




KPD-TAY COMPRESSION PROJECT

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<div></div> <div>ENAR Petrotech Services (Pvt.) Limited , 7-B , Sector 7-A , Korangi Industrial Area , Karachi Pakistan</div>		<div>TITLE:</div> <div>SPECIFICATION FOR LV POWER & CONTROL CABLES</div>												
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CLIENT : OIL & GAS DEVELOPMENT COMPANY LIMITED

PROJECT : KPD-TAY COMPRESSION PROJECT

**SPECIFICATION FOR
LOW VOLTAGE POWER & CONTROL CABLES**



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1. PURPOSE

This specification is intended to specify the basic requirements for design, engineering, selection, sizing, supply, inspection and testing of LV Power & Control Cables which deemed necessary for defining minimum requirement at preliminary stage and shall not be considered comprehensive and final for procurement. This specification does not absolve the CONTRACTOR from his responsibility of supplying, installing and commissioning suitable LV Power & Control Cables complete in all respect. The CONTRACTOR shall develop detailed datasheets, specifications, ITP and installation details for the offered LV Power & Control Cables based on this specification and submit to the COMPANY/CONSULTANT for approval during detailed engineering stage.

The offered LV Power & Control Cables shall comply with the *Reference Standards and Codes*. Where the manufacturer's standards differ from other supplementary requirements of this specification details shall be submitted to the COMPANY/CONSULTANT for approval.

In case discrepancies are found between this specification and other documents, COMPANY/CONSULTANT shall be referred for correct interpretation.

1.1. Definition

Where used in this specification, the following terms shall have the meanings indicated below unless otherwise clearly indicated by context of their use.

COMPANY – Oil & Gas Development Company Limited (OGDCL)

CONCESSION REQUEST - A deviation requested by the CONTRACTOR or VENDOR, usually after receiving the contract package or purchase order. Often, it refers to an authorization to use, repair, recondition, reclaim, or release materials, components or equipment already in progress or completely manufactured but which does not meet or comply with COMPANY/CONSULTANT requirements. A Concession Request is subject to COMPANY/CONSULTANT approval.

CONTRACTOR - The party which carries out all or part of the design engineering, procurement, construction and commissioning or management of the project.

DRAWINGS - Drawings provided by the CONTRACTOR/VENDOR.

SUPPLIER/MANUFACTURER - The party which manufactures and/or supplies the material/equipment, and provides technical documents/drawings and services to perform the duties specified by the COMPANY/CONTRACTOR.

PROJECT – KPD-TAY Compression Project

1.2. Errors & Omissions

- The review and comment by COMPANY/CONSULTANT of any CONTRACTOR's/VENDOR's drawings, procedures or documents shall only indicate acceptance of general requirements



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and shall not relieve the CONTRACTOR/VENDOR of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

- Any errors or omissions noted by the CONTRACTOR/VENDOR in this Specification shall be immediately brought to the attention of COMPANY/CONSULTANT.

1.3. Deviations

- All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of COMPANY/CONSULTANT as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of COMPANY/CONSULTANT prior to execution of Work. Such deviations shall be shown in the documentation prepared by the CONTRACTOR/VENDOR.

1.4. Conflicting Requirement

- In the event of any conflict, inconsistency or ambiguity between the CONTRACTOR's/VENDOR's scope of work, this Specification, National Codes and Standards, and referenced in the Project Specification or any other documents, the CONTRACTOR/VENDOR shall refer to COMPANY/CONSULTANT whose decision shall prevail.

1.5. Reporting Procedure

- A reporting and documentation system shall be agreed between the CONTRACTOR/VENDOR and COMPANY/CONSULTANT for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. The CONTRACTOR/VENDOR shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY/CONSULTANT.
- Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to COMPANY/CONSULTANT.

1.6. Third Party Inspection:

- In addition to the inspection and witnessing of tests by the inspectors to be appointed by the COMPANY/CONSULTANT during the manufacturing and shipment of the equipment/material, COMPANY/CONSULTANT may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at VENDOR's facility under this specification.
- Information w.r.t inspection and testing purposes as per applied reference Standards and Codes shall be submitted to COMPANY/CONSULTANT.

1.7. Unit Responsibility

- The CONTRACTOR/VENDOR shall be responsible for the complete design, manufacture, supply, inspection and testing of Power & Control Cable, including full compliance with all applicable design codes and standards, including those listed in "Section-2" of this document and the requirements of the certifying authority, if applicable. The CONTRACTOR/VENDOR



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shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing.

- The CONTRACTOR/VENDOR shall guarantee that all material and parts included in construction of the specified LV Power & Control cables shall be new, unused and of the required/ specified grade.

1.8. Documentation

- Documents, calculation/data sheets, technical details, etc., to be submitted to the COMPANY/CONSULTANT shall be in English Language.
- Unless otherwise specified, the metric units shall be used in documents and drawings by the CONTRACTOR/VENDOR.
- The form of drawings and documents may be as per the CONTRACTOR/VENDOR's Standards. However, the format of the data sheet will be submitted to COMPANY/CONSULTANT for approval.
- Variations from or additions to this specification shall be called to the attention of the COMPANY/CONSULTANT and approved in writing by the COMPANY/CONSULTANT prior to starting manufacturing.
- Comments made by COMPANY/CONSULTANT on drawing/technical details submittal shall not relieve the CONTRACTOR/VENDOR of any responsibility in meeting the requirements of the specifications.
- Such comments shall not be construed as permission to deviate from requirements of the Purchase Order unless specific and mutual agreement is reached and confirmed in writing.
- The CONTRACTOR/VENDOR shall notify the COMPANY/CONSULTANT of any apparent conflict between this specification, the related data sheets, the Standards & Codes and any other specification noted herein. Resolution and or interpretation precedence shall be obtained from the COMPANY/CONSULTANT in writing before proceeding with the design manufacture.

2. REFERENCE STANDARDS & CODES

The Power & Control Cables supplied by the CONTRACTOR/VENDOR shall comply with this Specification, and material selection shall confirm to the relevant and latest version of the following reference Standards and Codes.

It shall be manufacturer's responsibility to be, or to become, knowledgeable of the requirements of these reference Standards and Codes. Any changes, alteration and necessary re-certification of the equipment for compliance with the applicable Standards and Codes shall be at the expense of the Manufacturer.



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STANDARD	DESCRIPTION
IEC 60038	IEC standard voltages
IEC 60502 Part 1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV – Part 1: cables for rated voltages of 1 kV up to 3 kV
IEC- 60364-5-52	Electrical installation of buildings- Selection & erection of electrical equipment- Wiring Systems
IEC- 60853	Calculation of the cyclic and emergency current rating of cables
IEC- 60909	Short-circuit currents in three-phase A.C. systems
IEC- 61000	Electromagnetic compatibility (EMC)
IEC 60331	Tests for electric cables under fire conditions – circuit integrity
IEC 60332	Tests on electric cables under fire conditions
IEC 60028	International Standard of Resistance for Copper
IEC 60228	Conductors of insulated cables
IEC 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
IEC 60287	Electrical cables-calculation of the current rating
IEC 60189	Low frequency cables and wires with PVC insulation and PVC Sheath
IEC 60304	Standard colours for Insulation for Low-frequency cables and wires
IEC – 60724	Short-circuit temperature limits of electric cables with rated voltages of 1kV and 3kV
IEC 60754	Test on gases evolved during combustion of materials from cables
BS – 6004	Electric cable-PVC insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring

In addition to the above, the following codes shall be considered;

- NFPA-70 / National Electric Code.
- API Recommend Practice 500 A, B & C.
- Relevant British Standard Specification and Codes of Practice
- The Institute of Petroleum – Model Code of Sage Practice Electrical
- The Institute of Electrical Engineers, Regulations for Electrical Installation- Latest Edition.
- Institute of Electrical & Electronic Engineers (IEEE)
- Electricity Act. 1973 (Govt. of Pakistan)
- Oil & Gas (Safety in Drilling and Production) Regulation 1974, Govt. of Pakistan.

In the event of conflict between Standards, the most stringent shall prevail.

All standards, regulations and codes of practices used shall be of latest current issues at the date of contract award.



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The CONTRACTOR/VENDOR shall be responsible for the availability of the above mentioned specifications/publications, standards, and codes of practices and any other relevant documents and shall collect these documents on its own. The CONTRACTOR/VENDOR shall make sure that these documents are available all times and shall submit/present to COMPANY/CONSULTANT on request.

The design and installation shall also include the requirements of any applicable local laws, standards having jurisdiction over the site location following the principles and practices detailed in this document.

3. SERVICE CONDITIONS

3.1. Site Conditions

Electrical design shall be based on the following environmental conditions:

PARAMETERS	VALUE/UNIT
MAXIMUM AMBIENT TEMPERATURE	118 °F
MINIMUM AMBIENT TEMPERATURE	36 °F
WET BULB TEMPERATURE (DESIGN)	88 °F
MAXIMUM RELATIVE HUMIDITY	77%
MINIMUM RELATIVE HUMIDITY	20%
WIND VELOCITY	101 (Miles/Hour)
ELEVATION ABOVE MEAN SEA LEVEL (GPF)	250 ft.
SEISMIC ZONE	Zone 2A of Uniform Building Code- UBC-1997.

3.2. Power Supply Characteristics

The rated characteristics of the power supplies are:

PARAMETERS	VALUE/UNIT
VOLTAGE	400 V ac \pm 10%, 3-PHASE 230 V ac 1-PHASE
FREQUENCY	50 Hz \pm 2Hz
NEUTRAL SYSTEM	SOLIDLY EARTHED

4. DESIGN REQUIREMENTS

4.1. General

Power & Control Cables offered shall be **XLPE** insulated, 0.6/1kV Grade.

Cable shall be annealed copper wire conductor and conductor shall basically be in accordance with IEC standards.

All cables shall be flame retardant to meet the test requirements to IEC 60332 Part 3 Category C. All cables shall utilize materials that are UV stabilized and will not deteriorate under direct sunlight.



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For 400/230V power system, cables shall be 600/1000 volts grade as specified. For control system, cables shall be 600 volts grade.

The Conductor shall be stranded, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multi-core cables may be circular or shaped according to standard practices, and codes.

Cable protective sheaths shall be suitable for good resistance to ageing, good mechanical resistance to laceration, and repellent/deters against termite, chemical and solvents, aliphatic hydrocarbons; and flame retardant. Sustainable temperature rise during short circuit is 160 °C for PVC and 250 °C for XLPE. In compliance to *Section-2*, manufacturer shall ensure that there will be minimum production of noxious gases and fumes in the event of fire.

Polymeric insulated cables using cross-linked polyethylene (XLPE) shall have a maximum operating temperature of 90°C. XLPE cores shall be individually copper wire screened. The screen shall be heavy duty. Polymeric insulated cables using polyvinyl chloride (PVC) shall have a maximum operating temperature of 70°C. The laid up cores of three core cables shall have the interstices filled with non-hygroscopic filler to achieve a circular cross-section. Where installed, the earth conductor in multi-core cables shall be an insulated conductor with the same insulation level as the phase conductors.

Cables cores shall be identified throughout its length as follows:

- 1 Core Black
- 2 Core Red and Black
- 3 Core Red-Yellow and Blue
- 4 Core Red-Yellow-Blue and Black
- 5 and more core Cores shall be numbered

The colors shall be throughout the insulation. The numbers shall be printed in a color which contrast with the cores. The intervals between adjacent numbers shall not exceed 70mm.

Cables shall be suitable for either directly buried underground or for above ground installation as per identified in Bill of Quantity (BOQ).

The CONTRACTOR/VENDOR shall submit all technical details of cables, which shall include the minimum following:

- Type of insulation, sheathing & jacketing material
- Voltage grade
- Continuous current carrying capacity under different installation conditions (for above/ and underground installation)
- Applicable rating factors
- Short circuit rating details



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- Overall cable dimensions (Armour dimensions, inner & outer insulation thickness, thickness of armoured, and overall cable diameter)
- Cable weight/meter
- Minimum safe bending radii without distortion or bird-caging
- Resistance, reactance, capacitance per 1000 meters for 50Hz (values of each cable)
- Minimum handling temperature
- Standard/maximum drum lengths and the relevant drum overall sizes.

4.1.1. Steel wire Armouring

Steel wire armouring for multi-core cables shall consist of circular galvanized steel wire which shall be electrically continuous over the entire length of cable.

4.1.2. Aluminum Wire Armouring

Aluminum wire armouring (AWA) shall be applied to single core cables only.

COMPANY/CONSULTANT approval shall be sought before going to manufacturing / procurement of material. All the comments furnished by COMPANY/CONSULTANT shall be incorporated by the CONTRACTOR/VENDOR in latter & spirit.

4.2. Control Cables

Control cables shall satisfy the construction requirements of the relevant standard in *Section-2*. Conductors shall be stranded, annealed copper conductors to the relevant standard in *Section-2*, laid up in a concentric arrangement.

Cables shall have the length, number of cores, cross-sectional area, sheathing, insulation material, insulating voltage and armoring as stipulated in the cable schedule (created during detail design stage).

The designated operating voltage shall be 0.6/1 kV.

Cables shall be XLPE insulated. Polymeric insulated cables using cross-linked polyethylene (XLPE) shall have a maximum operating temperature of 90°C. XLPE cores shall be individually copper wire screened. The screen shall be heavy duty.

Multi-core armoured control cables shall have a layer of helically applied galvanised steel armour wires applied over the laid up assembly.

4.3. Earthing Cables

Earthing cables shall be single core satisfying the construction requirements of the relevant standard in *Section-2*. Conductors shall be high conductivity, stranded, circular, hard drawn copper conductor to the relevant standard in *Section-2*.

For below and above ground installation; earthing cables shall be PVC insulated, coloured green with yellow stripes. Earthing cable requirements shall be as stipulated in the cable schedules (created during detail design stage).



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4.4. Labels

In addition to the information required by the specified standards, the following information shall be embossed every one meter along the entire cable length on the external surface of the outer sheath:

- i. Governing standard / code
- ii. No. of cores e.g. 4C / 3C / 2C+E / 1C
- iii. Cable size e.g. 95mm / 70mm² / 35mm² / 16mm²
- iv. Voltage grade e.g. 600/1000V
- v. Manufacturer's name or trade mark e.g. XX
- vi. Type designation or cable type identification marking e.g. Cu/XLPE/PVC/SWA/PVC
- vii. Year of manufacture

Example;

IEC 60502 – **4C** – **50mm²** – **0.6/1kV** – **XX** – **Cu/XLPE/PVC/SWA/PVC** – **2022**
(i) (ii) (iii) (iv) (v) (vi) (vii)

4.5. TESTS

The testing procedure shall be submitted to the COMPANY/CONSULTANT for his approval prior to testing. All tests shall be conducted according to reference Standards and Codes.

The CONTRACTOR/VENDOR shall give at least one month notice prior to final tests. COMPANY/CONSULTANT may witness the tests at the Manufacturer's facility.

- 1) The VENDOR shall confirm the following routine and sample factory testing in accordance with IEC 60502 and quality control will provide for 100% testing and checking (including dimensional checks) of all electrical properties and physical properties of cables.

- Routine Test (As per IEC Standards recommended tests)

These are to be performed at the manufacturer's works on all cables in the finished state or, as appropriate (e.g. spark tests) during manufacture. The minimum tests required shall be as:

- Spark test on cores
- Spark test on over-sheath
- Visual examination and measurement of cable markings
- Measurement of conductor resistance
- Measurement of insulation resistance
- Voltage test on completed cables

- Regular Sample Test (As per IEC Standards recommended tests)

These tests shall be made at the manufacturer's works on representative sample selected regularly by the manufacturer, or as specified by the CONTRACTOR at the time of ordering in compliance to reference *Section-2* Standards and Codes. The minimum tests to be performed are as:



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- Conductor material and construction examination
- Measurement of insulation thickness
- Visual examination and measurement of core
- Visual examination of laid-up cores
- Measurement of extruded bedding thickness
- Measurement of over-sheath thickness

- **Special Sample Test** (As per IEC Standards recommended tests)

These tests are to be performed on one sample taken from each end of a manufacturing series of the same type and size of cable.

- Visual inspection to assess and also to clarify cable marking etc.
- Measurement of cable dimensions (sheath, armours and overall cable concentricity and smoothness, relative to the specified glanding schedule).

- **Type test reports*** (As per IEC Standards recommended tests)

*Manufacturer shall furnish the type test reports to COMPANY/CONSULTANT.

- 2) The Cable test shall include those quality control and other tests necessary to demonstrate the qualities of the materials used in the manufacturing of cables.
- 3) Each conductor of a multi-core cable shall be tested individually with each other conductor of the group and also with the earth. The minimum acceptable insulation resistance value will be as per Reference Standards & Code *Section-2*.
- 4) If insulation resistance test readings are found to be less than specified minimum in any conductor, the entire cable shall be replaced and the new cable shall be tested.
- 5) For testing of the cables, megger and continuity tests shall be carried out for each of the cable drum as minimum. However, the other tests may be carried by selecting the cable drums randomly.
- 6) In case where cables are re-drummed from manufacturing onto shipping drums after factory test, insulation resistance (Megger) tests shall be carried out on all the shipping drums.

5. GUARANTEE

The CONTRACTOR/VENDOR shall guarantee that the cable is free from fault in design, workmanship, is of adequate size and capacity, and of proper material to satisfactorily fulfill the operating conditions specified. Should any defect in design, material, workmanship or operating characteristics develop during the first year of operation, the Manufacturer shall make all necessary alterations, repairs, and replacements of defective equipment / components, at his own cost including transportation, installation and testing.



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6. SHIPPING

The material shall be properly conditioned for shipping against all possible damages. The CONTRACTOR/Supplier shall be responsible for shipment of equipment to site and for the adequacy of the preparations for shipment ensuring that materials and equipment arrive at their destination in undamaged condition. All components shall be shipped simultaneously.

6.1. CABLE DRUM MARKING

Cable drums shall each be provided with two 200mm x 200mm identification labels made from stainless steel, securely affixed one per side and at the top and bottom of each drum. The CONTRACTOR/Supplier shall ensure that each affixed label shall be engraved with the following information as a minimum:

- Manufacturer's Name or Trade Mark
- Purchaser's order number, and BOQ item no.
- Supplier's drum number
- Cable size and type code
- Voltage grade
- No. of Cores
- Drum length (meter)
- Net and gross weights (cable plus drum)
- Weight per meter
- Date of manufacture

Cables shall be supplied in standard production lengths, drum types and sizes for the quantities of each type of cable is required. All drum lengths shall be continuous.

Cable or conductor jointing in any form is un-acceptable. The cable drums shall be non-returnable.

Cable ends shall be sealed and protected prior to fixing to cable drum in order to prevent ingress of moisture during shipping and site storage. Cable drums shall be fitted with battens, fixed around the entire periphery of the drum.

The CONTRACTOR/Supplier shall develop and submit the overall cable drum schedule to COMPANY/CONSULTANT for review and approval.
