COVER SHEET

TECHNICAL SPECIFICATION

FOR

PROGRAMMABLE LOGIC CONTROLLERS

AND

AC DRIVES

REQUIRED FOR TYPICAL STEEL PLANT

CONTENTS

TECHNICAL SPECIFICATION

FOR

PROGRAMMABLE LOGIC CONTROLLERS

REQUIRED FOR TYPICAL STEEL PLANT

SECTION-A

SPECIFICATION NO: IS.BG4.08/01

CONTENTS

Prepared by	Checked by	Approved by
Name: R.L.Rani Designation: Manager Signature:	Name: Arun V Rao Designation: DGM Signature:	Name: C.G.K.Pillai Designation: AGM Signature:

SECTION – O

INTENT OF SPECIFICATION

1. The quotation will be made strictly in line with NIT and following conditions.
2. This requirement is not for any project purchase. These specifications are intended to select a vendor for long term contract for sourcing of product for Ongoing and Future projects of BHEL – ISG in Industry.
3. These specifications are made in order to cover a complete requirement of 'Automation System' in Industry. Therefore PLC Vendors are expected to quote for full range.
4. In case Vendor does not quote for complete requirement of Automation, will be disqualified.
5. Deviations if any shall be clearly mentioned in the format given in Section – VIII of this specification only and no where else.
6. Alternate proposal for PLC will be evaluated and accepted, if found suitable. However, reference will be made in the deviation format for such cases.
7. Tenderer shall make one copy of this specification duly signed and submitted along with the offer as a token of acceptance.
8. Price
    a. Shall be provided separately for each area as per the price formats provided separately.

    b. Un-priced price format shall be provided along with the techno-commercial offer.

SECTION – I
SITE DATA

1.0 **Site Data.**

1.1 Location : Steel Plant.

1.2 No data loss while operating : 0 Deg C to 45 Deg C.

1.3 Destruction proof while not operating : -40 Deg C to 70 Deg C

1.4 Max. Relative Humidity : 100 %

1.5 **Power supply available**

One source of UPS supply 240vAC, 2 wire shall be provided for PLC.
All AC/ DC power requirement of the various cards, modules, interrogation supply, components & sub systems under the package shall be in supplier's scope.

SECTION – II
APPLICABLE STANDARDS

2.0 The PLC shall comply to the following specification and to the specific standards mentioned in the respective clauses -

IPSS:2-07-015-88	Modular programmable logic controllers.
IPSS:2-07-016-88	Specification for panels.
IPSS:2-07-030-88	Guidelines for application software documentation.
IPSS:2-07-036-93	Guide for supply of computer hardware manuals.
IS:10118 (Part 1 to 4)-1982	Code of practice for selection, installation and maintenance of switchgear and control gear.
IS:13947 (Part 1,5)-1993	LV switchgear & control gear.
IS:12021-1987	Specification for control transformers for switchgear and control gear for voltages not exceeding 1000 Volt AC.
IS:8623 (Part 1)-1993	Specification for low voltage switchgear & control gear assemblies.
IEC 1131-2	Specification for Programmable Controllers

If any part, whole or specific aspect of equipment is not being covered under the above standards, the supplier shall specifically bring out such aspects in the 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 requirement of the purchaser at detailing stage without any additional cost to the Purchaser.

2.1 The equipment & system shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation.

2.2 All equipment & system shall also comply with the statutory requirement of the Government of India and the State Government in which the plant is located.

SECTION – III
SCOPE OF SUPPLY

3.1 The supplier shall be responsible for design, manufacture, assembly, testing at manufacturer's works, training, documentation, supply and delivery of system at site, other services and site assistance as mentioned in this enquiry.
The programmable logic controllers (PLC) shall be of rugged and modular construction, plug in type. PLC shall be suitable for reliable, failsafe operation in arduous steel plant environment where electromagnetic noise, high temperature, dust, humidity and mechanical shocks / vibrations are prevalent. It shall have field expandable design so as to accommodate incremental increase in memory and I/Os as required.

3.2 Main Equipment
Programmable logical controllers complete with Rack, Digital Input/Output cards, Analog cards, pulse counter cards, communication interface cards, Remote I/O racks, with necessary inter connection cable / connectors, Generation of all power supplies including field interrogation power supply, housed and wired in required number of control panels. Ethernet cards for connectivity to higher end system to be included.

*Please note that the Dual Hot redundant PLC shall have **Bumpless transfer** from working to standby and also dual redundancy in I/O communication and Ethernet communication*.
Please note that all the PLC and other cards provided shall be of the same type and from the same family.

Important Points :

Modbus / Profibus / TCP/IP communication to be available for any external electrical control system. This system shall be connected directly to dedicated PLC and not through PLC network.

Notes on items to be considered

1. PLC system

2. CPU Module (with or without redundant configuration)

3. Engineering pkg.

4. HMI pkg. – (latest version, factory suit)

5. HMI Tag - minimum 10,000 Tags

6. I/O series – Centralized / Expandable/ Remote (Hot swappable)

7. I/O connection - Industry Standard Ethernet/ Profibus/ Modbus/ controlnet for data/ command exchange

8. Suitable Communication Processor for message transfer between Level1 - Level2.

9. Industry Standard Ethernet/ Profibus/ Modbus/ controlnet for data/ command exchange communication to be available for any external electrical control system. This system shall be connected directly to dedicated PLC and not through PLC network.

10. Min. Speed acceptable is 8 Mbps .

11. All necessary repeater/ switches required for connectivity of RIOs, third party devices in all the units are in supplier's scope along with required cable.

12. All Engineering station (laptop) shall be suitable for adaptor/ node level communication apart from network connectivity. Supplier to confirm uploading and downloading application software facility in CPU through engineering station.

13. Drives shall be connected through communication link with PLC for necessary data transfer.

14. All PLC, RIO, Drives shall have `Rittal make' enclosure.

3.2.1 Configuration of PLC

a) PLC with redundant CPU and power supply, one power supply for interrogation, three communication and all necessary cards/connectors to meet the system configuration & specification.

b) Remote I/O rack with one power supply, one communication and all necessary cards/connectors to meet the system configuration & specification.

c) MCC-Remote I/O rack with one power supply, one communication card and all necessary cards/connectors to meet the system configuration & specification

d) PLC programming software with license , CD etc .This shall include all software required to interface with HMI stations , Input/Outputs ,drives, third party devices as mentioned below. It shall comply with IEC 1131-3– 1 set

e) HMI development with runtime software with 10,000 tags –1 no:

f) HMI runtime software with 10,000 tags –1 no

g) The following I/O, relay and third party interface count to be considered for each set of PLC.

3.2.1.1 PLC Configuration for a typical Steel Plant Application - I

Location: Area - A

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC A 1/2	583	404	118	13	11	-	6	2	64	203

Location: Area - B

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC B 1/2	598	224	45	9	1	-	6	3	31	133

Location: Area - C

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC C 1/2	221	115	87	6	2	2	-	-	5	96

Location: Area - D

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC D 1/2	181	79	48	22	-	-	-	-	2	54

Location: Area – E (Safety PLC)

Location	DI (24V dc)	DO (24V dc)	AI (mA)	Safety Barriers	Remarks
PLC E 1/2	136	52	31	31	Safety Standard as per EN 954-1, Category 4

20% additional I/Os to be included over & above total I/Os mentioned above for all PLCs.

3.2.1.2 PLC Configuration for a typical Steel Plant Application - II

Location: Area - A

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC AC	410	200	35	30	2	0	8	1	15	256
PLC A1	300	175	60	80	4	11		4	20	224
PLC A2	300	175	60	80	4	11		4	20	224

Location: Area - B

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC B1	700	400	50	40	4	0	6	2	15	480
PLC B2	700	400	50	40	4	0		2	15	480

Location: Area - C

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC C1	625	250	100	30	3	3	2	4	33	320

Location: Area - D

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC D1	535	250	85	35	4	0	6	5	30	320

PLC D2	535	250	85	35	4	0		5	30	320

Location: Area - E

Location	DI (24V dc)	DO (24V dc)	AI (mA)	AI (RTD)	AI - pulse	AI (thermo couple)	Drive i/f	Third party i/f	AO (mA/ V)	Relays for DO
PLC E1	625	780	77	65	0	4	1	0	20	960
PLC E2	625	780	77	65	0	4		0	20	960

20% additional I/Os to be included over & above total I/Os mentioned above for all PLCs.

3.2.2 For BHEL ISG

1 PLC programming package with license (as above)+ 1HMI software (runtime + development) with license for 10,000 tags (as above) + 1 no: emulator to check both PLC, HMI and interface between the PLC& HMI developed. To be provided 2 weeks after issue of LOI with all manuals.

3.3 Third party interface

Design, testing and establishing communication with third party devices provided by customer. Please note the following regarding these interfaces

- Communication between PLC and external electrical control system (on Modbus / Profibus / TCP/IP / etc), third party PLCs are to be established for signal/data exchange by the supplier. Communication shall be through standard protocol. **Corresponding protocol with compatible communication module shall be supplied by the supplier.** Communication module shall have the facility (selectable) to act like Master or Slave.
- The supplier will be provided with the details of the devices procured by the customer after order placement.
- The supplier will consider all hardware & software on PLC side and communication cables (approx 50m of communication cable can be considered for each device). Any software development/protocol development/driver development for third party device communication is also in the supplier's scope. Any standard software required shall also be considered. Please note that the communication cables shall be shielded type only.
- The supplier will provide all details and documentation regarding communication interface at different stages to BHEL.
- The supplier will demonstrate the interfaces functioning during inspection of PLC system at Supplier's works. Else it shall be demonstrated during integrated testing at BHEL, Bangalore/Supplier's works along with the application software developed by BHEL Bangalore.

- The supplier is responsible for demonstrating the interface at site to the customer's satisfaction. This shall include connection details on the third party device. Any co-ordination work required at will be done by BHEL and any manual labour required will be provided**.** Suitable mandays including travel ,lodging /boarding charges shall be considered by supplier for this purpose. Please note that three separate visits have to be considered for this purpose and it is not to be linked with any other services offered at site.

- Interface Test
  Interface test will be carried out at supplier's works where general procedure for message transmission (communication set-up, etc between level-1 and level-2 automation) is to be demonstrated. Also correctness of exchange of the messages at protocol as well as application level is to be proved.

- The following third party devices to be considered for interface purpose with PLC:

DRI Injection
Carbon injection
Electrode regulation
Temperature measurement
Lance manipulator
O2 side blowing system
Weighing System
Customer PLC
Pre-heater

3.4 The following additional engineering services are also including in your scope

a) Generation of PLC & HMI diagnostics pages on HMI, visually illustrating the fault location such as primary/secondary CPU failure, I/O card failure etc., Alarms for system fault to be shown on HMI . Screens to be finalized with BHEL after order placement and demonstrated during PLC Inspection or Integrated testing at BHEL, Bangalore / Supplier's Works.
b) Interface with HMI including supply of special card/cable if required in PC
c) Provide specification for PCs, Ethernet switch including special requirement if any
d) Any PLC program based switchover, if required is in your scope

3.5 Training

2 weeks training for 15 Nos. of BHEL/Customer engineers at your training institute. The training to be considered in two batches.

3.6 **Integrated testing** at BHEL, Bangalore /Supplier's Works – Integrated testing of Level 1 & Level 2 systems will be performed at BHEL, Bangalore/Supplier's Works. The supplier will be responsible for setting up the PLC, loading the software and ensuring the proper functioning of the PLC system and necessary communications.

3.7 Documentation as indicated in the respective section

3.8 -

3.9 Inspection & testing at factory

3.10 Supplier shall quote for any additional hardware /software such as communication software, cable, connectors etc required for successful operation of the system as per Configuration Diagram enclosed and it shall be clearly indicated in un-priced BOM (Computers and Ethernet switch need not be considered in your scope). The supplier shall also include any cable, connector, card etc.(on PLC-HMI side) for communication to third party devices as mentioned in the scope.

3.11 The application software development is in BHEL scope The supplier shall furnish all clarifications and extend all co-operation in preparing the application software.

SECTION – IV
TECHNICAL SPECIFICATION

4. BASIC PARAMETERS

4.1 Memory

Type memory	CMOS/ RAM (min. 16 MB) with Ni/Cd or Li backup battery for a min. period of 24 hours/FEPROM
Memory size for user programmer	Ensure that 50% spare space will be available. **It shall be possible to add memory incrementally if required later**
Interrogation voltage	24 V DC
For inputs galvanic isolation	Opto coupler
Output rating –continuous	2A
Inrush	1400 VA for 50 msec

4.2 Special functions/ Design criteria required for PLCs

4.2.1 Alpha Numeric report/ message generation for printer/ TFT display shall be possible.
4.2.2. Laptop based programming unit shall be possible. (laptop not in your scope)
4.2.3 Dynamic mimic generation.
4.2.4. Facility to start and stop drives through key board.
4.2.5 PLC in hot standby configuration with redundant CPU memory.
4.2.6 **CPU load not to exceed 50%. (to be proved at site)**
4.2.7 **Memory utilization not to exceed 50%**. **(to be proved at site)**
4.2.8 **Communication bus bandwidth utilization less than 50%**. **(to be proved at site)**
4.2.9 Spare I/Os installed and wired to terminal strip.
4.2.10 **Space and provision in I/O rack and wiring to terminals shall be provided for adding extra 15% of total I/O count**
4.2.11 Power supply distribution by MCB.
4.2.12 ALL I/O shall be connected through LED indication & fused terminals.
4.2.13 **Communication link between remote I/O and PLCs shall be redundant.**
4.2.14 All HMI packages shall be of minimum 10,000 tags (1 development version and others run time version). HMI tag if exceed the minimum 10000 tags, then actual requirement shall be supplied by the supplier without any cost.
4.2.15 On-line replacement of modules shall be possible

4.3 Constructional Features

4.3.1 Totally enclosed, sheet steel clad, dust & vermin proof and floor mounting type with IP 41 degree of enclosure. Only **Rittal make** panels of 2150 x 800 x 800 mm size shall be supplied for PLC and remote I/O panels.

4.3.2 Hinged transparent glass front cover shall be provided for PLC panel and the constructional features shall conform to IS:8623 (Part – I) – 1977.

4.3.3 All plug in modules to be mounted in suitable racks.
An extractor / handle to pull module out of rack.
Provision to guard against incorrect insertion and test points to check necessary signal.
Extender module for testing of plug in modules shall be provided.

4.3.4 Panel front, rear and side door shall be using 1.6 mm thick sheet steel and load bearing members with 2 mm thick sheet steel.

4.3.5 Paint shade outside and inside – RAL 7035.

4.3.6 Tinned copper earth bus size – 30 x 6 mm

4.3.7 Two Earthing studs shall be provided externally at side of the panel.

4.3.8 Front door shall be hinged type with concealed hinges.

4.3.9 Door swing shall be 85 to 90 degree.

4.3.10 Cable entry shall be from bottom

4.3.11 Panel shall be free standing type an each panel shall have 4 Nos removable lifting hooks at top.

4.3.12 Suitable cable clamping arrangement shall be provided.

4.3.13 Cable termination shall be done with pin/U type lugs.

4.3.14 Gland plate 3 mm HRSS shall be provided.

4.3.15 All door and cover plates for cutouts shall be provided with suitable Neoprene/ rubber gaskets to give the required degree of protection.

4.3.16 Toughened glass shall be 4 mm thick with rubber beading all around and clamps at back support.

4.3.17 Foundation frame shall be made using MS channels size 75 x 40 x 6 m thick painted black.

4.3.18 Panel internal wiring shall run through PVC channels with covers.

4.3.19 Door shall be provided with locking arrangements.

4.3.20 15 mm anti-vibration pad shall be provided.

4.3.21 Panel to panel jointed sides will be with cork sheet beading between frames.

4.3.22 Tolerance shall be $\pm$5 mm of panel dimension

4.3.23 Heat load data for each panel shall provided

4.3.24 All cubicles, racks and modules to be provided with readily visible identification labels.

4.3.25 Necessary 240V AC power supply spike buster (at least 4 switch sockets) to be provided for connection of instruments during maintenance.

4.3.26 Copper/ Aluminum bus shall be provided for grounding purposes.

4.3.27 All cables shall enter from bottom of panels and removable gland plates will be provided with each cubicle.

4.3.28 *Following shall be provided in each vertical panel –*

5A, 240V, AC Socket outlet with MCB.
Screw type incandescent lamps for cubicle illumination rated for 240V 50 Hz AC switched on by door switches.
Cooling fans of adequate rating for the ventilation of cubicles.

4.3.29 All panel shall be provided with BHEL Logo made of SS.

4.3.30 20% spare terminals shall be provided in each panel

4.3.31 *Metallic parts of all components shall be effectively earthed using green coloured insulated copper wire or other approved means. Electrical continuity of the whole enclosure / frame work shall be maintained even after painting. All hinged doors shall be earthed through flexible earthing braids of copper.*
Electrical & Electronic earthing shall be separate and marked in panels and diagrams.

4.4 Internal Wiring

4.4.1 Shall be with 1100 V grade multi stranded copper wires with PVC insulation.

4.4.2 *Segregation of wiring shall be done for different voltage levels.*

4.4.3 *Cross ferruling system shall be followed for internal wiring. Ferrules shall be interlocked type.*

4.4.4 Wiring

DESCRIPTION	***WIRING COLOUR CODE***
230V ac Phase (UPS & Non-UPS supply)	Red
230V ac Neutral (UPS & Non-UPS supply)	Black
24V DC , +VE	Blue
24V DC , -VE	White
SYSTEM GROUND	Green with White band
SAFETY GROUND (Electronic)	Green
DIGITAL INPUTS	Yellow
DIGITAL OUTPUTS	Blue
ANALOG INPUT / OUTPUT	Red
Relay Contact	Grey

4.5 Terminal Blocks

4.5.1 Shall be suitable for accommodating 2 Nos conductors of 2.5 sq mm copper controls.

4.5.2 Make shall be Phoenix/ WAGO

4.5.3 All TBs shall be fuse TBs with fuse failure LED indication.

4.5.4 Separate sets of terminal blocks for inputs and outputs. Digital inputs & outputs shall have fuses where there is a possibility of short circuit e.g., lamp drives for desks, contactor output etc.,

4.5.5 20% additional interposing relays (for 20% potential free DOs) shall be provided which shall be pre-wired to the TB. All spare contacts of the relays shall be pre-wired up to the TB.

4.5.6 *Terminal blocks shall be properly arranged to facilitate easy termination of cables. They shall have minimum clearance of 300 mm. to cable gland plates and of 150 mm. to adjacent terminal rows, panel sides & other equipment.*

4.6 Wiring Diagrams

In control schemes wiring diagrams, all the wires shall be designated with clearly defined external TB number, internal TB number card slots racks and ferrule Nos.

4.7 Technical specification of system components and auxiliaries

4.7.1 Processing Unit

The CPU will be 32 bit /64 bit microprocessor. It will be modular construction and will be plug-in type. It will be able to perform logic processing, timing counting, latching, comparing, retrieve, storage and arithmetic functions.
For the PLCs with dual CPU configuration in hot standby mode one CPU shall have provision of switching over instantaneously in case of failure, without any loss of system performance to another processor working simultaneously in hot standby mode (bumpless transfer). Both CPUs in master mode shall allow changeover form either to the other.

Any of the CPUs in hot stand-by mode can be master / slave depending on the choice of the user. There shall not be any designated slot for master /slave CPU. The changeover and selection shall be bumpless.

4.7.2 Memory Module

Shall be modular and plug in type. It will be nonvolatile.
Battery back up will be provided for RAM. The battery shall be Lithium/ Ni Cd type with backup for at lest 24 hours.

4.7.3 Input Module (Hot plug-in/ plug-out type)

Modular, plug in type. Input modules shall house LEDs for status indication of each input. Digital inputs shall be 24 VDC. Analog inputs shall be PT100/ 4.20 mA/ k type thermocouple.

4.7.4 Output Module (Hot plug-in/ Plug-out type)

Modules plug in type. Output modules shall house LEDs for status indication of each output. The output contact shall be 24 V DC, 2 A, suitable for driving 170 Amps contactor (relayed out-puts could be used). All individual outputs shall short circuit fuse protection with fuse failure indication. Analog outputs shall be 4-20 ma/$\pm$10 V.

4.7.5 Timers and Counters

- OFF delay and ON delay through software. Time delay will be from 1200 msec. to few hours.
- Timing accuracy will be +/- 0.1% of set value.
- Counter shall be suitable for down, up and up/down counting with range 0000 - 9999

4.7.6 Power Supply Unit

- Shall have following protections.
- Thermostat protection against over temperature.
- Electronic over, current protection.
- Surge voltage protection.
- Distribution of DC voltages to CPU, I/O modules shall be through single pole MCBs.
- Possibility of have Alarm contacts for failure.

Distributed (PLC + RIO panel) power supply unit of 24V DC, 40 Amps rating shall be supplied with PLC and 30 Amps for auxiliary PLC for I/O integration.

4.7.7 Engineering Station

Network level communication from Engineering Station required for program editing/ hardcopy generation of program for each plant unit. From the Engineering station it shall be possible for programming in the form of ladder diagram, statements or functional blocks with conversion from one form to another. Shall include for visual verification of programmer. Able to enter, add, alter and delete logic and data, monitor logic, set points, set timers, search contacts, coils, flags. Program writing or editing shall be editing shall be possible on-line without CPU going in to stop mode. *Programming shall be IEC-1131 compliant. In online mode, the status & logic continuity shall be high lighted. Forcing of I/Os, mode changing of processors, I/O data table view, editing, online program change shall be possible. All the above operations shall be possible both in direct connections with PLC system as well as a node data highway.*

4.7.8 HMI

Each drive can be controlled through HMI. Hence HMI shall be capable of following

Displaying Status information of all drives/systems etc.
Command execution for start/stop, setting of parameters for the system
Report generation
Data logging

Dynamic graphic display of mimic
System overview
Real time / historical trending etc.,
Alarms
Event logging of commands, parameter change etc executed from HMI

4.7.9 Approved Makes

Panel- Rittal
MCB – Havells /Indo Kupp /MDS/ S&S/ Schneider/ Standard
Lamps –Osram / Philips
5A/15A Piano switch –Anchor/Ellora/Precision
Switch socket outlet-Alstom /Anchor/BCH/CGL/ Essen
Power supply –Cossel/ Pheonix
Terminal blocks –Phoenix/WAGO

SECTION V
INSPECTION & TESTING

1.0 Test & inspection shall be as per BHEL/customer approved procedure. BHEL Quality Assurance Plan as per Annexure–I, and Inspection Test schedule as per Annexure-II are enclosed for reference. Supplier shall submit the test & Inspection procedure along with QAP immediately along with the offer.

Supplier shall produce during inspection:

a) Raw material inspection certificate.
b) In House test reports (Type test certificate shall be produced for exactly the same rating/specifications)
c) Statutory certificates as required.

- All Inspection & Testing shall be carried out based on the following documents:-

(a) Relevant Standards
(b) Specifications
(c) Approved Drawings.
(d) Data sheets.
(e) Approved supplier QAP

- Supplier shall furnish all type and routine test certificates along with the inspection call. Manufacturer's test certificates shall incorporate Model No, Sl No etc.

- Supplier shall submit Total BOM along with Inspection call.

- Inspection call shall be given at least 3 weeks in advance with all test reports.

- Supplier shall carryout/demonstrate various routine tests and any other test specified by Customer at suppliers works at no extra cost.

- Test inspection procedure specified hereunder is subject to change during detailed engineering and is only for reference.

- Equipment's Model version should be the latest available in the market.
- All reports / certificates shall bear company seal and signature of supplier / manufacturer.

2.0 Testing shall be carried out strictly as per Quality Assurance Plan, which is approved by Customer

SL. NO	TEST DESCRIPTION	TEST INSPECTION METHOD	ROUTINE TEST (See Note)
1	Visual inspection & dimensional Check.	As per GA drawing	BC
2	Insulation resistance test & HV test	IR measurement with suitable megger before and after HV test. High voltage shall be applied for 1 minute at 1.0 KV with all electronic cards pulled out.	BC
3	Temperature test (aging) for CPU and other modules		A
4	Mechanical vibration test for CPU and other modules		A
5	Functional test for modules and CPU& HMI	As per detailed control scheme and as per manufacturer's practice/approved FAT	BC
6	Noise immunity test for CPU and other modules		A
7	Integrated functional test	As per detailed control scheme and as per manufacturer's practice/approved FAT	BC

Note:-

A -Manufacturer's Test certificate to be furnished

B -Test to be conducted in presence of BHEL's representative & report to be submitted

C -Test to be conducted in the presence of customer / consultant or his authorized representative

SECTION VI
DOCUMENTATION

The following documents shall be submitted by the supplier for approval :

Sl no	Title	No: of copies	Date of first submission
1	Overall system configuration diagram	2 sets	1 week after receipt of LOI
2	Datasheet which includes technical leaflets of modules	2 sets	1 week after receipt of LOI
3	Catalogues + hardware and software manuals for PLC system in CD	2 sets+ 2 CDs	1 week after receipt of LOI
4	OGA ,BOM , Power Distribution SLD for Panel ,QAP, Foundation plan	2 sets	1 week after receipt of LOI
5	UPS power requirement for PLC	2 sets	1 week after receipt of LOI
6	Earthing requirements for PLC panel	2 sets	1 week after receipt of LOI
7	PLC I/O address to be added based on I/O list prepared by BHEL	2 sets	1 week after receipt of LOI
8	PLC Wiring Diagram with ferruling principle	2 sets	3 weeks after receipt of LOI
9	PLC Nest Loading /Module Loading Diagram / IO diagram & Terminal Plan in BHEL format	2 sets	3 weeks after receipt of LOI .Based on BHEL Format which will be provided.
10	Software / design philosophy / connection details for third party interface	2 sets	3 weeks after receipt of LOI
11	Project specific FAT procedures	2 sets	3 weeks after receipt of LOI
12	Internal Test Certificates	1 Original + 2 copies	Along with inspection notice
13	O&M manual –All final approved documents and hardcopy of manuals	2 sets + 2 sets of CDs +RFT	

1) Please note that initially one set of documents to be provided for BHEL approval and then after BHEL approval only the documents shall be multiplied.
2) Resubmission of any document incorporating comments shall be made within 3 days and the number of copies shall be as above.
3) All documents to be submitted in BHEL approved template, a soft copy of which shall be provided.

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4) If any additional document is required during detailed engineering it shall be included.

5) All drawings provided by the contractor shall be on standard size A4/A3 sheets, in the form of black or blue lines on a white background.
6) **Approval of drawings shall not relieve the supplier of his responsibility in terms of the contract**
7) Final payment is subjected to furnishing the complete documentation in required volumes in required number of sets.

SECTION – VII
INFORMATION REQUIRED FROM SUPPLIER

Please check with list below to ensure all the details required below are enclosed. Else your offer may be rejected

S.N.	Description
1	Please mark point wise confirmation for each clause for all sections in a copy of this enquiry specification, deviations major/minor shall be clearly brought out with clause number in a separate sheet. If no deviations are brought out it is assumed that all clauses are acceptable
2	Detailed configuration diagram
3	OGA of panel
4	The following details of CPU offered with **details marked clearly in your standard technical literature** -CPU scan time (in ms/K Byte of binary instruction) – Memory (in MB) available for User program and User tags separately –Type of memory and backup –On line replacement of I/O modules For dual redundant processors -CPU switchover time (in ms) –**Principle of hot standby redundancy** indicating exactly when cross loading takes place in a cycle. –Mark up in standard technical literature that the switchover is bumpless – On-line editing and transfer to secondary processor – How switchover affects HMI (Ethernet connectivity) and I/O connectivity. Any programming required
5	CD containing literature (catalogues + manuals) of all the cards, HMI, PLC programming package, emulator offered.
6	Design principle for third party interface
7	Confirmation that ladder logic, structured text, FB, SFC are all supported
8	Catalogue with rating for 24V dc interposing relay offered for Digital Output
9	List of recommended 2 years spares & commissioning spares

SECTION – VIII
LIST OF DEVIATIONS
(To be filled in by the Tenderer)

Tenderer shall clearly indicate the deviations from the tender specification.

Sl. No.	Deviations	Clause reference & Details	Remarks

FORM NO: IS-QEI-4-410/ 002

INDUSTRIAL SYSTEMS GROUP	ENQUIRY / JOB NO.	IS-BG4-06/01	**QUALITY ASSURANCE PLAN FOR EQUIPMENT**	CUSTOMER	BHEL / ISG
	I/O PO NO. & DATE			PROJECT	Electrics ,automation,instrumentation for Steel Plant Projects
	SUB-SUPPLIER			PACKAGE NO.	
				CUSTOMER REF. NO. & DATE	

INSTRUCTIONS FOR FILLING UP :

1. QAP shall be submitted for each of the equipment separately with break-up of assembly / sub-assembly & part / component or for group of equipment having same specification.
2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents.Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment.
3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
4. Weight in tonnes (T) must be indicated under column 5 for each item.Estimated weights may be indicated wherever actual weights are not available.(Wherever applicable).

ABBREVIATIONS USED :
MFR : MANUFACTURER, CUST : EPI

CODES FOR EXTENT OF INSPECTION , TESTS , TEST CERTIFICATES & DOCUMENTS

Code	Description	Code	Description	Code	Description
1.	Visual	12.	Routine Test as per IS/Other Standard defined.	23.	Short time rating
2.	Dimensional	13.	Type Tests as per IS /Other Standard defined	24.	Operational & Functional Checks
3.	Fitment & Alignment	14.	Impulse Test	25.	Overspeed Test
4.	Physical Test (Sample)	15.	Partial Discharge Test	26.	Flame Proof Test
5.	Chemical Test (Sample)	16.	Heat Run Test/Temp.Rise Test	27.	Clearance and Creepage distance
6.	Ultrasonic Test	17.	Enclosure Protection Test	28.	Verification of BOM
7.	Magnetic Particle Test (MPI)	18.	Calibration	29.	Correctness of Gasket
8.	Radiography Test	19.	Noise & Vibration		
9.	Dye Penetration Test	20.	Test Certificates for Bought out components / Equipment		
10.	Measurement of IR Value Before HV TestAfter HV Test	21.	Tank Pressure Test		
11.	High Voltage Test / Dielectric Test	22.	Paint Shade Verification Including Thickness		

DOCUMENTS

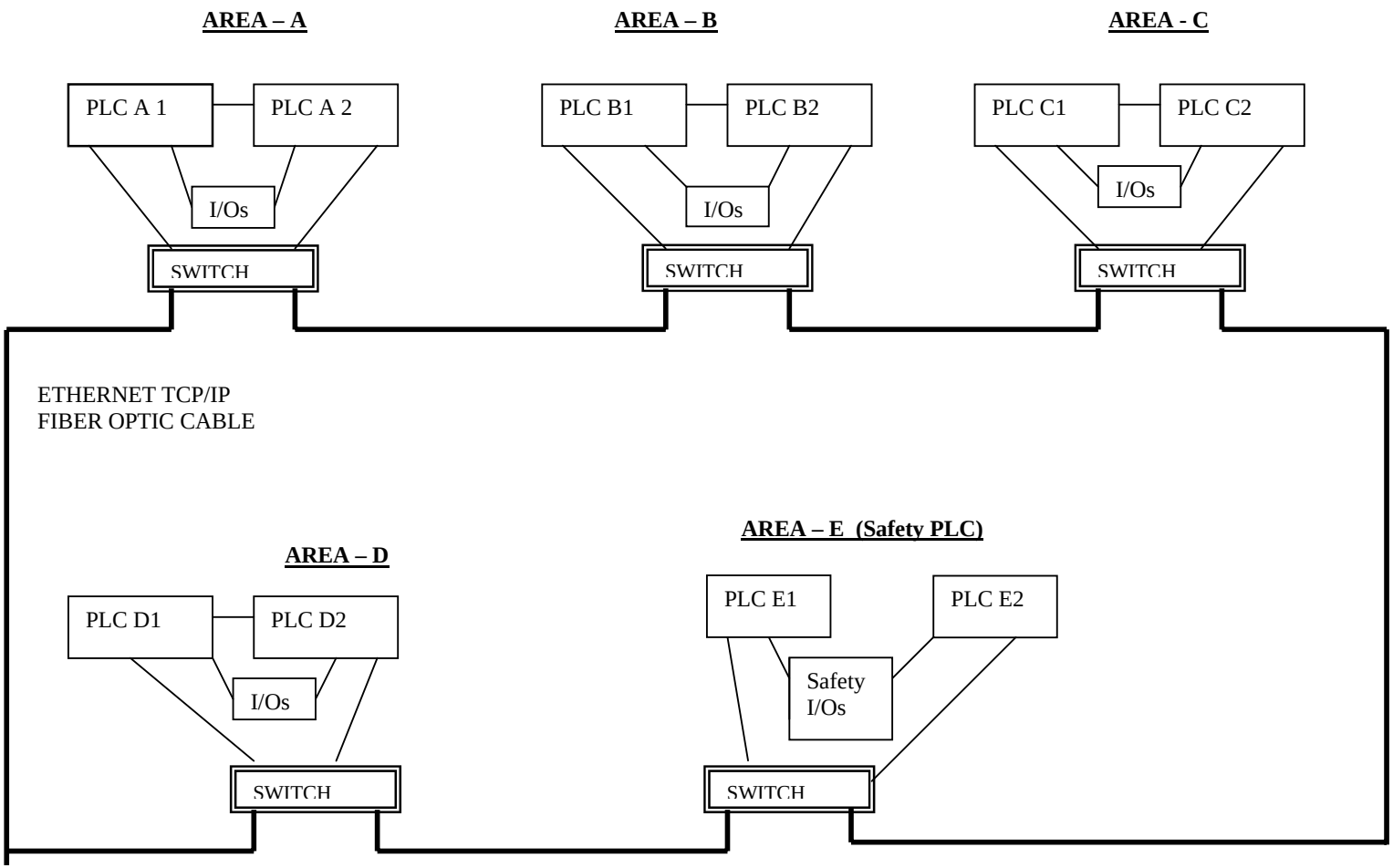
D1. Approved GA Drawings
D2. Approved Single Line Schematic Diagram
D3. Catalogs / Approved Data sheets
D4. Approved Bill OF Materials
D5. Unpriced PO Copy
D6. Calibration Certificate of Measuring Instruments & Guages
D7. Check List of Equipment
D8. Inspection Procedure and Test Schedule. (IS-QEI-4-410 / 001)
D9. Supplier's Recording Format
D10. FAT document

EQUIPMENT DETAILS							INSPECTION AND TESTS						Test Cfts. and Documents for Inspection / Verification	Acceptance Criteria Standard / IS or any other International Standard	Remarks
Sl. No.	Description (With equipment heading , place of use and brief specifications)	Identification No.	Quantity		Manufacturer's name & Address	Expected Schedule of Inspection	Raw Material and In process Stage Inspection			Final Inspection and Test By					
			No./ M	T			MFR	BHEL	CUS	MFR	BHEL	CUST			
1	2	3	4	5	6	7	8	9		11	12		14	15	16
	PLC system		1 Lot		-		1,2,12			1,2,3	1,2,3		D3 , D4		
							3			10,11	10,11		D6 , D8,D5		
										12,20,24	12,20,24		D1,D9,D10		

BHEL	SUB-SUPPLIER:	(QAP NO TO BE ALLOTED BY BHEL)
NAME : Arun.V.Rao	NAME : -	QAP NO. / REV .NO.00
SIGNATURE :	SIGNATURE : -	SHEET 1 OF 1 / DATE :11.07.2008

Annexure-1

CONFIGURATION DIAGRAM FOR A TYPICAL STEEL PLANT AUTOMATION APPLICATION - I

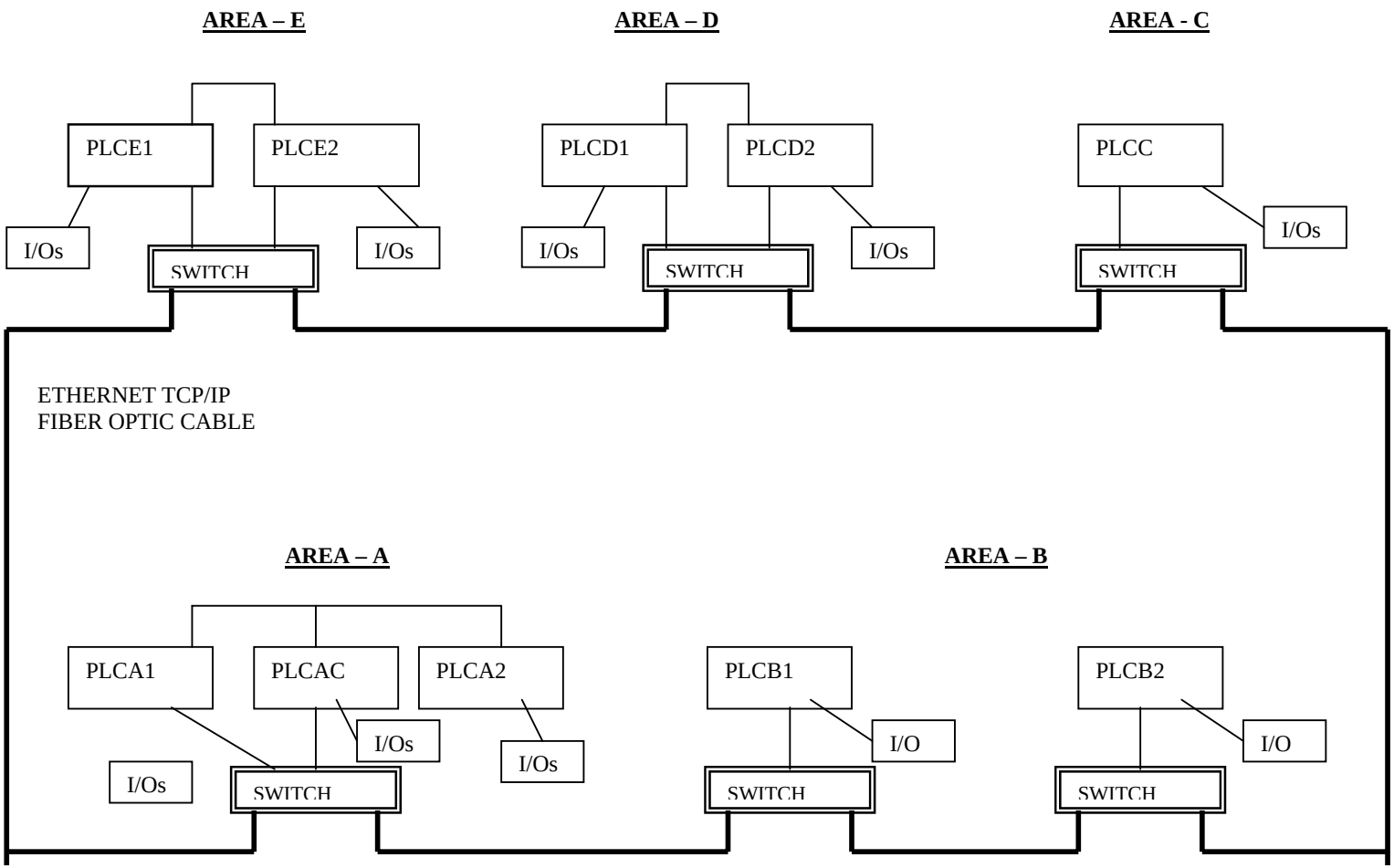


PLC – Programmable Logic Controller

SWITCH – Ethernet 10/100 Mbps Switch with dual Fiber Ports.

I/Os – Remote Input / Outputs & Third Party PLC device Input / outs.

CONFIGURATION DIAGRAM FOR A TYPICAL STEEL PLANT AUTOMATION APPLICATION - II



PLC – Programmable Logic Controller

SWITCH – Ethernet 10/100 Mbps Switch with dual Fiber Ports.

I/Os – Remote Input / Outputs & Third Party PLC device Input / outs.

TECHNICAL SPECIFICATIONS

FOR

AC DRIVE STSTEM

REQUIRED FOR TYPICAL STEEL PLANT APPLICATION

SECTION-B

SPECIFICATION NO: IS.BG4.08/02

CONTENT

Note: Detailed Scheme with catalogues of all items used to be furnished with Technical bid.

Prepared by	Checked by	Approved by
Name: R.M.Savadatti Designation: Sr. Manager Signature:	Name: Arun. V. Rao Designation: DGM Signature:	Name: C.G.K.Pillai Designation: AGM Signature:

SECTION – O

INTENT OF SPECIFICATION

9. The quotation will be made strictly in line with NIT and following conditions.
10. This requirement is not for any project purchase. These specifications are intended to select a vendor for long term contract for sourcing of product for Ongoing and Future projects of BHEL – ISG in Industry.
11. These specifications are made in order to cover a complete requirement of 'Drive System' in Industry. Therefore Drive Vendors are expected to quote for full range of Drives.
12. In case Vendor does not quote for complete requirement of drives, will be disqualified.
13. Deviations if any shall be clearly mentioned in the format given in Section – VIII of this specification only and no where else.
14. Alternate proposal for drives will be evaluated and accepted, if found suitable. However, reference will be made in the deviation format for such cases.
15. Tenderer shall make one copy of this specification duly signed and submitted along with the offer as a token of acceptance.
16. Price
    a. Shall be provided separately for each area as per the price formats provided separately.
    b. Un-priced price format shall be provided along with the techno-commercial offer.

SECTION – I

GENERAL SITE CONDITIONS:

1.1 Project site : STEEL PLANT

1.2 Max.ambient temperature inside control room : 45° C

1.3 Maximum relative humidity : 100 %, non-condensing

1.4 Altitude above mean sea level : Less than 1000 mts.

1.5 Environmental condition : Tropical humid climate with dusty industrial atmosphere. Maximum ambient temperature and maximum relative humidity do not occur simultaneously.

ALL EQUIPMENT SHALL BE DERATED FOR 45 DEG C AMBIENT IN CONTROL ROOM.

SECTION-II

POWER SUPPLY SYSTEM:

2.1 Power Supply

- HT Power Supply : 11000 volts, 3 ph, 50 Hz
  6600 volts, 3 ph, 50 Hz neutral earthed through resistance
- LT Power Supply : 415 volts 3 ph 4 Wire, 50 Hz, solidly grounded

2.2 Control Voltage

415 V Air Circuit breaker operation, AC contactor coil, auxiliary relays, LED indication lamps etc	: 240 V, 1-phase, 50 Hz
Contactor with DC coil	: 220 V DC
Normal single/double solenoid valves	: 24 V DC
PLC Digital Input	: 24 VDC
PLC Digital Output	: 24 VDC

2.3 Voltage and Frequency Fluctuations

Voltage Fluctuation:

- $\pm$10 for 11 kV, 6.6 kV
- ± 10% for 415 V

Frequency Fluctuation: ± 6% for all the voltage levels

2.4 Fault Level

Fault Level (For selection of equipment)

- 40 kA for 3 sec for 11 kV
- 40 kA for 3 sec for 6.6 kV
- 50 kA for 1 sec for 415 V

2.5 The power supply mentioned above will be made available by BHEL at only one place in the panel. For each inverter the necessary distribution and hardware required for distribution within the inverter panel is in the scope of Supplier.

SECTION-III

BASIC PARAMETERS OF AC DRIVE SYSTEM:

The Drive panel shall be complete in all respect and any device not included in the specification but essential for proper operation of the equipment shall be deemed to be within the scope of the specification, whether specifically mentioned in this specification or not.

3.1 Standards

The equipment shall generally comply with the requirement specified in relevant IS/ IES/ VDE specifications in the same order of preference and relevant Indian Electricity Rules and the associated Standards wherever available, in order that specific aspects under Indian Steel Plant conditions are taken care of. In case of major deviations, these will be mutually discussed and agreed upon.

3.2 Basic design parameters for Drive Panel

Power supply

Control voltage - 110/ 220 V AC (to be generated within the inverter panel)

Degree of Protection:

- Drive Panel IP 41

SECTION-IV

SCOPE OF SUPPLY:

All the drives shall be connected to PLC over Industry Standard Ethernet/ Profibus/ Modbus/ controlnet for data/ command exchange.

Drive panel shall be double front type totally enclosed, dust & vermin proof and floor mounted design. `Rittal make' Drive panel shall be with IP 41 class of enclosure as per IS: 2146 - 1962.

The scope consists of:

VVVF Drive Panel with **drive** *rating as per requirement for all the individual units. Broadly following VVVF drives are covered for typical steel plant application:*

4.1 AREA - A:

S No	Description	Motor Type	Motor KW	RPM	Motor Voltage	Motor Qty	VVVF Qty.	Remarks
1.	Converter Tilt Drive	SCIM/T	315	750	415V	4	4	AFE
2.	Lance Hoist	SCIM/T	75	1500	415V	2	2	AFE
3.	Transfer Car	SCIM/T	45	1500	415V	2	2	Each Inverter feeds 2 motors. Load will be shared by both motors. By-pass arrangement shall be made in case of One Drive failure
4.	Scrap box Transfer Car	SCIM/T	75	1500	415V	2	2	Each Inverter feeds 2 motors. Load will be shared by both motors. By-pass arrangement shall be made in case of One Drive failure
5.	ID Fan	SCIM/T	2700	1500	3300V	2	2	

SCIM: AC squirrel-cage motor /T: Motor with temperature monitoring

4.2 AREA –B:

Sl. No.	Equipment	Motor Type	Motor KW	Motor RPM	Motor Voltage	Motor Quantity	VVVF Quantity
1	Roller table	SCIM/G	4	0-1500	415	72	4
2	Roller table	SCIM/G	4	0-1500	415	13	1
3	Roller table	SCIM/G	4	0-1800	415	9	1
4	Pinch roll	SCIM	17	0-1800	415	1	1
5	Shear	SCIM	400	0-1132	690	1	1
6	Stand No. 1	SCIM	480	0-1000/2000	690	1	1
7	Stand No. 2	SCIM	480	0-1000/2000	690	1	1
8	Stand No. 3	SCIM	750	0-1000/2000	690	1	1
9	Stand No. 4	SCIM	750	0-1000/2000	690	1	1
10	Stand No. 5	SCIM	900	0-1000/2000	690	1	1
11	Stand No. 6	SCIM	900	0-1000/2000	690	1	1
12	Stand No. 7	SCIM	900	0-1000/2000	690	1	1
13	Stand No. 8	SCIM	900	0-1000/2000	690	1	1
14	Stand No. 9	SCIM	900	0-1000/2000	690	1	1
15	Stand No. 10	SCIM	900	0-1000/2000	690	1	1
16	Stand No. 11	SCIM	900	0-1000/2000	690	1	1
17	Stand No. 12	SCIM	900	0-1000/2000	690	1	1
18	Stand No. 13	SCIM	900	0-1000/2000	690	1	1
19	Stand No. 14	SCIM	900	0-1000/2000	690	1	1
20	shear #1	SCIM	400	0-1132	690	2	2
21	shear #2	SCIM	315	0-1000	690	2	2
22	Coil transfer	SCIM/G	3	0-1500	415	1	1
23	Lubrication unit	SCIM	55	1800	415	1	1
24	Lubrication unit	SCIM	55	1800	415	1	1
25	Lubrication unit	SCIM	55	1800	415	1	1
26	Stand No. 15H	SCIM	380	0-1000/2000	690	2	2
27	Stand No. 16V	SCIM	380	0-1000/2000	690	2	2
28	Stand No. 17H	SCIM	380	0-1000/2000	690	2	2
29	Stand No. 18V	SCIM	380	0-1000/2000	690	2	2
30	Mill # 1	SCIM	4800	0-900/1500	3300	2	2
31	Mill # 2	SCIM	3600	0-900/1500	3300	2	2
32	Rotary shear	SCIM	160	0-790	415	2	2
33	Pinch roll unit	SCIM	30	0-900/1200	415	4	4
34	Rotary shear	SCIM	160	0-790	415	2	2
35	Chopping shear	SCIM	86	0 -940	415	2	2

36	Pinch roll unit	SCIM	200	0-1500/2700	690	2	2
37	Horizontal Loop Layer	SCIM	250	0-1500/2600	690	2	2
38	First roller table	SCIM	10	65-800/2000	415	2	2
39	Cooling conveyor	SCIM	10	65-800/2000	415	20	20
40	Feeding roller table	SCIM	10	65-800/2000	415	2	2
41	Entry rollers	SCIM/G	1,1	n2=8-158/239	415	4	2

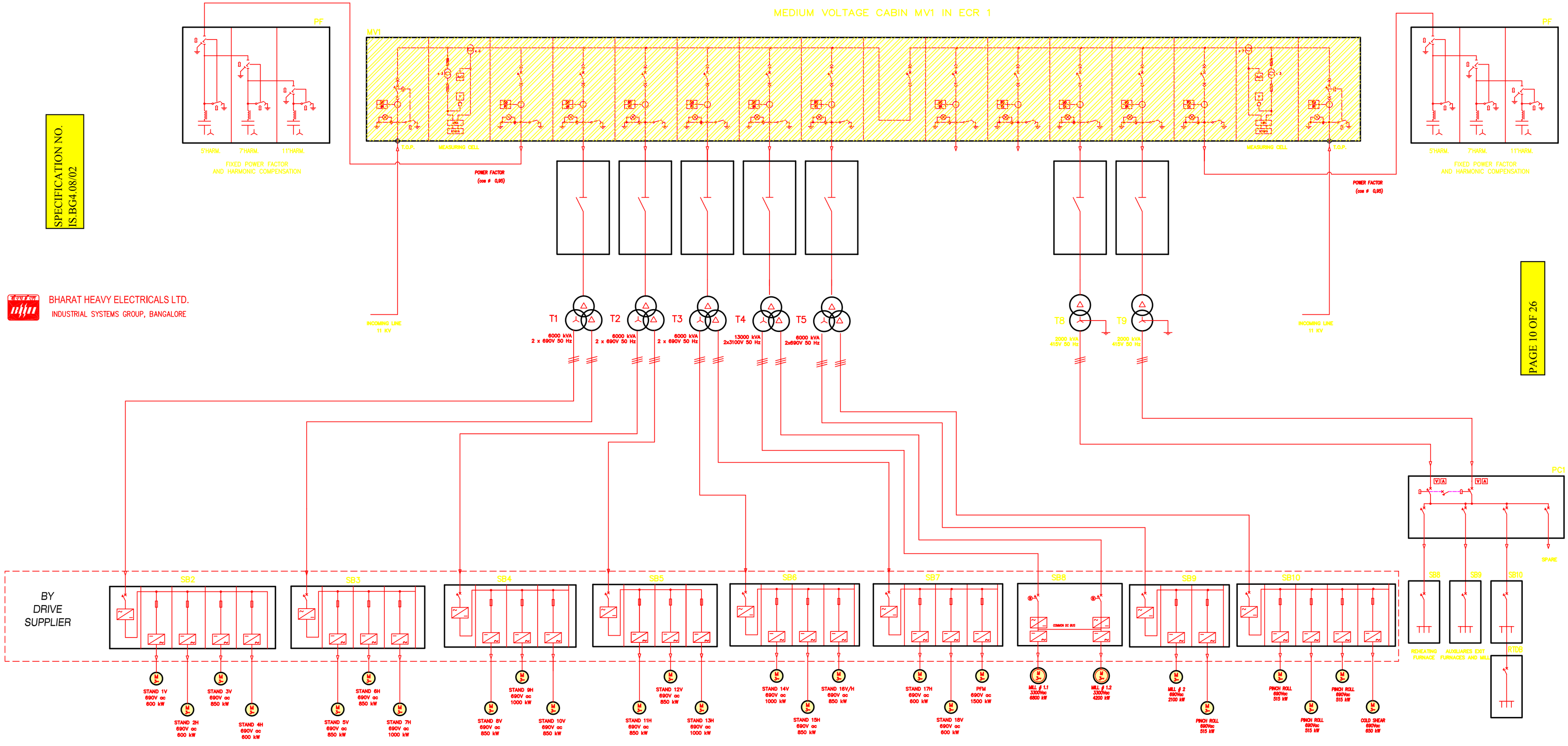
SCIM: AC squirrel-cage motor /G: Gear motor

4.3 AREA –C: 6Hi Cold Rolling Mill

			PAY-OFF REEL	REVERSING REEL 1	MILL STAND	REVERSING REEL 2
Sleeve		mm		690 / 605 * 1150	BUR : 1250 / 1150 * 1750	690 / 605 * 1150
					IR : 560 / 500 * 1990	
Diameter		mm	2200 / (644) - 610	2200 / (638) - 610	WR (1) : 450 / 400 * 1750	2200 / (638) - 610
Motor rating	100%	kW	1 x 0 - 760- 760 / 760	1 x 0 - 2180 - 2180 / 2180	1 x 0 - 5000 / 5000	1 x 0 - 2180 - 2180 / 2180
	115%				1 x 0 - 5750 / 5750	
Motor revolution		rpm	0 - 439- 443 / (1500)	0 - 292- 438 / (1500)	0 - 354 / 955	0 - 292- 438 / (1500)
Motor torque	100%	kNm	1 x 16,5- 16 / (4,8)	1 x 71,4 - 47 / (13,9)	1 x 135 / 50	1 x 71,4 - 47 / (13,9)
	115%				1 x 155,3 / 57,5	
Gear ratio		i	5,519 : 1	2,387 : 1	1 : 1	2,387 : 1
			0 - 80- 80 / (272)	0 - 122 - 184 / (629)		0 - 122 - 184 / (629)
Reels / Rolls (WR) speed		rpm			0 - 354 / 955	
Rolling speed		m/min	0 - 550 - 550 / 550	0 - 844 - 1260 / 1260	0 - 500 / 1200	0 - 844 - 1260 / 1260
Rolling torque	100%	kNm			135 / 50	
	115%				155,3 / 57,5	
Tension (max / min)		kN	80- 80 / 6,7	150 - 101 / 12,5		150 - 101 / 12,5
Axial Thrust to motor shaft (100/175 %)		KN	+/- 4 / 7 *	+/-9 / 17	+/-17 / 30	+/-9 / 17
*: with thrust bearing design +/- 4 / 7kN, without +/- 14 / 28						

All Motors are AC squirrel-cage motor

4.4 AREA–D: SHALL BE WITH ACTIVE FRONT END



SPECIFICATION NO.
IS.BG4.08/02

BHARAT HEAVY ELECTRICALS LTD.
INDUSTRIAL SYSTEMS GROUP, BANGALORE

4.5 AREA –E:

Sl. No.	Equipment	Motor Type	Motor KW	Motor RPM	Motor Voltage	Motor Quantity	VVVF Quantity
1	Mine Winder	SCIM	450	0-1000	415	1	1
2	Mine Winder	SCIM	1100	0-1000	690	1	1

SECTION-V

TECHNICAL SPECIFICATION OF AC DRIVE:

(A) The digital VVVF drive shall be used for intended application (Horizontal travel & Hoist travel control) which require accurate speed and torque control. The efficiency of the digital VVVF drive shall not be less than 97%.

(B) In the case of torque control, torque step rise time for open loop and closed loop control shall be less than 5 ms with nominal torque.

(C) In the case of speed control, for closed loop control, the static accuracy shall be in the range of 0.01 % of nominal speed and dynamic accuracy shall be in the range of 0.1-0.2% sec. with 100% torque step.

(D) Over Loads and Other requirement

a. Common
Following are the common points for all drives, unless otherwise specified elsewhere
   i. Although the ratings shown on the equipment list are at full motor base speed, the motor is capable of operating at down to 30% of base speed, with power decreased proportionately.
   ii. Control for these motors provides regulating means to insure that the steady-state speed error shall not exceed + 0.1 percent of base speed when operating below base speed, and shall not exceed + 0.1 percent of set speed when operating above base speed.
   iii. Each motor and power supply shall be rated 115% continuous, 150% for 60 sec.
   iv. All drives have to be equipped with adjustable current limiting control.
   v. All drives have to allow forward / backward inching.
   vi. Communication between Drives and Level-1 Automation (PLC/DCS) (on Industry Standard Ethernet/ Profibus/ Modbus/ controlnet), are to be established for signal/data exchange by the supplier. Communication shall be through standard protocol. Corresponding protocol with compatible communication module shall be supplied by the supplier. Communication module shall have the facility (selectable) to act like Master or Slave.
   vii. The supplier will consider all hardware & software on Drive side. Any software development/protocol development/driver development for third party device communication is also in the supplier's scope. Any standard software required shall also be considered. Supplier shall include Engineering Station for each area.

viii. The supplier will provide all details and documentation regarding communication interface at different stages to BHEL.

ix. The supplier will demonstrate the interfaces functioning during inspection of Drive system at Supplier's works. Else it shall be demonstrated during integrated testing at BHEL, Bangalore/Supplier's works along with the application software developed by BHEL Bangalore.

x. The supplier is responsible for demonstrating the interface at site to the customer's satisfaction. This shall include connection details on the third party device. Any co-ordination work required at will be done by BHEL and any manual labour required will be provided. Suitable man days including travel, lodging /boarding charges shall be considered by supplier for this purpose.

b. 415V Drives for Converter Tilt Drive Motors

i. Active Front End (AFE)

ii. Converter Vessel Tilting

- Max. tilt speed: nmax = 1.0 rpm
- Min. tilt speed nmin = 0.10 rpm
- Number of motors no. = 4
- Tilt angle = 360 °

iii. Static Torques:

Maximum Normal torque [MB1] = 3800 kNm
Maximum Emergency torque [MBEmer] = 14000 kNm

iv. Dynamic Torque

Moment of inertia related to the motor shaft without motor Jmec = 50 kgm

v. Operational Requirements:

Torques	No. of electrical Motors in operation	Acceleration Time	Deceleration Time	Maximum Speed required
M_{B1}	4	t_A= 4 sec	t_B= 4 sec	n = 1 rpm
M_{B1}	3	t_A= 4 sec	t_B= 4 sec	n = 1 rpm
M_{Bemer}	4	t_A= 30 sec	t_A= 30 sec	Reduced speed

c. 415V Drives for Roller Table Motors

i. Group control with individual overload protection

ii. Reversible, 8/1 range 100% Regenerative. (Extensive electrical breaking and quick reversing required)

d. 415V Drives for Shear Motors

i. Capable of 2 times full load torque for acceleration / deceleration

ii. The converter selected should be able to produce 1.8p.u

iii. 100% Regenerative
iv. speed and position regulated
v. counter type crop cut initiation
vi. Speed Feedback
vii. Shear position indicator by rotary encoder, (pulse encoder or single turn, absolute)

e. 690V Drives for Stand Motors
   i. The Torque available above base speed must be The same as for a dc motor
   ii. Constant power speed range as specified, typically to be 2:1.
   iii. All with individual VVVF unless otherwise specified elsewhere
   iv. Each motor and power supply shall be rated 115% continuous, 150% for 60 sec.
   v. VVVF, non-rev, jog forward & jog reverse, E-Stop & Normal Stop times no longer than 10 seconds with no material in mill.
   vi. The main drive motors and associated regulating equipment must be designed to reduce to a minimum the impact speed drop, the recovery time and the tendency toward oscillation after speed recovery. However, in no instance shall the impact speed drop exceed 0.25 percent-second in terms of base speed when operating at full voltage.

f. 3300V Drives for Stand Motors
   i. The Torque available above base speed must be The same as for a dc motor
   ii. Constant power speed range as specified, typically to be 2:1.
   iii. All with individual VVVF
   iv. Motors & power supplies rated 115% continuous, 10 second load 150% @ base & 140% @ top speed.
   v. VVVF, non-rev, Jog speed = 30 motor R/min max, jog forward & jog reverse, E-Stop & Normal Stop times no longer than 10 seconds with no material in mill.
   vi. The main drive motors and associated regulating equipment must be designed to reduce to a minimum the impact speed drop, the recovery time and the tendency toward oscillation after speed recovery. However, in no instance shall the impact speed drop exceed 0.25 percent-second in terms of base speed when operating at full voltage.

g. Drives for Mine Winder
   i. Each motor and power supply shall be rated 100% continuous, 200% over load frequently applied for 15 secs and occurring 120 times in an hour continuously 250% overload occasionally applied (under emergency operation)
   ii. VVVF, 100% Regenerative, jog forward & jog reverse, E-Stop & Normal stop times no longer than 10 seconds with no material in mill.
   iii. Hoisting speed of 3.6m/s

iv. Speed Feedback

(E) VVVF Converter system for AC drive shall comprise of following main units

a. Converter transformer
b. A.C Power circuit devices
c. Incomer VCB/ ACB / MCCB
d. Ac line surge suppression network
e. Thyristor bridge/ IGBT Converter AC to DC
f. Inverter bridge for DC to AC. The switching devices used in inverters are IGBTs.
g. Regulation & control equipment
h. Protection, indication & annunciation devices.
i. Load side filter, step up transformer as required. The necessity for filter shall be specified with technical reasoning.
j. Line contactor for remote closing of drive and for two motors fed from each inverter along with bi-metal relay.

(F) The VVVF Converter panels shall be sheet steel enclosed of minimum thickness 2 mm, dust and vermin proof, free standing, with base channel of ISMC75, floor mounted having panel illumination lamps, space heaters and sockets for soldering etc.

(G) The control blocks shall be plug-in type with required / necessary test sockets. The layout of components shall be such designed that the testing operation & maintenance is convenient. The panels shall have enclosure with class of protection conforming to IP-41.

(H) The protective features for the VVVF Converter shall include following:

a. Electronic type AC surge suppressor 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. Air Flow/ pressure switch for forced air cooling system.

(I) The DC side of VVVF Converter shall have following features:

a. Smoothening reactor.
b. Indication measurement & feedback of current on DC side.

(J) The digital drive regulation shall be considered ensuring precise control of speed and torque.

(K) The control functions to be carried by the VVVF Converter include following, but shall not be limited to:

a. Reference speed setter
b. Ramp generator
c. Speed feed back & controller
d. Current feed back & controller
e. Pulse transformer & trigger module
f. Logic control & sequence module
g. V/f control
h. Slip compensation control
i. Current limiter
j. Counter current/ regenerative braking
k. Regulated power supply for reference setting:
The variation of (+/-) 0.1% with the input variation of +10% -15% steady state regulation of (+/-) 0.25% against +3%, -6% input supply frequency variation and 100 to 200% load disturbances.

(L) The control regulation equipment shall be compatible to PLC in the distribution hierarchical control.

(M) The protections for the VVVF Converter are to be provided as per the clauses stipulated in IEEE-444 as suitable and required for each case and shall generally include the following.

a. Over voltage & Under voltage on DC link
b. Over current on DC link
c. Transients and surges over voltage and loss of phase.
d. Over speed monitor
e. DC side short circuit
f. DC side earth fault
g. Control power supply failure
h. Inversion fault, di/dt & dv/dt
i. Ventilation failure
j. Wrong phase sequence
k. Motor stalling monitor
l. Earth Fault
m. Any other protection as required for particular application

(N) In case of H.T motor and process drives display and data logging shall be considered by providing printer.

(O) The indications shall be provided as listed but not limited to the following:

a. Voltmeter and an Ammeter for output and input side shall be provided.

b. The Frequency meter for output side to be provided
c. Speed indicator of motor as required. Meter with selector switch for signal measurement at all important power points in regulation system.

(P) The annunciation shall be provided as listed but not limited to the following :
a. Main power ON
b. Control supply ON
c. DC Converter ON
d. DC breaker/ contractor ON & tripped
e. Earth fault
f. Converter transformer fault as applicable
g. Incoming breaker trip
h. Phase loss
i. DC over voltage
j. Microprocessor healthy

(Q) Following faults shall also be annunciated

Converter faults/ Inverter faults:
(R) Overload
(S) Over current
(T) AC fault
(U) DC fault
(V) Fuse failure
(W) Fan failure
(X) Surge suppressor failure

Motor faults:
(Y) Over load
(Z) Over current
(AA) Over speed
(BB) Over voltage
(CC) Speed sensor fault

Alarms:
(DD) Converter overload
(EE) Motor overload
(FF) Earth fault

Drive status:
(GG) Readiness
(HH) Field ON

(II) The load side shall comprise of filter network, suitable step up power transformer and isolator and overload relay for each motor. A provision of by-pass to be made for running the drive in case of failure of VVVF Converter.

(JJ) Motor characteristics if required shall be given during detailed engg phase.

(KK) Control philosophy:

The drive shall be made ON/OFF from Control Desk (CD) / Inverter panel. Drive ON indication shall be indicated on CD/inverter panel. Drive enable input shall be from CD/panel. The Voltage, current, speed of the drive shall be displayed from analog input/output of the drive on the inverter panel. The range shall be decided during detailed engg, Drive reset shall be given from panel. Drive runs in both directions.

Training

2 weeks training for 15 Nos. of BHEL/Customer engineers at your training institute. The training to be considered in two batches.

Constructional features

- Totally enclosed, sheet steel clad, dust & vermin proof and floor mounting type with IP 41 degree of enclosure. Rittal make panels of shall be supplied for Drive Panel.

(A) Panel front, rear and side door shall be using 2 mm thick sheet steel.
(B) Paint shade outside and inside - RAL 7035.
(C) Tinned copper earth bus size - 30x6 mm
(D) Earthing studs shall be provided externally at side of the panel.
(E) Front door shall be hinged type with concealed hinges.
(F) Door swing shall be 85 to 90 deg.
(G) Cable entry shall be from bottom.
(H) Panel shall be freestanding type and each panel shall have 4 nos. removable lifting hooks at top.
(I) Suitable cable clamping arrangement shall be provided.
(J) Cable termination on either side shall be done with pin/ U- type lugs.
(K) Gland plate 3 mm HRSS shall be provided.
(L) All door and cover plates for cutouts shall be provided with suitable Neoprene/ Rubber gaskets to give the required degree of protection.
(M) Toughened glass, if provided, shall be 4 mm thick with rubber beading all around and clamps at back support.
(N) Foundation frame shall be made using MS channel size 75x40x6 mm thick painted black.
(O) Panel internal wiring shall run through PVC channels with covers.
(P) Door shall be provided with locking arrangements.
(Q) 15 mm anti-vibration pad shall be provided.
(R) Panel to panel jointed sides will be with cork sheet beading between frame.
(S) Tolerance shall be ± 5 mm of panel dimension.

(T) Heat load data shall be provided by supplier of each panel.

- All cubicles, racks and modules to be provided with readily visible identification labels.

Necessary 240 V AC power supply socket to be provided for connection of instruments during maintenance.

- Copper / Aluminum bus shall be provided for grounding purposes.

(U) All cables shall enter from bottom of panels and removable gland plates will be provided with each Cubicle.

(V) Panels shall be provided with internal illumination.

(W) All panel shall be provided with BHEL Logo made of SS.

(X) 20% spare Terminals shall be provided.

(Y) 200 mm empty space from bottom shall be provided in the panels.

(Z) Clear, legible identification labels shall be provided for all compartment panels and control devices.

(AA) To ensure good earth continuity all bolted joints shall be provided with tooth spring washers.

(BB) Two separate earthing terminals shall be provided for earthing.

(CC) Components and devices accessible from the front.

(DD) Protection against accidental contact with live parts while maintaining a compartment and keeping others in service.

Internal wiring

- Shall be with 1100 V grade multi-stranded copper wires with PVC insulation.

Terminal blocks

- Shall be suitable for accommodating 2 No conductors of 2.5 sq.mm copper control.
- All TBs shall be either Phoenix or WAGO make.
- Separate sets of Terminal blocks for inputs and outputs.
  Digital Inputs & Outputs shall have fuses where there is a possibility of short circuit e.g. Lamp drives for Desks, contactor output etc.
  20% additional interposing relays (for 20% potential free DOs) shall be provided which shall be pre-wired to the up to TB. All spare contacts of the relays shall be pre-wired up to the TB.

Wiring Diagrams

In control schemes Wiring Diagrams - all the wires shall be designated with clearly defined external TB number, internal TB number card slots racks and ferrule nos.

- All wiring shall be accessible form the front and shall be done be 1.1 KV grade PVC insulated flexible copper wires.

- Not more than one wire shall be terminated in one terminal.
- Interlocked type identification ferrules shall be provided.
- Auxiliary wiring shall be properly marked as per IS 5578 (1984).
- All spare contacts of contactors / relays shall be wired up to terminal block.
- All control wiring shall be of 1.5 sq. mm. multi-stranded wire, P.T. wiring shall be of 1.5 sq. mm. multi-stranded duly colour coded and C.T. wiring shall be of 2.5 sq. mm. multi-stranded duly colour coded. The terminal blocks for the CT's & PT's shall be of disconnecting (CATD) type.

Specification of major components:

Contactors

- All Control contactors shall be AC 3 duty and Power contactor shall be AC 4 duty unless otherwise specified.
- Shall have at least 2NO+2NC auxiliary contacts with minimum rating of 32 A at 415 V.
- For reversible drives mechanically interlocked contactors shall be used.
- All coils shall be suitable for 110/ 220 VAC no economy resistor.
- Insulation of coil shall be class E or better.
- Shall pick up positively at voltage between 85% and 110% of the rated value.

Thermal overload relay

- Bimetallic Triple pole, ambient temperature compensated, inverse time lag, hand reset type.
- Shall conform to IEC - 292 -1.
- Shall have built in single-phase protection.
- Shall be provided with INO + 1NC auxiliary contacts.
- Manual reset push button shall be located on the compartment door.

Motor protection relay

- Protection against thermal overload, earth fault, phase unbalance and locked motor.
- Shall be manual or auto reset type as specified.
- Shall be provided with at least 1NO + 1NC auxiliary contacts.
- 75 kW and above motor starters shall be CMR relay, below 75 kW starters shall be with bi-metallic relay.

Current transformers

- Bar type primaries and 5A (max) secondary
- Measuring CT accuracy class 1.0
- Protective CT accuracy class 10P 10.

Indicating instruments

- Flush mounting, square dial with provision for zero adjustment.
- Accuracy class 1
- Voltmeter and ammeter for incomers 144 x144mm.
- Size of ammeter for motor feeders 96 x 96 mm.
- All meters shall be taut band type (i.e 240 deg. Deflection)

Auxiliary relays

- Coil Voltage 110 V AC
- Rating of contacts shall be at least 10 A.
- All relays shall be provided with RC circuit across the coil as these are driven by PLC.

Control transformers

- Epoxy moulded/ Wound dry type Control transformer shall be double wound dry type conforming to IS -2026 (1977) with tapping at + / - 2.5% and + / - 5% on the primary side. For control supply for each motor feeder module one No. 16A, DP MCB shall be used. Neutral shall be solidly earthed.

SECTION-VI

TEST SCHEDULE AND INSPECTION

6.1 Visual
6.1 Dimensional
6.1 Type test certificates to be given
6.2 Simulation of fault and record the fault indications.
6.3 Inspection notice shall be given 15 days earlier to inspection along with internal test certificates.

SECTION-VII

DOCUMENTATION:

7.1 Following documentation shall be furnished to BHEL at different stages of project indicated below. The drawings shall be prepared in ink and only A3 or A4 sizes shall be used for these documents. Drawing shall accompany with catalogues of all items used in the detailed scheme.

Sl. No.	Description	Time Schedule for submission
1	OGA/GA drawing showing dimensional & mounting details, weight, cable entry details, heat loss data, termination details etc.	6 copies within one week of Placement LOI. For approval.
1a	Detailed scheme.	4 copies
2.	Bill of materials along with catalogues of all components	---- do -----
3.	Internal Test Certificates / Internal Inspection reports	Along with Inspection call.
4.	Final documents for Sl. nos. 1 & 2	8 copies along with final document
5.	Storage instructions erection instructions	8 copies along with final document
6.	Catalogues, operation and Maintenance manuals	1 copy now and 8 copies along with final document.

7.2 All documents shall show the following particulars:-

Name of the customer : BHEL
Project title : Steel Plant application AC Drives
Number of sheets
Sheet number
Revision number
Drawing no

'7.3 Drawings shall be generally in A3 size. However, if inevitable, the size shall be to any one of the following sizes in accordance with Indian Standards: A0, A1, A2 or A3.

7.4 When a drawing is revised, every change made shall be identified on the drawing by circling the changes made and placing the revision number in a small triangle so as to be exactly recognisable. When a subsequent revision is made, the circles made for the previous revision shall be erased and the current changes circled. However, all revision numbers in small triangles shall be retained. In addition a record of revisions along with the coordinates showing the location of revisions shall be indicated at the left hand bottom corner of the drawing.

7.5 List of drawing submitted shall be complete with title, drawing no, no of sheets, size of the drawing (A0/A1/A2/A3), date for submission of drawings etc. Incase of any change in the contents in this list, revised list shall be submitted. A4 size drawings are not acceptable.

7.6 All drawings submitted shall, indicate the type, size, arrangement, weight of each component, breakdown for packing and shipping, the external connections, fixing arangements required, the dimensions required for installation and interconnection with other equipments and materials, clearances required between various portions of the equipment and any other information that is relevant or requested for.

7.7 Free hand drawing, lettering,overwriting, etc. shall be totally avoided and the same shall be stencilled in ink.

7.8 All drawings are to be submitted to customer for approval.If drawings are approved with comments,then the same shall be resubmitted after incorporating the comments . This will not be treated as final submission.

7.9 Test certificates shall invariably consist of details such as Name Plate Data, Project and Customer's Name.

7.10 Test certificates shall be strictly in A4 size (297 x 210 mm).

7.11 Records of test results / readings etc., made during internal testing shall be available during testing / inspection in Customer's presence.

7.12 In case of controversy in the manner of testing and inspection reference shall be made to IS and IEC.

7.13 All drawings and test certificates, etc. shall be marked as "Certified" and signed by the competent authority on the suppliers side.

7.14 Erection instructions shall be complete with necessary instructions for checking and recording proper assembly of equipments.

7.15 Erection drawings shall show all details and particulars in sequence required for ercetion and installation.

7.16 O & M manual shall contain the following

- Details on preventive / repair maintenance for equipments and accessories used.
- Details about the general specifications, design capacities of the equipments, their functions
- Required dismantling devices, tools etc.
- Test certificates.
- Technical literature, catalogues etc.
- Storage and Erection instructions
- Proper procedure & sequence of operation

- Details on consumables.

7.17 All manuals shall be supplied in properly bound books or in folders preferably in A4 size. Illegible copies shall not be acceptable. The volume number and section number of the O & M

Manual shall be intimated to the supplier later.

SECTION VIII

LIST OF DEVIATIONS

(To be filled in by the Tenderer)

Tenderer shall clearly indicate the deviations from the tender specification.

Sl. No.	Deviations	Clause reference & Details	Remarks

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FORM NO: IS-QEI-4-410/ 002

INDUSTRIAL SYSTEMS GROUP	ENQUIRY / JOB NO.	IS.BG4.06/02	**QUALITY ASSURANCE PLAN FOR EQUIPMENT**	CUSTOMER	BHEL
	I/O PO NO. & DATE			PROJECT	VVVF INVERTER DRIVE
	SUB-SUPPLIER			PACKAGE NO.	
				CUSTOMER REF. NO. & DATE	

INSTRUCTIONS FOR FILLING UP :

1. QAP shall be submitted for each of the equipment separately with break-up of assembly / sub-assembly & part / component or for group of equipment having same specification.
2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents.Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment.
3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
4. Weight in tonnes (T) must be indicated under column 5 for each item.Estimated weights may be indicated wherever actual weights are not available.(Wherever applicable).

ABBREVIATIONS USED :
MFR : MANUFACTURER, CUST : BHEL

CODES FOR EXTENT OF INSPECTION , TESTS , TEST CERTIFICATES & DOCUMENTS

Code	Description	Code	Description	Code	Description
1.	Visual	12.	Routine Test as per IS/Other Standard defined.	23.	Short time rating
2.	Dimensional	13.	Type Tests as per IS /Other Standard defined	24.	Operational & Functional Checks
3.	Fitment & Alignment	14.	Impulse Test	25.	Overspeed Test
4.	Physical Test (Sample)	15.	Partial Discharge Test	26.	Flame Proof Test
5.	Chemical Test (Sample)	16.	Heat Run Test/Temp.Rise Test	27.	Clearance and Creepage distance
6.	Ultrasonic Test	17.	Enclosure Protection Test	28.	Verification of BOM
7.	Magnetic Particle Test (MPI)	18.	Calibration	29.	Correctness of Gasket
8.	Radiography Test	19.	Noise & Vibration		
9.	Dye Penetration Test	20.	Test Certificates for Bought out components / Equipment		
10.	Measurement of IR Value Before HV TestAfter HV Test	21.	Tank Pressure Test		
11.	High Voltage Test / Dielectric Test	22.	Paint Shade Verification Including Thickness		

DOCUMENTS

D1. Approved GA Drawings
D2. Approved Single Line Schematic Diagram
D3. Catalogs / Approved Data heets
D4. Approved Bill OF Materials
D5. Unpriced PO Copy
D6. Calibration Certificate of Measuring Instruments & Guages
D7. Check List of Equipment
D8. Inspection Procedure and Test Schedule. (IS-QEI-4-410 / 001)
D9. Supplier's Recording Format
D10. FAT document

EQUIPMENT DETAILS							INSPECTION AND TESTS						Test Cfts. and Documents for Inspection / Verification	Acceptance Criteria Standard / IS or any other International Standard	Remarks
Sl. No.	Description (With equipment heading , place of use and brief specifications)	Identification No.	Quantity		Manufacturer's name & Address	Expected Schedule of Inspection	Raw Material and In process Stage Inspection			Final Inspection and Test By					
			No./ M	T			MFR	BHEL	CUS	MFR	BHEL	CUST			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Vvvf inverters		As per enquiry		-					1,2,3,10	1,2,3,10	1,2,3,10	D3 , D4		
										11,12,20,	11,12,20,	11,12,20,	D6 , D7, D8		
										22,24,28	22,24,28	22,24,28	D1,D9,D10		

BHEL	SUB-SUPPLIER:	(QAP NO TO BE ALLOTED BY BHEL)
NAME : A.V.RAO	NAME : -	QAP NO. IS-1-06-2002/QAP-590-001 REV .NO.00
SIGNATURE :	SIGNATURE : -	SHEET 1 OF 1 DATE :11-07-08