



BANGLADESH GAS
FIELDS COMPANY
LIMITED



CONSORTIUM OF
ZICOM EQUIPMENT PTE LTD
AND
SINOPEC PETROLEUM ENGINEERING CORPORATION



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SPECIFICATION FOR ELECTRIC INDUCTION MOTORS

Doc.No.: 252-0101 -EMEL-SP00-0003




Job No. : 252
Client : BANGLADESH GAS FIELDS COMPANY LIMITED
Location : Location I&J
Item No. :
Equipment Name : ELECTRIC INDUCTION MOTORS
Project Title : 2x75MMSCFD TEG DEHYDRATION TYPE NATURAL GAS
PROCESS PLANT
Year Built : 2015

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ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
API	American Petroleum Institute
BOD	Basis of Design
BS	British Standard
CT	Current Transformer
CTEP	Central Treatment Export Plant
GOSU	Gas Oil Separation Unit
GT	Gas Turbine
IEC	International Electrotechnical Commission
IFC	Issued for comments
AC	Alternating Current
API	American Petroleum Institute
IP	Ingress Protection
ISO	International Organization for Standardization
KO	Knock Out (Drum)
KV	Kilo Volt
KW	Kilo Watt
LP	Low Pressure
LV	Low Voltage
MMSCF/D	Million Standard Cubic Feet per Day
MV	Medium Voltage
OD	Outer Diameter
RIPI	Research Institute of Petroleum Industry
RTD	Resistance temperature detector
SCF	Standard cubic feet
SI	International System of Units
SINOPEC	SINOPEC PETROLEUM ENGINEERING CORPORATION

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1.0 INTRODUCTION

1.1 Scope of Document

This specification defines the minimum requirements for the material selection, design, manufacture, installation and testing of motors.

All requirements about packing, transportation or debugging are shown in relevant technical specifications in-detail.

1.2 Definitions

CLIENT	BANGLADESH GAS FIELDS COMPANY LIMITED
COMPANY	ZICOM(ZICOM EQUIPMENT PTE LTD)& SINOPEC (SINOPEC PETROLEUM ENGINEERING CORPORATION)
CONTRACOR	The firm/corporation with whom the COMPANY has entered into an agreement for the WORK, which can be a VENDOR or a BIDDER (as the case may be).
SUB-CONTRACTOR	The firm/corporation to which the CONTRACTOR may in turn sub-contract part of the WORK subject to prior approval of the COMPANY.
WORK	All temporary and permanent work described in CONTRACT and specifications.
VENDOR/BIDDER	The organisation awarded a Purchase Order/Contract for supply of materials, equipment or service required for the WORK.
MANUFACTURER	VENDOR/BIDDER should be supply all the equipment
WILL	Used in conjunction with an action
SHALL	Mandatory requirement

1.3 Language and Units of Measurement

All documentation exchanged on this Project shall be in the English language. Units of measurement shall in general follow SI practise. However, there are recognised exceptions and preferred units that are used in the Oil and Gas Industry. The applicable units of measurement are shown in Table 1-1 below.






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Table 1-1 Units of Measurement

Parameter	Units	Abbreviation
Area	Square meters , Square millimeters	m ² , mm ²
Current	Ampere, Kilo Ampere	A, kA
Length	Meter	m
Pipe / Tubing Diameter	Inches, millimeter	Inch, mm
Power	kilo Watt, kilo Volt Ampere	kW, kVA,
Thickness	Inch	Inch
Thickness	Inch , millimeter	Inch, mm
Voltage	Volts, Kilo Volts	V, kV
Current	Ampere, Kilo Ampere	A, kA

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2.0 CODES, STANDARDS AND REGULATIONS

2.1 General

The motor shall be designed, manufactured, inspected and tested in accordance with the requirements of this specification, the data sheets, the referenced project documents and other documents referenced therein. The latest revisions available at the date of issue of the enquiry shall apply.

The Codes, Standards and Regulations which follow are the industry codes and standards normally referenced for this type of equipment. All equipment supplied shall conform to all relevant national regulations and local codes and regulations.



The VENDOR/BIDDER shall obtain his own copies of the Codes, Standards and Regulations referenced herein. Failure to do so does not relieve the VENDOR/BIDDER of his obligation to offer equipment and materials in accordance with the Requisition and its attachments.

Where “in-house” standards have either been developed or are based on recognized National, International or industry standards these may be offered as an alternative, provided adequate detail is contained within the VENDOR/BIDDER's bid.

Compliance by the VENDOR/BIDDER with the provisions of this Specification does not relieve him of his responsibility to furnish equipment and accessories of a proper mechanical design suitable for the specified service conditions and/or local codes governing health and safety.




2.2 International Codes, Standards and Regulations

- IEC 60034-1 : Rotating Electrical Machines Rating and Performance
- IEC 60034-2 : Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests
- IEC 60034-5 : Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP Code)
- IEC 60034-6 : Methods of Cooling (IC Code)
- IEC 60034-7 : Classification of Types of Construction, Mounting Arrangements and Terminal Box Position (IM Code)
- IEC 60034-8 : Terminal Markings and Direction of Rotation
- IEC 60034-9 : Noise Limits
- IEC 60034-12 : Starting Performance of Single-Speed Three-Phase Cage Induction

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Motors for Voltages Up to and Including 660V

- IEC 60034-14 : Mechanical Vibration of Certain Machines with Shaft Heights 56 mm and Higher. Measurement, Evaluation and Limits of Vibration
- IEC 60034-15 : Impulse Voltage Withstand Levels of Rotating A.C Machines with Form-Wound Stator Coils
- IEC 60034-18 : Functional Evaluation of Insulation Systems for Rotating Electrical Machines
- IEC 60044-1 : Current Transformers
- IEC 60072-1 : Dimensions and Output Series for Rotating Electrical Machines Part 1: Frame Numbers 56 to 400 and Flange Numbers 55 to 1080
- IEC 60072-2 : Dimensions and Output Series for Rotating Electrical Machines Part 2: Frame Numbers 355 to 1000 and Flange Numbers 1180 to 2360
- IEC 60751 : Industrial platinum resistance thermometers and platinum temperature sensors
- IEC 60079-0 : Electrical Apparatus for Explosive Gas Atmospheres, General Requirements
- IEC 60079-1 : Electrical Apparatus for Explosive Gas Atmospheres, Flameproof Enclosures “d”
- IEC 60079-4 : Electrical Apparatus for Explosive Gas Atmospheres, Method of Test for ignition temperature
- IEC 60079-7 : Electrical Apparatus for Explosive Gas Atmospheres, type of Protection “e”
- IEC 60079-10 : Electrical Apparatus for Explosive Gas Atmospheres, Classification of Hazardous Areas
- IEC 60079-15 : Electrical Apparatus for Explosive Gas Atmospheres, Type of Protection “n”
- IEC 60085 : Thermal Evaluation and Classification of Electrical Insulation
- IEC 60423 : Conduits for Electrical Purposes-Outside Diameters of Conduits for Electrical Installations and Threads for Conduits and Fittings
- IEC 60445 : Identification of Equipment Terminals

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- API RP505 : Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as class 1, zone 0, zone 1 and zone 2
- API 670 : Vibration, Axial Position, and Bearing Temperature Monitoring Systems
- ISO 115 : Rolling Bearings-Radial Bearings-Boundary Dimensions- General Plan
- ISO 1132 : Rolling Bearings-Tolerances-Definitions

2.3 Order of Precedence

In case of conflict, the following order of precedence shall apply:



- i) IEC Regulations, Codes and Standards
- ii) This Specification
- iii) Other Referenced Project Specifications
- iv) Other International Codes, Standards and Regulations.

In the event of any conflicts or doubt refer to COMPANY.

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3.0 ENVIRONMENTAL CONDITIONS

The climate at the project area is defined as tropical monsoon, with three main seasons: Summer/Pre-monsoon is hot and dry, interrupted by cyclonic storm accompanied by heavy rainfall. The rainy season is hot and humid having about 90 percent of the annual rainfall. The winter season is predominantly cool and dry.

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4.0 GENERAL REQUIREMENTS

4.1 Voltages and Output Ratings

The voltage of the motors shall be selected based on the kW rating of the motor.

- 400V ac, 3 phase, 50 Hz electrical power, for motors 0.4 kW to 200kW
- 230V ac, 1 phase, 50 Hz electrical power, for motors rated up to 0.4 kW

Motors shall be capable of operating continuously at rated torque at any frequency between -2% and +2% of the nominal frequency together with a voltage variation of $\pm 5\%$. The nominal frequency is 50Hz.

4.2 Motor Application

Motors will generally be used to drive pumps, compressors, blowers, agitators and other constant speed equipment.

The type of driven load and the torque requirement will be specified in request for quotation and/or data sheet. Motor shall satisfy the speed torque requirement of the driven equipment over its entire starting and operating range.

4.3 Motor Sizing

Frame sizes and dimensions of the motors shall be in accordance with IEC 60072-1 and/or IEC60072-2.

Motors shall be sized, taking into consideration the appropriate multiplying factor/s related to each type and size of the driven equipment. The size of the motors versus the driven equipment shall be according to the recommendations of the driven equipment specifications.

Unless otherwise indicated in data sheet/s the duty of the motor shall be duty type S1, continuous running duty, as defined in IEC 60034-1.



4.4 Motor Starting

Unless otherwise specified in data sheet, motors shall be suitable for Direct-On-Line Starting.

The starting performance and pull up torque of the LV motor shall be in accordance with IEC 60034-12.

At any voltage between 80% and 100% rated voltage, motors shall be capable of:

- Three successive starts with the motor initially at maximum ambient temperature

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- Two successive starts with the motor initially at full load operating temperature

Motors shall be able to overcome starting load inertia as well as accelerating the load to rated speed, when the applied voltage is 80% of the nominal voltage.

In case of power interruption during operation, the motor may be reconnected to the supply voltage at any time. The residual voltage magnitude and phase angle shall not have any detrimental effect on the motor.

4.5 Vibration

Vibration level of the motors shall conform to the requirements of IEC 60034-14.

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5.0 CONSTRUCTION REQUIREMENTS

5.1 Enclosure

The motor enclosure shall be suitable for the site climatic condition indicated in article 3.0.

LV motor frame, fan cover and bearing end shields shall be made of steel sheet or cast iron.

Aluminium frame is acceptable for motor sizes up to and including 7.5 kW for indoor use in non hazardous areas only. No aluminium frame is acceptable for installation in hazardous areas.

Bolts and screws shall be made of corrosion resistant material.

The degree of protection of motors and auxiliaries shall be at least IP 54 according to IEC 60034-5. The degree of protection of terminal box and bearing housings shall be IP 55.

In hazardous areas classified as zone 0 no electrical motor shall be installed.

In hazardous areas classified as zone 1 the motors shall be Exd according to IEC 60079-1. The gas group classification of Exd motors shall be at least group IIB if not indicated otherwise in data sheet. The temperature class of Exd motors shall be suitable for the appropriate gas in the subject area and shall in no case be more than 135 °C (T4).




In hazardous areas classified as zone 2 the motors shall be Exd type according to IEC 60079-7. The temperature class of Exd motors shall be suitable for the appropriate gas in the subject area and shall in no case be more than 135 °C (T4). The IEC designation for such motor is (Exd IIBT4).

Motors shall be designed to prevent the accumulation of moisture within the enclosure.

Vertical motors with downward drive end shaft shall be provided with a rain cowl over the air inlets to prevent water entry into the motor. Precautions shall be taken to preclude water ingress through mechanical gaps.

Vertical motors with upward drive end shaft shall be provided with flinger rings on the motor shaft to prevent water ingress along the shaft of the motor under running and stop condition.

A minimum of two M12 threading grounding/earthing bosses shall be provided on the motor frame for connection to the earthing cable, they shall be diagonally opposite.

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Where terminal boxes gland plates are called for on the motor data sheets, they shall be bonded to the main motor enclosure.

Motors shall have jacking bolts to lift the motor in order to facilitate the alignment of the motor with the driven equipment.

5.2 Windings

All windings shall be adequately supported, braced and wedged to limit coil and end winding vibration and subsequent cracking of the winding insulation.

Windings shall be able to withstand the dynamic forces which result from frequent starting and from re-starting against full opposite residual voltage.

Stator windings - LV motors

- Stator windings shall be made of high quality enamelled copper wire with suitable insulation specified in article 4.3.
- The windings shall have their six leads accessible in the terminal box to allow star or delta connection. Windings shall be connected in delta at the MANUFACTURER's work.

5.3 Insulation

Insulation materials shall be class F as defined in IEC 60034-18. The rating of motor shall be based on class B temperature rise for all parts of the motor.

All insulated windings shall be non-hygroscopic, oil resistant and the materials shall be resistant to flame propagation. Insulation shall comply with the requirements of IEC 60085.

Stator windings of LV motors shall be full insulated for an unearthed system.




5.4 Bearing and Lubrication

Bearings can be grease lubricated rolling element type (ball and/or roller bearing) or oil lubricated sleeve bearing type as proposed by the motor MANUFACTURER.

Low voltage motor bearings shall be re-greasable. Pre-lubricated bearings can only be used for motors up to and including 7.5kW.

The lubricating intervals, quantity and type of grease and/or oil shall be indicated on the motor nameplate or on an additional plate fixed on the motor frame.

Grease lubricated bearings shall have grease relief devices which ensures that the old grease will be forced out of the bearing when new grease is added. Re-lubrication shall be possible with the motor in operation without dismantling parts.

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The grease lubricated bearings shall be supplied with inside end caps to prevent grease from migrating into the motor.

Grease lubricated bearings shall be packed with grease before the motor is dispatched.

The sleeve bearings shall be of spherical seated, self aligning type.

The sleeve bearings housing design shall permit the replacement of bearing liners without disassembly of couplings or other machine parts.

Suitable lube oil system for sleeve bearings shall be provided by the motor MANUFACTURER. When common lube oil system is to be adopted, the driven equipment MANUFACTURER shall be responsible to supply the common lube oil system, based on the lubrication requirement of the motor.

5.5 Rotor

The rotor core shall be made of high quality annealed insulated steel laminations.

The shaft shall be made of one piece heat treated steel.

The rotor shall be dynamically balanced at nominal speed with half the key fitted in the key way.

The rotor and internal fan(s) if fitted, shall be dynamically balanced with the key way(s) fully fitted with half key(s). The deviation shall not exceed 2.5gm/cm.

Shaft ends shall be provided with threaded holes to facilitate the assembly or removal of couplings and bearing etc.

Shaft extension shall be in accordance with IEC 60072-1 and IEC 60072-2. The design of the shaft end and coupling shall be in accordance with the instruction of the driven equipment MANUFACTURER.

Rotor-LV motors




- The rotor cage shall be copper or pressure die cast aluminium
- Balancing weights if fitted shall not be lead or similar ductile material. The rotor design shall allow the addition of balancing weights.

5.6 Rotor

Cooling fan/s shall be made of non-sparking anti-static material.

Metallic fans made of aluminium, cast iron or steel is preferred.

The external fan shall force the cooling air in the direction of the driving end.

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Bidirectional fan is preferable. For motors fitted with unidirectional fans, a permanent arrow shall indicate the direction of rotation. It shall not be possible to assemble the unidirectional fan on the shaft of the motor incorrectly.

5.7 Terminal Box

The degree of protection of terminal boxes shall be at least IP55. The design of the terminal boxes shall be such as to prevent small objects from dropping into the motor housing.

The main power terminal box and star point terminal box shall withstand the effects of short circuits inside the terminal boxes without being damaged and without emission of flame. The short circuit capability of the terminal boxes shall be as per IEC recommendations.

Terminal boxes for Ex motors shall be with the same protection degree as the motor itself (Exd IIB T4 for Exd motors).

Terminal boxes shall have ISO metric threaded entry as per IEC 60423, complete with threaded plug (including cable glands).

Means shall be included in the terminal boxes to prevent slackening of connections due to vibration.

In hazardous areas where motor purging is required, air will be the purge medium.



Inside the main power terminal box an earthing terminal shall be provided for earthing the cable shields. Such terminal shall be clearly marked with earthing symbol.

The phase sequence associated with the direction of rotation of the motor shall be clearly indicated on the motor terminals. Terminal markings shall be made in a clear and permanent manner according to IEC 60034-8. Unless otherwise specified, the main power terminal box shall be positioned on the right hand side of the motor enclosure when looking at or facing the driving end. The cable/s to the main terminal box will rise from the floor. Other positions of main power terminal box shall be agreed by COMPANY representative prior to manufacturing.

The additional connections to the motor shall be terminated in boxes separate from the main terminal box.

Terminal Box-LV motors

- Motor terminal box/s including removable covers shall be made of steel sheet or cast iron. Aluminium terminal boxes are acceptable for motors up to and including 7.5 kW rating with aluminium enclosure.

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- Terminal boxes shall be sized to have enough space for cable/s connections. The sizes of the power cable/s are indicated in data sheet.

5.8 Nameplate




Each motor shall be provided with nameplate/s securely fixed to the non-removable part of the motor frame.

The nameplate/s shall be made of stainless steel.

All nameplates shall be dual language in English.




Nameplates shall be durably marked with the items specified in IEC 60034-1 as far as they apply, and shall also include the following items. The items need not all be on the same plate.

- maximum ambient air temperature
- class of insulation
- degree of protection IP code of the motor enclosure, terminal box and auxiliary devices
- type and size of bearings
- type of lubricant, lubricating intervals and required oil pressure for force lubricated bearings
- explosion protection type of the machine, terminal box and auxiliary devices in accordance with the recommendations of IEC 60079 series
- gas group and temperature group of the motor in accordance with IEC 60079 series.

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6.0 TESTS AND INSPECTION



- Type tests and routine tests shall be carried out according to the recommendations of IEC 60034-1 and the relevant IEC publications referred to therein. The final performance test shall include at least the following:
- Insulation resistance test on windings, heaters, temperature detectors and bearing insulations
- Measurement of winding resistance (cold)
- Measurement of winding resistance (hot)
- Bearing temperature rise
- No load current
- Current unbalance at full load
- Locked rotor current
- Locked rotor torque
- Torque speed curve
- No load losses
- Direction of rotation
- Slip and nominal speed and full load
- Vibration severity
- Noise test
- Bearings inspection

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7.0 SPARE PARTS

Together with the supply of motors under this specification, a complete set of spare parts for commissioning shall be supplied for each motor. The supplied spare parts shall comply with the same specifications as the original parts and shall be fully interchangeable with the original parts without any modification. Spare parts shall be preserved to prevent deterioration during transport and storage in a humid tropical atmosphere.

The vendor shall also supply a list of recommended spare parts for two years of operation.

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8.0 DOCUMENTATION




The vendor shall supply the necessary information with the quotation to enable evaluation of the submitted proposal. General documents/drawings are not acceptable unless they are revised to show the equipment proposed.

The documents to be supplied with the quotation shall at least include the following:

- a) Completed enquiry data sheet/s.
- b) Summary of exceptions/deviations to this standard specification.
- c) Brochures and catalogues containing description of typical motors.
- d) Torque-speed curves.
- e) Preliminary dimensional drawings.
- f) Approximate shipping weights and sizes.
- g) Copies of relevant certification documents.
- h) Induction motor thermal limit characteristic.
- i) Time-current and thermal limit curve.
- j) Induction starting characteristic.
- k) Induction running performance.

The documents which shall be supplied together with the equipment shall at least include the following:

- a) Updated and completed enquiry data sheet/s.
- b) General arrangement drawings showing main dimensions, arrangement of components and terminal boxes, jacking points, and cable entry positions.
- c) Windings connection diagrams.
- d) Junction box connection diagrams for RTD's.
- e) List of components, showing complete reordering information for all replaceable parts.
- f) Bearing arrangement drawing with bearing replacement procedure.
- g) Installation, operation and maintenance instruction/s.
- h) Recommended spare parts list for two years of operation.

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i) Test reports for type tests and routine tests.

j) Certificates of conformity for Exd type motors.

9.0 SHIPMENT

The supplier of the equipment under this specification is the sole responsible for packaging and preparation for shipment.

The packaging and preparation for shipment shall be adequate to avoid mechanical damage during transport and handling.

Motors shall be shipped with bearing lubricated.

Rotors shall be locked during shipping to avoid damage to the bearings.




Depending on motor size and weight, motors shall be securely fastened to a hardwood skid or pallet suitable for fork truck handling, and shall be covered for protection against dirt and moisture during transport and outdoor storage.

Open cable entries on motor terminal box shall be adequately sealed before the motor is dispatched from the manufacturer's works.

Each motor package/container shall be provided with permanently attached identification tag containing necessary information together with the motor identification number.

Silica gel or similar dehydrating compound shall be enclosed in each motor package/container.

Shipping documents with exact description of equipment for custom release shall be supplied, with the equipment.

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10.0 GUARANTEE

The supplier of the equipment under this specification shall guarantee the equipment and shall replace any damaged equipment/parts resulting from poor workmanship and/or faulty design.

The supplier shall replace any equipment/part failed under the following condition:

- Failure under startup and commissioning tests performed according to IEC recommendations.
- Failure under normal usage for a period of 12 months, not exceeding 18 months from the date of dispatch from the manufacturers works.