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|  | RMG MADNEULI EXISTING PLANT UPGRAD BOLNISI - GEORGIA | |  |
| <i>Projet N° :</i> | Document N° : | Rev : | Date : |
| C22006 | C22005-06-SPC-001 | 1 | 2020/03/30 |
| MV ELECTRICAL CABLES SPECIFICATION | | | |

**MV ELECTRICAL CABLES
SPECIFICATION**
(LINK FROM MAIN SUBSTATION TO MV ELECTRICAL ROOM IN PLANT)

| Rev. | Description | Prepared by | Verified by | Adm. Approval by | Customer Approval | Date |
|------|-------------|-------------|-------------|------------------|-------------------|------------|
| 1 | FOR BIDDING | L.A | | F.B | | 2020-03-20 |
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|  RMG | RMG MADNEULI EXISTING PLANT UPGRAD BOLNISI - GEORGIA | |  <small>Bureau mines, géologie et métallurgie</small> |
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1.0 INTRODUCTION

This specification is related to the Madneuli existing plant upgrading project located in Bolnisi, Georgia. The present technical sheet covers the specifications for Medium Voltage (MV) Electrical Cables needed to feed the new MV Switchgear that will be installed in Madneuli exiting plant, from the existing Main Electrical Substation 110106/6kV.

2.0 PROJECT GENERAL DATA

- Project Owner : RMG Copper.
- Process type: Flotation.
- Location: Bolnisi - Georgia (Eastern Europe).

3.0 SCOPE OF SUPPLY

This specification defines the minimum requirements for the design, construction, and testing of MV Power Cables that will be installed to connect the Main Electrical Substation 110106/6kV to the new MV switchgear. This specification does not discharge the SUPPLIER from his responsibility for the technical performance of the cables.

The quantities of cables to be provided are listed in the tables below:

| Item | Total Length (m) | Section mm ² | Conductors Number | Rated Voltage (kV) | Service Voltage (kV) |
|------|------------------|-------------------------|-------------------|--------------------|----------------------|
| 1 | 12000 | 240 | 1 | 7.2 | 6 |

4.0 QUANTITY

A total of 12,000 meters of cable will be supplied. They will be installed as following:

From Main Transformer:



3x4x500 meters =6,000 meters (3 phases x 4cables/phase x 500m length/cable/phase)

From Stand-by Transformer:

3x4x500 meters =6,000 meters (3 phases x 4cables/phase x 500m length/cable/phase)

5.0 CONDITIONING

To avoid cables splicing as much as possible during installation operations, the whole quantity of cables should be delivered in reels of 500 meters for a total of 24 reels.

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6.0 STANDARDS, CODES AND REGULATIONS

MV cables shall comply with the latest editions of IEC standards, codes and regulations.

In general, cables will be designed, manufactured, tested and installed in accordance with the relevant standards and good practices.

7.0 TECHNICAL SPECIFICATIONS

Electrical Characteristics:

- Type: Single Core.
- Electrical System: 3 Phase System.
- Rated Voltage: 6 kV (between any two conductors).
- Rated Voltage: 7.2 kV.
- Frequency: 50Hz.
- Short Circuit Current: 28 kA.
- Section: 240mm².
- Conductor Material: Copper Stranded Conductor.
- Insulation: XLPE.
- Sheath : PVC.
- Screening: Yes.
- Armour: No.
- Sunlight exposition : Yes.
- Incoming Power Source: MV Switchgears.

Installation:



- Number of cables/phase: 4 cables/phase.
- Arrangement type: Trefoil.
- Installation: on cable tray (Ladder type).
- Burial: No.

8.0 OPERATING CONDITIONS

The MV cables shall mainly be installed on cable trays (Ladders type).

Cables must comply with all aspects for a reliable and continuous operation.

All cables shall be suitable for operation at 50Hz.

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9.0 LOCAL CONDITIONS

The local conditions are:

- Seismic activity: Yes,
- Climate: Continental.
- Plant elevation: 718 m above mean sea level.
- Outside temperature: -15 to 35 °C minimum and maximum (annual average).
- Min. Relative humidity: 45%.
- Max. Relative humidity: 100%.
- Rainfall: 400 mm (annual average).
- Maximum snow accumulation: 300 mm.
- Snow load: 100 kg/m².

10.0 SHIPPING

The cables should be packed in wooden cable reels. The cable reels shall be packaged in suitable packaging be shipped to Poti port (Georgia) and then transported by trucks to the final destination in Bolnisi.

11.0 TECHNICAL PROPOSAL



The technical proposal must include the following documentation:

- Technical specification.
- List of Certifications.

12.0 COMMERCIAL PROPOSAL

The proposal must include but not limited to:

- Price Breakdown.
- Modalities and general sales conditions.
- Products description.
- Packaging.
- Budgetary cost for shipment CIF Port of Poti, Georgia.
- List and cost for the documents to be delivered.
- Payment terms.
- Warranties and Performance Guaranties.
- Delivery Time and schedule.
- Validity of the proposal (Days).

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13.0 ATTACHMENTS

- An example of requested cable.

3.6/6 (7.2) KV - SINGLE CORE, XLPE INSULATED, PVC SHEATHED

SCREENED, UNARMoured CABLES

Type M2N, M2A - Conforming to IEC 60502-2

Dimensional Characteristics

| Nominal cross section | Nominal Thickness of | | | Nominal Diameters | | | Approximate net weight | | | | Length on drum |
|-----------------------|----------------------|--------------|--------------|-------------------|------------|---------|------------------------|-------|----------------|-------|----------------|
| | Insulation | Inner Sheath | Outer Sheath | Conductor | Insulation | Overall | Copper cable | | Aluminum cable | | |
| | | | | | | | Conductor | Cable | Conductor | Cable | |
| mm ² | mm | mm | mm | mm | mm | mm | Kg/Km | Kg/Km | Kg/Km | Kg/Km | m |
| 10 | 2.5 | - | 1.4 | 3.82 | 9.82 | 15 | 90 | 310 | 28 | 245 | 500 |
| 16 | 2.5 | - | 1.4 | 4.83 | 10.83 | 16 | 142 | 385 | 43 | 285 | 500 |
| 25 | 2.5 | - | 1.5 | 6.02 | 12.02 | 17 | 224 | 500 | 68 | 350 | 500 |
| 35 | 2.5 | - | 1.5 | 7.15 | 13.15 | 19 | 311 | 610 | 95 | 400 | 500 |
| 50 | 2.5 | - | 1.6 | 8.3 | 14.3 | 20 | 421 | 755 | 128 | 465 | 500 |
| 70 | 2.5 | - | 1.6 | 10.0 | 16.0 | 22 | 608 | 985 | 185 | 560 | 500 |
| 95 | 2.5 | - | 1.7 | 11.8 | 17.8 | 24 | 843 | 1270 | 256 | 685 | 500 |
| 120 | 2.5 | - | 1.7 | 13.3 | 19.3 | 25 | 1065 | 1530 | 324 | 790 | 500 |
| 150 | 2.5 | - | 1.8 | 14.8 | 20.8 | 27 | 1307 | 1820 | 398 | 910 | 500 |
| 185 | 2.5 | - | 1.8 | 16.55 | 22.55 | 29 | 1640 | 2200 | 499 | 1050 | 500 |
| 240 | 2.6 | - | 1.9 | 18.73 | 24.93 | 31 | 2098 | 2740 | 638 | 1280 | 500 |
| 300 | 2.8 | - | 2.0 | 21.3 | 27.9 | 35 | 2646 | 3420 | 804 | 1570 | 500 |
| 400 | 3.0 | - | 2.1 | 24.1 | 31.3 | 37 | 3460 | 4280 | 1051 | 1870 | 500 |
| 500 | 3.2 | - | 2.2 | 27.3 | 34.9 | 41 | 4361 | 5300 | 1325 | 2280 | 500 |
| 630 | 3.2 | - | 2.3 | 31.0 | 39.0 | 45 | 5631 | 6700 | 1710 | 2780 | 500 |
| 800 | 3.2 | - | 2.5 | 37.1 | 45.0 | 51 | 7203 | 8500 | 2188 | 3480 | 500 |
| 1000 | 3.2 | - | 2.6 | 41.6 | 49.6 | 56 | 3080 | 10550 | 2758 | 4200 | 500 |

Electrical Characteristics

| Nominal cross section | DC Resistance at 20°C* | | Nominal inductance | | Nominal capacity | Current carrying capacity** | | | | | |
|-----------------------|------------------------|--------|--------------------|----------------|------------------|-----------------------------|-----|---------------|------|----------------|------|
| | Copper | Alu | Trefoil formation | Flat formation | | Underground Cable | | Cables in air | | Cables in duct | |
| | | | | | | Copper | Alu | Copper | Alu | Copper | Alu |
| mm ² | Ω/km | Ω/km | mH/Km | mH/Km | μF/km | Amp | Amp | Amp | Amp | Amp | Amp |
| 10 | 1.83 | 3.08 | 0.462 | 0.646 | 0.169 | 90 | 75 | 95 | 75 | 80 | 70 |
| 16 | 1.15 | 1.91 | 0.428 | 0.612 | 0.195 | 120 | 95 | 125 | 95 | 105 | 85 |
| 25 | 0.727 | 1.20 | 0.396 | 0.580 | 0.225 | 160 | 125 | 165 | 125 | 140 | 105 |
| 35 | 0.524 | 0.868 | 0.384 | 0.568 | 0.254 | 195 | 150 | 200 | 150 | 165 | 125 |
| 50 | 0.387 | 0.641 | 0.364 | 0.549 | 0.283 | 230 | 180 | 235 | 185 | 200 | 155 |
| 70 | 0.268 | 0.443 | 0.346 | 0.531 | 0.325 | 285 | 220 | 295 | 230 | 250 | 195 |
| 95 | 0.193 | 0.320 | 0.330 | 0.515 | 0.370 | 340 | 260 | 360 | 280 | 305 | 240 |
| 120 | 0.153 | 0.253 | 0.315 | 0.499 | 0.407 | 385 | 300 | 420 | 325 | 350 | 275 |
| 150 | 0.124 | 0.206 | 0.308 | 0.493 | 0.444 | 430 | 335 | 475 | 370 | 395 | 310 |
| 185 | 0.0991 | 0.164 | 0.301 | 0.485 | 0.487 | 485 | 380 | 550 | 425 | 465 | 365 |
| 240 | 0.0754 | 0.125 | 0.289 | 0.474 | 0.523 | 560 | 440 | 650 | 510 | 550 | 430 |
| 300 | 0.0601 | 0.100 | 0.288 | 0.472 | 0.548 | 630 | 500 | 740 | 580 | 635 | 495 |
| 400 | 0.0470 | 0.0778 | 0.274 | 0.459 | 0.598 | 720 | 570 | 860 | 680 | 740 | 580 |
| 500 | 0.0366 | 0.0605 | 0.270 | 0.454 | 0.631 | 800 | 640 | 990 | 790 | 855 | 670 |
| 630 | 0.0283 | 0.0469 | 0.263 | 0.448 | 0.711 | 910 | 740 | 1140 | 920 | 1000 | 780 |
| 800 | 0.0221 | 0.0367 | 0.252 | 0.437 | 0.832 | 1000 | 830 | 1300 | 1070 | 1165 | 910 |
| 1000 | 0.0176 | 0.0291 | 0.248 | 0.433 | 0.923 | 1090 | 920 | 1450 | 1220 | 1340 | 1090 |

* At different operating T(°C): $R = R_{20°C} \{1 + \alpha(T°C - 20)\}$

α: Temperature coefficient at 20°C = 0.00393 for copper & 0.00403 for aluminum

** Laying conditions: - Underground: Temperature of the soil 20°C - Thermal resistivity 100°C cm/w - In air: Ambient temperature 30°C

*** Greater sizes are also available