NPS/002/022 – Technical Specification for 66kV Power Cables

1. Purpose

The purpose of this document is to detail the technical requirements of Northern Powergrid (the Company) in relation to 66kV power cables for use on the Company's distribution network.

This document supersedes the following documents, all copies of which should be destroyed.

Document Reference	Document Title	Version	Published Date
NPS/002/022	Technical Specification for 66kV Power Cables	4.0	January 2023

2. Scope

This specification details the requirements for 66kV power cables for use on the company's distribution network.

It will also be necessary to consider and include any project specific requirements as detailed in Appendix 4: Addendum to Supplier Requirements. Additionally, suppliers shall provide details of any periodic inspection and maintenance information requirements in Appendix 5: Maintenance and Inspection Requirements.

Technical documents referenced within this specification refer to the latest versions of the relevant International Standards, British Standard Specifications and all relevant Energy Networks Association Technical Specifications (ENATS) current at the time of supply.

The following appendices form part of this technical specification:

- Appendix 1 - Cables Type / Sizes,
- Appendix 2 - Logistical requirements,
- Appendix 3 - Self certification conformance declaration,
- Appendix 4 - Addendum to Supplier Requirements,
- Appendix 5 - Maintenance and Inspection Requirements, and,
- Appendix 6 - Technical Information Check List.

2.1. Table of Contents

3. Technical Requirements

3.1. Conditions of Installation

Cables specified in this document shall be installed in accordance with the Company's policy NSP/002 – Policy for the Installation of Distribution Power Cables. Cables specified in this document will be pulled or laid into open trenches, pulled into ducts or installed in air. Cables may also be installed directly by trenchless installation techniques. During storage and after installation cables can be expected to be subjected to the full range of climatic conditions encountered in the UK. Cable may be surrounded by ground water for most of their operating lives. Where cable is installed in ducts, flooding of ducts can occur resulting in permanently wet sections along the cable route. Cables installed above ground will be supported by means of cleats either vertically or horizontally and these cables may be exposed to direct sunlight for significant periods. Cables may be installed up wood poles in contact with the pole and therefore in contact with a pole preservation medium such as creosote.

Accessories may be cold applied or require the application of heat.

3.2. Conditions of Operation

Power cables purchased in accordance with this specification are required to operate under conditions stipulated in:

- IMP/001/913 - Code of Practise for the Economic Development of the EHV System, and,
- IMP/001/909 – Code of Practice for Distribution System Parameters.

The following are general conditions of operation and represent the minimum requirements for 66kV power cables:

- Nominal system voltages: 66kV.
- All cables and associated equipment for use on the system shall be rated at a minimum of 72.5kV.
- Nominal system frequency: 50Hz.
- The system operates with the neutral point earthed either directly or through a resistance or reactance at one or more points.
- Suitable for 3 ph symmetrical short circuit currents of 20kA for 2 seconds and phase to earth fault currents of 3kA for 2 seconds (note: at 66kV phase to earth currents are less than 3 ph currents) where the system has been designed with an earth fault factor of 1.73.

3.3. 66kV Power Cables

66kV power cables of single core extruded insulation design shall be in single core configuration only.

66kV power cables required to be supplied against this specification shall comply with the latest issues of the relevant ENATS, British and International Standards specified. These are:

- BS 7912 - Power cables and accessories, for rated voltages 66kV to 132kV,
- BS EN 60885-2 - Electrical test methods for electric cables — Part 2: Partial discharge tests,
- IEC 60840 - Power cables with extruded insulation and their accessories for rated voltages above 30kV (Um = 36kV) up to 150kV (Um = 170kV) – Test methods and requirements,
- IEC 60228 - Conductors in Insulated cables,
- BS EN 60228 - Conductors in Insulated cables,

- CIGRE TB 446 - Advanced design of metal laminated coverings: recommendation for tests, guide to use, operational feedback,
- CIGRE TB 303 - Revision of qualification procedures for HV and EHV AC extruded underground cable systems,
- HD 632 S2 - Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um = 42 kV) up to 150 kV (Um = 170 kV),
- ENATS 09-16 - Tests on power cables with XLPE insulation and metallic sheath and their accessories, for rated voltages of 66 kV (Um = 72.5 kV), 110 kV (Um = 123 kV) and 132 kV (Um = 145 kV).

Further reference can be found in Appendix 3 – Self Certification Conformance Declaration.

3.3.1. Conductors

Conductors shall be class 2 compacted stranded copper or aluminium in accordance with BS EN 60228/IEC 60228. Aluminium conductors shall be longitudinally water-blocked utilising tapes/fabrics. Hygroscopic powders or gels as a barrier between the conductor wires shall not be accepted.

Waterblocking shall be tested to meet or exceed the requirements of;

- Water penetration test as specified in IEC 60840((Annex F)
- Water blocking test for phase conductors as specified in BS 7912 Annex D

For 1600mm² and above conductors of a Milliken design shall be used. The minimum number of sectors of Milliken conductor shall be five, but six sectors are preferred.

Both copper and aluminium conductor constructions shall be compatible with use of mechanical connectors. The manufacturer shall declare as to whether water blocking materials within the conductor should be removed or left in-situ when installing mechanical connectors.

The range of conductor cross sections and materials required is as detailed in Appendix 1.

3.3.2. Insulation and Screens

The conductor screen, insulation and insulation screen shall be applied as a continuous single pass triple extrusion free of factory repairs. The cross-linking process shall be completely “Dry Cured” and no water will be used during this process. The vulcanisation tube shall be filled with either dry nitrogen or with oil that is compatible with the insulation and screen materials.

The average thickness of the conductor and insulation screen shall be equal to or thicker than 1.5mm.

The volume resistivity of the conductor screen before and after ageing shall not exceed 1000 Ω·m and insulation screen shall not exceed 500 Ω·m.

The insulation type shall be cross linked polyethylene (XLPE), with properties as detailed in tables 6 and 8 of IEC 60840. The nominal insulation thickness shall be 12mm.

The insulation screen shall be the "fully bonded" type.

All cables will be “De- gassed” for a minimum four days at a continual 65ºC **± 5˚C**. Manufacturers should ensure that cables are sufficiently degassed to ensure optimal cable performance.

Shrinkage tests of insulation shall be as specified in BS 7912 Clause 10.1.6 (Table 4)

3.3.3. Metallic Screen and Moisture Blocking

Cables shall have either a lead sheath or smooth welded aluminium sheath (SWAS) which will normally comply with the required fault rating and no less than the source substation single phase to earth fault.

However, in areas of high fault current, additional copper screen wires may be required. Smooth welded aluminium sheath (SWAS) without the required additional copper wire screens that covers the higher fault current requirement, is preferable. If copper wire screens are to be used for SWAS cable, the supplier shall provide evidence that no corrosion between the copper wire screens, and SWAS will not compromise earth fault performance throughout serviceable life.

All cables shall be blocked against longitudinal moisture transmission and shall pass the moisture penetration tests outlined in IEC 60840 (annexe F).

3.3.3.1. Lead Sheathed Cables

The lead sheath shall consist of a seamless tube of lead alloy E (Types as set out in BS EN 12548 or BS EN 50307) extruded over the longitudinal water blocking tape(s)..

A layer of Bitumen, having a softening point > 80˚C, or a suitable, agreed alternative shall be applied over the lead sheath.

3.3.3.2. Smooth Welded Aluminium Sheath(SWAS) Cables

The welded aluminium sheath shall be a longitudinally alloy tube and shall be effectively bonded to the protective oversheath to prevent the passage of moisture along the interface between the two components and to provide a cable construction with appropriate mechanical performance.

The smooth welded aluminium sheath shall provide equivalent or superior thermo-mechanical and moisture blocking performance when compared to a traditional seamless extruded metallic sheath. The manufacturer shall demonstrate effective and reliable performance of their welded aluminium sheath design.

Cable system earth fault continuity (comprising the longitudinally welded aluminium sheath, it's connections to accessories and the accessories themselves) shall be demonstrated by testing as per Cigre 446 to have a short circuit capability greater than or equal to that that specified for the cable system. IEC 60840 does not define specific requirements for welded aluminium cable sheaths and the requirements of this specification are based on the guidance in CIGRE TB 446.

• The aluminium sheath shall be a "Combined Design" as defined in TB 446.

• The aluminium sheath shall be longitudinally welded; glued designs are not permitted.

• The aluminium sheath shall be of sufficient cross section to carry the required short circuit current without additional copper wires.

• The aluminium sheath shall be straight walled, corrugated designs are not permitted.

• The aluminium sheath shall be fully bonded to the extruded oversheath. Long term ageing of the adhesive bonds of the components of the laminated covering shall be in accordance with CIGRE TB 446 section 2.2.1.4

• Delivered cable lengths shall contain a longitudinal Weld only, circumferential welds shall not be permitted

Manufacturers shall carry out a sheath shrinkage cable system test over 80 cycles as recommended in CIGRE TB 303 and referenced in CIGRE TB 446

3.3.4. Protective Oversheath

The over sheath shall consist of an extruded layer of black MDPE, either Polyolefin DMZ1 coloured black or Polyethylene type ST7 coloured black. The mechanical properties complying to HD 632 S2(Table 7) for DMZ1 type and IEC 60840 (Table 7) for ST7. Abrasion test according to CIGRE TB 446 shall be required for Polyolefin DMZ1 type.

Manufacturers shall carry out a sheath shrinkage cable system test over 80 cycles as recommended in CIGRE TB 303 and referenced in CIGRE TB 446.

Lead Sheath Cables - Manufacturers shall carry out a sheath shrinkage test in accordance with IEC 60840 12.5.17

SWAS Cables - Manufacturers shall carry out a sheath shrinkage cable system test over 80 cycles as recommended in CIGRE TB 303 and referenced in CIGRE TB 446.

Nominal thickness of the oversheath for lead sheath cables shall be accordance with BS 60840 Clause 10.6.2. Nominal thickness of the oversheath for SWAS cables shall be 3.8mm for cables up to 1200mm² and 4.3mm above 1200mm²

A continuous extruded semi conducting layer shall be applied upon the outer sheath to provide an electrode for sheath voltage tests. A “baked” graphite layer may be offered as an option, although preference will be given to cables having a semi-conducting extruded material

The over sheath shall be indent printed or embossed with the following legend along two or more evenly spaced lines.

ELECTRIC CABLE 66000 V

Additional markings indicating the manufacturing reference, the year and month of manufacture, and metre length marking can be either indented or printed.

The oversheath shall be marked in accordance with the requirements of HD 632 4A and 6A with the following details in a legible and durable manner.

- Identification for traceability (lot or batch number)
- Metre markings
- Manufacturers reference
- Year and month of manufacture
- Standard of manufactured cable specification(i.e. IEC 60840) and conductor size(i.e. 1 x 630)

The height of the characters shall be a minimum of 8mm and the spacing between the end of one sequence of marks and the beginning of the following sequence of marks shall not exceed 300 mm.

The markings shall be applied in two identical lines, equally spaced by 180° around the circumference of the cable.

3.3.5. Long Term Ageing

Cable designs offered must have successfully undergone CIGRE long term ageing tests in accordance with amendment 3, clause 5.4.15 to CENELEC HD 605. See also section 3.3 and clause 4.5.

Long term ageing of the adhesive bonds of the components of the laminated coverings shall be carried out according to Cigre TB 446.- The recommended temperature for the long-term ageing of the bonding is 80±3oC.

4. References

The cables shall comply with the relevant International Standards, British Standard Specifications and all relevant Energy Networks Association Technical Specifications (ENATS) current at the time of tendering, except where varied by this standard. In respect the following documents are particularly relevant.

4.1. External Documentation

Reference	Version / Date	Title
BS 7912	Dec 2012	Power cables and accessories, for rated voltages 66kV to 132kV
BS EN 60228	Mar 2005	Conductors in Insulated cables
IEC 60228	2023	Conductors in Insulated cables
BS EN 60885-2	Sep/2003	Electrical test methods for electric cables — Part 2: Partial discharge tests
CENELEC HD 605		Electrical Cables – Additional test methods
ENATS 09 - 16	2023	Tests on power cables with XLPE insulation and metallic sheath and their accessories, for rated voltages of 66 kV (Um = 72.5 kV), 110 kV (Um = 123 kV) and 132 kV (Um = 145 kV)
IEC 60840	May 2020	Power cables with extruded insulation and their accessories for rated voltages above 30kV (U_m = 36kV) up to 150kV (U_m = 170kV) – Test methods and requirements
CIGRE TB 446		Advanced Design of Metal Laminated Coverings: Recommendation for Tests, Guide to Use, Operational Feed Back
CIGRE TB 303		Revision of qualification procedures for HV and EHV AC extruded underground cable systems.
IEC 60229		Electric cables – Tests on extruded oversheaths with a special protective function
BS 7970		Electric cables - Metal foil and longitudinally welded aluminium sheath constructions of power cables having XLPE insulation for rated voltages from 66 kV (Um = 72.5 kV) to 132 kV (Um = 145 kV)
HD 632 S2		Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um = 42 kV) up to 150 kV (Um = 170 kV)

The supplier shall provide with the tender full technical details of the equipment offered and shall indicate any divergence from these standards or specifications.

4.2. Internal Documentation

Reference	Title
IMP/001/909	Code of Practice for Distribution System Parameters
IMP/001/913	Code of Practice for the Economic Development of the EHV System
NSP/002	Policy for the Installation of Distribution Power Cables

4.3. Amendments from Previous Version

Reference	Title
Document version	Changed from version 4.0 January 2023 to version 5.0 October 2024
3.3 - 66kV Power Cables	Amended and added/removed specifications(ENATS, BS and international) relevant to NPS specification
3.3.1 - Conductors	Amended to relevant specifications and new addition of Aluminium conductors
3.3.2 – Insulation and Screens	Amended to include new specifications Removed and replaced updates on thickness of semi-conductive screens

Reference	Title
	Removed specifications for 2% shrinkage and replaced with current shrinkage specifications requirements
3.3.3 – Metallic Screen and Moisture Blocking	Amended to include new specifications and SWAS cable Added 3.3.3.1 & 3.3.3.2 3.3.3.1 – additional requirement change for Bitumern layer
3.3.4 – Protective Oversheath	Change for 'Oversheath' to 'Protective Oversheath' Amended to include new specifications and SWAS cable Removed specifications for 2% shrinkage and replaced with current shrinkage specifications requirements
3.3.5 – Long Term Ageing	Amended to include additional SWAS cable requirements
4.1 – External Documentation	Amended to remove irrelevant specifications and add relevant specifications
Appendix 1 – Cable Types Utilised	Include new SWAS Aluminium cross sections
Appendix 3 - Self Certification Conformance Declaration	Amended to relevant specifications and requirements and additional SWAS cables.

5. Definitions

Term	Definition
The Company	Northern Powergrid
SWAS	Smooth Welded Aluminium Sheath
XLPE	Cross Linked Polyethylene
MDPE	Medium Density Polyethylene

6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document, and I am satisfied with its content and submit it for approval and authorisation.

		Date
Eve Fawcett	Governance Administrator	04/11/2024

6.2. Author

I sign to confirm that I have completed and checked this document, and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period;

Standard CDS review of 3 years?	Non-Standard Review Period & Reason	
No	Period: 5 Years	Reason: Update will be dictated by contract renewal date or any significant changes in the specification or documents referenced.
Should this document be displayed on the Northern Powergrid external website?		Yes

		Date
Paul Hanrahan	Engineer – Asset Management	04/11/2024

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Aaron Chung	Policy & Standards Engineer	05/11/2024
Steve Salkeld	Policy & Standards Engineer	04/11/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	System Engineering Manager	27/11/2024

Appendix 1 – Cable Types Utilised

Cable Type	Commodity Code
66kV Single Core – Lead Sheath	
300mm^2 Circular Stranded Copper Conductor*	TBC
400mm^2 Circular Stranded Copper Conductor	TBC
500mm^2 Circular Stranded Copper Conductor*	TBC
630mm^2 Circular Stranded Copper Conductor	TBC
800mm^2 Circular Stranded Copper Conductor	TBC
66kV Single Core - SWAS	
630mm^2 Circular Stranded Aluminium Conductor	TBC
800mm^2 Circular Stranded Aluminium Conductor	TBC
1000mm^2 Circular Stranded Aluminium Conductor	TBC
1200mm^2 Circular Stranded Aluminium Conductor	TBC
1600mm^2 Circular Stranded Aluminium Conductor	TBC
2000mm^2 Circular Stranded Aluminium Conductor	TBC

* The 66kV cable types presented in the above table align with the standard design requirements of IMP/001/913 - Code of Practice for the Economic Development of the EHV System.

Further cable types presented in the above table form part of the company Assessed Product Database as they may be required as a result of individual scheme designs.

Appendix 2 – Logistical Requirements

All cable drums shall be returnable, and the tenderer shall arrange to collect empty drums from the company's normal delivery locations.

Tenderers shall state at the time of tender their proposed cable drum sizes and weights for each cable type offered.

All cable drums shall be marked in accordance with the relevant cable Specification or Standard. The drum label shall also contain:

(a) Customers catalogue number

(b) Name of manufacturer

(c) Supplied length

(d) Rated voltage

(e) Number of cores

(f) Size of conductor

(g) Type of conductor material ("Cu" or "Al")

(h) Abbreviated description of cable construction

(I) Gross and nett weights

(j) Direction of rolling drum

(k) The metre marking starts and end values

(l) The unique reference number

Cable drums may be stored for long period's outdoors. All drum labels shall remain legible and durable under these conditions.

The ends of all cables shall be effectively sealed against the ingress of moisture by a method appropriate to the cable type. Tenderers shall detail at the time of tender their proposed sealing arrangement for each cable type offered.

The cable end projecting from the drum shall be protected from damage during transit, storage and handling on site.

The cable on the drum shall not be susceptible to damage during transit, storage and handling on site.

Tenderers shall state at the time of tender their proposed method of protection for each cable.

Each delivery length of cable shall be allocated a unique reference number. This number shall appear on the factory test sheet covering the cable length, shall be clearly marked on the drum on which the length is delivered and shall be referred to on all invoices and advice notes.

Appendix 3 – Self Certification Conformance Declaration

66kV power cables required to be supplied against this specification shall comply with the latest issues of the relevant ENATS, British and International Standards specified. The following tables are intended to amplify and/or clarify the requirements of elements of these Standards but do not preclude meeting all requirements of the standards.

The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes, where appropriate indicating if tests are type or routine tests.

Conformance declaration codes

N/A = Clause is not applicable/ appropriate to the product

Cs1 = The product conforms fully with the requirements of this clause

Cs2 = The product conforms partially with the requirements of this clause

Cs3 = The product does not conform to the requirements of this clause

Cs4 = The product does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

Instructions for completion

- When Cs1 code is entered no remark is necessary.
- When any other code is entered the reason for non-conformance shall be entered.
- Prefix each remark with the relevant 'BS EN' 'IEC' or 'ENATS' as appropriate.

Manufacturer:

Product Reference:

Details of the Cable Type (Voltage, Conductor Type and Size)

Name:

Signature:

Date:

NOTE: One sheet shall be completed for each type of cable offered.

Specification for 66kV Power Cables			
	Clause / Requirements	**Conformance Code**	**Remarks / Comments**
Lead Alloy Sheathed			
Conductor	• BS EN 60228 • IEC 60228		
Conductor Examination	• IEC 60840 10.4		
Conductor Resistance	• IEC 60840 10.5		
Conductor and Insulation Screen Thickness	• Average equal to or thicker than 1.5mm		
Conductor Screen, Insulation & Insulation Screen:	• Continuous single pass triple extrusion (free from factory repairs)		
	• Fully Bonded		
	• Dry Cured Cross Linking		
Conductor Screen	• Volume resistivity before and after ageing, not exceeding 1000 Ω·m.		
Insulation Screen	• Volume resistivity before and after ageing, not exceeding 500 Ω·m.		
Insulation Thickness	• Nominal 12mm		
	• IEC 60840 10.6.2 • BS 7912 9.6.2 & 12.4		
Insulation Shrinkage	• BS 7912 Clause 10.1.6 (Table 4) • ENATS 09-16		
Metallic Sheath Thickness	• IEC 60840 10.7 • BS7912 9.6.4		
	• Fault Current Capacity		
Moisture Penetration Test	• IEC 60840 (annexe F)		
Protective Oversheath : (Lead sheath cables)	• Extruded MDPE, IEC 60840 Table 2		
	• IEC 60840 9.4		
- Electrical Test	• IEC 60840 10.6.3 • BS 60840 12.5.16		

- Thickness - Shrinkage			
Bending Test	• BS 7912 12.5 • IEC 60840 12.4.3		
Hot Set Test(All Cable Types)	• IEC 60840 10.9		
Partial Discharge Test(All Cable Types)	• IEC 60840 9.2 / BS 7912 12.6		
Voltage Test(All Cable Types)	• IEC 60840 9.3		
Voltage Test(All Cable Types)	• BS 7912 9.3		
Load Cycle Voltage Test	• BS 7912 12.9		
Impulse Voltage Test (All Cable Types)	• BS 7912 12.10		
Smooth Welded Aluminium Sheath (SWAS)			
Conductor	• BS EN 60228		
Water-blocking longitudinally (Aluminium conductors)	• IEC 60840(Water penetration test) • BS 7912 Annex D		
Water blocking material mechanical connector compatibility	• Remove: • Leave in-situ:		
Conductor Examination	• IEC 60840 10.4		
Max dc Conductor Resistance	• IEC 60228 Annex A		
Conductor and Insulation Screen	• Conductor screen before and after ageing shall not exceed 1000 Ω·m: • Insulation screen before and after ageing shall not exceed 500 Ω·m:		
Conductor and Insulation Screen Thickness	• Equal to or thicker than 1.5mm:		
Insulation Thickness	• Nominal 15mm:		
	• IEC 60840 10.6.2		
Insulation Shrinkage	• BS 60840 12.5.16		
Longitudinal Moisture Barriers	• IEC 60840: (Annexe F) • IEC 60840: (Annexe E) • BS 7912 (Annex D)		

	• CIGRE TB 446 section 2.1.1.4 – Long Term Ageing of the adhesive bonds on the laminated covering		
Metallic Sheath	• Grade of Aluminium - 1050		
	• BS 7912 - 15.4: Corrosion penetration test for Aluminium sheathed cables		
	• Nominal thickness - earth fault current level:- - 31.5Ka/1 sec: - 40Ka/1 sec: • Aluminium sheath only: • Aluminium sheath + CWS:		
	• Mechanical properties of the welding:- • - CIGRE TB 446 section 2.2.1.5		
	• Sheath Shrinkage test:- - CIGRE TB 303: 80 cycles:		
Metallic Sheath(including Copper Wire Screens)	• 3.3.3. – Evidence of non-corrosion and performance		
Bending and Impact Test	• Bending Test:- - IEC 60840 – 12.4.3: - CIGRE TB 446: • Impact Test:- - IEC 60840: - CIGRE TB 446: - BS 7912 - 15.2:		
Protective Oversheath(MDPE)	• Mechanical Properties; • Polyolefin DMZ1 coloured black: - HD 632 S2 (Table 7) • Polyethylene type ST7 coloured black: - IEC 60840 (Table 7)		

	• Abrasion test : (Polyolefin DMZ1 only) - CIGRE TB 446: - BS 7912 – 15.3:		
	• Nominal Thickness:- - <1200mm² :3,8mm - <1200mm²: 4.8mm		
	• Conductive Layer: - Extruded - 'Baked' Graphite		
	• sheath shrinkage cable system test over 80 cycles as recommended in CIGRE TB 303 and referenced in CIGRE TB 446		

Appendix 4 – Addendum to Supplier Requirements

For each power cable offered the Tenderer shall provide the following cable rating data: -

- Cable rating laid direct (Amps)
- Cable rating laid in a 150mm internal diameter duct (Amps)
- Cable rating in air (Amps)
- The 3 ph symmetrical short circuit and phase to earth short circuit rating
- Maximum dc resistance per phase conductor at 20^0C (Ohms/km)
- Maximum ac resistance per phase conductor at maximum conductor temperature (Ohms/km)
- Star reactance at 50Hz (Ohms/km)
- Star capacitance at 50Hz (Ohms/km)
- Charging current per phase at normal voltage and frequency (mA/m)
- Zero sequence impedance $R_0 + jX_0$ (Ohms/km)
- Minimum dynamic bending radius (mm) (In Triplex and single core formations)
- Minimum static bending radius (mm)
- The minimum average insulation thickness
- The maximum electrical stress on the conductor screen and insulation screen
- Recommended pulling method and maximum pulling tension (kgF)

The following assumptions shall be made when quoting ratings: -

- Single core cables laid direct or in air are in close trefoil, in ducts trefoil at 150mm centres.
- Cover to top of cables being 910mm
- Ground Thermal Resistivity = 1.2 K m/W
- Ground temperature = 15^0C
- Air temperature = 25^0C

The oversheath of all cables shall be marked in accordance with the requirements of the relevant Standard specified in this document.

All cables shall be metre marked throughout the length of the cable and the start and end values shall be marked on the drum label.

Cables shall be marked with some form of reference or batch number that can be used to ensure batch trace ability of materials and manufacturing facilities used in the construction of the cable.

Appendix 5 – Pre-commission testing, Routine Inspection and Maintenance Requirements

Suppliers shall provide details of the recommended pre-commission testing and inspection required.

They shall also provide information regarding periodic inspection and maintenance requirements to be undertaken during the lifetime of their product.

Detailed inspection and maintenance instructions shall also be provided.

Appendix 6 – Technical Information Check List

The following information shall be provided by the supplier for technical review by Northern Powergrid. Additional information shall be provided if requested.

Requirement	Provided (Y/N)
Full product descriptions and part number/reference	
Appendix 3 – completed self-certification conformance declaration	
Complete set of drawings for each variant	
Type test evidence	
Routine test plan (example)	
Pre-commissioning testing/inspection requirements	
Recommended periodical inspection and maintenance requirements	
Packaging/delivery information	