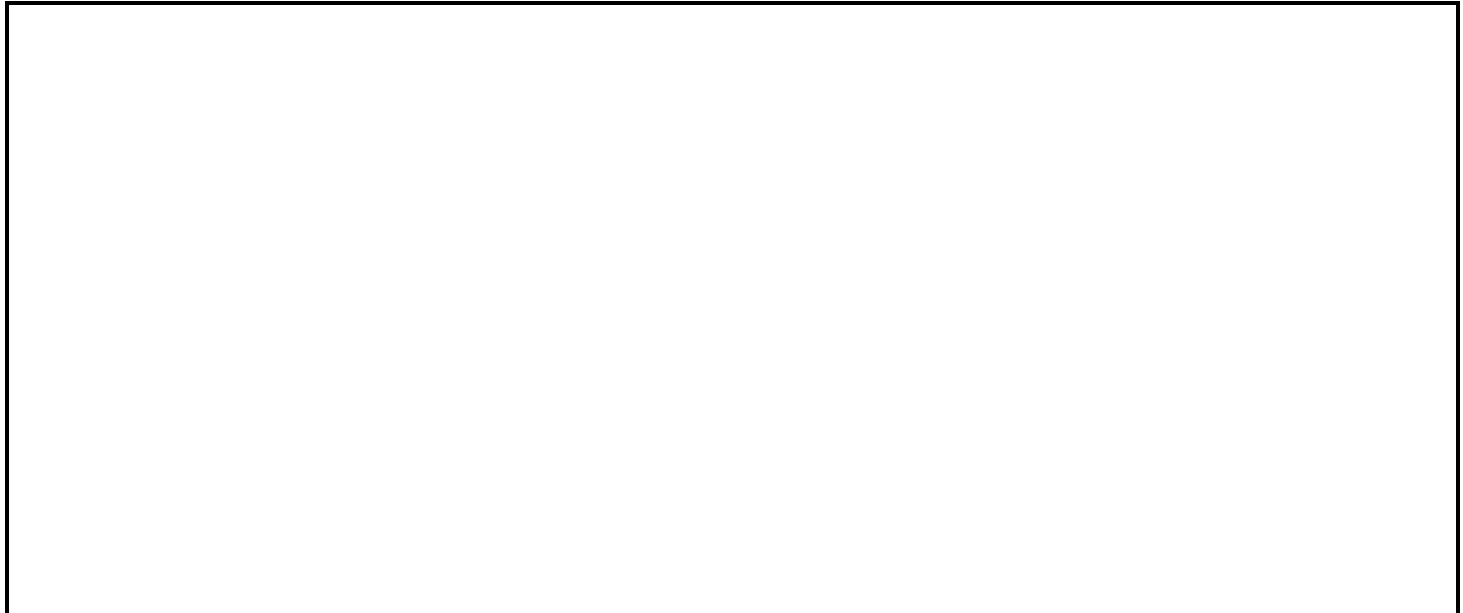


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1. General

1.1. Introduction

The plant will be referred to as “phase 3” in the rest of the report.

“Nominal” and “Design” capacity of the project is equal to 2340 depth and 2700 depth fresh ore feed conditions respectively. The plant is “Designed” to accommodate the “Maximum” conditions.

1.2. Definitions of Terms

Throughout this document the following words and expressions shall have the meanings hereby assigned to them except where the context otherwise requires:

- **“CLIENT” &/OR OWNER**
- **“BUYER &/OR PURCHASER”**
- **“BUYER REPRESENTATIVE”**
- **“SUPPLIER &/OR CONTRACTOR &/OR VENDOR”** means the firm or company which the contract will be made with.
- **“SUB-SUPPLIER”** means any person or company (other than the supplier) named in the contract for any part of the works.
- **“WORKS”** means all obligations of the Contractor described in the "scope of works" of this document.
- **“PLANT”**
- **“APPROVE”** means approval in writing letter confirmed by buyer.

1.3. Document Priority

In the event of conflict, actual or implied, among documents relating to an enquiry or order, following order of precedence shall govern, unless agreed in writing by CLIENT.

1. Material Requisition
2. Data sheet

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3. Drawings
4. specification
5. Design Criteria
6. Code and standards
7. In any case the vendor shall inform purchaser and obtain clarification before proceeding with any work.

The Vendor shall notify the CLIENT of any apparent conflict between this specification, the Codes and Standards and any other specification noted herein. Resolution and/or interpretation of precedence shall be obtained from the CLIENT in writing before proceeding with the design/manufacture.

2. Site Condition and Utilities

2.1 General Site Location

4-1-1

- Elevation: about 2500 meters above sea level.

4-1-2- Temperature:

- Max. (Summer): 35 C
- **Design Max (indoor and outdoor) 40 C**
- Min. (Winter): -25 C
- **Design Min.(outdoor) -25 C**

4-1-2- Relative Humidity:

- Humidity: 30 % @ 33°C
- Max.: 70 %
- Min.: 23 %

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For specific indoor area (above open sumps and flotation cells and above thickeners) due to special condition (water evaporation and water spraying) relative humidity shall be considered 100 %.

4-1-3- Wind Condition:

- Max. Wind Velocity already recorded: 100 Km/h
- Prevailing Wind Direction:
- Winter: Between South and South West
- Summer: Between North and North East
- Stormy days per annum: 10

4-1-4- Rainfall:

- Average: 500 mm/a
- Design: 500 mm/a
- Rainfall Intensity: 76 mm/h

4-1-5- Snowfall:

- Average: 100 mm/a (as water)
- Design Intensity: 150 mm/a (as water)
- Frost Line: 1200 mm below grade

2.2 Site description

4-2-1- Lithology:

The Site lithology consists of colluviums or slope wash overlying a deep volcanic weathering profile.

The Site lithology is summarized in below table:

Unit	Description	Top of Unit (m)	Approx. thickness (m)
------	-------------	-----------------	-----------------------

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1	Colluvium/ Slope wash	Surface	1-3
2	Residual Solids	3	5-10
3	Volcanic Rocks	10	>10

4-2-1- Seismicity:

SITE is classified as a high hazard zone and the above standard shall be considered during design of all foundation, structures and buildings.

3. Objective & Scope

This specification covers the minimum technical requirements, design, procurement, manufacture, quality control, testing, inspection, spare parts engineering and transportation of Power and Control Cables to the site location.

It is basically a performance-type specification and covers only those general aspects that are considered minimum quality and performance requirements by the purchaser. More detailed and specific data are contained in the drawings, data sheets and other documents that form the tender.

Standard design and models from bidders manufacturing program will be accepted in case they meet the requirements of this specification and serve the intended purpose. If a substantial improvement of any or all of the specified requirements expressed or implied herein is available from bidder, and this improved design offers economic advantages to purchaser, this should be proposed as an alternative together with basic proposal that conforms to this specification.

All equipment described in this specification are intended for continuous duty at the specified ratings under specified service conditions.

Compliance of the manufacturer with the provisions of this specification does not relieve him of the responsibility of furnishing Power and Control Cables. and

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accessories of proper design electrically and mechanically suited to meet the operating guarantees at the specified service conditions.

4. Codes and Standards

The equipment covered by this Specification, including all components and auxiliaries shall be designed, manufactured and tested in accordance with the latest IEC Standards wherever they may apply, and in particular: unless otherwise specified, the design, equipment, materials, installation, inspection and testing shall be conformed to the requirements of the latest edition of the followings:

- IEC 60502 Extruded solid dielectric insulation power cable for rated voltage from 1kV up to 30 kV.
- IEC 60840 Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) Test methods and requirements
- IEC 60183 Guide to the selection of high-voltage cables
- IEC 60228 Nominal cross-sectional areas and composition of conductors of insulated cables
- IEC 60331 Fire resisting characteristics of electric cables.
- IEC 60332 Test on cables under fire conditions.
- IEC 60227 Specification for insulating covering and sheaths
- IEC 60811 Common test methods for insulation and sheathing materials of electric cables
- IEC 60055 Paper-insulated metal-sheathed cables for rated voltages up to 18/30 kV
- BS 6480 Power cable, Impregnated paper insulated, lead or lead alloy heated electric cables
- BS 6622 Specifications for cables with extruded XLPE or EPR insulation rated voltage 3800/ 6600 up to 19000/33000 Volts.

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- BS 6724 Specification for armored cable with low emission of smoke and corrosive gases
- IEC – 60375 general instrumentation, general and communication cables.
- B.S - 6346 specification for P.V.C insulated cables.
- B.S - 5467 Cables with thermo setting insulation for electricity supply for rated voltage, up to and including 600/ 1000 V.

Note: Electrical equipment shall be designed, manufactured, erected, and installed according to the latest editions of the IEC (International Electro technical Commission) standards.

Minimum requirement for installation shall be follow local codes and norms. In lack of them normal European industrial practice is followed. Other standards that can use in reference, but shall be equivalent with IEC standard, are as below:

BS-IEEE-ANSI-VDE -DIN -ISO -NEMA (National Electrical Manufacturers Association)
-NFPA-NACE-API-ISA-NACE

All standards shall be of the latest issue.

5. Technical Specification

5.1. 33 kV Power Cable

All ratings shall be at site conditions, but in no case, performance levels cannot be less than those required by standards.

The insulation level for 33kV cables shall be rated 19/33/(36) kv for U₀/U/(U_m) voltages, and for 6.6kV and less than 6.6kV cables shall be rated 3.8/6.6/(12) kv for U₀/U/(U_m) voltages (For all cable with nominal voltage 1000<V<12kV, 12kV shall be considered). The insulation level for LV cables shall be 0.6/1 (1.2) kV for current carrying cables and control cables.

Cables for underground installation shall be directly Buried or normally laid in concrete trenches and cable ladder/tray with concrete block covers. Cabling shall be protected

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by concrete duct bank(s) with suitable pipe sleeves when crossing roads and pipe racks.

The minimum current carrying capacity of cables after being derated shall be as follows:

- The transformer feeder cables shall have a current carrying capacity equal to the transformer rated current in ONAF condition when applicable.
- The motor feeder cables shall be selected based on motor nameplate rating taking into account the cable derating factors according to IEC60364-5-52
- All the remaining cable not mentioned above shall have a current carrying capacity according to IEC 60364-4-43.
- Cables shall be suitable for such use and be duly protected against mechanical wear and be coated against environmental factors.

The maximum conductor temperature shall not be exceeded, according to IEC-60502, as follows:

- Insulation should be capable of withstanding a maximum continuous conductor temperature of 90° C for XLPE and 70°C for PVC insulation at 100% continuous load.
- Insulation should be capable of withstanding a conductor temperature of 250° C for XLPE and 160°C for PVC insulation during short circuit conditions.
- Cables above 6mm² may have a higher cyclical current carrying capacity than the continuous rating, providing the maximum conductor temperature of 90°C is not exceeded. Periods of rest shall be greater than three times the thermal time constant of the cable. Cable selection and method of protection is by the contractor.
- PVC/PVC insulated three core cables shall be used for lighting purpose.

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5.2. 6.6 KV Power Cable

Medium power cable designed to supply power to utilization devices of the plant systems rated 6.6kV.

Medium voltage power cables shall be rated $U_0/U/(U_m)$ equal to 6/10kV (12 kV).

Cable construction starting from conductor to the outer sheath is as follows. IEC 60502-2 shall be followed for details:

- Insulation voltage: /10 kV
- Core: single / three core
- Conductor: copper round stranded wire, according to IEC 60228, class 2
- Conductor size for three core cables: $\leq 70 \text{ mm}^2$
- Conductor size for single core cables: 95 to 400 mm^2
- Max - conductor load temp.: 90°C
- Short circuit temp: 250°C
- Core insulation: XLPE, cross-linked polyethylene
- Semiconductive layer: Extruded layer of semi-conductive material between conductor and insulation and between insulation and screen.
- Metallic Screen: Copper wire helicoidal layer
- Filler and Inner Sheath: Extruded PVC or Poly Propylene with sheath (for multi core cables).
- Armour for three core cables (In case of application): strapping steel
- Armour for single core cables (In case of application): strapping aluminium
- Oversheath insulation: PVC-ST2
- Sheath color: Red

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5.3. 6.6 kV VFD Power Cable

Cable construction starting from conductor to the outer sheath is as follows. BS EN 60228 shall be followed for details:

- Phase Conductor: Copper wire helicoidal layer
- Insulation: XLPE (Cross-Linked Polyethylene)
- Insulation Screening: Non-metallic extruded semi-conducting XLPE
- Metallic Screen: Over Each Core Copper tape
- Earthing Conductor: Split-earth conductor. Laid in the interstices of phase conductors
- Inner Covering: Polyolefin
- Screen: Copper/polyester tape (copper side in contact with copper braid) Braid of copper wire
- Sheath: Polyolefin
- Voltage Rating: 8kV
- Test Voltage: 15kV

5.4.LOW VOLTAGE POWER AND CONTROL CABLES

5.4.1. Type of Cables

A) The power cable (underground or above ground) shall be of the following type:

1- LV Power Cable, 0.6/1 (1.2) kV, stranded annealed Copper core conductor, XLPE primary insulated, individual Screen, unarmored and PVC Jacket, for underground cable shall be armored.

2- Lighting Power Cable, 0.6/1 (1.2) kV, Flexible annealed Copper core conductor, PVC primary insulated and PVC Jacket.

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3- Single Core PVC Insulated Wires: unless otherwise specified single conductor wires for wiring in conduit are to have annealed copper conductors, generally with concentric strands and insulated with flame retardant, moisture and heat resistant PVC/E to IEC 227 suitable for semi industrial locations and for conductor temperature of 85 deg. C. Wires are to be 450/750 V grade.

B) The control cable (underground or above ground) shall be of the following type:

1- Control cable, 0.6/1kV, Rigid, round, solid, annealed copper conductor, PVC insulated and PVC jacket.

2- Instrumentation Cable, 300/500 V, Flexible annealed copper conductor, PVC Insulated with Overall Shield.

3- RTD cable, 300/500 V, flexible annealed copper conductor, PVC insulated with individual and overall shield.

4- Communication cable (including telephone, paging, intercom. & etc.), Annealed copper conductor, twisted pair with Aluminum shield and PE insulated.

5-Cable for Variable Speed Drive Shall be Copper Wire Screen (cws) if externally recommended by VSD Vendor obligate.

All Cables shall be flame retardant according with low production of corrosive and toxic gas.

Conductors

Conductors of LV and control cable shall be:

Conductor sizes up to and including 6 mm² shall be plain solid annealed copper.

Conductor sizes 10 mm² and Larger shall be stranded annealed copper.

Conductors in the same cable shall be all same size except when four-core cable with reduced neutral is specified.

5.4.2.Primary insulation

Insulation shall be XLPE extruded for LV power cables, Lighting, control and signaling cables.

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5.4.3.Core screen

Core screen shall consist of a layer of semi-conducting compound and a metallic layer. The metallic layer shall be copper tape according to IEC 60502-1.

5.4.4.Filler and Bedding

The Filler shall be non-hygroscopic material, to obtain circular form of the cables, shall be pre-shaped PVC.

The bedding shall be an extruded layer of PVC compound.

5.4.5.Outer Sheath

The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirement specified in the applicable standards. To protect the cable against rodent and termite attack suitable chemicals shall be added into the PVC compound of the outer sheath.

- Motor cable from output VFD at the normal voltage of 0.6/1kV drives will be NYCY

6.Color codes for conductors of power and control cables

- 3-cores: Black, Blue, Yellow/Green (L1, N, PE)
- 4-cores: Black, Brown, Gary, Yellow/Green (L1 , L2 , L3 , PE)
- 5-cores: Black, Brown, Gary, Blue, Yellow/Green (L1 , L2 , L3 , N , PE)
- 6-cores and up: Black with White numbers (for Control Cables)
- 1 or 2-Cores (DC- Cables): Red (for Positive) & Blue (for Negative)

6.1.Color of external sheath

- Medium Voltage Power cables: Red
- Low Voltage Power cables: Black
- Low Voltage Control cables: Gray
- Low Voltage DC Power cables: Red (+) , Blue (-) , Orange (for 2-Cores)

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6.2.Cable marking

Cable shall be marked on the outer sheath to provide the following information :

- Manufacturer's name
- Number of cores and conductor size
- Construction code
- Insulation voltage
- Length of Cable (per meter)

7.SPECIAL CHARACTERISTICS

Cables shall have all or some of the following special characteristics as will be specified in the requisition:

- Hydrocarbon resistant.
- Non – flame propagation.
- Non – fire propagation.
- Fire resistance.
- Low production of corrosion gas.
- Low production of toxics gas.
- Low production of opaque – smoke.

Listed characteristics shall be specified according to the reference code.

8.ADDITIONAL REQUIREMENTS

Cables shall be supplied on wooden drums in one continuous length.

The wood used for construction of the drums shall be properly seasoned, sound and free from defects. Preservatives shall be applied to the entire drum.

Unless otherwise specified, the cables to be supplied on maximum per drum up to total drum weight of:

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- a) 1.5 ton for cable size less than 6 mm².
- b) 3.0 ton for cable size from 6 mm² up to and including 50 mm².
- c) 5.0 ton for cable size greater than 50 mm².

Supplier shall engrave or paint the following information on each drum. If paint method is used, it shall be weatherproof and not affected by direct sunlight. This label/plate shall be suitable for two years site storage and usage.

- a) Purchase order number.
- b) Purchase order item number.
- c) Cable type (size, number of cores, type, etc.).
- d) Cable length.
- e) Drum weight.
- f) Drum number.
- g) Manufacturer name and year of manufacture.

9.CABLE ACCESSORIES

The termination and straight joint kits shall be suitable for the type of cables offered. The termination and straight joints shall be supplied in kit form. The kit shall include all insulation and sealing materials apart from conductor fittings and consumable items. An installation instruction shall also be included in each kit.

The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor.

JOINTING KITS

The straight jointing kits shall be suitable for aboveground/underground buried installation with uncontrolled backfill and possibility of flooding by water.

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10.TEST REQUIREMENTS

Purchaser reserves the right to inspect at any stage of manufacturing, testing or preparation for shipment.

Manufacturer shall describe and include in the quote his standard routine factory tests.

10.1.ACCEPTANCE TEST

The acceptance test aim is to guarantee the compliance of cables with the relevant design documentation and to detect any fault in materials and fabrication.

Acceptance tests and checks as detailed in clause 8.2 shall be carried out on:

- All cable lengths.
- Cable samples.
- Cable materials.

Samples shall consist of pieces of cables, random chosen, whose length shall be as stated in the reference codes. If no information is given in the reference codes, the sample shall be defined as follows:

- For visual and dimensional checks, the sample length shall be 5% of all purchased cable length, with the minimum of one drum length for each type of cable.
- For test on sample (not cut piece), the sample length shall be:
 - One drum length for each type of cable, when the supply is less than 10 km.
 - Two drums length for each type of cable, when the supply is more than 10 km.
- For test on piece, the test on core components and relevant materials shall be carried out on only one core of each selected drum. Checks and tests shall be carried out in accordance with methods indicated in the reference codes.

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Tests on accessories shall comply with reference codes. For the purpose of tests on accessories, cable supplier shall provide evidence that these tests have actually been carried out and provide appropriate test documentation.

10.2.LIST OF TESTS AND RELEVANT NOTES

5.1.1.Test on All Cable Lengths

- Applied voltage test.
- Corona level test (measurements of partial discharge), (see note I).
- Measurement of conductor and screen electrical resistance.
- Checking of the length for each type of cables.

Test on Lengths and Cross sections forming part of the Sample

- Measurement of capacitance.
- Measurement of insulation resistance in the cold condition referred to 20° C.
- Visual and dimensional checks: see note II.

5.1.2.Tests on Material Samples

- Conductor coating test (e.g. tinning).
- Testing of mechanical characteristics of the insulation and external jacket without ageing in heater.
- Insulation and external jacket elongation test in the hot condition.
- External jacket heat stroke test.
- Bending tests in the cold condition on PVC for insulation and jacket.

Note I: Only for cables with individually screened cores (PE and XLPE insulated cables) with a rated voltage U0/U greater than 1.8/3 kV and PVC insulated cables with a rated voltage U0/U greater than 3.6/6 kV.

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Note II: A visual check shall be carried out to check the compliance with requirements prescribed in respect of cable formation, core and external sheath colors, marking legibility and repetition, etc.

The following shall also be carried out:

Checking of the construction consistency and thickness of the insulation and external sheath, measurement of screen, measurement of the mass of main components; the latter only for information purposes.

11.INFORMATION REQUIRED WITH BID

The following information shall be provided with quotation:

List of clause wise deviations from project specification. If the same is not furnished, it will be assumed that offered equipment meets all the requirements of this standard.

Catalogues and brochures giving technical and physical details of the cable like current rating, overall diameter, weight, etc.

Recommendations in respect of installation and limitation of use.

“Type Test” certificates and “Special Test” results for cables offered.

Type test certificated for cable accessories.

Note: Offer is likely to be rejected, if the above information is not furnished with bid.

12.SHIPPING

Manufacturer shall be solely responsible for the adequacy of the preparation for shipping provisions employed, with respect to materials and their application to ensure that the cable reaches its destination in perfect working condition when handled by commercial carrier systems.

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13.Guarantees

The supplier shall replace any damaged equipment resulting from poor workmanship and/or faulty design. The supplier shall also replace any equipment failed under the following conditions:

- Failure under startup and commissioning tests performed according to IEC recommendations.
- Satisfactory and trouble-free operation of equipment under specified conditions generally shall be guaranteed for a period of 12 months from starting to operation.

The supplier shall guarantee to support any spare parts for a period of 10 years.