



TECHNICAL SPECIFICATION FOR
AC SYSTEM
(ELECTRICAL PORTION)

SPECIFICATION NO. PE-TS-
VOLUME II B
SECTION-C
REV 00 DATE 28.05.12
PAGE 1 OF 1

ELECTRICAL EQUIPMENT SPECIFICATION FOR AC SYSTEM

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC loads required for the system at different voltage levels (eg. 400V AC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3& 4.4 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for **AC System** and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical Scope Matrix between BHEL & vendor (Annexure-I).
- 4.2 Technical specification and Data Sheets for 400V Electric Motors.
- 4.3 Technical Specification for Power, Control, Instrumentation Control Cable & Miscellaneous electrical item
- 4.4 Quality Plan for motors.
- 4.5 Load data format (Annexure-II).

ANNEXURE-I
ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: MARIB 400MW GTPS PROJECT, PHASE-II

PACKAGE: AC SYSTEM

<u>S.N O</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	400V MCC	BHEL	BHEL	BHEL will provide 400V, 3-phase 4-wire supply. Any other voltage level (AC/DC) required will be derived by the vendor. Any other local panels if required shall be in vendor scope.
2	Local push button station (for motors)	BHEL	BHEL	Located near the motor
3	Power cables, ordinary control cables and screened control cables between equipments supplied by vendor.	Vendor	BHEL	
4.	Power cables, ordinary control cables and screened control cables between equipments supplied by vendor & BHEL.	BHEL	BHEL	
5	Any special type of cable like compensating. Co-axial, prefab, MICC and fibre optical	Vendor	Vendor	
6	Illumination	BHEL	BHEL	
7	Cabling material (cable trays, accessories and cable tray-supporting system etc.)	BHEL	BHEL	
8	Marshalling Boxes/Junction Boxes for Power, control, instrumentation and special cable	Vendor	BHEL	
9	Conduits and conduit accessories for cabling between equipments by vendor	Vendor	BHEL	
10	Equipment earthing.	BHEL	BHEL	Arrangement at equipment end for earthing connection to be ensured by vendor.
10	Motors with Base frame and fixing hardware for motors.	Vendor	BHEL	
11	a) Input cable schedules b) Cable interconnection details. c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for control cables for vendor-supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor.
12	Equipment layout drawings.	Vendor	-	Layout details between vendor supplied equipment and installation drawings by vendor
13	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands (suitable for selected cable size). 2. Solder less crimping type heavy duty tinned copper lugs (suitable for selected cable size).

Note:-

1. Make of all electrical equipments/ items supplied shall be of reputed make & shall be subject to approval of BHEL/ Customer after award of contract.
2. All QPs shall be subject to approval of BHEL/ Customer after award of contract.
3. Soft Copy of Cable Schedule in the Cable Schedule Format Shall Be Furnished By Vendor After Award of Contract.

400 MW MARIB GTPS PHASE-II, YEMEN

PROJECT INFORMATION-REV00

1.	Owner	PUBLIC ELECTRICITY CORPORATION, MINISTRY OF ELECTRICITY AND ENERGY , REPUBLIC OF YEMEN
2.	Project	400 MW MARIB GTPS PHASE-II
3.	Owner's consultant	The Kuljian corporation , Philadelphia , USA
4.	Location	Marib , Yemen
5.	Nearest Airport	El Rahaba Airport (SAH), Sana'a, Yemen
6.	Nearest Railway Station	No rail network in Yemen
7.	Access to site	<p>a. <u>Through sea</u>:</p> <ul style="list-style-type: none">Distance of site: From Aden Port (Gulf of Aden): 419 Km <p>b. <u>By Air</u> : Sana'a Airport</p> <ul style="list-style-type: none">Distance from site : 172 Km
8.	Site data	
A	Altitude	1100 m above Mean Sea Level
B	Ambient Air Temperature	45 °C

	1. Design Minimum Temp.	-----
C	RELATIVE HUMIDITY	
	Design Relative Humidity	60%
D	RAINFALL	
1.	Average Rainfall per annum	< 100 mm
E	WIND VELOCITY & PRESSURE	
1.	Max. Design Wind Velocity	120 km/h
2.	Max. Barometric Pressure Barometric Pressure at sea level	1023.6 mbar 887.7 mbar
F	SEISMIC ZONE	UBC 1997,Zone-2 A
9.0		
A	Design Ambient temperature for Gas Turbine & Mechanical equipment	45 °C
B	Design Ambient temperature of electrical equipment	50 °C
10.0	Electrical Details	Refer attached Anx-I

Electrical Power Sources and Equipment Voltage Rating

ANX-I

- i. 400,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- ii. 33,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
- iii. 6600±10% volts, 3-phase, 50 Hz, low resistance grounded system.
- iv. 400±10% volts, 3-phase, 50 Hz, solidly grounded system
- v. 230±10% volts, 1-phase, 50 Hz, (PH/N of 400 volt) for lighting, receptacles and small power
- vi. AC 230 ± 5% volts, 50 Hz, 1-phase, for instrumentation and controls.
- vii. 220V / 125 / 24 / 48V (+) 10% to (-) 15% volts (DC), ungrounded system

Electric Equipment Voltage Rating

AC Equipment Voltage Rating

- | | | | |
|------|--------------------------------------|---|---------------------|
| i. | Motors larger than 250 kW | : | 6.6 KV, 3-ph, 50 Hz |
| ii. | Motors less than and equal to 250 kW | : | 400V, 3-ph, 50 Hz |
| iii. | Lighting with associated equipment | : | 230V, 1-ph, 50 Hz |
| iv. | MOV motors | : | 400V, 3-ph, 50 Hz |

Frequency : 50 Hz ± 5%

Fault Level

- | | | | |
|------|----------------------|---|---|
| i. | 400,000 volts system | : | 31.5KA for 3 sec. (In line with Phase - I) |
| ii. | 33,000 volts system | : | 31 kA for 3 sec. (In line with Phase - I) |
| iii. | 6600 volts system | : | 25 kA for 3 sec. (In line with Phase - I) |
| iv. | 400 volts system | : | Min. 50 kA for 1 sec. in line with Phase-I to be uprated based on calculation to be submitted for Phase - II. |
| v. | DC system | : | By Bidder for 1 sec. |

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REPUBLIC OF YEMEN PEC – ME .400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.8
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8.8	ELECTRIC MOTORS AND ACTUATORS
8.8.1	General <p>This specification covers the design, manufacture, supply, erection, testing and commissioning of Motors for various driven equipment and Actuators.</p> <p>It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.</p> <p>Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.</p>
8.8.2	Scope of work <p>The scope of work shall include but not limited to the following:</p> <ul style="list-style-type: none">- AC & DC Motors required for various application- Actuators required for various applications.- List of recommended spare parts as per Section-10.0, Vol.-II.- Commissioning spares.
8.8.3	Technical Requirements <p>Motors shall confirm to IEC and other applicable international standards amended upto date. Equivalent ANSI standards are also acceptable.</p>
8.8.3.1	Motors <p>Design Features</p> <p>All AC motors shall be squirrel cage three phase/ single phase induction motors. Lifts/Crane motors may be of slip ring type. DC motor shall generally be of shunt wound type rated for 220 V DC. DC motors shall be sized for operation with fixed resistance starter for maximum reliability. DC motors under GTG package may be rated for 220V DC. All motors shall be rated for continuous duty. Crane motors shall be rated for intermittent duty.</p> <p>Inching type motors as per the requirement shall be provided.</p> <p>The motor rating shall be at least 15% (service factor) over the maximum input power requirement of the driven equipment at rated point.</p> <p>Continuously operating motors shall be of high efficiency type.</p> <p>Power supply for AC motors shall be as follows:</p> <ul style="list-style-type: none">- Motors less than and equal to : 400 V, 3 Phase, 50 Hz solidly grounded system 250 kW- Motors larger than 250 kW : 6.6kV, 3 Phase, 50 Hz. resistance grounded system

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Motors shall be capable of delivering the rated output with supply voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ and absolute sum of 10% .

The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, breakdown and full load torques are available for the intended service.

Squirrel cage induction motors shall be designed for direct on line starting Starting current shall not exceed 600% of full load current with 20% tolerance for ratings upto and including 1000 kW . For motors rated above 1000 kW , starting current shall be limited to 600% of full load current without any tolerance.

The starting current of 220V motors shall be restricted to 200% of full load current whereas for 125V motors, the same shall be restricted to 160% .

The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. Motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Permissible number of starts per hour for continuous duty motors shall be as follows.

Starts	No. of Starts
No. of hourly startups uniformly distributed, starting from final steady working temperature (Hot)	3
No. of consecutive startups with initial temperature of motor at final steady working temperature (Hot)	2

Motors subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energised shaft rotating at 125% of rated speed in reverse direction.

The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors with 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time. Starting time shall be at the minimum permissible voltage of 80% rated voltage. If the above conditions cannot be met in unavoidable cases, special provisions such as motor shaft speed switch, etc. shall be provided. Hot thermal withstand curve shall have 3 margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

The motor shall be designed to withstand any torsional and / or high current stresses which may result during bus transfer, without experiencing any deterioration in the normal life & performance characteristics.

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8.8.3.2 Constructional details

Enclosure

Motors located indoor shall have IP 44 degree of protection and those located outdoor shall have IPW 55 degree of protection for the enclosure. For hazardous areas, approved type of flameproof and increased safety enclosure shall be provided.

The motors shall generally be of self ventilated type totally enclosed fan cooled (TEFC). Alternatively for large motors, closed air Circuit Air Cooled (CACA) System shall be adopted.

Winding and Insulation

The winding for all the motors shall be of super enameled copper wire of suitable gauge or copper strip conductor depending on its rating. All motors shall be class F insulated limiting temperature rise to class B limit.

The windings, fittings and hardware shall be corrosion resistant. The windings shall be tropicalised and shall be impregnated to make them non-hygroscopic and oil resistant.

Main insulation and inter turn insulation of Motors shall be capable of withstanding switching surges as per IEC 34, Part 15.

Motors of rating 37 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated for 230 V, single phase, 50 Hz, and sized to maintain the motor internal temperature above dew point when the motor is idle.

All HT motors shall be provided with six (6) duplex type winding temperature detectors, two (2) per phase and the motor bearing shall be provided with 2 Nos. duplex type temperature detectors on driving end and non driving end. These temperature detectors shall be resistance type, 3 wire, platinum wound, 100 ohms at 0°C. The temperature detectors shall be connected to the DCS system.

Bearings

Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type are preferred.

Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

Provide one pt-100 RTD or chromed – constant type E thermocouple, temperature measurement thermocouples, on bearing or oil reservoir associated with an anti-friction on thrust bearing.

Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types.

Bearings shall be insulated as required to prevent shaft current and resultant bearing damage for a motor rating of above 1000 kW.

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In case forced lubrication is adopted, a shaft driven oil pump shall be provided along with an electrical auxiliary pump. Alternatively, two motor driven pumps may be provided, one working and one standby. All necessary auxiliaries and accessories shall be provided to complete the system. A pressure gauge and pressure switch for low oil pressure warning and to start the standby oil pump automatically shall also be provided. A motor driven jacking oil pump may be provided, for heavy shaft loads.

Indicator/Switch

Dial type local indicator with alarm contacts shall be provided for the following:

- HT motor bearing temperature
- Hot and cold air temperatures of the closed air circuit for CACA motors.

Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V D.C. and 5A at 230 V A.C.

Motor Terminal Box

Motor terminal boxes shall be provided with a detachable extension box (cable core splitter box). Terminal box shall be capable of being turned 360° in steps of 90°, unless otherwise approved. The terminal boxes shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. The terminal box shall have sufficient space inside for termination/connection of cables.

Terminals shall be of stud type, substantially constructed and thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. The terminal box shall be capable of withstanding maximum system fault current for 0.2 sec for all breaker operated motors and shall be provided with explosion vent. However for contactor operated motors, the terminal box shall be capable of withstanding the fault current for let through time of the fuse preceding it.

For 6600 V motor (if required), the terminal box shall be phase segregated type and neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection. For motors for 1000 kW and above, PS class current transformers shall be provided in the neutral side terminal box on all three connections for differential relay.

All accessory equipment such as space heater temperature detector, etc., shall be wired and terminated in a enclosure, separate from motor (power) terminal box. The degree of protection for accessory terminal box shall be same as that of motor. Terminal box shall be complete with double compression brass glands and stud type terminals and shall be suitably mounted on the side of the motor. If possible, the accessory terminal boxes shall be located on the same side of the motor as the main (power) terminal box.

Earthing Terminals

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

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The cable terminal box shall have a separate grounding terminal.

Noise & Vibration

The noise level and vibration limits shall not exceed the limits specified in relevant ANSI / IEEE / IEC standards.

Rating Plate

The motors shall be provided with a rating plate of stainless steel.

In addition to the minimum information required by IEC, the following information shall be shown on motor rating plate:

- Temperature rise in °C under rated condition & method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

Lifting

All electric motors shall be provided with lifting lugs.

8.8.4 DRAWINGS, DATA & MANUALS

To be submitted with the Bid.

List of electric motor actuators

Type test certificates on similar equipment

To be furnished for Approval and Distribution. (After award of contract)

Actuator data sheet

Internal wiring diagram

Torque switch and limit switch contact development.

Manufacturer's catalogue.

Any other relevant drawings, documents, or data necessary for satisfactory installation, operation and manufacturing.

Instruction Manuals for Actuators

The manuals shall clearly indicate method of installation, check-ups and tests to be carried out before commissioning of the equipment.

The Bidder may note that the drawings, data and manuals listed are herein minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves, calculations and information required to fully describe the equipment are submitted with his bid.

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8.8.5 Specified Design Data

SECTION : ELECTRIC MOTORS & ACTUATORS		
8.8.5.1 AC Motors		
Rated Voltage		
Less than and equal to 250 kW	V	400
Larger than 250 kW	V	6600 V
Rated Frequency	Hz	50
Voltage variation		±10%
Frequency Variation		±5%
Absolute sum of variation		10%
Rated Voltage for DC Motors	V	220 V ±10% to -15% (125 +10% to -15% if GTG supplier's standard)
Class of Insulation for all Motors		Class 'F' with temperature Limited to Class 'B'
Starting Current		6 times FLC.
Degree of protection		IP 44/IP W 55
Method of cooling		TEFC/CACA
Fault withstand capability of terminal box		Fault current for 0.2 sec. for breaker controlled motors
No. of consecutive hot starts with initial temperature of motor at final steady working temperature		Two
No.of hourly starts uniformly distributed from final temperature		Three (3)

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8.8.6 Technical Data by the Tenderer

SECTION : ELECTRIC MOTORS & ACTUATORS

8.8.6.1 MOTORS (Bidder to fill data for each type and rating of motor)

General

* Application

-

* Quantity

Nos

* Make & Country

-

Frame size

-

Applicable standard

-

Type of motor

-

* Service

-

* Rating

kW

Duty cycle/ designation

-

Rated continuous output at max. ambient

kW

Rated speed

rpm

* Rated voltage and Voltage variation range

V
%

* Rated frequency and Frequency variation range

Hz
%

Full load current

A

No load current

A

Rated power factor

-

Efficiency at rated voltage and frequency

Full load

%

Three quarter

50% load

%

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Method of starting	-	
Starting current at rated voltage (as % of full load current)	%	
Starting current at 80% of rated voltage (as % of full load current)	%	
Starting torque (as % of full load torque)	%	
Time to attain full speed		
- with load	s	
- without load	s	
Locked rotor withstand time		
- from cold	s	
- from hot	s	
* Degree of protection of enclosure		
Method of cooling	-	
* Insulation class	-	
* Temperature rise over max. ambient	°C	
No. of hot starts		
Winding connection	-	
Bearing	-	
Make	-	
Type	-	
Recommended lubricant	-	
Motor Terminal Box		
Type	-	
Fault with-stand current and time	kA, s	
Number of grounding pads provided		
- On motor body	-	
- On terminal box	-	
Type of mounting	-	


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Overall dimensions		
Length	mm	
Breadth	mm	
Height	mm	
Weight		
Stator	kg	
Rotor	kg	
Total	kg	
Moment of inertia		
Stator	kg.sq.m	
Rotor	kg.sq.m	
Total	kg.sq.m	
Dynamic load and foundation	-	
Drawings furnished	Yes/No	
General arrangements	Yes/No	
Terminal box details	Yes/No	
Torque vs speed (at 100% rated voltage, at 80% rated voltage at 110% rated voltage) with the driven equipment torque speed curve super imposed.	Yes/No	
Thermal withstand curves (hot & cold)	Yes/No	
Locked rotor curves (hot & cold)	Yes/No	
Starting characteristics (at 80% rated voltage and at 100% rated voltage.	Yes/No	
Performance curves (output vs efficiency, output vs current output vs slip	Yes/No	
10% margin considered for motor rating above the rated shaft power requirement.	Yes/No	
15% margin considered for BFP and GBC motor	Yes/No	


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		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
		SHEET 1 OF 2		BIDDER/ VENDOR :		TITLE			NUMBER :			
				SYSTEM		QUALITY PLAN			SPECIFICATION			
						NUMBER PED-506-00-Q-006, REV-01			TITLE			
						ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									


		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
				VENDOR			QUALITY PLAN			SPECIFICATION :		
		SHEET 2 OF 2		SYSTEM			NUMBER PED-506-00-Q-006, REV-01			TITLE :		
				ITEM AC ELECT. MOTORS BELOW 55KW (LV)						SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES:												
1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON												
2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.												
3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.												
<u>Legends for Inspection agency</u>												
1. BHEL/CUSTOMER												
2. VENDOR (MOTOR MANUFACTURER)												
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)												
P. PERFORM												
W. WITNESS												
V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


			CUSTOMER			PROJECT			SPECIFICATION		
QUALITY PLAN			BIDDER/ VENDOR			TITLE			NUMBER		
SHEET 1 OF 9			SYSTEM			QUALITY PLAN			TITLE		
NUMBER PED-506-00-Q-007, REV-03			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL										
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFRS DRG./SPEC	MANFRS DRG./SPEC	-DO-	3	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFRS DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	2	
										PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFRS DRG./SPEC	RELEVANT IS/	SUPPLIERS TC	3	2	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFRS DRG.	MANUFRS DRG.	LOG BOOK	3	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100%	MANFRS DRG./SPEC	MANFRS DRG./SPEC	LOG BOOK	3	2	
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE								
BIDDER'S/VENDORS COMPANY SEAL											


			CUSTOMER			PROJECT			SPECIFICATION		
QUALITY PLAN			BIDDER/ VENDOR			TITLE			NUMBER		
			SHEET 3 OF 9			NUMBER PED-506-00-Q-007, REV.03			TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT. SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	ITEM, AC REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	AGENCY	VOLUME III
1	2	3	4	5	6	7	8	9	10	11	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-
		2. DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG.	MANUF'S DRG.	-DO-	3	-	2
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIERS TC	3	-	2
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*
		2. ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDORS INSPN. REPORTS	3	-	2
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

		CUSTOMER :				PROJECT				SPECIFICATION		
		BIDDER/ VENDOR				TITLE				NUMBER		
		SYSTEM				QUALITY PLAN				SPECIFICATION		
SHEET 4 OF 9		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)				NUMBER PED-506-00-Q-007, REV.03				TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS		
1	2	3	4	5	6	7	8	9	10	11		
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUFS CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
		1.11	SUP RING (WHEREVER APPLICABLE)	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUFS DRG	MANUFS DRG	-DO-	3	-	-	
		3.TEMP.WITH- STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUFS SPEC./ BHEL SPEC.	MANUFS SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
		1.12	OIL SEALS & GASKETS	MA	VISUAL	100%	MANUFS DRG/SPECS	MANUFS DRG./ SPECS.	-DO-	3	-	-
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUFS DRG	MANUFS DRG	-DO-	3	-	-	
		BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME										
		SIGNATURE										
		DATE										
BIDDER/S/VENDORS COMPANY SEAL												

		QUALITY PLAN			CUSTOMER		PROJECT		SPECIFICATION :														
				BIDDER/ VENDOR		TITLE		NUMBER		TITLE													
				SYSTEM		NUMBER PED-506-00-Q-007, REV-03		SECTION		VOLUME III													
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		ACCEPTANCE		AGENCY		REMARKS													
SHEET 5 OF 9		CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		NORM		FORMAT OF RECORD		P		W		V			
SL. NO.		COMPONENT/OPERATION		CHECK		4		5		6		7		8		9		10		11			
1		2		3																			
2.0		IN PROCESS																					
2.1		STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)		1.WORKMANSHIP & CLEANNESS		MA		VISUAL		100%		-DO-		GOOD FINISH		LOG BOOK		3/2		2		-	
				2.DIMENSIONS		MA		MEASUREMENT		-DO-		MANUF'S DRG		MANUF'S DRG		-DO-		2		-		-	
2.2		MACHINING		1.FINISH		MA		VISUAL		100%		-DO-		GOOD FINISH		LOG BOOK		2		-		-	
				2.DIMENSIONS		MA		MEASUREMENT		-DO-		MANUF'S DRG		MANUF'S DRG		-DO-		2		-		-	
				3.SHAFT SURFACE FLOWS		MA		PT		-DO-		RELEVANT SPEC./ ASTM-E165		MANUF'S SPEC./ BHEL SPEC./		-DO-		2		-		1	
2.3		PAINTING		1.SURFACE PREPARATION		MA		VISUAL		100%		MANFRS SPEC./ BHEL SPEC./ RELEVANT STAND		BHEL SPEC. SAME AS COL.7		LOG BOOK		2		-		-	
				2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)		MA		MEASUREMENT BY ELOCOMETER		SAMPLE		-DO-		-DO-		-DO-		2		-		-	
				3.SHADE		MA		VISUAL		-DO-		-DO-		-DO-		Log Book		2		-		-	
				4.ADHESION		MA		CROSS CUTTING & TAPE TEST		-DO-		-DO-		-DO-		Log Book		2		-		-	

			CUSTOMER			PROJECT			SPECIFICATION		
QUALITY PLAN			BIDDER/			TITLE			NUMBER		
			VENDOR			NUMBER PED-506-00-Q-007 REV-03			SPECIFICATION		
SHEET 6 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		
CHARACTERISTIC			CAT.			REFERENCE DOCUMENT			ACCEPTANCE NORM		
CHECK			TYPE/ METHOD OF CHECK			EXTENT OF CHECK			FORMAT OF RECORD		
			4			5			6		
			7			8			9		
			10			11					
1			2			3			4		
24			SHEET STACKING			MA			MEASUREMENT		
			1.COMPLETENESS			MA			MEASUREMENT		
			2.COMPRESSION & TIGHTENING			MA			100%		
			3.CORE LOSS & HOTSPOT			MA			ELECT. TEST		
			1.COMPLETENESS			CR			VISUAL		
			2.CLEANLINESS			CR			-DO-		
			3.IR-HV/IR			CR			ELECT. TEST		
			4.RESISTANCE			CR			-DO-		
			5.INTERTURN INSULATION			CR			-DO-		
			6.SURGE WITH STAND AND TAN DELTA TEST			CR			-DO-		
			1.VISCOSITY			MA			PHY. TEST		
			2.TEMP. PRESSURE VACCUM			MA			PROCESS CHECK		
			3.NO. OF DIPS			MA			-DO-		
			26			IMPREGNATION			MA		
			1.VISCOSITY			MA			PHY. TEST		
			2.TEMP. PRESSURE VACCUM			MA			PROCESS CHECK		
			3.NO. OF DIPS			MA			-DO-		
			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE								
			BIDDER/VENDOR								
			BIDDER/VENDORS COMPANY SEAL								

		QUALITY PLAN				CUSTOMER		PROJECT		SPECIFICATION	
SHEET 7 OF 9		BIDDER/ VENDOR		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		TITLE		NUMBER	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT. SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III	
									AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10		
									P	W	V
									11		
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA MA	-DO- VISUAL	-DO- 100%	-DO- -DO-	-DO- -DO-	Log Book Log Book	2	-	1
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR CR	-DO- MALLET TEST & UT	-DO- -DO-	-DO- -DO-	-DO- -DO-	Log Book Log Book	2	-	1
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE 2.SOUNDNESS OF DIE CASTING	MA CR CR	ELECT. TEST DYN. BALANCE ELECT. (GROWLER TEST)	-DO- -DO- -DO-	-DO- MFG SPEC./ ISO 1940 MFG. SPEC.	-DO- MFG. DWG. MFG. SPEC.	Log Book Log Book Log Book	2	1	VERIFICATION FOR MV MOTOR ONLY
2.10	ASSEMBLY	1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS	MA MA MA MA	MEAS. VISUAL MEAS. -DO-	-DO- -DO- -DO- -DO-	-DO- -DO- -DO- MFG.DRG/ MFG SPEC.	-DO- -DO- -DO- MFG. DRG/ RELEVANT IS	Log Book Log Book Log Book Log Book	2	-	-
		5.CORRECTNESS, COMPLETENESS/ TERMINATIONS/ MARKING/ COLOUR CODE 6. RTD, BTD & SPACE HEATER MOUNTING.	MA MA	VISUAL VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	1
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									

					CUSTOMER		PROJECT		SPECIFICATION			
		QUALITY PLAN			BIDDER/ VENDOR		TITLE		NUMBER :			
SHEET 9 OF 9					SYSTEM		QUALITY PLAN		SPECIFICATION			
SL. NO.		CHARACTERISTIC CHECK			CAT. TYPE/ METHOD OF CHECK		ITEM: AC ELECT MOTOR 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
							REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD	
1		2			3		4		5		6	
							7		8		9	
									10		11	
<div>NOTES:</div> <div>1. DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</div> <div>2. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.</div> <div>3. IN CASE TEST CERTIFICATES, FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.</div> <div>4. WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</div> <div><div>Legends for Inspection agency</div><div>1. BHEL/CUSTOMER</div><div>2. VENDOR (MOTOR MANUFACTURER)</div><div>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</div><div>P. PERFORM</div><div>W. WITNESS</div><div>V. VERIFY</div></div>												
<div><div>BHEL</div><div>PARTICULARS</div><div>BIDDER/VENDOR</div><div>NAME</div><div>SIGNATURE</div><div>DATE</div></div> <div>BIDDER/SVENDORS COMPANY SEAL</div>												

Project	Subject	Tender Doc. No.	Rev	Section
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-EPC-700-001	C	8.14
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				1

8.14 POWER AND CONTROL CABLES

8.14.1 General

This specification covers the design, manufacture, supply, erection, testing and commissioning of Power and Control Cables.

It is not the intent to specify completely herein all details of the equipment, nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.

8.14.2 Scope of work

The scope of work shall include but not limited to the following:

6.6 kV, XLPE unearthed grade power cables

1000 V, XLPE power cables

1000 V grade XLPE control cables

Special cables for excitation system etc.

Special cables for cranes, hoists, etc.

Heat resistant cables.

Fire proof cables

List of recommended spare parts as per Section-10.0, Vol:-II.

Commissioning spares.

8.14.3 Technical requirements

8.14.3.1 Design Features

The cables shall be suitable for laying on overhead cable trays or on cable trays in trenches. Buried cables in ground may be used for small number cable runs to outlying areas of the Plant

Cables shall be adequately sized considering

- Full load current
- Short circuit current and duration
- Voltage drop during starting & running condition
- Ambient temperature
- Grouping and installation conditions
- Soil resistivity (for buried cables)
- Earth fault current (for sizing screen and armour)
- To limit the cables to some standard sizes instead of using too many sizes.

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For breaker protected circuits minimum size will be determined by short circuit rating for a duration of 0.2 sec. for 400 V and 6.6 kV feeders.

Ambient air temperature shall be considered as 50°C. Overall derating factor for cable shall be based on the above factors.

Separate cables shall be provided for circuit of different plant and auxiliaries for different voltage levels and for circuits fused separately. Power, control and instrumentation circuits shall be taken through separate cables.

XLPE insulated cables shall be suitable for continuous conductor temperature of 90°C and short circuit withstand temperature of 250°C.

Cables installed in hot areas shall be specially designed for that ambient temperature. The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be enough to withstand mechanical stresses during handling.

Cables shall be adequately sized to take care of any derating due to fire stop cable sealing/fire resistant coating.

Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop at motor terminals during starting of motors shall be limited to 15% of the rated voltage.

Voltage drop in cable from MLDB to any lighting fixture shall not exceed 3% under steady state.

All the cables shall be FRLS type. Cable outer sheath shall have following flame retardant low smoke type (FRLS) properties.

- Oxygen index of not less than 29 when tested as per ASTM D 2863.
- Smoke density of not more than 60% when tested as per ASTM D 2843.
- Acid gas emission of not more than 20% by weight when tested as per IEC-754 I.

The cables shall meet flammability test requirement as per IEEE-383 and SS 4241475 (Category F3)

Minimum size of power cables shall not be less than 2.5 sq.mm copper. Minimum size of control cables shall be not less than 2.5 sq.mm copper and maximum no. of cores shall be limited to 19. Cables upto 7 core will have atleast 1 spare conductor, 12C and 19C cables will have atleast 2 spare conductor.

All the cables PVC shall be protected against rodent and termite attack. Necessary chemicals shall be added in to the PVC compound of the outer sheath.

All the single core cables shall be provided with non magnetic Aluminum wire armour & single round wire of galvanised steel for multicore cables.

Fire survival cables with withstand rating of 3 hours at 750°C shall be provided for emergency application such as DC emergency oil pump, turning gear, Jacking oil pump, emergency control, fire fighting, interconnection of DC battery, charger, DCDB, turbine / generator protection panel, DC emergency lighting and essential communication system.

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8.14.3.2 Constructional Features

6.6 kV cables

These Cables shall be of single core / multicore, (class – 2 as per IEC) stranded copper conductor, XLPE insulated, extruded PVC inner sheathed conforming to multicore cables and single core cables shall have no inner sheath, armoured and extruded FRLS - PVC outer sheathed.

The 6.6 kV power cables shall be of 6000 V /10000 V grade suitable for use in 6.6 kV \pm 10%, 50 Hz \pm 5%, 3 phase resistance earthed system.

The 6.6 kV cables shall be provided with both conductor and insulation screening. Insulation screen shall consist of extruded semi conducting layer as per ICEA-S – 68 –516, S-66-524 & UL-1072 and bare copper shield. The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers.

LV Power Cables

The LV power cables shall be of 1000 V grade suitable for use in 400 V \pm 10%, 3 phase, 50 Hz \pm 5%, solidly grounded system and also for 220 V DC ungrounded system.

The LV Power cables shall be of heavy duty power cables with stranded copper conductors, XLPE insulated, extruded PVC inner sheathed conforming to ST2 compound armoured and extruded FRLS – PVC outer sheathed.

Control Cables

The control cables shall be 1000 V grade, multicore stranded annealed copper conductor having high conductivity, XLPE insulated, cores laid up, extruded PVC inner sheathed conforming to ST-2 compound armoured and extruded FRLS – PVC outer sheathed cable.

Cable drum

Cable drums shall be made of good quality wood, pressure impregnated against fungal and insect attack. The ends of each length of cable shall be sealed before despatch.

8.14.4 Drawings, Data & Manuals

To be submitted with the Bid

Manufacturer's catalogues giving cable construction details and characteristics

Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables

Type test certificates on all specified cables