

KAMENG HYDRO ELECTRIC PROJECT (4 x 150 MW)

PURCHASE SPECIFICATION (TECHNICAL) OF 10 KVA, 240V AC INVERTER AND AC DIST. BOARD

		NORTH EASTERN ELECTRIC POWER CO. LTD. (A GOVERNMENT OF INDIA ENTERPRISE)						
PROJECT :- 4x150MW KAMENG HYDRO ELECTRIC POWER PROJECT								
		BHARAT HEAVY ELECTRICAL LTD. BHOPAL INDIA		DEPT CODE HPE 415	NAME PREP CKD APPD	SIGN SS RE RE	DATE 28.06.19 28.06.19 28.06.19	NO OF VAR 00
REV 00	DATE 28.06.19	ALTERED SS CHECKED RE APPROVED RE	TITLE :- PURCHASE SPECIFICATION (TECHNICAL) OF 10 KVA, 240V AC INVERTER AND AC DIST. BOARD.		SUB-VENDOR DRG. NO.		PO REF.	NO OF ITEMS
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1.0 SCOPE:-

The scope shall include planning, design, engineering, manufacturing, assembly, testing, inspection, packing, delivery, supply, transportation of specified number of Inverter as detailed given below.

Sl. No.	Equipments	Qty	Remark
1.	INVERTER PANEL comprising of following: Each set comprising as following • 10 KVA inverter with static switch, manual bypass switch, Bypass Isolation Transformer with SCVS, distribution feeders etc.- 01 Set • AC Distribution Boards (Wall Mounted)- 04 Nos.	01 Set	Refer SLD (drawing no: 32926119002)
2.	Supervision of Erecting &Commissioning of Inverter	01 Set	-----

Price shall be furnished separately as per equipments given above.

The supplier shall ensure completeness of equipments for correct functioning of Inverter and include any other device/equipments as necessary that may not have been specifically mentioned in these specifications, but are usually necessary for completion of equipments for satisfactory and trouble free operation / maintenance of the equipments. The supplier shall include the same without any extra cost to BHEL. All new equipments are to be supplied.

2.0 PROJECT DETAILS:-

Refer annexure-A

3.0 REFERENCE STANDARDS:-

(i) Indian standards :-

- IS: 1248 - Electrical indicating instruments.
- IS: 13947 - Degree of protection provided by enclosures for low voltage switchgear and control gear.
- IS: 3895 - Poly-crystalline & semi-conductor rectifier cells & stocks
- IS: 4540 - Non-crystalline & semi-conductor rectifier assemblies & equipment.
- IS: 13947 - Low Voltage Switchgear & Control Gear (Pt. 1 to 3).
- IS: 8828 - Miniature air break circuit breakers for voltage not exceeding 1000 volts.
- IS:8623 - Factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V DC.
- IS: 2209 - HRC fuse links up to 650V.

(ii) International standards :-

- IEC 60073 : Basic and safety principles for man-machine interface, marking and identification - Coding principles for indication devices and actuators
- IEC 60076 : Power transformers
- IEC 60146 : Semiconductor converters
- IEC 60204 - 1 : Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- IEC 60359 : Expression of the performance of electrical and electronic measuring equipment
- IEC 60364 : Electrical installations of buildings.
- IEC 60439 - 1 : Low voltage switchgear and control gear assemblies, Part 1: Requirements for type-tested and partially type-tested assemblies.
- IEC 60447 : Man-machine interface (MMI) - Actuating principles
- IEC 60529 : Degrees of protection provided by enclosures. (IP code)
- IEC 60060 : High voltage test techniques
- IEC 61000 : Electromagnetic compatibility (EMC)
- IEC 62040-3 : Uninterruptible power system – Method of specifying the performance and test requirements

All equipments and material shall comply with the latest revision of standards.

If requested by BHEL, the supplier shall supply at his own expense, one copy in English & one in original language of standards applicable to the contract.

4.0 CONSTRUCTION & DESIGN FEATURE OF UNINTERRUPTIBLE POWER SUPPLY (INVERTER)

The Inverter shall be designed to operate continuously at rated capacity as on-line. Normally the DC power shall be supplied to the critical loads directly. In the event of DC power failure, the inverter shall derive its input from 415V AC supply. In case of DC supply resume, the input supply shall be automatically switched AC to DC power without any interruption.

The inverter panel shall include:

- i) Electronic switches / accessories for uninterrupted power supply
- ii) Instruments for Input/output voltage, current and frequency
- iii) Alarms on the panel front

i)	Inverter Type	IGBT based PWM Inverter.
ii)	Rated capacity	10kVA (minimum) at $\cos \phi = 0.8$ lag.
iii)	Rated input voltage	Source-1: 220V DC + 10% to -15% Source-2: 415V AC $\pm 10\%$
iv)	Rated output voltage	1 phase 240V AC
v)	Rated frequency of output	50Hz
vi)	Voltage regulation	$\pm 2\%$
vii)	Frequency	$50 \pm 0.5\%$ Hz
viii)	Wave form	Pure Sine wave, with max. 2.5 % THD at linear load & max. 5 % THD at 100% non-linear load
ix)	Inverter efficiency	Min 90% at 100% Load
x)	Overload capacity for 100 ms	2 times rated current
xi)	Overload capacity for 1 min	1.5 times rated current

4.1 DESCRIPTION OF THE SYSTEM

Power Module

Each power module will be composed by following functional blocks:

- **Booster/ DC-DC Converter**
- **Inverter**
- **Bypass switch**

A) Booster / DC-DC Converter

The booster/ DC to DC converter shall boost 220V DC as per inverter input voltage requirement. The booster utilizes solid state Pulse Width Modulation (PWM) controlled Insulated Gate Bipolar Transistors (IGBT).

B) Inverter

The inverter shall generate AC power derived from DC power supplied from the 220V Station DCDB. The inverter shall be capable of providing rated output as specified while operating from any DC voltage within the operating range. The inverter shall utilize the following technology:

1. Solid state PWM controlled IGBT power transistors.
2. UPS Module Full Direct Digital Control (DDC) Adoption:
 - Field Programmable Gate Array (FPGA) Control.
 - DSP based Control

Voltage Regulation :

The inverter output voltage shall not deviate by more than $\pm 1\%$ RMS with the following steady state conditions:

- 0 to 100% loading.
- Inverter DC input varies from maximum to minimum.

Voltage Adjustments

The inverter shall have the ability to automatically/manually control and adjust the output voltage to within $\pm 5\%$ of the nominal value.

Voltage Transient Response:

The dynamic regulation and transient response shall not exceed $\pm 2\%$ for 100% step load (applied or removed), $\pm 1\%$ for loss or return of AC input and $\pm 5\%$ for inverter to bypass and vice versa transfer.

Transient Recovery

Voltage transient response shall not exceed the above specification and shall recover to within nominal voltage regulation tolerance within 20 ms.

Frequency Control :

The Inverter output frequency shall be controlled by an oscillator internal to the UPS module logic. It shall be capable of synchronizing to an external reference (e.g. the bypass source) or operating asynchronously. A message located on the touch screen shall identify the loss of synchronization. Synchronization shall be maintained at 50 Hz $\pm 0.5\%$ continuously for the duration of loss of the external reference. The Inverter output frequency shall not vary during steady state or transient operation due to the following conditions:

- 0 to 100% loading.
- Inverter DC input varies from maximum to minimum.

Output Voltage Harmonic Distortion :

The inverter output shall limit the amount of harmonic content to 2.5% maximum at 100% linear load, and 5% maximum at 100% non-linear load. The need for additional filtering to limit the harmonic content shall not be required. Therefore high efficiency, reliability and original equipment footprint are maintained.

Output Overload Capability:

The inverter output shall be capable of providing an overload current while maintaining rated output voltage (and voltage regulation) to:

- 200% for 10ms duration.
- 150% for 1 minute duration.

Inverter Output Isolate:

The inverter output MCCB isolates the inverter from the load and bypass source as per Single line diagram.

C) Bypass Switch:

The bypass switch shall be two types:

- Static bypass switch
- Manual bypass switch

In the event that the inverter must be taken off line due to an overload condition or inverter failure, the critical load shall be transferred to the bypass source via the static switch without interruption of AC power to the critical load. A paralleling, wrap-around contactor shall be used to maintain the bypass source. The static switch shall only be utilized for automatic emergency transfers. A re-transfer from bypass to inverter shall be performed automatically in overload conditions. Manual bypass switch shall be used for manual transfer of load. The rating of the bypass switch shall be as per Single line diagram.

5.0 REQUIREMENT FOR PANELS:-

Design and construction features of the panels/board shall be subjected to BHEL / customer approval. Panels/board constructed with prefabricated and preprinted standard & new components of reputed make will be preferred.

- | | |
|------------------------|---|
| ➤ Sheet metal | - 2 mm thickness CRCA steel sheet & 1.6mm thickness CRCA steel for side cover. |
| ➤ Base frame | - 5 mm thick M.S. channel frame with accessible foundation holes |
| ➤ foundation | - Anchor bolts with associated hardware to be provided |
| ➤ Lifting arrangement | - Eye bolt/hooks to be provided |
| ➤ Gland plate | - Bottom/Top gland plates undrilled min 3 mm thick stainless steel |
| ➤ Doors | - 2.0 mm thickness CRCA steel sheet , concealed hinged doors with door handle and key for locking arrangement, door swing 120 °C. |
| ➤ Protection class | - IP 42 |
| ➤ Gasket | - Neopren rubber for all doors, covers & opening & joints |
| ➤ Antivibration pad | - Neopren rubber |
| ➤ Dimension of cubicle | - All floor mounting cabinets shall be mounted on a bases channel 100mm high minimum |

5.1 Design and Construction:

The panels shall be totally enclosed and shall have adequate cross-ventilation arrangement to avoid any undue rise in temperature. All equipment and wiring shall be tropicalized, dust and vermin-proof. The degree of protection provided for the panel shall be IP: 42 as per IS: 13947. Necessary terminals for grounding the panels with two distinct and separate earthing shall be provided.

All external cable connection to the panels shall be arranged for bottom entry. Suitable cable glands and supports shall be provided for PVC insulated unarmoured cables.

The panel shall be so designed as to permit extension in either direction and shall be complete with all accessories, including fixtures, supporting frame channels, foundation

bolts, etc. for securing the panels to the floor. Space heaters to operate from the 240 V AC supply shall be provided. The panel shall match with that of charger panels in respect of colour shade & enclosure thickness and shall be given necessary primer and finishing coats.

The incoming and the outgoing feeders shall be controlled by moulded case circuit breakers. All the breakers shall be provided with instantaneous and thermal over load releases. The breakers shall be suitable for manual operation. The breakers shall be removable from front without disturbing the electrical connections. The breakers shall be provided with "ON" and "OFF" indicating lamps. The making and breaking capacity of the breakers shall be stated by the tenderer.

The DC bus shall be provided with an insulation checking device comprising of a selector switch (for checking insulation of the positive and negative bus) push button, potentiometers with centre earthed a voltmeter and a voltage relay for annunciation. The device will measure the insulation of each pole in k-Ohm/M-Ohm and also indicate the voltage of each pole with respect to the earthing point. Alternatively the tenderer may quote the standard device normally used to detect earth fault and measure the insulation of each pole of the DC bus.

DC under voltage relays shall be connected to initiate alarm whenever the bus voltage falls below 198 V.

At least 10% spare terminals shall be provided in the terminal blocks. The interior of the panel shall be provided with AC lighting and spare AC plug socket for maintenance test, etc.

All wiring shall be properly supported and cleated. Both ends of the wiring shall have numbered ferrules for proper identification.

The panel/board shall be designed for operation under site condition given below

SITE CONDITION:-

- | | |
|-----------------------------|---|
| (a) Ambient air temperature | -3.3 ° C (Dry bulb) (min), 40 ° C (max) |
| (b) Humidity | 100 % |
| (c) Earthquake zone | Zone -V. Also Refer " SEISMIC DESIGN " |
| (d) Altitude above M.S.L. | Less than 1000m |

5.3 MANUFACTURING AND ASSOCIATED INSPECTIONS

5.3.1 MANUFACTURING

5.3.1.1 GENERAL

The supplier shall establish rules to guarantee the conformity of the equipment to the specified characteristics and performances.

The entire supply shall be manufactured in the factory.

5.3.1.2 MARKING

Each board and each section shall be marked using two screwed or riveted plates: one shall be on the fixed part of the front, the other at the rear, if this is accessible.

5.3.1.3 CORROSION PROTECTION

Metal surfaces to be painted shall be smoothed and prepared to ensure adherence of anti-rust coating.

After application of the anti-corrosion coating, machining or drilling of the parts shall be prohibited.

The finished painted surfaces shall be smooth, with no roughness, bubbles, scratches, etc.

The Employer reserves the right to refuse any equipment with appearance defects.

5.3.2 CONTROL DURING MANUFACTURING

The supplier shall perform, during manufacture, all inspections and tests guaranteeing that specifications on design and manufacturing are complied with.

Cabling inspection shall include verification of conformity of wiring to the design drawing and documentation on wiring.

5.3.3 FACTORY TESTS

5.3.3.1 GENERAL

Equipment shall be tested and assembled exactly as it will be when in normal operation. Testing shall concern:

- ◆ The entire board and cabinet,
- ◆ Components (sections, draw-out racks, switchgear, etc.).

The tests shall comply with type-tests defined in IEC standards 60439-1 - IEC 60158-1 - IEC 60947-1 - IEC 60947-2 - IEC 60947-3 and IEC 60947-5-1.

The tests shall be performed on elements assembled within the board and cabinet. However, tests of which the results are not likely to be affected by the presence of the board may be performed on detached elements (to be specified in the test report).

5.3.3.2 TESTS ON THE ENTIRE BOARD AND/OR CABINET

The following tests shall be performed:

- ◆ Visual inspection

Conformity of:

- the assembly of sections,
- paint and quality of the board's surface finish,
- labelling of the board,
- measuring and protection equipment of the board,
- switchgear within the cabinets.

- ◆ Verification of degree of protection

Verification shall be carried out in compliance with IEC standards 60529 (clauses 7 and 8) and IEC 60439-1 (clause 8.2.7.).

- ◆ Verification of dielectric qualities

For main and auxiliary circuits, tests shall be performed in accordance with modalities specified in IEC standard 60439-1 (clause 8.2.2.4.).

The board and cabinets shall be assembled as for normal operation, i.e. with all access panels in place, door closed and switchgear in service position.

- ◆ Verification of the earth circuit

Tests shall be performed in accordance with IEC standard 60439-1 (clause 8.2.4.2.).

These tests shall apply to the earthing circuits of boards and cabinets, including the flow of current from the sliding contacts of the draw-out rack to the boards and the general earth point.

- ◆ Verification of non-spreading of flames

These tests shall be performed on conductors, cables and organic components within boards and cabinets (partitions, chutes, etc.).

Test samples of conductors and cables shall undergo verifications in compliance with IEC standard 60332-2. Other samples taken shall be subject to the glowing wire test in accordance with IEC standard 60695-2-1.

5.3.3.3 COMPONENT TESTS

The following tests shall be performed:

- ◆ Verification of mechanical operation

Tests shall be performed in accordance with IEC standard 60439-1 (clause 8.2.6.).

Each type of rack shall undergo the following tests:

- testing of operations involving movement of withdrawal parts into service position and disconnected position, and handling of these parts,
- testing of safety devices (*interlock*) and verification of their mechanical strength.

- ◆ Verification of electrical connections

Tests shall be performed according to working drawings.

Each type of board bay and each cabinet shall undergo the following tests:

- ◆ testing of switchgear (circuit-breaker, contactor, thermal protection device, CT, etc.),
- ◆ inspection of cabling,
- ◆ inspection of marking,
- ◆ testing of main and auxiliary terminal blocks located in the cable connection compartment,
- ◆ live tests on control of breaking devices (contactor, circuit-breaker, etc.) and on the associated auxiliary contacts for each piece of equipment (extending to control terminal blocks),
- ◆ testing of voltage level at the power terminal blocks after energising of each section.

All these tests shall be recorded in the factory test report.

5.3.3.4 PREPARATION FOR SHIPPING

After acceptance the supply shall be prepared for shipping.

Following surface preparation, all metal parts which could be subjected to corrosion shall be covered with protective material, excepting surfaces of parts to be embedded in concrete. Such surfaces shall be cleaned of any mill scale, rust or paint and of any traces of pollutants (e.g. grease).

5.4.0 VERIFICATIONS AND ON-SITE TESTS

5.4.1 TEST ON COMPLETION

The aim of these tests shall be to verify the installation of the bays and boards and their correct functioning after assembly.

5.4.1.1 PRIOR TO ENERGISING

Factory inspections and tests shall be performed again on site, with, in addition, the following:

- ◆ Verification of electrical continuity between exposed conductive parts and the general earth circuit,
- ◆ Trial operational tests, coordinated with other supplier,
- ◆ Testing of interlocks with the rest of the system,
- ◆ Testing of main and auxiliary circuit insulation,
- ◆ Verification of phase order,
- ◆ Correct functioning of protection relays and their action on equipment.

5.4.1.2 AFTER ENERGISING

Inspections and tests shall be as follows:

- ◆ Setting protection devices (circuit-breaker, thermal protection, insulation monitoring device),
- ◆ Testing of automatic control devices,
- ◆ Testing of indicators (voltmeters, ammeters, etc.)

All these tests shall be recorded in the site test report.

5.5 BUSBAR:

The busbars shall be of high conductivity copper confirming to relevant standard liberally sized for the specified current ratings (both short circuit and continuous current ratings). Maximum temperature rise of the bus-bar and bus bar connections when carrying rated normal current shall not exceed 30 degrees C above ambient temperature. The neutral bus shall run along side and full length of the phase busbar and it shall be rated for half the normal current rating of the main bus for the same short circuit current.

Calculations for arriving at the cross section of the busbars taking into consideration the temperature rise and fault level shall be furnished along with the prequalification bid.

Busbar shall be of uniform section/rating throughout the length of the panel and shall be capable of being easily extended at site on either side.

The horizontal and vertical busbars shall be insulated throughout their length by heat shrunk, coloured HR PVC sleeves to provide protection. The sleeves shall be able to withstand the temperatures attained by busbars during normal service and short circuit

conditions. **Painting of Busbars will not be considered as Insulation.** Main busbar joints shall be provided with removable thermosetting plastic shrouds/heat shrinkable HR PVC tape.

Appropriate colour bands/ colour sleeves shall be used in each compartment to identify the phase sequence of the horizontal and vertical busbars.

Busbars shall be adequately supported and braced to withstand the stresses due to short circuit currents. All the busbar supports shall be made of glass reinforced thermosetting plastic having anti tracking design.

Separate support shall be provided for each phase of the busbars. If a common support is provided for all the three phases, anti-tracking barrier shall be incorporated.

The busbars shall be housed in totally enclosed busbar chambers completely shrouded from the feeder units and cable chambers. The incoming connections from the busbars to various feeders shall be so designed as not to disturb the cabling connection, to ensure safety of operating and maintenance personnel and facilitate work on the outgoing side of a particular feeder without the necessity to switch off the adjacent feeders .

Horizontal and vertical busbars shall be enclosed in separate chambers.

The bus bars and supports shall be designed to withstand a short circuit fault level of 25KA for 1 second. (Necessary type test certificates of identical design shall be furnished along with the prequalification bid.)

All joints of bus bars shall be made by suitable bolts and nuts only and shall be tightened using Belleville washers only.

Disconnectable neutral link shall be provided for each feeder.

A separate copper earth bus of adequate cross section as per the relevant standard shall be provided through out the length of the Board wherever not specified.

6.0 TESTS AND INSPECTION:-

6.1 ROUTINE AND ACCEPTANCE TEST

All routine & acceptance tests shall be carried out as per relevant standard and approved QA plan. Supplier is required to submit QA plan, checklist & inspection report formats for approval. Final inspection shall be done and testing will be witnessed by BHEL & customer representatives.

Routine test and Acceptance tests on Battery, Battery Chargers, Inverters, UPS and Distribution Board shall be performed as per relevant IEC/IS with latest amendments.

Following Test on Inverter/UPS shall be performed at the manufacturer works as per IEC/ IS :-

- BOM, Dimensions, Paint Shade
- Rating
- Light Load Test
- Overload Capacity test
- Voltage/ Current Stability Test (Input line)

- Regulation/Full load Test
- Power Efficiency Test
- Regulation, Ripple & Noise Measurement Test
- THD at linear load (Harmonics measurements)
- Protective device Test (Short Circuit test)
- Output Over Voltage/ Under Voltage test
- AC input Failure & Return test
- DC failure & return test
- Synchronization Test
- Unballanced/ Ballanced Load test
- Transfer- Retransfer Test
- Dynamic/ Transient response test (Overshoot/ Undershoot test)
- Checking of Protective Devices
- Measurement of Inherent Voltage Regulation
- Alternating current Input Return Test
- Manual Switching from Inverter to Mains and Back at Full Load
- Manual bypass switch test
- Heat run test
- Rated Full load Test
- Burn in Test
- Measurement of Neutral Grounding Voltage
- Alarm & indication test (Auxiliary Device Test)
- HV and IR Test
- No Load Test
- Out Put Test
- Restart test

Assembled AC Distribution panels shall also be subjected specifically to following routine tests at supplier's works.

(i) Mechanical operation test	--
(ii) Continuity test on wiring & earth connections	--
(iii) I.R. measurement before and after H.V. test / Milivolt drop test	- By 1000V megger (IR > 100M ohms)
(iv) H.V. test	- 2.5KV rms for 1 min on power and control circuit
(v) Operation/Functional/Sequence test/ Visual inspection	- As per schematic diagram

6.2 TYPE TESTS

All type tests on panel shall be done as per relevant standard.

Type test certificate for specified enclosure protection class, short circuit and temperature rise tests for similar design & rating shall also be required.

In case valid type test reports are not available/not acceptable to customer. The supplier shall carry out the type test (without any extra cost to BHEL) as per relevant IEC/ International Standards on one apparatus of each type and similar rating and shall be submitted the reports to the customer for approval.

6.3 FIELD TESTS

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Supplier, in the presence of representative of the Customer.

Procedure to be adopted for conducting the operational, pre- commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Customer.

6.4 Tests during installation, pre commissioning and commissioning

At least the following tests shall be performed:

- Installation check of all components installed according to drawings and engineering,
- Functional test of subsystems,
- Functional test of complete system,
- AC withstand voltage tests,
- Functional and operation tests,
- Measurement of the insulating resistance of batteries, power and control circuits against earth,
- Adjustment of protection equipment,
- Resistance measurement of all major circuits,
- Other tests as suggested by the Contractor.

6.5 Field Acceptance Tests

At least the following acceptance tests shall be performed.

- Physical examination,
- Polarity and absence of short circuit,
- Testing of voltage uniformity,
- Ampere-hour capacity,
- Insulation resistance test.

6.6 RECEIVING AND INSPECTION AT SITE

Upon arrival to site, the Supplier shall formally identify his equipment and shall verify:

- The condition of the equipment and goods,
- The compliance with the packing list.

After this verification, equipment shall be stored in compliance with storage instructions.

The Supplier shall inform the Employer of any problem observed during equipment inspection or storage, and in particular if any problem observed may affect the overall Project deadline.

The Supplier shall transmit all necessary instructions for correct storage of parts on site; they shall define all precautions required to maintain the packing in good condition; a copy of these instructions shall be attached to each package, and shall be accessible when parts are stored in their storage areas; these instructions shall also appear in the equipment operation and maintenance guide.

7.0 GENERAL REQUIREMENTS

7.1 TERMINAL BLOCKS:

The terminal blocks for power and control circuits shall be of ELMEX make or equivalent and shall be stud type and suitable for connecting ring type lugs

For CT and PT circuits CAT DM4 type of ELMEX make or equivalent make, disconnecting type and shall be suitable for connection of ring type lugs.

The power and control TBs shall be separated by a barrier in order to avoid accidental touching of Power terminal while working on control circuits.

All TBs shall be suitably labeled for identification.

Terminal blocks shall be sturdy and made of good quality moulded phenolic resin or other suitable synthetic insulating materials. Terminals shall be designed to avoid bimetallic corrosion. Any changes in site connections should be such that it should not disturb internal wiring.

Required number of terminals with at least 20% spare shall be provided for all circuits.

7.2 NAME PLATES:

Engraved acrylic resin labels for identification of the switch gear, switch gear boards and on all incoming and outgoing feeder compartments and various equipment there of shall be provided. The exact legend to be engraved will be furnished after placement of order.

7.3 EARTHINGS:

The earthing contact and the general earthing system should satisfy the requirement given in IS: 8623 under "Protection against shock in case of fault" The earthing contact and rest of the path of the protective conductor (earth bar) should have a low resistance and should be able to carry the let through energy of the protective device (generally fuses) in the associated feeder circuit. The earthing contact employed should make contact in all the three positions namely "service", "test" and "isolated".

Continuous earth bus bar of minimum 6x50 mm tinned copper conductor, connected to earth terminals at two ends, shall be provided. All metal casings of current carrying components shall be connected to the earthing bus with bi-colour (green & yellow) HR PVC FRLS insulated tinned copper wire. Hinged doors shall be connected to earth bus by bare copper flexibles. Two number brass terminals with necessary hardwares shall be provided on the panel for earthing. Earthing symbol shall be shown near each earthing terminal. Details of earth terminals and earth busbar shall be shown in General Arrangement drawing.

7.4 AIR CIRCUIT BREAKERS:-

Air circuit breaker shall be four pole electrically operated drawout type of latest design conforming to BIS 13947 part-2 (latest issue). ACB shall have proven microprocessor based protection trip unit and following features.

- Inverse time over current and earth fault release.
- S.C. release with adjustable time delay
- Self powered.
- Memory function
- Integrated test and query function.
- Potential frees contacts for remote trip indication.

Various time delays and current settings shall be continuously adjustable over wide range, A separate direct operated instantaneous short circuit release shall also be provided as backup to micro processor trip unit. The ACBs with self checking function like ready to close condition, contact erosion will be preferred.

The operation of trip switches shall comply with IEC standard 60947-2.

7.5 CONTACTORS:-

The contactor shall be able to shut-down the running motor (in accordance with the definition of category AC3 of IEC standard 60947-4-1.).

Contactors mounted as reversing switches shall have mechanical and electrical interlocks ensuring that the two contactors are never closed at the same time (in accordance with definition in category AC4 of IEC standard 60947-4-1).

The number of on load operating cycles for electrical endurance (in accordance with IEC 60947-4-1, annex B.2.1.) shall be 30×10^6 with a maximum frequency of 15 cycles per hour.

The ratio of starting currents for motors in transient state and blocked rotor ($\hat{I}_R / I_R$) may reach 2.5.

The contactor shall be able to perform at least two consecutive motor start-ups from cold in one hour under normal operating conditions.

The values measured for opening and closing times shall fall within the acceptable outer values.

7.6 "CONTACTOR/FUSE" COMBINATIONS:-

The characteristics of this combination once implemented shall be such that for any fault current level below or equal to the presumed short-circuit current, the coordination, in accordance with NFC standard 63.810 (or equivalent International Standards), shall be of type "T".

However, the "contactors/fuses" combination shall be replaceable by a "contactor-magnetic circuit breaker" combination as long as the breaking capacity is sufficient. In this case, the operation of the circuit-breaker trip switch shall comply with IEC standard 60947-2.

In either case, the combination once implemented shall be such that for the supply of an I_n rated motor, with thermal release set at $1.15 I_n / R$ (R being the transformation ratio of the current transformer) no deterioration of associated equipment shall occur.

Post fault re-commencement of operation shall necessitate at most a change of fuses and resetting of the protection relay (or the circuit-breaker).

7.7 CONTROL /INTERLOCK SCHEMES:-

Automatic change over control circuit shall be provided in LV board. In case main supply failed, board/panel shall be automatically connected to standby supply.

The automatic changeover shall be within a period of time which ensures a safe and continuous operation of the units without any shutdown.

When the failing power source is again available, the associated LV switchboard shall be automatically disconnected from the other and then supplied by its normal power source.

All automatic transfer devices (including control) shall be independent systems, and shall be integrated in the considered board.

General protection circuit breakers, contactors and board to board coupling circuit breakers, and disconnectors (if any) shall be:

- ◆ Electrically controlled (opening and closing), locally and remotely,
- ◆ Mechanically and electrically interlocked, whenever the board is supplied by several sources or whenever boards are paired (coupling circuit breakers).

Circuit breakers / MCCB / Power contactor shall be mechanically and electrically interlocked in order to ensure safety manoeuvres.

Supplier shall take adequate quantity of auxiliary contactors, timers, relay, etc. to achieve the automatic change over system & any items required to achieve the same shall be provided without extra cost.

7.8 DRAWOUT ASSEMBLIES/ MODULES

- | | |
|----------------------|--|
| ➤ Drawout system | - Roller with guide rails, preferably telescope type |
| ➤ Power contacts | - Stab-in type silver plated |
| ➤ Control contacts | - Spring loaded sliding types silver plated |
| ➤ Module position : | |
| • Service | - Power and control contacts engaged, test contacts disconnected |
| • Test | - Power & control contacts disconnected, test contacts engaged. |
| • Isolate | - All contacts disconnected |
| ➤ Interchangeability | - Modules of same rating shall be interchangeable |

7.9 LAYOUT OF DEVICE:-

- Symmetrical and uniform.
- Terminal shall be easily accessible.
- No mounting direct on panel covers.
- Operating level of front door mounted device to be maximum 1500mm and not less than 750 mm from floor.
- The cubicle shall contain enough extra space for 20% more equipments.

7.10 LAYOUT OF TERMINALS:-

- Min clearance between gland plate and bottom most terminal block - 250 mm
- Min spacing between adjacent terminal raw/columns - 150 mm

7.11 ELECTRICAL CLEARANCES:-

- Phase to phase - 25.4 mm (min)
- Phase to earth - 19 mm (min)

7.12 AUXILIARY SUPPLY VOLTAGE:-

Auxiliary supply voltage :-		
- AC	:	240V / 415V AC
- DC	:	24V / 220V DC
Voltage and frequency operating limits :-		
- 415V, 3-Phase/1-Phase	:	-15% to +10% voltage $\pm$ 5% Hz
- Inverter supply	:	$\pm$ 5% voltage $\pm$ 1% Hz
DC system :-		
- 220 V	:	-15% to +10% voltage (187V to 242V)

7.13 EXTERNAL CONNECTIONS:

All incoming & outgoing connection shall be by cables. Cable entry shall be from top or bottom as per approved GA drawing. Cable lugs for all power cables and cable gland for all power and control cables shall be supplied by supplier loose with the boards. Necessary AL cable clamps/cable supports shall be provided in the board. Separate cable alleys shall be provided in modular & compartmentalized panels/boards.

7.14 INTERNAL WIRING:

Stranded copper conductor, annealed and tinned PVC insulated conformed to IS 1554

- Lugs
 - Crimping types, tinned copper with insulation sleeve, ring type for device terminals. Pin type or jaw type for terminal blocks.
- Ferrules
 - PVC, for colour refer clause "Marking & labeling"
- Ferrules numbering
 - To read from device terminals outward
- Method
 - Bunch wiring or PVC duct wiring

7.15 SIZE AND COLOURS FOR WIRING

All internal wiring shall be at least of seven stranded copper conductor type.

CIRCUIT	SIZE SQ. MM	COLOUR
Control, auxiliary circuit		
-AC	1.5 mm ²	Black
-DC	1.5 mm ²	Grey
VT secondary	2.5 mm ²	R -red, Y-yellow, B-

		blue, N-black
CT secondary (1 or 5A)	4 mm ²	R -red, Y-yellow, B-blue, N-black
CT secondary outside the cabinets (5A)	6 mm ²	R -red, Y-yellow, B-blue, N-black
Earthing of metallic cases of devices	2.5 mm ²	Bicolour - green & yellow
Power circuit :- -AC (3 phase) - AC (1 phase) -DC	As per circuit rating -do- -do-	R -red, Y-yellow, B-blue, N-black R -red, N-black Positive - Red, negative Blue

For all analog measurement circuits (e.g. 4-20mA or 0-10V) special terminal blocks shall be supplied, so as to allow easy inspection of portable measurement device.

In the case of no voltage operating circuits, the terminal blocks gathering the tripping circuits shall include a mechanical protection

A minimum of 20% of reserve terminal blocks shall be installed.

Within the interposing cubicle, the conductors, continuity shall be ensured by crimping pre- insulated connectors. The latter shall be installed on the supporting combs. Unused conductors shall be maintained with the same length as the longest connected conductor, and their ends carefully insulated after crimping a connector

In certain interposing cubicle, it shall be necessary to provide terminals, and in this case clip connections shall preferably be used.

All cabinets and cubicles shall be equipped with incandescent or fluorescent lighting controlled by door switch. Lighting sources shall not disturbed the functioning of electronic equipments.

All cabinets shall be equipped with power supply sockets for

- UPS supplied power
- Normal AC distribution power

UPS sockets shall only be used for special maintenance purpose (e.g. connection of portable maintenance tools) and shall be limited to 500W each. UPS sockets shall be clearly distinguished in term of size and plug type.

7.16 MARKING AND LABELLING:-

(i) MARKING:-

All markings shall be made of a material which maintains its mechanical qualities over time, under normal ambient and atmosphere conditions. Any exceptional ambient conditions shall be taken into account.

All marking shall be legible and indelible, and written in the language English/Hindi. Marking with removable stickers shall be prohibited.

Unless specified otherwise all marking and tagging shall comply with the applicable requirements of IEC Standards

(a) SUB-ASSEMBLY IDENTIFICATION

Each equipment sub-assembly shall be equipped with a name plate comprising in particular:

- ◆ the Supplier's name or his manufacturing brand,
- ◆ identification of type, series number, and serial number,
- ◆ any special identification,
- ◆ electrical or mechanical characteristics,
- ◆ function.

Marking of the sub-assembly as designated on the diagrams or drawings shall also appear on this name plate.

(b) COMPONENT MARKING

Each component of a system shall be easily identifiable. This requirement shall apply in particular to components, terminals, conductors, actuators, and indicators. The same markings shall be recorded on the various diagrams or drawings.

Each element that is separately dismantled shall be identified by a unique marking. Different elements (including identical elements of two different assemblies) shall have different markings.

This marking shall be inscribed on the element itself, the connector or the fixed element, as well as on all documents and drawings.

- ◆ **Identification of plug-in printed circuit boards**

Each board shall be perfectly identifiable by means of inspection stamps, update indexes, etc. The space reserved for this type of circuit shall bear the type and the necessary marking.

- ◆ **Marking of actuators and operation elements**

Markings shall allow easy identification of an element, as well as a precise indication of the moving direction and the foreseen result.

The indicator light colors shall be defined in the detailed specifications. These specifications shall remain within the framework of existing standards (see IEC 60073).

- ◆ **Marking of components**

All basic components shall be easily identifiable (*type, value*), with clear and legible marking.

- ◆ **Marking of plug-in elements**

Each plug-in element shall be marked with its function, possibly with a code. When repetitive functions necessitate several identical elements, additional marking numerals shall be added.

The fixed part into which the element is plugged shall bear identical marking, to prevent mixing up of equipment.

(c) MARKING OF CABLES AND WIRING

CABLE MARKING

Cable identification marking shall be steel sheet metal tags or any other material withstanding chemical and atmospheric factors, attached at both ends with clamps withstanding the same constraints.

The marking on a cable end shall correspond to the equipment connected to the opposite end. This marking shall be completed with the cable's identification symbol.

The marking shall be engraved in the plate.

All cable conductors connected to a terminal block shall be marked according to the terminals to which they are connected.

MARKING OF WIRING

Wiring terminal end colors (SEE CLAUSE « marking system ».)

Each wire shall bear at its ends a color coded mark or tag. The color coding scheme shall be designed to prevent maintenance errors by providing an easy to remember means of identifying the general function of the wire.

Within individual devices (*change-over switches, separate relays, instruments, metering, etc.*) or assemblies (*protection boxes, automatic control boxes, relay boxes, auxiliaries boxes, HV equipment junction cabinets, indicator light boxes, etc.*) systematic use of colored terminal ends shall not be required.

All markings for terminal blocks, cables, conductors, and wiring shall be recorded on the corresponding diagrams and drawings.

All choices of label-holders, terminal end markers, etc. shall be submitted to the Employer for information.

Types of marking

Marking shall be performed with ferrules or similar elements, of an appropriate diameter for the wiring in question. Marking with stickers shall be prohibited.

- ◆ DC. supply circuit
- Direct polarities

The wires of DC direct polarities shall be marked with red or blue ferrules (*positive or negative polarity*), along with an indication of the corresponding polarity (*control, horn, alarm, etc.*), followed by marking with numerals (in increasing order from left to right and bottom to top).

- Cut-off polarities (arriving not directly from polarities distribution)

The wires of cut-off DC polarities shall be marked with purple terminal end ferrules, completed with the marking recorded on the corresponding repair diagram. Marking shall be black on a yellow background.

- ◆ AC. supply circuits
- Direct polarities

The wires of AC direct polarities supply circuits shall be marked with an orange terminal end ferrule, with the displacement index of the phase in question.

- Cut-off polarities (arriving not directly from polarities distribution)

The wires of cut-off AC. polarities shall be marked with terminal end ferrules according to CLAUSE « marking system », completed with the marking recorded on the corresponding repair diagram. Marking shall be black on a yellow background.

TERMINAL END FERRULES CHARACTERISTICS

All terminal end ferrules shall be inserted onto the conductors that they identify.

They may be made:

- ♦ of straight parallelepipeds with a square base,
- ♦ or cylinders of moulded material,
- ♦ or of tubular elastic sleeves.

They shall be colored indelibly according to the marking system defined hereafter.

MARKING SYSTEM

♦ Terminal End Ferrules Colors

The following table indicates the color of terminal end to be used, according to the type of circuit to which the conductors belong.

TYPE OF CIRCUIT	ADDITIONAL MARKING	COLOURS
Direct auxiliary DC. circuits (<i>general polarities for dedicated supply or information, proportional DC. Telemetry circuit, etc.</i>)	positive polarity	Red
	negative polarity	Blue
Direct auxiliary AC. Circuits	phase displacement index	Orange
Voltage transformer secondary circuits	phase displacement index	Gray
Current transformer secondary circuits	phase displacement index	Green
Closing and tripping of breakers		White
All other switched circuits		Purple

♦ Marking of the Neutral Conductor and the Phase Conductors

The neutral conductor and the phase conductors shall be marked, indelibly, either directly on the terminal end, or if this is impossible, on an additional ferrule, with the following symbols:

- For the neutral conductor: the letter N
- For the phase conductors of the alternative auxiliary circuits: the letters A - B - C, or R-Y-B or the displacement index

- For secondary circuits of instrument transformers: the network's corresponding displacement index or the letters A - B - C or R-Y-B, if marking by phase displacement number is impossible.

CODE USE

- ◆ *Direct circuit* (DC polarities, AC supply) shall mean the conductors from the source which can only be cut off using protective or disconnecting devices used for isolation and locking of the circuit or the dedicated supply of which they are a part (*fuses, circuit-breakers, disconnectors, contactors, links, signalling switches for the dedicated supply, etc.*).

After passing through relay contacts or contactors in a manual or automatic operating chain in the system, a direct conductor's color shall change to a new color corresponding to the function performed (*white, purple*).

- ◆ In the particular case of "no-voltage" diagrams, the common circuit for closing and tripping can be marked with *bi-coloured black and white* terminal ends, made by placing a black and a white terminal end ferrule next to each other.

MARKING OF CABLE RACKS

A cable rack shall be identified by markings on its supports (*a series of numerals and/or letters*).

For this purpose, each cable rack shall be marked at several points when length is considerable and at each change in direction or level.

MARKING OF PROTECTIVE SHEATHS LEAVING THE EARTH CHAMBERS

These protective sheaths shall be:

- ◆ Black : for the main earth circuit
- ◆ White : for the exposed conductive part collectors
- ◆ Red : for neutrals at high voltage

All connections leaving the control chamber, as well as all connection links, shall be insulated with a 1.50 m long plastic sheath.

(d) MARKING EQUIPMENT

◆ Name plates

Name plates shall be made of amagnetic material (*e.g. dilophane*) and engraved. They shall be attached with screws or rivets, never glued. Their shape and color shall be in accordance with IEC 60073 standard.

◆ Component marking labels

Labels shall be made of amagnetic material (*e.g. dilophane*) and screwed or riveted (to fixed supports and not to chute covers unless the latter have also been marked), never glued.

• Relays

- ⇒ Alarm relays shall be distinguished by a yellow label.
- ⇒ Safety relays shall be distinguished by a red label.
- ⇒ Automatic control relays shall be distinguished by a black label.

• Other components

- ⇒ Circuit-breakers, contactors, and transducers shall be marked with black labels.

- **Indicator lights**

⇒ Indicator lights shall have the following colors:

White	: presence of voltage
Yellow	: alarm or outgoing unavailable
Red	: "in operation" (circuit-breaker closed or valve open), tripping fault
Green	: "out of service" (<i>circuit-breaker open or valve closed</i>)

(ii) DESIGN:-

The supplier shall provide parts lists for all equipment and elements with full identification marking corresponding to their function.

7.17 SEISMIC DESIGN:-

The supplier shall design all equipment supplied under this contract to satisfy the following seismic criteria. The Supplier shall submit to the Employer the method of calculation and relevant codes he intends to use for this purpose.

(a) Maximum Credible Earthquake (MCE)

The design acceleration for the MCE shall be defined: 0.5 g (mean PGA).

All equipment supplied under this contract shall be designed to withstand an earthquake of the magnitude of the MCE without any breach of safety. Interruption of operation and power production and significant damages shall be acceptable. However, the equipment shall be capable of shutting down safely.

(b) Operating Basis Earthquake (OBE)

The design acceleration for the OBE shall be defined: 0.2 g (mean PGA).

All equipment supplied under this contract shall be designed to safely withstand an earthquake of the magnitude of the OBE, without any significant damage. The equipment shall be capable of either maintaining operation through such an event or, if a shut down occurs, to be re-started after appropriate verifications within 24 hours.

In addition to the above, the IS 1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipments in addition to hydro static loads.

7.18 ELECTRICAL DEVICE:-

SL. NO	DEVICES	APPROVED MAKE	GENERAL SPECIFICATION
1	Air circuit breaker	Siemens, L&T, BCH, GE, CGL, Schneider, ABB.	3/4Pole, 50KA for 1 sec, with 6NO + 6NC aux. switch and trip signal potential free contact, control & charging/tripping device voltage 24VDC / 220VDC. Drawout type, electrically operated with door interlock mechanism, microprocessor based (IDMT, O.C., E.F., S.C.) release, local mechanical ON/OFF operation, indication, position indication, mechanical & electrical interlock and standard accessories.

			Utilization category B Rated Operating duty:- B-3 Min, M-B-3 Min.-MB
2	Moulded case circuit breaker	Siemens, L&T, BCH, GE, CGL, Schneider, ABB.	3 Pole, TH O.L. & S.C. release, current limiting type, aux. switch, alarm/trip switch, door interlock & door handle, S.C. interrupting capacity 50KA at 415V Rated Operating duty:- B-3 Min, M-B-3 Min.-MB
3	Miniature circuit breaker	Siemens, MDS, ABB, Schneider	S.C. interrupting capacity of 25KA, 240V AC
4	Fuse switch	L&T, siemens, C&S	Panel mounting type with neutral link and door interlock handle mechanism
5	Thermal o/l relay	L&T, Siemens, C&S	Hand reset type with 1NO+1NC potential free contacts and single phase preventor
6	Power contactors	L&T, siemens, BCH, Telmecanique	With minimum 2NO+2NC aux. contacts
7	CT & PT	Kappa, Intravidyut, Instrans engg, Paras, Kalpa	Epoxy cast, acc class 1.0 for metering & 5P20 for protection class
8	Indication meters	AEL, MECO, RISHABH	Deflection 90°/240° acc. Class 1.0 size 96x96mm cramped scale for motor circuit
9	Energy meter	SEMS, ABB, Schlumberger	Digital type, Acc. Class 0.2
10	Trivector meter	DAE pvt. ltd., Secure meters, BHEL B'lore, L&T, ABB	Digital type, Acc. Class 0.2
11	Selector and control switches	Kaycee, salzer	Switch board type with square aluminum escutcheon plate, stay put type with spade handle SRN type with pistol grip handle Control - break before make Selector- make before break
12	Pushbuttons (P.B.) illuminated P.B. (IPB) & signal lamp	L&T, siemens, Teknic, ABB, GE	22.5 dia. Size Contact rating - 1A at 220V DC - 6A at 230V ac Lamp - Multi LED type
13	Auxiliary contactor/ relay	L&T, siemens, ABB, BCH, telmecanique	-----
14	Time delay relay	L&T, siemens, EAPL	Electronic
15	Transducers	ABB, AE, RISHABH, Southern	Dual & isolated outputs calibrated 4-20mA output, 24VDC / 220VDC / 240V AC supply, Acc. Class 0.5
16	Protection relays	ABB, Siemens ALSTOM, BHEL, TOSHIBA	Numerical communicable as per protocol IEC 61850, 24V/220V DC operated wherever required
17	Permanent insulation monitoring device	Merlin Gerin/ Schneider	- Automatic fault detection, locating and measurement. - 4NO+4NC potential free aux. contacts for

	(PIM)		remote indication/alarm/trip
18	Cubicle heater, thermostat, illuminations lamps, switch & sockets	Any reputed make	Standard components with BIS mark
19	Fuses	Siemens, L&T, GEC ALSTOM, S&S	Standard components with BIS mark
20	Control terminals blocks	ELMEX, equivalent reputed make	Clip on screwed, stud type with transparent shrouds
21	Power terminal blocks	ELMEX, equivalent reputed make	• Clip on screwed, stud type for cable up to 6 sq. mm • Moulded bolt type for cables up to 70 sq. mm • Busbar type for cable above 70 sq. mm
22	Cable gland	Reputed make	Double compression solid brass gland, suitable for cable size
23	Check synchronizing relay	GEC ALSTAM or equivalent reputed make	Static
24	Synchroscope	Reputed make	Electronic type, bezel 96x96 mm
25	Auto synchronizer	Reputed make	
26	Ethernet switch	During detail design	Ethernet switch suitable for protocol IEC 61850

NOTE: Any other reputed make proposed by supplier has to be approved by BHEL/Customer.

7.19 NAME PLATE/LABELS

NAME PLATE/LABEL	MATERIAL		FIXING
<u>External</u>			
- Main title	Acrylic resin or anodized aluminum	15 mm	Screwed
-Function	Anodized aluminum	5 mm	Screwed
-Device no	Anodized aluminum	5 mm	Screwed
<u>Internal</u>			
-Device no.	Acrylic resin or anodized aluminum	3 mm	Pasted
-Rating	Anodized aluminum	3 mm	Pasted

7.20 SAFETY REQUIREMENTS

- All metallic cases of devices to be connected to earth bus.
- Two earthing terminals of brass, one on each side of panel with earth symbols, and complete with two nuts, two plain washer and one spring washer.
- Door interlock for main switching device
- Safety shutters on power contacts opening in drawout sections.
- Safety instruction, danger warning labels near open live terminals (415V and above)

7.21 ENVIRONMENTAL REQUIREMENT

In compliance with ISO 1125001 & OHSAS 1800, the equipments supplied shall not contain any material, which is detrimental to the safety of environment. Guidelines for the end user for handling & disposal of any harmful packing material shall be clearly given in the instruction manual. Statutory clearances required from local authorities if any are in supplier's scope.

7.22 PAINTING - CORROSION PROTECTION

All metallic enclosures shall be coated with a textured polyester epoxy coating (minimum thick 60 µm) applied either over pre-galvanized steel or over a primer (after derusting degreasing and phosphatization).

For metallic enclosures installed outdoor or in humid areas, epoxy coating shall have a minimum thickness of 120 µm, and shall be fungicide.

The equipment's attachment elements, hinges and locks shall undergo hot galvanizing. All drilling shall be performed prior to galvanizing.

All hinges, screws and bolts, locks, handles, etc. shall be protected from rust and corrosion either by treatment or by nature (*stainless steel, metallising, dacrometisation, etc.*).

- Pre treatment
 - Seven tank cleaning degreasing , derusting & phospating process
- Colour shade & finish
 -
 - External colour shade shade be 631 (*) as per IS:5
 - Internal - Colour shade shall be provided during detail design
 - * Subject to customer approval.

8.0 PURCHASER RIGHTS

Purchaser reserves the right for altering / modifying the scheme/drawings even if the panels are under manufacture/testing. The supplier shall have to make the corresponding changes in the panels as required.

9.0 RECOMMENDED SPARES:-

The supplier may furnish as optional the list of recommended spares in addition to the mandatory spares which are essentially required for satisfactory operation & maintenance of the equipment.

10.0 PACKING, SHIPPING & STORAGE:-

Supplier shall furnish packing list as per format given in Annexure-B one month before dispatch.

Standard packing instructions are given in Doc. No. HSE-Pkg.inst-01.

(a)Electrical and Electronic Equipment

Circuit Breakers

Switchgear cubicles shall be packed and shipped in separate and convenient sections. All withdraw able equipment like circuit breakers and circuit breaker arc-chutes shall be

packed and shipped separately. All relays and instruments shall be packed and shipped separately, with their operating mechanisms temporarily immobilized, for transport purposes.

Batteries

Batteries, except those of the sealed type, shall be shipped in dry, uncharged condition. Appropriate quantity of acid of the correct specific gravity shall be shipped separately in non-returnable porcelain jars packed in steel wire baskets.

Cables

Cables shall be shipped in non-returnable drums, adequately braced, and with cable ends adequately sealed to avoid ingress of moisture.

Electronic equipment

Electronic equipment shall be packaged, shipped and stored in anti-static packing. These packages shall become the property of the Employer. For every package, the Supplier shall indicate whether it is preferable to keep the equipment with power supplied during shipping and storage. If needed, the Supplier shall provide power supply accordingly.

(b) Case and Package Handling

The Supplier shall supply all the required accessories (slings, hooks, rings, temporary protection, etc.) for loading, handling in transit areas, unloading and storage of cases and packages.

The Supplier shall record the necessary information for package handling on each package.

11.0 HANDLING

HEAVY AND/OR BULKY PARTS

The Supplier shall provide all the necessary instructions for unloading, unpacking and handling these parts (descriptive manual, drawings and diagrams, etc.), as well as a list of the required tools.

PART HANDLING DURING EQUIPMENT MAINTENANCE

The Supplier shall provide all the necessary drawings for part handling during maintenance, as well as the tools or accessories required.

12.0 ERECTION, COMMISSIONING & SITE TESTING :-

Unloading, receipt & storage at site will be in BHEL scope. Supplier representative shall be present at site during unloading/verification / handling of material, if required.

Erection & Commissioning will be BHEL scope. Supplier representative shall be present at site during erection, commissioning & site testing.

13.0 GUARANTEE / DEFECT LIABILITY PERIOD

Performance of control panels shall be guaranteed for the period state below, against any defect or damage due to wrong workmanship, defective material or commission in design.

(i) 18 months from the date of completion of facilities or

(ii) 12 months from the date of operational acceptance whichever is earlier.

Supplier shall change/replace defective or damage parts of the equipments at his own cost during guarantee period.

14.0 DRAWING AND DOCUMENTS

All the drawings shall be worked out on computer using latest version of AUTOCAD on maximum A1 size. All electrical drawings shall be made on A3 size. All documents shall be made in MS office. Offer/ all drawings and documentation shall be in English and units of measurement shall be MKS/SI.

(a) WITH TECHNICAL OFFER

Following information shall be given in the technical offer by supplier

- Scope of supply
- Description & catalogues of main equipments
- Schedule of guaranteed/technical particular (as per annexure B)
- Type test certificate
- Performance certificate
- Reference list
- List of spares (mandatory, recommended and spares required for erection and commissioning)
- List of tools & tackles
- List of deviation if any

The bidder shall indicate clearly & specifically deviation, if any in their offer. Only deviations furnished separately in the offer will be considered. It will be assumed that the balance offer is complying with the Purchase specifications in totality

(b) AFTER PLACEMENT OF ORDER

Supplier shall submit 10 sets (hard copy) and softcopy of following drawings within one month after placement of order for approval/reference. The QA plans are to be furnished within two weeks of placement of order. The drawings and documents will be reviewed by BHEL and approved by customer.

- (i) Outline general arrangement drawings
- (ii) Final schedule of guaranteed/technical particular
- (ii) Foundation/loading details
- (iii) Details assembly and component drawing
- (iv) Design Calculations
- (v) Internal panel wiring diagram/connection drawing/terminal arrangement drawing
- (vi) Bill of material
- (vii) QA plan
- (viii) Field QA plan
- (ix) Painting process specification

(c) FINAL DRAWINGS & DOCUMENTS:-

Following final/ as built drawing & documents shall be submitted by supplier before dispatch the equipments

- | | |
|--|-------------------------------------|
| (i) Final/as built drawing/doc. state at clause 14.0 (b) | - 10 sets (hard copies & soft copy) |
| (ii) Inspection test reports | - 8 sets (hard copies & soft copy) |
| (iii) Packing list | - 8 sets (hard copies & soft copy) |

Ten sets (hard copies) and softcopy of following manuals shall be submitted by supplier before dispatch the equipments.

- (i) Operation & maintenance manual
- (ii) Installation manual
- (iii) Commissioning manual

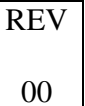
The soft copies shall be furnished on CD.

15.0 enclosures

(i) Project information	:	Annexure-A
(ii) Technical data sheet :- • Recommended Spares • Special tools & tackles for Erection & commissioning, repair & maintenance • Consumables • Packing/packaging for the shipment of equipment. • Deviation (if Any)	:	Annexure-B
(iii) Schedule of Guaranteed / Technical particular	:	Annexure-C
(i) Single Line Diagram	:	Drg. No. 32926119002
(ii) Standard packing instruction	:	Doc. No. HSE-Pkg.inst -01

PROJECT INFORMATION

- | | | |
|----|-------------------------|---|
| 1 | Name of project | : Kameng Hydro Electric Project |
| 2 | Customer | : NEEPCO |
| 3 | No of units & rating | : 4x150 MW |
| 4 | Site condition :- | |
| | - Ambient air temp | : -3.3 ° C (Dry bulb) (min), 40 ° C (max) |
| | - Related humidity | : 100% |
| | - Altitude above M.S.L. | : Less than 1000m |
| | - Seismic forces | : Seismic zone V as per IS 1893 |
| 5 | Location :- | : Kimi village, near Bhalukpong, 65 km from Tezpur in Arunachal Pradesh |
| 6. | Nearest rail head | Bhalukpong |
| 7 | Nearest air port | Tezpur/ Guwahati |
| 8 | Application | Inverter panel & AC distribution panel. |
| 9 | Installation | Indoor |

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**GENERAL INFORMATION/DATA
OIL FILLED TRANSFORMER
(TO BE FILLED BY SUPPLIER)**

DOC. NO

ANNEXURE -B

REV

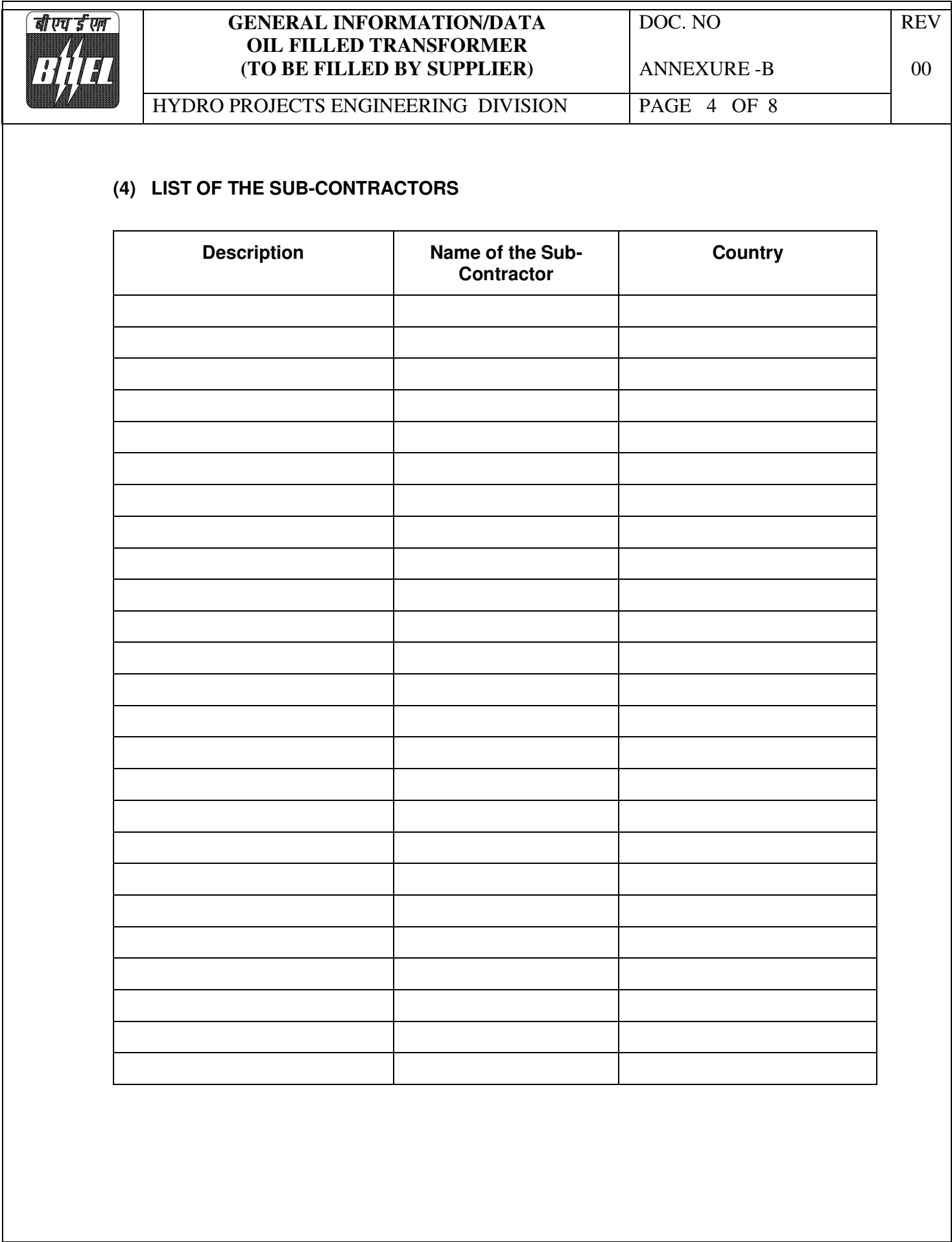
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(3) CONSUMABLES:-

ITEM	Unit quantity	Supplier 1	Supplier 2





**GENERAL INFORMATION/DATA
OIL FILLED TRANSFORMER
(TO BE FILLED BY SUPPLIER)**

DOC. NO

ANNEXURE -B

REV

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HYDRO PROJECTS ENGINEERING DIVISION

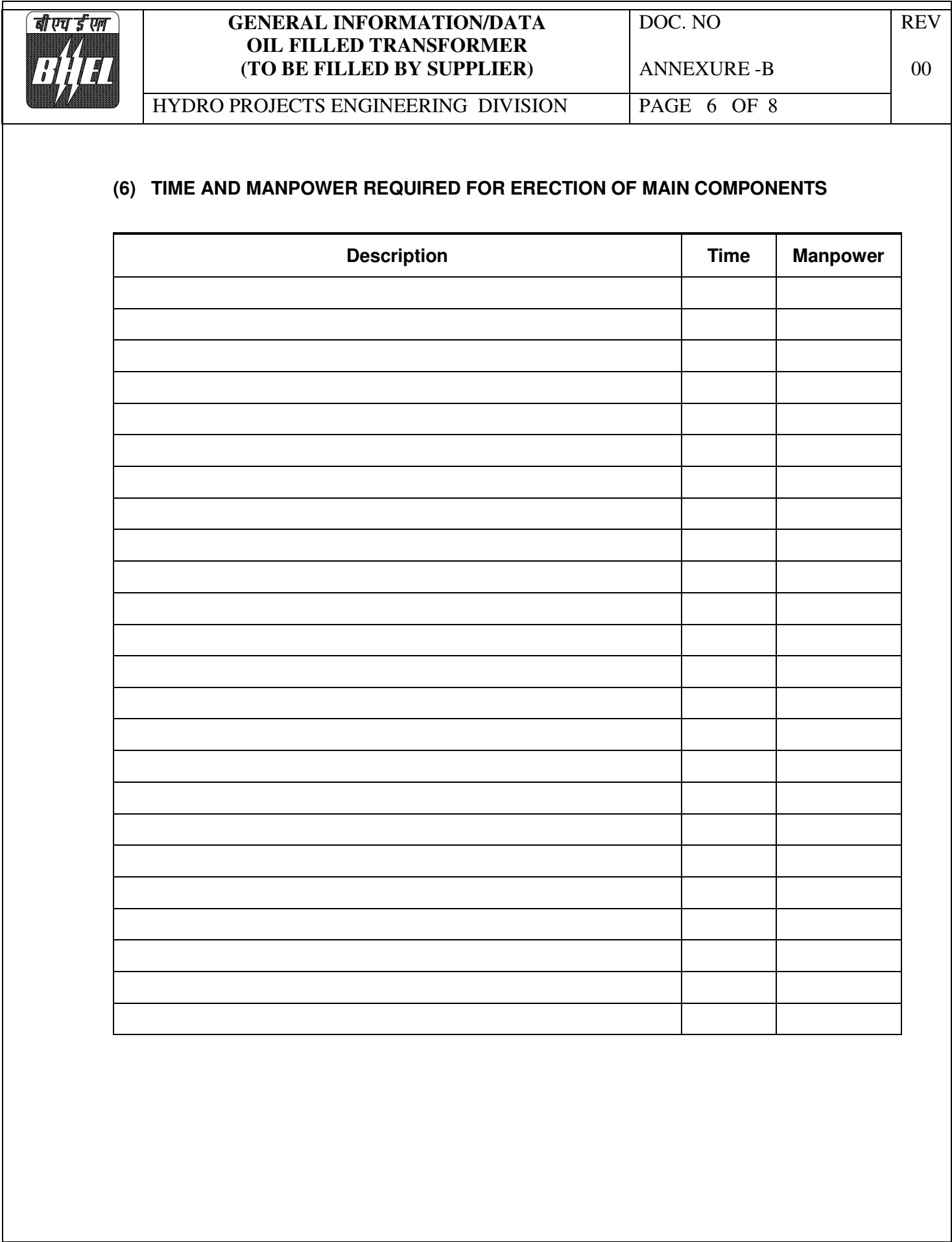
PAGE 5 OF 8

(5) PACKING/PACKAGING FOR THE SHIPMENT OF THE EQUIPMENT

The equipment shall be shipped in package.

The outline dimensions and weight of the main elements shall be specified in the following table.

Type	Quantity	Length (m)	Width (m)	Height (m)	Weight (kg)



(7) DEVIATIONS FROM THE SPECIFICATIONS

[illegible]



**TECHNICAL DATA SHEET FOR
DC SYSTEM
(TO BE FILLED BY SUPPLIER)**

DOC. NO

ANNEXURE -C

REV

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HYDRO PROJECTS ENGINEERING DIVISION

PAGE 1 OF 2

Guaranteed Technical Particulars

Item / Cl. No.	Parameter	Units	Supplier's Data
A.	Panel		
1.	Manufacturer		
2.	Place of manufacture		
3.	Applicable standards		
4.	Protection class of cubicle		
5.	Sheet material & thickness		
6.	Dimension		
7.	Type of gasket		
8.	Finish colour		
B.	Inverter		
1.	Make		
2.	Applicable standards		
3.	Type designation	-	
4.	Input supply		
4.1	- Input voltage	V	
4.2	- Maximum admissible variation of input voltage	%	
5.	AC Output		
5.1	- Rated voltage UN	V	
5.2	-Range of adjustment of output voltage	%	
5.3	-Rated output	kVA	
5.4	-Number of phases		
5.5	-Frequency	Hz	
5.6	-Frequency Regulation	%	
6.	Inverter Efficiency		
7.	Voltage Waveform		
8.	Over loading capacity & duration	% I _N	
9.	Harmonic Distortion at rated load	%	
10.	Type of cooling		
C.	STATIC SWITCH		
1.	Make		
2.	Rating	A	
3.	No. of Static switch		
4.	Type of static switch		
5.	Over loading capacity & duration		
6.	Short circuit capacity & duration		



**TECHNICAL DATA SHEET FOR
DC SYSTEM
(TO BE FILLED BY SUPPLIER)**

DOC. NO

ANNEXURE -C

REV

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HYDRO PROJECTS ENGINEERING DIVISION

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D. BYPASS SWITCH

- | | | |
|----|--------|---|
| 1. | Make | |
| 2. | Rating | A |

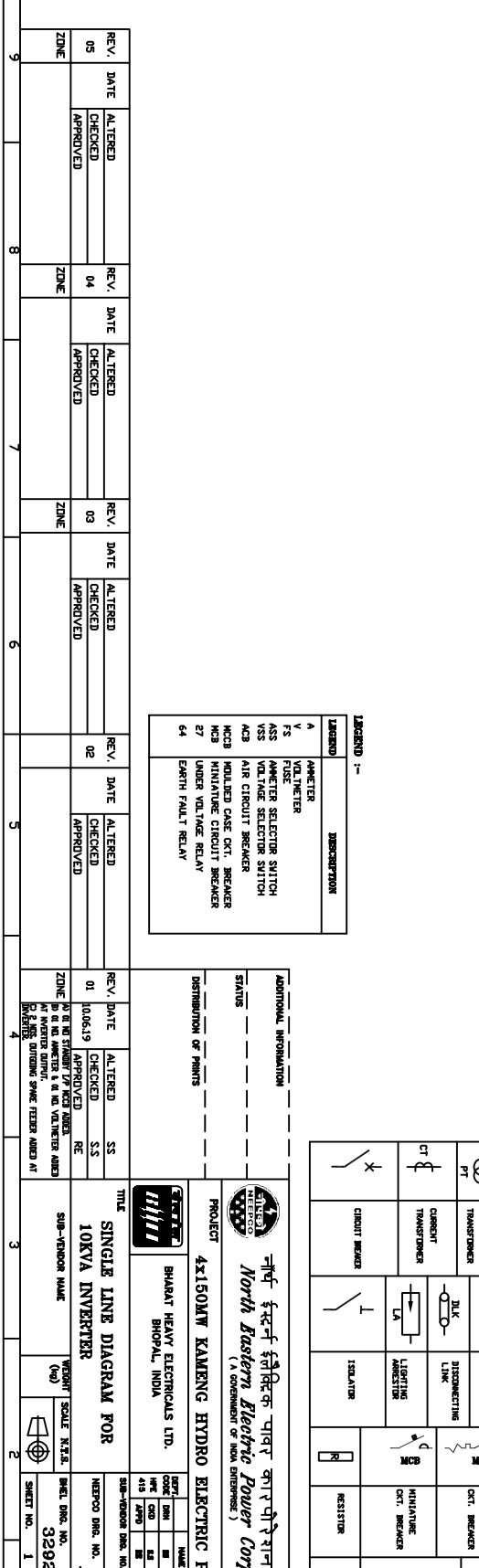
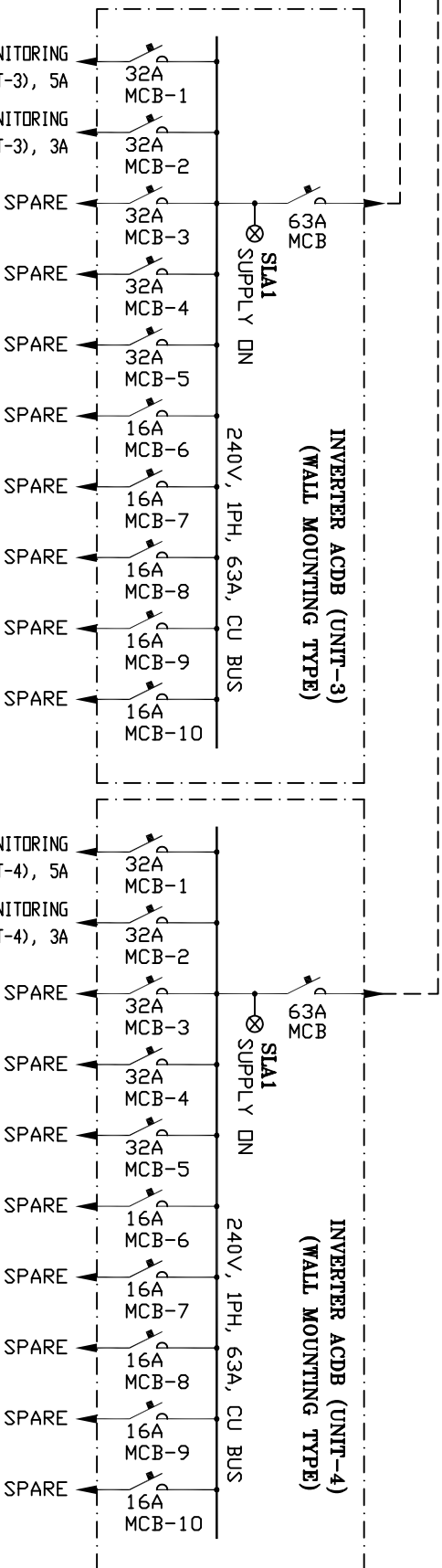
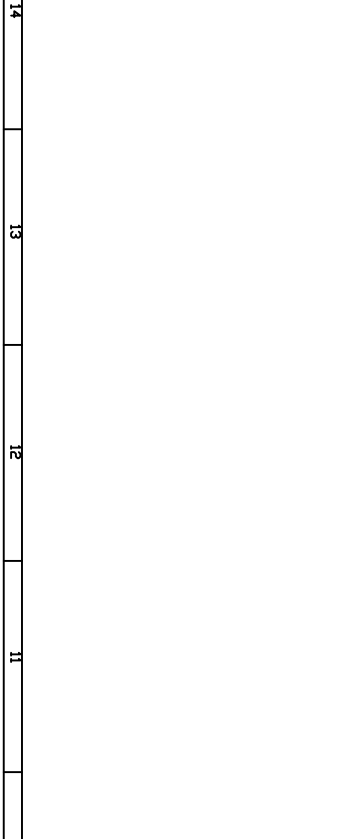
E. MCCB

- | | | |
|----|------------|----|
| 1. | Make | |
| 2. | Rating | A |
| 3. | S.C RATING | KA |

F. BUSBAR

- | | | |
|----|--------------------------|----|
| 1. | Material | |
| 2. | Size (Width x Thickness) | |
| 3. | S.C Rating | KA |

I, _____ ENGINEER IN CHARGE	SIGNED & DATED _____ _____ SUPERVISOR	_____ DATE
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	REV.	DATE	ALTERED
	02		CHECKED
			APPROVED
			5

		नॉर्थ ईस्टर्न इलेक्ट्रिक पावर कारपोरेशन लिमिटेड <i>North Eastern Electric Power Corporation Ltd.</i> (A GOVERNMENT OF INDIA ENTERPRISE)	
PROJECT		4x150MW KAMENG HYDRO ELECTRIC POWER PROJECT	
TITLE			
		BHADRAT HEAVY ELECTRICALS LTD. BHRAPAL, INDIA	
SS	SS	SINGLE LINE DIAGRAM FOR 10KVA INVERTER	
RE	RE		
AS	AS		
SUB-VENDOR NAME		WEIGHT SCALE N.E.S.	
		(kg)	
SHEET NO. 1		SHEET NO. 1	
NO. OF SHEET 1		NO. OF SHEET 1	
BHEL DNR. NO. 332926119002		NEEPO DNR. NO. ----	

ADDITIONAL INFORMATION STATUS _____ DISTRIBUTION OF PRINTS _____ PROJECT _____																													
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REV. DATE 01 10/06/19		ALTERED CHECKED S.S RE		SHEET NO. 1		NO. OF SHEET. 1																							
ZONE NO. OF SHEETARY 17 KVA RATED NO. OF AMPERES & NO. VOLTS RATED 2.5 KVA. OTHERS SPEC. FEEDER RATED AT 4																													



**HYDRO STATION ENGINEERING
DIVISION**

HSE-Pkg. Inst. - 01

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**STANDARD PACKING INSTRUCTIONS FOR
BALANCE OF PLANT (BOP) PACKAGES FOR
HYDRO ELECTRIC PROJECTS**

Prepared	Checked	Approved	Rev No.			
AP	NCN	TR				
<i>A. B. S. / 03/04/2006</i>	<i>NCN / 03/04/06</i>	<i>TR / 03/04/06</i>	00			



PACKING INSTRUCTIONS

1.0 GENERAL

- 1.1 This instruction cover the general requirements of packing of Balance of Plant (BOP) items of hydro projects.
- 1.2 This packing instruction shall apply to all the packages transported through sea, rail or road routes.
- 1.3 For detailed packing instruction refer enclosed BHEL Plant Standard No. BP 0490399.

2.0 PACKING WOOD

- 2.1 The packing quality shall be suitable for at least five years storage at site.
- 2.2 The packing wood used for packing cases shall be of good quality suitable for long term storage in tropical climate.
- 2.3 In case the customer specifies fumigation (for export jobs) the packing wood will be treated for fumigation.
- 2.4 In case the customer specifies special wood for making boxes then the wood material shall be as per customer specifications.
- 2.5 Special instruction for quality of wood or fumigation shall be issued by HSE engineers.
- 2.6 For general construction of boxes refer plant standard BP 0490399.
- 2.7 Special care to be taken to make the boxes water proof from all sides to protect from rain at hydro site.
- 2.8 The type of box e.g. open type, partially packed, crate packing, case packing, shall be decided by the vendor depending on the type of item being packed & dispatched and approval for the same is to be taken from BHEL.

3.0 METHOD OF PACKING:

- 3.1 All material shall be suitably packed & checked before dispatch.
- 3.2 Preservative grease shall be used wherever applicable to avoid rusting of unpainted items during long term storage.
- 3.3 Items shall be wrapped in thick polyethylene sheet of at least 100 micron thickness so as to avoid damage from rain water & moisture.
- 3.4 All the delicate items like electrical & electronics shall be packed using thermocole boxes/sheets.
- 3.5 Silica gel shall be provided in packing boxes so as to avoid damage due to moisture.
- 3.6 Extreme care shall be taken so that the items are not damaged by hammer or any sharp item like nail etc. during process of packing.

All the spare parts shall be packed in strong wooden boxes, using preservatives for long term storage each spare part to be provided with metallic identification tags giving description, drawing no. etc for ease of identification.



HYDRO STATION ENGINEERING DIVISION

HSE-Pkg. Inst. - -01

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4.0 PACKING LIST

- 4.1 Box-wise packing list shall be submitted to BHEL at least one month prior to dispatch.
- 4.2 Inside the Box: The packing list should be placed in polythene bag and nailed at the top of the side wall. The position should be easily visible & accessible.
- 4.3 Outside the case : The packing list should be placed in Polythene bag and covered with sheet metal cover fixed on to the outside and near the top of side wall.

5.0 STRAPPING the CASE

- 5.1 Steel strap 20/25 mm wide to IS 5872 should be strapped around the case with tensioned & crimped. At least two straps per case should be used. These straps should be across the top cover of the box.
- 5.2 Use 20/25mm wide corner straps to IS 5872, wherever necessary.

6.0 MARKING :

The case should have the following markings.

- i. Store in umbrella/covered/open/ weather protected area as per requirement.
- ii. Sling position markings as per requirement.
- iii. Upright position indicator.
- iv. "Fragile & Do not turn" for delicate items.
- v. Consignee Address
- vi. Case identification number
- vii. Weight Net..... Gross.....
- viii. Dimension of case L.....B.....H.....

7.0 ENCLOSURES:

1. BHEL Plant Standard BP 0490399

Note : For other standards called in the BHEL Plant Standard BP 0490399 vendors may use equivalent IS Standard.



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BP 049 03 99

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SUPERSEDES
BP 049 03 99 Rev 01

PACKING INSTRUCTIONS FOR GENERAL COMPONENTS/ASSEMBLIES/EQUIPMENTS

1. GENERAL:

This standard lays down packing instructions for packing of Components/Assemblies/Equipments to be despatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage.

For specific applications the concerned engineering department shall issue a product standard. Reference of this product standard, must appear in the Shipping list/Packing List (H).

2. SCOPE:

This standard covers 5 types of Packing Processes identified by a two digit alpha code. This two digit alpha code is to be reflected in the Shipping List/Packing List (H) under "Packing Type", Entry No.29 for Shipping List or Entry No.10 for Packing List (H) by the concerned Engineering Department. If the item described is a Despatchable Unit - "DU".

3. TYPE OF PACKING:

The following 5 types of packings have been standardized for packing of General Components/Assemblies.

3.1 'OP' - Open Type.

3.2 'PP' - Partially Packed.

3.3 'CP' - Crate Packing - Components/Equipments requiring physical protection.

3.4 'CQ' - Case Packing - Small & medium Components/ Assemblies/ Equipments which require corrosion & physical protection.

Revision : Brought upto date.

Issued by :

STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPARTMENT

Rev. No. : 02

Date : 12.1.1996

Date of first issue : 18.10.76

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3.5 'CR' - Case Packing - Electrical Components/Assemblies which require special packing viz. Water Proof, Shock Proof etc.

4. DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

4.1 'OP' - Open Type

In case, of components which are not effected by water & dust & do not require special protection & are generally not machined, shall be sent as open packages. However these components may be sent in crates, wherever necessary.

Typical Examples:

Pipes, Conservator, Foundation/Turbine Parts, Draft tube, Elbow liner, Draft tube pier nose liner, Fabricated large components without machining, Pit Housing (Pelton), Pit Liner. Loose Structures Galvanised Structures, Fan Support, Transformer Tank, Radiators, Conservators etc.

4.2 'PP' - Partially Packed

Components which need special protection, at selected portions only, shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces after application of TRP should be protected with Polyethylene Coated Bitumen Hessain Kraft Paper to AA 51409 or Polyethylene sheet to AA 51408 of at least 100 micron thickness.

Typical Examples - Elbow liner with machined flange, Fabricated large components with machining, inlet pipe, Stay ring, Spiral casing quadrants. Foundation ring, Runner envelope, Lower cone with door etc, etc.

4.3 'CP' - Crate Packing - General

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

4.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipments

Small & medium sized components/assemblies/equipments due to size/weight & to avoid handling, and pilferage, problems shall be packed in Case/Containers.

Wherever required adequate quantity of silicagel to AA 55619 or VCI Powder/ Tablets, packed in thin muslin cloth cotton bags shall be suitably placed.



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Rev. No. 02

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Small machines/components of less weight, shall be provided with suitable cushioning. Wood Wool/Expanded Polyethylene Foam Sheet, if used, shall be sandwiched between polyethylene sheet and sealed.

The components inside the case shall be entirely covered with a polyethylene sheet of at least 100 micron thickness to AA 51408, where-ever required.

Typical Examples:

Fitted Bolts, Highly finished components like pins & shear pins, Bearing pads, Carbon and ferro-asbestos rings, Oil coolers, Springs, shaft and Inlet valve trunnion etc.

4.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons.

Adequate quantity of Silicagel to AA 55619 packed in cotton bags, of 100 grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with a polyethylene sheet to AA 51408 of at least 100 micron thickness, before being packed in the cases.

VCI Powder/Tablets, can be used as an alternative to Silica Gel to AA 55619.

Empty space in the cartons shall be filled with small chips of Expanded Polystyrene (Thermocole), Wood Wool etc.

Polyethylene air bubble film shall conform to IS:12787/AA51426.

Expanded polystyrene (Thermocole) shall conform to AA 51418.

The cartons shall be manufactured from corrugated Fibre Board, meeting requirements of AA 51414.

Typical Examples

Electrical/Electronic components, Level indicator, Gauges & instruments, Oil level relay, limit switch, Pressure relay, Resistance thermometer, Governor & its components etc.

5. TYPICAL CONSTRUCTION OF PACKING CASES

5.1 General:

The components/assemblies are to be packed as per clause 4.3, 4.4 & 4.5 depending on the type of the component/assemblies, before they are ready to be put into the wooden case/crates.

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BHOPAL**

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5.2 Material:

The packing wood shall conform to AA 51401 - Coniferous Timber for General Packing Purposes.

5.3 Type of Cases:

For specific requirements of packing, the cases are to be provided with Tongue and Groove joints.

5.4 Preparation of Packing Case

- 5.4.1 The base of the case shall be made of wooden battens & planks giving necessary reinforcement, such that the bottom of the equipment is at a height of 100 to 200 mm from the ground level depending upon size, & weight of equipment.

NOTE: However for packing cases of smaller size equipment can be at a height of 40 mm from the ground level.

- 5.4.2 In case of 'CR' - Packing viz. Electrical & Electronic components & instruments/assemblies, a rubber sheet, strips/expanded polyethene foam sheet, preferably 10 mm thick, shall be fixed on to the base to act as cushioning to the equipment.

- 5.4.3 The four sides, shall be lined, from inside with packing paper water proof bitumen laminated to AA 51410 Type - I or polyethylene sheet to AA 51408 of at least 100 micron thickness and tacked at suitable places.

Whenever specified in addition to the bitumen laminated paper/polyethylene sheet the top cover will have a layer of bitumen felt over the cover. This should project about 100 - 250 mm on all sides.

It is preferable to have a single piece of the above kraft paper fixed on the four sides. In case jointing is unavoidable, it should be done by overlapping of approximately 100 mm.

- 5.4.4 Place the Components/cartons with corrosion inhibitors duly applied wherever necessary & place suitably, thin muslin cloths bags containing 100 grams (approx) of activated Blue Silica Gel to AA 55619, wherever necessary. Alternatively VCI Powder or Tablet may be used.

- 5.4.5 In case, depression is formed, at the top, after the equipment is lowered, provide plyboard/wooden battens.

- 5.4.6 Cover the whole equipment with polyethylene sheet of at least 100 micron thickness, on all sides preferably by a single piece.



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5.4.7 For indoor panels/equipments, provide suitable packing battons with covering of Thermocole/expanded soft polyethylene foam/polyethylene air bubble film wrapped with suitable cords, to avoid cutting of the polyethylene sheet so that finished surface is not damaged.

5.4.8 Empty space in the box shall be filled with adequate cushioning material e.g. Thermocole Chips, Wood Wool etc. to avoid movement & shocks. alternatively put wooden blocks/battons wherever necessary.

5.4.9 The inner side of the top cover shall be lined with polyethylene sheet, of at least 100 micron thickness, which shall project approximately 25 to 150 mm depending upon the size of the case on all sides of the top cover shall be provided below the top cover. This projection, after nailing the top cover, shall be folded over, on the sides of the crates & tacked, to, prevent ingress of water from the top.

5.4.10 Follow the General Precautions, specified in clause 6.

6. GENERAL PRECAUTIONS:

6.1 Before packing the components, in cases, it should be ensured by the manufacturing departments that wherever required suitable rust preventives have been used for effective protection in line with Plant Standard BP 069 00 84 "Protection of Ferrous Components with Temporary Rust Preventive Systems".

6.2 Packing cases, crates, cradles and shooks, manufactured as per drawing & procured from outside suppliers shall conform to BP 085 14 99 "Technical Delivery Conditions For Wooden Packagings".

6.3 Whenever felt necessary, the top of packing boxes, of important items, shall be made tapered/inclined.

6.4 While fixing the nails during packing necessary care shall be taken to ensure that materials used for protection inside the case e.g. Paper, Polyethylene sheet, Coir etc. do not get damaged.

6.5 Rubber Sheets of dimensions depending upon the weight/type of equipments shall be used & shall conform to the following corporate purchase specifications.

AA 59001 : "Sheet Rubber Jointing - Gr.I, Type A".

AA 59002 : "Sheet Rubber Jointing - Gr.II, Type A".

6.6 Water Proof Bitunised Paper shall conform to following Corporate Purchasing Specification.

AA 51410 : "Packing Paper Water Proof Laminated Type 1".

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6.7 "Expanded Polyethylene Foam Sheet" shall conform to AA 51420.

6.8 Wherever possible, equipment shall be bolted to the case, and secured to the bottom in preference to the sides or ends. Large Washers are to be provided to distribute the pressure.

6.9 Steel packing hops shall be provided at suitable positions.

6.10 Sling protection brackets to be provided on cases wherever required.

6.11 It shall be ensured that all stencil marks outside the casing shall be of water proof material to prevent obliteration in transit.

Following materials shall be used for marking & stencilling.

BP 56187 "Yellow Marking & Stencilling Paint".

BP 56188 "Brilliant Green Marking And Stencilling Paint".

Black And Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

6.12 Multi Layered Cross Laminated Plastic Film of 45 g.s.m. to AA 51420 may be used as an alternative to Polyethylene Film Sheet to AA 51408.

6.13 The following details are to be marked on the packing cases:

- i) Address of Consignee.
- ii) W.O.No.
- iii) Description of item or title of packing list (Optional).
- iv) Case No.
- v) Tare Weight. (Optional)
- vi) Gross Weight (Optional)
- vii) Dimensions of box.
- viii) Marking showing upright position.
- ix) Marking showing sling position, wherever necessary.
- x) Marking showing umbrella (i.e. for machines/components to be stored under covered storage).



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**PLANT STANDARD
BHOPAL**

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xi) All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink "HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER" and other International Markings if any, Refer AA 023 26 01 for details.

xii) In case of returnable steel containers full address for return to be marked.

xiii) Any other special markings.

7. **STEEL CONTAINERS:**

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies.

The containers are to be made of structural steel as per AA 10108 with proper reinforcement with I, C and T Sections.

Following precautions are to be taken during packing:-

- i) Put the machine in the steel container properly.
- ii) Cover the machine with polythene.
- iii) To arrest the movement in the steel container necessary wooden Blocks/Battons may be put.
- iv) Put cover on steel container and Bolt Properly.