IPP DEVELOPER

نور للطاقة1
NOOR ENERGY1

EPC CONTRACTOR

上海电气
SHANGHAI ELECTRIC

EPC ENGINEERING

EMPRESARIOS AGRUPADOS

PROJECT

NE1 - 700MW CSP + 250MW PV Hybrid Project

03	2019-10-09	For Purchase	IDI	ITZ	ITZ
02	2019-07-30	For Purchase	IDI	ITZ	ITZ
01	2019-04-30	For Purchase	SRO	IDI	ITZ
REV	***DATE***	***DESCRIPTION***	***DONE***	***CHECKED***	***APPROVED***

DOCUMENT NUMBER

NE1-00-EM-EAI-TSP-YE_(E)-20901

EAI DOCUMENT NUMBER

476-00-I-E-20901

DOCUMENT NAME

CT & PTs MV, LV, Control and Instrumentation Cables Technical Specification

CLASSIFICATION

Contains information for the design of structures, systems or components: Yes ☒ No ☐

Design verification : Not applicable ☐ Head of OU/Supervisor ☒ Verifier Level 1 ☐ Level 2 ☐

CONTROL OF MODIFICATIONS

Issue	Modifications
1	First edition
2	Second edition considering NE1 and SEGC comments
3	Third edition considering NE1 and SEGC comments

PRELIMINARY OR PENDING INFORMATION

Issue	Paragraphs	Subject	Status
3	-	-	-

DISTRIBUTION

External	Internal	No. copies/Format
Shangai Electric	DND, MCQ, ITZ, IDI, AGD	1 electronic file

CONTENTS

Page No.

1. PURPOSE

The purpose of this specification is to establish the general technical requirements for the design, construction, supply and testing of MV, LV, Control and Instrumentation cables for Noor Energy 1-700MW CSP + 250MW PV Hybrid Project.

2. DESCRIPTION OF THE PLANT

Noor Energy 1-700MW CSP + 250MW PV Hybrid Project comprises 250 MW of photovoltaic power units and four (4) concentrated solar power units: one (1) based on CT configuration using molten salt central receiver technology with a maximum net capacity of 100 MW and three (3) based on PT collector technology (200 MW each).

For further details, see document No. NE1-00-EM-EAI-PLN-OOO(G)-00400, General Project Requirements.

3. LOCATION OF THE PLANT

The Plant is located in a greenfield site within the Mohammed Bin Rashid Al Maktoum Solar Park plot. The Solar Park is located at the Saih al Dahal Area, which is about 50 km south of Dubai, or 20 km southeast of the small town of Al Lisaili.

For further details, see document No. NE1-00-EM-EAI-PLN-OOO(G)-00400, General Project Requirements.

4. SCOPE OF SUPPLY

4.1 CABLES AND COMPONENTS

The scope of supply of this specification includes the MV and LV power cables, the control cables, the I&C cables and the terminals for the MV cables.

The types of cables and terminals are indicated in the document No. NE1-00-EM-EAI-LIS-YE_(E)-60800, Cable Type List.

Estimation of cables and terminals are included in the document NE1-10-EM-EAI-LIS-YE_(E)-60510, Cable Material List (MV, LV, I&C, Communic).

The terminals are to be supplied complete with all the accessories required for assembly.

4.2 SERVICES INCLUDED

- Packing, shipping and transport, in accordance with the requirements stated in the Purchasing Conditions
- Performance of the tests listed in Section 7
- Supply of the documentation required by Section 11

5. AMBIENT CONDITIONS

See document No. NE1-00-EM-EAI-PLN-OOO(G)-00400, General Project Requirements, for the environmental and seismicity site conditions.

6. DESIGN REQUIREMENTS

The general design characteristics shall be as set out below:

6.1 APPLICABLE CODES AND STANDARDS

The Supplier shall comply with local or national Regulations, Codes and Standards in accordance with the country in which the Plant is erected as well as with all Purchaser requirements.

Cables and components to be supplied shall be designed, manufactured and tested in accordance with the applicable standards from the ones listed below:

IEC 60028	International standard of resistance for copper
IEC 60228	Conductors of insulated cables
IEC 60332-1-2	Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable
IEC 60332-3-24	Tests on electric cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um=1.2 kV) up to 30 kV (Um=36 kV)- Part 1: Cables for rated voltages from 1 kV (Um= 1.2 kV) up to 3 kV (Um=3.6 kV)

IEC 60502-2	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 30 kV (Um = 36 kV) - Part 2: Cables for rated voltages from 6 kV (Um =7.2 kV) up to 30 kV (Um = 36 kV)
IEC 60502-4	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 30 kV (Um = 36 kV) - Part 4: Test requirements on accessories for cables with rated voltages from 6 kV (Um = 7.2 kV) up to 30 kV (Um = 36 kV)
IEC 60584-3	Thermocouples. Part 3: Extension and compensating cables
EN 61034	Measurement of smoke density of cables burning under defined conditions
IEC 60189-2	Low frequency cables and wires with PVC insulation and PVC sheath: Cables in pars, triples, quads and quintuples for inside installations
IEC 61442	Electric cables - Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7.2 kV) up to 30 kV (Um = 36 kV)
IEC 60754-1	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
EN 60754-2	Test on gases evolved during combustion of materials from cables. Determination of acidity (by pH measurement) and conductivity
IEC 60793-2	Optical fibres. Part 2: Product specification
IEC 60794-1-2	Optical fibre cables- Part 1-2: Generic specification – Basic optical cable test procedures General guidance
ANSI/TIA-568-C2	Balanced Twisted-Pair Telecommunication Cabling and Components Standard
ISO/IEC 11801	Generic cabling requirements for twisted-pair and optical fiber cables

6.2 REFERENCE DOCUMENTS

The following reference documents shall be considered as part of this Specification and shall also be complied:

- Cable Type List (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800)
- Cable Material List (MV, LV, I&C, Communic.) (Doc. NE1-10-EM-EAI-LIS-YE_(E)-60510)

The latest edition of all the documents is applicable.

6.3 MAIN TECHNICAL CHARACTERISTICS

All cables will be prepared for fixed installation in trays or inside conduits, above-ground. For underground runs, the cables will be laid on cable trays in man-accessible galleries or covered trenches or in PVC or steel ducts, embedded in concrete. In some cases, the cables may be buried directly (i.e auxiliary PV areas, solar field…). Outdoor trays exposed to sun light will be provided with sun-shades.

Outdoor cables shall be resistant to heat, moisture, ozone, sunlight and ultraviolet as per IEC standards.

All cables shall comply with the flame retardant tests as per IEC 60332-1-2 and fire retardant as per IEC 60332-3-24 (Test for vertical flame spread of vertically- Category C).

The following characteristic shall be fulfilled as an exception the cables running exclusively along the solar field:

- Reduced emission of halogen as HCI<15% as per IEC 60751-1/-2

- Reduced smoke emission IEC 61034-1/2

6.3.1 MV Power Cables

MV cables shall be manufactured in accordance with IEC 60502-2 and shall have a rated voltage of 12/20 kV for 11 kV and 6/10 kV for 6.6 kV.

MV cables shall be single or three core type, as indicated in the Cable Type List (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800).

MV cables will be stranded and compacted copper class 2 conductors (according to IEC 60228), with XLPE insulation and PVC/ST2 oversheath.

MV Cables shall be armoured if required in the Cable Type List. (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800). The armour shall be wired type and be made of aluminum (single-core cables) or steel (multi-core cables).

Both conductor and insulation shall be screened with an extruded semi-conductive material.

All cables shall have a metal layer surrounding the cores, either individually or collectively.

6.3.2 LV Power Cables

LV cables shall be manufactured in accordance with IEC 60502-1 and shall have a rated voltage of 0.6/1kV.

LV cables shall be of stranded and compacted copper class 2 or 5 conductors (according to IEC 60228), with XLPE insulation and PVC/ST2 oversheath.

The following may be required if it is indicated in the document Cable Type List (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800):

- Aluminium conductor for solar field cables
- Armoured cable. The armour shall be wired type and be made of aluminum (single-core cables) or steel (multi-core cables).
- Screened cable
- Single or multicore type.

6.3.3 Control Cables

Control cables shall be manufactured in accordance with IEC 60502-1 and shall have a rated voltage of 0.6/1 kV.

Control cables shall have multicore copper class 5 conductors, XLPE insulation, PVC inner sheath, metallic screen and PVC oversheath and galvanised steel wire armoured if required in the Cable Type List. (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800).

Pilot cables inside of the plant (if applicable):

- Multicore pilot cables shall have copper conductors, thermoplastic insulation, thermoplastic inner sheath, galvanised steel wire armour and thermoplastic sheath overall.

6.3.4 Instrumentation Cables

Instrumentation cables (≤ 60 V analogue and digital signals, etc.) shall be manufactured in accordance with IEC 60189-2, 300/500 V rated for several pairs or triples, copper class 5 conductor material, XLPE insulation, thermoplastic inner sheath and PVC oversheath.

Instrumentation cables shall have galvanised steel wire armoured if required in the Cable Type List. (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800).

Instrumentation cables will have an overall screen, for added immunity against electromagnetical interference. The individual pairs or triples will also be screened.

Instrumentation cables shall be:

- Twisted pairs, individually shielded and with a common shield

- Twisted triads, individually shielded and with a common shield
- Multiconductors with a single common shield

All extension cables shall be for thermocouple type E or K, flexible and in accordance with IEC 60584-3. Conductors pairs shall be twisted individually and with a common shield.

Fibre optic cables shall be monomode or multimode type (as required in the Cable Material List (MV, LV, I&C, Communic (Doc. NE1-10-EM-EAI-LIS-YE_(E)-60510) manufactured in accordance with IEC 60794. They shall have a metallic armour (when applicable) and the outer sheath shall guarantee flame retardant properties.

Communication cables shall be UTP category 6 or STP/FTP category 5e (as required in the Cable Material List (MV, LV, I&C, Communic) Doc. NE1-10-EM-EAI-LIS-YE_(E)-60510), according to ANSI/TIA-568-C2 or ISO/IEC 11801.

6.4 CABLE IDENTIFICATION

Cable identification shall be in compliance with the document Cable Type List (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800).

Each core of a multi-core control cable shall be readly identified by a number impressed into insulation every 100 mm (Owner Technical Specification requirement)

6.5 TECHNICAL AND CONSTRUCTION CHARACTERISTICS OF THE MV TERMINALS

The MV terminals shall be manufactured in accordance with IEC 60502-4.

The MV terminals shall comply with the following requirements:

- Terminals shall be for connection inside boxes or cabinets, or for outdoor installation in accordance with that indicated in Appendix A.
- All terminals shall be fitted with a linear voltage distributor for electrical field distribution inside the cable terminal and with a cable shield ground connection point.
- Terminal ends shall be equipped with metal terminals so that they can be screwed and bolted to motor terminals, transformers, busbars and cabinet terminals.
- Terminals shall be insulated with ethylene-propylene, silicone rubber, or other material of suitable mechanical, electrical and sealing characteristics.

7. TESTS

Cables and terminals shall be subjected to the tests in accordance with the relevant standards.

7.1 CABLES TESTS

The cables shall be subjected to shop tests in accordance with the relevant standards to test the design and general qualities of the cables as below:

- Routine tests on each drum of cables
- Sample tests
- Type tests on each type of cable

Type test protocols certificates will be accepted

Routine Tests

MV power cables, LV power cables and control cables will be subjected to the routine tests in accordance with IEC 60502 on each drum of cables.

Instrumentation cables shall be tested as per their applicable standard.

Type Tests

Each type of cable shall also be subject to the following additional type tests:

- Flame propagation tests as per the requirements of IEC 60332-3-24
- Fire propagation tests as per the requirements of IEC 60332-1-2
- Halogen content as per the requirements of IEC 60754-1 (if applicable)
- Smoke Smoke opacity test as per the requirements of IEC 61034 (if applicable)

OTS cables tests requirements:

- Routine insulation tests shall be made and recorded on all cables, joints and sealing ends etc.
- HV dc tests shall be made between conductors and sheath on cables operating at and above 3.3 kV
- 1000 V insulation tests shall similarly be made on LV power cables and dc power supplies cables

- 500 V insulation tests shall be applied between all cores and earth on all multicore cables
- On terminations with insulated glands (single core cables) a 1000 V insulation test shall be carried out between armour and/or sheath and earth

7.2 TERMINAL TESTS

The MV terminal tests shall be carried out in accordance with IEC 60502-4.

The performance of the tests indicated in this standard is not necessary if certificates of the corresponding type test protocols are provided by the manufacturer.

8. TECHNICAL GUARANTEES

The Supplier shall guarantee the values indicated on the Technical Data Sheets corresponding to Attachment A and B hereto.

9. QUALITY ASSURANCE

The Manufacturer shall implement a quality management system in accordance with the stipulations of the General Purchasing Conditions.

10. INSPECTION POINTS PROGRAMME

The Supplier shall submit to the approval of the Purchaser an Inspection Points Programme that explicitly and correlatively develops each and every one of the phases of the procurement, manufacture and testing, and preparation for shipment. The inspection points to be carried out by the supplier shall be indicated.

For each point the Supplier shall indicate the internal procedure that is applicable. He shall also indicate whether a report or protocol will be generated for each point, or whether other associated documentation will be provided (quality certificates, reception reports, etc).

The Purchaser shall select the points on this programme which they or their representatives shall witness.

During the inspection visits, the Purchaser reserves the right to review applicable documentation that has not been presented for his approval (reception procedures, manufacturing procedures, etc).

The Inspection Points Programme shall comprise a minimum of the following sections in which the following information shall be given:

a) Materials inspection

Main materials and components: inspection upon reception of materials to be used in manufacture, with indication of those that will require quality certificates.

b) Inspection of manufacturing

List of the main in-process inspection points.

c) Examinations and tests

A list of all the tests indicated in this specification, with reference to each associated procedure that specifies the acceptance criteria for the test in question

d) Protection, labelling and delivery. Final documentation

A statement of the monitoring or inspection of these activities setting out the procedures to be applied and including a revision point for the final documentation dossier and an issue point for the Delivery Note.

11. DOCUMENTATION

11.1 DOCUMENTATION TO BE SUPPLIED WITH THE PROPOSAL

The following information shall be supplied with the bid, as a minimum:

- Complete description of the scope
- Detailed list of the cables and terminals to be supplied, including description and sketch of the transversal section of each type of cable
- Data Sheets, included as Appendix A to this Technical Specification, correctly completed
- Catalogues and technical brochures of the cables and terminals offered, giving cable construction details and characteristics
- Cable current ratings for different types of installation, including derating factors for ambient temperature, grouping, etc.
- Manufacturer's recommended method of splicing, jointing, termination, etc. of the cables.
- List of references of the supply of cables identical or similar to that offered
- Description of the tests offered, indicating the standard applied
- Type test certificates on all specified cables and terminals.

In addition, the Bidder shall present a "List of Exceptions" containing the technical discrepancies between the characteristics of the cables and terminals offered and what is required by this Technical Specification, those established in applicable codes and standards and the documents attached.

All exceptions shall be included in this list, indicating their justification and they shall be listed referencing the corresponding sections of this Specification.

The exceptions not included in the List of Exceptions shall not be contractually valid.

11.2 DOCUMENTATION TO BE SUPPLIED WITH THE PURCHASE ORDER

Upon award of the purchase order, the supplier shall deliver the following documentation:

	Max delivery period from date of award
• Certified Technical Data Sheets of the Proposal	2 weeks
• List of documents with delivery schedule	1 week
• Manufacturing programme and delivery schedule	2 weeks
• Inspection Points Programme, for approval.....	2 weeks
• Test procedures, for approval	4 weeks
• Equipment test certificates, reports and protocols	16 weeks or after tests
• Commissioning, operating and maintenance instructions manual	16 weeks

11.3 FINAL DOCUMENTATION

Any modification made to the documents shall be monitored and controlled during project execution. Such modifications may arise from design changes, nonconformities, deviations, as-built observations, etc. All Purchaser-approved modifications shall be integrated in the associated project documents to keep them up to date. The final issue of the documents (as-built) shall be incorporated into the corresponding Final Dossier, which shall be sent to the Purchaser after performance of the final acceptance test, as indicated below.

11.3.1 Engineering Dossier

When manufacture has been finalised, the supplier shall send the Purchaser an engineering dossier containing the following documents, as a minimum requirement:

- Certified technical data sheets
- General list of cables and terminals
- Instructions for equipment storage and preservation at the plant prior to its commissioning
- Instructions for equipment, commissioning and testing

11.3.2 Quality Dossier or Final Supply Dossier

Once supply has been finalised, the supplier shall submit a final supply dossier containing the following documents:

- Description of the supplier's quality assurance and quality control programme
- Copy of the Official Certificate of the supplier's Quality System, if any
- Completed Inspection Points Programme. As long as all the points are duly signed and stamped by the supplier and all the points witnessed by the Purchaser are duly signed and stamped by him, this document will serve in general as a record of the inspection activities
- Copy of the procedures submitted for approval
- Copy of the quality certificates, reception reports, test reports, test protocols, etc, that are to be issued for each point indicated in the Programme
- Documented reports on significant deviations that have occurred, if any
- Copy of the Authorisation for Shipment, if required
- Supplier's Final Quality Certificate

APPENDIX A

DATASHEETS

BIDDER:	REQUIRED	OFFERED
1. MEDIUM VOLTAGE CABLES		
1.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable type list"(*)	
Manufacturer		
Place of manufacture		
Type		
Model		
Applicable standard	IEC 60502-2	
Rated Voltage, kV	6/10 (12) for 6.6 kV and 12/20 (24) for 11 kV	
Number of conductors		
Maximum continuous current (20ºC), A		
Power frequency voltage test for 5 min, kV (for 6.6 kV / 11 kV)	21 / 42	
Power frequency voltage test for 4 hours, kV (for 6.6 kV/11 kV)	24 / 48	
Impulse voltage test, kV peak (for 6.6 kV/11 kV)	75 / 125	
Core identification		
Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling tension, N/m		
Maximum permissible continuous conductor temperature, ºC	90	
Maximum permissible short-circuit conductor temperature, ºC	250	
1.2 CONDUCTOR CHARACTERISTICS		
Material	Electrolytic annealed copper (Cu ETP 99.9%)	
Class	2	
Cross section, mm^2	As indicated in "Cable type list"(*)	
Diameter, mm		
Shape		
Stranding type		
Weight, kg/km		
DC. Resistance (20ºC), Ω/km	Less than maximum value stated in IEC 60228	

BIDDER:	REQUIRED	OFFERED
Thickness of conductor screen, mm		
1.3 INSULATION CHARACTERISTICS		
Material	XLPE	
Thickness, mm	As per IEC 60502-2	
Weight, kg/km		
Thickness of insulation screen, mm		
1.4 SHIELD/ SCREEN		
Material	Continuous copper wires-helically applied	
Thickness, mm		
Weight, kg/km		
Shape		
Lap degree, %		
Longitudinal water sealing	REQUIRED	
1.5 INNER COVERING		
Material		
Thickness, mm		
Weight, kg/km		
1.6 ARMOUR (IF APPLICABLE)		
Material	Aluminium (single-core cables) or Steel (Multi-core cables)	
Type	Wires	
Thickness, mm		
Weight, kg/km		
1.7 OUTER SHEATH		
Material	PVC-ST2	
Thickness, mm	As per IEC 60502-2	
Additives		
Weight, kg/km		
1.8 OTHER CHARACTERISTICS		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCI<15%) as per IEC 60754-1/2	REQUIRED	
Reduced smoke emission as per IEC 61034-1/2	REQUIRED	
1.9 TEST		
Routine tests (acc. to IEC 60502 – 2)	REQUIRED	
Samples tests (acc. to IEC 60502 – 2)	REQUIRED	

BIDDER:	REQUIRED	OFFERED
Type tests (acc. to IEC 60502 – 2)	CERTIFICATE	
No flame propagation according to IEC 60332-1-2	CERTIFICATE	
No fire propagation according to IEC 260332-3-24	CERTIFICATE	
Halogen content test acc. to IEC 60754-1	CERTIFICATE	
Smoke opacity test acc. to IEC 61034	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2)	CERTIFICATE	
2. MV TERMINALS		
Number of single-core terminals and three-core terminals	As indicated in the "Cable material list (MV, LV, I&C, Communic.)"(**)	
Manufacturer		
Installation		
Type		
Name		
Material of the insulating part		
Material and dimensions		
Testing and manufacturing standards	IEC 60502-4	
Rated voltage (kV)	6/10 (12) for 6.6 kV and 12/20 (24) for 11 kV	
Rated lightning impulse withstand voltage (kV peak) (for 6.6 kV/11 kV)	75 / 125	
Power frequency withstand voltage for 5 minutes (kV) (for 6.6 kV/11 kV)	27 / 54	
Total length of terminals (mm)		
Maximum diameter of the insulating part (mm)		
Length of creepage line (mm)		
Weight (Kg)		
3. LOW VOLTAGE CABLES		
3.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable type list" (*)	
Manufacturer		
Place of manufacture		
Type		
Model		
Applicable standard	IEC 60502-1	
Rated Voltage, kV	0.6/1	
Number of conductors		

BIDDER:	REQUIRED	OFFERED
Maximum continuous current (20ºC), A		
Power frequency voltage test for 5 min, kV	3.5	
Power frequency voltage test for 4 hours, kV	2.4	
Core identification	As indicated in "Cable type list"(*)	
Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling tension, N/m		
Maximum permissible continuous conductor temperature, ºC	90	
Maximum permissible short-circuit conductor temperature, ºC	250	
3.2 CONDUCTOR CHARACTERISTICS		
Material	Electrolytic annealed copper (Cu ETP 99.9%) or Aluminium (only solar field cables, type H)	
Class	2 or 5	
Cross section, mm^2	As indicated in "Cable type list"(*)	
Diameter, mm		
Shape		
Stranding type		
Weight, kg/km		
DC. Resistance (20ºC), Ω/km	Less than maximum value stated in IEC 60228	
3.3 INSULATION CHARACTERISTICS		
Material	XLPE	
Thickness, mm	As per IEC 60502-1	
Weight, kg/km		
3.4 SHIELD/ SCREEN (IF APPLICABLE)		
Material	Continuous copper wires-helically applied	
Thickness, mm		
Weight, kg/km		
Shape		
Lap degree, %		

BIDDER:	REQUIRED	OFFERED
Longitudinal water sealing	REQUIRED	
3.5 INNER COVERING (IF APPLICABLE)		
Material		
Thickness, mm		
Weight, kg/km		
3.6 ARMOUR (IF APPLICABLE)		
Material	Aluminium (single-core cables) or Steel (Multi-core cables)	
Type	Wires	
Thickness, mm		
Weight, kg/km		
3.7 OUTHER SHEATH		
Material	PVC-ST2	
Thickness, mm	As per IEC 60502-1	
Additives		
Weight, kg/km		
3.8 OTHER CHARACTERISTICS		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCl<15%) as per IEC 60754-1/2	As per "Cable type list"(*)	
Reduced smoke emission as per IEC 61034-1/2	As indicated in "Cable type list"(*)	
3.9 TEST		
Routine tests (acc. to IEC 60502 – 1)	REQUIRED	
Samples tests (acc. to IEC 60502 – 1)	REQUIRED	
Type tests (acc. to IEC 60502 – 1)	CERTIFICATE	
No flame propagation according to IEC 60332-1-2	CERTIFICATE	
No fire propagation according to IEC 60332-3-24	CERTIFICATE	
Halogen content test acc. to IEC 60754-1 (if applicable)	CERTIFICATE	
Smoke opacity test acc. to IEC 61034 (if applicable)	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2) (if applicable)	CERTIFICATE	
4. CONTROL CABLES		
4.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable type list"(*)	

BIDDER:	REQUIRED	OFFERED
Manufacturer		
Place of manufacture		
Type		
Model		
Applicable standard	IEC 60502-1	
Rated Voltage, kV	0.6/1	
Number of conductors/pairs/triples		
Maximum continuous current (20ºC)		
Power frequency voltage test for 5 min, kV	3.5	
Power frequency voltage test for 4 hours, kV	2.4	
Core identification	As indicated in "Cable type list" (*)	
Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling tension, N/m		
Maximum permissible continuous conductor temperature, ºC	90	
Maximum permissible short-circuit conductor temperature, ºC	250	
4.2 CONDUCTOR CHARACTERISTICS		
Material	Electrolytic annealed copper (Cu ETP 99.9%)	
Class	5	
Cross section, mm^2		
Diameter, mm		
Shape		
Stranding type		
Weight, kg/km		
DC. Resistance (20ºC), Ω/km	Less than maximum value stated in IEC 60228	
4.3 INSULATION CHARACTERISTICS		
Material	XLPE	
Thickness, mm	As per IEC 60502-1	
Weight, kg/km		
4.4 SCREEN		
Material		
Thickness, mm		

BIDDER:	REQUIRED	OFFERED
Weight, kg/km		
Shape		
Lap degree, %		
4.5 INNER SHEATH		
Material	PVC	
Thickness, mm	As per IEC 60502-1	
Weight, kg/km		
4.6 ARMOUR		
Material	Galvanised steel	
Type	Wires	
Thickness, mm		
Weight, kg/km		
4.7 OUTHER SHEAT		
Material	PVC	
Thickness, mm	As per IEC 60502-1	
Additives		
Weight, kg/km		
4.8 OTHER CHARACTERISTICS		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCl<15%) as per IEC 60754-1/2	As indicated in "Cable type list"(*)	
Reduced smoke emission as per IEC 61034-1/2	As indicated in "Cable type list"(*)	
4.9 TEST		
Routine tests (acc. to IEC 60502 – 1)	REQUIRED	
Samples tests (acc. to IEC 60502 – 1)	REQUIRED	
Type tests (acc. to IEC 60502 – 1)	CERTIFICATE	
No flame propagation according to IEC 60332-1-2	CERTIFICATE	
No fire propagation according to IEC 60332-3-24	CERTIFICATE	
Halogen content test (acc. to IEC 60754-1) (if applicable)	CERTIFICATE	
Smoke opacity test (acc. to IEC 61034) (if applicable)	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2) (if applicable)	CERTIFICATE	
5. INSTRUMENTATION CABLES		
5.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable type list" (*)	

BIDDER:	REQUIRED	OFFERED
Manufacturer		
Place of manufacture		
Type	E and K	
Model		
Applicable standard	IEC 60189-2	
Rated Voltage, kV	0.3 / 0.5	
Number of conductors		
Power frequency voltage test for 5 min, kV	2	
Core identification		
Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling tension, N/m		
5.2 CONDUCTOR CHARACTERISTICS		
Material	Electrolytic annealed copper (Cu ETP 99.9%)	
Class	5	
Cross section, mm^2	As indicated in "Cable type list"(*)	
Diameter, mm		
Shape		
Stranding type		
Weight, kg/km		
DC. Resistance (20ºC), Ω/km	Less than maximum value stated in IEC 60228	
5.3 INSULATION CHARACTERISTICS		
Material	XLPE	
Thickness, mm		
Weight, kg/km		
5.4 INDIVIDUAL SCREEN		
Material		
Lap degree, %		
Thickness, mm		
Weight, kg/km		

BIDDER:	REQUIRED	OFFERED
5.5 OVERALL SCREEN		
Material		
Lap degree, %		
Thickness, mm		
Weight, kg/km		
5.6 INNER SHEATH		
Material	Thermoplastic (PVC)	
Thickness, mm	As per IEC 60502-1	
Weight, kg/km		
5.7 OUTER SHEATH		
Material	PVC	
Thickness, mm		
Additives		
Weight, kg/km		
5.8 OTHER CHARACTERISTICS		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCI<15%) as per IEC 60754-1/2	As indicated in "Cable type list" (*)	
Reduced smoke emission as per IEC 61034-1/2	As indicated in "Cable type list" (*)	
5.9 TEST		
Routine tests (acc. to applicable standard)	REQUIRED	
Samples tests (acc. to applicable standard)	REQUIRED	
Type tests (acc. to applicable standard))	CERTIFICATE	
No flame propagation according to IEC 60332-3-24	CERTIFICATE	
No fire propagation according to IEC 60332-1-2	CERTIFICATE	
Halogen content test(acc. to IEC 60754-1 (if applicable)	CERTIFICATE	
Smoke opacity test (acc. to IEC 61034) (if applicable)	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2) (if applicable)	CERTIFICATE	
6. FIBER OPTIC CABLES: Monomode		
6.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable Type List"(*)	
Manufacturer		
Place of manufacture		
Fiber category	OS1	

BIDDER:	REQUIRED	OFFERED
Fiber type	Monomode	
Number of fibers	4 / 8 / 12 / 16 / 24 / 48	
Applicable standard	IEC 60793, IEC 60794	
Core diameter, µm	9	
Cladding diameter, µm	125	
Cladding non-circularity, %	≤ 1	
Core/ Cladding Concentricity error, µm	≤ 0.6	
Coating diameter (un-dyed)		
Mode field diameter, µm		
6.2 OPTICAL PARAMETERS		
Wavelength, nm	1310 / 1550	
Cable cut-off wavelength (dcc), nm	≤ 1260	
Attenuation • 1310 nm wavelength, dB/km • 1550 nm wavelength, dB/km	 ≤ 0.4 ≤ 0.3	
Dispersion • 1310 nm wavelength, ps/nm · km • 1550 nm wavelength, ps/nm · km	 ≤ 3.5 ≤ 18	
Zero dispersion wavelength, nm	(1300 – 1324)	
PMD (Polarization mode dispersion)	≤ 0.2	
6.3 CONSTRUCTION CHARACTERISTICS		
No. of fiber in loose tube		
Loose tube • Material • Thickness, mm		
• Diameter, mm		
Filler • No. of fillers • Material		
Central Strength Member (CSM) • Material		

BIDDER:	REQUIRED	OFFERED
Core • Material • Water blocking	REQUIRED	
Inner sheath • Material • Thickness	PVC	
Armour • Material • Thickness, mm	Galvanized steel wires	
Outer sheath • Material • Thickness • Colour	PVC	
Water blocking	REQUIRED	
Mechanical protection	REQUIRED	
High resistance to pulling stress	REQUIRED	
Cable Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling stress, N/m		
Proof stress level, GPa	≥ 0.69	
Strip force (average), N		
Strip force (peak), N		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCl<15%) as per IEC 60754-1/2	REQUIRED	
Reduced smoke emission as per IEC 61034-1/2	REQUIRED	
6.4 TESTS		
As per IEC 60793 and IEC 60794	REQUIRED	
Optical Time Domain Reflectometer (OTDR) test	REQUIRED	
No flame propagation according to IEC 60332-1-2	CERTIFICATE	
No fire propagation according to IEC 60332-3-24	CERTIFICATE	
Halogen content test (acc. to IEC 60754-1)	CERTIFICATE	
Smoke opacity test (acc. to IEC 61034)	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2)	CERTIFICATE	

BIDDER:	REQUIRED	OFFERED
7. FIBER OPTIC CABLES: MULTI MODE		
7.1 GENERAL CHARACTERISTICS		
Cable Code	As indicated in "Cable Type List"(*)	
Manufacturer		
Place of manufacture		
Fiber category	OM1	
Fiber type	Multimode	
Number of fibers	4 / 8 / 12	
Applicable standard	IEC 60793 and IEC 60794	
Core diameter, µm	62.5	
Cladding diameter, µm	125	
Core non-circularity, %		
Cladding non-circularity, %		
Core-cladding concentricity error, µm		
Primary coating diameter, µm	500	
Primary coating non-circularity, %		
Primary coating-cladding concentrity error, µm		
Secondary buffer diameter, µm	900	
Numerical aperture	0.275	
7.2 OPTICAL PARAMETERS		
Wavelength, nm	850 / 1300	
Maximum attenuation: • 850 nm wavelength, dB/km • 1300 nm wavelength, dB/km	 ≤ 3.5 ≤ 1.25	
Minimum model bandwidth: • 850 nm wavelength, MHz-km • 1300 nm wavelength, MHz-km	 ≤ 200 ≤ 500	
Index of refraction: • 850 nm wave • 1300 nm wave		
7.3 CONSTRUCTION CHARACTERISTICS		
No. of fiber in loose tube		

BIDDER:	REQUIRED	OFFERED
Loose tube • Material • Thickness, mm • Diameter, mm		
Filler • No. of fillers • Material		
Central Strength Member (CSM) • Material		
Core • Material • Water blocking	REQUIRED	
Inner sheath • Material • Thickness	PVC	
Armour • Material • Thickness, mm	Galvanized steel wires	
Outer sheath • Material • Thickness • Colour	PVC	
Water blocking	REQUIRED	
Mechanical protection	REQUIRED	
High resistance to pulling stress	REQUIRED	
Cable Weight, kg/km		
External diameter, mm		
Permanent bending radius, mm		
Temporary bending radius, mm		
Maximum pulling stress, N/m		
Proof stress level, GPa	≥ 0.69	
Strip force (average), N		
Strip force (peak), N		
Flame retardant as per IEC 60332-1-2	REQUIRED	
Fire retardant as per IEC 60332-3-24	REQUIRED	
Low Halogen Emission (HCI<15%) as per IEC 60754-1/2	REQUIRED	

BIDDER:	REQUIRED	OFFERED
Reduced smoke emission as per IEC 61034-1/2	REQUIRED	
7.4 TESTS		
As per IEC 60793 and IEC 60794	REQUIRED	
Optical Time Domain Reflectometer (OTDR) test	REQUIRED	
No flame propagation according to IEC 60332-1-2	CERTIFICATE	
No fire propagation according to IEC 60332-3-24	CERTIFICATE	
Halogen content test (acc. to IEC 60754-1)	CERTIFICATE	
Smoke opacity test (acc. to IEC 61034)	CERTIFICATE	
Determination of acidity (by pH measurement) and conductivity test (acc. to IEC 60754-2)	CERTIFICATE	

Notes:

(*) Cable Type List (Doc. No. NE1-00-EM-EAI-LIS-YE_(E)-60800)

(**) Cable Material List -MV, LV, I&C, Communic- (Doc. No. NE1-00-EM-EAI-PLN-YE_(E)-0035)1

APPENDIX B

DATASHEETS FOR FIBER OPTIC CABLES MULTIMODE (6 FIBERS)

(PAGE 10 OF THE DOC. NE1-10-EM-ABE-DST-YY_(I)-00009_REV. 01)

Description:

Data Sheet

Fiber Optic Cables Multimode (Outdoor)

Rev.	Date	Description
01	2019/06/06	First Edition

Cable	1	Fibers number		6/12		
	2	Fiber Type		Multi-mode 50 µm		
	3	Cable Type		Loose-Tube Fiber		
Service Conditions	4	Use		Directly Buried		
	5	Service		Distances less than 2000 m		
	6	Storage Temperature		2.8ºc to +85ºc (1)		
	7	Operation Temperature		2.8ºc to +85ºc (1)		
	8	Installation Temperature		2.8ºc to +85ºc (1)		
	9	Humidity		100%		
	10	Hazardous area classification		ATEX Class I, Zone 2, IIA T1 or IECEx equivalent		
	11	Application Standard		ISO/IEC 11801, ANSI/TIA/EIA-598-B-2		
Optical Fiber	12	Transmission Characteristics	Wavelength	850	1310	nm
	13		Maximum Attenuation	2.5	0.7	dB/km
	14		Bandwidth	500	1000	MHz*km
	15		Numerical Aperture	0.2	0.2	-
	16	Mechanical Characteristics		Installation	Permanent	
	17		Radius of curvature	By manufacturer	By manufacturer	µm
	18		Maximum Tractive Force	2700	1600	N
	19		Maximum Lateral Pressure	4400	3000	N/ dm
Physical Characteristics	20	Fiber Cladding		125.0µm Thermoplastic		
	21	Strength Individual Members		No		
	22	Subcable Coating		FRNC material		
	23	Central Element		Yes		
	24	Core Configuration		By Supplier		
	25	Fibers number per tube		By Supplier		
	26	Loose tubes (material/filling)		Thermpolastic tube filled with water repellent gel		
	27	Moisture Protection Element		Water Repellent Filling Gel		
	28	Inner Sheath		Polyethylene		
	29	Strength Members		Aramid yarn		
	30	Scratched Wire		Yes		
	31	Armour		Metallic Corrugated Steel / Galvanized Steel Wire Ring		
	32	Outer Sheath (jacket)		Polyethylene		
	33	Cable Diameter		By Supplier		
	34	Core-Coating Concentricity Error		≥2.0%		
Options	35	Additives Anti Rodent		Yes		
	36	Treatments for chemical protection		-		
	37	Resistant to ultraviolet radiation		Yes		
	38	No Flame Propagation		IEC-60332-1		
	39	No Fire Propagation		IEC-60332-2		
	40	Fire Resistant		-		
	41	Smoke Emissions		Emis. HCl < 15% (IEC-60754-1-2)		
	42	Other Properties		-		
Notes	43	(1) Service conditions has been detailed in NE1-00-EM-EAI-PLN-OOO(G)-00400 General Project Requirements				
	44	Connector: Fiber optic cable 50/125 with SC conector				
	45					
	46					
	47					
	48					
	49					
	50					
	51					
Eq.	52	Manufacturer		By Supplier		
	53	Model		By Supplier		
	54	Serial Number		By Supplier		