STUDY, SUPPLY AND INSTALLATION OF XLPE 150 kV UNDERGROUND AND SUBMARINE CABLES FOR TRANSMISSION LINE SKIATHOS - MANTOUDI

Μελέτη, Προμήθεια και Εγκατάσταση Υπογείων και Υποβρυχίων Καλωδίων XLPE 150 kV για την Καλωδιακή Γ.Μ. ΣΚΙΑΘΟΣ – ΜΑΝΤΟΥΔΙ

TECHNICAL DOCUMENTS OF TENDER DEA – 41877

ΤΕΧΝΙΚΑ ΤΕΥΧΗ ΤΗΣ ΔΙΑΚΗΡΥΞΗΣ ΔΕΑ – 41877

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TECHNICAL DESCRIPTION OF PROJECT SKIATHOS – MANTOUDI

1. GENERAL

This description concerns the complete project of design, supply and installation of a single circuit 150kV AC Submarine and Underground Transmission Line for the interconnection of Skiathos Island to the Greek Mainland (Mantoudi).

The project is located in Skiathos Municipality, Magnisia Regional Unit (Thessalia) and in Istiaia – Aidipsos Municipality, Evia Regional Unit (Central Greece). The geographical location of the whole project is depicted on drawing ΤΜΓΜ – 2067.

In summary the project consists of the installation and supply of the following:

1) A Cable System consisting of one (1) three-core 150 kV AC XLPE Submarine Cable (630 mm^2 Cu cross-section) of 200 MVA Power transmitting capacity, and one (1) interstitial Optical Submarine Cable of 48 fibers (inside the corresponding power cable) from the Landing Point of «Xanemos» bay in the Municipality of Skiathos to the Landing Point of «Ellinika» bay in the Municipality of Istiaia – Aidipsos with a length of approximately 30 km.

2) A Cable System consisting of three (3) single-core 150 kV AC XLPE Land Cables (630 mm^2 Cu cross-section) of 200 MVA Power transmitting capacity, and one (1) Optical Land Cable of 48 fibers (installed in the same trench) from the Landing Point of «Xanemos» bay to the new S/S GIS 150 kV/MV in the Municipality of Skiathos with a length of approximately 600 m .

3) A Cable System consisting of three (3) single-core 150 kV AC XLPE Land Cables (630 mm^2 Cu cross-section) of 200 MVA Power transmitting capacity, and one (1) Optical Land Cable of 48 fibers (installed in the same trench) from the Landing Point of «Ellinika» bay to the new Terminal Tower Π#78N in the Municipality of Istiaia – Aidipsos with a length of approximately 160 m.

4) Two transition joint pits and the necessary equipment and accessories for the connection of three single-core land cables to the three-core submarine cable.

5) All the necessary equipment and accessories (single-pole outdoor type sealing ends) for the connection of the three land cables to the new 150 kV Overhead Line in Municipality of Istiaia – Aidipsos. The accessories should be suitable for installation in the new Terminal Tower Π#78N.

6) All the necessary equipment and accessories (single-pole indoor type sealing ends) for the connection of the three land cables to the new 150 kV GIS bay in the new S/S GIS 150 kV Skiathos in Municipality of Skiathos.

7) All other necessary equipment (earthing system, shafts, link boxes, material for cable protection), for the full completion of the link.

8) A complete Distributed Temperature Sensing (DTS) and Dynamic Cable Rating (DCR) system.

In order for IPTO to decide for the technical approval of the solution, the bidder must submit specifically but not exclusively:

1. For each item of the table of Materials and Prices, a complete technical description and specification with the attached Technical Characteristics Datasheet as well as with test documents and certifications of the item offered.
   Especially for the sets of the fields 1.9-1.11 and 2.10-2.12 of the table of Materials and Prices, a detailed list with the materials and its prices shall be attached.
2. A detailed study (including calculation of expected forces) in order to prove the adequacy of the Vessel and its equipment to successfully lay the cable (in respect to cable weight and length as well as installation depths).
3. Repair method with a complete program for repair preparedness, the design of repair joint and any other necessary document.
4. Detailed calculations of the maximum continuous current carrying capacity, according to the I.E.C. publications 60287 and 60853, latest editions for the reference conditions included in paragraphs 3.1.1 and 3.2 of this document.
5. Detailed calculations of transient overcharge analysis of the cables for temperature of 90^{o} C and 95^{o} C and with initial permanent cable load of 75%, 80%, 85% and 100% of the maximum.

Notes to be considered:

1. AUTHORIZATION PERMITS

   For the entire project, the right of way for the cable system through private roads or properties will be ensured by IPTO S.A. Furthermore, the approval of the Environmental Impact Survey of the project lies within IPTO S.A responsibilities.

   Right of way permits through forest, municipal, rural and community roads, as well as every other authorization required, is the responsibility of the Contractor.

2. PROJECT BOUNDARIES

   In Substations and/or Terminal Areas, the Contractor is obliged to coordinate / work in conjunction with the other contractors of IPTO, but also with other authorities (for example HEDNO) in order to abide by the set timeframes for the completion of the project.

   IPTO shall bear responsibility for coordination of communication and exchange of technical information between the contractor of this project and other contractors of under construction projects that have common points with this project.

   A. Object boundaries between the contractor of this project and the contractor of the S/S GIS 150 kV Skiathos.

   This project includes the supply and transport of the cable terminations-SF6, "plug-in" type, that are required to connect the 150 kV cables to the 150 kV GIS

bay of the GIS 150 kV/MV S/S Skiathos. Sealing ends must include both male and female part of equipment. The female parts of the sealing ends shall be delivered by this project's contractor to the "S/S GIS contractor" in order to be incorporated to their equipment, whereas the male parts will be attached by this project's contractor to the 150 kV cables.

The setup of the female and the male parts of the termination shall be conducted by this Declaration's contractor, in the presence of the respective specialized personnel of the "S/S GIS contractor". It is mentioned that all the necessary data must be provided to the involved parties in order to ensure compatibility between the GIS equipment and the above mentioned terminations, in accordance with the IEC 62271-209 standard for GIS.

The supply and installation (in duct banks) of the conduits for the route of the 150 kV underground cables and of the optical fiber cable inside the area of the S/S GIS 150 kV Skiathos, are part of the "S/S GIS contractor's" object. The adjustment of the cables inside the aforementioned conduits is out of the scope of this Declaration. It is highlighted that the route of the cable system inside the substation area, as depicted in Drawing ΤΜΓΜ-2057, is indicative and it will be finalized after the substation design layout submission from the "S/S GIS contractor".

B. Object boundaries between this project's contractor and the contractor of the overhead 150 kV transmission line.

This project includes the supply, transport and installation of the outdoor terminations as well as their suspension and fastening on TZ4 towers. The construction designs of the TZ4 tower are included in the tender and in those designs the necessary safety distances for the connection equipment (sealing ends, lightning rods) have been defined. The cables' placement that is depicted is indicative and has to be confirmed as feasible by the contractor, otherwise the contractor has to define the relevant route and proceed with constructing all necessary auxiliary metallic constructions that may be needed for such. The Department shall provide all necessary data that concerns the TZ4 tower.

It is highlighted that the supply and installation of lightning rods, if required, on the TZ4 tower is out of the contractor object's scope in this Declaration.

Supply, loading-unloading, transport and installation of the above materials as well as every other material (linkboxes, concentric cable for linking the sheaths to the box, e.t.c.) that is necessary for their assembly, shall be on the contractor's expense.

3. TECHNICAL REQUIREMENTS AND SPECIFICATIONS OF PROJECT

The current document specifies the technical requirements and specifications of the project and includes the following Appendices.

A1 - Technical Requirements And Specifications Of Equipment And Material

The technical specifications of materials and equipment are included in the Appendix A1. The bidder must provide the technical data of the offered equipment according to the attached "Technical Characteristics Datasheet" of each specification document. In case of nonsubmission of all required Technical Characteristics Datasheets, the offer shall be rejected.

A2 - DRAWINGS

The Bidder must include their proposed transition joint pit design and relevant drawings in their offer. The Contractor may choose to provide an alternative transition joint pit design and relevant drawings which they consider appropriate for the project.

The following drawings are contained in the attached Appendix A2 (separate volume):

a. Drawing No: ΤΜΓΜ – 2067: Indicative plan view for the submarine cables zone from Skiathos to Evia and the land cables route for the whole project.
b. Drawing No: ΤΜΓΜ – 2063: Indicative drawing of transition joint pit design.
c. Drawing No: ΤΜΓΜ – 2057: Indicative plan view of the land cable route, transition joint pit and terminals for the single-circuit underground section in the new S/S GIS 150 kV Skiathos in Municipality of Skiathos.
d. Drawing No: ΤΜΓΜ – 2058: Indicative plan view of the land cable route, transition joint pit and terminals for the single-circuit underground section from the Sea-Land Joint Bay to TZ4 Terminal Tower in Municipality of Istiaia – Aidipsos.
e. Drawing No: ΤΜΓΜ – 2059: Indicative profile view of the land cable route from the landing point to the new S/S GIS 150 kV Skiathos in Municipality of Skiathos.
f. Drawing No: ΤΜΓΜ – 2060: Indicative profile view of the land cable route from the landing point to the TZ4 Terminal Tower in Municipality of Istiaia – Aidipsos.
g. Drawing No: ΤΜΓΜ 2061: Submarine cable route (6 sheets).
h. Drawing No: ΤΜΓΜ – 2062: Indicative drawings of land cables trench cross-sections (2 sheets).
i. As built drawings of tower TZ4.

A3 - MARINE SURVEY

The bathymetry and morphology for the crossing and the indicative cable route are presented on the charts and drawings of attached Appendix A3 "Marine Survey" which includes the Marine Survey performed by IPTO.

A4 - METEOROLOGICAL DATA

The Submarine Cable shall be designed by the contractor for a safe operation according to the meteorological data given in appendix A4.

2. SCOPE OF DELIVERY

For the delivering of the cables under this Contract the contractor shall:

1. Complete and submit a detailed bottom survey for the cable route.
2. Design, manufacture and perform the appropriate factory acceptance tests (FAT) for the necessary length of submarine and land cables.
3. Design, manufacture and perform the appropriate factory acceptance tests (FAT) for all the joints (including Rigid Repair Joints) and sealing ends (terminations).
4. Provide the appropriate certificates or perform the appropriate type tests for the entire offered cable system and all the offered equipment (cables, joints, terminations).
5. Transport the cables to the site, lay the cables, protect the cables and complete the full end-to-end installation of the system (subsea and land cables, joints, optical fibers, terminations, etc).
6. Deliver and install the appropriate cable terminations (sealing ends), including support stands and foundation, as well as the grounding system of the cable's metallic sheath.
7. Make all civil work on land and sea bed to complete the construction.
8. The contractor has to provide and install for all installed cables a complete Distributed Temperature Sensing (DTS) and Dynamic Cable Rating (DCR) system.
9. For the quality assurance of the project, all bidders will include tests in their offer that cover their offered system according to par. 4 of this document.
10. Documentation of the "as laid", "as protected" position of the land and submarine cables and the "as built" details of civil, mechanical and electrical works associated with the cables, in printed and digital form (all drawings in Autocad or other compatible editable format, all text in editable format). Documentation shall be in full compliance with the technical specifications of the project and Articles 4 and 8 of the Special Terms of the Contract.
11. Supply, put into storage and make good for long term storage the length of spare cables and other necessary spares. In case of material with a definite expiry date, the time till this date is considered as the long term storage time.
12. Supply and pack well for long term storage all equipment, tools and documentation necessary for making repair joints. In case of material with a definite expiry date, the time till this date is considered as the long term storage time.
13. Supply shall not be restricted to the above materials, but shall include all miscellaneous materials, equipment and control instruments, required to secure the safe and reliable operation of the whole installation.
14. Generally the laying of the cables shall include all necessary work, required for the proper, safe and complete installation and operation of the cables and their accessories, all in accordance with good practice.
15. All bidders have to provide sufficient references, type tests and repair method with a complete program for repair preparedness, the design of repair joint and any other necessary document, mentioned in this document.

3. EQUIPMENT AND ACCESSORIES

3.1 SUBMARINE 150 kV AC POWER CABLE

3.1.1 THREE CORE SUBMARINE 150 kV AC CABLE

The design and construction of the three-core submarine 150 kV AC power cable shall be in accordance with the Technical Specification td-222 included in Appendix A1 by making precise the following requirements:

3.1.1.1 The conductor of the submarine cable, made with annealed copper according to the IEC 228 standard. The cross section of the conductor must be 630 mm^2.

3.1.1.2 The Power Cable shall be designed for a transmitted power at nominal voltage at both ends of 200 MVA.

Calculations of the maximum continuous current carrying capacity during the bidding phase, will be performed according to the I.E.C. publications 60287 and 60853, latest editions for the following **reference conditions**:

1) Thermal resistivity of the sea bottom : 0.7 Km/W
2) Soil thermal resistivity (uniform, without backfill material*[1]) : 1.2 Km/W
3) Temperature of the seabed : +15° C
4) Ground temperature (landfall) : +25° C
5) Air temperature : +40° C
6) Max burial depth on the coast : 1.6 m
7) Max burial depth over the sea bottom route : 2 m
8) Max burial depth of the land section : 1.6 m
9) Load factor : 1
10) Grounding: The submarine cable metallic sheaths are solidly bonded to earth at both cable ends.

Moreover, a detailed calculation of the maximum short circuit current capability of the conductor (for 1 s) and of the metallic sheath of the cable (for 0.5 s), according to IEC 60949 shall be provided in the Offer.

[1] The backfill material shall have thermal resistivity according to Table 3.1. However, it is highlighted that the calculation of the maximum continuous current carrying capacity, for the aforementioned reference conditions, will be performed with no backfill material.

Inability to achieve the required transmitted power for the aforementioned **reference conditions** and the short circuit current capability of the conductor and of the metallic sheath of the cable, will result to rejection of the offer. It is noted that calculated values for the maximum continuous current capacity shall be submitted at the field 31 of the Technical Characteristics Datasheet of the Technical Specification td-222 included in Appendix A1.

During the detailed study after contract signing, the calculation of the maximum continuous current carrying capacity will be performed according to the I.E.C. publications 60287 and 60853, latest editions with the actual conditions and the actual thermal resistivity of the backfill materials that will be used, taking into consideration the required specifications of Table 3.1, the technical specifications included in Appendix A1 and the Drawings of Appendix A2. The Contractor shall submit measurement of the thermal resistivity of the backfill materials.

Backfill Material	Thermal resistivity
Sand	≤ 0.8 K·m/W
Crashed material mixed with sand (3A)	≤ 1.2 Km/W
Cement	≤ 0.6 K·m/W

Table 3.1: Maximum permissible thermal resistivity of backfill materials.

3.1.1.3 The maximum sea depth of the submarine crossing is estimated approximately 300 meters according to the marine survey conducted by IPTO and therefore a double zinc - coated steel wire armoring will be used in this interconnection according to td-222.

3.1.1.4 Land cables must conform to the submarine ones, therefore they will be designed according to par. 3.2 of this document and will be installed according to the requirements and instructions of technical descriptions and specifications attached in Appendix A1.

3.1.2 MARINE SURVEY AND SELECTION OF FINAL ROUTE

3.1.2.1 The maximum sea depth of the submarine crossing is approximately 300 meters according to the marine survey conducted by IPTO.

3.1.2.2 The contractor will carry out a marine survey in order to obtain the necessary information, which will support the selection of the final cable route, will indicate special measures that have to be taken along the selected cable route and will give all necessary information for the final determination of the protection method for all route length.

IMPORTANT NOTE: Deviations from the data of the survey, given in the Inquiry, can in no way support any claims whatever, financial or related to the extension of the delivery time of the project.

3.1.2.3 In the Drawing ΤΜΓΜ-2061 (6 sheets) is depicted a proposed area in which the final Marine Survey of the Contractor is to be performed.

3.1.2.4 The contractor shall have the full responsibility for the selection of the route and the length of cable including addition for navigation and bottom profile. Final route proposal of the contractor shall be stated to and approved by IPTO S.A. After final route has been agreed, the nominal length shall be adjusted. The contractor shall be compensated for the adjusted length plus the additional length for profile and navigation.

3.1.3 CABLE LAYING VESSEL AND ACCOMMODATION REQUIREMENTS

3.1.3.1 The Cable Lay Vessel must be equipped with adequate, efficient, reliable and safe equipment necessary for the size of the project (length and depth). Following equipment must be included, as a minimum:

- Turntable
- Dynamic positioning system (At least DPS-2 Class)
- Satellite DGPS positioning system C/W positioning Computer System
- Cable tension monitoring system
- R.O.V. with Video Recording System

The bidder must include in their offer a detailed study (including calculation of expected forces) in order to prove the adequacy of the Vessel and its equipment to successfully lay the cable (in respect to cable weight and length as well as installation depths). This study must include the following table filled for every vessel that is proposed for the installation of cable system.

VESSEL	**CLV 1**	**…..**	**CLV X**
Number of tensioners (or cap stain)			
Linear Length of each tensioner (provide design details)			
Type of tensioner (2-4track system)			
Crushing strength of cable (Provide calculation or crush test report)			
Suitability of vessel layout for tensioner accommodation (provide drawing)			
Tensile Force (Max) provide analytical calculation			
Force distribution (conductor-armour)			
Geometrical data (cable section)			
Calculated mechanical stress (σ) conductor - armor			
Design strength of conductor and armour (declare safety factors)			

3.1.3.2 During laying, the following shall continuously be documented:

- Position of cable laying vessel
- Length of cable laid
- Positioning of joints
- Water depth
- Laying speed
- Angle of cable outlet
- Residual traction
- Traction at sea level
- Wind velocity and direction
- Other information or events of importance during laying

The cables shall be laid with minimum possible residual traction. The cables must not form a loop. The predetermined residual traction shall be given in the tender. The traction at sea level during the laying must not exceed in any moment the tension at which the cable is tested.

After laying, the documentation (including full video of laying campaigns) shall be worked out in an easily understandable way and in such a format that it will be easy to file.

3.1.3.3 A detailed laying plan showing laying speed, residual traction, water depth and angle of cable outlet shall be made in good time before laying and be presented to the purchaser.

3.1.3.4 An inspection of the whole laid cables at the sea bottom, by suitable equipment should be done, to avoid the suspended catenaries on the cables on irregularities of the sea bottom. The maximum permitted length of catenaries will be agreed after the survey performed by the contractor.

3.1.3.5 Interruptions:

No rigid repair sea joint is allowed for this crossing. In case of unplanned event, there will be an investigation of the situation and the necessity of an unplanned joint will be judged.

The contractor determines, based upon the safety of the cables, whether or not the laying shall be postponed or interrupted, due to bad weather. A detailed description of the boat laying capabilities in accordance with the weather conditions must be included in the tender. In case that laying of the cables must be postponed or interrupted, due to bad weather, the contractor will have no compensation for the first ten (10) days of interruption. The amount of the compensation per day of delay, for a more than 10 days period, is stated in the Contingencies list of the contract.

The purchaser reserves the right to postpone the laying, before starting of the procedure. Compensation for the delay will then be paid to the contractor. The amount of the compensation per day of delay is stated in the Contingencies list of the contract.

Interruption of excavation and backfilling of sea trenches, due to bad weather, will not be compensated.

Interruptions for bottom survey, if any, due to bad weather, will not be compensated.

3.1.4 REPAIR METHOD AND PREPAREDNESS PROGRAM

3.1.4.1 The offer shall include the repair method with a complete program for repair preparedness, the design of repair joint and any other necessary document.

3.1.4.2 The program for repair must include repair at the shallow water and repair at the maximum sea depth. The repair method at the maximum sea depth, where use of the "omega" method is not possible, must be described in detail.

3.1.4.3 The supplier must state whether he recommends a particular repair vessel for repairing, its domicile harbor, frequency of the other commissions and overall cost per day.

3.1.4.4 The supplier must state in the contract how long will it take to mobilize personnel from the cable manufacturer and the required equipment for the repairing, before the repair vessel will be available on the site of damage.

3.1.4.5 A repair method with a complete program with time schedule for repair preparedness shall be available when the link is commercially taken into operation. The program shall be both in Greek and English. The English version shall prevail.

3.1.5 PROTECTION OF THE SUBMARINE CABLE

3.1.5.1 The cables shall be protected from Skiathos landing point to Evia landing point for the entire length of the interconnection against external damages or movement on the sea bottom. This shall be accomplished by applying the followings:

- The land sections of the submarine cables shall be buried at a depth of 1.6 m or more, unless a different trench design is explicitly permitted for special reasons. The land portion of the submarine cables shall be protected by concrete slabs according to td-249 attached in Appendix A1 and the instructions of the Supervising Authority of IPTO .

- The cable has to be placed in a trench, at least 2 m below the original sea bottom and to be covered with strong concrete layer of 25 cm thickness up to a distance of 30 m from the shore line.

- After that, and up to the point of 15 m sea depth, as well as in areas of shallow waters (up to 15 m sea depth) along the cable route, the cables are placed in a 2m deep trench. Then, for the rest of the route, the cable is placed in a 1 m deep, trench. In case of rocky sea bottom this trench shall be at least 1 and 0.5 m deep respectively. In the most severe case that not even 0.5 m depth can be reached, the cables shall be protected using cement bags or cast-iron shells or other equivalent protection method, depending on the conditions.

- For the above described protection, both jetting and trenching methods can be used, depending on the analysis of the sea bottom soil.

- In the contract there is the estimation of the quantity in meters for jetting, trenching and use of cast-iron shells and cement bags, for every landfall and a price is given at the Materials and Prices list, based on a unit price (per meter) for each work. This estimation is based on the marine survey, conducted by IPTO and

the referring quantity will be taken account for the economic evaluation of the bids.

Estimated quantity for cable protection for all submarine length:

- Jetting (for 2m below the sea bottom, down to 15m sea water depth (swd)) : 500 meters
- Jetting (for 1m below the sea bottom and swd > 15m) : 23500 meters
- Trenching (for 2m below the sea bottom, down to 15m swd) : 500 meters
- Trenching (for 1m below the sea bottom and swd > 15m) : 4500 meters

Estimated quantity for cable protection in areas of the submarine cable route where trenching or jetting is not applicable:

Protection method using cast-iron shells : 1000 meters
Protection method using cement bags : 100 meters

The above lengths shall be finally determined after the completion of the detailed bottom survey for the selected cable route, performed by the Contractor.

- The burial assessment for the inshore parts that will accompany the Contractor's Marine survey shall propose the protection method and respective quantities along the route which will be approved by IPTO along with the Survey. Minor differences from the above estimated quantity are expected.
- After completion of the protection works, the final distance will be measured and the final cost of the cable protection shall be calculated using the unit price (per meter) for each work, given at the Materials and Prices list.

3.1.5.2 Cable shall be designed in such a way to provide satisfactory resistance against fishing equipment, small anchors etc.

The design of the submarine cable shall allow its recovery from the sea bottom in case that this kind of repairs is necessary.

The distances between the conductive connections through the polyethylene sheath inside the cable, shall be short enough to limit transient voltage to a value which does not puncture the polyethylene sheath.

3.1.5.3 In case of a crossing with other cables or networks found in the survey conducted by IPTO or found in the marine survey undertaken by the contractor, the contractor shall proceed with the protection of the cables as follows:

- Supply and install 2 articulated concrete block mattress (ACBM) of dimensions 5,26m x 2,26m x 0,30m per crossing.
- Supply and install 50m Uraduct protection per crossing.

If the existing cable or network is buried at a significant depth, the supply and installation of articulated concrete block mattresses (ACBM) will be cancelled, after agreement of the network owner.

In case that the network owner demands a different kind or quantity of protection, the contractor shall fulfill this demand, after IPTO's approval and the corresponding item of the Price list will be adjusted accordingly.

In the contract there is the estimated number of crossings, which is based on the results of the marine survey, conducted by IPTO. The corresponding ACBM and Uraduct units given at the Materials and Prices list, will be taken account for the economic evaluation of the bids.

If the number of crossings, defined by the Contractor's Marine survey, is different than the one from IPTO's survey, the final cost for these works shall be accordingly adjusted. In this particular project, the IPTO's survey has defined seven (7) crossings in total. Six (6) of them are with HEDNO's network while one (1) of them is with OTE's network.

3.1.5.4 The protection of the cables in the crossings shall include the supply of the above materials as well as all related installation works including but not limited to the use of installation personnel, installation equipment and installation vessels.

During protection works the following shall continuously be documented:

- Position of protection vessel
- Protection Method and equipment
- Length of cable protected
- Water depth
- Wind velocity and direction
- Achieved Trench Depth vs Target
- Other information or events of importance during protection

After the completion of protection works, the documentation (including full video of protection campaigns) shall be worked out in an easily understandable way and in such a format that it will be easy to file.

3.1.6 SUBMARINE CABLE ACCESSORIES

3.1.6.1 No rigid repair sea joint is allowed for this crossing. In case of unplanned event, there will be an investigation of the situation and the necessity of an unplanned joint will be judged. The contract includes spare rigid repair sea joint as described in Spare equipment List L-1. These joints shall have mechanical and electrical characteristics as close as possible to those of the original submarine cable and must have passed all the required tests mentioned in par. 4.

In case of unplanned event during laying of the cable, there will be an announcement to the Supervising Authority of IPTO and after investigation of the situation, the necessity of a rigid repair (sea) joint will be judged. In any case, increase of the number of rigid repair (sea) joints compromises the designed quality of the project, therefore must be avoided unless absolutely necessary.

3.1.6.2 In order to connect the submarine cable to the land cable, a transition joint pit shall be constructed and a suitable transition joint will be supplied and installed. The joints will be transported by the Contractor on-site and will be assembled by specialized assembling crew. If contractor proposes a different design that he considers appropriate for the project, this transition joint pit must be included in the technical part of the offer and the corresponding cost shall be included in the corresponding item of the Price list.

3.1.6.3 Factory joints must be of the flexible type and shall meet the same requirements as for the cable. The flexible joints must be made in the factory and each cable shall be laid in one length, equipped with continuous steel wire armoring.

Only one (1) planned factory joint per phase, for ten (10) completed kilometers of cable shall be allowed. In case of unplanned event, there will be an announcement to the Supervising Authority of IPTO and investigation of the situation and the necessity of an unplanned joint will be judged.

3.1.6.4 The factory joints, if any, shall be measured and marked on the cable. The design of the marking shall be approved by the purchaser.

3.1.7 EARTHING NETWORK FOR SUBMARINE CABLE

The submarine cable metallic sheaths are solidly bonded to earth with two-points bonding method.

The local earthing network consists of tinned copper ground conductors and rods around the transition joint pit (as seen in drawing ΤΜΓΜ - 2063).

The metallic screens of the cables is connected to earth by using suitable earth link-boxes.

The specifications of the waterproof – airtight shaft and the earth link-boxes that will be placed inside the shaft shall be in accordance with the Technical Specification TD-247 included in Appendix A1.

3.1.8 SPARE EQUIPMENT

The contract includes spare equipment as described in Spare equipment List L-1, in accordance with the following items:

3.1.8.1 All spare submarine cable shall be stored on one cable drum, if possible or on a basket. The cable drum or basket is included in the contract. After cable laying, the remaining surplus shall be stored on the above items together with the spare cable.

3.1.8.2 All equipment needed to operate the cable drum or basket and to load and unload the spare cables is included in the contract such as:

- Trestles for the drum
- Drives
- Stands
- Cable rollers

3.1.8.3 The supplier includes in the contract all other spare equipment described at the L-1 list. The supplier can recommend different quantities and/or material of spare equipment, explaining the reasons for this necessity. IPTO will decide about the necessity of these quantities / material and modify accordingly the L-1 list.

3.1.8.4 Design of the repair and transition joints as well as all other spare equipment, is specified in the contract.

3.1.8.5 The Contractor shall deliver the spare equipment at an IPTO storage area. The storage area will be defined during the contractual period and the cost of Transportation and loading are in contractor’s obligations.

3.2 LAND 150 kV AC POWER CABLES

The design and construction of the single-core land 150 kV AC power cables shall be in accordance with the Technical Specification td-220 included in Appendix A1 by making precise the following requirements:

3.2.1.1 The conductor of the land cable shall be made with annealed copper, according to the IEC 228 standard. The cross section of the conductor must be 630 mm^2.

3.2.1.2 The Power Cable shall be designed for a transmitted power at nominal voltage at both ends of 200 MVA.

Calculations of the maximum continuous current carrying capacity during the bidding phase, will be performed according to the I.E.C. publications 60287 and 60853, latest editions for the following reference conditions:

1) Soil thermal resistivity (uniform, without backfill material*[3]) : 1.2 Km/W
2) Ground temperature : +25° C
3) Air temperature : +40° C
4) Typical burial depth : 1.7 m*[4]
5) Max burial depth : 2.5 m*[4]
6) Cable arrangement : Flat formation
7) Minimum distance between phases : 25 cm
8) Load factor : 1
9) Grounding : Single-point-bonding

[3] The backfill material shall have thermal resistivity according to Table 3.2. However, it is highlighted that the calculation of the maximum continuous current carrying capacity, for the aforementioned reference conditions, will be performed with no backfill material.

[4] The cables burial depth varies depending on the crossing of obstacles (typical burial depth is 1.7 m). However, it is highlighted that the calculation of the maximum continuous current carrying capacity, for the aforementioned reference conditions, will be performed with max burial depth (reference depth) 2.5 m.

Moreover, a detailed calculation of the maximum short circuit current capability of the conductor (for 1 s) and of the metallic sheath of the cable (for 0.5 s), according to IEC 60949 shall be provided in the Offer.

Inability to achieve the required transmitted power for the aforementioned **reference conditions** and the short circuit current capability of the conductor and of the metallic sheath of the cable, will result to rejection of the offer. It is noted that calculated values for the maximum continuous current capacity shall be submitted at the field F.5 of the Technical Characteristics Datasheet of the Technical Specification td-220 included in Appendix A1.

During the detailed study after contract signing, the calculation of the maximum continuous current carrying capacity will be performed according to the I.E.C. publications 60287 and 60853, latest editions with the actual conditions and the actual thermal resistivity of the backfill materials, taking into consideration the required specifications of Table 3.2, the technical specifications included in Appendix A1 and the Drawings of Appendix A2.

Backfill Material	Thermal resistivity
Sand	≤ 0.8 K·m/W
Crashed material mixed with sand (3A)	≤ 1.2 Km/W
Cement	≤ 0.6 K·m/W

Table 3.2: Maximum permissible thermal resistivity of backfill materials.

It is highlighted, that the dimensions of the trench shall be as depicted at the Drawings of Appendix A2 except for technical difficulties that cannot be overcome, assuming IPTO's approval.

It is noted that an estimation of the quantity of the backfill materials and expected excavated amounts according to IPTO detailed study, the required specifications of Table 3.2, the technical specifications included in Appendix A1 and the Drawings of Appendix A2 is given at the Materials and Prices list. This estimation (referring quantity) will be taken account for the economic evaluation of the bids.

After IPTO's approval of the final detailed study, if the estimation defined by IPTO is different than the actual, the final cost for these materials and works shall be accordingly adjusted.

3.3 LAND CABLE ACCESSORIES

3.3.1 150kV SINGLE-POLE INDOOR TYPE SEALING ENDS

The project includes study, supply and installation of indoors terminations of cables for the GIS 150 kV bay of the new S/S GIS 150 kV Skiathos.

The design of the 150kV single-pole indoor type sealing ends shall be in accordance with the Technical Specification TD-226/2 included in Appendix A1.

All the above mentioned terminations shall be compatible with the type of 150 kV XLPE insulation cables and the tests for a cable–joints-terminations system of the same type must have been conducted according to the latest version of the IEC 60840 regulation.

3.3.2 150kV SINGLE-POLE OUTDOOR TYPE SEALING ENDS FOR INSTALLATION ON TZ4 TOWER

The project includes study, supply and installation of outdoors terminations of cables to be set on TZ4 tower for the connection of the three land cables to the new 150 kV Overhead Line in Municipality of Istiaia – Aidipsos.

The design of the 150kV single-pole outdoor type sealing ends suitable for XLPE 87/150 kV single core cables shall be in accordance with the Technical Specification TD-227/4 included in Appendix A1.

The supply, transport and installation of outdoor terminations to be set on TZ4 tower as well as their setting and fastening on the tower, shall be the present tender's Contractor's responsibility.

Drawings for the TZ4 tower are included in the tender, where the necessary safety distances for the connection equipment (terminations, lightning rods) have been defined. Installation of equipment other than terminations and cables is the responsibility of IPTO S.A. . The placement of cables that is depicted is indicative and its feasibility shall be confirmed by the Contractor, otherwise the Contractor shall define the respective cable route and proceed with the necessary supportive metal constructions that may be needed for such. IPTO shall provide to the Contractor all necessary data for the TZ4 tower.

The design and construction of 150kV single-pole outdoor type sealing ends for installation on TZ4 tower shall be in accordance with the Technical Specification td-227 included in Appendix A1 by making precise the following requirement:

- The creepage distance of the sealing ends for this project is 31 mm/kV.

The supply, loading/unloading, transport and installation of the above equipment as well as every other equipment (linkboxes, concentric cable for connecting sheaths to the linkbox etc.) that is required for assembling the former, shall be on the Contractor's expense.

All the above mentioned terminations shall be compatible with the type of 150 kV XLPE insulation cables and the tests for a cable–joints-terminations system of the same type must have been conducted according to the latest version of the IEC 60840 regulation.

3.3.3 EARTHING NETWORK FOR LAND CABLES AND EARTHING LINK BOXES

Single-point-bonding is used for short cable lengths. In order to reduce the voltage rise along the shields/sheaths the contractor shall install a Ground Continuity Conductor (GCC) that runs parallel to the cables according to IEEE 575-2014. This conductor should be transposed at the mid-point location and solidly bonded to the ground at both ends.

The Bidder shall submit the respective straight line diagram. In the pricelist that will be given in the Materials & Prices Table, all materials that are required for the suggested technical solution shall be included, whether there is a reference for every material or the materials are included in a price total.

The connection of the metallic screens of the cables to earth is facilitated by using suitable earth link-boxes.

The specifications of the waterproof – airtight shaft and the earth link-boxes and SVLs (if required) that will be placed inside the shaft shall be in accordance with the Technical Specification TD-247 included in Appendix A1.

3.4 PROTECTION WARNING AND MARKING MATERIAL

3.4.1 CONDUIT SYSTEMS

In case of road crossings and in any other case according to the technical description or the instructions of the Supervising Authority, the cables shall be installed in conduits of adequate size and mechanical strength, according to td-252.

3.4.2 BACKFILL MATERIALS

The backfill materials shall be in accordance with the Technical Specification td-235 included in Appendix A1 and the requirements of paragraph 3.2 regarding the maximum continuous current carrying capacity of the cable system.

3.4.3 WARNING AND MARKING MATERIAL

3.4.3.1 ELECTRICAL WARNING MESH FOR UC CABLES 150 KV

One electrical warning mesh shall be used according to td-248 technical description included in Appendix A1.

3.4.3.2 PRECAST CONCRETE CABLE PROTECTION COVER TILES FOR UC CABLES 150 KV

The protection of the land cable will be made by precast concrete cable protection cover tiles according to the td-248 technical description included in Appendix A1.

3.4.3.3 CABLE ROUTE SIGN FOR UC CABLES 150 KV

The marking of the route from the transition joint pits to the terminal areas, where community roads are used for the cables passage and where instructed by IPTO, will be made by plates standing on metallic poles, according to the td-248 technical description included in Appendix A1.

3.4.3.4 CONCRETE SLABS FOR UC CABLES 150 KV

The transition joint pit and the cable route in areas other than community roads may also be marked by concrete slabs according to td-249 attached in Appendix A1 and the instructions of the Supervising Authority of IPTO.

3.5 FIBER OPTIC CABLES

3.5.1 LAND FIBER OPTIC CABLES

The project includes supply and installation of :

1 Land Fiber Optic Cable in conduit in the same trench with Power cables in Skiathos and Mantoudi area (Skiathos S/S GIS – Xanemos LP, Mantoudi LP – TZ4).

The Land Fiber Optic Cable must meet the following requirements:

- Total number of fibers: 48
- Type of fibers: 12 ITU-T G654D type and 36 ITU-T G652D fibers

The design and construction of the land optical fiber cables shall be in accordance with the Technical Specification TD-231 included in Appendix A1.

The design and construction of the three-channel conduit for optical fiber cable installation shall be in accordance with the Technical Specification TD-233 included in Appendix A1.

3.5.2 SUBMARINE FIBER OPTIC CABLES

The project includes supply and installation of :

1 Submarine Fiber Optic Cable (Xanemos LP – Mantoudi LP). The submarine optical fibers cables shall be contained inside the assembled three core submarine power cables (interstitial).

The Submarine Fiber Optic Cable must meet the following requirements:

- Total number of fibers: 48
- Type of fibers: 12 ITU-T G654D type and 36 ITU-T G652D fibers

The design and construction of the submarine optical fiber cables shall be in accordance with the Technical Specification TD-232 included in Appendix A1.

3.6 DISTRIBUTED TEMPERATURE SENSING SYSTEM

The design and construction of the Distributed Temperature Sensing system shall be in accordance with the Technical Specification TD-234 included in Appendix A1.

The contractor has to provide and install for all installed cables a complete Distributed Temperature Sensing (DTS) and Dynamic Cable Rating (DCR) system that will include:

- Sensor Cables, Accessories and all other required material provision and installation
- Visualization and Analysis Software
- Open and Standard Interface to IPTO Monitoring systems
- Training and Support

A fiber-optic distributed temperature sensing (DTS) system shall be used to provide IPTO a real-time temperature measurement with a high degree of accuracy over significant distances, for each Cable Transmission Line.

The system must also include a Dynamic Cable Rating (DCR) module in order to provide dynamic cable ratings based on real-time DTS measurements and a thermal model. This could be implemented by using a real-time software system taking inputs from the Power System and the Distributed Temperature Sensor (DTS) and applying a Thermal Model based on IEC 60287 & IEC 60853.

4. QUALITY ASSURANCE AND TEST COMPLIANCE

For the quality assurance of the project, all bidders will include tests in their offer that cover their offered system according to the relative international standards (IEC) and IPTO Specifications and Article 15 of the Special Terms of this Declaration.

Technical Specifications of Appendix A1 must be taken into consideration. In any other case, the tests will be performed according to the relevant standards.

The contractor will perform the appropriate type tests for the complete cable system and present the appropriate certificates. The tests shall include as a minimum:

- Submarine cable
- Submarine Cable Subsea Field Joint
- Submarine Factory Joint
- Transition Joint
- Land Cable(s)
- Land Joint

After the completion of works for the entire project and full installation of the system (cables, joints, sealing ends, etc) the contractor shall perform all "after installation tests" mentioned at the IEC standard no 60840, latest edition and the CIGRE Recommendations published in Cigre Technical Brochure N.623 (June 2015), ELECTRA No 189, April 2000 and in CIGRE Recommendation N.490 WG B1.27 (Recommendations for testing of long AC Submarine Cables with extruded insulation for system voltage above 30 (36) to 500 (550) kV).

For the A.C. high voltage test, the 150 kV transmission network will be used, upon authorization of the operator of the national transmission system. The supervising authority must be informed at least ten (10) days before, in order to be present during the tests and approve the procedure and the method that will be used. The contractor shall recommend any other method, applicable for the A.C. high voltage test, as mentioned in the above standards, in case that the national transmission system operator cannot perform the test for technical reasons. The contractor may choose to perform "after installation tests" using an alternative method, applicable for the A.C. high voltage test, as mentioned in the above standards, without the use of the 150 kV transmission network, on their own expense.

NOTE: The number of samples and the whole program of the routine tests on cables will be a matter of agreement between the purchaser and the manufacturer.

APPENDICES

APPENDIX A1 - TECHNICAL SPECIFICATIONS

APPENDIX A2 – DRAWINGS

APPENDIX A3 – MARINE SURVEY

APPENDIX A4 – METEOROLOGICAL DATA

APPENDIX A1

TECHNICAL SPECIFICATIONS

APPENDIX A2

DRAWINGS

APPENDIX A3

MARINE SURVEY

APPENDIX A4

METEOROLOGICAL DATA

Source: National Observatory of Athens