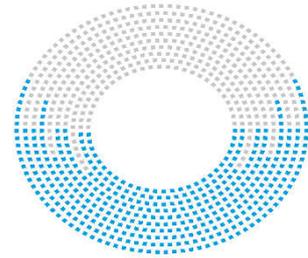


IPP DEVELOPER



نور للطاقة 1
NOOR ENERGY1

EPC CONTRACTOR



上海电气
SHANGHAI ELECTRIC

EPC ENGINEERING



EMPRESARIOS AGRUPADOS

PROJECT

NE1 - 700MW CSP + 250MW PV Hybrid Project

REV	DATE	DESCRIPTION	DONE	CHECKED	APPROVED
02	2019-08-26	For Purchase	IDI	ITZ	ITZ
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DOCUMENT NUMBER

NE1-00-EM-EAI-TSP-YE_(E)-20030

EAI DOCUMENT NUMBER

476-00-I-E-20030

DOCUMENT NAME

**Auxiliary PV Plants 33kV
Transmission Insulated Cable
Technical Specification**



Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030
Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page I Issue 02

CLASSIFICATION

<p>Contains information for the design of structures, systems or components: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Design verification : Not applicable <input type="checkbox"/> Head of OU/Supervisor <input checked="" type="checkbox"/> Verifier Level 1 <input type="checkbox"/> Level 2 <input type="checkbox"/></p>
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1	First edition
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PRELIMINARY OR PENDING INFORMATION

Issue	Paragraphs	Subject	Status
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DISTRIBUTION

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Shangai Electric	DND, MCQ, ITZ, ICB, IDI, AGD	1 electronic file

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page i	Issue 02

CONTENTS

	Page No.
1. PURPOSE.....	1
2. DESCRIPTION OF THE PLANT	1
3. REQUIREMENTS. LOCATION OF THE PLANT	1
4. SCOPE OF SUPPLY	1
4.1 EQUIPMENT AND COMPONENTS	1
4.1.1 33 kV Cables and Accessories	1
4.1.2 Other Components of the Supply.....	2
4.2 SERVICES INCLUDED	2
4.3 EQUIPMENT AND SERVICES TO BE SUPPLIED BY OTHERS.....	2
5. AMBIENT CONDITIONS.....	3
6. DESIGN REQUIREMENTS.....	3
6.1 APPLICABLE CODES AND STANDARDS.....	3
6.2 SERVICE CONDITIONS	4
6.3 CHARACTERISTICS OF THE 33 KV CABLES	4
6.3.1 Design Requirements	4
6.3.2 Construction Characteristics.....	5
6.3.3 Marking	7
6.4 ACCESSORIES OF THE CABLES.....	7
6.4.1 Design Requirements	7
6.4.2 Cable Terminations	7
6.4.3 Cable Joints.....	8
7. TESTING.....	8
8. TECHNICAL GUARANTEES	8
9. QUALITY MANAGEMENT	8
10. INSPECTION POINTS PROGRAMME	8
11. DOCUMENTATION	9
11.1 DOCUMENTATION TO BE SUPPLIED WITH THE PROPOSAL.....	9
11.2 DOCUMENTATION TO BE SUPPLIED WITH THE PURCHASE ORDER	10
11.3 FINAL DOCUMENTATION.....	11
11.3.1 Engineering Dossier	11
11.3.2 Quality Dossier or Final Manufacturing Dossier	11
 APPENDIX A TENDER DATA SHEETS	
 APPENDIX B DATA SHEETS	

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 1	Issue 02

1. PURPOSE

The purpose of this specification is to establish the general technical requirements for the design, construction, supply and testing of the 33 kV single core cables and their accessories for the power plant.

2. DESCRIPTION OF THE PLANT

Noor Energy 1-950MW CSP Project (“The Plant”) comprises 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) and two (2) photovoltaic plants.

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

3. REQUIREMENTS. 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.

4. SCOPE OF SUPPLY

4.1 EQUIPMENT AND COMPONENTS

4.1.1 33 kV Cables and Accessories

The scope of supply shall include the 33 kV insulated cable systems and accessories, in accordance with the characteristics set out in section 6. The 33kV cable systems shall include the following:

- Single-core 33 kV cable with dry extruded insulation made in cross-linked polyethylene (XLPE). The following sections and length per phase shall be considered:

System	Section	Length per phase (Preliminary)
PT1 Cable System	630 mm ²	2* x 1100 m
PT2 Cable System	630 mm ²	2* x 1100 m
PT3 Cable System	500 mm ²	2* x 2000 m
CT Cable System	400 mm ²	1700 m

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 2	Issue 02

(*) Two cable per phase

The final length shall be determined during detail design.

- Twenty-one (21) outdoor air cable terminations, complete with all their accessories, for the connection to the 33/6.9 kV Transformers.
- Forty-two (42) outdoor air cable terminations, complete with all their accessories, for the connection to the 33 kV PV Switching Substation.
- Twenty-one (21) outdoor air cable terminations, complete with all their accessories, for the connection to the 33 kV PV Switchgear.
- Earthing kit (as applicable)

4.1.2 Other Components of the Supply

- Recommended spare parts for startup and performance tests, if applicable
- Recommended spare parts for two (2) year operation, if applicable
- One (1) set of special tools that the Supplier considers necessary for plant assembly or maintenance, including the compression die and equipment for jointing works.

4.2 SERVICES INCLUDED

- Supply of the documentation required in Chapter 12 of this specification
- Packing, shipping and transport in accordance with the requirements included in the purchasing conditions
- Performance of the tests indicated in Chapter 8 of this specification
- Supervision of the erection, testing and commissioning of the cable systems and their accessories

4.3 EQUIPMENT AND SERVICES TO BE SUPPLIED BY OTHERS

The following equipment and services shall be supplied by others:

- Constructive drawings of the electrical raceways
- Civil works: construction of the electrical raceways, crossroads, opening and closing of trenches, filling material for trenches and material for protection and signalling of the cables laid in trenches
- Laying, support and attachment of the cables
- General grounding network

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 3	Issue 02

- Connections between the cable terminations supplied and the other equipment terminals
- Cable termination support structures
- 33 kV cable from PV1 and PV2 and their associated terminals

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

6.1 APPLICABLE CODES AND STANDARDS

Unless otherwise indicated in the corresponding paragraphs, the cables and their accessories to be supplied shall be designed, manufactured and tested in accordance with the following standards:

IEC 60060	High Voltage test techniques
IEC 60183	Guide to the selection of high-voltage cables
IEC 60028	International standard of resistance for copper
IEC 60228	Conductors of insulated cables
IEC 60229	Tests on cable oversheaths which have a special protective function and are applied by extrusion
IEC 60230	Impulse tests on cables and their accessories
IEC 60287	Electrical cables. Calculation of the current rating
IEC 60332	Tests on electric cables under fire conditions
IEC 60502-2	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - Part 2: Cables for rated voltages of 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC 60502-4	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - Part 4: Test requirements on accessories for cables with rated voltages from 6 kV ($U_m = 7.2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC 60529	Degrees of protection provided by enclosures
IEC 60811	Common test methods for insulating and sheathing materials of electric cables

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 4	Issue 02

IEC 60885	Electrical test methods for electric cables
IEC 60986	Short-circuit temperature limits of electric cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC 61442	Electric cables - Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7.2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC 62138	Compression and mechanical connectors for power cables for rated voltages up to 30 kV ($U_m = 36$ kV)

The applicable issues of these standards shall be the latest published, including the corresponding modifications, at the time of award of the order.

6.2 SERVICE CONDITIONS

The following service conditions shall be taken into consideration for the design of the 33 kV cables and their accessories:

- System rated voltage 33 kV
- Maximum system voltage under normal operating conditions 36 kV
- Rated frequency 50 Hz
- Number of phases 3
- Neutral grounding Earthed through a earthing transformer that limit the fault current to 300 A, 10s
- Maximum symmetrical current of the three-phase short-circuit 6 kA for 1 s
- Short-circuit peak current 16 kA (peak)
- Installation conditions Trefoil formation, directly buried (when approaching to an equipment)

6.3 CHARACTERISTICS OF THE 33 KV CABLES

6.3.1 Design Requirements

The cable systems shall comply with the requirements defined in the data sheets included in the Appendix B of this specification.

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 5	Issue 02

The life of the cables shall be of at least 35 years, with the plant in full operation for 8000 equivalent hours per year.

The capacity of the cable conductors supplied shall be determined taking into consideration the service conditions specified in Chapter 6.2 and the most unfavourable installation conditions applicable. The resulting load reduction shall be subject to approval.

6.3.2 Construction Characteristics

The following paragraphs present a description of the insulated 33 kV cables. Other similar constructions may be acceptable, subject to approval.

The design of the cables shall include means to prevent water penetration in the cable, both in the longitudinal direction and in the radial direction.

The portions of the cables exposed to direct sunlight shall be sunlight resistant or mechanically shielded from sunlight.

The cables shall be flame retardant in accordance with IEC 60332-1-2.

Additionally, the cables shall have reduce emission of halogen as per IEC 60754-1/-2 2 and fire retardant as per IEC 60332-3-24 (category C) (to be confirmed).

6.3.2.1 Conductor

The conductor shall be formed by a round compact cord or round segmented cord formed by annealed class 2 aluminium wires, as per IEC 60228.

6.3.2.2 Conductor screen

The conductor screen shall consist of a semi-conducting layer applied over the conductor and bonded to the inner surface of the insulation.

6.3.2.3 Insulation

The insulation shall be made in cross-linked polyethylene (XLPE), zero halogen content, applied by extrusion simultaneously with the semiconductive layers. It shall have a reduced emission of smoke during combustion according to IEC 61034 and a low toxicity and corrosion index as per IEC 60754.

6.3.2.4 Insulation Screen (non-metallic)

The insulation shall have a semi-conducting layer so as to obtain a homogenous distribution of the electrical field between the insulation and the metallic screen.

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 6	Issue 02

6.3.2.5 Bedding Tape

Over the semi-conducting layer described above there shall be a semi-conducting tape to prevent mechanical damage to the cable core.

6.3.2.6 Insulation Screen (metallic)

There shall be a metal screen of the cable with an adequate cross-section to withstand the conditions of short-circuit.

Various designs are possible for metal screens: bunch of metal wires, metal sheaths, longitudinal applied metal tapes or foils bonded to the oversheath or composite screens (combining various designs).

For the design of the screen it shall be taken into account that the phase-to-ground short circuit current is limited to 300 A by means of earthing transformers.

6.3.2.7 Longitudinal Water Blocking

Means shall be provided to prevent the longitudinal passage of water between the insulation screen (non-metallic), the insulation screen (metallic) and the metallic sheath.

6.3.2.8 Water Blocking

The cables shall incorporate a radial and longitudinal moisture barrier.

6.3.2.9 Armour

The cables shall be provided with a metallic armour as per IEC 60502 consist of non-magnetic material such as aluminium or aluminium alloy.

6.3.2.10 Outer Sheath

The outer sheath shall be PVC-ST2. It shall be flame retardant as per IEC 60332-3. Also. It shall have a reduced emission of smoke and fume as per IEC 61034 during combustion and IEC60754-1, where appropriate

An outer conducting coating shall be applied to the oversheath to serve as electrode for the voltage test on the oversheath.

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 7	Issue 02

6.3.3 Marking

The following information shall be legibly indented or embossed on one or more lines along the extruded outer sheath of the cable:

- The manufacturer's name
- The year of manufacture
- The rated voltages (U_0/U_{Um})
- The conductor size in mm^2
- The conductor material
- The insulation material
- The oversheath material

6.4 ACCESSORIES OF THE CABLES

6.4.1 Design Requirements

The accessories of the cables shall comply with the requirements included in the datasheets of Appendix B.

All cable accessories shall be made by the same manufacturer as that of the cable unless the Supplier justifies the compatibility with the cables.

The life of the cable accessories shall be of at least 35 years.

6.4.2 Cable Terminations

Cable terminations shall be supplied for the connection of the 33 kV cable systems to the Auxiliary PV MV switchgear, to the PV Switching Substation and to the PV Unit Auxiliary Transformers of the associated PT or CT units.

Cable terminations shall comply with standards, IEC 60502-4.

The vendor shall coordinate the mechanical, thermal and electrical interfaces related with the design and assembly of the terminations with the suppliers of the equipment to be connected.

Additionally, the design of the connection shall allow the performance of the required site tests.

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 8	Issue 02

6.4.3 Cable Joints

The 33 kV single-core cables shall be of a single section. Therefore, no joints are foreseen.

7. TESTING

The cables and their accessories shall undergo tests in accordance with standard IEC 60502-2. These tests shall include those required in the datasheets of Appendix B.

The following types of tests shall be considered:

- Routine tests on each drum of cable.
- Tests on cable samples.
- Type tests on each type of cable.
- Electrical tests on site after the cables and accessories have been installed.

8. TECHNICAL GUARANTEES

The Supplier shall guarantee the values indicated in the Technical Data Sheets corresponding to Appendix A and B of this specification.

9. QUALITY MANAGEMENT

The Manufacturer shall implement a quality management system in accordance with what is indicated in the 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 plan which they or their representatives shall witness.

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 9	Issue 02

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) Material 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

Breakdown of the main manufacturing inspection plan.

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, labeling 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 documentation shall be supplied with the tender, 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 in Appendix A to this Specification duly fulfilled
- 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

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 10	Issue 02

- Type test certificates on all specified cables and terminals.
- Description of the tests offered, indicating the standard applicable.
- Manufacturing schedule
- Spares and consumables needed for start-up and guarantee tests (if applicable)
- List of recommended spare parts for two (2) year operation, indicating the following for each spare (if applicable)

In addition, the Bidder shall present a “List of Exceptions” indicating the technical discrepancies between the characteristics of the equipment and services offered as opposed to the requirements of this Technical Specification.

All exceptions must be included in said list, indicating their justification, and they shall be broken down with references to the corresponding sections of the Specification.

The exceptions not included in the List of Exceptions shall not have contractual validity.

11.2 DOCUMENTATION TO BE SUPPLIED WITH THE PURCHASE ORDER

The Supplier must provide the following documentation for approval:

	Deadline for delivery from the date of award
• Certified Data Sheets (Appendix B)	2 weeks
• List of documents, with delivery schedule	1 week
• Certificated cross sectional drawing	1 week
• Certified dimension drawings of the cable accessories, including details of the cable termination and the flanges for coupling to the equipment, for approval	2 weeks
• List of materials and components	4 weeks
• Calculation justifying the cable capacity.....	2 weeks
• Manufacturing programme and delivery schedule	2 weeks
• Inspection Points Program.....	2 weeks
• Test procedures	4 weeks
• Equipment test certificates, reports and protocols.....	1 week after the tests have been performed

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 11	Issue 02

Deadline for delivery
from the date of award

- Commissioning, operating and maintenance instructions manual 16 weeks

11.3 FINAL DOCUMENTATION

Any modification of the documentation shall be monitored during the development of the project. Modifications may occur because of design changes, non-conformities, as-built changes, etc. All the modifications that are approved by the Purchaser shall be incorporated so as to maintain all the project documentation updated. The final issue of the documentation, depending on what is built or assembled, shall be incorporated to the corresponding Final Dossier. The Final Dossier shall be sent to the Purchaser after the final acceptance test, as indicated in the following sections.

11.3.1 Engineering Dossier

On completion of manufacturing, the Supplier shall send the Purchaser an Engineering File that contains, but is not limited to, the following documents:

- Certified data sheets
- General list of cables and terminals
- Certified general layout and dimensions drawings
- Dimensions and weights for transport
- Calculations
- Testing procedures
- Equipment catalogues
- Instructions for equipment storage and preservation at site before commissioning
- Instructions for commissioning and testing

11.3.2 Quality Dossier or Final Manufacturing Dossier

Upon completion of the supply, the Supplier will deliver a final manufacturing dossier comprising the following documents:

- Description of the Quality Assurance and Quality Control Program by the Supplier
- Copy of the Official Certificate of the Supplier's Quality System, if applicable

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page 12	Issue 02

- Completed Inspection Points Programme

This document should be duly signed and stamped by the supplier on all points and by the Purchaser on all points witnessed. In general, this will suffice as a register of inspection operations

- Copy of all procedures subject to approval
- Copy of the quality certificates, reception reports, test reports, test protocols, etc that the Schedule indicates as to be issued at each corresponding point
- Documented reports of any major deviation which occurs, if any
- Copy of the shipping authorization, if applicable
- Supplier's Final Quality Certificate
- Final cable sizing reports, prior to commissioning

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page A-1	Issue 02

APPENDIX A

DATA SHEETS

BIDDER	REQUIRED		OFFERED
1. SCOPE OF SUPPLY			
33 kV cable systems, including:			
a) Single-core XLPE cable (preliminary), m	<u>Per phase</u>	<u>Total</u>	
– PT1 Cable System (630mm ²)	2 x 1100	6600	
– PT2 Cable System (630mm ²)	2 x 1100	6600	
– PT3 Cable (500mm ²)	2 x 2000	12000	
– CT Cable System (400 mm ²)	1700	5100	
b) Number of outdoor cable terminations for connection to 33/6.9 kV transformers	21		
c) Forty-two (42) outdoor air cable terminations to PV switching substation	42		
d) Twenty-one (21) outdoor air cable terminations to PV MV switchgear	21		
e) Terminal boxes for connection and protection of the cable sheaths, including earth conductor	YES		
Spare parts for startup and guarantee tests	YES		
Spare parts for two (2) year operation	YES		
Special tools necessary during erection/installation, maintenance and/or operation	YES		
2. SCOPE OF SERVICES			
Packing, shipping and transport	As per Purchasing Conditions		
Performance of tests required	Vendor to perform as per technical specification		
Supply of documentation required	Vendor to submit as per technical specification		
Supervision of erection, commissioning and site testing of the cable systems and their accessories	OPTIONAL		
Erection, commissioning and site testing	OPTIONAL		
3. TECHNICAL CHARACTERISTICS			
3.1 GENERAL DATA			
Manufacturer	//		
Place of manufacture	//		
Applicable standards	IEC 60502-2		
Number of conductors per phase	1 (CT) and 2 (PT)		
Cable cross section, mm ²	CT: 400 mm ² PT1: 630 mm ² PT2: 630 mm ² PT3: 500 mm ²		

BIDDER	REQUIRED	OFFERED
Rated frequency, Hz	50	
Rated voltages (U ₀ /U/U _m), kV	18/30/36 (to be confirmed by the manufacturer)	
Operational voltage. kV	33	
Maximum voltage, kV	36	
Maximum current to be transmitted through the cable, A		
<ul style="list-style-type: none"> • PT1 Cable System • PT2 Cable System • PT3 Cable System • CT Cable System 	// // // //	
Maximum short-circuit current in the conductor, based on the maximum admissible temperature during normal operation, for a duration of 1 s, kA	6	
Screen grounding system	Both ends	
Maximum induce voltage at the cable screens at normal operation and maximum load, V	150	
Total losses in the three phases at rated voltage and current, with the maximum service current and with the conductor at the maximum admissible temperature during normal operation, kW/km	//	
Minimum curvature radius of the cable (during installation/ in the final installation), mm	//	
Diameters of the cable:		
<ul style="list-style-type: none"> • Rated diameter of the conductor, mm • Rated diameter on the insulation, mm • Rated exterior diameter, mm 	// // //	
Number, dimensions and weights of the cable drums	//	
Minimum useful life of the cables and accessories, years	35	
Protection against longitudinal and radial water penetration	REQUIRED	
3.2 CONSTRUCTION CHARACTERISTICS		
Conductor:		
<ul style="list-style-type: none"> • Material • Diameter, mm • Type of longitudinally water sealing 	Aluminium // //	
Conductor screen:		
<ul style="list-style-type: none"> • Thickness, mm 	//	

BIDDER	REQUIRED	OFFERED
Insulation: <ul style="list-style-type: none"> Material Thickness, mm External diameter Manufacturing process 	XLPE // // Triple extrusion	
Insulation screen (non-metallic): <ul style="list-style-type: none"> Thickness, mm 	//	
Bedding tape (core): <ul style="list-style-type: none"> Material Thickness, mm 	// //	
Insulation screen (metallic): <ul style="list-style-type: none"> Material / Construction Nominal thickness, mm Cross section, mm² 	// // //	
Bedding tape (metallic screen): <ul style="list-style-type: none"> Material Nominal thickness, mm Type of longitudinally water sealing 	// // //	
Metallic sheath: (if applicable) <ul style="list-style-type: none"> Material Nominal thickness, mm Cross section, mm² 	Non magnetic // //	
Armour: <ul style="list-style-type: none"> Material Type Nominal thickness, mm 	// // //	
Outer sheath: <ul style="list-style-type: none"> Material Thickness, mm External diameter, mm Conductive coating on the oversheath 	PVC-ST2 // // REQUIRED	



Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page A-5	Issue 02

BIDDER	REQUIRED	OFFERED
3.3 ACCESSORIES		
General data <ul style="list-style-type: none"> • Manufacturing standard • Manufacturer/ Place of manufacturer • Rated Voltage (Uo/U/Um), kV • Operational voltage, kV 	IEC 60502-4 18/30/36 (to be confirmed by the manufacturer) 33	
Cable terminations for 33kV Transformers Model Quantity		
Cable terminations for PV Switching Substation Model Quantity		
Cable terminations for PV 33kV Switchgear Model Quantity		

 EMPRESARIOS AGRUPADOS	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page B-1	Issue 01

APPENDIX B

DATA SHEETS

BIDDER:	REQUIRED		OFFERED
1. 33 kV CABLES AND ACCESSORIES			
1.1 CABLES			
1.1.1 General data			
Manufacturer	//		
Place of manufacture	//		
Applicable standard	IEC 60502-2		
Number of conductors per phase			
• PT1/PT2/PT3 Cable System	2		
• CT Cable System	1		
Cable cross section, mm ²			
• PT1 Cable System	630		
• PT2 Cable System	630		
• PT3 Cable System	500		
• CT Cable System	400		
Total length of the cable per phase to be supplied, m (Preliminary)	<u>Per phase</u>	<u>Total</u>	
• PT1 Cable System	2 x 1100	6600	
• PT2 Cable System	2 x 1100	6600	
• PT3 Cable System	2 x 2000	12000	
• CT Cable System	1700	5100	
Rated frequency, Hz	50		
Rated voltages of cable (U ₀ /U/U _m), kV	18/30/36 (to be confirmed by the manufacturer)		
Operational voltage, kV	33		
Maximum voltage, kV	36		
Test voltages:			
• Power frequency voltage test, kV (5min)	63		
• Lightning impulse voltage test, kV peak	170		
Maximum admissible temperature in the conductor under normal operation, °C	90		
Maximum admissible temperature in the conductor under short-circuit operation (maximum duration 1 seconds), °C	250		

BIDDER:	REQUIRED	OFFERED
Maximum current to be transmitted through the directly buried cables at the standard conditions as per IEC 60502-2, A		
<ul style="list-style-type: none"> PT1 Cable System 	//	
<ul style="list-style-type: none"> PT2 Cable System 	//	
<ul style="list-style-type: none"> PT3 Cable System 	//	
<ul style="list-style-type: none"> CT Cable System 	//	
Maximum short-circuit current in the conductor, based on the maximum admissible temperature during normal operation, for a duration of 1 s, kA	6	
Maximum resistance at 50 Hz at the maximum admissible temperature of the conductor during normal operation, Ω /km	//	
Maximum equivalent reactance per phase at 50 Hz, Ω /km	//	
Capacitance between the conductor and the screen, μ F/km	//	
Capacitive load current per phase and km of cable under normal operating conditions, A/km	//	
Electrical dissipation factor (tag δ) measured at rated voltage U_0	//	
Cable wave impedance, Ω	//	
Screen grounding system	Both ends	
Maximum induced voltage in the screens during an external symmetrical three-phase short-circuit of 6 kA, V	//	
Losses in the three phases at rated voltage and current, with the maximum current (directly buried as per IEC 60502-2) and with the conductor at the maximum admissible temperature during normal operation:		
<ul style="list-style-type: none"> PT1 Cable System, kW/km 	//	
<ul style="list-style-type: none"> PT2 Cable System, kW/km 	//	
<ul style="list-style-type: none"> PT3 Cable System, kW/km 	//	
<ul style="list-style-type: none"> CT Cable System, kW/km 	//	
Diameters of the cable:		
<ul style="list-style-type: none"> Rated diameter of the conductor, mm 	//	
<ul style="list-style-type: none"> Rated diameter on the insulation, mm 	//	
<ul style="list-style-type: none"> Rated exterior diameter, mm 	//	
Minimum curvature radius of the cable (during installation/ in the final installation)		
<ul style="list-style-type: none"> During installation, mm 	//	
<ul style="list-style-type: none"> In the final installation, mm 	//	
Cable tension, N/m	//	
Approximate weight of the cable, kg/m	//	

BIDDER:	REQUIRED	OFFERED
Dimensions and weights of the cable drums		
• Number of cable drums	//	
• Diameter, m	//	
• Width, m	//	
• Approximate weight, kg	//	
• Normal length of the cable per cable drum, m	//	
• Drum material	//	
Minimum useful life of the cables (and accessories), years	35	
External colour of the cable	//	
Protection against longitudinal water penetration	REQUIRED	
Protection against radial water penetration	REQUIRED	
1.1.2 Conductor		
Material	Aluminium	
Composition (no. of strands and diameter, mm)	//	
Type (compact round/segmented)	//	
Type of conductor, in accordance with IEC 60228	Class 2	
Cross section, mm ²	//	
External diameter, mm	//	
Maximum AC resistance at 50 Hz of the conductor during normal operation at :		
• 20°C, Ω/km	//	
• 90°C, Ω/km	//	
Maximum DC resistance at 20°C, Ω/km	//	
Type of longitudinally water sealing	//	
1.1.3 Conductor Screen		
Material	//	
Thickness, mm	//	
Manufacturing process	Triple extrusion	
1.1.4 Insulation		
Material	XLPE	
Thickness, mm	//	
External diameter, mm	//	
Manufacturing process	Triple extrusion	

BIDDER:	REQUIRED	OFFERED
Maximum dielectric stress calculated with the rated voltage (U_0) <ul style="list-style-type: none"> On the conductor screen, kV/mm On the insulation screen, kV/mm 	//	
Maximum dielectric stress calculated with lightning impulse voltage: <ul style="list-style-type: none"> On the conductor screen, kV/mm On the insulation screen, kV/mm 	//	
Maximum dielectric stress calculated with switching impulse voltage: <ul style="list-style-type: none"> On the conductor screen, kV/mm On the insulation screen, kV/mm 	//	
1.1.5 Insulation screen (non-metallic)		
Material	//	
Thickness, mm	//	
External diameter, mm	//	
Manufacturing process	Triple extrusion	
1.1.6 Bedding tape (core)		
Material	//	
Thickness, mm	//	
External diameter, mm	//	
1.1.7 Insulation screen (metallic)		
Material	//	
Construction	//	
Thickness, mm	//	
Cross section, mm ²	//	
External diameter, mm	//	
Maximum resistance with direct current at 20°C, Ω/km	//	
1.1.8 Bedding tape (metallic screen)		
Material	//	
Thickness, mm	//	
1.1.9 Longitudinally water sealing between insulation screen and sheath		
Type of longitudinally water sealing (bedding tape, swelling power)	//	

BIDDER:	REQUIRED	OFFERED
1.1.10 Metallic sheath (if applicable)		
Material	Non magnetic material	
Thickness, mm	//	
Cross section, mm ²	//	
Maximum resistance with direct current at 20°C, Ω/km	//	
1.1.11 Radial water barrier		
Type of radial water barrier	//	
1.1.12 Outer sheath		
Material	//	
Type	//	
Thickness, mm	//	
1.1.13 Outer sheath		
Material	PVC-ST2	
Thickness, mm	//	
External diameter, mm	//	
Additives	//	
Conductive coating on the oversheath	REQUIRED	
1.2 ACCESSORIES OF THE CABLES		
1.2.1 General Data		
Manufacturer	//	
Place of manufacture	//	
Applicable standard	IEC 60502-4	
Rated voltages (U _o /U/U _m), kV	18/30/36 (to be confirmed by the manufacturer)	
Operational voltage, kV	33 kV	
Test voltages:		
• Power frequency voltage test, kV	63	
• Lightning impulse voltage test, kV peak	70	
Manufacturing standard	IEC 60502-4	
1.2.2 Cable Termination for 33 kV Transformers		
Model	//	
Quantity	21	
Approximate weight, kg	//	
Rated current, A	//	



Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page B-7	Issue 01

BIDDER:	REQUIRED	OFFERED
1.2.3 Cable Termination for 33 kV PV Switching Substation		
Model	//	
Quantity	42	
Approximate weight, kg	//	
Rated current, A	//	
1.2.4 Cable Termination for 33 kV PV Switchgear		
Model	//	
Quantity	21	
Approximate weight, kg	//	
Rated current, A	//	
1.3 TESTS ON CABLES AND ACCESSORIES (AS PER IEC 60502-2)		
1.3.1 Routine Tests		
1.3.1.1 Cable testing		
Measurement of the electrical resistance of conductors	REQUIRED	
Partial discharge test	REQUIRED	
Voltage test	REQUIRED	
Electrical test on the oversheath	REQUIRED	
1.3.1.2 Tests on accessories		
Verification of dimensions	REQUIRED	
Partial discharge test	REQUIRED	
Voltage test	REQUIRED	
1.3.2 Tests on Cable Samples (as per section 17 of IEC 60502-2)		
Conductor examination	REQUIRED	
Check of dimensions	REQUIRED	
Measurement of diameters	REQUIRED	
Voltage test	REQUIRED	
Hot set test for XLPE insulation	REQUIRED	
1.3.3 Type Tests		
Certificates of the type tests on the cable with its accessories as per section 18 and 19 of the IEC 60502-2 standard	CERTIFICATE	
1.3.4 Electrical Tests after the Installation (as per section 20 of IEC 60502-2)		
DC voltage test of the oversheath	REQUIRED	
Insulation test (AC test)	REQUIRED	
Verification of the phase sequence	REQUIRED	

	Document No. NE1-00-EM-EAI-TSP-YE_(E)-20030	EAI Document No. 476-00-I-E-20030	
	Auxiliary PV Plants 33kV Transmission Insulated Cable Technical Specification	Page B-8	Issue 01

BIDDER:	REQUIRED	OFFERED
Testing of bonding/earthing system	REQUIRED	