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Underground cables from 1 kV to 20 kV (U_M =24 kV)

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Underground cables from 1 kV to 20 kV (U_M =24 kV)

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CONTROL CHANGES

Rev.	Date	Summary of changes/Reason for changes	Modified pages
00	October 2017	Initial Edition	All
01	July 2018	Changed Annexes structure Annex A1 and D1 - Addition of 630 mm^2 Aluminium cables to the designation and codes cables for i-DE Inclusion of UIL company in AVANGRID	All
02	January 2020	Main Body: removed Avangrid references to copper tape shield cable Annex A3: Revised Avangrid 15kV cable codes as part of standardization effort Annex D3: Revised Avangrid 15kV cable additional characteristics & tests as part of standardization effort	All
		Annex A1.2: Revised i-DE references – reduction of codes	Chapter A1.2
		Logo and company name changed from IBDE to i-DE	All
		Integration of all the Brazilian distribution companies into Neoenergia	All
03	May 2021	Insertion of Neoenergia Distribuição Brasília as new Neoenergia Company	Specific pages for Neoenergia
		Change in tables 2, 3 and 4 for Neoenergia	10, 11 and 13
		Insertion of Section 4.8 Sustainability Requirements	16
		Included Standardized wording in Section 10	20
		Revised Neoenergia Annex A4 and Annex D4 to include all currently existing Neoenergia cable codes	Annex A4 and Annex D4
		Section D2.4 included for SPEN	Annex D2
04	September 2023	General Updates for Avangrid	Specific pages for Avangrid
		Section D4.1.2 for Neoenergia	Annex D4

CONTENTS

1. SCOPE

This specification details the requirements for distribution cables (U_M = 24kV) with extruded XLPE, HEPR or EPR insulation intended to operate in Iberdrola Networks.

For the purposes of this specification, the term “Iberdrola Networks” refers to i-DE, SP Energy Networks (SPEN), Central Maine Power Company, New York State Electric & Gas, Rochester Gas and Electric, and United Illuminating (AVANGRID), and Coelba, Cosern, Elektro, Pernambuco and Neoenergia Distribuição Brasília (NEOENERGIA).

The requirements specific to i-DE, SPEN, AVANGRID and NEOENERGIA, are addressed in the ANNEXES of this specification.

The figures given in this standard are for illustration only.

2. REFERENCES

The following documents, in whole or in part, are normatively referenced in this document and are necessary for its application. In case of a discrepancy between any of the listed reference standards and the INS-Standard, the INS standard shall take precedence. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

In the event of conflict(s) among standards, codes, and this specification, the supplier shall refer the conflict to The Company for resolution. All decisions made by the Company shall be stated in writing to be valid.
The cable furnished shall be in accordance with, but not limited to, the requirements and specifications outlined in the following standards.

For i-DE and SPEN (XLPE only):

- HD 605: Electric cables. Additional test methods.
- HD 308: Identifications and use of cores of flexible cables.
- HD 620 - (1): Distribution cables with extruded insulation for rated voltages from 3.6 / 6 (7.2) kV to 20.8 / 36 (42) kV. Part 1: General requirements.
- HD 620 - (9-E): Distribution cables with extruded insulation for rated voltages from 3.6 / 6 (7.2) kV to 20.8 / 36 (42) kV. Part 9: HEPR insulated single core and single core pre-assembled cables. Section E: Cables with polyolefin compound sheath (types 9E-1, 9E-4 and 9E-5).
- HD 620 - (10-E): Distribution cables with extruded insulation for rated voltages from 3.6 / 6 (7.2) kV to 20.8 / 36 (42) kV. Part 10: XLPE insulated single core and 3 core cables, and single core pre-assembled cables. Section E: Cables with polyolefin compound sheath (types 10E-1, 10E-3, 10E-4 and 10E-5).
- HD 620-S2 (11-O-1): EPR Insulated Cables, 11 and 33 kV single core with copper wire screen

- HD 620-S2 (10-O-1): XLPE Insulated Cables, 11 to 33 kV single core with copper wire screen, 11kV three core with collective wire screen, 33 kV single core with lead sheath
- IEC 60 228: Conductors of insulated cables.

For i-DE:

- UNE 21167: *Bobinas de madera para cables aislados de transporte y distribución. Características generales.* / Wood coils for transmission and distribution for insulated cables. General characteristics.

For SPEN:

- BS 6234: Specification for polyethylene insulation and sheath of electric cables.
- BS 6346: Specification for 600/1000 V and 1900/3300 V armoured electric cables having PVC insulation
- BS 7655: Insulation and sheathing materials for cables
- BS 7870: LV and MV polymeric insulated cables for use by distribution and generation utilities.
- ENATS 09-6: Auxiliary multicore and multipair cables.
- ENATS 09-17: Single core cable for use in substations having extruded insulation and rated voltages of 6.350/11.000 volts and 19.000/33.000 volts.

For AVANGRID:

- AEIC CS8-20: Specification for Extruded Dielectric Shielded Power. Rated 5 through 46 kV.
- ANSI/ICEA S-94-649-2021: Standard for Concentric Neutral Cables Rated 5 through 46 kV.
- ASTM B496 – 16(2021): Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductor.
- ASTM B400 – 19: Standard Specification for Compact Round Concentric-Lay-Stranded Aluminium 1350 Conductor
- ASTM B231/B231M – 16(2021): Standard Specification for Concentric-Lay-Stranded Aluminium 1350 Conductor.
- ASTM B122/B122M – 20: Standard Specification for Copper-Nickel Alloy.
- ASTM B3-13(2018): Standard Specification for Soft or Annealed Wire.
- ASTM B8-11(2017): Standard Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium Hard or Soft.
- ANSI / ICEA T-31-610, " Guide for Performance of a Longitudinal Water Penetration Resistance Test for Sealed Conductor"

- NEMA WC 26/EEMAC 201-2008 “Binational Wire and Cable Packaging Standard”.

For NEOENERGIA:

- ABNT NBR 6251: Insulated Power Cables for rated voltages 1 kV to 35 kV. Constructive requirements
- ABNT NBR 7286: Power Cables with Extruded Ethylene Propylene Rubber (EPR, HEPR or EPR 105) insulation for rated voltages from 1 kV to 35 kV. Performance requirements
- ABNT NBR 7295: Electric Wires and Cables. Test for Capacitance and Dissipation Factor.
- ABNT NBR 9311: Isolated Electric Cables. Classification and Designation Electrical Cables in Alternating Current and Impulse. Static Analysis of Dielectric Strength.
- ABNT NBR 16132: Halogen free, low smoke insulated and sheathed power cables, for rated voltages from 3 kV up to 35 kV — performance requirements

3. TERMS AND DEFINITIONS

Iberdrola Networks refers to i-DE, SPEN, AVANGRID Networks and NEOENERGIA.

i-DE: i-DE Redes Eléctricas Inteligentes
SPEN: SP Energy Networks, the brand name for the division of the ScottishPower group of companies that encompasses SP Transmission plc, SP Distribution plc, SP Manweb plc, SP Power Systems Limited and Scottish Power Energy Networks Holdings Limited.
AVANGRID Operating Companies: Central Maine Power Company, New York State Electric & Gas, Rochester Gas and Electric and United Illuminating Company.
NEOENERGIA: Coelba, Cosern, Elektro, Pernambuco and Neoenergia Distribuição Brasília
UNE: Una Norma Española
HD: Harmonization Document
IEC: International Electrotechnical Commission
IEEE: Institute of Electrical and Electronics Engineers
ICEA: Insulated Cable Engineers Association
AEIC: Association of Edison Illuminating Companies
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
ANSI: American National Standards Institute
ASTM: American Society for Testing and Materials
ISO: International Organization for Standardization
ABNT NBR: Brazilian Association of technical Standard
BS: British Standard
CENELEC: Comité Européen de Normalisation Electrotechnique
CNE: Combined Neutral & Earth
ENATS: Electricity Networks Association Technical Specification
EPR: Ethylene Propylene Rubber

LSOH: Low Smoke Zero Halogen
MDPE: Medium Density Polyethylene
PP: Polypropylene
PVC: Poly Vinyl Chloride
SNE: Separate Neutral & Earth
UNIPEDE: Union Internationale des Producteurs et Distributeurs d'Energie Electrique
XLPE: Cross Linked Polyethylene
SHEATH: Jacket in AVANGRID
OVERSHEATH: Also known as “outer sheath” or “protective (overall) jacket” (North America)

- non-metallic sheath applied over a covering, generally metallic, ensuring the protection of the cable from the outside
- Note 1 – In North America, the term sheath is generally used for metallic coverings, whereas the term jacket is used only for non-metallic coverings.
- Note 2 – In case of special bonding, the oversheath may provide electrical insulation of the underlying conducting covering.

APPROVED: Approved in writing by The Specifying Engineer
THE SPECIFYING ENGINEER: Person nominated by SP Energy Networks having responsibility for all technical matters relating to this Specification.
COMPANY: Refers to Iberdrola Networks
THE TENDERER: The supplier invited to submit a tender in accordance with this Specification.
THE CONTRACTOR: The Tenderer who has been awarded a supply contract based on this Specification.

Where applicable, the definitions provided in section 2 of HD 620-S2 (1) shall apply where the same terms are used in this document.

4. REQUIREMENTS

In following points there will be compared the requirements of different regions.

4.1 Ratings

4.1.1 Rated Voltage and Frequency

The rated voltages and frequency for the cables defined in this standard are indicated in *Table 1.*

Table 1: Rated Voltages by networks in i-DE, SPEN, AVANGRID and NEOENERGIA					
Designation	Unit	i-DE	SPEN[1]	AVANGRID	NEOENERGIA
U_0 (nominal phase-to-earth system voltage)	kV	12	6,35	8,66	8,7
U (nominal phase-to-phase system voltage).	kV	20	11	15	13,8
U_M (maximum design phase-to-phase voltage).	kV	24	12	16,5	17,5
Frequency	Hz	50	50	60	60

[1] - The working voltage of any part of the system does not normally exceed the normal system voltage by more than 10%. The system operates with the neutral point earthed directly. For 11kV system voltage, the maximum system earth fault level: phase – earth is 13.1kA for 3 seconds

4.1.2 Rated Current

Cable ratings will depend on various factors and shall be assessed for each individual installation project. Information about the most common installation conditions is provided in ANNEX D for buried and air installations.

Based on the installation condition types considered and according to the applicable standard for calculating, allowable intensities in steady state and the correction factors can be calculated the intensities admissible under these conditions other than the conditions described in ANNEX D, and should be justified to the project.

4.2 Conductor

Type of conductor, cross section and material are detailed in following annexes for each Company:

- ANNEX A1 for i-DE.
- ANNEX A2 for SPEN
- ANNEX A3 for AVANGRID
- ANNEX A4 for NEOENERGIA

4.3 Insulation

The conductor screen/shield, insulation and insulation screens/shield shall be applied in a continuous, single-pass, triple extrusion process free of factory repairs. The curing process shall be dry.

Type of insulation, insulation thickness, maximum electric potential gradient and maximum temperature in shortcircuit for different Iberdrola Networks regions are as follows:

Table 2: Insulation characteristics for i-DE and SPEN				
Insulation	Unit	i-DE(12/20)		SPEN(6,35/11)
Type		XLPE	HEPR	XLPE
Thickness	mm	5,5		3,4 (nominal)[1] 2,96 (minimum at any point)[1]
Maximum temperature in shortcircuit	ºC	250º in 5 sec		250º in 3 sec

Table 2: Insulation characteristics for AVANGRID and NEOENERGIA					
Insulation	Unit	AVANGRID(8,66/15)	NEOENERGIA(8,7/15)		NEOENERGIA(12/20)
Type		EPR	EPR	HEPR	EPR/ HEPR
Thickness	Mm(in)	4,445 (0,175)	4,5	3,5	5,5
Maximum temperature in shortcircuit	ºC	250º	250º in 5 sec		

[1] - The thickness of the insulation shall be as specified in BS 7840-4.10, Table 1.

4.4 Conductor and insulation screen/shield

The conductor and insulation screens/shields shall be compatible with the conductor and insulation materials, with no harmful effects on either material.

The interfaces between the screens and the insulation shall be smooth and free from protrusions, voids or contaminants and they shall adhere perfectly to the insulation surface.

Insulation screen thickness and type for different Iberdrola Networks regions are as follows:

Table 3: Conductor and insulation screen for i-DE and SPEN				
Cable Type	Unit	i-DE		SPEN
		XLPE	HEPR	XLPE
Screen type		Extruded cross-linked layer of semiconducting compound over the conductor	Extruded layer of semiconducting compound over the conductor	An extruded layer of semi-conducting compound, which shall be cross-linked during the manufacture of the cable and applied over the conductor.
Conductor screen thickness	mm	0,5		0,7 (nominal) 0,3 (minimum at any point)
Insulation screen type		Strippable	Strippable.	For single core cables the insulation screen shall be of the "fully bonded" type. For all other types, the insulation screen shall be of the "strippable" type

Insulation screen thickness	mm	0,5	Bonded: 0,5 (nominal) Bonded: 0,3 (minimum at any point) Strippable: 0,7 (nominal) Strippable: 0,5 (minimum at any point)

Table 3: Conductor screen for AVANGRID

Cable Type	Unit	AVANGRID			
		33.6-53.5-107.2 mm² 2-1/0-4/0 AWG	253.4 mm² 500 kcmil	380.0 mm² 750 kcmil	506.7 mm² 1000 kcmil
Screen/shield type		Covered with an extruded thermosetting conductor shield material. ICEA specification			
Conductor screen/shield thickness	mm(in)	>0,3(0,012)	>0,41(0,016)	>0,51(0,020)	>0,51(0,020)
Insulation screen type		Extruded semiconducting material. ICEA specification			
Insulation screen thickness	mm(in)	0,76(0,030) min. 1,52(0,060) max.	1,02(0,040) min. 1,91(0,075) max.	1,02(0,040) min. 1,91(0,075) max.	1,40(0,055) min. 2,29(0,090) max.

Table 3: Conductor and insulation screen for NEOENERGIA

Insulation	Unit	NEOENERGIA
		EPR/HEPR
Screen type		Non-metallic, consisting of a thermoset extruded layer juxtaposed to the conductor, easily removable and not adhering to the conductor, according to ABNT NBR 6251
Conductor screen thickness	mm	>=0,4
Insulation screen type		Extruded sheath of thermoset semiconductor composite, according to ABNT NBR 6251.
Insulation screen thickness	mm	>=0,4

4.5 Oversheath/Jacket

The cable that includes designation (AS) shall be used in cable galleries and substations and where the regulations of the local government or other regulatory agencies require cables with resistance to flame propagation.

Oversheath/jacket type, colour and thickness for different Iberdrola Networks Companies are listed in Table 4:

Table 4: Oversheath for i-DE					
	Unit	i-DE			
Conductor size	mm²	50	150	240	400
Thickness	mm	2,5	3		
External colour		Red with two longitudinal stripes of green in AS designation			
Type of sheath		DMZ1 for standard cables DMZ2 for AS designation cables UNE HD 620 10E in XLPE UNE HD 620 9E in HEPRZ1			

Table 4: Oversheath for SPEN									
	Unit	SPEN							
		single-core copper wire screened cables					three core copper wire screened cables[1]		
Conductor size	mm²	95	185	300	500	630	95	185	300
Minimum average thickness	mm	1,8	1,9	2,1	2,3	2,4	2,7	3,0	3,3
Minimum thickness at any point	mm	1,43	1,51	1,68	1,85	1,94	2,2	2,45	2,71
External colour		Red. Orange for AS designation (to BS 7870-3.50)							
Type of sheath		The oversheath shall consist of an extruded layer of red MDPE complying with the requirements of BS 6234 and the relevant sections of BS 7870 part 4. The compound shall have a density within the range quoted in EATS09-17.							

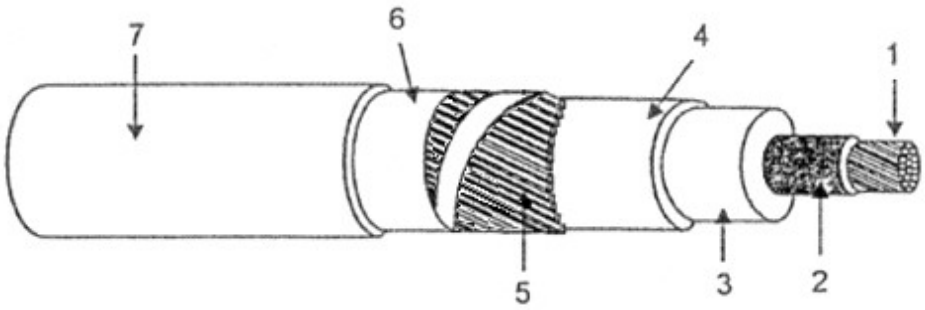
Table 4: Oversheath/Jacket for AVANGRID			
Conductor size		33.6 -53.5 -107.2- 253.4- 380.0 mm² 2-1/0-4/0 AWG-500-750 kcmil	506.7 mm² 1000 kcmil
Thickness	mm(in)	1,14(0,044)< th< 2(0,078)	1,77(0,069)< th< 3(0,118)
External colour	mm(in)	Black with three longitudinal red stripes	
Type of Sheath/Jacket		LLDPE (linear low density polyethylene) per ICEA S-94-649 part 7.1 PP (Polypropylene) per ICEA S-94-649 part 7.1	

Table 4: Oversheath for NEOENERGIA							
Conductor size	Unit	35	50-70	95-120	185	300	500
Thickness	mm	1,5	1,6	1,7	1,8	2	2,2
External colour	mm	Black (underground)					
Type of sheath		Non-metallic cover, consisting of thermoplastic compound (ST7) or non-halogenated thermoplastic and with low emission of smoke (SHF1), according to ABNT NBR 6251 and NBR 16132.)					

4.6 DESIGN AND CONSTRUCTION OF CABLES

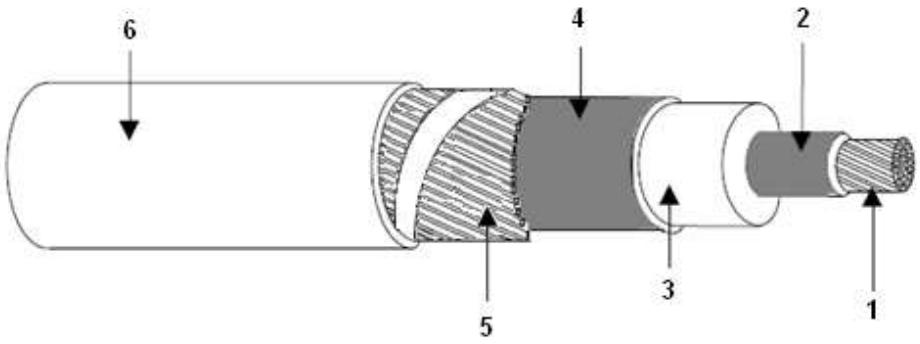
General construction characteristics for XLPE, HEPR and EPR cables are shown in Figures 1a, 1b, 1c1, 1c2 and 1d.

Figure 1a: Structure of the XLPE cable (Spain and UK)



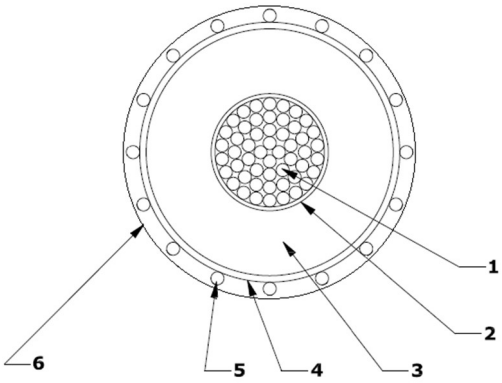
1. Conductor with longitudinal water blocking
2. Conductor screen
3. XLPE insulation
4. Insulation screen
5. Metallic earth screen (copper wires and counter-wound copper tape)
6. Longitudinal moisture barriers (OL)
7. Oversheath – polyolefin DMZ1 / DMZ2

Figure 1b: Structure of the HEPR cable (Spain and UK)



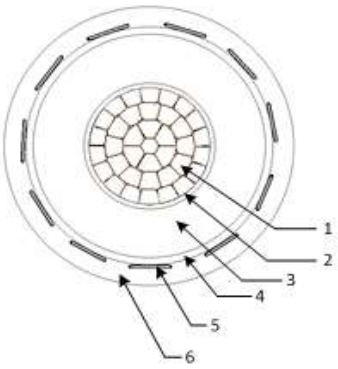
1. Conductor
2. Conductor screen
3. HEPR insulation
4. Insulation screen
5. Metallic earth screen (copper wires and counter-wound copper tape)
6. Oversheath – polyolefin DMZ1 / DMZ 2

Figure 1c1: Structure of the EPR cable (USA)



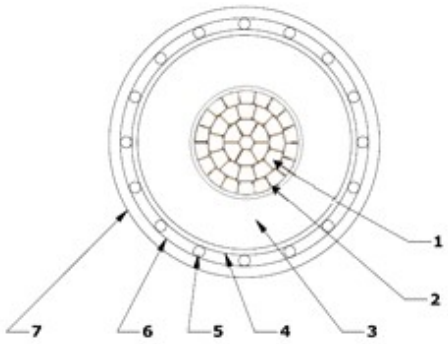
1. Conductor
2. Conductor screen
3. EPR insulation
4. Insulation screen
5. Copper concentric wires
6. Oversheath (Jacket) – polyethylene LLDPE

Figure 1c2: Structure of the EPR cable with Copper Flat Strap (USA)



1. Conductor
2. Conductor screen
3. EPR insulation
4. Insulation screen
5. Copper flat strap concentric wires
6. External sheath (Jacket) – polypropylene

Figure 1d: Structure of the EPR cable (NEOENERGIA)



1. Conductor
2. Conductor screen
3. EPR insulation
4. Insulation screen
5. Cooper concentric wires
6. Blocked against water penetration
7. Oversheath (Jacket) – SHF1/ST7

4.6.1 Longitudinal water blocking – conductor

For cables with XLPE insulation, stranded aluminium conductors shall be longitudinally water blocked. Continuous barriers shall be provided to prevent longitudinal moisture penetration along the phase conductor and along the space occupied by the longitudinal water blocking (conductor).

Water blocking in the form of a powder or gel shall not be permitted.

For cables with HEPR or EPR insulation and stranded aluminium conductors, inclusion of longitudinal water blocking is optional.

Cables with stranded copper conductors shall not require longitudinal water blocking.

4.6.2 Earth screen/shield

The metallic earth screen/shield shall comprise helically applied copper wires (and flat ribbons or tape, only for AVANGRID), overlaid with a copper equalising tape. The tape shall be counter-wound onto the underlying copper wire screen

The copper equalising tape shall be of sufficient cross section to facilitate sharing of fault current around the copper screen wires. This does not apply for AVANGRID.

4.6.3 Radial water blocking

When required the materials used to provide radial water blocking shall be compatible with all of the cable elements that they come into contact with. In the phase conductor, the water blocking material shall be in the form of a swellable yarn. Water blocking in the form of a powder or gel shall not be permitted.

Additionally, an optional non-metal spacer can be applied on the screen, provided that it does not have harmful effects on other components of the cable.

4.7 Equipment identification and marking

Condition	i-DE	SPEN	AVANGRID	NEOENERGIA
Name of manufacturer and/or trademark	X	X	X	X
Complete cable designation	X	X	X	X
Year of manufacture	X	X	X	X
Mark N of quality product	X			
State: ELECTRIC CABLE		X		
Rated voltage designation	X	X	X	X
Start and end values marked on the drum label		X		
Type and thickness of insulation			X	
Conductor size	X	X	X	X
Footage			X	
Material type of conductor, insulation and external sheath	X	X (Only type of conductor)		X
Number of cable standard	X	X		X
Cable metre-marked along its full length		X		X
CPR Marking for all LSOH (AS) cable	X	X		X

4.8 Sustainability Requirements

The cable system shall not contain harmful, dangerous or environmentally unacceptable quantities of volatile hydrocarbons, halogens or heavy metals.

The design and construction of the cable shall allow easy separation and recovery of constituents for recycling or treatment at the end of its useful life. The manufacturer shall provide information regarding re-use, recycling, recovery and disposal of the elements of the cable system at the end of its life.

In its composition, the material of the oversheath of cable shall contain no volatile hydrocarbons, halogens or heavy metals except lead, which is admissible containing less than 0.5%.

5. TESTING

The test methods and requirements for each cable shall be dependent on the cable insulation type and the network in which the cable is to be installed.

Qualification/Type Tests

All cables offered shall be fully tested and Qualified according to the requirements of the Technical Specifications and Standards detailed for each cable type. The Tenderer shall provide Type Test certificates and Type Test reports, including details of independent witnesses, at the time of Tender.

Where a Tenderer wishes to offer a cable which has been Type Tested to an alternative Standard(s), full details of the alternative Standard(s) and how it differs from the Specified Standard(s) shall be provided at the time of Tender along with Type Test certificates, Type Test reports and details of independent witnesses. Decisions regarding the acceptability of any alternative Type Test regime offered will be made by The Company.

If, during the period of the Contract, the Contractor/ cable manufacturer wishes to make any change to the Approved product, packaging or labelling, proposals for such changes shall be made, in writing, to the Specifying Engineer. No such changes shall be implemented without the prior written Approval of the Specifying Engineer. If the Specifying Engineer deems that the changes require the Type Approval testing to be repeated, in full or in part, the cost of such testing shall be borne by the Contractor/ cable manufacturer.

Production/ Routine Tests

The Company reserves the right to be present and witness routine and sample tests. The date and time of testing shall be mutually agreed to.

Copies of Production test reports, signed by an authorized company representative, shall be furnished if requested for all tests performed.

Additional requirements for each country are listed in ANNEX C: ADDITIONAL REQUIREMENTS AND TESTS.

The supplier shall furnish all labor and materials for all tests, including testing facilities, power, instrumentation, and replacement of damaged parts

5.1 Type tests

Table 6a: Type tests for i-DE, SPEN, AVANGRID and NEOENERGIA

i-DE	SPEN	AVANGRID	NEOENERGIA
UNE HD 620 9E UNE HD 620 10E parts 3.3 and 3.4	BS 7870-4.10 section 8	AEIC CS8-07 ANSI/ICEA S-94-649	ABNT NBR 7286 (EPR)

5.2 Routine tests

Table 6b: Routine tests for i-DE, SPEN, AVANGRID and NEOENERGIA			
i-DE	SPEN	AVANGRID	NEOENERGIA
UNE HD 620 9E UNE HD 620 10E part 3.1	BS 7870-4.10 section 6	ANSI/ICEA S-94-649	ABNT NBR 7286 (EPR)

5.3 Sample tests

Table 6c: Sample tests for i-DE, SPEN, AVANGRID and NEOENERGIA			
i-DE	SPEN	AVANGRID	NEOENERGIA
UNE HD 620 9E part 3.2	BS 7870-4.10 section 7	ANSI/ICEA S-94-649	ABNT NBR 7286 (EPR)

6. DESIGNATION AND CODING

Designations for each individual cable type are listed in ANNEX A.

7. TRANSPORT, PACKING, STORAGE AND INSTALLATION

Cables described in this specification shall be supplied on steel/wooden drums (steel for some sizes for Avangrid) of suitable dimensions so as not to damage any of the elements which make up the cable during transit, storage and handling on site.

This specification presents the minimum requirements for packaging. The supplier's own experience and practice shall determine any additional provisions to ensure safe delivery of the cables

Other systems of transport and storage shall only be permitted through prior agreement between the manufacturer and Iberdrola Networks.

The following guidelines are an integral part of the purchase order:

- Unless otherwise specified, the packaging itself shall protect the cables (cable and cable ends) from shocks and weathering, environmental and marine agents, preventing any damage

or corrosion during shipping, storage, and handling. Tenderers shall state at the time of tender their proposed method of protection and sealing for each cable type offered.

- Protection of cables shall not only be guaranteed during shipping, but also for a period of at least six months (12 months for AVANGRID and SPEN) of outdoor storage under normal atmospheric conditions at the final destination point (see specific terms for AVANGRID).
- All reels, for safety reasons, will be supplied with metal bushings. Painted reels are not required but if provided the paint must be suitable for the environmental conditions sited above.
- The cables shall be protected by staves or a protective mantle and exposed cable ends, shall be effectively sealed to prevent the ingress of moisture and water penetration into the cable. The cable ends shall be sealed with heat shrink or cold shrink polymeric caps or other suitable sealing method approved by Iberdrola Networks. Tape is not allowed.
- The reels shall be protected against movement during shipping. Loading and unloading shall be facilitated by suitable devices to avoid damage to both cable and reel. When moving reels, due regard should be paid to the weight, method and direction of rolling, protruding nails and wood splinters.

All cases and crates shall be stenciled with waterproof ink in English. International and illustrative marking shall be stenciled on two sides of each case to identify the proper methods for loading, unloading, and handling the crates or reels.

It shall be the supplier's duty and responsibility to supply the necessary storage instructions once an order is placed. Any damage incurred, due to incorrect or missing handling and storage instructions, shall be at the supplier's expense.

Packing lists must be securely fastened to each package in a visible location to permit inspection. Each volume shall have the quantity, the Company's order number, the material code and the supplier´s name marked for inspection purposes.

Instructions for handling, loading and off-loading of packages must be securely fastened to each reel or crate and must be protected to be perfectly legible until acceptance at the final destination.

For specific conditions in each country please refer to Annex C.

Cables described shall be supplied on steel or wooden drums/reels of suitable dimensions to prevent damage the cable. Other systems of transport and storage shall only be permitted through prior agreement between the manufacturer and Iberdrola Networks.

The ends of all cables shall be protected against damage during transit, storage and handling on site and the ingress of moisture using a shrinkable cap or other appropriate method Approved by Iberdrola Networks.

All drums shall be designed to be recyclable.

8. HEALTH & SAFETY

The Supplier shall ensure that the equipment offered fully complies with the statutory Health & Safety requirements (if any) particular to i-DE, SPEN, AVANGRID and NEOENERGIA depending on where the product will be installed.

9. DOCUMENTATION

All the documentation shall be issued in English language.

Additional languages may be requested to allow understanding of the documentation by other parties as required.

10. INFLUENCE OF THE PRODUCT ON THE ENVIRONMENT

The Tenderer shall provide evidence at the time of tender that they are certified to the environmental management system BS EN ISO 14001 or comparable environmental management system for the products tendered for as detailed in this specification.

Iberdrola has a vision of being a sustainable business and embedding the principles of sustainability in its decision making, with the targets shown in the table below.

Year	Carbon & Energy Reduction	Sustainable Resource Use	Water Efficiency & Protection
2050	Carbon neutral*	Zero waste	-50% water use*

*based on 2013/14 values.

Additionally, SPEN, Avangrid Networks and Neoenergia have set further sustainability interim targets:

SPEN:

Year	Carbon & Energy Reduction	Sustainable Resource Use	Water Efficiency & Protection
2023	-15% carbon footprint*	Divert 95% of waste from landfill	-10% water use*
2030	-80% carbon footprint*	100% waste reused or recycled	-25% water use*

*based on 2013/14 values.

Avangrid Networks:

Year	Sustainability Target
2020	Reduce emissions intensity by 25%
2035	Carbon Neutral

Neoenergia:

Year	Sustainability Target
2030	Reduce emissions intensity by 50%***
2050	Carbon Neutral

***This is related to Energy Generation.

Iberdrola's ability to meet these targets is dependent upon the environmental impact of its supply chain. To assist Iberdrola in meeting these targets, at the time of tender the Tenderer shall provide the following information:

- Provide a detailed breakdown of the materials used in each item and give evidence how material use has been optimised in each item.
- Provide details of the transportation and packaging arrangements for each item, and commit to optimising these, reducing the amount of packaging and the return of packaging for reuse over the contract period.
- Provide details of the end of life requirements for individual components and component packaging, including any circular economy practices and sustainable resource management. This information shall also be included with the delivered item.
- Provide details on the embodied carbon Provide details on the embodied carbon (in kgCO_2e or tonneCO_2e), including the amount of energy used to manufacture each item, expressed in kWh, details of what percentage of the energy used is from renewable sources and details of carbon intensity in the country of manufacture, if known.
- Provide accurate environmental data in relation to each item e.g. environmental product declaration.
- Provide evidence of how they have been delivering sustainability and reducing carbon emissions over the last 3 years.

Despite the requirement to optimise transportation and packaging arrangements, the Tenderer shall ensure that each item is suitably packaged and protected to maintain the product and packaging as "fit for service" prior to use. All packaging shall be sufficiently durable giving regard to the function, reasonable use and contents of the packaging.

If the above information requested is not available, the Tenderer shall commit to developing mechanisms to provide this information within the first year of the contract period. If the Tenderer is unable to provide this information within the first year, then the Tenderer shall state the length of time required. Acceptance of the proposed timeline is at the discretion of Iberdrola. Milestones shall be set before the commencement of the contract award and progress checked through quarterly business review meetings. Tenderers with the mechanisms described in this section already in place shall be preferred.

11. QUALIFICATION AND ACCEPTANCE

11.1 Qualification

Manufacturers shall operate a fully documented quality assurance system and shall provide details of this system on request. (For SPEN: and also at the time of Tender).

Manufacturers must be certified by an approved quality assurance system.(ISO 9000 or similar).

In general, the qualification of suppliers and products will be carried out according to Company requirements.

Cables shall not be qualified for purchase until all Type Testing is completed.

Iberdrola Networks reserves the right to repeat certain tests previously performed by the manufacturer or performed in the process of obtaining quality standards.

Once the qualification process is completed, Iberdrola Networks shall draw up an internal Quality Management Annex for each manufacturer and model.

11.2 Acceptance

Acceptance criteria may vary according to the requirements of Iberdrola Networks, based on the quality management system implemented at the factory and the relationship with the supplier in respect to the product (experience, quality agreements, etc.).

If a test coil fails any of the specified tests during an Acceptance test then that test coil shall be rejected.

Two new test coils shall then be selected from the same and subjected to the same test as the first failed test coil.

If the two additional coils pass the test then the batch shall be excepted, except the first failed test coil.

If the two additional coils fail the test then the entire batch shall be rejected.

12. ANNEXES

ANNEX A RATINGS, DESIGNATION AND CODES

- ANNEX A1: i-DE
- ANNEX A2: SPEN
- ANNEX A3: AVANGRID NETWORKS
- ANNEX A4: NEOENERGIA

ANNEX B INTERFACES AND COMPATIBILITY

- Not applies to any country.

ANNEX C REQUIREMENTS FOR AUXILIARY AND CONTROL CIRCUIT COMPONENTS

- Not applies to any country.

ANNEX D ADDITIONAL CHARACTERISTICS AND TESTS

- ANNEX D0: COMMON FOR i-DE AND SPEN
- ANNEX D1: i-DE
- ANNEX D2: SPEN
- ANNEX D3: AVANGRID NETWORKS
- ANNEX D4: NEOENERGIA

ANNEX E INFORMATION TO BE PROVIDED BY THE SUPPLIER

- ANNEX E1: i-DE
- ANNEX E2: SPEN
- ANNEX E3: AVANGRID NETWORKS

ANNEX F HEALTH AND SAFETY

- Not applies to any country.

ANNEX A: DESIGNATIONS AND CODES FOR i-DE

A1: i-DE

A1.1 Designations

Cables shall be designated as follows:

Table A1.1: Cable Designation

Field	Description	Designation
Insulation	HEPR	HEPR
	XLPE	R
	Semi-conducting screen and metallic screen added	H
Oversheath	Polyolefin	Z1
	Fire protection	(AS)
Moisture sealing	Longitudinal water blocking	2OL
Rated voltage	U_0 / U (see table 1)	12/20 kV
Conductor	Single phase	1x
	Cross section (mm²)	50, 150, 240,400,630
	Shape – stranded circular compact	K
	Material	Al
Copper wire screen	Cross section (mm²)	+H (screen cross sectional area)

Examples of typical cable designations:

Cable **RHZ1-2OL (AS) 12/20 kV 1x150 K Al + H16 INS 56.43.03**

Cable **HEPRZ1 (AS) 12/20 kV 1x150 K Al + H16 INS 56.43.03**

A1.2 Codes

Table A1.2: Standard cable types i-DE

Designation	Insulation Type	Outer sheath Type	Moisture Sealing	Conductor		Screen Cross-section (mm^2)	Stock Code
				Material	Size (mm^2)		
HEPRZ1 12/20 kV 1x240 K Al + H16	HEPR	Polyolefin DMZ1	-	Al	240	16	5641820
HEPRZ1 12/20 kV 1x400 K Al + H16					400		5641822
HEPRZ1 (AS) 12/20 kV 1x50 K Al + H16		Polyolefin DMZ2 (AS)			50		5641830
HEPRZ1 (AS) 12/20 kV 1x240 K Al + H16					240		5641835
HEPRZ1 (AS) 12/20 kV 1x400 K Al + H16					400		5641837
HEPRZ1 (AS) 12/20 kV 1x630 K Al + H16					630		5641839

Cables with a conductor cross-sectional area of 50 mm^2 shall only be used in i-DE for connections between transformers and switchgear in medium voltage substations.

A2: SPEN

A2.1 Designations

Cables shall be designated as follows:

Table A2.1: Cable Designation

Field	Description	Designation
Insulation	XLPE	R
	Semi-conducting screen and metallic screen added	H
Oversheath	Polyolefin	Z1
	Fire protection	(AS)
Moisture sealing	Longitudinal water blocking	2OL
Rated voltage	U_0 / U (see table 1)	6,35/11kV
Conductor	Single core	1x
	Cross section (mm²)	95, 185, 300
	Shape – stranded circular compact	K
	Material	Al
Conductor	Single core	1x
	Cross section (mm²)	300, 500, 600
	Shape – stranded circular compact	K
	Material	Cu
Conductor	3 core	3x
	Cross section (mm²)	95, 185, 300
	Shape – stranded circular compact	K
	Material	Al
Copper wire screen	Cross section (mm²)	+H (screen cross sectional area)

Examples of typical cable designations:

Cable **RHZ1-2OL (AS) 6,35/11 kV 1x95 K Al + H35 INS 56.43.03**

ANNEX A2: DESIGNATIONS AND CODES FOR SPEN

A2.2 Codes

Table A2.2: Standard cable types SPEN

Designation	Insulation Type	Oversheath Type	Moisture Sealing	Conductor		Screen Cross-section (mm^2)	Part Number
				Material	Size (mm^2)		
RHZ1-2OL 6,35/11 kV 1x95 Al + H35	RH	Polyolefin DMZ1	2OL	Al (solid)	95	35	30980100
RHZ1-2OL 6,35/11 kV 1x185 Al + H35					185		30980101
RHZ1-2OL 6,35/11 kV 1x300 Al + H35					300		30980102
RHZ1-2OL (AS) 6,35/11 kV 1x95 Al + H35		Polyolefin DMZ2 (AS)			95		30980103
RHZ1-2OL (AS) 6,35/11 kV 1x185 Al + H35					185		30980104
RHZ1-2OL(AS) 6,35/11 kV 1x300 Al + H35					300		30980105
RHZ1-2OL 6,35/11 kV 1x300 K Cu + H35		Polyolefin DMZ1		Cu (stranded)	300		30980098
RHZ1-2OL 6,35/11 kV 1x500 K Cu + H35					500		30980099
RHZ1-2OL 6,35/11 kV 1x630 K Cu + H35					630		30026565
RHZ1 6,35/11 kV 3x95 Al + H70	RH	Polyolefin DMZ1	2OL	Al (solid)	95	70	30980092
RHZ1 6,35/11 kV 3x185 Al + H95					185	95	30980093
RHZ1 6,35/11 kV 3x300 Al + H95					300	95	30980094
RHZ1 (AS) 6,35/11 kV 3x95 Al + H70		Polyolefin DMZ2 (AS)			95	70	30980095
RHZ1 (AS) 6,35/11 kV 3x185 Al + H95					185	95	30980096
RHZ1 (AS) 6,35/11 kV 3x300 Al + H95					300	95	30980097

ANNEX A3: AVANGRID NETWORKS

A3.1 Ratings

Cables shall be rated for normal, emergency and short circuit operation. The ratings are included in Table A3.1.

Table A3.1: Conductor Temperature Limitations

Type of insulation	Temperature Rating		
	Normal operation (ºC)	Emergency overload (ºC)	Short circuit (ºC)
EPR	105	140	250

All cables shall meet the requirements of AEIC CS8-13, ANSI/ICEA S-94-649-2013, , ASTM B496-16, ASTM B400-19, ASTM B231/B231M-16, ASTM B122/B122M-16, as appropriate.

- **Normal**

  Normal ratings are values for which cables can be operated continuously with negligible loss of life.

- **Emergency**

  Emergency ratings are values for which cables can be operated for 300 h over a period with negligible loss of life.

A3.2 Designation

Table A3.2: Cable Designation		
Field	Description	Designation
Insulation	EPR	EPR
	Semi-conducting screen and metallic screen added	Shielded
	Insulation Level	100%
Oversheath	Low Linear Density Polyethylene	LLDPE
	Polypropylene	PP
Moisture sealing	Conductor longitudinal water blocking	Strand filled
	Shield / jacket longitudinal water blocking	Jacket Seal
Rated voltage	U_0 / U (see table 1)	8,66/15
Conductor material	Copper	Cu
	Aluminium	Al
Conductor shape	Stranded- concentric compressed	compressed
	Stranded- concentric compact round	compact
Conductor size	Cross section AWG/kcmil (mm²)	AWG/kcmil
Conductor shield	Semi-conducting crosslinked polymer	Semi-conducting
	Insulating polymer	Permashield®
Insulation shield/screen – semi-conducting	Semi-conducting crosslinked polymer	Semi-conducting
Insulation shield/screen - metallic	Copper round concentric wires	Concentric
	Flat Strap Concentric Wires	Flat Strap Concentric
Metallic insulation shield Neutral conductor Capacity	Full Concentric Neutral Capacity	Full Concentric
	1/3rd Concentric Neutral Capacity	1/3rd Concentric
Insulation shield dimensions – concentric wires	Number of wires x AWG size	# - AWG
Insulation shield dimensions – flat strap	Number of straps x thickness x width	# - Thickness x width
Insulation shield cross sectional area (vs. phase conductor area) – concentric wires or flat straps	1 conductor cables – Full neutral, 3 conductor cables, one third neutral	Full neutral or One Third neutral
Cable Configuration	Single Conductor	1/C
	Three Conductor Triplexed Lay	3CT

A3.3 Codes

Table A3.3: Standard Cable Types AVANGRID

Description	Insulation Type	Jacket	Conductor Size and Material	Nominal Ins. O.D.	Assembly Phase/Lay	Neutral Capacity	Neutral Construction	Overall Diameter	Material ID AVANGRID
CBL 15KV 1C # 2 AL JCN 100% INSLTN	EPR 175 mil	LLDPE	#2 AWG AL 7-Strand Compressed	0.68”	ONE	FULL	10 x #14 Bare Copper Round Concentric Wires	0.99”	30924404
CBL 15KV #2 AWG AL EPR 175 JCN 3/CT	EPR 175 mil	LLDPE	#2 AWG AL 7-Strand Compressed	0.68”	TRIPLEX	1/3	6 x #14 Bare Copper Round Concentric Wires	2.155”†	30053665
CBL 15KV 1C 1/0 AL JCN	EPR 175 mil	LLDPE	1/0 AWG AL 19-Strand Compressed	0.751”	ONE	FULL	16 x #14 Bare Copper Round Concentric Wires	1.062”	30924407
CBL 15KV 1C 1/0 CU JCN	EPR 175 mil	LLDPE	1/0 AWG Cu 19-Strand Compressed	0.755”	ONE	FULL	25 x #14 Bare Copper Round Concentric Wires	1.066”	30924346
CBL 15KV 4/0 AWG AL EPR 175 JCN 3/CT	EPR 175 mil	LLDPE	4/0 AWG AL 19-Strand Compact Round	0.902”	TRIPLEX	1/3	11 x #14 Bare Copper Round Concentric Wires	2.614”†	30053653
CBL 15KV 4/0 AWG CU EPR 175 FS 3/CT	EPR 175 mil	LLDPE	4/0 AWG Cu 19-Strand Compact Round	0.878”	TRIPLEX	1/3	8 x 200 mil x 35 mil Bare Copper Flat Straps	2.41”†	30053676
CBL 15KV 500 KCMIL CU EPR 175 FS 3/CT	EPR 175 mil	Polypropylene	500 kcmil Cu 37-Strand Compact Round	1.143”	TRIPLEX	1/3	8 x 200 mil x 35 mil Bare Copper Flat Straps	2.980”†§	30053678
CBL 15KV 500 KCMIL CU EPR 175 FS 1/C	EPR 175 mil	Polypropylene	500 kcmil Cu 37-Strand Compact Round	1.143”	ONE	1/3	8 x 200 mil x 35 mil Bare Copper Flat Straps	1.383”§	30053675
CBL 15KV 750 KCMIL CU EPR 175 FS 3/CT	EPR 175 mil	Polypropylene	750 kcmil Cu 61-Strand Compact Round	1.306”	TRIPLEX	1/3	12 x 200 mil x 35 mil Bare Copper Flat Straps	3.30”†§	30053654
CBL 15KV 750 KCMIL CU EPR 175 FS 1/C	EPR 175 mil	Polypropylene	750 kcmil Cu 61-Strand Compact Round	1.306”	ONE	1/3	12 x 200 mil x 35 mil Bare Copper Flat Straps	1.531”§	30053677
CBL 15KV 1C 750 KCM AL JCN	EPR 175 mil	LLDPE	750 kcmil AL 61-Strand Compressed	1.393”	ONE	1/3	24 x #12 Bare Copper Round Concentric Wires	1.827”	30924416
CBL 15KV 1C 1000 CU JCN EPR	EPR 175 mil	LLDPE	1000 kcmil Cu 61-Strand Compressed	1.543”	ONE	1/3	32 x #10 Bare Copper Round Concentric Wires	2.055”	30924409

† Circumscribed diameter of triplex bundle
§ Maximum acceptable overall cable diameter listed

- All conductors shall be class B stranded compressed or compact round copper, or compressed aluminium per ANSI / ICEA S-94-649.
- Water blocking powder or water swellable yarn is permitted for compressed stranded aluminum phase conductor.
- Conductor shield reduced wall thickness per ANSI / ICEA S-94-649 section 3.2.1 and insulation shield reduced wall thickness (24 mil minimum point to 60 mil maximum) is permitted for 500kcmil copper and 750kcmil copper 15kV cables with written consent from Avangrid Electric Network Standards
- Class III or Class IV Ethylene Propylene Rubber (EPR) Insulation. Operating temperatures: 105°C Normal, 140°C Emergency, 250°C Short Circuit. The EPR insulation compound shall include lead oxide. Lead-free EPR formulations shall not be used.
- Cable shall have three red stripes spaced 120° apart extruded into the jacket.

ANNEX A4: DESIGNATIONS AND CODES FOR NEOENERGÍA

A4.1 Designations

Cables shall be designated as follows:

Table A4.1: Cable Designation

Field	Description	Designation
Insulation	EPR	EPR
	HEPR	HEPR
	Semi-conducting screen and metallic screen added	H
Oversheath	Polyolefin	ST7
	Thermoplastic material, halogen-free, low-smoke	SHF1
Moisture sealing	Longitudinal water blocking	2OL
Rated voltage	U_0 / U (see table 1)	8,7/15kV 12/20 kV
Conductor	Single phase	1x
	Cross section (mm²)	35, 50, 95, 120 , 185, 240, 300, 500
	Shape – stranded circular compact	Rc
	Material	Cu
Copper wire screen	Cross section (mm²)	+H (screen cross sectional area)

A4.2 Codes

Table A4.2: Standard cable types Neoenergia

Designation	Insulation Type	Outer sheath Type	Moisture Sealing	Conductor		Screen Cross-section (mm^2)	Stock Code Neo-NE Neo-SE Neo-Brasília
				Material	Size (mm^2)		
50 CU Rc EPR 12/20KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	50	16	2225050 36731 31015162
95 CU Rc EPR 12/20KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	95	16	2225097 35737 31015139
120 CU Rc EPR 12/20KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	120	16	2225092 35741 31015160
185 CU Rc EPR 12/20KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	185	16	2225108 37419 31015163
300 CU Rc EPR 12/20KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	300	16	2225068 35736 31015161
300 CU Rc HEPR 8,7/15KV ST7-2OL H70	HEPR	ST7	2OL	Cu	300	70	2225091 - 31015169
500 CU Rc HEPR 12/20KV ST7-2OL H16	HEPR	ST7	2OL	Cu	500	16	2225098 35738 31015138
35 CU Rc EPR 8,7/15KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	35	16	- - 31015178
95 CU Rc EPR 8,7/15KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	95	16	- - 31015179
185 CU Rc EPR 8,7/15KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	185	16	- - 31015180
240 CU Rc EPR 8,7/15KV SHF1-2OL H16	EPR	SFH1	2OL	Cu	240	16	- - 31015181

ANNEX D: ADDITIONAL CHARACTERISTICS AND TESTS

D0: COMMON FOR i-DE AND SPEN

D0.1 Cable Characteristics

The design and construction of cables specified in this document utilising XLPE insulation shall comply with the specification HD 620-S2 (10E).

The design and construction of cables specified in this document utilising HEPR insulation shall comply with the specification HD 620-S2 (9E).

D0.1.1 Conductor

The phase conductor material shall be compacted and circular with strands of copper or aluminium (class 2) according to the IEC 60 228 specification.

D0.1.2 Longitudinal water blocking – conductor

Cables specified with longitudinal water blocking shall meet or exceed the requirements of the water penetration test outlined in HD 605-S2, section 2.4.9.

D0.1.3 Insulation

XLPE Insulation: Cross-linked polyethylene (XLPE), with characteristics as specified in Table 2A of the specification HD 620-S2 (1) (type DIX-3).

Nominal insulation thickness shall be 8.0 mm, as specified in Chapter 2 Section 3.2 of HD 620-S2 (10E).

- Maximum continuous service temperature: 90 ºC.
- Maximum short circuit temperature for maximum of 5 seconds: 250 °C.

HEPR Insulation: Mixture based on high modulus ethylene propylene (HEPR), with characteristics as specified in Table 2C of the specification HD 620-S2 (1) (type DIH-2).

The electrical potential gradient at rated voltage (U_0) shall be less than or equal to 4 kV/mm across the conductor screen and less than or equal to 2.4 kV/mm over the insulation as indicated in Chapter 2, Paragraph 3.2 of HD 620-S2 (9E). The manufacturer shall declare the insulation thickness required to meet these requirements.

- Maximum continuous service temperature: 105 °C.
- Maximum short circuit temperature for maximum of 5 seconds: 250 °C.

Single core cables with extruded insulation shall comply with the requirements of BS 7870-4.10.

Three core cables with extruded insulation shall comply with the requirements of BS 7870-4.20.

All cores shall comply with the concentricity (circularity) requirements of BS 7870-4.10, Section 4.2 including Section 7.4 (Circularity of insulated core) for all single core cables and BS 7870-4.20, Section 4.2 including Section 7.4 (Circularity of insulated core) for all three core cables.

Cables will require to be supplied in "true single core" configuration. There may also be requirements for cable to be supplied in "triplex" configuration from time to time.

The manufacturer shall declare the nominal Lay Factor for each of the three cable sizes where Lay Factor is defined as L/D (L = lay length and D = diameter over the laid up cores). Lay Factor for manufactured cables shall be in the range 24 to 40.

D0.1.4 Semi-conducting screens

Conductor screen: The conductor screen shall consist of an extruded, mixed compound semiconducting layer (semiconductor internal). The conductor screen shall be of the fully bonded type.

The nominal thickness shall be greater than 0.5 mm, as specified by the characteristics listed in chapter 2, paragraph 2, of the specifications HD 620-S2 (9E and 10E).

Insulation screen: The insulation screen shall consist of an extruded, mixed compound semiconducting layer (semiconductor external). For cables with HEPR insulation, the insulation screen shall be of the strippable type. For cables with XLPE insulation, the insulation screen shall be of the fully bonded type.

The nominal thickness shall be 0.5 mm – 1.0 mm, as specified by the characteristics listed in chapter 2, paragraph 4, of the specifications HD 620-S2 (9E and 10E).

D0.1.5 Longitudinal water blocking

Cables specified with longitudinal water blocking shall meet or exceed the requirements of the water penetration test outlined in HD 605 S2, section 2.4.9.

D0.1.6 Oversheath

The oversheath shall consist of an extruded thermoplastic compound-based composite of polyolefin DMZ1 or DMZ2, as specified in HD 620-S2 (1), section 4.9.1 and Table 4C.

Type (AS) cables, providing an increased level of resistance to the spread of fire, shall have distinctly coloured oversheath in order to differentiate them from standard cables.

The nominal thickness of the oversheath shall be not less than indicated in Table 2 of specification HD 620-S2 (9E) for cables with HEPR insulation and Table 2 of specification HD 620-S2 (10E) for cables with XLPE insulation.

D1: i-DE

D1.1 Special characteristics for oversheaths

The oversheaths of cables to be installed in shall be coloured **red**.

Type (AS) cables to be deployed in the i-DE network shall be coloured **red with two longitudinal stripes of green** incorporated into the sheath. The width of the stripes shall be between 5 mm and 10 mm, with 180º separation between the stripes.

D1.2 Qualification and acceptance

D1.2.1 Qualification

For i-DE the quality mark “N” of AENOR is required in accordance with the specification HD 620-S2 (9E), for which the supplier shall deliver the certificate issued by the accrediting agency.

D1.2.2 Special conditions for Transportation

For cables to be deployed in the i-DE network, the cable drum types and supply lengths are shown below in *Table D1.1.*

Table D1.1: Cable drum types and supply lengths

Cable type	Supply length (m)	Drum type*
1x50 K Al+H16	580	14
1x150 K Al+H16	1000	22
1x240 K Al+H16		22
1x400 K Al+H16		22
1x630 K Al+H16	600	24

* Cable drum types are as specified in UNE 21167. For safe handling the drums must have a metal tube with the inner diameter shown in Table 1 of UNE 21167, in the centre of the plates and rigidly attached thereto by a suitable system.

D2: SPEN

D2.1 Technical Requirements

Where a requirement of this Specification differs from that of another quoted Specification or Standard, the requirement of this Specification shall apply.

If a Tenderer is unsure regarding any requirement of this Specification, clarification shall be sought in writing from SPEN.

D2.2 General

D2.2.1 Insulation

Single core cables with extruded insulation shall comply with the requirements of BS 7870-4.10.

Three core cables with extruded insulation shall comply with the requirements of BS 7870-4.20.

All cores shall comply with the concentricity (circularity) requirements of BS 7870-4.10, Section 4.2 including Section 7.4 (Circularity of insulated core) for all single core cables and BS 7870-4.20, Section 4.2 including Section 7.4 (Circularity of insulated core) for all three core cables.

Cables will require to be supplied in "true single core" configuration. There may also be requirements for cable to be supplied in "triplex" configuration from time to time.

The manufacturer shall declare the nominal Lay Factor for each of the three cable sizes where Lay Factor is defined as L/D (L = lay length and D = diameter over the laid up cores). Lay Factor for manufactured cables shall be in the range 24 to 40.

D2.2.2 Conditions of Installation

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 it’s operating life. 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.

D2.2.3 Long Term Ageing Type Tests

Manufacturers shall provide evidence that the cable designs offered have successfully undergone the long term ageing tests specified in the cable testing standards listed in *Table D2.1* using the method described in Clause 5.4.15 of HD 605-S2.

D2.2.4 Technical Support

From time to time during the contract period questions will arise regarding unusual or non-standard applications where advice will be required on matters such as cable ratings etc. The successful Tenderer(s) will be expected to support SPEN with technical advice on these matters.

D2.3 Special characteristics for oversheaths

The oversheaths of cables to be installed in shall be coloured **red**.

Type (AS) cables to be deployed in the SPEN network shall be coloured **orange**.

The fire performance properties of the cable shall also comply with BS 7870-3.50.

D2.4 Additional Testing Requirements

D2.4.1 Routine and Sample Tests

The Contractor shall carry out all Routine and Sample Tests as specified in Section 6.2 and Section 6.3 respectively.

Tenders shall state at the time of tender their proposals for Sample Test frequencies where such frequencies are not detailed specifically by this Specification or the relevant referenced Standards or Specifications.

The Specifying Engineer reserves the right to be present and witness routine and sample tests. Where the Specifying Engineer wishes to witness any such test, the date and time of testing shall be mutually agreed.

D2.4.2 Samples

During the tender period the Tenderer shall submit samples for approval as required by the Specifying Engineer. Such samples shall remain the property of SPEN.

During the contract period the Contractor shall provide samples as required by the Specifying Engineer. Such samples shall remain the property of the SPEN.

D2.5 Special conditions for Transportation

For cables to be deployed in the SPEN network, cable drum types, dimensions, weights and supply lengths for each cable type offered shall be specified and agreed at the time of order.

Proposed cable drum types, dimensions, weights and supply lengths for each cable type offered shall also be stated at the time of tender.

SPEN Logistics retain the right to reject a stated drum dimension, weight and/or supply length for any cable type at the time of order if it is deemed a possible risk to health and safety or if they do not have the appropriate equipment to accommodate it at the point of delivery. The cable manufacturer shall liaise with SPEN Logistics regarding drum types.

Drums may be stored for long periods outdoors. All drum labels shall remain legible and durable under these conditions for a minimum of 12 months.

D2.6 Equipment identification and marking

The oversheaths of all single core cables shall be marked in accordance with the requirements of BS 7870-4.10.

The oversheaths of all three core cables shall be marked in accordance with the requirements of BS 7870-4.20.

Each delivery length of cable shall be allocated a unique reference number. This number shall appear on the factory test records 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.

All cable drums shall be marked in accordance with the relevant cable Specification or Standard

Each drum shall bear a distinguishing number on the outside of the flange and particulars of the cable, as detailed in Table 5. The drum label shall also show the metre marking start and end values, the unique reference number, the cable length, gross mass and the direction for rolling shall be indicated by an arrow.

D2.7 Qualification and acceptance

Analysis of any defective items either on receipt or in use will be taken into account by SPEN during any future tender analysis.

Tenderers shall also provide at the time of tender copies of any relevant QA Approvals held by them and quality plans for each cable type offered (these should identify the control stages during manufacture and test).

The Tenderer shall provide at the time of tender details of manufacturing location(s) for each cable offered. The Tenderer shall also provide details of extrusion lines and curing technology for each cable offered.

Any Approval granted will be site and line specific and will not be transferable to any other site or line without the prior written agreement of the Specifying Engineer.

D2.8 Influence of the Product on the Environment

D2.8.1 Embodied Carbon

Where available, the tenderer shall provide Environmental Product Declarations aligned to ISO 14025:2006 for significant materials streams and products. The tenderer shall use the UK Government GHG Conversion Factors for Company Reporting under Scope 3 (other indirect) emissions, material use

and waste disposal to calculate the embodied carbon dioxide equivalent (CO_2e) in kilograms (or tonnes) per tonne of material within the product and packaging, splitting by different material.

D2.8.2 Supply Chain Sustainability Knowledge

The tenderer shall agree at the time of tender to register as members of the Supply Chain Sustainability School at commencement of the contract and undertake training requested by SPEN. Free registration and membership can be obtained using the following link https://www.supplychainschool.co.uk/ . SPEN's Sustainability team shall confirm training expectations (Learning Pathways) to be undertaken through the Supply Chain Sustainability School by the supplier at the time of tender.

D2.8.3 Periodic Reporting

SPEN are improving supplier reporting through the use of the Smartwaste tool and the successful tenderer will be required to provide monthly reports on sustainability aspects and environmental compliance requirements directly related to contract delivery. The tenderer shall agree at the time of tender that monthly reports will be submitted through the Smartwaste tool. SPEN's Sustainability team shall provide further information regarding the Smartwaste tool at the time of tender.

D3: AVANGRID NETWORKS

D3.1 Cable Characteristics

D3.1.1 Conductor

All conductors shall be class B stranded compressed or compact round copper, or compressed aluminium per ANSI / ICEA S-94-649. Conductors shall meet requirements of the standards ASTM B 496-04, ASTM B 400, ASTM B231/B231M and ASTM B8.

D3.1.2 Longitudinal water blocking – conductor

Requirements shall be as outlined in ANSI / ICEA S-94-649 section 2.2 and ANSI / ICEA T-31-610. Water blocking is optional for EPR insulated cables and is not permitted for compact round stranded copper conductors without Avangrid Electric Network Standards Department written consent.

Water blocking powder or water swellable yarn is permitted for compressed stranded aluminum phase conductor.

Water blocking gel or mastic shall not be included in any conductor material or type.

D3.1.3 Conductor screen/shield

Requirements shall be as outlined in the core part of this standard. The nominal thickness shall be as specified by the characteristics provided as per ANSI / ICEA S-94-649.

Conductor shield reduced wall thickness per ANSI / ICEA S-94-649 section 3.2.1 is permitted for 500kcmil copper and 750kcmil copper 15kV cables. Conductor shield reduced wall thickness shall be approved by Avangrid Electric Network Standards Department in writing prior to manufacture of cable.

Conductor shield made of polyethylene shall not be used.

D3.1.4 Insulation

The conductor screen/shield, insulation and insulation screens/shields shall be applied in a continuous, single-pass, triple extrusion process free of factory repairs.

The curing process shall be either dry cured or steam cured. The insulation shall meet the requirements of ANSI / ICEA S-94-649 and shall be a high quality, heat, moisture, ozone, impact and corona resistant insulation.

The primary insulation shall have a minimum point thickness as defined in ANSI / ICEA S-94-649 for all conductor sizes. The insulation must be a compound pre-approved by AVANGRID. Any alterations in the compound will require re-evaluation and approval. The EPR insulation compound shall include lead oxide. Lead-free EPR formulations shall not be used.

The primary insulation shall be compatible with and bonded to the underlying conductor shield and allow stripping the overlying semi-conductive insulation shield per ANSI / ICEA S-94-649.

EPR Insulation: Class III or Class IV Ethylene Propylene Rubber (EPR), with characteristics as defined under ANSI / ICEA S-94-649.

- Maximum normal operating temperature: 105°C.
- Maximum emergency overload temperature: 140°C.
- Maximum short circuit temperature: 250°C.

Insulation thickness level shall be 100% (175 mils nominal) unless specified otherwise. The primary insulation shall have minimum point thicknesses as defined in Table 4.7 of ANSI / ICEA S-94-649 for all conductor sizes.

The cable insulation outer diameter shall be within the ranges listed in AEIC CS8, Table C-4, Table C-5, or Table C-7.

The EPR insulation shall have a maximum hot creep set of 2%.

D3.1.5 Insulation Shield

The insulation shield shall meet the requirements of ANSI / ICEA S-94-649 part 5. The insulation shield shall meet all thermal operating temperature requirements.

The semi-conducting insulation shield shall be an ‘easy strip’ compound, and be easily removable from the insulation using conventional stripping tools but without the use of chemicals or heat. The maximum stripping tension shall be not less than 0,674 newtons (3 pounds) or more than 5,39 newtons (24 pounds).

The insulation shield shall be readily removable in the field at temperature from -10ºC to 40ºC. The semi-conductive insulation shield shall be removable without damaging the insulation and without leaving conductive material.

The semi-conductive insulation shield shall have a minimum thickness, as specified in ANSI/ICEA. It shall be legibly and permanently surface printed with the following information:

a. The identification of the insulation shield as being semi-conductive
b. The instruction to strip the insulation shield before splicing or terminating the cable.

Insulation shield reduced wall thickness may be accepted with written approval from the Avangrid Electric Network Standards Department, in order to meet cable maximum overall diameter requirements for 500kcmil copper and 750kcmil copper 15kV cables. Upon approval, reduced insulation shield minimum point thickness shall not be less than 24 mils and maximum point thickness shall not be greater than 60 mils. Insulation shield reduced wall thickness shall be requested and approved prior to manufacture of cable

Insulation shield made of polyethylene shall not be used.

D3.1.6 Metallic Shield

The metallic shield (earth screen) shall be comprised of helically applied round concentric bare copper wires or flat strap concentric bare copper wires in the sizes and quantities detailed in Table A3.3 of this document, and shall meet all requirements of ANSI / ICEA S-94-649 Section 6.

The cross sectional area shall be as per ANSI / ICEA S-94-649 and as follows (also summarized under Description and Material ID codes):

a) For single cables with conductor sizes #2 AWG AL, 1/0 AWG AL, or 1/0 AWG CU, the concentric neutral wires shall have the full capacity of the phase conductor.

b) All other cables shall have 1/3 neutral capacity.

D3.1.7 Oversheath (Jacket)

The jacket shall be extruded-to-fill, and shall be either nonconductive linear low density polyethylene (LLDPE) or polypropylene (PP), as specified, per ANSI / ICEA S-94-649. The cable jacket shall be easily field strippable.

The jacket oversheath shall be **black with THREE RED STRIPES**, each with a width of 15 percent of the total cable circumference of the jacket and each stripe 120 degrees apart for identification of the cable as power cable. The red stripes shall be extruded into the jacket to a depth of 0,127mm (0,005”). The striping material shall meet the *physical and electrical requirements of ANSI / ICEA S-94-649.* Alternate products shall be approved by AVANGRID prior to use.

D3.2 Cable identification and marking

The surface of the jacket shall be durably marked per ANSI / ICEA S-94-649 section 8.2.1 with the addition of the following:

- All markings shall be clearly legible, weatherproof and sunlight resistant
- Temperature Rating
- Jacket Material
- Year and Month of Manufacture
- Manufacturing Plant
- The cable jacket shall have the sequential length of the cable marked at regular intervals of 2’.

D.3.3 Testing

Cables shall not be shipped, except as otherwise agreed to by AVANGRID in writing, unless all required tests have been completed and the cable in compliance with all the requirements of this specification.

All testing required per ANSI/ICEA, as outlined in AEIC CS8, shall be performed. In addition, the insulation shield/screen Field Strippability and Partial Discharge Measurement Tests, as described in AEIC CS8 Section 10, shall be performed on each completed cable.

The manufacturer shall retest a cable that fails any test, using the procedure specified in AEIC CS8. The manufacturer shall make available test reports or manufacturing logs for review by AVANGRID during or after production.

When requested, certified test reports for production and completed cable tests, shall be provided electronically to AVANGRID at the time of shipment of the cable and they shall be received no later than two weeks after the shipment date of the cable from the point of manufacture. Should any problems with the cable be discovered after its receipt by AVANGRID, the cable will be returned at the manufacturer's expense.

All test reports shall be accurately labeled and shall include at least the following:

- Name of test.
- Test procedure.
- Standard or specification which is the source of the test and procedures (noting exceptions where applicable).
- Frequency of testing.
- Test values.
- An indication of successful completion of the test.
- Reference to AVANGRID and manufacturer's order numbers, and, as applicable, the particular length of cable.

D.3.3.1 Type/Qualification Tests

The manufacturer shall have tested production cable samples per ANSI / ICEA S-94-649. When requested, the manufacturer shall supply the purchaser with a certified copy of the qualification test and CV extrusion qualification test that represent the cable being purchased. The cable continuous vulcanization (CV) extrusion line shall be certified for EPR insulation AC withstand voltage of 400 volts per mil (175 mil nominal insulation thickness).

D.3.3.2 Routine tests

Manufacturers supplying cable under this specification are required to perform all of the tests required under AEIC CS8 and ANSI / ICEA S-94-649 on all cable produced for AVANGRID. Test methods and frequency shall be in accordance with ANSI / ICEA S-94-649, unless otherwise indicated.

- When used the electrical integrity of the inner Permashield, conductor energy suppression layer shall be checked during manufacture by continuously subjecting this layer to a 1 kV DC test voltage, applied to its outer surface with the cable's conductor maintained at ground potential. The DC test voltage shall be applied to the entire circumference of the cable.
- The conductor energy suppression layer shall be tested for its specific inductive capacity (SIC). The test shall be conducted at room temperature and at 60 Hz. One measurement shall be taken for every 10,000 feet of cable produced, but with a minimum of two measurements for each extruder run. The SIC value shall be ten (10) or greater.
- The electrical integrity of an extruded non-conducting energy suppression strand shield shall be tested by the partial discharge (corona) test per ICEA S-94-649. Section 3.6.2.

- During the 7-day waiting period after the insulation extrusion process and before testing is performed, no additional layers shall be installed on the cable (i.e. metallic shield or jacket). For cable with round concentric neutral wires additional layers may be installed 4 days after the extrusion process.

- Hot creep and set requirements shall be in accordance with ICEA Publication T-28-562, with the following modifications:

    - Three test specimens shall be prepared from the inner 25% of the insulation from the sample. At least one test specimen shall come from the insulation layer adjacent to the conductor shield (i.e. insulation material closest to the conductor that does not contain conductor shield material). The elongation and set of each of these specimens shall be measured and recorded.
    - If no specimen test value is above the max requirement, the sample passes the HCE test.
    - If the HCS of all specimens tested is within the required range, the lot passes the HCS test.
    - The values of all tests shall be recorded.
    - The solvent extraction test is not an approved referee test for test specimens failing the Hot Creep Test.
    - The EPR insulation shall have a maximum hot creep set of 2%.

D.3.3.3 Production Testing Sampling Frequency test

The sampling frequency for production tests shall be according to ANSI / ICEA S-94-649 as appropriate, section 9.2 “Sampling Frequency” unless otherwise specified.

D.3.3.4 Tests during and immediately after installation

At the time of initial installation of the cable, a high voltage DC proof test may be made at a maximum voltage as specified in ICEA S-94-649, Table E-1. The test duration shall be up to 15 consecutive minutes.

D.3.4 Transport, Packaging, Storage and Installation

All cable packaging shall meet the requirements of NEMA WC 26, “Binational Wire and Cable Packaging Standard”.
The following requirements shall also apply to cable manufactured to this specification.

- The cable shall be placed on reels suitable for protecting it from damage during shipment. Each end of the cable shall be firmly and properly secured to the reel. Care shall be taken to prevent looseness of cable on the reels.
- Each end of each reel of cable shall be durably sealed before shipment to prevent entrance of moisture.
- Each length of cable listed on the purchaser's order or detail list shall be shipped on a separate reel, except where the purchaser specifies multiplexed or parallel cable assemblies.
- Cable reel coverings shall meet the requirements of NEMA WC 26 Level 1 (no protection) unless otherwise specified by the purchaser.
- The minimum diameter of the reel drum of the shipping length shall be not less than prescribed in NEMA WC 26.

- The inner or drum end of the cable, when allowed to project through the flange of the reel shall be protected to avoid damage to the cable or seal. Each reel shall be marked with a durable label securely attached to the outside of a flange of the reel and plainly stating:
  - AVANGRID Material ID Number or UI Material ID Number
  - AVANGRID Purchase Order Number or UI Purchase Order Number
  - Manufacturer's Name
  - Manufacturing Plant
  - Date of Manufacture (Month and Year)
  - Beginning and Ending Footage Numbers
  - Shipping Destination
  - Number, Type, and Size of Conductors
  - Cable Configuration
  - Insulation Thickness and Type
  - Jacket Thickness and Type
  - Cable Voltage Rating
  - Length of Cable on Reel
  - Gross, Tare and Net Weight
  - Cable Reel Diameter and Width
  - Manufacturer's Reel Number

The finished single-phase cable shall be assembled either, one-phase, 3-phase parallel or triplexed onto the reel as specified in Annex A or as otherwise specified at time of order. Reel size and cable length shall be per the following table:

Table D3.1: AVANGRID Reel Sizes and Cable Lengths

Material ID AVANGRID	Description	Reel Type	Maximum Reel Flange O.D.	Maximum Reel Overall Width	Cable Length
30924404	CBL 15KV 1C # 2 AL JCN 100% INSLTN	Wood	66"	38.5"	2500'
30053665	CBL 15KV #2 AWG AL EPR 175 JCN 3/CT	Wood	66"	38.5"	1000'
30924407	CBL 15KV 1C 1/0 AL JCN	Wood	66"	38.5"	2500'
30924346	CBL 15KV 1C 1/0 CU JCN	Wood	66"	38.5"	2500'
30053653	CBL 15KV 4/0 AWG AL EPR 175 JCN 3/CT	Steel	84"	48"	1000'
30053676	CBL 15KV 4/0 AWG CU EPR 175 FS 3/CT	Steel	96"	60"	2500'
30053678	CBL 15KV 500 KCMIL CU EPR 175 FS 3/CT	Steel	84"	48"	1200'
30053675	CBL 15KV 500 KCMIL CU EPR 175 FS 1/C	Steel	84"	48"	1500'
30053654	CBL 15KV 750 KCMIL CU EPR 175 FS 3/CT	Steel	90"	55"	1100'
30053677	CBL 15KV 750 KCMIL CU EPR 175 FS 1/C	Steel	84"	48"	1500'
30924416	CBL 15KV 1C 750 KCM AL JCN	Steel	84"	48"	1000'
30924409	CBL 15KV 1C 1000 CU JCN EPR	Steel	84"	48"	1000'

- All cable listed as steel reel type shall be provided on returnable steel reels.
- All wooden reels shall have arbor hole steel plates.
- All cable listed as steel reel type shall be provided on returnable steel reels.

- All cable shipped on returnable steel reels shall have a nominal arbor hole diameter of 5-1/4″ to 5-1/2″. The two drive holes shall be 2-1/2″ to 3″ in diameter and on a radius of 11-1/2″ to 13″ from the center of the arbor hole. The trailing end of the cable shall not extend out of the dog hole."

D4: NEOENERGIA

D4.1 Cable Characteristics

The design and construction of cables specified in this document using EPR insulation shall comply with ABNT NBR 7286, ABNT NBR 6251 and ABNT NBR 16132.

D4.1.1 Conductor

The phase conductor material shall be compacted and circular with copper wires (class 2) in accordance with ABNT NBR 6251 and ABNT NBRNM 280.

D4.1.2 Longitudinal water blocking – conductor

The conductors shall have longitudinal water blocking and shall meet or exceed the requirements outlined in ABNT NBR 7286 e ABNT 6251.

D4.1.3 Insulation

EPR Insulation: The insulation shall consist of extruded, thermosetting compound based on copolymer or ethylene propylene terpolymer (EPR or EPR 105), according to ABNT NBR 6251.D1.1.4 Semi-conducting screens.

D4.1.4 Semi-conducting screens

Conductor screen: The conductor shield must conform to ABNT NBR 6251. The conductor shield must consist of a thermoset extruded layer and be juxtaposed to the conductor or to the semiconductor tape (if any), being easily removable and not attached to the conductor. The minimum and medium thickness of the shield shall be measured in accordance with ABNT NBR NM IEC 60811-1-1.

Insulation screen: The insulation shield, comprising semiconductor and metal part, shall conform to ABNT NBR 6251. The semiconductor part must be thermoset and be extruded simultaneously to the insulation and the shielding of the conductor in single head, that is, in coextrusion process in three layers.

The mean and minimum thicknesses of the insulation semiconductor shield shall be measured in accordance with ABNT NBR NM IEC 60811-1-1.

D4.1.5 Earth screen

The metal part of the insulation shall comply with ABNT NBR 6251.The shield must have electrical continuity along its entire length and be applied to the semiconductor part of the insulation. The metal shield shall consist of a concentric layer of wires.

The concentric layer of wires should be uniformly distributed, and the total section of wires should be equal to or greater than 16.0 mm2. The value of the short-circuit current in the shield can be determined according to the calculation method described in Annex E of ABNT NBR 6251.

D4.1.6 Outer Sheath

The outer sheath should consist of an extruded thermoplastic compound of polyolefin ST7, in accordance with ABNT NBR 6251, and the SHF1 cover shall provide a higher level of resistance to the spread of fire, shall be halogen-free and causes minimal smoke in the event of fire, according to ABNT NBR 16132.

D4.2 Equipment identification and marking

The following information must be indelibly marked on the outer cover of the cables at regular intervals up to 50 cm, in accordance with ABNT NBR 6251:

(a) The mark of origin (name, brand or logo of the manufacturer);

(b) Number of conductors and nominal section of conductor (s), expressed in square millimeters

(mm2);

c) Insulation voltage Uo / U, expressed in kilovolts (kV);

d) Material of the driver, insulation and cover, by the abbreviations established in ABNT NBR 6251;

e) Year of manufacture;

f) Number of the cable standard.

The manufacturer or supplier responsible may include the trademark of the product, preferably after the origin mark.

The year of manufacture and other contractual requirements may be marked on a placed tape.

The technical regulations issued by Inmetro must also be observed.

The markings in high or low relief or in ink are the standard ones.

In the case of thermosetting, the ink marking is standardized.

Any other type of marking shall be subject to agreement between manufacturer and buyer.

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.

D4.3 Testing

D4.3.1 Type tests

The method and test requirements for approval shall be those described by the shown in ABNT NBR 7286.

D4.3.2 Routine tests

Individual tests shall be carried out on all parts of cable manufactured observing the method and test requirements described by the shown in ABNT NBR 7286.

D4.3.3Especial tests

Especial tests shall be carried out according to the method and test requirements described by the relevant specifications shown in ABNT NBR 7286.

D4.3.4 Control tests

Control tests must be performed in accordance with ABNT NBR 7286.

D4.3.5 Testing during and after installation

Testing during and after installation must be performed according to the method and requirements described in ABNT NBR 7286.

D4.3.6 Criteria for sampling

All shipping units must be submitted to ABNT NBR 7286 sampling criteria.

ANNEX E: INFORMATION TO BE PROVIDED BY THE SUPPLIER

E1: I-DE

E1.1 Documentation for qualification

The following information shall be provided by the supplier in CD/DVD format:

- Manufacturing location(s) for all cables offered.
- Confirmation documented system of quality assurance of the production.
- Proposed cable protection for each cable type.
- Drum sizes and weights for each cable type.
- Certificate N product mark, according to HD 620, issued by AENOR.

E1.2 Documentation for expedition

Before issuing a delivery the Supplier shall send the following documentation of routine tests reports with each order:

- Report of individuals test, according to section **Erro! Fonte de referência não encontrada.**.

The complete documentation shall be supplied no later than 15 days after the factory acceptance test.

The manufacturer will wait i-DE notify if an inspection.

E2: SPEN

E2.1 Documentation for qualification

The following minimum information shall be provided by the supplier in CD/DVD format at the time of tender:

- Manufacturing location(s) for all cables offered.
- Extrusion & curing technology for XLPE and HEPR cables.
- Type Test Cert, reports & details of witnesses for all cables.
- Details of any alternative type test standards.
- Sample test frequencies for all cables.
- Cable ratings data for all power cables.
- Cable impedance data for all power cables.
- Cable installation parameters for all power cables.
- Means of water blocking for stranded Al conductors.
- Long term ageing test evidence for all cables.
- Proposed sealing arrangement for each cable type.
- Proposed cable protection for each cable type.
- Drum sizes and weights for each cable type.
- Confirmation of documented quality assurance system.
- Quality policy statement, QA approvals and plans.
- Completed, signed and dated Self Certification Confirmation Declaration

E2.2 Documentation for expedition

The supplier shall supply routine and sample tests reports with each order.

Supplier shall notify in advance the different stages in the manufacturing process in order to attend for inspection.

E2.3 Self Certification Confirmation Declaration

The Supplier shall complete and submit a Self-Certification Conformance Declaration to show compliance with each Tender.

The Supplier shall declare conformance or otherwise, clause by clause, using the levels of conformance declaration codes detailed in following tables:

Details	To be completed by the Supplier	
Supplier		Page: ___ of ___
Manufacturing Location (production line identification)		
Product Reference		

Name: Title:	Signature:	Date:

Clause	Clause Title	Conformance Code	Comments	Reference	Hyperlink
1	Scope				
4.1	Ratings				
4.2	Conductor				
4.3	Insulation				
4.4	Conductor and insulation screen				
4.5	Oversheath / Jacket				
5 / 5.1	Design and construction of cables				
5.2	Equipment identification and marking				
6.1	Type tests				
6.2	Routine tests				
6.3	Sample tests				
7	Designation and coding				
8	Transport, packing, storage and installation				
9	Health & Safety				
10	Documentation				
11	Influence of the product on the environment				
12.1	Qualification				
12.2	Acceptance				
Annex A2	Designations and Codes for SPEN				
Annex B	Additional Characteristics for i-DE and SPEN				
Annex B2	Additional Characteristics for SPEN				
Annex E2	Information to be Provided by the Supplier for SPEN				

Details	To be completed by the Supplier
Any other comments?	

Conformance Declaration Codes	
Code	
NA	Clause is not applicable or appropriate to the product.
Cs1	The product fully conforms with the requirements of this clause.
Cs2	The product partially conforms with the requirements of this clause.
Cs3	The product does not conform with the requirements of this clause.
Cs4	The product does not currently conform with the requirements of this clause, but the Supplier proposes to modify and test the product in order to comply.

When Cs1 code is entered the Supplier shall:

- Detail how their product complies with the specific clause, including any values and/or test results.
- Reference where in the Tender pack this evidence is recorded (filename, email, etc.)
- Provide a Hyperlink to the exact section where the relevant information is held within the submitted evidence.

When any other code is entered, the reason for non-conformance shall be clearly detailed and if necessary justified with supporting evidence that is referenced (with Hyperlinks provided).

Each sheet of this declaration should be signed and dated by a responsible representative of the Tendering Company.

E3: AVANGRID NETWORKS

The following information/data/drawings shall be provided for the cables purchased under this specification inclusive with the information specified in the rest of this specification.

- Conductor metallurgy, type, diameter (inches), size (kcmil), standing, and weight per foot.
- Nominal diameters (inches) over conductor, conductor shield, insulation, insulation shield, metallic shield, and jacket.
- Insulation type, nominal thickness, and tolerances (inches).
- Jacket material, nominal thickness, tolerances (inches).
- Lay of shield wires, ribbons or metallic shield tapes (inches), dimensional values, size and number of concentric wires (if used) (kcmil), and weight per foot.
- 1/C Cable overall diameter (inches), weight per foot, metallic weight per foot.
- Completed cable overall circumscribed diameter (inches), weight per foot, metallic weight per foot, (if three conductor, indicating conductor configuration (3CP, 3CT, 3/C, etc.))
- Minimum allowable bending radius.
- Allowable pulling tension based on pulling by basket grip over cable jacket and by conductor. Specify pulling method and allowable tensions.
- Number of reels, dimensions, drum and arbor hole size.