



EPD - BANGALORE

**Indent Specifications
For
4Q, 4000A,750V Thyristor converter system**

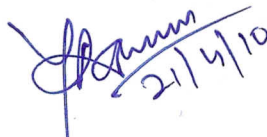
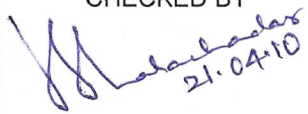
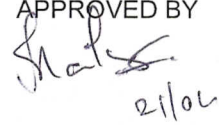
Specification No
EL-19-HY10/001

**PROJECT: BHEL Hyderabad Test Bed
Modernization and Up gradation Project**

Technical Specifications
For
DC Drive System

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SECTION - I

1. SITE CONDITIONS:

1.1. Maximum and Minimum Ambient Temperature

1.1.1. Outdoor: 50°C

1.1.2. Indoor: 48°C and 15°C

1.2. Relative Humidity Outdoor: 90 % Indoor: 27 %

1.3. Location: Indoor: Equipment shall be located indoor in hot, humid, tropical and dusty atmosphere in adverse industrial environment. Maximum ambient temperature and relative humidity do not occur simultaneously.

1.4. The following inputs shall be provided.

Following will be made available at the site of installation of this drive

- a. AC Supply: 11 KV +/- 10%, 3 phase, 50Hz +/- 3%,
- b. AC Supply: 415V +/- 10%, 3 phase, 50Hz +/- 3%.
- c. DC Supply 220 V +/- 15%, ungrounded. (Emergency power through battery station)
- d. DC Supply 30 V +/- 15%, ungrounded. For operation of VCBs

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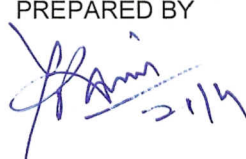
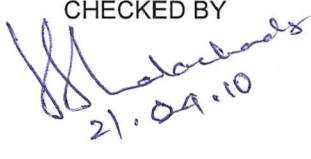

SECTION - II

APPLICABLE STANDARDS

The equipment shall conform to latest Indian Electricity rules as regards to safety, earthing and other essential provisions specified therein of Electrical equipments. The Drive System & its components shall conform to the Indian statutory regulations & Indian Electricity Rules, 1956 edition 1993 as applicable in West Bengal & the following standards.

SL. NO	STANDARD NO.	DESCRIPTION
1	IEC 146-X-X & IEEE444	For design, Over Loading & testing of drives.
2	IS2026	For design, over loading & testing of Transformers.
3	IS: 5 - 1994	Color shades.
4	IS: 13947-1993	Standard for degree of protection of electrical enclosure.
5	IS: 3043 - 1987Re91	Code of practice for Earthing
6	IS 2551 -1982 Rev1	Danger boards / warning symbols

1. The Thyristor Drive regulators shall conform to IEEE-444.
2. If any part, whole or specific aspect of Thyristor Drive Regulators/ system is not being covered under Indian Standards, the tenderer shall specifically bring out such aspects in the tender offer and decide during tender scrutiny / evaluation stage as to the specific standards which shall be applicable. Otherwise the successful tenderer shall be liable to abide by the specific instruction of the purchaser at detailing stage without any additional cost to the Purchaser.
3. All Thyristor Drive Regulators/ system shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein.
4. All Thyristor Drive Regulators/ system shall also comply with the statutory requirement of the Government of India and the state government of the province in which the plant is located as given in the Purchaser's 'Tender specification'.

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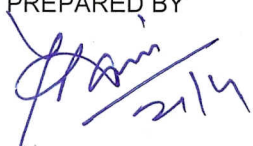
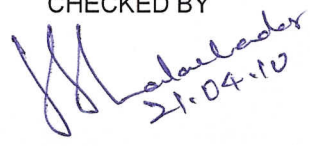
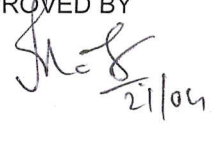
SECTION III


SCOPE OF SUPPLY

The complete scope of supply (DC Drive unit) is as below.

SL NO	Drive Description	Rating	Qty	Remarks
1	Thyristor Drive Regulators / system both for Armature and Field Control	2500KW Cont, 4Q for Armature and 1 Q for field control	1 Set	controlled by PLC through I/O and comm link.

- 1) The supply shall include all items & accessories (like communication cards, connectors, other special connectors, mounting accessories, scaler boards, i/o boards, communication boards, technology boards, HMI interface, required software , Pulse cable, CT interface, etc.) though not specifically mentioned in the specification but essential for completeness of the system shall be provided without any extra price.
- 2) All panel items like power components, MCB, Reactors, transformers, DCCB, relays, ACB, pulse transformers, DC shunt, Pulse tachos, Fuse monitoring switches etc. are required to be included.
- 3) The drive system shall be operated in 3 modes.
 - a) Supply source for existing Drive motor of DC 1900 kW, 750 V, 2750 A, 750/1000 rpm Field 220 V, 20A with gear box 1: 4 ratio ie 1000rpm/4000 rpm.
 - b) Supply source for DC 2500 kW Drive Motor and Drive Motor field.
 - c) Supply source for Generator field during testing of generator with different current limit settings.
- 4) Drive Motor Field thyristor convertor system for 2500 kW Drive motor and 1900 kW Drive Motor shall be part of the main system.
- 5) Supplier shall quote training charges/trainee/day for imparting training to Customer/ Consultant/ BHEL engineers on drive operations & working.
- 6) Supplier shall quote for 2 years critical spares as part of offerings.

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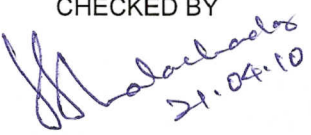
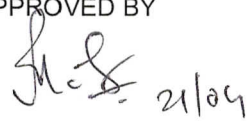
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SECTION IV

DETAILED TECHNICAL SPECIFICATIONS

General

1. Input supply : Supply from the existing transformer of 4000 kVA 11kV/750 V
HV Amps : 210 A, LV Amps : 3079 A
2. The proposed system shall be designed for starting of 2.5 MW DC Motor coupled to upto 150 MW Generator along with Gear box. (Torque characteristics of 150 MW Generator is as given in annexure.
3. The proposed MG set (both armature and fields of Drive motor and Field of generator) shall comply the following three modes of operation as given in point 3, Section III
4. Over speed switch is to be provided to monitor the over speeding of the drive.
5. The system shall be installed in the existing Thyristor converter system location. The existing thyristor converter system wherever required needs to be dismantled.
6. Safety interlocks with upstream breaker to be provided. Upstream breaker status indication and closing /tripping facility to be available on this panel.
7. In case of emergency, it is required to bring the system to standstill. Fast breaking action mechanism is required to bring the speed of the drive along with the driven load from the operating speed to zero speed in very short time. Hence the existing Dynamic brake resistance shall be used for the purpose. Additional DC contactor shall be supplied if required.
8. Short time voltage dips up to 10% shall not cause the control system to stop functioning.
9. The drive Motor shall be operated in both the directions. Hence required provision shall be provided for change of direction of rotation.
10. The operation shall be from the existing control panel and through SCADA System operated through PC located in control room.

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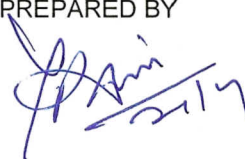
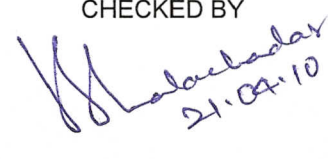
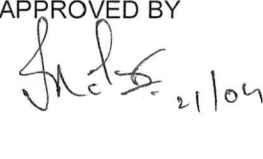
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11. Manual operation and auto operation should be software driven and there shall be provision for change of sequence of operation in the system.

ARMATURE CONTROL

12. The voltage ratings vary upto 750V
13. The thyristor converter are made up of fully controlled three-phase thyristor bridges.
14. Speed feedback shall be from Hubner make pulse tachos with PPR upto 1024. The speed controlled shall be from zero rpm to full speed of the motor. Required digital pulse tachometer shall be supplied.
15. Thyristor Drive regulation & control equipment shall be designed for the following power system parameter variation:
- i) Voltage : +10%, -10%
 - ii) Frequency : +3%, -3%
 - iii) Phase voltage Unbalance: + 2% between any two phase
16. The design should consider the adverse condition of cooling fan failure of thyristor converter and the designer has to specify the minimum period of continuity of working of Thyristor Drive under full load conditions.
17. The Thyristor Drives shall be incorporating the latest development in the area of regulation and control technology based on digital system. The design shall be such that a common digital regulator is used in different rating of converters if supplied under one package. 32 bit Microprocessor based digital regulation & control shall be provided.
18. The microprocessor based digital regulation and control system shall be compatible for reference from existing RAIL make PLC in the distributed control system.
19. Each thyristor unit shall have a control pad provided at the panel door. The control pad shall have provision for uploading, downloading, changing, displaying and saving the digital regulation parameters, display of actual value of speed, torque etc. display of ready, run, trip or fault message etc.
20. Digital thyristor converters shall have in built provision of analog and digital I/O connection and should have I/O expansion capability.
21. Thyristor Drive System for DC drives shall comprise of following main units :
- (a) Thyristor bridge/converter

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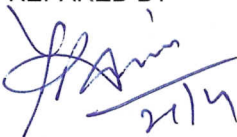
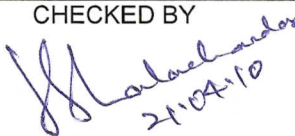
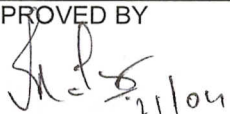
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- (b) A.C. Power circuit Devices
- (c) Regulation & control equipment
- (d) Protection, indication & annunciation units.

THYRISTOR BRIDGE / CONVERTOR:

22. DC Drive shall be state of the art technology with Independent Control and Power Sections and they should be connected through Fiber optic cable which enhances the Drive reliability.
23. It is preferred to have Drive being embedded into a High end Automation System So that all the application needs like profile generation, System parameters Real Time control, critical Data Logging, Trending etc can be realized more effectively through a backplane connectivity.
24. The Thyristor Bridge is provided with natural air-cooling or forced air-cooling by low noise & vibration free ventilation fans at the top of cubicle/panel. The cubicle/panel vane switch for air flow monitoring is provided.
25. Wherever thyristor devices are connected in parallel the allowances to be given for unequal current sharing between them and the feature of asymmetrical current protection shall have alarm annunciation in case of failure of one thyristor device and tripping of converter in case second one also fails.
26. Thyristor gate firing shall be microprocessor based digital system.
27. Minimum rating of thyristor devices is
- (a) PIV rating to be 2.5 times the peak line voltage.
 - (b) dv/dt rating : 200 V/micro second
 - (c) di/dt rating : 100 A/micro second
28. The protective features for the Thyristor Drive provided are as follows :
- a) Electronic type AC surge suppresser with fuse monitoring device AC incomer under voltage & over load.
 - b) Phase sequence protection & monitoring
 - c) Converter transformer fault
 - d) RC snubber across each Thyristor device
 - e) Semi-conductor fuses with fuse monitoring device in series with each thyristor device.
 - f) Pulse transformer for potential free transmission of pulses.
 - g) Air Flow/pressure switch for forced air cooling system.
29. The DC side of Thyristor Drive includes following feature:
- a) Auto/manual balancing.

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b) Earth fault millimeter and relay

REGULATION AND CONTROL EQUIPMENT

30. The digital drive regulation shall be considered and speed and torque accuracy of drives shall be as required for the process under consideration.

FIELD EXCITATION CONTROL

31. The motor field excitation shall be fed through a separate solid-state current regulated thyristor bridge configuration. Where-ever applicable high speed communication between Armature and field control regulators shall be possible and field weakening operations shall be undertaken over this communication channel

32. It is preferred to have both Field Controller and Armature controller interact through a backplane to have vary high speed communication among them

PROTECTION, INDICATION AND ANNUNCIATION:

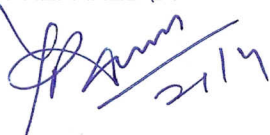
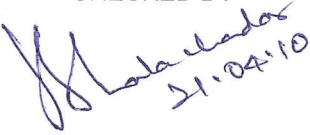
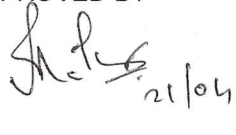
33. The Thyristor Drive regulation shall provide as per the clauses stipulated in IEEE-444 as suitable and required for each case :

- Over current, over voltage, under voltage on DC side.
- Transients and surges over voltage and loss of phase.
- Control power supply failure
- Inversion fault, di/dt & dv/dt
- Any other protection as required for particular application.
- Speed indication of motor
- An Operator Terminal shall be provided to control and Monitor Drive Parameters

34. Following annunciation shall be provided through the touch Screen of the Operator Terminal :

GENERAL ANNUNCIATIONS:

- Main power ON
- Control supply ON
- DC converter ON
- DC breaker/contactors ON & tripped
- Earth fault
- Incoming breaker trip
- Phase loss
- DC overvoltage

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- i. Drive controller healthy

CONVERTER FAULT ANNUNCIATION:

1. Overload
2. Over current
3. Fuse failure
4. Fan failure

DC MOTOR FAULT ANNUNCIATION:

1. Over load
2. Over current
3. Over speed
4. Over voltage
5. Speed sensor fault

ALARMS:

1. Convertor overload
2. Motor overload

TEST BED AUTOMATION:

- CONTROL SYSTEM:
- OPERATOR CONTROL STATION:
- SUPERVISORY CONTROL SYSTEM:

SOFTWARE DEVELOPMENT:

- APPLICATION SOFTWARE DEVELOPMENT
- MMI SCREENS – OPERATION, CONTROL AND MONITORING
- HMI SCREENS – OPERATION, CONTROL AND MONITORING
- HMI SCREENS - RECEIPE CREATION, MODIFICATION AND MANAGEMENT:
- HMI SCREENS – DATA LOGGING, TRENDING AND ANALYSIS
- HMI SCREENS - REPORT GENERATION

INSPECTION AND TESTS WITNESS:

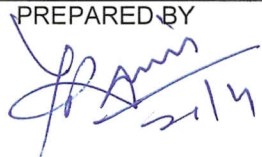

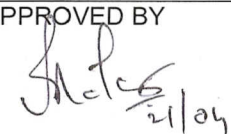
The equipment supplied shall be completely tested at manufacturers works. The inspection and performance testing shall be offered for witnessing at the manufacturers works.

PACKING AND DELIVERY:

The consignments shall be suitably packed to protect against all possible damages during transportation and storage at site and delivered to BHEL Ramachandrapuram, Hyderabad works. It is responsibility of the vendor to deliver the complete equipment to site.

INSTALLATION AND COMMISSIONING. :

Erection and commissioning of the main equipment and auxiliaries shall be part of BHEL EPD scope. However the supplier shall consider the supervision of erection

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and complete commissioning of Drive system in their scope along with BHEL EPD.
The system shall be proved out at BHEL Hyderabad Electrical machines test bed.

TRAINING OF BHEL TEAM:

Training for Six Engineers for operation and maintenance for one week at manufacturers works shall be free of charge. Necessary training documents & other materials shall be provided for each participant at free of charge.
Training to BHEL Engineers by supplier at site after commissioning of the equipment shall be free of charge.

GUARANTEE:

The equipment supplied shall be guaranteed for 18 months from the date of handing over after commissioning.

CRITICAL SPARES:

List of Commissioning spares shall be provided along with the price. List of spares for 2 years of operation shall be quoted along with the offer as optional.

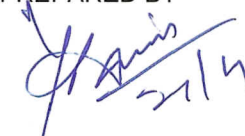
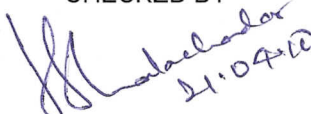
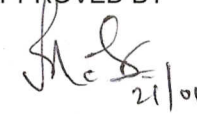
SECTION V


TESTS AND INSPECTION

Thyristor Drive shall be tested at manufacturer's works and

Routine tests

Assembly inspection
Functional tests

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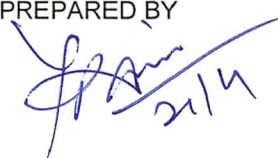
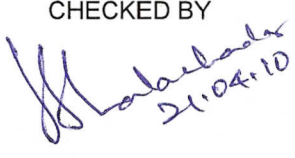
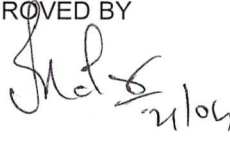
SECTION VI


DOCUMENTATION:

The Suppliers shall submit following documentation

1. At the time of Techno commercial Offer submission:
 - a. Detailed Technical Offer
 - b. DC Drive Power configuration diagram in a Single Line Format.
 - c. Total control System Configuration Diagram
 - d. Point wise deviation List for the tender specification
 - e. All the product Catalogues and supporting documents for the confirmed specification
2. After the order placement, at the time of Design approval stage:
 - a. Detailed Engineering Drawings of Drive system
 - b. Detailed Engineering Drawings of Control System
 - c. Flow Diagram for Operator Terminal and SCADA system.
3. After the order placement, at the time of dispatch of the system:
 - a. Complete Schematic Drawings as manufactured.
 - b. User Manual for the complete System
 - c. Trouble Shooting / Maintenance Manual
 - d. Product catalogues and User manual
 - e. External connection/cable schedule

Test records and test reports

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SECTION VII

Additional Information for the Thyristor convertor system provided by end customer

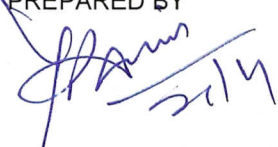
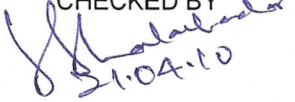
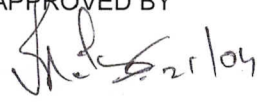
Scope of supply:


1. Thyristor based panel for Driving of 2.5 MW Motor with Generators of upto 150 MW coupled.
2. Erection and commissioning.
3. Implementation of the system in existing control panel in control room.
4. Microprocessor based controls operated from remote location.

Duty : Continuous.


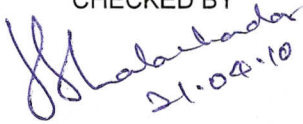
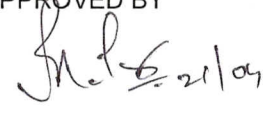
Technical requirements of the system:

1. Type : Thyristor based convertor system.
2. Output Rating : 750 V, current as required by the Drive Motor+Gearbox+ 150 MW Generator. (Torque Vs Speed, Power Vs Speed characteristics with jacking oil is given in annexure)
3. Input supply : Supply from the existing transformer of 4000 kVA 11kV/750 V HV Amps : 210 A, LV Amps : 3079 A
4. The system shall be designed for starting of 2.5 MW DC Motor coupled to upto 150 MW Generator along with Gear box. (Torque characteristics of 150 MW Generator is as given in annexure.)
5. The drive system shall be operated in 3 modes.
 - a. Supply source for existing Drive motor of DC 1900 kW, 750 V, 2750 A, 750/1000 rpm Field 220 V, 20A with gear box 1: 4 ratio ie 1000rpm/4000 rpm.
 - b. Supply source for new DC Motor 2500 kW ,750 V, 750/1000 rpm Field 220 V, 20A with gear box 1: 4 ratio ie 1000 rpm/4000 rpm.
 - c. Supply source for Generator field during testing of generator with different current limit settings starting from 750A
6. The system shall be installed in the existing Thyristor convertor system location. The existing thyristor convertor system wherever required needs to be dismantled(Dismantling scope of BHEL).
7. The existing transformer of 4000 kVA, 11 kV/750V, HV Amps : 210 A, LV Amps : 3079A shall be used for input supply to Thyristor convertor system.
8. Harmonic filters/chokes (if required) for reduction of ripples in the output wave forms shall be part of the main system.
9. Drive Motor Field thyristor convertor system for 2500 kW Drive motor and 1900 kW Drive Motor shall be part of the main system.

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10. Complete protection and annunciation shall be provided.
11. Safety interlocks with upstream breaker to be provided. Upstream breaker status indication and closing /tripping facility to be available on this panel.
12. In case of emergency, it is required to bring the system to standstill. Fast breaking action mechanism is required to bring the speed of the drive along with the driven load from the operating speed to zero speed in very short time. Hence the existing Dynamic brake resistance shall be used for the purpose. Additional DC contactor shall be supplied if required.
13. The speed controlled shall be from zero rpm to full speed of the motor. Feed back shall be from the digital pulse tachometer. Required digital pulse tachometer shall be supplied for both 1.9 MW and 2.5MW motors.
14. Short time voltage dips up to 10% shall not cause the control system to stop functioning.
15. The drive Motor shall be operated in both the directions. Hence required provision shall be provided for change of direction of rotation.
16. The operation shall be from the existing control panel and through microprocessor based system operated through PC located in control room. Intrgration of the Thyristor converter to the existing set up in the control room, including SCADA will be in the scope of the supplier. The supplier may visit BHEL Hyderabad to understand the system before quoting.
17. The scheme of having the control part of the thyristor system in the control room and the power part at a different location may also be given as an option.
18. Manual operation and auto operation should be software driven and there shall be provision for change of sequence of operation in the system.
19. The following inputs shall be provided.
Following will be made available at the site of installation of this drive
 - a. AC Supply: 11 KV +/- 10%, 3 phase, 50Hz +/- 3%,
 - b. AC Supply: 415V +/- 10%, 3 phase, 50Hz +/- 3%.
 - c. DC Supply 220 V +/- 10%, ungrounded. (Emergency power through battery station)
 - d. DC Supply 30 V +/- 10%, ungrounded. For operation of VCBs
20. One set of complete system software and other supporting software has to be part of the supply so that BHEL shall be able to carry out necessary changes in operation of the converter system independently, if required at a later date.
21. Following documents must be provided soft copies (2 sets) and hard copies 5 sets each

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- 1) Relevant OGA drawings with mounting details
- 2) Complete Schematic drawings with descriptions
- 3) External connection/cable schedule
- 4) Test records and test reports
- 5) O & M manuals

Inspection and tests witness: The equipment supplied shall be completely tested at manufacturer's works. The inspection and performance testing shall be offered for witnessing at the manufacturers works.

Packing and Delivery: The consignments shall be suitably packed to protect against all possible damages during transportation and storage at site and delivered to BHEL /HYD works.

Erection and commissioning. : Erection and commissioning of the main equipment and auxiliaries shall be part of BHEL EPD scope. However the supplier shall consider the supervision of erection and complete commissioning of Drive system in their scope along with BHEL EPD. The system shall be proved out at BHEL Hyderabad Electrical machines test bed

Training of BHEL personnel:

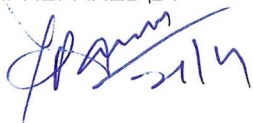
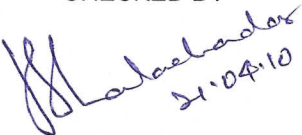
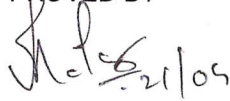
Training for Six Engineers for operation and maintenance.
Necessary training documents & other materials shall be provided for each participant during training.


Guarantee:

The equipment supplied shall be guaranteed for 18 months from the date of handing over after commissioning.

Spares:

List of Commissioning spares shall be provided along with the price.
List of spares for 2 years of operation shall be quoted along with the offer as optional apart from the mandatory spares already listed.

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SECTION VIII

QUALIFICATION/ EVALUATION CRITERIA FOR TENDERERS.

1. Bidders shall have successfully executed jobs of similar nature with any Govt organizations / PSU / Public Limited Company of Value equal to or more than Rs 50 lakhs (Single Order) and shall submit the following along with the offer.

- Copy of various Purchase orders received in the last three years with the name of Contact Person of the Customer and telephone numbers
- Performance / Commissioning Certificate for the above from the client

2. Vendor must be a Total Solution Provider and must have executed projects of DC Drives, Programmable Automation Controller based system, Man machine Interface based Operator Control, Extensive SCADA system, Panelling, Wiring, Instrumentation etc. The vendor must have executed at least four such projects

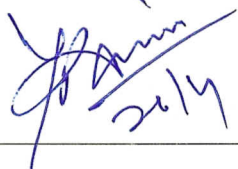
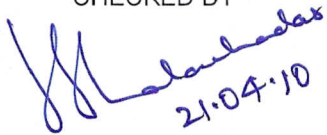
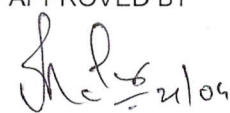
3. The bidder shall have a minimum average turnover of Rs 40 crore per year for the last three consecutive years. The Bidder shall submit Audited Balance Sheet and profit and loss account of the company for the last three consecutive year for proof of turnover.

4. The bidder shall be the original manufacturer however they may authorise their authorized dealer /channel partner only. However the responsibility of successful execution of the system lies with the original manufacturer. This must be supported with submission of documentary evidence for the same.

5. The product shall be manufactured by a firm whose quality system is in compliance with IS/IEC/ISO 9001/IS 14001.

6. Tenderer should have adequate qualified manpower to undertake erection & commissioning of the system.

7. Tenderer should have valid registration under CST / VAT, Excise/ Service Tax Acts. The corresponding documentary proof to be furnished.

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PRICE FORMAT

SL No	Description	Qty.	Unit Price	Total Price	Remarks
1	Supply and Supervising the commissioning 4Q, 4000A, 750V Thyristor Converter system	1 set			
2.	Commissioning spares	1 set			
3.	Mandatory spares a) Semicon fuses b) Micro switch for fuses c) Analog Input Module d) Analog output Module e) Digital Input Module f) Digital Output Module	2 Nos 2 Nos 1 No 1 No 1 No 1 No			
4.	Training for BHEL Engineers on drive operations & working.	6 Engineers			

- Note : 1) All the above four components will be considered for deciding the successful tenderer
2) List of spares of 2 years of operation apart from the above spares mentioned in slno 3 shall be quoted along with the offer as optional

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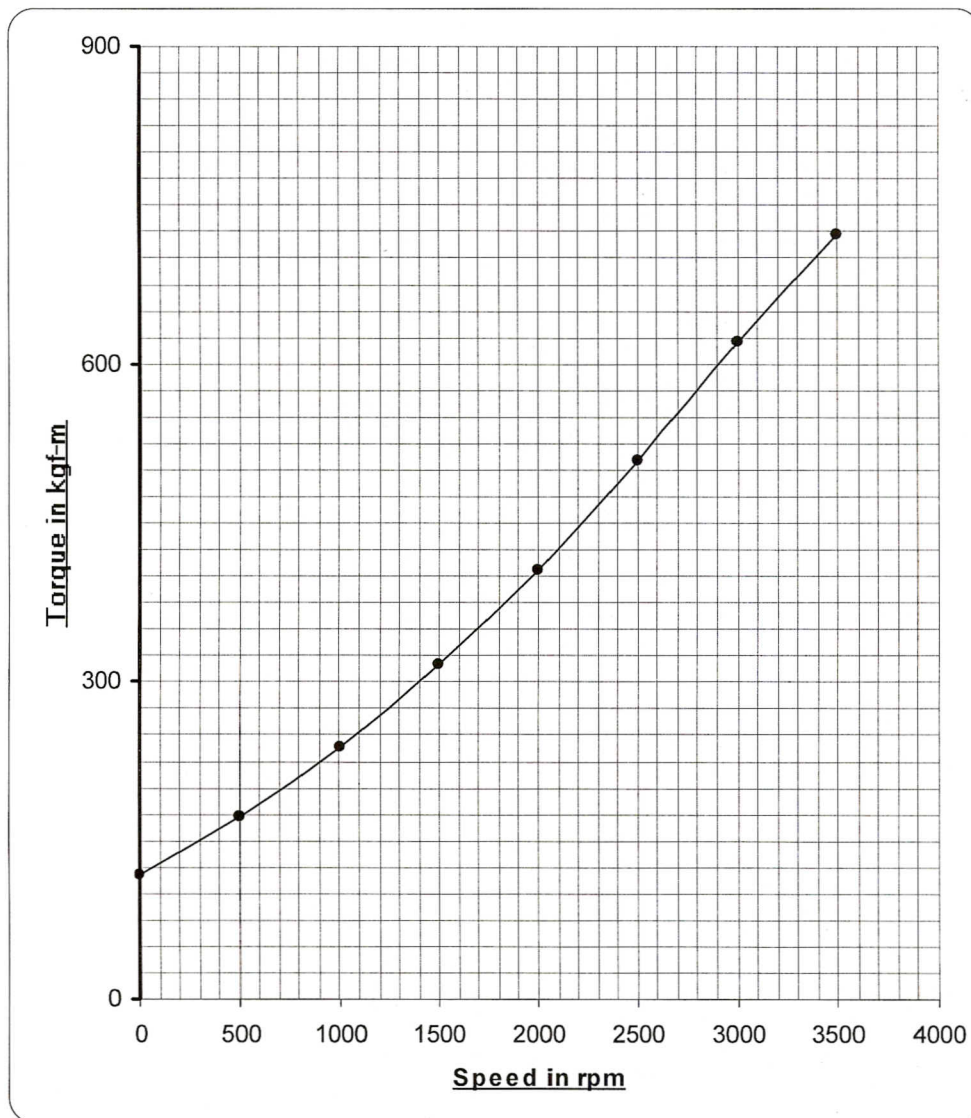
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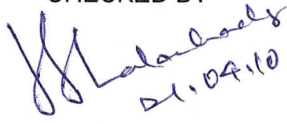
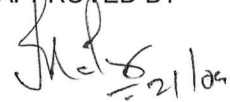
**Indent Specifications
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ANNEXURE -I

Torque Vs Speed of 150 MW Generator



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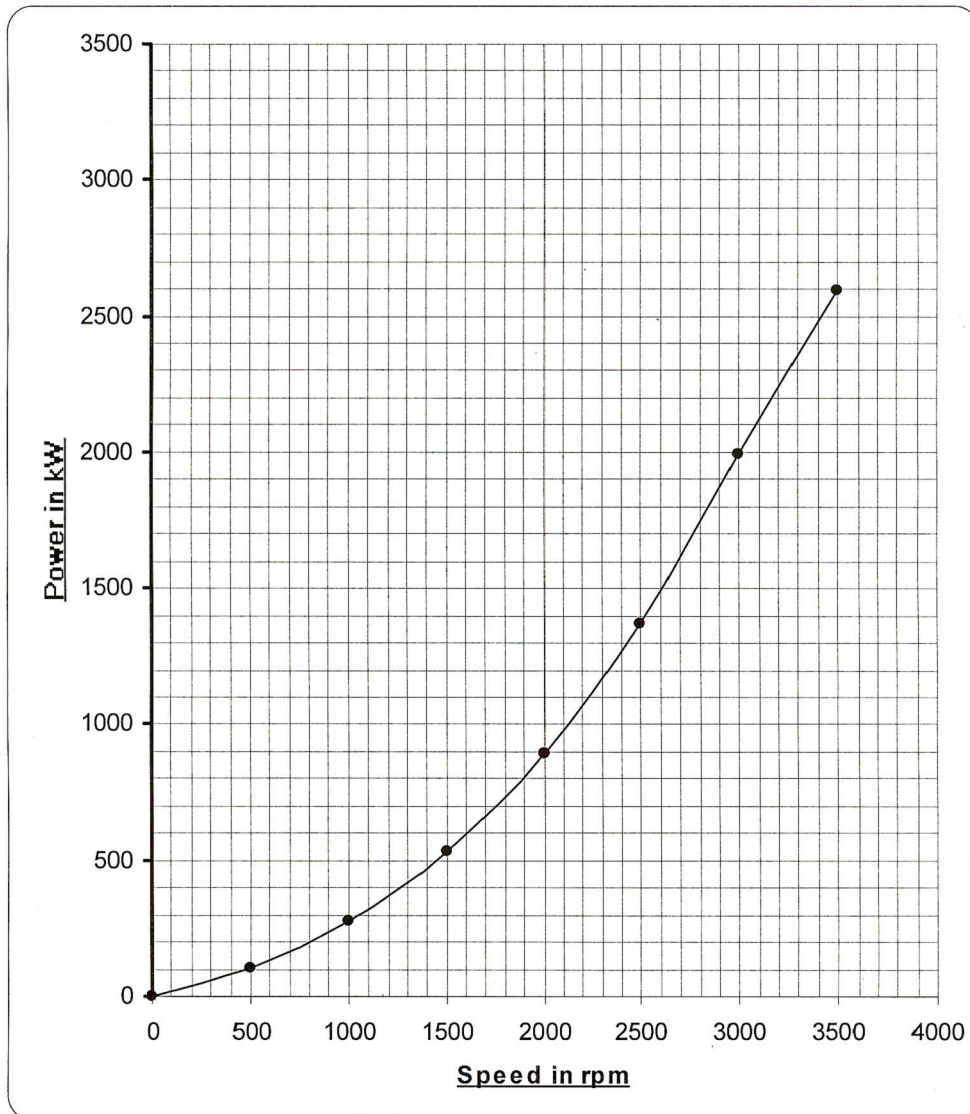
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ANNEXURE -II

Power Vs Speed of 150 MW Generator



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