |

## 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.<br><br>New document template<br><br>Shall-requirements clarified with identification numbers.<br><br>*2 Content extent and Target Group*<br>Removed<br><br>*3 Roles and Responsibilities*<br>Removed<br><br>*4 Information Classification*<br>Removed<br><br>*3 Terms and definitions*<br>New chapter<br><br>*4 Cable types*<br>Text clarified<br><br>*5 Standards*<br>Text clarified<br><br>*"Or equivalent"*<br>New section<br><br>*5 General*<br>*System description*<br>Text clarified<br><br>*System category*<br>New section<br><br>*Installation methods*<br>Text clarified<br><br>*Installation in water*<br>Text clarified<br><br>*Warrantee*<br>New section<br><br>*Acceptance*<br>New section<br><br>*7 Electrical design*<br>Renamed<br><br>*8 Non-electrical design*<br>Renamed<br><br>*Metallic screen (general)*<br>Text clarified | David Söderberg Erdal | 2020-04-15 |

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

**Contents**


1 Purpose ..... 6
2 Introduction ..... 6
3 Terms and definitions ..... 6
4 Cable types ..... 6
Single core cables ..... 6
Three core cables ..... 6
Three core cables, for overhead line use ..... 6
5 Standards ..... 7
“Or equivalent” ..... 7
6 General ..... 7
Cable laying and installation ..... 8
Installation temperature ..... 8
Installation in water ..... 8
Drums and logistics ..... 8
Heat treatment of wooden packaging ..... 8
European directives and regulations ..... 8
Warrantee ..... 8
Acceptance ..... 8
7 Electrical design ..... 9
8 Non-electrical design ..... 9
Conductor material ..... 9
Conductor design ..... 9
Insulation material ..... 9
Insulation screen ..... 9
Water blocking ..... 9
Metallic screen (general) ..... 9
Metallic screen, cables for overhead line use ..... 10
Metallic screen, cross-section area ..... 10
Rip cord ..... 10
Outer sheath ..... 10
Shore *D* hardness of outer sheath ..... 10
Maximum bending moment of complete cable ..... 10
9 Testing ..... 11
Initial sample inspection ..... 11
Routine, sample and type test ..... 11
Zero sequence impedance ..... 11
Shore *D* hardness ..... 12
10 Marking ..... 12
General ..... 12
Indication of origin ..... 12

Meter marking ..... 12
11 Sealing and packing ..... 12
End caps ..... 12
12 Documentation ..... 12
Language ..... 12
Data sheets ..... 12
Test protocols ..... 13
Material safety data sheet ..... 13
Additional documentation ..... 13
13 Changes ..... 14
The supplier's duty to provide information on changes ..... 14
Approval for changes ..... 14
Renewed type testing ..... 14


Confidentiality: C1 - Public

# 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:<br>- 1 x 630 $mm^2$ |
| Three core cables | Number of cores and cross sections for three core cables shall be (S4.2):<br>- 3 x 50 $mm^2$<br>- 3 x 95 $mm^2$<br>- 3 x 150 $mm^2$<br>- 3 x 240 $mm^2$<br>- 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:<br>- 3 x 50 $mm^2$<br>- 3 x 70 $mm^2$<br>- 3 x 95 $mm^2$ |

## 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.

| | |
|---|---|
| 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).<br><br>Cables with conductor areas ≤ 240 mm$^2$ shall (S6.5) be suitable for ploughing.<br><br>The Supplier shall (S6.6) describe the cables' properties related to ploughing. |
| Installation temperature | Minimum installation temperature shall (6.7) not exceed values below:<br><br>-10 °C under normal conditions of care.<br><br>-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.<br><br>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:<br><br>- 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.<br><br>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)

## 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:<br>- Round stranded compacted.<br><br>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:<br>- Cables to be installed in ground and water: Totally water blocked (longitudinal and radial)<br>- Cables for overhead installation: Longitudinal water blocking of conductors.<br><br>Cables for overhead installation should be radially water blocked.<br><br>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.<br><br>Example of corrosion protected Al include, but is not limited to:<br>- Copper-clad Al<br>- Al embedded in semi-conductive material.<br><br>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

| | |
|---|---|
| | The screen wires shall (S8.9) be applied in any of the following ways:<br>a) Wires helically applied around the cable cores.<br>b) Wires helically applied around the cable cores with the wires embedded in semi-conducting material.<br>c) Wires applied along each cable core. The wires may be applied in a bed of semi-conducting material.<br><br>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:<br>a) Wires helically applied around the cable cores, or<br>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.<br><br>The outer sheath shall (S8.14) be constructed as:<br>a) Homogenous layer of PE, or<br>b) Multi-layer PE<br><br>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.<br><br>For cables with an outer sheath consisting of a multi-layer PE, the shore *D* hardness shall (S8.16) be:<br>- For complete cable: ≥ 50<br>- 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. |

# 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.<br><br>The initial sample inspection is part of the prequalification process.<br><br>The supplier shall (S9.2) deliver the following free of charge:<br>- Two cable samples cut into 1 meter long sections. (not opened) with end caps on one cable sample.<br>- Display samples (exhibition samples), i.e. opened cable samples.<br>- Data sheet for actual cable including:<br>a) Dimensions of conductor and insulating materials.<br>b) Electrical data.<br><br>Initial sample inspection include, but is not limited to:<br>- Visual inspection.<br>- Measurement of conductor and insulation thickness.<br>- 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*. |

| | |
|---|---|
| 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.<br><br>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.<br><br>End caps shall (S11.2) be of type cold shrink, hot shrink or equivalent. (Tape only, is not accepted.)<br><br>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.<br><br>Extended data sheets shall (S12.3) include information related to:<br>- Three dimensional drawing of the cable<br>- Rated voltage<br>- Conductor type<br>- Conductor screen<br>- Insulation<br>- Insulation screen<br>- Metallic screen<br>- Water blocking (tightness)<br>- Outer sheath<br>- Outer diameter<br>- Weight<br>- Minimum bending radius |

- 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.<br><br>Tender: Test protocols shall be (S12.5) submitted for all cable types offered.<br><br>The following test protocols shall (S12.6) be submitted for each cable type (prequalification and tender):<br>- Type test protocol (electrical and non-electrical)<br>- Bending test protocol<br>- Shore *D* hardness test protocol<br><br>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.<br><br>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. |

## 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.<br><br>The renewed type test shall (S13.4) be carried out free of charge to Vattenfall. |

| Document Type | Document ID | Document no. | Version | C class | Valid from |
|---|---|---|---|---|---|
| Spec. / Beskrivn. | ND-Sb-00725 | | 1 | C1 - Öppen information | 2020-04-15 |
| | | | Replaces | No. App. | Org. Owner of Doc. |
| | | | ND-G-00006 | 0 | DS-UG |

## Technical specification:

# Covered conductors for overhead lines not exceeding 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.<br><br>New document template<br><br>Shall-requirements clarified with identification numbers.<br><br>*2 Content extent and Target Group*<br>Removed<br><br>*3 Roles and Responsibilities*<br>Removed<br><br>*4 Information Classification*<br>Removed<br><br>*3 Terms and definitions*<br>New chapter<br><br>*4 Types & design*<br>Text clarified<br><br>*Design*<br>New section<br><br>*5 Standards*<br>*General*<br>Text clarified<br><br>*"Or equivalent"*<br>New section<br><br>*5 General*<br>*Warrantee*<br>New section<br><br>*Acceptance*<br>New section<br><br>*7 Testing*<br>*Initial sample inspection*<br>New section<br><br>*13 Changes*<br>New chapter | David Söderberg Erdal | 2020-04-15 |

## Contents


1 Purpose ..... 4
2 Introduction ..... 4
3 Terms and definitions ..... 4
4 Types & design ..... 4
5 Standards ..... 5
General ..... 5
Conductors ..... 5
“Or equivalent” ..... 5
6 General ..... 5
Installation temperature ..... 5
Drums and logistics ..... 5
Heat treatment of wooden packaging ..... 5
European directives and regulations ..... 6
Warrantee ..... 6
Acceptance ..... 6
7 Testing ..... 6
Initial sample inspection ..... 6
Routine, sample and type test ..... 6
8 Documentation ..... 7
Language ..... 7
Data sheets ..... 7
Test protocols ..... 7
Material safety data sheet ..... 7
Additional documentation ..... 7
9 Changes ..... 8
The supplier's duty to provide information on changes ..... 8
Renewed type testing ..... 8

# 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 the SS-EN 50397-series and SS-EN 50182. 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 covered conductors.

# 3 Terms and definitions

Vattenfall Vattenfall Eldistribution AB

Supplier Supplier of covered conductors

Prequalification
Process to become prequalified supplier for covered conductors.

# 4 Types & design

Types

Conductors shall (S4.1) be designed according to the following standard codes[1]:

| Code | Old Code |
|---|---|
| CCST 54-AL1 / 9-ST1A W 24kV | FeAl 63 (Raven) |
| CCST 85-AL1 / 14-ST1A W 24kV | FeAl 99 (Pigeon) |
| CCST 159-AL7 W 24kV | AlMgSi - 159 |
| CCST 241-AL7 W 24kV | AlMgSi – 241 |

Design

Covered conductors hall (S4.2) be triple extruded in one operation.

The supplier shall (S4.3) describe the water blocking system..

[1] Code designations according to SS-EN 50397-1:
CC Covered conductor
S Semi-conductive conductor screen
T Thermoplastic polyethylene (PE) cover
W Watertight
…kV Rated voltage in kV.

Code designations according to SS-EN 50182:
AL1 Hard drawn Aluminium as per EN 60889
AL7 Aluminium alloy as per EN 50183
ST1A Zinc coated steel wire as per EN 50189

## 5 Standards

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

| | |
|---|---|
| General | SS-EN 50397-1<br>*Covered conductors for overhead lines and the related accessories for rated voltages above 1 kV a.c. and not exceeding 36 kV a.c. – Part 1: Covered conductors*<br><br>SS-EN 50397-2<br>*Covered conductors for overhead lines and the related accessories for rated voltages above 1 kV a.c. and not exceeding 36 kV a.c. – Part 2: Accessories for covered conductors – Tests and acceptance criteria*<br><br>SS-EN 50397-3<br>*Covered conductors for overhead lines and the related accessories for rated voltages above 1 kV a.c. and not exceeding 36 kV a.c. – Part 3: Guide to use* |
| Conductors | SS-EN 50182<br>*Conductors for overhead lines –*<br>*Round wire concentric lay stranded conductors* |
| "Or equivalent" | Public procurement regulations require that references to a national standard implementing a European standard must be followed by the words "or equivalent".<br><br>The Supplier shall (S5.2) confirm however the referenced standards are followed or if other equivalent standards are followed. |

## 6 General

| | |
|---|---|
| Installation temperature | Minimum installation temperature shall (S6.1) not exceed:<br>-10°C under normal conditions of care.<br><br>-20°C with special care in handling and with only moderate bending radius. |
| Drums and logistics | The Supplier shall (S6.2) provide information of type of drums and logistics solution. |
| Heat treatment of wooden packaging | Wooden packaging, such as drums, shall (S6.3) be approved and marked according to the ISPM 15 standard[2] if the cable and/or packaging are imported from outside the European Union. |

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

| | |
|---|---|
| European directives and regulations | Cables shall (S6.4) fulfill all applicable European directives and regulations. This includes, but are not limited to:<br>- 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 (S6.5) be in written form. |

## 7 Testing

| | |
|---|---|
| Initial sample inspection | The initial sample inspection aims to gain general understanding of the Supplier's product quality.<br><br>The initial sample inspection is part of the prequalification process.<br><br>The Supplier shall (S7.1) deliver the following free of charge:<br>- One sample cut into a 1 meter long section for each type.<br>- Display samples (exhibition samples), i.e. samples with the cover and conductor sheet opened.<br>- Data sheet for actual covered conductor including:<br>a) Dimensions of conductor and insulating materials.<br>b) Electrical data. |
| Routine, sample and type test | Routine, sample and type tests shall (S7.2) be according to SS-EN 50397-1 (or equivalent).<br><br>Test protocols should not be older than 5 years.<br><br>Sample tests shall (S7.3) be conducted on every 20th drum or 10 km. |

[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

## 8 Documentation

| | |
|---|---|
| Language | All documentation shall (S8.1) be in Swedish or English. |
| Data sheets | Data sheets for each covered conductor type shall (S8.2) be included in tender.<br><br>The data sheet shall (S8.3) include information on:<br>- Three dimensional drawing of the covered conductor<br>- Voltage<br>- Conductor type<br>- Conductor screen<br>- Insulation<br>- Outer diameter<br>- Weight<br>- Minimum bending radius<br>- Maximum pulling force<br>- Resistance<br>- Maximum short circuit current (1 s)<br>- Minimum temperature for installation<br>- Maximum continuous temperature<br>- Standard drum type<br>- Length per drum |
| Test protocols | Test protocols from type- and sample tests shall (S8.4) be delivered as part of the Prequalification. |
| Material safety data sheet | A material safety data sheet shall (S8.5) be submitted as part of the Prequalification for each cable type.<br><br>The data sheet shall (S8.6) be structured according to REACH (16 sections). |
| Additional documentation | Additional documentation can be requested during Pre-qualification and/or tendering. |

## 9 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 (S9.1) inform Vattenfall of changes affecting shall-requirements in this document.<br><br>Changes affecting shall-requirements in this document affects prequalification status and shall (S9.2) be evaluated and approved by Vattenfall before deliveries are allowed for installation in Vattenfall's distribution network. |
| Renewed type testing | Type test shall (9.3) be renewed for all changes that will affect the results of previous type test.<br><br>The renewed type test shall (S9.4) be carried out free of charge to Vattenfall. |

# Cable factory audit requirements and process, 12-24 kV

**Contents**


1 Audit process ..... 2
1.1 Questionnaire ..... 2
1.2 Pre-inspection meeting ..... 2
1.3 Factory inspection ..... 2
1.4 Action plan ..... 2
1.5 Follow-up on action plan ..... 2
2 Audit objectives, scope and criteria ..... 2
2.1 Criteria ..... 2
3 Capability maturity level ..... 3
4 References ..... 3

# 1 Audit process

The audit process contains three to five parts as illustrated in the figure below. The two last steps are only required in case of moderate or significant findings.




## 1.1 Questionnaire

The purpose of the questionnaire is to get a description of the factory's operations and methods to approach management of quality, environment and operational health and safety (OHS).

The questionnaire is the base for the pre-inspection meeting and the factory inspection. The questionnaire is sent out when date for audit has been agreed.

## 1.2 Pre-inspection meeting

The pre-inspection meeting usually includes:

- A factory presentation.
- Clarifications to the questionnaire.
- Description and demonstration of management systems and other support systems, e.g. for production planning and quality management.

## 1.3 Factory inspection

The purpose of the factory inspection is to verify that the factory is working according to described methods and processes. Focus areas are decided based on the answers in the questionnaire and pre-inspection meeting.

## 1.4 Action plan

An action plan is required in case of moderate or significant findings. The factory needs to provide the action plan within a determined time (e.g. within one month).

## 1.5 Follow-up on action plan

Follow-up activities are chosen dependent on type of issues and the factory's action plan. Activities may include:

- Written response to the action plan.
- Follow-up meeting
- New factory inspection.

# 2 Audit objectives, scope and criteria

The objectives, scope and criteria of the factory audit is based on Vattenfall's code of conduct for suppliers [1] including guideline [2] and Vattenfall Eldistribution AB's environmental requirements [3].

## 2.1 Criteria

A factory is approved if the following criteria is fulfilled:

1) Compliance with Vattenfall's Code of Conduct for Suppliers [1]
2) Information is provided according to Vattenfall Eldistribution AB's environmental requirements [3].
3) The capability maturity level is on level "Defined" or higher.

## 3 Capability maturity level

Capability maturity levels are used to describe the factory's maturity within support systems (management systems and other systems providing support to processes and procedures).

The maturity levels are defined in the table below and the lowest acceptable level is "Defined".

| Level | Critera | Characteristics (generic) |
|---|---|---|
| ***Excellent / Optimizing*** (highest) | Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. | ***Stable and flexible.*** The organization is focused on continuous improvements and is built to pivot and respond to opportunity and change. The organization's stability provides a platform for agility and innovation. |
| ***Capable/ managed*** | Detailed data of processes and product quality are collected. | ***Measured and controlled.*** The organization is data-driven with quantitative performance improvement objectives that are predictable and align to meet the needs of the internal and external stakeholders |
| ***Defined*** | Processes for both quality management and design/engineering activities is documented, standardized, and integrated into a standardized processes for the factory. | ***Proactive, rather than reactive.*** Organization-wide standards provide guidance across projects, programs and portfolios. |
| ***Repeatable*** | Basic processes are established to track quality and other processes. The necessary process discipline is in place to repeat earlier successes on projects with similar applications. | ***Managed on the project level***. Projects are planned, performed, measured, and controlled. |
| ***Initial*** (lowest) | Processes are characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort. | ***Unpredictable and reactive.*** Work gets completed but is often delayed and over budget. |

## 4 References


[1] GP07 *Vattenfall's Code of Conduct for Suppliers*
[2] Guidance to Vattenfall's Code of *Conduct for Suppliers*
[3] VN-D-I-267-2008 *Miljöhänsyn vid inköp och upphandling*

## General information

Suplier name:
Production site(s):
Cable type:
Conductor cross-section area:
Contact person and contact information:

| No | Requirement |
|---|---|
| S5.1 | All cables shall (S5.1) be designed, constructed and tested based on the following standards or equivalent<br>(latest versions including amendments applies).<br><br>SS 4241416 Power cables – XLPE-insulated cables of rated voltages 7/12 kV to 21/36kV – Specifications for design and testing<br><br>SS 42414419 Power cables – Test methods |
| S6.1 | Cables shall (S.6.1) be designed and constructed for system category B according to SS 4241416 (or equivalent). |
| S6.2 | All cables shall (S6.2) be designed and constructed for:<br>a)Indoor installation<br>b)Laying in trench<br>c)Pulling into pipes<br>d)Ploughing<br>e)Installation in water |
| S6.3 | In addition to above, cables for overhead line use shall (6.3) be designed and constructed for:<br>f)Overhead installation |
| S6.4 | 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). |
| S6.5 | Cables with conductor areas ≤ 240 mm2 shall (S6.5) be suitable for ploughing. |
| S6.6 | The Supplier shall (S6.6) describe the cables' properties related to ploughing. |
| S6.7 | Minimum installation temperature shall (6.7) not exceed values below:<br>-10 °C under normal conditions of care.<br>-20 °C with special care in handling and with only moderate bending radius. |
| S6.8 | 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. |
| S6.9 | The Supplier shall (S6.9) provide information of type of drums and logistics solution. |
| S6.10 | Wooden packaging, such as drums, shall (S6.10) be approved and marked according to the ISPM 15 standard if the cable and/or packaging are imported from outside the European Union. |
| S6.11 | Cables shall (S6.11) fulfill all applicable European directives and regulations. This include, but is not limited to:<br>-Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) |

| | |
|---|---|
| S6.12 | Acceptance of test protocol, other technical documents and changes shall (S6.12) be in written form. |
| S7.1 | Nominal and maximum capacitance shall (S7.1) be calculated. |
| S7.2 | Zero sequence impedance shall (S7.2) be calculated or measured. |
| S8.1 | The conductor material shall (S8.1) be Al. |
| S8.2 | Conductors shall (S8.2) be of type:<br>-Round stranded compacted |
| S8.3 | Conductors shall (S8.3) be without welding points. Single wires may be welded. |
| S8.4 | The insulation material shall (S8.4) be triple extruded XLPE, dry cured. |
| S8.5 | The semi-conducting insulations screen shall (S8.5) be strippable or bonded. |
| S8.6 | Cables shall (S8.6) be:<br>-Cables to be installed in ground and water: Totally water blocked (longitudinal and radial)<br>Cables for overhead installation: Longitudinal water blocking of conductors. |
| S8.7 | The Supplier shall (S8.7) describe the water blocking (water tightness) design. Including but not limited to swelling powder, helically or longitudinally metal foil. |
| S8.8 | All cables shall (S8.8) have a metallic screen of Cu or corrosion protected Al. |
| S8.9 | The screen wires shall (S8.9) be applied in any of the following ways:<br>a)Wires helically applied around the cable cores.<br>b)Wires helically applied around the cable cores with the wires embedded in semi-conducting material.<br>c)Wires applied along each cable core. The wires may be applied in a bed of semi-conducting material. |
| S8.10 | Technical properties of the corrosion protection shall (S8.10) be described by relevant documentation. |
| S8.11 | The metallic screen for cables for overhead line use shall (S8.11) consist of:<br>a)Wires helically applied around the cable cores, or<br>b)Woven metallic band |
| S8.12 | The Supplier shall (S8.12) describe how the metallic screen cross-section area is calculated. |
| S8.13 | Cables shall (S8.13) be equipped with rip cord. |
| S8.14 | The outer sheath shall (S8.14) be constructed as:<br>a)Homogenous layer of PE, or<br>b)Multi-layer PE |
| S8.15 | For cables with an outer sheath consisting of a homogenous layer of PE, the shore D hardness shall (S8.15) be ≥ 55. |
| S8.16 | For cables with an outer sheath consisting of a multi-layer PE, the shore D hardness shall (S8.16) be:<br>-For complete cable: ≥ 50<br>-For test on outermost material only: ≥ 60 |
| S8.17 | Maximum bending moment (Mmax) for cables with conductor cross-section areas of ≤ 240 mm2 shall (S8.18) be ≤ 500 Nm for the first bending. |
| S9.1 | Testing shall (S9.1) be conducted according to SS 4241416 (or equivalent) if not otherwise stated. |

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.

S9.2 b)Electrical data.

S9.3 Routine tests, sample tests and type tests shall (S9.3) be according to SS 4241416 (or equivalent) and SS 4241419 (or equivalent).

S9.4 Zero sequence impedance shall (S9.4) be calculated for each cable type. Alternatively, the zero sequence impedance can be measured.

S9.5 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.

S9.6 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.

S10.1 Marking of cables shall (S10.1) be durable.

S10.2 Marking of cables shall not (S10.2) decrease the mechanical properties of the cable.

S10.3 Indication of origin shall (S10.3) be marked on outer sheath using indenting or embossing.

S10.4 Meter marking shall (S10.4) be made on outer sheath using printing, indenting or embossing.

S11.1 Cables shall (S11.1) be equipped with end caps in order to prevent water penetration.

S11.2 End caps shall (S11.2) be of type cold shrink, hot shrink or equivalent.

S11.3 The Supplier shall (S11.3) submit data sheet or other relevant documentation for end caps.

S12.1 All documentation shall (S12.1) be in Swedish or English.

S12.2 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
-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

S12.3 -Cable length per drum

Prequalification: Test protocols shall be (S12.4) submitted for all cable types for which

S12.4 prequalification is applied for.

S12.5 Tender: Test protocols shall be (S12.4) 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

S12.6 -Shore D hardness test protocol

Test protocols submitted for prequalification or in tender shall (S12.7) not be older than 5

S12.7 years.

A material safety data sheet shall (S12.8) be submitted together with tender for each cable

S12.8 type.

S12.9 The material data sheet shall (S12.9) be structured according to REACH (16 sections).

Prequalified Suppliers shall (S13.1) inform Vattenfall of changes affecting shall-

S13.1 requirements in this document.

Changes affecting shall-requirements in this document affects prequalification status and shall (S13.3) be evaluated and approved by Vattenfall before deliveries are allowed for

S13.2 installation in Vattenfall distribution network.

Type test shall (13.4) be renewed for all changes that will affect the results of previous type test.

S13.3

S13.4 The renewed type test shall (S13.5) be carried out free of charge to Vattenfall.

| |
|---|
| |
| |
| |
| |

| Reply | Reference to appendix |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

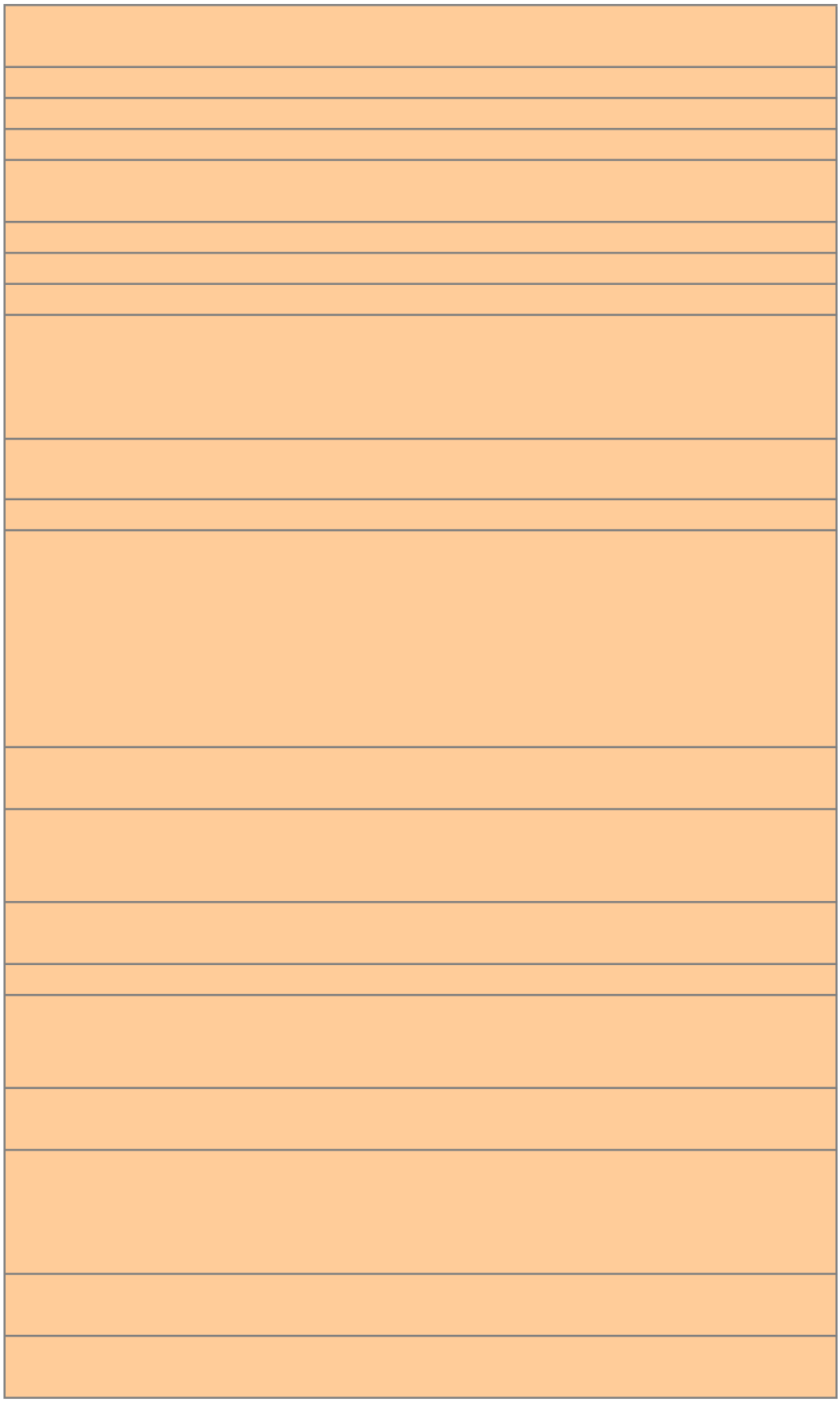
| | |
|---|---|
| | |
| | |
| | |

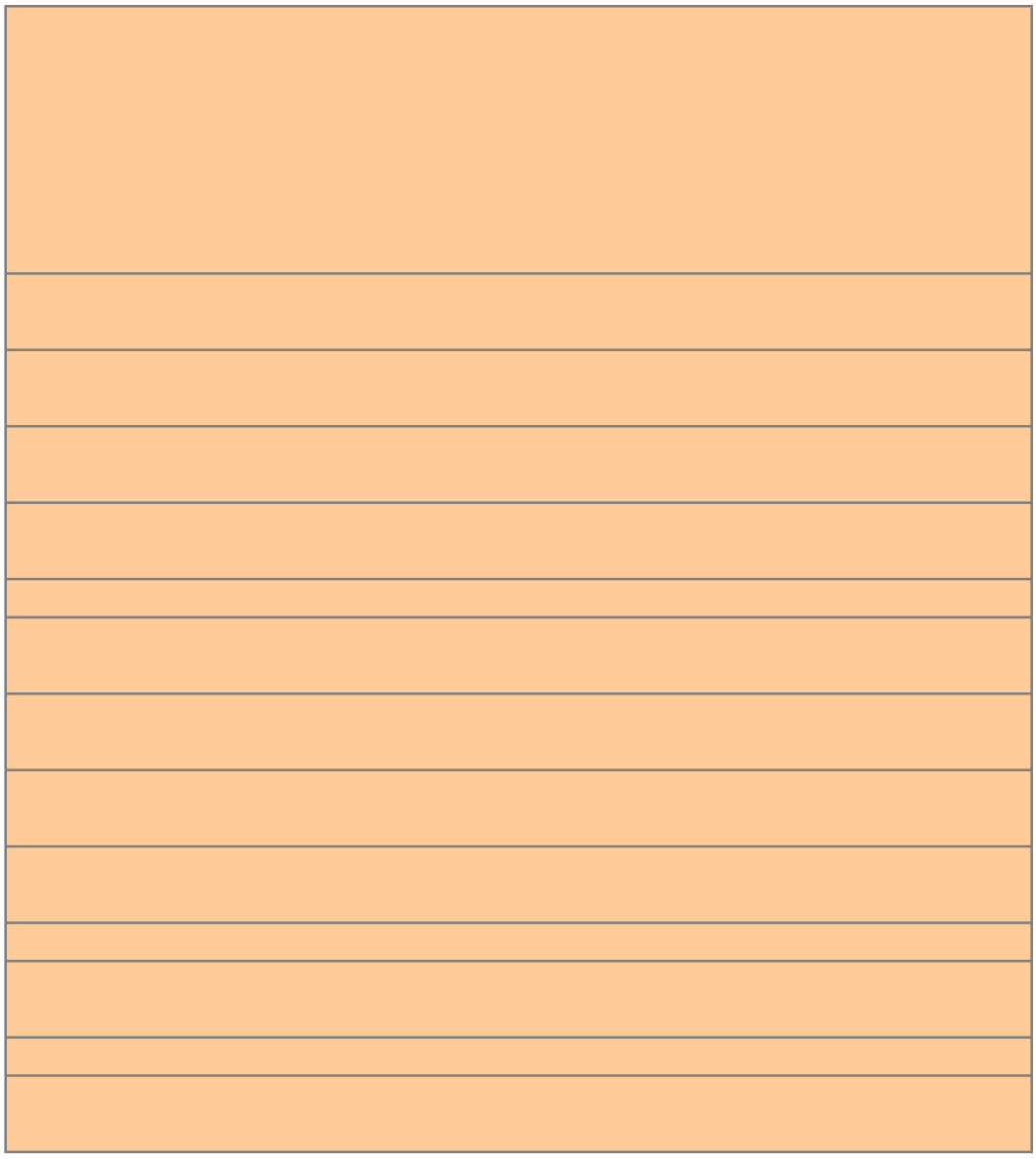
| | |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

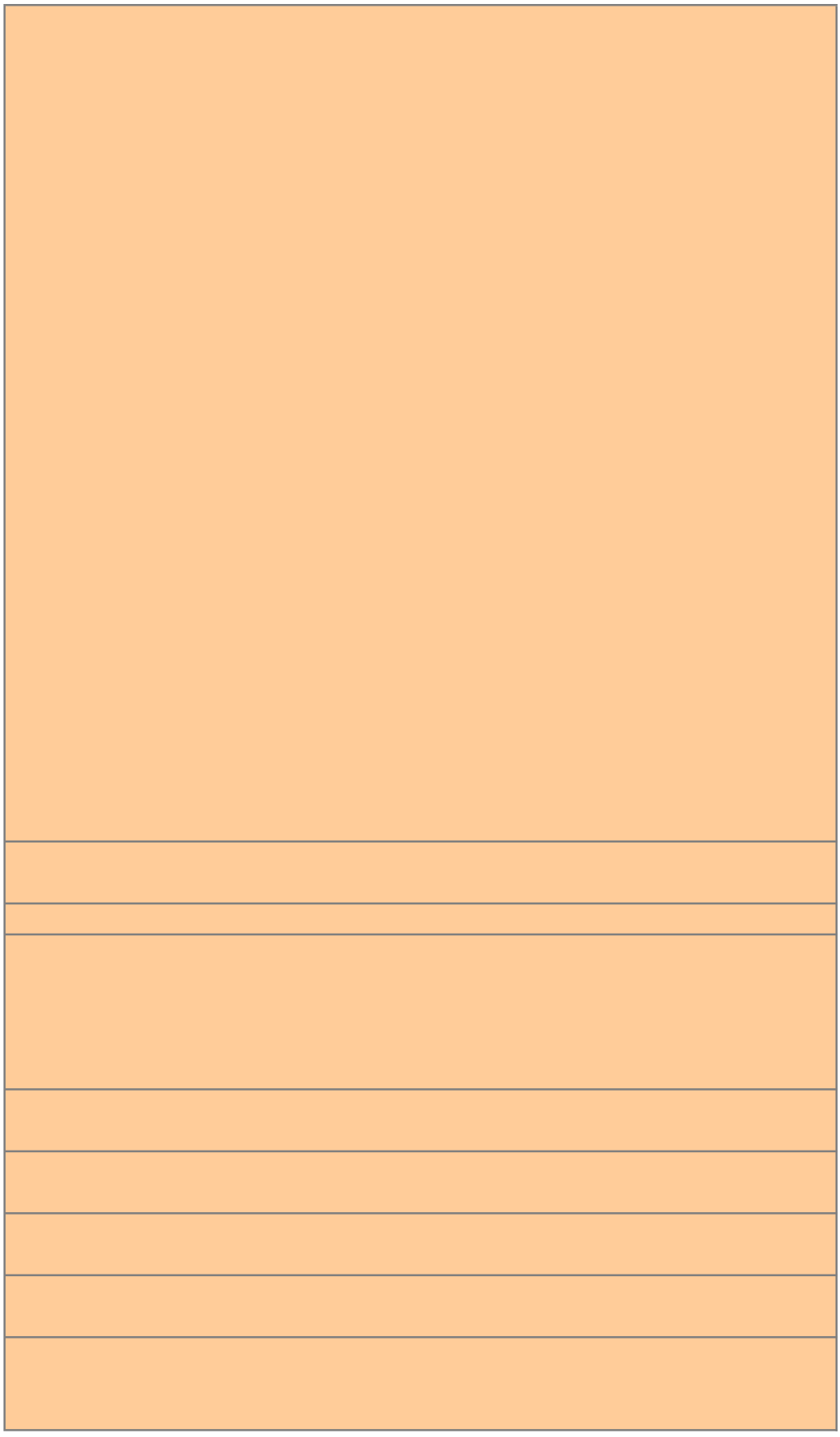
| | |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| | |
|---|---|
| | |

## Comments









# Prequalification System Questionnaire

## Prequalification System Questionnaire form

| 1. Applicants information |
|---|
| Company Name |
| Postal Address |
| Company Identification/ Registration Number |
| Sales Tax Number |
| Country |
| Type of company structure |
| Managing Director |
| Date of application |
| 2. Applicant´s Production Site(s)´s Full Infomration: Name of the factory, Postal Adre |
| For Low Voltage cable (LV) |
| For Middle Voltage cable (MV) |
| For High-Voltage cable-systems (HVS): |
| For High Voltage Sub Sea (HVS SS) cables: |
| 3. Contact details during the pre-qualification period |
| Applicant´s Contact Person |
| Title |
| Telephone |
| E-mail Address |
| Website |
| 4. Project organisation |
| Representative |
| Key Account Manager |
| Environment Manager |
| Quality Manager |
| 5. Certificate of incorporation |
| Certificate of incorporation from "Bolagsverket" (the Swedish Companies Registration Office) or equivalent.<br>"We hereby certify that the company is free of hindrances under the Swedish Public Procurement Act (SFS2007:1092) Chap 10. " |
| Yes |
| No |
| Note |

| 1. General information |
| --- |
| A - 1.1 UNCE/ Vattenfall Supplier Bank/ Sellicha |
| http://www.achilles.com/en |
| Note |
| A - 1.2 Batches of the PQ-system |
| Please select, which batch(es) you are applying for. |
| Low Voltage cable (LV) |
| Medium Voltage cable (MV) |
| High Voltage cable-systems (HVS) |
| High Voltage Sub Sea (HVS SS) cables |
| Note |
| A - 1.3 Local law |
| For the purpose of drafting and processing any forthcoming commercial contract do you accept that local Swedish law and Public Procurement Act? (http://www.konkurrensverket.se/en/publications-and-decisions/swedish-public-procurement-act/) |
| Yes |
| No |
| Note |
| B - 1.4 PQ-status with other clients |
| Is your company already prequalified as supplier for other clients/utilities as part of a |
| Yes |
| No |
| Note |
| UN Global Compact, as described in http://www.unglobalcompact.org? |
| Yes |
| No |
| Note |
| A - 1.5 Key financial figures |
| Please state the following key financial figures for last three business years (cable ty |
| Turnover total: |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Turnover Low-Voltage cables |
| 2015 (SEK) |
| 2016 (SEK) |

| |
|---|
| 2017 (SEK) |
| Turnover Medium-Voltage cables |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Turnover High-Voltage cable-systems |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| High Voltage Sub Sea cable |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Turnover related services: |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Profit before taxes: |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Equity ratio: |
| 2015 (SEK) |
| 2016 (SEK) |
| 2017 (SEK) |
| Note |
| A - 1.6 My company is up to date with payment of all national, local and employee re |
| Yes |
| No |
| Note |
| A - 1.7 My company has met all legal requirements for the preparation, auditing and |
| Yes |
| No |
| Note |
| A - 1.8 At the date of answering this questionnaire my company is not subject to deb |
| Yes |
| No |

| |
|---|
| Note |
| 1.9 - Is your company, or any of its representatives, the subject of any past convictio |
| Yes |
| No |
| Note |
| 1.10 - Does your company have a Liability Insurance? |
| Yes |
| No |
| Note |
| 1.10 - Does your company have a Liability Insurance? |
| Yes |
| No |
| Note |
| **2. Organization** |
| A - 2. Organisational charts |
| A - 2.1 General |
| A - 2.1.1 Company total |
| A - 2.1.2 Company - local organisation in Sweden (if any) 1b |
| Production & Logistics |
| A - 2.1.3 Production |
| A - 2.1.4 Logistics |
| Quality Assurance (QA) |
| A - 2.1.5 Global QA-networking between your production locations 3a |
| A - 2.1.6 QA-organisation at respective production site to be prequalified for Vattenfa |
| R&D, Sales, Services |
| A - 2.1.7 Research & Development |
| A - 2.1.8 Sales organisation within Sweden |
| A - 2.1.9 Technical service organisation |
| A - 2.1.10 Customer service organisation |
| Note |
| B - 2.1 Swedish-speaking staff |
| Please tell us how many Swedish-speaking staff you have employed for the following |
| Total number |

| |
|---|
| Client acquisition |
| Technical sales and distribution |
| Assenbling staff |
| Note |
| A - 2.2 Swedish and/ or English-speaking staff |
| Do you have Swedish speaking staff for managing the communication with Vattenfall and its suppliers? |
| Yes |
| No |
| Note |
| B - 2.3 German-speaking staff |
| Please tell us how many Swedish-speaking staff you have employed for the following |
| Total number |
| Client acquisition |
| Technical sales and distribution |
| Assenbling staff |
| Note |
| A - 2.4 German and/ or English-speaking staff |
| Do you have German speaking staff for managing the communication with Vattenfall and its suppliers? |
| Yes |
| No |
| Note |
| **3. Technical criteria** |
| B - 3.1 Launch of production |
| Please state when the requested product group was first launched in your company. |
| Low Voltage cable |
| Date |
| Medium Voltage cable |
| Date |
| High Voltage cable-systems (HVS) |
| Date |
| High Voltage Sub Marine (HVS SM) cables |
| Date |
| Note |
| B - 3.2 Overall cable volume supplied per year (in km) |

| Please state how many km of each product group have been supplied per year. |
| --- |
| In total |
| B - 3.2.1 Low Voltage cable |
| 2015 |
| 2016 |
| 2017 |
| B - 3.2.2 Medium Voltage cable |
| 2015 |
| 2016 |
| 2017 |
| B - 3.2.3 High Voltage cable-systems (HVS) |
| 2015 |
| 2016 |
| 2017 |
| B - 3.2.4 High Voltage Sub Marine (HVS SM) cables |
| 2015 |
| 2016 |
| 2017 |
| B. 3.2.5 According to specification main cable types to Vattenfall |
| Low Voltage cable |
| 2017 |
| Medium Voltage cable |
| 2017 |
| High Voltage cable-systems (HVS) |
| 2017 |
| High Voltage Sub Marine (HVS SM) cables: |
| 2017 |
| Note |
| A - 3.3 Product description and documentation (local language) |
| Please state if, in case of a contract, you will provide the product description and documentation in local language (Swedish and German). |
| Yes |
| No |
| A - 3.4 Do you confirm all requirements for the cables according to Vattenfall´s techr |
| Regarding Low Voltage cable (Ref DD-N-G008 for 1kV) |
| Yes |
| No |
| Note |
| Regarding Medium Voltage cable (Ref ND-G-00006 for 24kV) |
| Yes |

| |
|---|
| No |
| Note |
| Regarding Medium Voltage, Covered Conductor (Ref ND-G-00007 for 24kV) |
| Yes |
| No |
| Note |
| Regarding High-Voltage cable-systems (HVS) (Ref VTR 14-01E for 36-170kV) |
| Yes |
| No |
| Note |
| Regarding High Voltage Sub Marine (HVS SS) cables (Ref VTR 14-04E Single Sub |
| Yes |
| No |
| Note |
| Regarding High Voltage Sub Marine (HVS SS) cables (Ref VTR 14-05E Sub Marine |
| Yes |
| No |
| Note |
| Regarding Low Voltage cable (Ref KG 4073 and appendix Germany) |
| Yes |
| No |
| Note |
| Regarding Medium Voltage cable (Ref KG 4073 and appendix Germany) |
| Yes |
| No |
| Note |
| Regarding High Voltage cable (Ref TD 3514 Germany) |
| Yes |
| No |
| Note |
| A - 3.5 Which components for a high-voltage-cable system can be provided and assembled by you? (For instance fittings, sealing ends, protection- and monitoring-systems, please name with type, description etc.) |
| Note |
| A - 3.6 Which references are available for the HV- & Sub Marine cable system? |
| 1) Project name |
| 2) Country |
| 3) Client (if not restricted) |
| 4) Year* |
| 5) Production site |
| 6) Voltage-level |

| |
|---|
| 7) Cable (length, type, cross section**, conductor material) |
| 8) Fittings (type, number of junction straight-joints, sealing ends, plug connectors) |
| Note |
| A - 3.7 Can you provide general Product Data Sheet for the cables / components you may provide acc to the Vattenfall´s technical specification? |
| Yes |
| No |
| Note |
| **4. Health & Safety** |
| B - 4.1 Do you have a certificate for Health & Safety (e.g. ISO 18 001 OHSAS)? |
| Yes |
| No |
| Note |
| B - 4.2 Are the test staff/ engineers fully conversant with the latest industry test standards (IEC, IEEE, etc) and customer specific test requirements? |
| Yes |
| No |
| Note |
| **5. Environment** |
| A - 5.1 Environmental Management System |
| A - 5.1.1 Do you have a certified environmental management system compliant to IS |
| Yes |
| No |
| Note |
| A - 5.1.2 Who is the environmental officer and to whom is he/she reporting to? |
| Note |
| A - 5.1.3 When and by Whom was the last audit conducted? |
| Date |
| Note |
| A - 5.1.4 When was the last audit conducted by Vattenfall? |
| Date |
| Note |
| B - 5.2 Are there special regulations for dangerous goods which have to be followed regarding your products (for instance REACH and/or RoHS 2 EU-directive) http://echa.europa.eu/regulations/reach? |
| Yes |
| No |

| |
|---|
| Note |
| A - 5.3 Can you confirm that your products are: PCB-free; Lead-free (not applicable for Sub Marine Cabels);<br>Bromine-free; Free of any carcinogenic substance? |
| Yes |
| No |
| Note |
| **6. Quality management** |
| A - 6.1 Quality management system |
| A - 6.1.1 Do you have a certified quality assurance management system compliant to |
| Yes |
| No |
| Note |
| A - 6.1.2 When was the last audit conducted by Vattenfall? |
| Date |
| Note |
| A - 6.1.3 When and by Whom was the last audit conducted? |
| Date |
| Note |
| A - 6.1.4 Who is the QA officer (where applicable, for each production location) and t |
| Note |
| A - 6.1.5 Is there any quality plan of QA in the production process. |
| Yes |
| No |
| Note |
| B - 6.2 Service providers for Quality management |
| B - 6.2.1 Do you use external service providers for QA? |
| For testing of cables: |
| Yes |
| No |
| Note |
| For calibration of measurement devices: |
| Yes |
| No |
| Note |
| B - 6.2.2 Who conducts these tests and which checks do they do? |
| Note |
| A - 6.3 Tests of HV-cable systems |
| A - 6.3.1 Routine testing (electrical tests) |

| |
|---|
| A - 6.3.1.1 Which products (except cables) are subject to routine testing? |
| Note |
| A - 6.3.1.2 Which tests are conducted? |
| Note |
| A - 6.3.1.3 How many test bays are available? |
| Note |
| B - 6.3.1.4 Which parameters are checked? |
| Note |
| B - 6.3.1.5 How frequent are the checks? |
| Note |
| the<br>manufacturing process? |
| Yes |
| No |
| Note |
| B - 6.3.1.7 How do you document abnormalities/ deviations and how do you analyse |
| Note |
| B - 6.3.1.8 How are rejects laballed? |
| Note |
| A - 6.3.2 Screening (non-electrical tests) |
| Note |
| A - 6.3.2.1 Which products undergo screening? |
| Note |
| A - 6.3.2.2 Which tests are conducted and how often? |
| Note |
| A - 6.3.3 Technical Equipment |
| A - 6.3.3.1 Can you provide the technical equipment to carry out on-site voltage-tests |
| Yes |
| No |
| Note |
| A - 6.3.4 Long-term-test for  HV- and Sub Marine cables |
| voltage cables? |
| Yes |
| No |
| Note |
| **7. Production** |
| A - 7.1 Location |
| A - 7.1.1 Which requested products are manufactured at each location? |
| Note |
| A - 7.1.2 Is a QA system in place at each location? |

| |
|---|
| Note |
| A - 7.1.3 Could you provide a plan of the production process (incl. all manufacturing s |
| LV Cables |
| Yes |
| No |
| MV Cables |
| Yes |
| No |
| HV Cables |
| Yes |
| No |
| HV Sub Marine cables |
| Yes |
| No |
| Note |
| A - 7.1.4 Are the employees able to define settings and make adjustments during the production process in order to optimize the process and quality? If required, can they adjust the machine parameters? |
| Yes |
| No |
| Note |
| B - 7.2 Material monitoring |
| B - 7.2.1 Which incoming materials are checked? And how? |
| Note |
| B - 7.2.2 Which division carries out the checks? |
| Note |
| B - 7.2.3 Who creates the guidelines for the checks? Who updates them? |
| Note |
| B - 7.2.4 Where are the guidelines stored? |
| Note |
| B - 7.2.5 Which checks are conducted by the supplier? |
| Note |
| B - 7.2.6 How are the results of the checking of the incoming goods documented? |
| Note |
| A - 7.3 Labelling of incoming goods after checking |
| A - 7.3.1 How are the incoming goods labelled? |
| Note |
| A - 7.4 Handling of intermediate products during the production process (e.g. conduc |
| A - 7.4.1 Which intermediate products do you have? |
| Note |

| |
|---|
| A - 7.4.2 Do you have test-plans for every intermediate product? |
| Yes |
| No |
| Note |
| A - 7.4.3 How are intermediate products labelled? |
| Note |
| B - 7.4.4 Who creates the guidelines for the checks? Who updates them? |
| Note |
| B - 7.4.5 Where are the guidelines stored? |
| Note |
| B - 7.4.6 Where are the intermediate products stored? |
| Note |
| B - 7.5 Finished product  (cable on drum for FAT) |
| B - 7.5.1 Who conducts the checks? |
| Note |
| B - 7.5.2 Do you have test-plans for the finished product? |
| Yes |
| No |
| Note |
| B - 7.5.3 How are finished products labelled? |
| Note |
| B - 7.5.4 Who creates the guidelines for the checks? Who updates them? |
| Note |
| B - 7.5.5 Where are the guidelines stored? |
| Note |
| B - 6.5.6 (7.5.6) Where are the finished products stored? |
| Note |
| 7.6 (7.5) Monitoring of the production process |
| A - 7.6.1 (7.5.1) Are the process data recorded and stored for the state of warranty? |
| Yes |
| No |
| Note |
| B - 7.6.2 (7.5.2) Do you follow-up or analyse on the recorded process data regularly |
| Note |
| **8. Material/Component suppliers** |
| 8.1 Most important resources for raw-materials |
| B - 8.1.1 What are the most important resources (Cu, Al, metal sheath, stell etc)? |
| Note |
| B - 8.1.2 Which suppliers have been approved for these resources? |
| Note: Cu |

| |
|---|
| Note: Lead |
| Note: Al |
| Note: Wire |
| Note: XLP |
| Note: SC.XLP |
| Note: SC Poly Water blocking tape |
| Note: Jackating Compound |
| Note: General |
| B - 8.1.3 Who inspects the materials? |
| Note |
| B - 8.1.4 How often is the quality checked? |
| Note |
| B - 8.1.5 Who creates the specification for these resources (in-hous resource, extern |
| Note |
| B - 8.1.6 Have your critical sub-supplier(s) a quality system certified by third party ac |
| Note |
| 8.2 Most important resources for semi-finished goods |
| B - 8.2.1 What are the most important resources (material insulation/ polymer, insula |
| Note |
| B - 8.2.2 Which suppliers have been approved for these resources? |
| Note |
| B - 8.2.4 How often is the quality checked? |
| Note |
| B - 8.2.5 Who creates the specification for these resources (in-hous resource, extern |
| Note |
| **9. Final assembly, packaging and shipping** |
| 9.1 Location |
| B - 9.1.1 From where are the products (outgoing goods) shipped? |
| Note |
| B - 9.1.2 Do you have intermediate storage facilities in Sweden? |
| Note |
| A - 9.1.3 Is final assembly, packaging and shipping ensured in the QA at each manu |
| Yes |
| No |
| Note |
| B - 9.1.4  In which form does the final inspection of the products take place? |
| Note |
| B - 9.1.5 How is the final inspection documented? |
| Note |
| B - 9.1.6 How is the final inspection labelled? |

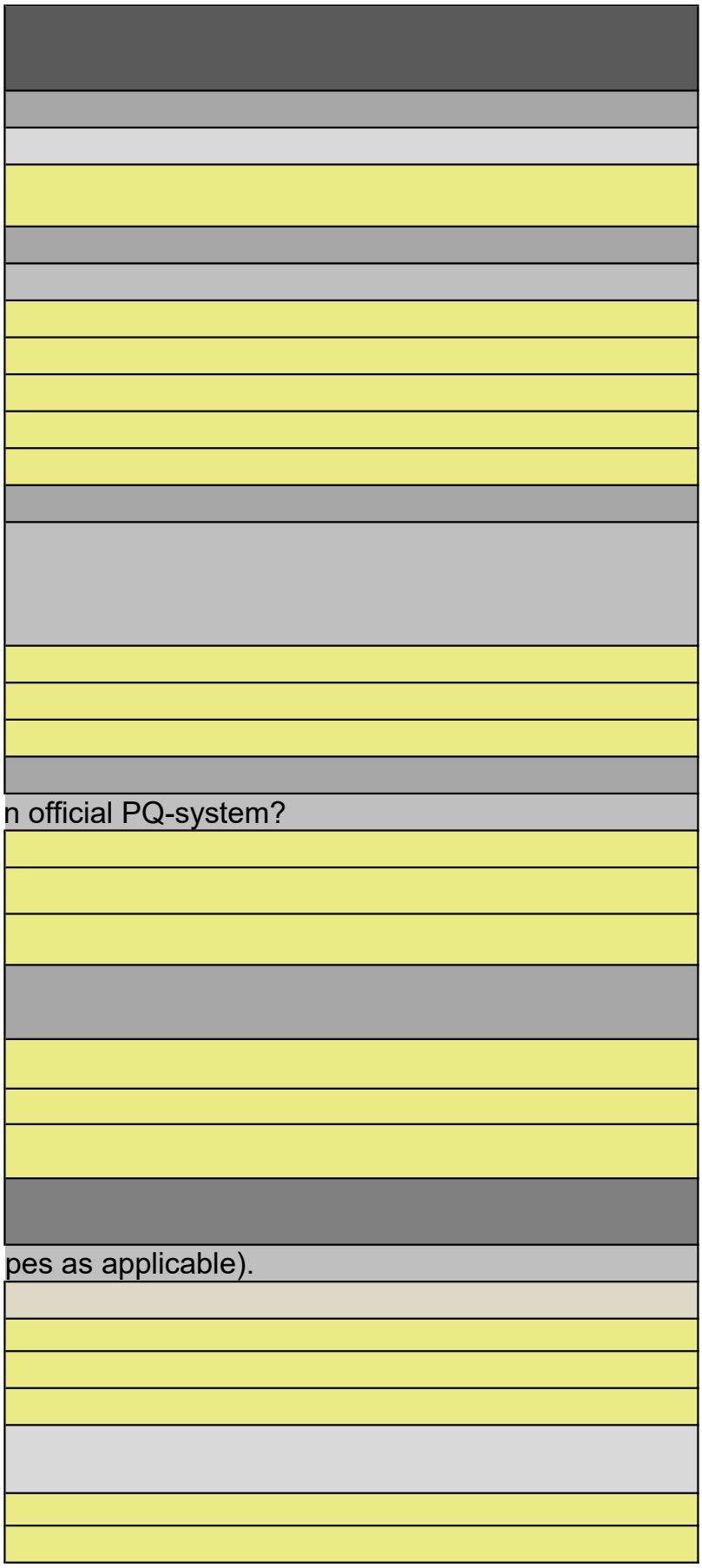
| |
|---|
| Note |
| 9.2 Logistic system |
| A - 9.2.1 Do you use the Selcable-system for the logistic of cable-drums? |
| Yes |
| No |
| Note |
| A- B - 9.2.2 Do you have or are you able to build up a logistic system? |
| Yes |
| No |
| Note |
| **10. Technical service** |
| B - 10.1 Technical sales support |
| B - 10.1.1 How many people are employed in the technical sales support for Sweden |
| Note |
| B - 10.1.1 How many people are employed in the technical sales support for German |
| Note |
| B - 10.2 Training |
| B - 10.2.1 What product-based training is offered to the client? |
| Note |
| B - 10.2.2 Do you have your own training centre? If yes, where is this located? |
| Note |
| 10.3 Assembly (on site/ in the field) |
| A - 10.3.1 How many employees work in the assembly area? |
| Note |
| A - 10.3.2 How are these employees organised within the company? |
| Note |
| A - 10.3.3 How do you document the qualification of your assembling-staff?<br>Are ID-cards with the specific qualification of the assembling-staff available? |
| Note |
| A - 10.3.4 What product-based training is offered to the client's assembly workers? |
| Note |

| |
|---|
| A - 10.3.5 Where is assembly training carried out? |
| Note |
| that you can provide?<br>How many projects are possible in parallel? |
| Note |
| A - 10.3.7 Do you use sub-contractors for the assembling of fittings etc.? |
| Yes |
| No |
| Note |
| A - 10.3.8 In a case of failure, can you start a repair within 24 hours after notification? |
| Yes |
| No |
| Note |
| A - 10.3.9 Are you prepared to provide the correspondent volumes of cables and fittir |
| Yes |
| No |
| Note |
| A - 10.3.10 Are there contact persons in your company that are reachable, also outsi |
| Yes |
| No |
| Note |
| A - 10.3.11 Are you prepared to assemble transition joints for different building-types of cables (for instance oil-insulated cable >> XLPE-cable)? |
| Yes |
| No |
| Note |
| A - 10.3.12 Are you prepared to have a Swedish-speaking contact-person which is available at the construction-site at anytime during the project? |
| Yes |
| No |
| Note |
| A - 10.3.13 Do you have special guidelines for the laying of cable? |
| Yes |
| No |
| Note |
| **11. Facilities & R& D** |
| 11.1 Employees |
| B - 11.1.1 How many people are employed in the R&D department? |
| Note |
| B - 11.1.2 How are these employees organised within the company? |

| |
|---|
| Note |
| 11.2 Technical facilities of Research & Development |
| B - 11.2.1 What facilities are available (university, internationl testing etc…)? |
| Note |
| B - 11.2.2 How many development test bays are available (eg. laboratory for mechar |
| Note |
| B - 11.2.3 What equipment is available in the test bays? |
| Note |
| B - 11.2.4 How many test bays are accredited? |
| Note |
| B - 11.2.5 Which service providers are used for test jobs? |
| Note |
| **12. Technical description** |
| 12. Customer's technical product requirements/ Technical descriptions |
| B - 12.1 How are the customer's technical descriptions/specifications stored? |
| Note |
| B - 12.2 How long are technical descriptions/specifications stored? |
| Note |
| B - 12.3 Who has access to the technical descriptions/specifications? |
| Note |
| B - 12.4 Who integrates the technical descriptions/specifications into production? |
| Note |
| A - 12.5 Can you assure that the correct customer`s testing requirement are available to the employees in the test-field in the manufacturing process? |
| Yes |
| No |
| Note |
| A - 12.6 How are requirements from the technical descriptions/specifications incorpo |
| Note |
| A - 12.7 How are employees informed about changes or exceptions to regular produ |
| Note |
| A - 12.8 Can you assure that changes to the customer`s testing requirement are available to the employees in the test-field in the manufacturing process? |
| Yes |
| No |
| Note |
| **13. Quality monitoring** |

| annual Quality Monitoring  System for cables in the projects where cable supplied by you?<br>This to be mutually agreed on between the Supplier, Vattenfall and Vattenfall´s |
| --- |
| Yes |
| No |
| Note |

| e with to reference to announceme |
| --- |
| SUPPLIER RESPONS |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| ss, Company ID no and Contact Person |
| |
| |
| |
| |
| |
| |
| |
| |
| |
|



n official PQ-system?

pes as applicable).

lated taxes.

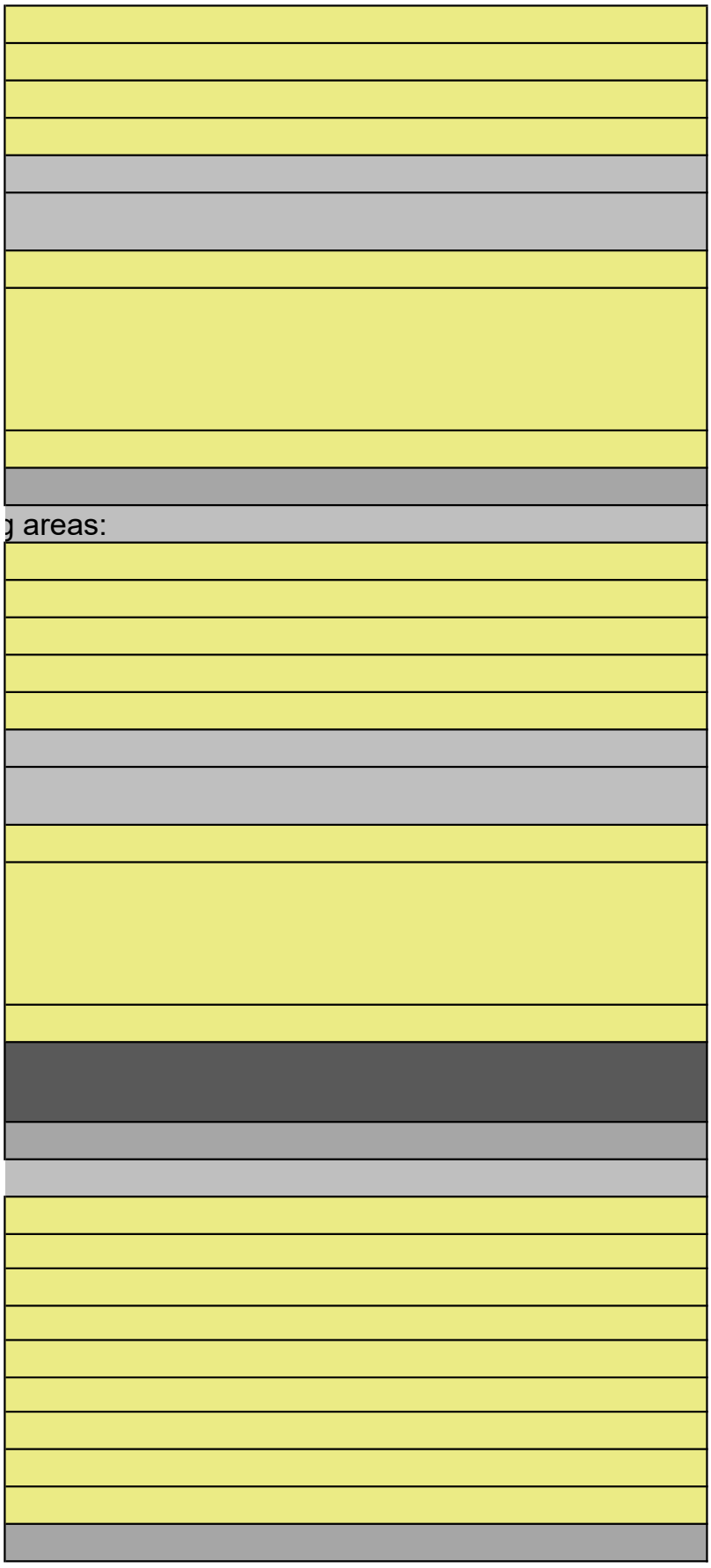
filing of its latest annual report and financial statemer

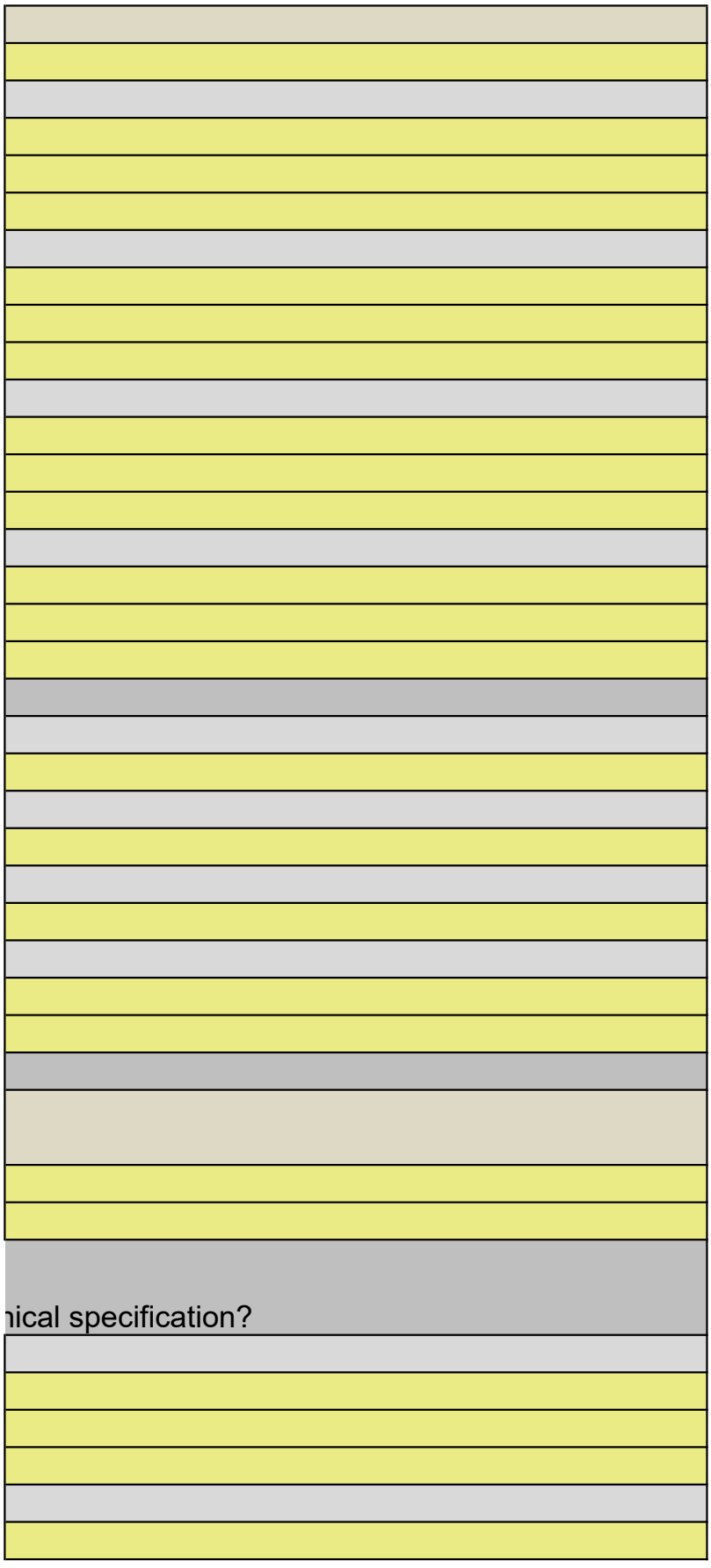
t recovery proceedings by its creditors and it is not su

ns or current legal claims, court proceedings or arbitr

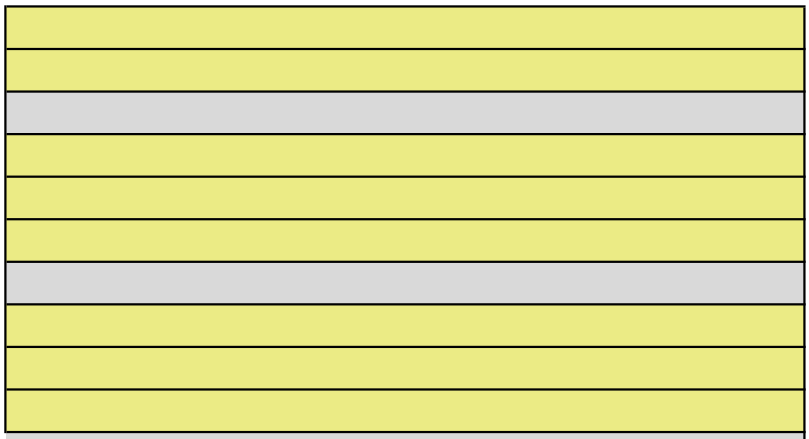
ıll

g areas:

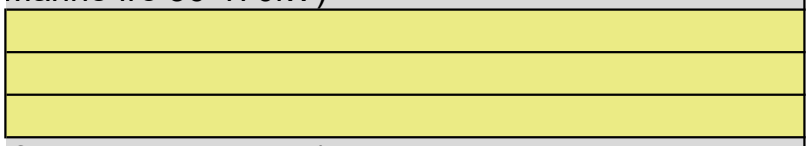

g areas:



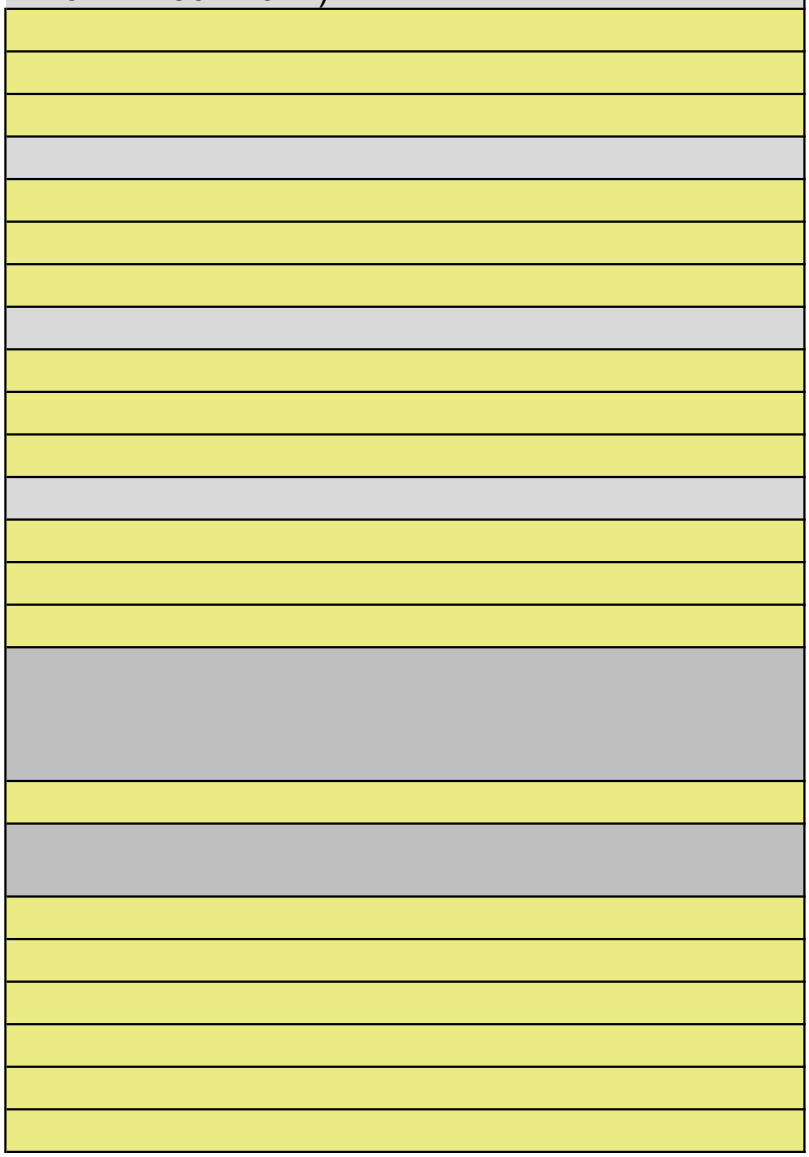
nical specification?

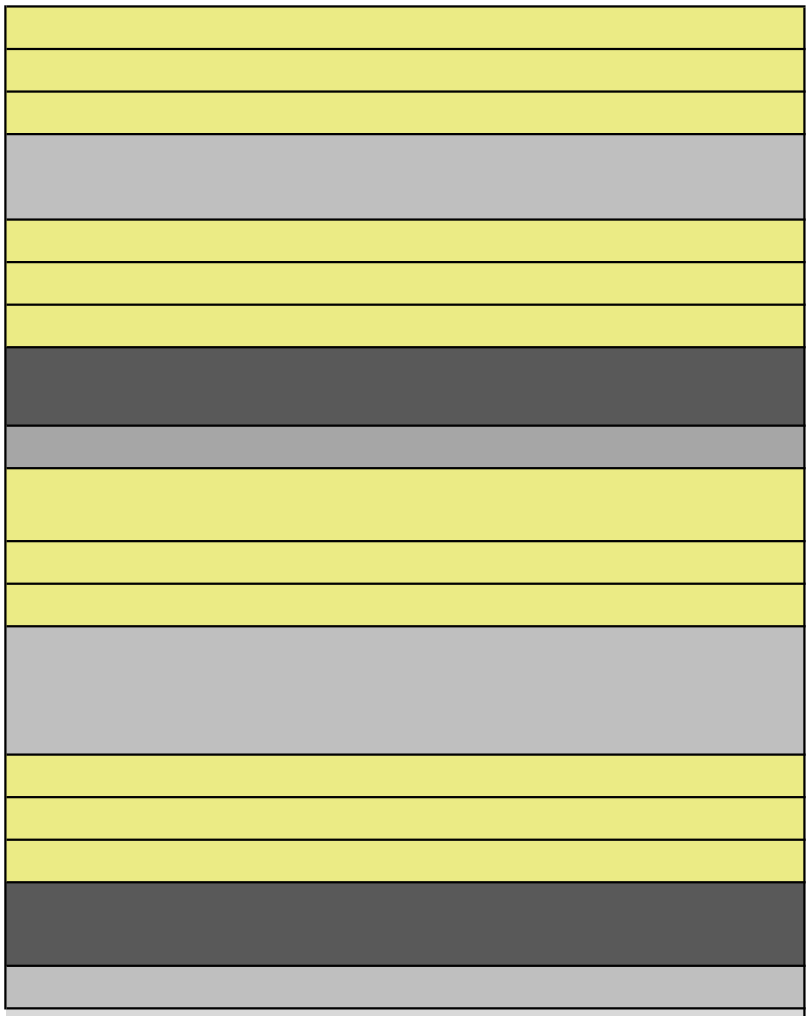


Marine fro 36-170kV)

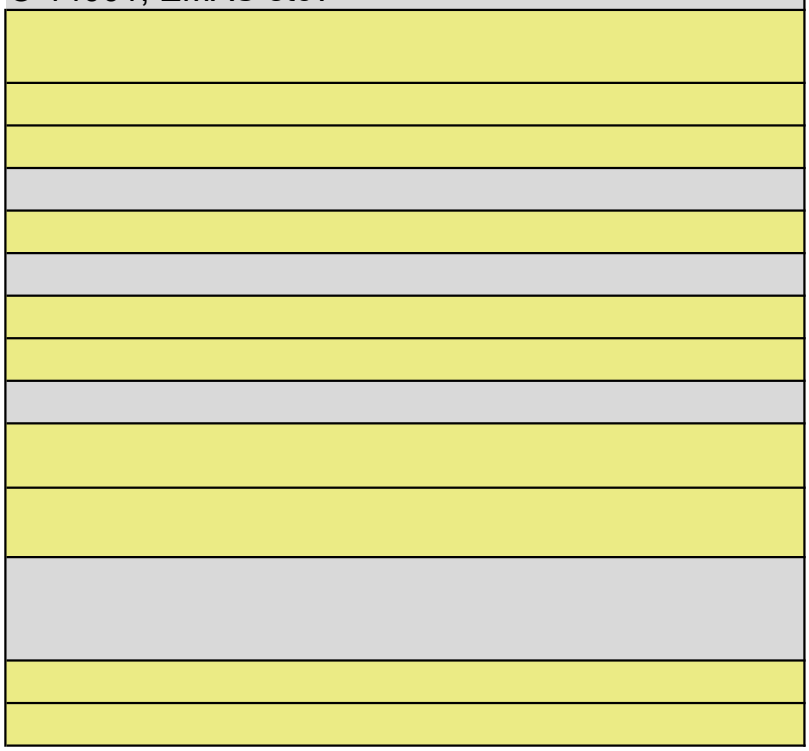


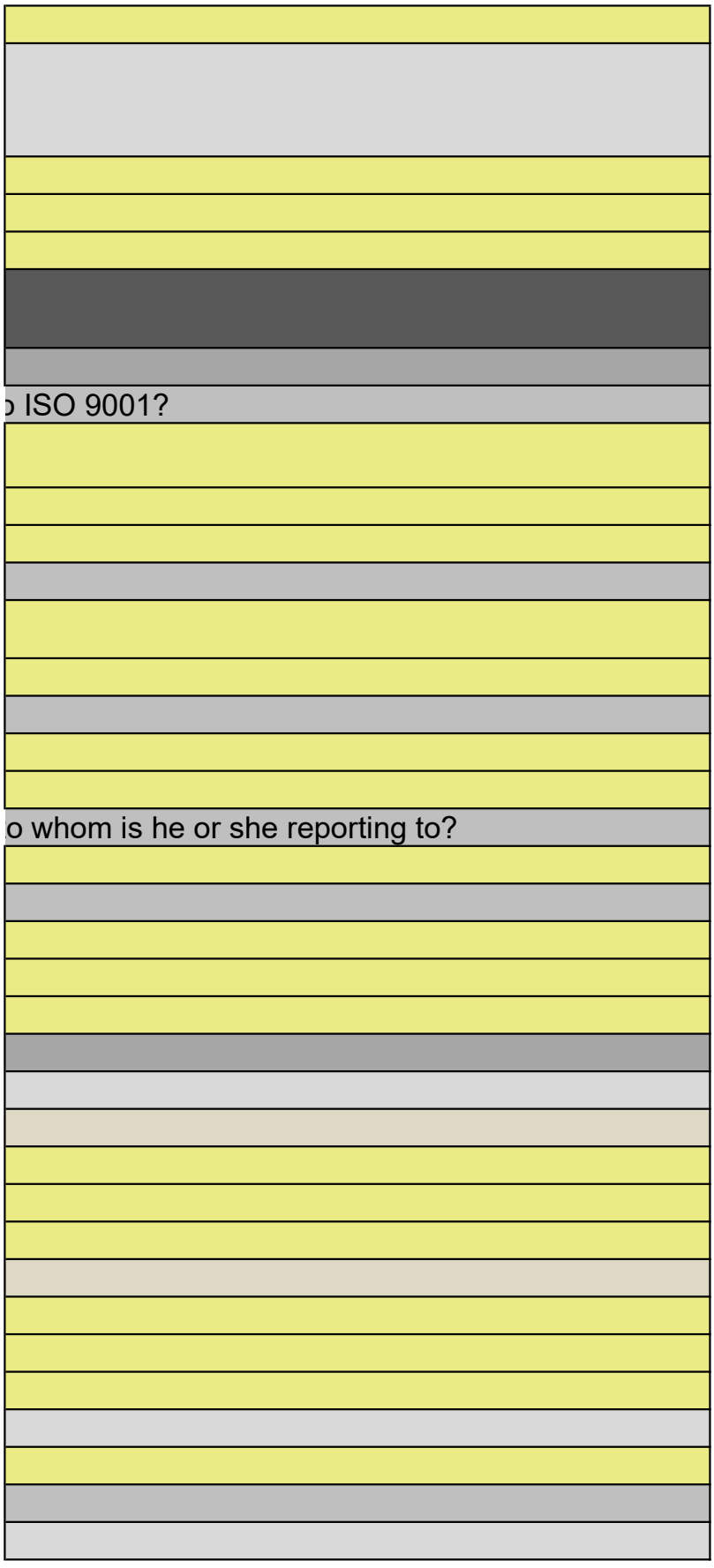
for 3-core 36-170kV)

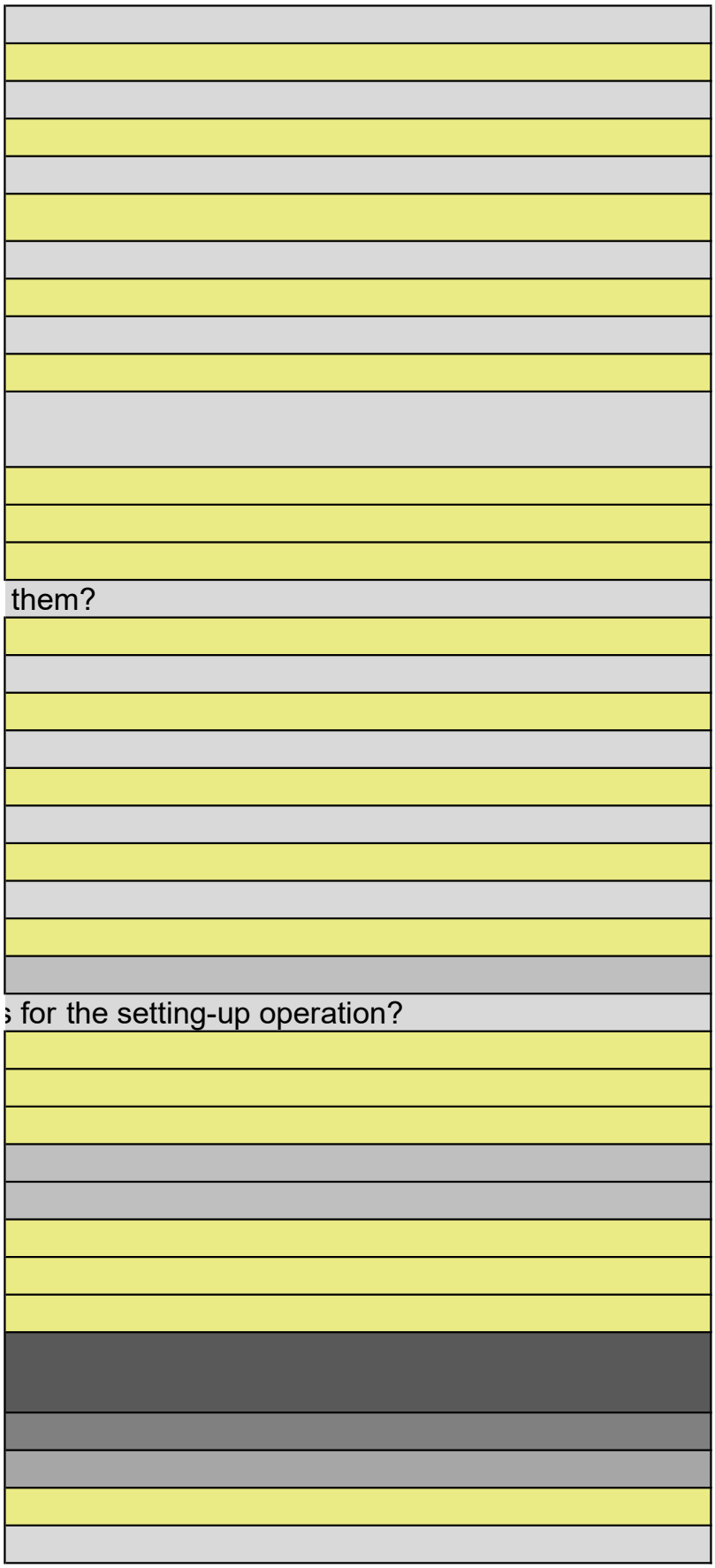




O 14001, EMAS etc?

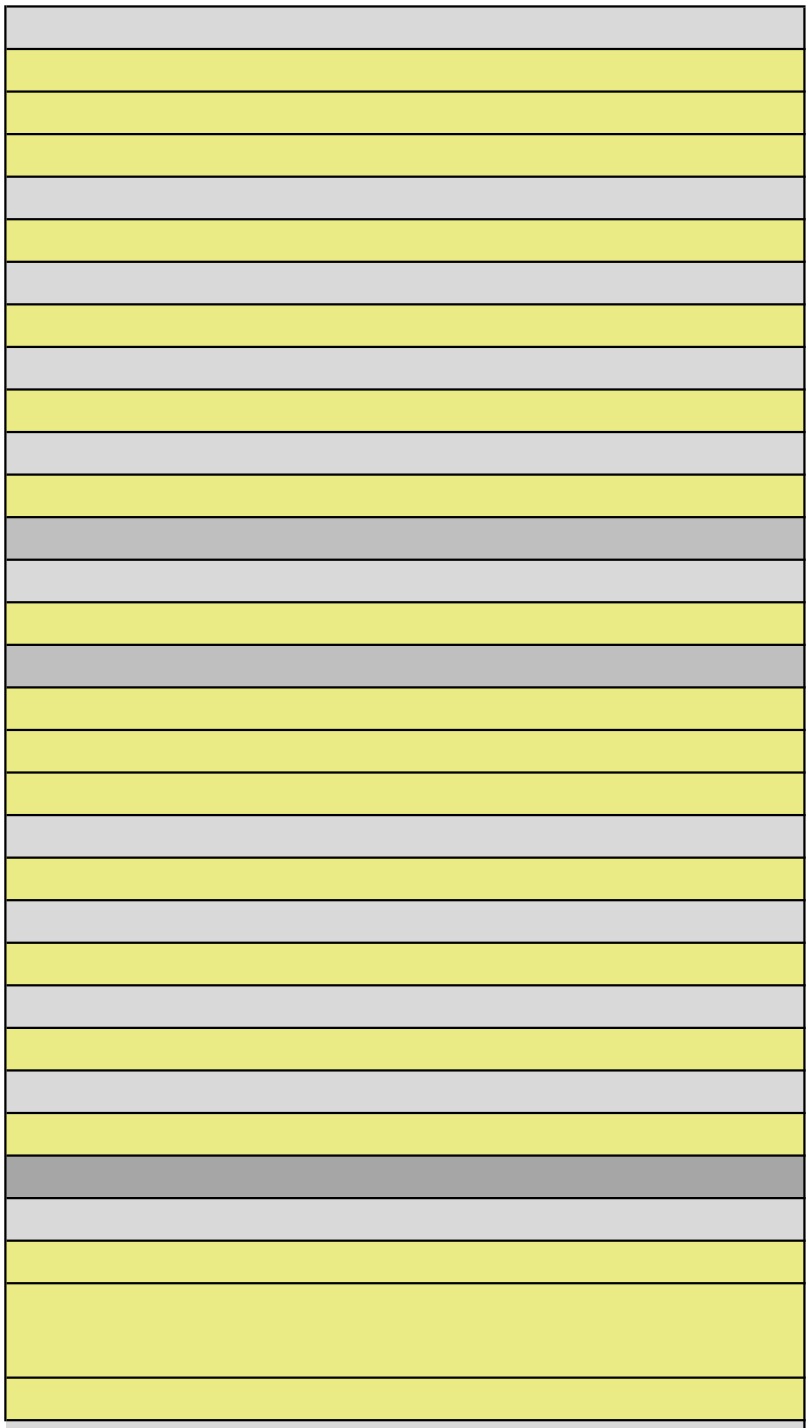



ISO 9001?
o whom is he or she reporting to?

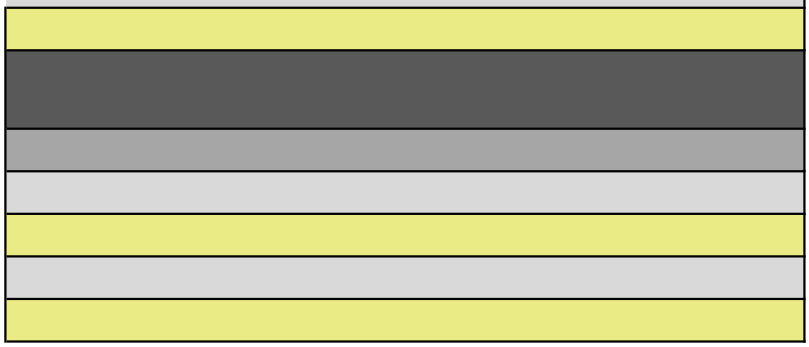

them?
s for the setting-up operation?

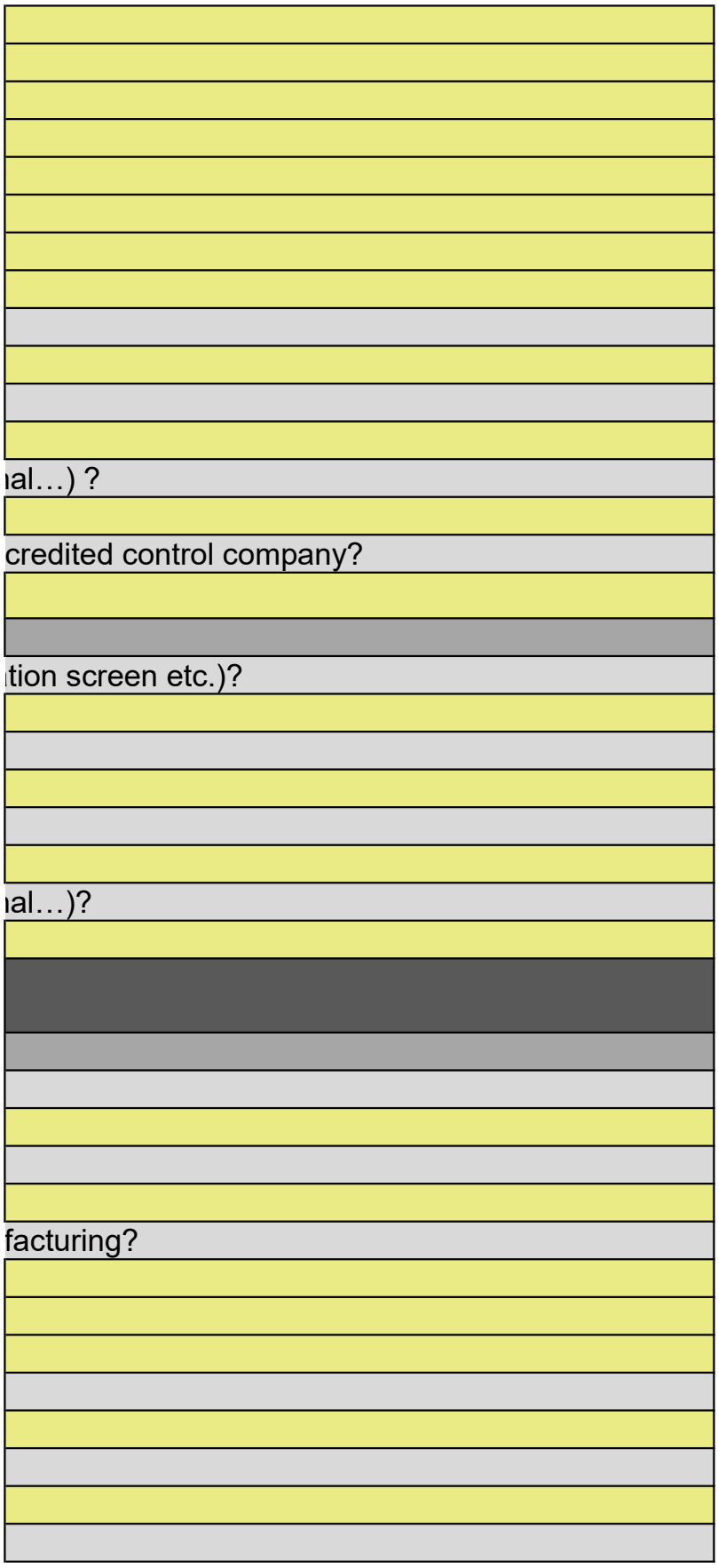
steps) for:

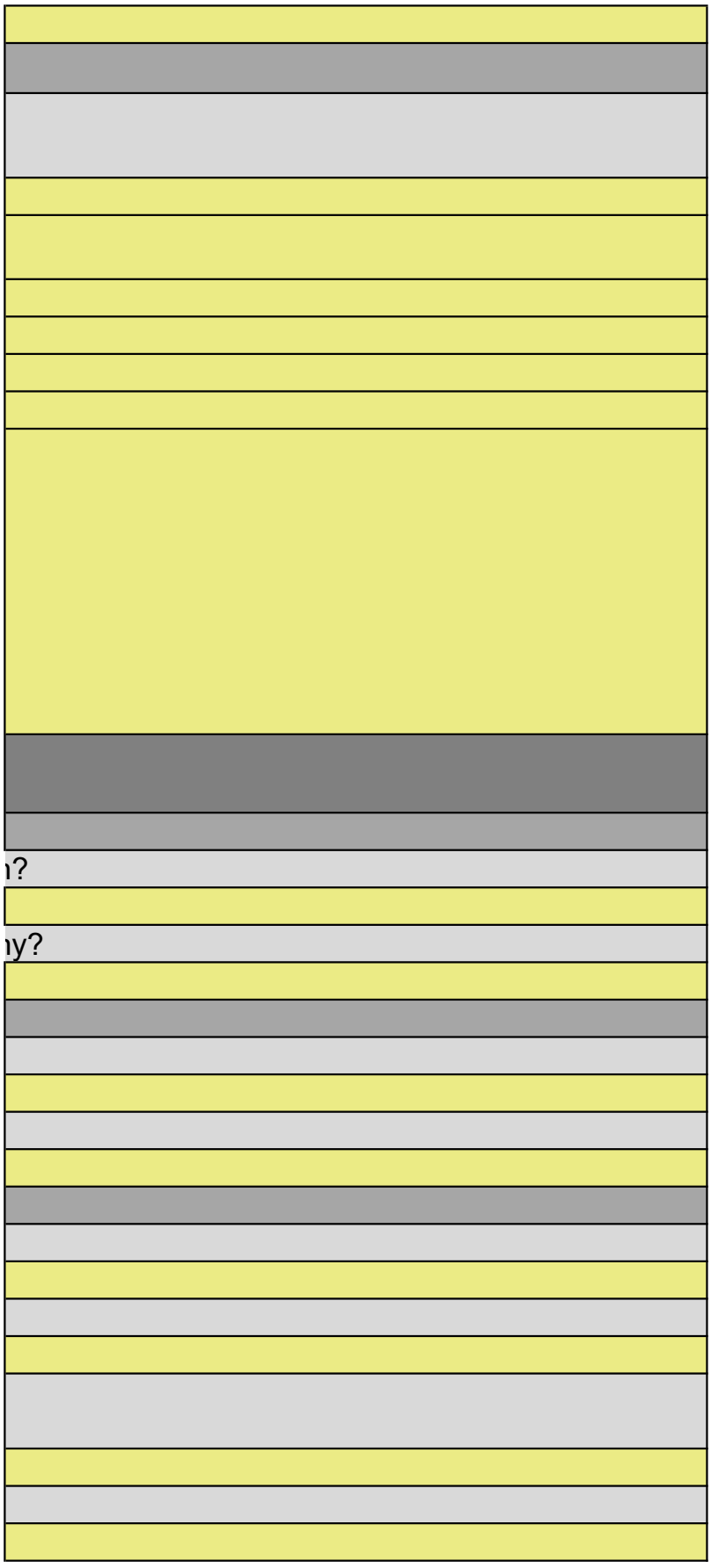
tor, insulated cables, screened cables)



and how is this



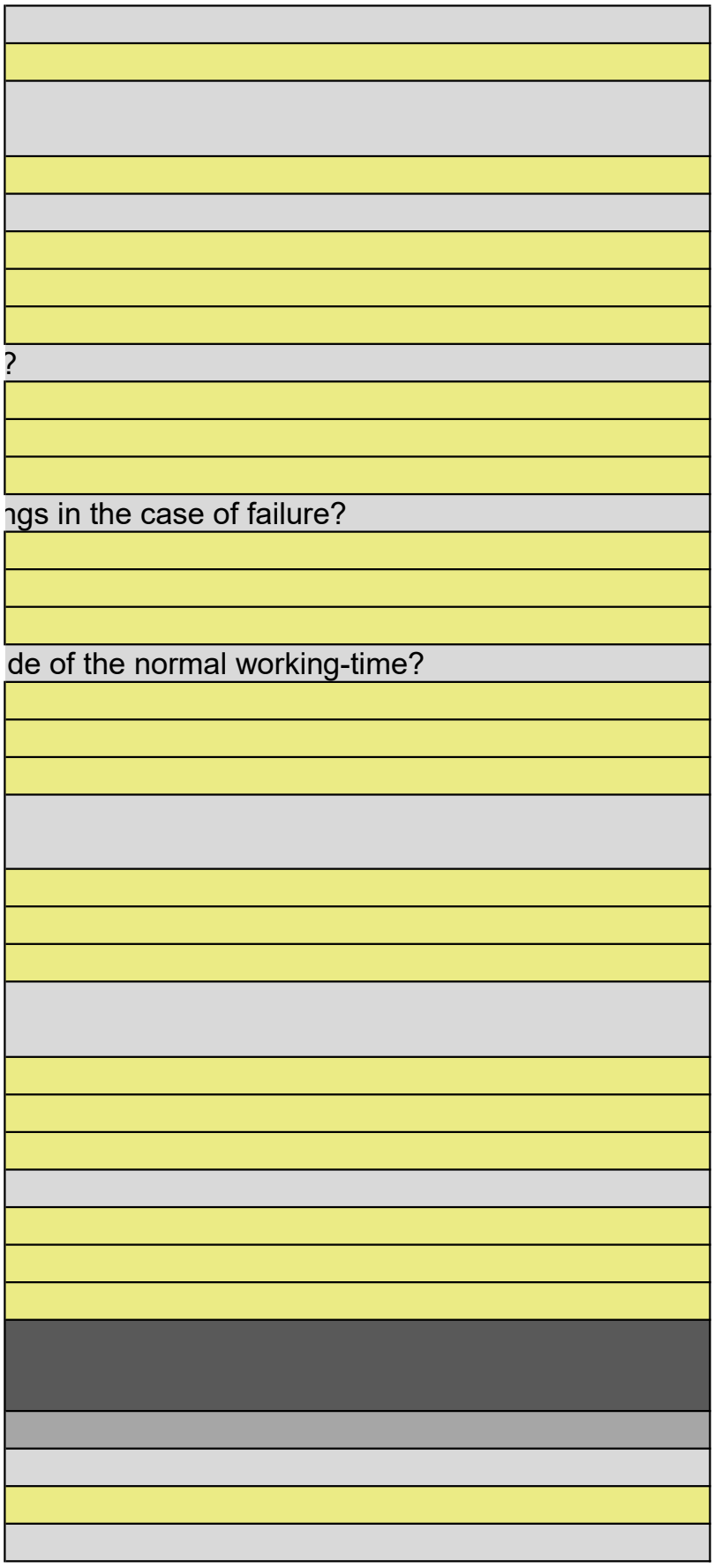

ıal…) ?
credited control company?
ıtion screen etc.)?
ıal…)?
facturing?

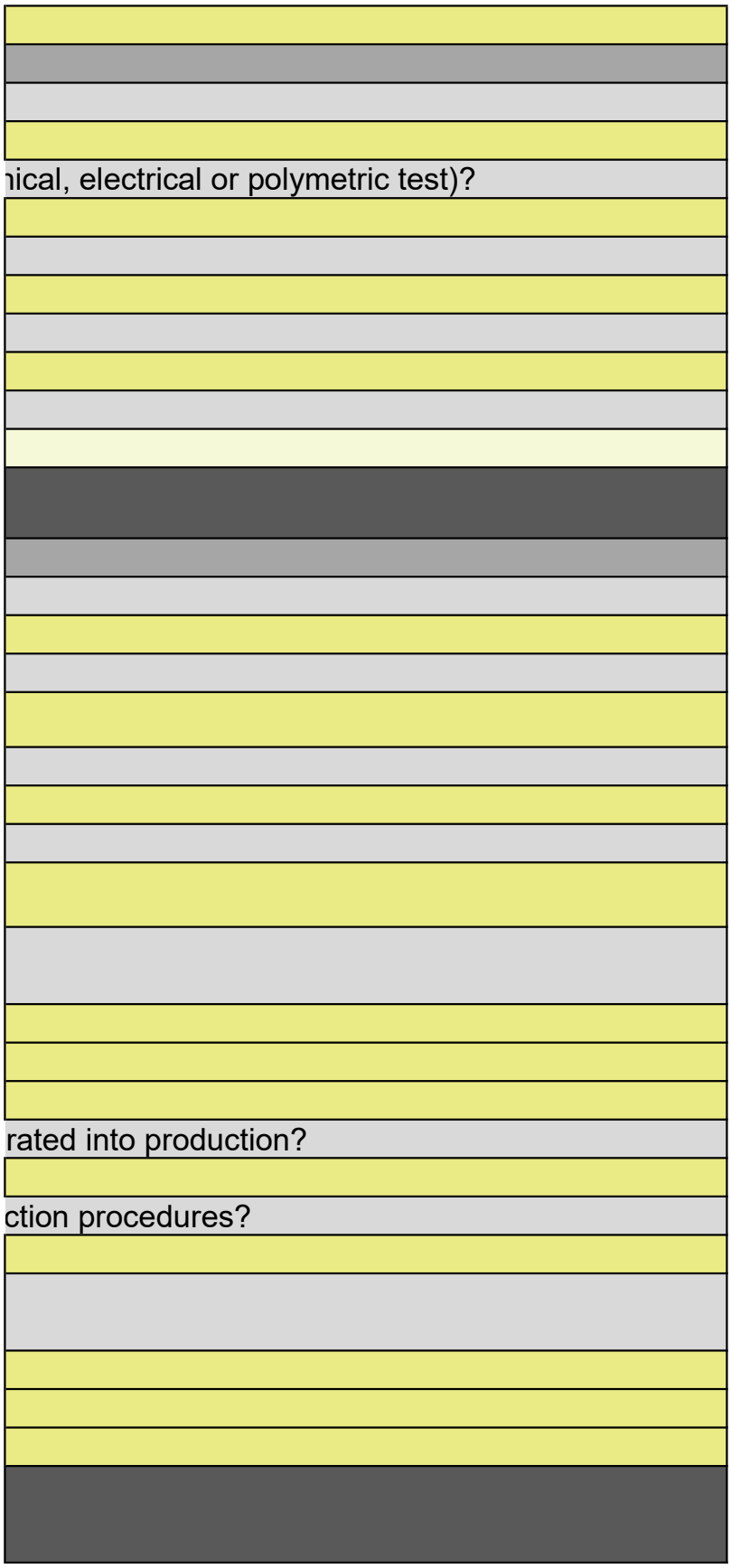

n?
ny?

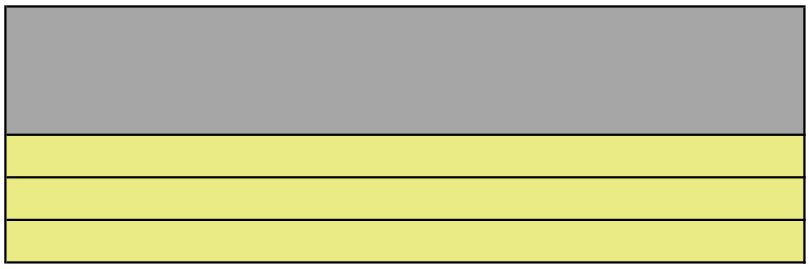
?

ngs in the case of failure?

de of the normal working-time?




nical, electrical or polymetric test)?
rated into production?
ction procedures?



# nt in e-Vergabe nb 2019003277

| QUESTIONS RELATED<br>INFORMATION FROM VATTENFALL |
| --- |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| Applicable for cable supply to Vattenfall Nordic |
| |
| |
| |

| |
|---|
| Applicable for cable supply to Vattenfall Nordic |
| Applicable for cable supply to Vattenfall Nordic |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| Applicable for cable supply to Vattenfall Nordic |
| |
| |
| |
| |
| |
| |
| |
| |
| |
|

nts.

ubject to any formal insolvency procedures.

| |
|---|
| |
| ·ation proceedings? |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| Please attach the following organisational charts of your company as appendices. |
| |
| Applicable for cable supply to Vattenfall Nordic |
| Applicable for cable supply to Vattenfall Nordic |
| |

| |
|---|
| |
| Only applicable for HV-cable systems |
| |
| Applicable for cable supply to Vattenfall Nordic |
| Applicable for cable supply to Vattenfall Nordic |
| |
| In case of "No" the resonsible technical contact person must be able to communicate in the English language. For HV-projects, a Swedish-speaking contact person must be available at the construction site. Please state if you can ensure that. |
| |
| Applicable for cable supply to Vattenfall Germany |
| Applicable for cable supply to Vattenfall Germany |
| |
| |
| |
| Only applicable for HV-cable systems |
| |
| Applicable for cable supply to Vattenfall Germany |
| Applicable for cable supply to Vattenfall Germany |
| |
| In case of "No" the resonsible technical contact person must be able to communicate in the English language. For HV-projects, a German-speaking contact person must be available at the construction site. Please state if you can ensure that. |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

In general, the specifications and standards shall be met. In case of improved design, the new design has to be approved by Vattenfall. The functional requirements (e.g. testing) shall be fulfilled.

| |
|---|
| |
| |
| |

| |
|---|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes" please provide valid certificate.<br>System shall be audited/ approved by third party accredited company |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes" please provide valid certificate.<br>System shall be audited/ approved by third party accredited company |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes", which parts of these regulations? |
| If "No", please state the exceptions. |

| |
|---|
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes" please provide valid certificate.<br>System shall be audited/ approved by third party accredited company |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes" please provide an overview (quality plan) of QA in the production process. |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

| |
|---|
| |
| |
| |

| |
|---|
| |
| |
| Providing a plan of the production process. |
| |
| |
| Providing a plan of the production process. |
| |
| |
| Providing a plan of the production process. |
| |
| |
| Providing a plan of the production process. |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

If "Yes" please provide according plan.

If "No", how do you ensure that, in case of a claim/warranty issue, there was no failure during?

| |
|---|
| |
| |
| |
| Only for supply to Vattenfall Nordic |
| If "No", please describe your logistic solution,<br>especially the return of the cable-drums. |
| |
| Only for supply to Vattenfall Nordic |
| |
| |
| Minimized need for administrative work by Vattenfall administration of cable- drums, tracing of cable drums, delivery acknowledgements, invoicing, etc.).<br>Possibility of integrating planning systems so that the supplier’s production planning and Vattenfall’s project planning can be matched and jointly optimised.<br>Trucks for the delivery have to be equipped with proper unloading-equipment and GPS-device.<br>Handling of scrap-cables need to be included.<br>Please see enclosed the present logistical solution Vattenfall Nordic has with the current logistic provider regrading LV and MV cables. |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

| |
|---|
| |
| |
| |
| |
| |
| If "Yes", how to you ensure the qualification of your sub-contractors? |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| If "Yes", which types of cable-building-types: |
| |
| |
| |
| |
| |
| |
| |
| If "Yes", please attach them to your checklist. |
| |
| |
| |
| |
| |
| |
| |

| |
|---|
| |
| |
| |

The "Concept of Quality Monitoring" is attached in the separate worksheet called "Conc

:ept Quality Monitoring".

# 1 - 30 kV cables with PVC or cross-linked polyethylene insulation

**Technical Description - KG4073**

**TECHNICAL DESCRIPTION KG4073**

PAGE/OF
**2/10**

COORDINATOR
**L-AB / L-AH / NB**

PUBLISHER
**Volkmar Ulewski**

ISSUE
**Version 1_12.08.2005**
**activated 06.05.2019**

**Contents** Page


| | | |
|---|---|---|
| 1 | Changes and revisions | 3 |
| 2 | General points | 3 |
| 3 | Scope of application | 3 |
| 3.1 | 1 kV PVC cables | 3 |
| 3.2 | 1 kV cross-linked polyethylene cables | 3 |
| 3.3 | 10 kV cross-linked polyethylene cables | 3 |
| 3.4 | 20 kV cross-linked polyethylene cables | 4 |
| 3.5 | 30 kV cross-linked polyethylene cables | 4 |
| 4 | General requirements | 4 |
| 4.1 | Technical acceptance of cables | 4 |
| 4.2 | Transport and storage of cables | 4 |
| 5 | Technical requirements | 4 |
| 5.1 | Technical requirements for cables with PVC insulation, rated voltage 1 kV | 4 |
| 5.1.1 | The cables must conform to DIN VDE 0276-603. | 4 |
| 5.1.2 | Additional requirements: | 5 |
| 5.2 | Requirements for cables with cross-linked polyethylene insulation, rated voltage 1 kV | 5 |
| 5.2.1 | The cables must conform to DIN VDE 0276-603. | 5 |
| 5.2.2 | Additional requirements: | 5 |
| 5.3 | Requirements for cables with cross-linked polyethylene insulation, rated voltage 10 - 30 kV | 6 |
| 5.3.1 | The cables must conform to DIN VDE 0276-620. | 6 |
| 5.3.2 | Additional requirements: | 6 |
| 5.4 | Markings | 6 |
| 5.5 | Special tests | 7 |
| 5.5.1 | Evidence of adhesion capability | 7 |
| 5.5.2 | Aging test in warming cabinet | 8 |
| 6 | Approval | 9 |

# 1 - 30 kV cables with PVC or cross-linked polyethylene insulation

**TECHNICAL DESCRIPTION KG4073**

PAGE/OF
**3/10**

COORDINATOR
**L-AB / L-AH / NB**

PUBLISHER
**Volkmar Ulewski**

ISSUE
**Version 1_12.08.2005**
**activated 06.05.2019**

## 1 Changes and revisions

None

## 2 General points

This Technical Description (TB) is intended for use as a supplement to the applicable versions of the DIN VDE provisions and the DIN standards.

This version replaces all previous issues of the Stromnetz Berlin, requirements for 1 - 30 kV cables with PVC or cross-linked polyeth-ylene insulation.

## 3 Scope of application

The Technical Description applies to 1, 10 and 30 kV cables with PVC or cross-linked polyethylene insulation.

### 3.1 1 kV PVC cables

**NAYY-J 4x35 re**

### 3.2 1 kV cross-linked polyethylene cables

NA2XY-J 4 x 150 se

### 3.3 10 kV cross-linked polyethylene cables

NA2XS(F)2Y 1 x 240 rm / 25

NA2XS(F)2Y 3x1 x 240 rm / 25, stranded

3.4

## 3.5 30 kV cross-linked polyethylene cables

N2XS(F)2Y 1x150 rm / 25

# 4 General requirements

## 4.1 Technical acceptance of cables

The supplier must give due advance notice of the delivery of the cables for acceptance and approval
( Stromnetz Berlin: 3 weeks).

## 4.2 Transport and storage of cables

The following requirements must be met in addition to DIN VDE 0276, Parts 603 and 620:

The starts and ends of the cables must be sealed with watertight shrink-fit caps which are coated with adhesive and must be sufficiently secured to the shipping drum. The inner cable end must not be routed out of the side of the drum disk but should be secured on a continuous screw. Only drums conforming to DIN EN 46391 are to be used. The following information must be affixed to the shipping drum in a watertight and clearly legible manner: exact cable designation, cross section (conductor, screen), voltage, cable length, drum number and direction of rotation of drum.

# 5 Technical requirements

## 5.1 Technical requirements for cables with PVC insulation, rated voltage 1 kV

### 5.1.1 The cables must conform to DIN VDE 0276-603.

## 5.1.2 Additional requirements:

| | |
|---|---|
| Conductor: | Without welding points. |
| Core sheath: | It must be possible to remove the common core sheath for the extruded version and the fillers from the conductor insulation easily without leaving any residues, including after aging in the warming cabinet according to DIN VDE 0276-603, Table 1. No stripping agents are permitted. |
| Strand length: | For NAYY-J 4 x 35 re: 0.5 m to 0.8 m |
| Filler: | Non-hygroscopic and rubbery-elastic, free from stripping agents; must be removable without tools. |

## 5.2 Requirements for cables with cross-linked polyethylene insulation, rated voltage 1 kV

## 5.2.1 The cables must conform to DIN VDE 0276-603.

## 5.2.2 Additional requirements:

| | |
|---|---|
| Conductor: | Without welding points. |
| Insulation: | Free from separating agents, capable of adhesion to PUR resins through modification (cf. 5.5.1), stripping possible after thermal aging (cf. 5.5.2), with conductor cross section of 150 mm² max. thickness of insulating wall 2 mm (single value). |
| Cores: | Winding with tape permissible, must be removable without tools. |
| Strand length: | With conductor cross section of 150 $mm^2$ 1.0 m - 1.5 m. |
| Core sheath: | It must be possible to remove the common core sheath for the extruded version and the fillers from the conductor insulation easily without leaving any residues, including after thermal aging in the warming cabinet (cf. 5.5.2). |
| Filler: | Non-hygroscopic and rubbery-elastic, free from stripping agents; must be removable without tools. |

## 5.3 Requirements for cables with cross-linked polyethylene insulation, rated voltage 10 - 30 kV

### 5.3.1 The cables must conform to DIN VDE 0276-620.

### 5.3.2 Additional requirements:

| | |
|---|---|
| Insulation: | Cross-linked dry,<br>inner screen, insulation and outer screen triple-extruded and permanently bonded. |
| Longitudinal watertightness: | For versions with longitudinal watertightness:<br>Longitudinal watertightness in the screen area must be verified by testing for conformity with DIN VDE 0276-605, section 2.4.9.3 f, and HD 605, note 3. |
| Strand length: | On delivery in stranded version 1.2 m - 1.6 m. |

Type tests must be carried out according to DIN VDE 0276-620 and the test reports submitted to the customer. The results of the long-term aging tests must be submitted to the customer annually.

## 5.4 Markings

| | |
|---|---|
| Outer sheath: | The outer sheath must be marked with the following information: VDE test mark, manufacturer, year of manufacture, model code, rated voltage, cross section (conductor and screen) and embossing of length in metres. In addition, a cable code number that can be used to trace all manufacturing processes must be embossed on the sheath. |

## 5.5 Special tests

### 5.5.1 Evidence of adhesion capability

Table 1: Test requirements

| Seq-uence | Test procedures according to DIN EN 50393 | Test statistics | Analysis |
|---|---|---|---|
| 1 | AC voltage test in air, section 8.3 | Test voltage: 4 kV Test duration: 1 min. | No breakdown |
| 2 | Alternating load test in air, section 8.6 | Mean heater current 335 A Heating time: 5 hours Cooling time: 3 hours Number of load changes: 63 | No breakdown |
| 3 | Thermal short-circuit strength, DIN EN 61442 section 11 | Test current: acc. to HD 628 S1 section 11 Short-circuit current: 14.2 kA/1s Number of short circuits: 2 per conductor | No breakdown |
| 4 | Alternating load test in water, section 8.6 | Mean heater current: 335 A Heating time: 5 hours Cooling time: 3 hours Number of load changes: 63 | No breakdown |
| 5 | Testing of insulation resistance in water bath, section 8.4 | Measuring DC voltage Ut= 1000 V | Insulation resistance ≥ 50 MΩ |
| 6 | AC voltage test in water bath, section 8.3 | Test voltage: 4 kV Test duration: 1 min. | No breakdown |

Table 2: Cables to be used for testing

| Specifications | Main conductor | Branch conductor |
|---|---|---|
| Standard | DIN VDE 0276-603 | DIN VDE 0276-603 |
| Cable type | NA2XY-J | NAYY-J |
| Rated voltage | 0.6/1 kV | 0.6/1 kV |
| Material | Aluminium | Aluminium |
| Waveform | se | re |
| Cross section | 150 mm² | 35 mm² |
| Insulation | Cross-linked polyethylene | PVC |
| Sheath | PVC | PVC |
| Number of cores | 4 | 4 |
| Longitudinal watertightness | No | No |
| Main dimensions of cable | Compliant with VDE 0276-603 | Compliant with VDE 0276-603 |

The test must be performed with **one** of the PUR casting compound housing combinations listed below:

Table 3: Fittings/casting compounds which can be used for testing

| Manufacturer | Fitting | Casting compound |
|---|---|---|
| Höhne | HSM 260/130 | PU 500/2 |
| | | |
| TE Connectivity | MM 5-3D160-DE04 | Rapid 3010 (Rapid 3-D160 |

## 5.5.2 Aging test in warming cabinet

Test requirement

The test cable should be 500 mm long. The test is to be conducted at a temperature of 100°C and for a period of 168 hours in accordance with DIN VDE 0276-603, Table 2A.

Analysis

Once the test cables have cooled down, these must be shortened to a length of 160 mm from the middle of the cable.
To spread the cores, it must be possible to drive in an insulating wedge by hand at an angle of 90° centrically to the longitudinal axis of the cable for working when the cable is in operation.

The test is regarded to have been passed if:

- the core insulation is not damaged;
- the rubbery-elastic filling can be removed without the use of tools and without leaving residues;
- there are no cracks (embrittlement) in the core sheath.

## 6 Approval

Prior to use in the distribution network, cables must be approved by the relevant departments ( Stromnetz Berlin ).

| | Issued: | Checked: | Approved: |
|---|---|---|---|
| Date:<br>Name: | 12.08.2005<br>Volkmar Ulewski | 12.08.2005<br>Dietmar Obst | 12.08.2005<br>Frank Michelsen |

| | Approved: | Signed off: |
|---|---|---|
| Date:<br>Name: | 12.08.2005<br>Jürgen Lembke | 12.08.2005<br>Claus-Georg Henningsen |

Appendix dated 03.09.2012
activated 06.05.2019

# Additions to KG4073

## 1. General points

This appendix is supplementary to Technical Description KG4073 (Version 1_12.08.2005) and must be applied together with this specification and observed during manufacture!

## 2. 10 kV cross-linked polyethylene cables

The following 10 kV cross-linked polyethylene cable types (cf. KG4073 section 3.3.) are required:

NA2XS(F)2Y 1 x 240 rm or re / 25

NA2XS(F)2Y 3x1 x 240 rm or re / 25, stranded

## 3. Tests on cables

### 3.1 Routine test

All routine tests on cables must be carried out in accordance with DIN VDE 0276-603 and DIN VDE 0276-620. Contrary to DIN VDE 0276-620, the following applies:

Measurement of partial discharge: Directly after the voltage test

Calibrating pulse 2 pC (calibration prior to voltage test)

Background noise level <= 1pC

Test voltage 3.5xUo (during voltage test)

or 2xUo (prior 20% increase in test voltage, 1 min. to 14.4 kV)

Duration 1 min.

Permissible noise level <= 1pC

Test reports must be submitted to the customer.

### 3.2 Sample test

All sample tests on cables (10% of delivery lengths) must be carried out in accordance with DIN VDE 0276-603 and DIN VDE 0276-620. The number of sample tests can increase for initial delivery or in the case of

defects. The number of sample tests must be agreed with the customer prior to initial delivery. Test reports must be submitted to the customer.

## 3.3 Acceptance in the plant

As a general rule, routine and sample tests are conducted on 10% of the delivery lengths in the plant in the presence of the customer. The full delivery length is tested on initial delivery. The number of tests is increased in the case of defects.

The schedule for acceptance and the scope of testing must be submitted to the customer in good time before the acceptance date.

The supplier must give the plant due notice of the delivery lengths scheduled for acceptance prior to delivery. A minimum notice period of four weeks applies in the case of
Stromnetz Berlin GmbH department.

# 4. Approval and delivery

The delivery lengths must be approved by the customer prior to delivery. The request for approval of the delivery or acceptance in the plant must be delivered at least four weeks prior to the planned delivery for Stromnetz Berlin GmbH department.

# 5. Transport and storage of cables

The following requirements must be met in addition to DIN VDE 0276, Parts 603 and 620:

The starts and ends of the cables must be sealed with watertight shrink-fit caps which are coated with adhesive. The outer end must be secured with a V-shaped bracing so that the outer layers of the cables cannot come loose during transport. The inner cable end must not be routed out of the side of the drum disk but must be secured on a continuous screw.

The coil size must be agreed with the customer. The coil size must be adapted to the requisite delivery length so that damage to the outer cable layer is prevented. At least 1x the diameter of the cable or strand bundle must remain clear for the flange bearing surface.

Coils conforming to DIN EN 46391 must be used.

The following information must be specified on the sheets accompanying the coils on both sides of the flange in a watertight and clearly legible manner: delivery data, exact cable designation, cross section (conductor, screen), voltage, cable length, coil number and direction of rotation of coil.

| Document Type: | Document Designation: | Confidentiality Class: | Appendices: | No. of Pages: |
|---|---|---|---|---|
| Technical description | TD3514 | Medium (C2) | 1 | 30 |

| Contact person: | Document Owner: | Approved by: | Version: | Valid from: |
|---|---|---|---|---|
| Volkmar Ulewski (CD-OHB) | Manager High-Voltage Grid Vattenfall Europe Netservice | Manager technical department SNB | Berlin 1.1 | 1 June 2019 |

# 110 KV CABLES AND FITTINGS


## Summary

This technical description (TD) sets out the requirements that apply to assembly and testing of 110 kV cables with cross-linked polyethylene extruded insulation and their fittings.

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 2 (30) |

CONTENTS:


1 Amendments ..... 4
2 Purpose ..... 4
3 Scope ..... 4
4 Supplementary documents ..... 5
4.1 Regulations ..... 5
4.2 Standards ..... 5
5 Copyright ..... 5
6 Parameters ..... 5
7 Authorisation ..... 6
8 Cable system requirements ..... 6
8.1 Standard cables for the Berlin network ..... 6
8.2 General fittings information ..... 7
8.3 Standard fittings for the Berlin network ..... 7
8.3.1 Switchgear connection termination ..... 7
8.3.2 Outdoor cable termination with composite insulator ..... 7
8.3.3 Outdoor cable termination in air core design ..... 7
8.3.4 Connection sleeves ..... 7
8.4 Modifications to cables or fittings ..... 8
9 Cable design ..... 8
9.1 Conductor ..... 8
9.2 Insulation ..... 8
9.2.1 Requirements for conductor insulation for conductor cross section of up to 800 mm² 8
9.2.2 Requirements for conductor insulation for conductor cross section of 1000 mm² or above 8
9.2.3 Additional insulation requirements ..... 9
9.2.4 Irregularities in the insulation ..... 9
9.3 Conductive layers ..... 9
9.3.1 Inner conductive layer ..... 10
9.3.2 Outer conductive layer ..... 10
9.4 Wire ..... 10
9.5 Shield ..... 10
9.6 Separation layer ..... 11

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 3 (30) |

9.7 Oversheath ..... 11
9.7.1 PE-copolymer coated aluminium sheath ..... 11
9.7.2 Metallic foil ..... 12
9.7.3 Labelling on oversheath ..... 12
9.7.4 External diameter ..... 12
10 General test conditions ..... 13
11 Tests on cables ..... 13
11.1 Routine cable inspection and testing ..... 13
11.2 Screening of cables ..... 13
11.3 Official acceptance to be carried out with client present ..... 13
11.4 Repetition of tests ..... 14
11.5 Type approvals ..... 14
11.5.1 Type approval (electrical properties) ..... 14
11.5.2 Type approval (non-electrical properties) ..... 15
11.5.3 Repetition of type approvals ..... 15
11.6 Silicone transparency test ..... 15
12 Fitting requirements ..... 15
12.1 Sleeve transverse watertightness ..... 15
12.2 Connecting the transversal water barrier and cable shield ..... 15
13 Fitting tests ..... 16
13.1 Routine inspection and testing of fittings ..... 16
13.2 Type approval for fittings (electrical properties) ..... 16
13.2.1 General ..... 16
13.2.2 Leak tests using variable pressure and DC voltage tests for the sleeve outer protective jacket 16
13.2.3 Electrical strength of shield break for cross-bonding sleeves ..... 17
13.2.4 Repetition of type approvals ..... 17
14 Geometry of the insulation connector ..... 18
15 Test tables ..... 19
15.1 Routine inspection and testing of 110 kV XLPE cables ..... 19
15.2 Screening of 110 kV XLPE cables ..... 20
15.3 Type approval for 110 kV XLPE cables (electrical properties) ..... 21
15.4 Type approval for 110 kV XLPE cables (non-electrical properties) ..... 23

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 4 (30) |

15.5 Routine inspection and testing of prefabricated fittings and pre-testable fittings parts25
15.6 Type approval for 110 kV XLPE-cable fittings (electrical properties).....26
Appendix..... 29
I. Abbreviations and definitions.....29
II. List of illustrations .....29
III. List of tables.....29
IV. Revision index.....29

# 1 Amendments

All amendment notes from older versions are laid out in Annex V in the revision index, Table V-01.

Table 1-01 Overview of amendments

| Version | |
|---|---|
| Section | Topic |
| Whole document | Converting KG4023 into TD3514 |

# 2 Purpose

This technical description sets out the desired nominal state for technical parameters and other equipment properties and should be applied to procedures for equipment procurement and approval.

# 3 Scope

This technical description shall apply for work within the companies below:

**Stromnetz Berlin GmbH**

This TD replaces KG4023 "110 kV cables and their fittings".

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 5 (30) |

# 4 Supplementary documents

## 4.1 Regulations

None

## 4.2 Standards

This version of the TD should be used to supplement the relevant IEC, EN, HD and DIN VDE rules. The most recent version of the document in question is to be used for all undated references.

| | |
|---|---|
| DIN VDE 0276-632-3 (+Part 4-D) | Power cables with extruded insulation and their fittings, for rated voltages above 36 kV (Um = 42 kV) up to 150 kV (Um = 170 kV) |
| DIN EN 60229 (VDE 0473-229) | Electric cables – Tests on extruded oversheaths with a special protective function |

# 5 Copyright

Unless expressly stated otherwise, the contents of this technical description, as well as all images and drawings [tables, diagrams etc.] are copyrighted. They may not be fully or partially copied, distributed, edited or amended without the express prior written permission of Stromnetz Berlin GmbH.

# 6 Parameters

### Electrical parameters

The TD applies to single-core 110 kV cables with cross-linked polyethylene extruded insulation and their fittings (e.g. sleeves, connection terminals and outdoor cable terminations) with the following parameters:

- $U_0/U$ = 64/110 kV (rated voltage)
- $U_m$ = 123 kV (maximum voltage for equipment)
- $U_{rB}$ = 550 kV (rated lightning surge voltage)
- $U_{??}$ = 230 kV (rated short-term AC voltage)
- $I_a$ = 40 kA/1s (rated short-circuit current / rated short-circuit duration)

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 6 (30) |

- $I_{??}$ = 100 kA (rated surge current)
- $I_{??}$ = 10 kA (earth fault current)

## 7 Authorisation

110 kV cables and their fittings may only be procured and used after successful completion of testing and approval by the technical department.

Manufacturers must notify the technical department of changes to the components or design of approved products. The testing required to obtain authorisation must be performed for any existing modifications. Any unnotified changes to the authorisation status will invalidate the authorisation.

## 8 Cable system requirements

### 8.1 Standard cables for the Berlin network

The conductor should be a stranded, compressed circular conductor.

The nominal cross sections for copper conductors are 300 mm², 630 mm² or 800 mm².

The nominal cross section for aluminium conductors is 1000 mm².

The copper sheath cross section (in the form of a geometric cross section of the shield wires and helix copper tape) is **35 mm²** and may only exceed these dimensions by max. 3.0 mm².

When using fibre optic cables (FOC) in the shield, a cross section of **50 mm²** may be required for structural reasons. In this case, all three conductors within the system (including those without FOC) must have a shield cross section of 50 mm².

**Oversheaths with a special protective function**

**(optional, only provided at the client's specific request)**

The cable sheath should be an oversheath with a special protective function according to DIN EN 60229 (VDE 0473-229) and shall be subject to the relevant tests. These tests must be documented and transmitted to the client accordingly.

Electrical tests after installation in line with DIN EN 60229 10 kV/1 min (Annex B to DIN EN 60229 Guidelines).

**The oversheath should be an outer sleeve with a black, conductive covering.** A graphitised version may not be used.

- Abbreviation: **>C<**

**The PE cable sheath must be red (UV stabilised) .**

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 7 (30) |

## 8.2 General fittings information

Only prefabricated, slip-on sleeve parts or stress cones may be used for cable terminations, connectors or sleeves.

This does not include the non-prefabricated oil side of transition sleeves for connecting XLPE cables with oil cables.

## 8.3 Standard fittings for the Berlin network

Due to the need to provide fittings and short supply recovery times in the case of a fault, only approved "standard fittings for the Berlin network" may be used in the case of a fault in the Berlin network.

### 8.3.1 Switchgear connection termination

The switchgear connection termination must have installation dimensions compatible with IEC 62271-209 (from Südkabel company type D) (voltage series 123 kV – 145 kV).

For conductor cross sections of up to 800 mm², the **plug contact** cross section must be **60 mm** (see Appendix 1).

Pure manufacturer systems (plug + socket) must be provided for conductor cross sections of 1000 mm² or over.

### 8.3.2 Outdoor cable termination with composite insulator

The Berlin Network uses composite insulators made of glass-fibre reinforced plastic (GRP) with cast-on, parallel (rather than screwed on) shields made out of electrical high-quality silicone rubber.

The minimum creepage distance is 2460 mm (equivalent to pollution layer class 2 under VDE 0111-2: 1997-09, Table 1).

### 8.3.3 Outdoor cable termination in air core design

The use of outdoor cable terminations in air core design with and without support (but with a support insulator) is only permitted with technical department approval and upon gaining type approval.

The minimum creepage distance is 2460 mm (equivalent to pollution layer class 2 under VDE 0111-2: 1997-09, Table 1).

### 8.3.4 Connection sleeves

Only prefabricated, silicone slip-on sleeve parts (one-piece or three-piece) may be used.

Glass fibre reinforced sleeves with integrated metal diffusion barriers must be used to protect against external damage and to act as water vapour barriers.

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 8 (30) |

## 8.4 Modifications to cables or fittings

In principal, no other designs (for cables or fittings) which diverge from that laid out in the type approval may be used. If modifications are necessary after type approval, the client and manufacturer must agree upon said changes before starting any bids for tender or production of equipment. For significant modifications, enough time must be set aside for a new type approval.

In order to avoid an additional type approval after this TD, the required product function checks may be carried out in conjunction with the technical department.

# 9 Cable design

## 9.1 Conductor

The conductor must conform with DIN EN 60228 .

The conductor design should be either that of a stranded, compressed circular conductor made from copper or aluminium, or a solid circular aluminium conductor (depending on client authorisation and request). To minimise skin effect, all conductors with cross sections of 1200 mm² or above should have a segmented conductor design with at least five segments.

There must be semi-conductive tape over the conductor.

## 9.2 Insulation

The insulation must be made out of single-layer extruded and cross-linked polyethylene compound. Only triple extruders may be used. The cross-linking must be dry and peroxydic.

An air separator and magnetic separator must be used when feeding in insulation.

### 9.2.1 Requirements for conductor insulation for conductor cross section of up to 800 mm²

In insulation for cables with conductor cross sections below or equal to 800 mm², the wall thickness must have a median and nominal value of 18.0 mm.

The minimum value may not be lower than 17.30 mm.

The ratio between maximum and minimum measured values must not exceed a ratio of 1.07 within one sectional plane.

**T max / T min ≤ 1.07**

### 9.2.2 Requirements for conductor insulation for conductor cross section of 1000 mm² or above

For cables with conductor materials made from aluminium, a median and nominal value of 16.0 mm applies for all cross sections of 1000 mm² or above.

The minimum value may not be lower than 15.4 mm.

The ratio between maximum and minimum measured values must not exceed a ratio of 1.07 within one sectional plane.

**T max / T min ≤ 1.07**

### 9.2.3 Additional insulation requirements

Measurement of individual values for insulation must ensure proper measuring and documentation of the thickest and thinnest point in the insulation. Additional measurements are to be carried out if more than six measurements (with 60° increments) are required in order to obtain these values.

Inner and outer conductive layers must be excluded when calculating the insulation layer thickness.

The insulating cover cross section may not be larger or smaller than the values below (necessary individual values for wall thickness measurement):

| Cross section | Min. diameter | Max. diameter |
|---|---|---|
| 300 mm² | 58.00 mm | 62.00 mm |
| 630 mm² | 68.50 mm | 72.00 mm |
| 800 mm² | 73.00 mm | 78.00 mm |

### 9.2.4 Irregularities in the insulation

Irregularities in the insulating cover can only be tolerated when isolated (maximum of two per 250 mm sample length – irrespective of size). The following requirements apply:

- There cannot be any irregularities larger than 0.10 mm at their widest point.
- Irregularities smaller than 0.10 mm at their widest point must be inspected in conjunction with the client, then assessed and individually approved (regardless of the inspection results).
- Additional checks (follow-up tests) must be carried out if irregularities are discovered in the insulation. (See 10.4 Repetition of tests)
- Irregularities in the insulating cover must not extend into the inner conductive layer by more than 0.060 mm.

## 9.3 Conductive layers

Cables must have an inner conductive layer for field boundaries with the conductor, or an outer conductive layer for those with the insulating layer.

The conductive layers must be connected to the insulation via a triple extrusion. The extrusion must have a triple extrusion head.

The conductive layers must be made of an extruded, conductive polymer compound.

The conductive layer wall thickness must not be below 0.50 mm.

**The difference between the highest and lowest values for wall thickness measurements must not exceed 0.80 mm (within one sectional plane).**

### 9.3.1 Inner conductive layer

Contact cables under the inner conductive layer must establish electrical contact between the conductor and the inner conductive layer. The inner conductive layer must not extend so far into the outer wire layers of the conductor that they affect the boundary layer with the insulation.

There should not be any significant protrusions or indents on the inner conductive layer. Isolated irregularities can be tolerated if they are in line with the following:

- Irregularities on the inner conductive layer may not extend more than 0.060 mm into insulating cover.
- Irregularities with height h ≥ 0.040 mm must have a difference of ≥ 3 between the base (b) and height (h).
- Irregularities with height (h) smaller than 0.040 mm are not counted.

When exposed to the maximum authorised short-circuit force (Berlin = 40 kA/1s), the inner conductive layer and contact cables must not be affected in any way which would stop the cable from functioning properly.

### 9.3.2 Outer conductive layer

Shield wires may only extend very slightly into the outer conductive layer. This must not fall below the minimum required wall thickness (0.50 mm).

## 9.4 Wire

Degasification of manufactured wires must be performed in a suitable heating cabinet and documented. This log must be transmitted to the client. The log must include clear information on the starting point (date, time), end point (date, time) plus the temperature (measurements taken during this period). Furthermore, the relevant degasification work instruction must be provided.

## 9.5 Shield

The specific resistance for shield components must not exceed the following value: 0.01786 ohm x mm²/m at a temperature of 20°C.

Cables in the shield must be laid in a longitudinally and transversely watertight manner. Use of unbound swelling powder is prohibited. No toxic materials may be used to ensure longitudinal watertightness. The relevant material safety data sheets must be submitted.

The shield must consist of copper wires and one or two helix copper tape(s). The shield must be laid directly over the outer conductive layer binding.

The minimum required diameter for shield wires is 0.50 mm. The minimum thickness for helix copper tape is 0.10 mm. The following requirements apply to the amounts and dimensions of helix copper tape: either a helix copper tape with a diameter of minimum 1.00 mm² may be used, provided that the distance between two neighbouring tapes along the cable longitudinal axis does not exceed 4D, or two helix copper tapes with diameters of minimum 0.50 mm² may be used, provided that the distance between two neighbouring tapes does not exceed 2D (where D = constructed value for diameter under the shield).

The wires should be evenly distributed over the circumference. The average interval (based on measurements of five largest and smallest intervals over a circumference) between individual wires and any other metallic components (e.g. steel tubes for fibre optic cables) may not exceed 4.0 mm. The interval between individual wires and any other metallic components must never exceed 8.0 mm.

Permissible bends in shield wires may be ≥ 150°.

The shield cross section is calculated as a geometric cross section. At least 10% of the wires must be measured. The required shield cross section is calculated by adding the geometric cross sections of individual components (individual wires + helix copper tape; minus aluminium foil on the transversal water barrier).

## 9.6 Separation layer

There must be a suitable, **conductive** separation layer (semi-conductive tape) between the shield wires and the aluminium foil, acting as a transversal water barrier for the sheath.

When exposed to the maximum authorised short-circuit force, the separation layer must not be affected in any way which would prevent the cable from functioning properly (including impairment of longitudinal watertightness).

## 9.7 Oversheath

Compliant with DIN VDE 0276-632-3, Table 7, $ST_7$

### 9.7.1 PE-copolymer coated aluminium sheath

The oversheath must be an aluminium/polyethylene polymer coated sheath (Al/PE-copolymer coated aluminium = overlapping, metallic foil held in place by a PE sheath). It must be manufactured via an extrusion process. Use of other substances in order to obtain minimum wall thickness is prohibited, as is any removal of the sheath for a second extrusion. **The oversheath should not have a conductive layer unless specifically requested by the client.**

The median wall thickness for the PE-oversheath is 4.0 mm. The layer of aluminium foil should be excluded from the calculation of the oversheath wall thickness. At no point may the thickness be under the minimum limit of 3.3 mm.

The layer of aluminium foil must be excluded from the calculation of the sheath wall thickness.

### 9.7.2 Metallic foil

A longitudinally inserted layer of aluminium foil of at least 0.2 mm should be used.

The entire surface of the aluminium foil layer must be securely glued to the PE sheath. There must not be any air bubbles or creases.

The aluminium foil overlap must be at least 15 mm and must be securely glued across the whole surface without any creases.

There should not be any detached parts which have peeled off the aluminium foil overlap area. Individual peeled-off parts can be tolerated under the following circumstances:

- if the individual strips are of max. 1 mm
- if the wall thickness (as measured from the tip of the detached strip of aluminium foil on the PE sheath to the outside of the PE sheath) is not below the median wall thickness of the PE sheath.

### 9.7.3 Labelling on oversheath

Each cable oversheath must display the manufacturer name, the product model, description, date of manufacture, four-digit metre designation, an indication of the semi-conductive cable sheath and a cable code number. Labelling on the oversheath must be repeated at least every 100 cm.

All labelling, including metre designation, should be stamped onto the cable sheath (embossed or stamp-pressed).

Colour printing processes are not permissible. If the contractor justifies use of such a process when no other alternative is possible, then approval must first be obtained from the client's technical department before cable production commences. Proof that print labelling is resistant to abrasion (e.g. under DIN VDE 0276-605) must be assessed and documented so that the durability of printed labelling can be verified.

### 9.7.4 External diameter

The diameter across the oversheath must not exceed the following dimensions:

| **Conductor cross section** | **Max. diameter** |
|---|---|
| 300 mm² | 76.0 mm |
| 630 mm² | 85.0 mm |

| | |
|---|---|
| 800 mm² | 90.0 mm |

## 10 General test conditions

Ambient temperature during testing should be 15 to 25°C, unless agreed otherwise.

More specifically, the **following section of the standard on measuring resistance** should be used:

- **DIN VDE 0276-632-3; Section 10.5 – Measuring the electrical resistance of conductors and metal shields/sheaths.**

## 11 Tests on cables

### 11.1 Routine cable inspection and testing

Table 1 of this TD must be used for these tests, in addition to DIN VDE 0276-632-3.

### 11.2 Screening of cables

Table 2 of this TD must be used for these tests, in addition to DIN VDE 0276-632-3.

### 11.3 Official acceptance to be carried out with client present

Appointments for these tests must be made and agreed upon **at least eight weeks** in advance.

The client must be present for 30% of all routine inspection and testing.

A technical fact sheet including electrical characteristics must be submitted for approval.

The following electrical tests must be performed:

- voltage testing of cables on the cable delivery drum
- PD measurement
- measuring electrical resistance in the conductor and metal shield
- measuring capacity
- tan δ measurement
- sheath testing, where necessary.

Samples should be taken from cable ends for screening, with the client present. The following non-electrical screening tests are to be performed:

- assembly checks for cables (one sample from cable outer end – 1 m)

  - External diameter
  - coating (adherence)
  - position of shield wires, shield wire intervals, bends in shield wire
  - shield cross section, number of shield wires
  - diameter of outer conductive layer
  - conductor diameter, number of conductor wires
- measurement of conductor wire wall thickness (two samples from both cable ends)
- measurement of oversheath wall thickness (two samples from both cable ends)
- silicone transparency test (for every two axial and radial samples from both cable ends)
- thermal expansion/hot set test (two samples from both cable ends).

## 11.4 Repetition of tests

As specified in DIN VDE 0276-632-3.

If a sample fails the tests set out in DIN VDE 0276-632-3 and in this TD, the following steps should be taken:

As well as further samples taken from two other parts of the same batch, two additional samples should also be taken from the section which initially failed the tests, and tested according to DIN VDE 0276-632-3.

## 11.5 Type approvals

### 11.5.1 Type approval (electrical properties)

See Table 3 for details of tests to be carried out. The tests set out in this table are to be performed on a length of cable in the order specified. The cable length must be at least 20 m long without fittings, or should measure 10 m between the terminal and other fittings.

The cable length between (non-terminal) fittings must be at least 5 m long.

Type approval for cables must be performed as a system test including fittings. Section 12 in this TD also applies to fittings.

The selection of fittings must be carried out and agreed upon before commencing tests. All fittings included in the type approval process must first be subject to routine inspection and testing with the client present (as set out in Table 5) before commencing type approval.

The testing system should normally include two outdoor cable terminations, a CB sleeve and a (Vattenfall-standard) connector solution.

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 15 (30) |

### 11.5.2 Type approval (non-electrical properties)

See Table 4 of this TD for details of tests to be carried out.

### 11.5.3 Repetition of type approvals

As specified in DIN VDE 0276-632-3.

## 11.6 Silicone transparency test

The silicone transparency tests require sufficiently large, cylindrical beakers and clear, clean silicone oil as well as a suitable light source (evenly illuminated surface). The test is performed in silicone oil.

Axial test samples must be at least 300 mm long (with a minimum of 250 mm for the silicone oil for transparency test + 50 mm for rotation of sample in the oil). The outer conductive layer should be removed in a way which strips away as little insulation as possible. The person performing these tests must have suitable protective clothing made available to them (safety goggles, suitable gloves).

Furthermore, radial test samples with an outer conductive layer and without a conductor must be produced for testing. They must be at least 80 mm long. The visible surface of the insulation should be treated in a way which provides a clear, unobstructed view of the insulation.

Both ends of the cable on each drum should undergo a silicone transparency test, which is to be performed and documented. These logs must be sent to the client's technical department before delivery.

If any abnormalities are observed during the silicone transparency test then further tests must be performed. The client and contractor should agree upon the number of additional tests to be performed. However, at least three additional samples must be taken from the section of cable showing abnormalities for further silicone transparency tests. If abnormalities are still observed in these test samples, then the cable has failed the silicone transparency test and the cable section will not be approved.

# 12 Fitting requirements

## 12.1 Sleeve transverse watertightness

The sleeve must be an effective water vapour barrier with integrated metal diffusion barriers.

There must be an electrically conductive interconnection between this water vapour barrier and the cable shield.

## 12.2 Connecting the transversal water barrier and cable shield

Sleeves and terminals must have a current-conducting connection between the cable's metal (aluminium foil) transversal water barrier and the shield.

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 16 (30) |

# 13 Fitting tests

## 13.1 Routine inspection and testing of fittings

Routine inspection and testing of **all** prefabricated and pre-testable sleeves, cast resin parts and stress cones for terminals or connectors must be carried out with the client present.

Electrical strength and lack of partial discharge must be verified as part of routine electrical inspection and testing of prefabricated sleeves, cast resin parts and stress cones.

Inspection for any mechanical damage to sleeve parts and stress cones following the electrical tests can be carried out by visually checking the cleaned test units. No deviations from desired nominal state can be tolerated.

See Table 5 for details of routine inspection and testing to be carried out.

## 13.2 Type approval for fittings (electrical properties)

### 13.2.1 General

All fittings included in the type approval process must first be subject to routine inspection and testing with the client present (as set out in Table 5) before commencing type approval.

See Table 6 for details of tests to be carried out. The tests set out in this table are to be performed on a sample in the order specified.

The fittings are to be fitted onto a length of cable which should conform to "the technical description for 110 kV cables with cross-linked polyethylene insulation". There must be at least 5 m of cable separating the fittings.

Fitting type approval can be carried out at the same time as cable type approval.

In addition to electrical tests, all fittings must be taken apart and evaluated with the client present.

### 13.2.2 Leak tests using variable pressure and DC voltage tests for the sleeve outer protective jacket

Pressure cycling tests must be used to verify sleeve impermeability, with 20 cycles in the air and 20 cycles in water (water temperature at 70°C). This test can be combined with the pressure cycling tests under Table 6, Section 4.1.

The water pressure part of the test should involve the sleeve being exposed to water pressure in a 1 m water column. The test must be set up so that all sealed parts of the outer casing are subject to water pressure.

Following pressure cycling tests, the test cable length must be allowed to cool down to room temperature. Then DC voltage tests can be carried out, at 25 kV for a duration of 1 minute.

Voltage is applied between the cable shield and a counter electrode placed across the whole surface of the sleeve outer casing.

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 17 (30) |

### 13.2.3 Electrical strength of shield break for cross-bonding sleeves

See Table 6 Point 8 for details of tests to be carried out.

DC voltage tests and surge voltage tests must be carried out on the interval between cable shields on the cable ends to be connected (including outer conductive layers) and the outer casing surface, as well as between the conductive layers. Before these tests, the sleeve must undergo pressure cycling tests with 20 cycles in the air and 20 cycles in water (water temperature at 70℃). This pressure cycling test can be combined with the pressure cycling tests under Table 6, Section 4.1.

Surge voltage tests and subsequent DC voltage test are to be performed on the conductive layers and the surface of the outer sleeve casing.

The surge voltage test on the conductive layers (Table 6 Point 7.3.2) requires 10 surges each of both positive and negative polarity. Test voltage must be 75 kV.

DC voltage tests (Table 6 Point 7.3.1) are to be performed at 25 kV for a duration of 1 minute.

The surge voltage test (Table 6 Point 7.3.3) on the conductive layers and surface of the outer sleeve casing requires 10 surges each of both positive and negative polarity. Test voltage must be 37.5 kV. As part of this test, the cable sheath on the test section must also be tested. A suitable counter electrode must be applied to the cable sheath in order to do this.

DC voltage tests (Table 6 Point 7.3.1) are to be performed at 25 kV for a duration of 1 minute.

### 13.2.4 Repetition of type approvals

If the samples do not pass the tests set out in this technical description, the entire type approval shall be deemed to have been failed and must be repeated.

## 14 Geometry of the insulation connector

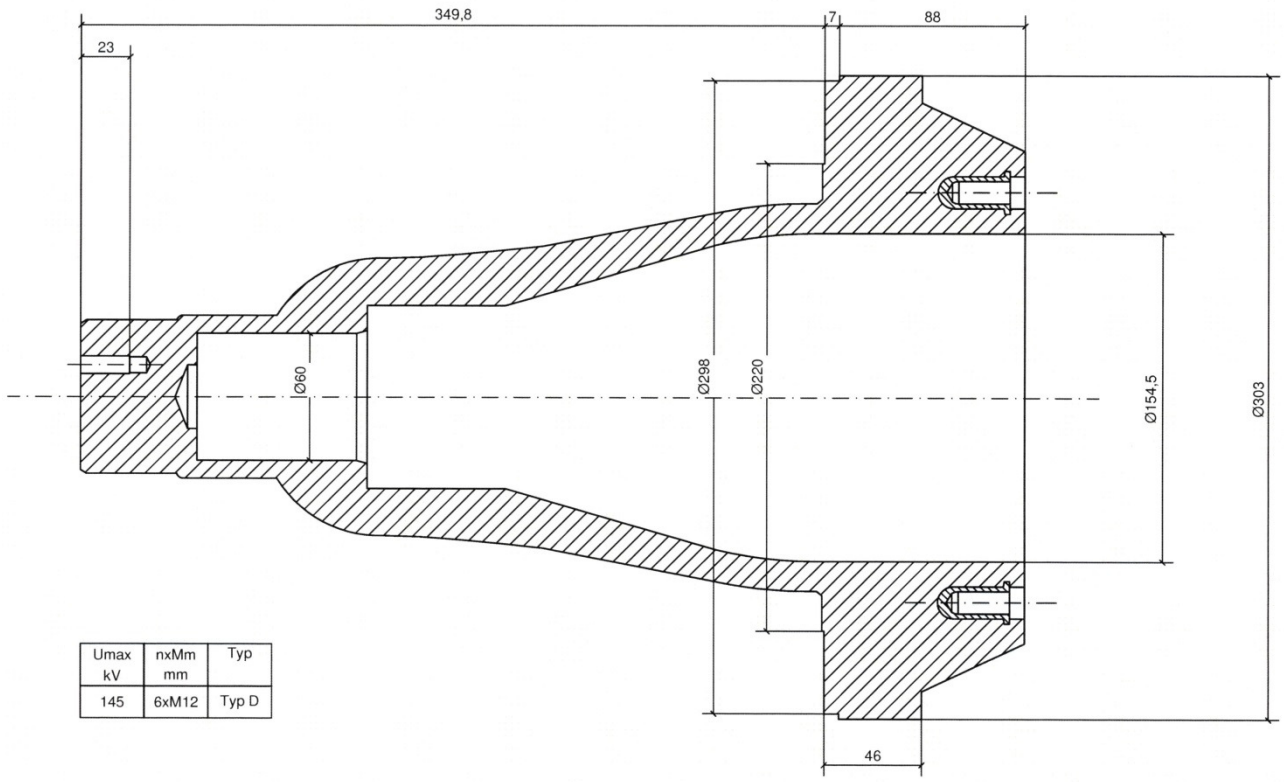



Illustration 14-1 *Geometry of the insulation connector*

Geometry of the insulation connector equipment for 110 kV SF6 switchgears and 110 kV transformers – layout drawing (excerpt from drawing 3-1-0257-1 dated 15 April 2013).

# 15 Test tables

## 15.1 Routine inspection and testing of 110 kV XLPE cables

Table 15-1 Routine inspection and testing of 110 kV XLPE cables

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Order of tests | Sections 2 to 8 in this table | |
| 2. | Electrical tests on oversheath without conductive layer | No disruptive breakdown | DIN EN 60229<br>Section 3.2 |
| 3. | Voltage test<br>- Sample: delivery length<br>- Test voltage 3.0 $U_0$<br>- Duration of testing 30 min. | No disruptive breakdown | DIN VDE 0276-632-3 Part 4-D |
| 4. | Partial discharge test (to be performed immediately after test 3)<br>- Sample: delivery length<br>- Strength of calibration pulse 2 pC<br>- Permissible interference level $\leq$1 pC<br>- Test AC voltage 2.5 $U_0$ | No partial discharge from test specimen observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 5. | tan **δ** measurement | DIN VDE 0276-632-3 Table 3 | DIN VDE 0276-632-3<br>Section 12.4.5 |
| 6. | Conductor resistance<br>- Conductor<br>- Shield | DIN EN 60228<br>Table 2<br>Table 2<br>Current TD, Section 9.5 | DIN EN 60228<br>Section 5.3<br>Section 5.2 |
| 7. | Capacity | Manufacturer fact sheet | DIN VDE 0276-632-3<br>Section 10.10 |
| 8. | Electrical tests on oversheath with conductive layer | No disruptive breakdown | DIN EN 60229<br>Section 3.1 |

Note:

Testing for partial discharge test must be carried out immediately following the voltage test and during voltage reduction.

## 15.2 Screening of 110 kV XLPE cables

Table 15-2 Screening of 110 kV XLPE cables

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Conductor<br>- Number of individual wires<br>- Diameter | DIN EN 60228<br>Current TD, Section 9.1 | DIN EN 60228<br>Visual checks<br>DIN VDE 0276-605 |
| 2. | Conductive layers<br>- Wall thickness<br>- Irregularities | <br>Current TD, Section 9.3<br>Current TD, Section 9.3 | <br>DIN EN 60811-201<br>DIN VDE 0276-605<br>Section 2.1.10.2 |
| 3. | Insulation<br>- Wall thickness<br>- Diameter across insulating cover<br>- Minimum wall thickness<br>- Consistency of wall thickness<br>- Irregularities/silicone transparency test<br><br><br>- Thermal expansion/hot set test | <br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 11.6<br><br>DIN VDE 0276-632-3 | <br>DIN EN 60811-201<br>DIN EN 60811-203<br>DIN EN 60811-201<br>DIN EN 60811-201<br>Current TD, Section 11.6<br>DIN VDE 0276-605<br>Section 2.1.10.2<br>DIN EN 60811-507 |
| 4. | Shield<br>- Measures and nominal cross section (geometric)<br>- Shield wire intervals<br>- Specific resistance of shield structure | <br>Current TD, Section 9.5<br>Current TD, Section 9.5<br>DIN VDE 0276-632-3 | <br>DIN VDE 0276-605<br><br>DIN EN 60228 |
| 5. | Oversheath<br>- Wall thickness<br>- Minimum wall thickness<br>- External diameter | <br>Current TD, Section 9.7<br>Current TD, Section 9.7<br>DIN VDE 0276-632-3<br>Current TD, Section 9.7 | <br>DIN EN 60811-202<br>DIN EN 60811-202<br>DIN EN 60811-203 |
| 6. | Labelling | Current TD, Section 9.7 | Visual checks |

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 21 (30) |

## 15.3 Type approval for 110 kV XLPE cables (electrical properties)

Table 15-3 Type approval for 110 kV XLPE cables (electrical properties)

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Order of tests<br>- Sample: whole cable | Section 2 to 8 in this table | |
| 2. | Bending testing followed by rated power frequency withstand voltage test and partial discharge test | | |
| 2.1 | Bending testing<br>- Bending diameter: 20 (d + D) +5%<br>D = outer diameter, actual value<br>d = conductor diameter, actual value | | DIN VDE 0276-632-3 |
| 2.2 | Rated power frequency withstand voltage test<br>- Test AC voltage 230 kV<br>- Duration of testing 1 min. | No disruptive breakdown | |
| 2.3 | Partial discharge test (ambient temperature)<br>- Strength of calibration pulse 2 pC<br>- Permissible interference level $\leq$1 pC<br>- Test AC voltage 2.5 $U_0$ | No partial discharges from test subject observed | DIN EN 60885-3 |
| 3. | tan $\delta$ measurement | DIN VDE 0276-632-3 Table 3 | DIN VDE 0276-632-3 Section 12.4.5 |
| 4. | Pressure cycling tests followed by partial discharge test | | |
| 4.1 | Pressure cycling test<br>- Heating the sample via conductor heating<br>- Heating cycle: 24 hours<br>Heat sample for eight hours at 5 to 10 K above the permitted conductor temperature, maintaining this temperature for at least two hours before 16-hour cool-down<br>- Test AC voltage 2.5 $U_0$<br>- Number of cycles 20 | | DIN VDE 0276-632-3 Part 4-D |

| | | | |
|---|---|---|---|
| 4.2 | Partial discharge test<br>- Strength of calibration pulse 2 pC<br>- Permissible interference level ≤1 pC<br>- Test AC voltage 2.5 $U_0$ | No partial discharges from test subject observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 5. | Surge voltage test followed by AC voltage test | | |
| 5.1 | Lightning surge voltage test (at increased temperature)<br>- Heat the sample at 5 to 10 K above the permitted conductor temperature, maintaining this temperature for at least two hours<br>- Surge voltage amount 550 kV<br>- Number of surges: - 10 surges of positive polarity<br>- 10 surges of negative polarity | No disruptive breakdown | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60230<br>DIN EN 60060 |
| 5.2 | Voltage test<br>- Test AC voltage 2.5 $U_0$<br>- Duration of testing 4 hours | No disruptive breakdown | DIN VDE 0276-632-3 Part 4-D |
| 6. | Partial discharge test<br>- Strength of calibration pulse 2 pC<br>- Permissible interference level≤1 pC<br>- Test voltage 2.5 $U_0$ | No partial discharges from test subject observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 7. | Testing the oversheath<br>- DC Voltage 20 kV/1 min.<br>- Surge voltage 37.5 kV<br>- Number of surges - 10 surges of positive polarity<br>- 10 surges of negative polarity | No disruptive breakdown<br>No disruptive breakdown | DIN EN 60229 |
| 8. | Visual checks | DIN VDE 0276-632-3 | DIN VDE 0276-632-3 |

## 15.4 Type approval for 110 kV XLPE cables (non-electrical properties)

Table 15-4 Type approval for 110 kV XLPE cables (non-electrical properties)

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Tests on insulation | | |
| 1.1 | Mechanical properties<br>a) before ageing<br>b) after ageing in heating cabinet | DIN VDE 0276-632-3 | DIN EN 60811-501<br>DIN EN 60811-401 |
| 1.1 | Contraction | DIN VDE 0276-632-3 | DIN EN 60811-502 |
| 1.2 | Thermal expansion/hot set test | DIN VDE 0276-632-3 | DIN EN 60811-507 |
| 2. | Tests on oversheath | | |
| 2.1 | Mechanical properties<br>a) before ageing<br>b) after ageing in heating cabinet | DIN VDE 0276-632-3 | DIN EN 60811-501<br>DIN EN 60811-401 |
| 2.2 | Heat/pressure resistance | DIN VDE 0276-632-3<br>DIN EN 60811-508 | DIN EN 60811-508 |
| 2.3 | Stress-fracture resistance | HD 620, Part 1<br>Table 4 B, DMP 2 | EN 60811-406<br>Follow testing method B but change duration to 1000 h |
| 2.4 | Soot content | DIN VDE 0276-632-3 | DIN EN 60811-605 |
| 2.5 | Contraction test | DIN VDE 0276-632-3 | DIN EN 60811-503 |
| 2.6 | Test on PE-copolymer coated aluminium sheath | DIN VDE 0276-632-3 Annex F<br>Current TD, Section 9.7 | DIN VDE 0276-632-3 Annex F |
| 3. | Ageing test on whole cable to verify compatibility of materials | DIN VDE 0276-632-3 | DIN EN 60811-401 |
| 4. | Tests on whole cable | | |
| 4.1 | Ageing across whole cable | DIN VDE 0276-632-3 | DIN EN 60811-401 |
| 4.2 | Shore type-D hardness of the PE sheath | HD 620, Part 1<br>Table 4 B, DMP 2 | HD 605<br>Section 2.2.1 |

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 24 (30) |

| | | | |
|---|---|---|---|
| 4.3 | Water penetration test | DIN VDE 0276-632-3 Annex E<br>**Along a cable length of 3 m rather than 6 m** | DIN VDE 0276-632-3<br>Annex E |
| 5. | Review of cable assembly | | |
| 5.1 | Conductor<br>- Number of individual wires<br>- Diameter | DIN EN 60228<br>Current TD, Section 9.1 | DIN EN 60228<br>Visual checks<br>DIN VDE 0276-605 |
| 5.2 | Conductive layers<br>- Wall thickness<br>- Irregularities | <br>Current TD, Section 9.3<br>Current TD, Section 9.3 | <br>DIN EN 60811-201<br>DIN VDE 0276-605<br>Section 2.1.10.2 |
| 5.3 | Insulation<br>- Wall thickness<br>- Diameter across insulating cover<br>- Minimum wall thickness<br>- Consistency of wall thickness<br>- Irregularities/silicone transparency test | <br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 9.2<br>Current TD, Section 11.6 | <br>DIN EN 60811-201<br>DIN EN 60811-203<br>DIN EN 60811-201<br>DIN EN 60811-201<br>Current TD, Section 11.6<br>DIN VDE 0276-605<br>Section 2.1.10.2 |
| 5.4 | Shield<br>- Measures and nominal cross section (geometric)<br>- Shield wire intervals<br>- Specific resistance of shield structure | <br>Current TD, Section 9.5<br>Current TD, Section 9.5<br>DIN VDE 0276-632-3 | <br>DIN VDE 0276-605<br><br>DIN EN 60228 |
| 5.5 | Oversheath<br>- Wall thickness<br>- Minimum wall thickness<br>- External diameter | <br>Current TD, Section 9.7<br>Current TD, Section 9.7<br>DIN VDE 0276-632-3<br>Current TD, Section 9.7 | <br>DIN EN 60811-202<br>DIN EN 60811-202<br>DIN EN 60811-203 |
| 5.6 | Labelling | Current TD, Section 9.7 | Visual checks |

## 15.5 Routine inspection and testing of prefabricated fittings and pre-testable fittings parts

Table 15-5 Routine inspection and testing of prefabricated fittings and pre-testable fittings parts

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Dimension checks and visual checks | No deviations from desired nominal state detected (e.g. dimensions, bumps, holes, loose parts, blemishes) | Measuring equipment<br>Lamp<br>Endoscope |
| 2. | Voltage test<br>- Test voltage 3.0 $U_0$<br>- Testing time 30 min.<br>- Permissible interference level ≤1 pC | No disruptive breakdown | DIN VDE 0276-632-3 |
| 3. | Partial discharge test (to be performed immediately after test 3)<br>- Strength of calibration pulse 2 pC<br>- Test voltage 2.5 $U_0$<br>- Duration of testing 1 min.<br>- Permissible interference level ≤1 pC | No partial discharges from test subject observed | DIN VDE 0276-632-3<br>DIN EN 60885-3 |
| 4. | Visual checks | - Test subject cleaned and degreased<br>- No deviations from desired nominal state detected (e.g. bumps, holes, loose parts, blemishes) | Lamp<br>Endoscope |

Note:

If the test setup for fittings parts produces higher electrical field strengths in voltage testing (compared with readings which would have been obtained if the fittings had been fitted on a cable that conformed to the present provisions), the manufacturer and client's technical department should agree upon a test voltage.

## 15.6 Type approval for 110 kV XLPE-cable fittings (electrical properties)

Table 15-6 Type approval for 110 kV XLPE-cable fittings (electrical properties)

| | Tests | Requirements | Testing method |
|---|---|---|---|
| 1. | Order of tests | Sections 2 to 8 in this table | |
| 2. | Rated power frequency withstand voltage test<br>- Test AC voltage 230 kV<br>- Duration of testing 1 min. | No disruptive break-down | |
| 3. | Partial discharge test<br>- Strength of calibration pulse 2 pC<br>- Test voltage 2.5 $U_0$<br>- Duration of testing 1 min.<br>- Permissible interference level $\leq$1 pC | No partial discharg-es from test subject observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 4.<br><br>4.1 | Pressure cycling tests followed by partial dis-charge test<br>Pressure cycling test<br>- Heating the sample via conductor heating<br>- Heating cycle: 24 hours<br>Heat sample for eight hours at 5 to 10 K above the permitted conductor tempera-ture, maintaining this temperature for at least two hours before 16-hour cool-down<br>- Test AC voltage 2.5 $U_0$<br>- Number of cycles in the air 20<br>Number of cycles in water 20 | | DIN VDE 0276-632-3 Part 4-D |
| 4.2 | Partial discharge test<br>- Strength of calibration pulse 2 pC<br>- Test voltage 2.5 $U_0$<br>- Duration of testing 1 min.<br>- Permissible interference level $\leq$1 pC | No partial discharg-es from test subject observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 5. | Surge voltage test followed by AC voltage test | | |

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 27 (30) |

| | | | |
|---|---|---|---|
| 5.1 | Lightning surge voltage test<br>- Heat the sample at 5 to 10 K above the permitted conductor temperature, maintaining this temperature for at least two hours<br>- Surge voltage amount 550 kV<br>- Number of surges<br>10 surges of positive polarity<br>10 surges of negative polarity | No disruptive breakdown | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60230<br>DIN EN 60060 |
| 5.2 | Voltage test<br>- Test AC voltage 2.5 $U_0$<br>- Duration of testing 4 hours | No disruptive breakdown | DIN VDE 0276-632-3 Part 4-D |
| 6. | Partial discharge test<br>- Strength of calibration pulse 2 pC<br>- Permissible interference level $\leq$ 1 pC<br>- Test AC voltage 2.5 $U_0$ | No partial discharges from test subject observed | DIN VDE 0276-632-3 Part 4-D<br>DIN EN 60885-3 |
| 7. | Test on sleeve outer protective jacket<br>Authorisation for sleeves without separated shields can be officially accepted once the tests on a cross bonding sleeve have been successfully completed.<br>This test must be performed on a sleeve which has already successfully passed the previous tests from Sections 2 to 6. | | DIN VDE 0276-632-3 Annex G |
| 7.1 | Storage in water and heating cycles<br>- Water column 1 m<br>- Heating/cooling cycles: minimum 24 hours<br>Heat sample for 12 hours at 15 to 20 K below the permitted conductor temperature, followed by cooling in water at 30 °C<br>- Number of water heating/cooling cycles 20 | | DIN VDE 0276-632-3 Annex G |
| 7.2 | Underwater test on **sleeves without separated shields**<br>- Test DC voltage 25 kV<br>- Duration of testing 1 min. | No disruptive breakdown | DIN VDE 0276-632-3 Annex G |

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 28 (30) |

| | | | |
|---|---|---|---|
| 7.3<br>7.3.1 | Underwater tests on **cross bonding sleeves**<br>Voltage test<br>1. Test between the shield/metal sheaths at both ends of sleeve<br>2. Test between the shield/metal sheaths and the earthed surface of sleeve outer protective casing<br>- Test DC voltage 25 kV<br>- Duration of testing 1 min. | No disruptive breakdown | DIN VDE 0276-632-3 Annex G |
| 7.3.2 | Surge voltage test between conductive layers<br>- Surge voltage amount 75 kV<br>- Number of surges: - 10 surges of positive polarity<br>- 10 surges of negative polarity | No disruptive breakdown | DIN VDE 0276-632-3 Annex G<br>DIN EN 60230 |
| 7.3.3 | Surge voltage tests on the conductive layers and the surface of the outer sleeve casing<br>- Surge voltage amount 37.5 kV<br>- Number of surges: - 10 surges of positive polarity<br>- 10 surges of negative polarity | No disruptive breakdown | DIN VDE 0276-632-3 Annex G<br>DIN EN 60230 |
| 8. | Analysis of testing procedure | No visible signs of water or corrosion detected | DIN VDE 0276-632-3 Annex G |

| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 29 (30) |

# Appendix

## I. Abbreviations and definitions

| | |
|---|---|
| TD | technical description |
| XLPE | cross-linked polyethylene |
| CB sleeve | cross-bonding connection sleeve |

## II. List of illustrations

Illustration 14-1 Geometry of the insulation connector

## III. List of tables

Table 1-01 Overview of amendments

Table 15-1 Routine inspection and testing of 110 kV XLPE cables

Table 15-2 Screening of 110 kV XLPE cables

Table 15-3 Type approval for 110 kV XLPE cables (electrical properties)

Table 15-4 Type approval for 110 kV XLPE cables (non-electrical properties)

Table 15-5 Routine inspection and testing of prefabricated fittings and pre-testable fittings parts

Table 15-6 Type approval for 110 kV XLPE-cable fittings (electrical properties)

Table IV-01 Revision index

Table IV-02 Overview of document creation, document owners, checking and approval

## IV. Revision index

Table IV-01 *Revision index*

| Version n | |
|---|---|
| Section | Topic |
| | |
| | |
| **Version n-1** | |
| Section | Topic |
| | |

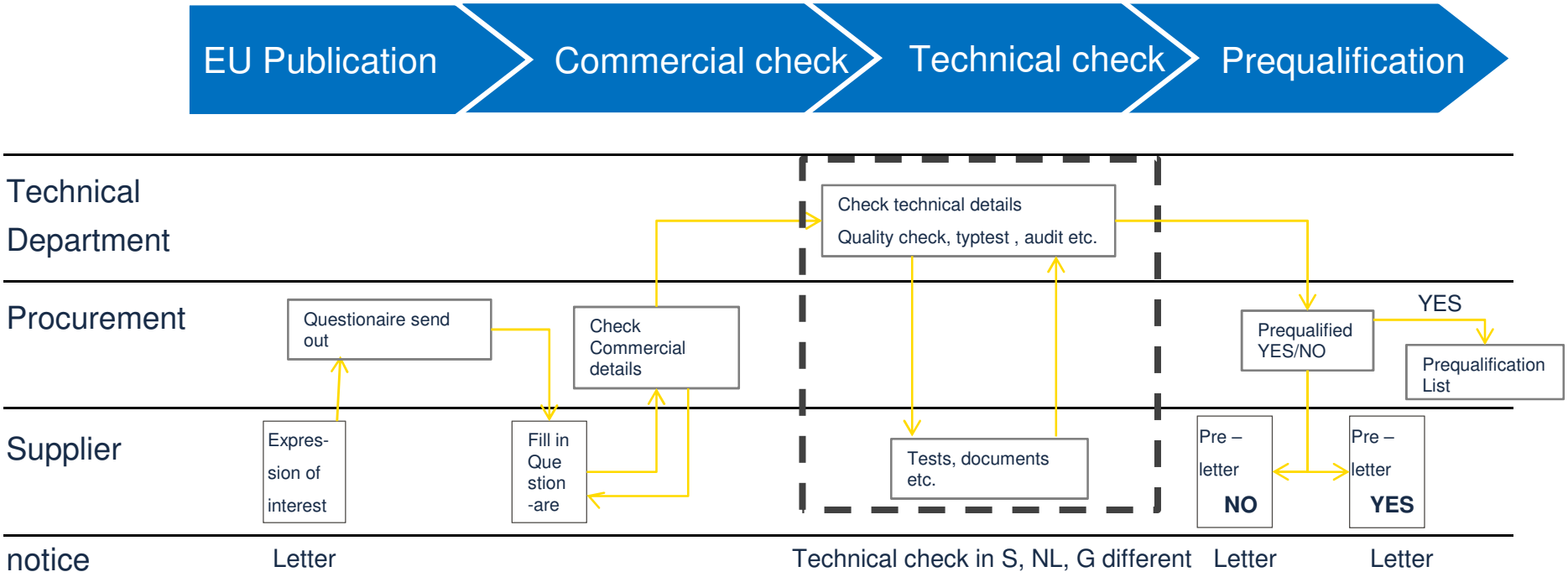
| Document Reference Number: | Title: | Version: | Number of Pages: |
|---|---|---|---|
| TD3514 | 110 kV cables and fittings | Berlin 1 | 30 (30) |

| | |
|---|---|
| | |

Table IV-02 *Overview of document creation, document owners, checking and approval*

| | Created: | Owned by: | Checked: | Approved: |
|---|---|---|---|---|
| Date: | 8 April 2014 | | | |
| By: | Volkmar Ulewski | Mr Wunderlich | | |

# Process of Prequalification (simple)




The same documents in Sweden and Germany for EU Publication, Questionnire , Concept of PQ Evaluation concept and checklist audit

## 4. Concept of Quality Monitoring

| CONCEPT OF QUALITY MONITORING | | Quality status of supply | | | | Related infromation from Vattenfall |
|---|---|---|---|---|---|---|
| **Quality criteria** | **Sub-Criteria** | **Approved** | **Action plan** | **Escalation plan** | **Stopped** | Note: If one category (=sub criteria) gets into "red" status, the supplier will immediately lose its general PQ-status. A new application fro pre-qualification is posible. |
| Technical | Deviation to technical specification | | | | | |
| | Deviation to technical specification influencing functionality of the cable or system. | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to technical specification not influencing functionality of the cable or system. | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation during factory acceptance testing (FAT) | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to type test setup | | | | | |
| | Deviation during testing (SAT) | | | | | |
| Logistics | Late delivery according to Purchase Order/ Project Time Plan (OTD) | | | | | |
| | Incorrect handling of cables/ drums/ goods | | | | | |
| | Incorrect packaging of cables/ drums/ goods | | | | | |
| | Damaged cables/ drums/ goods | | | | | |
| Execution | Deviation to SFT (specification to tenders) - Health & Safety | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to SFT - Personnel | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to SFT - Technical requirements and general regulations | | | | | Applicable only for HV & Sub Marine Cables |
| | Deviation to Documentation | | | | | Applicable only for HV & Sub Marine Cables |
| Commercial | Failures during guarantee time | | | | | |
| | Deviations in delivery statistics | | | | | |
| Other | Health & Safety Issues | | | | | |
| | Environmental Issues | | | | | |
| | Cooperation | | | | | |

# KRITERIENKATALOG
Qualifizierungssystem

Verfahren: 2020001980 - CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL - Sweden and Germany

## EIGNUNGSKRITERIEN

# KRITERIENKATALOG
Qualifizierungssystem

Verfahren: 2020001980 - CABLE PRE QUALIFICATION SYSTEM FOR USE BY VATTENFALL - Sweden and Germany

## LEISTUNGSKRITERIEN

| Name | Dateiname | Größe | MIME-Type |
|---|---|---|---|
| Cable Prequalification System Sweden and Germany | Cable Prequalification System Sweden and Germany.pdf | 798,77 KB | application/pdf |
| 1.1 ND-Sb-00724_TS MV, 12-24 kV | 1.1 ND-Sb-00724_TS MV, 12-24 kV.pdf | 343,85 KB | application/pdf |
| 1.2 ND-Sb-00725_TS Covered con oh-l, 24 kV | 1.2 ND-Sb-00725_TS Covered con oh-l, 24 kV.pdf | 323,09 KB | application/pdf |
| 1.3 Cable factory audit - SE | 1.3 Cable factory audit - SE.pdf | 494,00 KB | application/pdf |
| 1.4 MV Cables SWEDEN - Supplier reply form | 1.4 MV Cables SWEDEN - Supplier reply form.xlsx | 18,58 KB | application/vnd.openxmlformats-officedocument.spreadsheetml.sheet |
| 2.1 PQ questionnaire LV MV HV cables | 2.1 PQ questionnaire LV MV HV cables .xlsx | 358,39 KB | application/vnd.openxmlformats-officedocument.spreadsheetml.sheet |
| 2.2 GER_LV_MV_specification ENG | 2.2 GER_LV_MV_specification ENG.pdf | 540,38 KB | application/pdf |
| 2.3 GER_LV_MV_specification ENG_Supplements | 2.3 GER_LV_MV_specification ENG_Supplements.pdf | 117,84 KB | application/pdf |
| 2.4 GER_TB3514_110kV-Kabelsystem_V-B1.1_Berlin_EN_akt- 06.2019 | 2.4 GER_TB3514_110kV-Kabelsystem_V-B1.1_Berlin_EN_akt- 06.2019.pdf | 490,15 KB | application/pdf |
| 3.1 Process of EU Cable Prequalification | 3.1 Process of EU Cable Prequalification.pdf | 15,28 KB | application/pdf |
| 3.2 Concept of Quality Monitoring | 3.2 Concept of Quality Monitoring.pdf | 31,01 KB | application/pdf |