



EOI Reference Number:

BHEL-EPD/CPBG/EOI/2014-15/01, REV 00

**NOTICE INVITING EXPRESSION OF INTEREST
FOR TECHNICAL COLLABORATION IN THE
AREA OF DRAW-OUT AND FIXED LOW
VOLTAGE SWITCHGEAR AND
CONTROLGEAR ASSEMBLIES AS PER IEC
61439**

**EOI REFERENCE NUMBER
BHEL-EPD/CPBG/EOI/2014-15/01, REV 00**



**BHARAT HEAVY ELECTRICALS LIMITED,
ELECTRO PORCELAINS DIVISION, BANGALORE-12**



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1. DISCLAIMER

The information contained in this Expression of Interest document (the “EOI”) or subsequently provided to Applicant(s), whether in documentary or any other form, by or on behalf of BHEL or any of its employees or advisors, is provided to Applicant(s) on the terms and conditions set out in this EOI and such other terms and conditions subject to which such information is provided.

This EOI is not an agreement and is neither an offer nor invitation by BHEL to the prospective Applicants or any other person. The purpose of this EOI is to provide interested parties with information that may be useful to them in the formulation of their application for qualification pursuant to this EOI.

BHEL also accepts no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance of any Applicant upon the statements contained in this EOI.

The issue of this EOI does not imply that BHEL is bound to select and shortlist Applicants for next stage or to enter into any technology tie-up agreements with shortlisted Applicants for the Project.

The bidder shall bear all costs associated with the preparation, technical discussion/presentation and submission of bid, the Purchaser/Consultant shall in no case be responsible or liable for these costs regardless of the conduct or outcome of the bidding process.

Canvassing in any form by the Bidder or by any other agency on their behalf may lead to disqualification of their bid.



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**BHARAT HEAVY ELECTRICALS LIMITED (BHEL),
ELECTROPORCELAINS DIVISION (EPD), Bangalore, India
INVITES EXPRESSION OF INTEREST FOR TECHNICAL
COLLABORATION IN THE AREA OF DRAW-OUT AND FIXED LOW
VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES**

2. Schedule of Events

- (i) Last date for receipt of queries/clarifications: **18/11/2014**
- (ii) Consolidated Reply to all queries/clarifications by BHEL-EPD: **29/11/2014**
- (iii) Last Date for Receipt of final consolidated EOI & response to NIT at BHEL-EPD: **20/12/2014**

3. Mode of Submission of Documents:

In sealed cover to be dropped in EPD tender box so as to reach the contact person on or before the date mentioned above. The cover shall be super-scribed with Reference number **BHEL-EPD/CPBG/EOI/2014-15/01, REV 00 & EP-4-TS-GEN-001,REV 00** and the words **“EXPRESSION OF INTEREST FOR TECHNICAL COLLABORATION IN THE AREA OF DRAWWOUT AND FIXED LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES”**(herein called as LV Switchgear) The documents as above should be submitted in a sealed envelope and should bear the name address and telephone number of the Applicant. The envelope should be addressed to

DGM/CPBG

**Electro Porcelains Division,
Bangalore, Karnataka, India, 560012”.**



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4. ABOUT BHEL:

BHEL, an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing companies in India in terms of turnover. It was established in 1964, ushering in the indigenous Heavy Electrical Equipment industry in India - a dream that has been more than realized with a well-recognized track record of performance. The company has been earning profits continuously since 1971-72 and paying dividends since 1976-77.

We are engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy, viz. Power, Transmission, Industry, Transportation (Railway), Renewable Energy, Oil & Gas and Defence. We have 16 manufacturing divisions, two repair units, four regional offices, eight service centres and 15 regional centres and currently operate at more than 150 project sites across India and abroad. We place strong emphasis on innovation and creative development of new technologies. Our research and development (R&D) efforts are aimed not only at improving the performance and efficiency of our existing products, but also at using state-of-the-art technologies and processes to develop new products. This enables us to have a strong customer orientation, to be sensitive to their needs and respond quickly to the changes in the market. The high level of quality & reliability of our products is due to adherence to international standards by acquiring and adapting some of the best technologies from leading companies in the world including General Electric Company, Alstom SA, Siemens AG and Mitsubishi Heavy Industries Ltd., together with technologies developed in our own R&D centres.

Most of our manufacturing units and other entities have been accredited to Quality Management Systems (ISO 9001:2008), Environmental Management Systems (ISO 14001:2004) and Occupational Health & Safety Management Systems (OHSAS 18001:2007).

We have a share of 57% in India's total installed generating capacity contributing 69% (approx.) to the total power generated from utility sets (excluding non-conventional capacity) as of March 31, 2013.

We have been exporting our power and industry segment products and services for over 40 years. BHEL's global references are spread across over 75 countries. The cumulative overseas installed capacity of BHEL manufactured power plants exceeds 9,000 MW across 21 countries including Malaysia, Oman, Iraq, the UAE, Bhutan, Egypt and New Zealand. Our physical exports range from turnkey projects to after sales services.

We work with a vision of becoming a global engineering enterprise providing solutions for a better tomorrow. To know more about BHEL visit: www.bhel.com



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5. DESCRIPTION OF EOI:

BHEL-EPD, Bangalore proposes to Design, Manufacture, and Test & Supply DRAW-OUT AND FIXED LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES.

This EOI is published for seeking response from Existing manufacturers in this field, who are willing to be associated with BHEL-EPD, Bangalore for the above requirement.

The EOI process involves qualification of interested parties/ groups who make an application in accordance with the provisions of this EOI (the "Applicant"). At the end of this process, BHEL expects to short-list suitable pre-qualified Applicants and finalize the collaborator for technology and supplier for the requirement specified in tender specification EP-4-TS-GEN-001, R0.

The EOI in 2 copies (original plus one) shall be submitted on or before Bid Submission date. EOI received after the due date for submission (and any extension thereof) will not be considered.

Any request for further information or clarification on the EOI document may be submitted in writing via mail to sm@bhelepd.com, bala@bhelepd.com, trinath@bhelepd.com and djkumar@bhelepd.com. BHEL may respond to the queries raised/clarifications sought to the best of its ability. However, no extension of the time or date of EOI submittal would be granted on the ground that BHEL has not responded to any query/clarification raised by any party. BHEL at its discretion may extend the due date for submission of EOI and the decision of BHEL in this respect would be final & binding on the Applicants.

No oral modification or interpretation of any provisions of this EOI shall be valid. Written communication shall be issued by BHEL regarding changes, clarifications or amendment to the EOI document, if any, is deemed necessary by BHEL at its sole discretion.

EOI submittals should be in English duly signed and sealed on each page of the documents by authorized representative. Emphasis should be on (a) conformance to EOI instructions; (b) responsiveness to the EOI requirements; (c) completeness and clarity of content.

BHEL is authorised to seek clarification at any stage of evaluation from the perspective bidders and same shall be furnished by the said bidder in reasonable time limit to complete the evaluation process.

EOI which is found to be incomplete in content and/or attachments and/or authentication etc. is liable to be rejected.



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6. INSTRUCTION TO APPLICANTS:

6.1 Qualifying Criteria

The applicant should meet following Qualifying criteria

1. Technical Criteria
2. Financial Criteria
3. Experience

6.1.1 The Applicant for pre-qualification under the EOI may be (i) a single entity; or (ii) a **Group of Entities (“GOE”)** coming together to meet the scope of the EOI. The GOE shall elect one of their members as the lead member of the GOE. The term Applicant used herein would apply to both a single entity and the GOE. The technology transfer agreement would be entered into with the single entity applicant or the lead member of the GOE. The copy of agreement between participants of GOE shall be furnished to BHEL and it should be valid for at least the period mentioned in the agreement of EOI. The lead member of the GOE would be responsible to BHEL for the entire scope of work and shall ensure back to back tie ups with other members of the GOE.

6.1.2 An Applicant shall not have a conflict of interest that affects the EOI Process. Any Applicant found to have a conflict of interest shall be disqualified. An Applicant shall be deemed to have a conflict of interest if a constituent of such Applicant is also a constituent of another Applicant.

6.2 Right to accept or reject any or all Applications:

6.2.1 Notwithstanding anything contained in this EOI, BHEL reserves the right to accept or reject any Application and to annul the EOI Process and reject all Applications, at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons therefore. In the event that BHEL rejects or annuls all the Applications, it may, at its discretion, invite all eligible Bidders to submit fresh Applications.

6.2.2 BHEL reserves the right to disqualify any Applicant during or after completion of EOI process, if it is found there was a material misrepresentation by any such Applicant or the Applicant fails to provide, within the specified time, supplemental information sought by BHEL.

6.2.3 BHEL reserves the right to verify all statements, information and documents submitted by the Applicant in response to the EOI. Any such verification or lack of such verification by BHEL shall not relieve the Applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.

6.3 Documents to be submitted with EOI:

i) Offer Letter should comprise with filled up formats specified in Clause no. 8 and Clause no. 9. And Data required as per Attachments and supporting documents thereof.



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- ii) Copy of Articles & Memorandum of Association or partnership deed;
- iii) Copies of Applicant's duly audited balance sheets and profit and loss accounts for the preceding five years

6.4 The EOI process shall be governed by, and construed in accordance with, the laws of India and the Courts at New Delhi shall have exclusive jurisdiction over all disputes arising under, pursuant to and/ or in connection with the EOI process.

7. SCOPE OF TECHNOLOGICAL COLLABORATION:

Transfer of technology under a single Technology License agreement valid for a period of 5years , with fully paid up rights **and to continue using the same even after expiry of agreement**, for:

a) Transfer of state of the art technology relating to the design, engineering, Manufacture, assembly, quality control, testing, installation & Commissioning complying with requirements specified for LV Switchgear as per IEC 61439 and as specified in various parts of the EOI.

(b) Transfer of Improvement, modification, developments, up gradations carried out by the Applicant over the duration of the technology transfer agreement for taking care of new market requirements and obsolescence of components used in the system.

(c) Transfer of applicable computer software's & programs related to design, manufacturing, and assembly and testing.

(d) Transfer Information & recommendation to enable BHEL to source/procure the items, which the Applicant sources from outside (as they are not manufactured by the Applicant) for use in the LV Switchgear. Applicants shall recommend minimum 3 Vendors to the maximum extent possible.

(e) Transfer of Site feedback and troubleshooting information.

(f) Training of BHEL engineers in the design & manufacture assemble of 50 PCC switchboards & 25 MCC switchboards irrespective of length or rating, quality control / quality assurance, test, install, commissioning, maintain & operation of "LV Switchgear".

(g) Deputation of the Applicant's experts to assist BHEL in absorbing the technology for licensed products.

(h) Support engineering services from the Applicant's design office /Manufacturing facilities for licensed products.

(i) Prototype manufacture and testing of complete Range of LV Switchgear Panels. As per latest IEC Standards and BHEL proposed design philosophy. Before manufacturing the



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prototype, the design/drawings would have to be submitted to BHEL for approval. Applicant engineers shall be associated during prototype manufacturing & testing at BHEL works.

(j) Assistance in planning of the facilities at EPD and technical scrutiny of sub-vendors for EPD in terms of identifying, sizing & selection of equipment required for manufacturing and assembly, their layout and foundation etc.

(k) Assistance for setting up of the manufacturing facilities, establishing manufacturing processes, commissioning of the manufacturing facilities, design of special tools and dies, jigs & fixtures etc., production of prototype at the new facility and its testing, as well as approval of prototype from by way of deputation of experts for agreed number of man days as and when required by BHEL.

(l) Handover of complete set of final approved documents.

8. Pre-qualification criteria:

8.1 Technical Capability & Technical Requirement:

The Applicant should have designed, manufactured, supplied and commissioned LV Switchgear in at-least Three thermal power projects of minimum 250MW. Under each single contract the applicant would have supplied at-least a total 350 Verticals (ACB verticals/Single Front or Double Front Draw out MCC) in which a minimum of 100 ACB verticals. The commissioned equipment supplied should be working satisfactorily for at-least 2 years as on 16 August 2014. This data shall be furnished as per the format below with copy of all documents and satisfactory certificate from respective customer shall be furnished:

Sl.No.	Contract no. & Date	Customer & Project	No. of verticals	No. of Breaker Verticals	Date of Commissioning
1					
2					
3					
4					
5					

Data for technical requirement shall be filled below:

SL.No.	TECHINCAL REQUIREMENT	APPLICANT RESPONSE	BHEL ACCEPTANCE CRITERIA
1.	Design shall be suitable to rated operating voltages Min. 380V to Max. 690V		If 'NO' rejected.



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2.	Design shall be suitable to rated operating frequencies Min. 50Hz to Max. 60Hz		If 'NO' rejected.
3.	Shall have design from Rated Current: 250A to 4000A		If 'NO' rejected.
4.	Shall have design from Rated Current: 250A to 6300A		Optional
5.	Design shall suit Ambient Temp.: 45Deg. to 50Deg.		If 'NO' rejected.
6.	Shall have design to withstand a min. of 50KA RMS short circuit for 1sec with Momentary peak of 105KA.		If 'NO' rejected.
7.	Shall have design to withstand a min. of 65KA RMS short circuit for 1sec with Momentary peak of 143KA.		Optional
8.	Shall have design which satisfies the temperature rise of the horizontal and vertical busbars and main bus links including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. over ambient. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material over ambient. Temperature rise for the busbars shall be carried out at 90% of the rated current.		If 'NO' rejected.
9.	Shall have design which satisfies the temperature rise of the horizontal and vertical busbars and main bus links including all power drawout contacts when carrying 100% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 35deg C with all other types of joints over an outside ambient Temperature of 50 deg C. The temperature		Optional



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	rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current.		
10.	Whether Valid type tests conducted within last 5 years from dt. 16.08.2014 as specified in IEC 61439 for the ratings 630A, 800, 1000A, 1250A(Optional), 1600A, 2000A, 2500A, 3200A&4000A		If 'NO' rejected.
11.	Whether Bus Bar Support Drawings are standardised		If 'NO' rejected.
12.	Whether fabrication drawings are standard .		If 'NO' rejected.
13.	Whether Horizontal busbar chamber drawings are available for various ratings of		If 'NO' rejected.
14.	Whether Standard design available for vertical busbar chamber		If 'NO' rejected.
15.	Whether design available for standard ratings of drawout contacts		If 'NO' rejected.
16.	Whether standard manufacturing procedure available to check the alignment of drawout contacts		If 'NO' rejected.
17.	Whether standard documentation and process flow charts for manufacturing available		If 'NO' rejected.
18.	Whether standard documentation and process flow charts for In-process and final Quality inspection available		If 'NO' rejected.
19.	Whether panel construction design is available for both welded or bolted		Optional
20.	Whether drawout design is available up-to 500Amps rated module.		If 'NO' rejected.
21.	Whether design suits IP protection up-to 1600A IP54 and >1600A is IP42 available.		If 'NO' rejected.
22.	Whether design suits IP protection up-to 3000A IP54		Optional
23.	Whether the company is ISO 90001 certified.		If 'NO' rejected.
24.	Whether the design is supported by both Copper and Aluminium busbar.		If 'NO' rejected.
25.	Whether Form IVb Type 7 Design for cable separation available		If 'NO' rejected.
26.	Whether standard design document for		If 'NO' rejected.



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	busbar sizing available.		
27.	Whether design drawings for fabrication of trolley is standardised.		If 'NO' rejected.
28.	Whether standard design is available for both 3Ph 3W and 3Ph 4W systems		If 'NO' rejected.
29.	Whether standard design is available for Two-tier breaker system upto 1000A.		If 'NO' rejected.
30.	Whether standard design is available for Two-tier breaker system upto 1600A.		Optional
31.	Whether module to be drawn out for terminating outgoing power cable.		If 'YES' rejected.
32.	Whether the design is completely confirming to attached Spec. EP-4-TS-ENC-001 Rev 00		If 'NO' rejected.
33.	Whether design confirms separate chamber for control bus bar and power bus bar separated with perforated sheet available.		If 'NO' rejected.
34.	Whether Cable alley design to be accommodate flexible width from 250mm to 300mm		If 'NO' rejected.
35.	Whether standard procedure available to check alignment of power and control contacts.		If 'NO' rejected.
36.	Whether the indication for Service, Test and Isolate positions are available on bottom or side position. However indication is compulsory.		Optional.

8.2 Information Transfer

Applicant should be willing to transfer the information to BHEL-EPD, Bangalore for design, manufacture, inspection, testing, commissioning, trouble shooting, servicing/maintenance, quality assurance methods etc., for the LV Switchgear. Non-Confirmation on the points listed in scope of EOI shall lead to rejection. This is expected to facilitate BHEL to manufacture LV Switchgear without dependency on any factor.

8.3 Financial Criteria

The company shall make turnover 15crores/Year in last consecutive 5years for Only LV Switchgear panels. Necessary supporting documents shall be submitted for our review and acceptance like audited balance sheet and P&L account etc.



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Information on Net Worth :

Cash Accruals	Year1	Year2	Year3	Year4	Year5
Single Entity					
Lead members of GoE					

Instructions:

- The Applicant shall attach copies of the balance sheets, financial statements and Annual Reports for 5 (five) years preceding the Application Due Date. The financial statements shall:
 - reflect the financial situation of the Applicant;
 - have been audited by a statutory auditor;
 - be complete, including all notes to the financial statements; and
 - correspond to accounting periods already completed and audited.
- Net Cash Accruals shall mean Profit After Tax + Depreciation.
- Net worth shall mean (Subscribed and Paid-up Equity + Reserves) less (Revaluation reserves + miscellaneous expenditure not written off + reserves not available for distribution to equity shareholders).
- Year 1 will be the latest completed financial year, preceding the EOI. Year 2 shall be the year immediately preceding Year 1 and so on.
- The Applicant shall provide an Auditor's Certificate specifying the Net worth of the Applicant

PRICE FORMAT FOR EOI

Sl.NO.	Description	Unit Price	TOTAL PRICE
1.	TRANSFER OF PATENTED DESIGN DRAWINGS		
2.	TRANSFER OF INFORMATION ON MANUFACTURING FACILITIES		
4.	Training of BHEL engineers in the design & manufacture assemble of 50 PCC switchboards & 25 MCC switchboards irrespective of length or rating		
5.	20 Visits Logistics		
6.	Cost for 100Days visit to EPD (For stay fare to be included in this only)		
	TOTAL		

Note:

- Vendor will not be eligible for any other payment like royalty apart from the above mentioned.
- The transfer of technology to BHEL will not come in the way of collaborator's business.

**TECHNICAL SPECIFICATION FOR ENCLOSURE
WITH FORM IV B TYPE 7
Specification No. EP-4-TS-ENC-001 Rev 00**

A. GENERAL FEATURES & CONSTRUCTIONAL DETAILS

1. Enclosure shall be of double front draw out floor mounting modular bolted/Welded.
2. The bus bar shall be well supported with non- hygroscopic anti tracking non inflammable high dielectric strength insulating material (SMC/ DMC/ FRP) capable of withstanding high dynamic stresses. Hylam sheet or SRBP support are not acceptable. Only moulded support shall be used.
3. The bidder shall provide dimension of the Enclosures for various types of feeders and verticals.
4. The Enclosure should be designed such that the Main bus-bars is easily approachable.
5. The Enclosure should be designed such that ample working space shall be provided.
6. The cable alley shall be provided adjacent to the module portion and shall have front access. The cable alley shall have doors with concealed hinges and screws/ half turn cams for locking. The screw head shall be slotted or with moulded metal knobs.
7. For each vertical section, separate vertical bus bar compartment shall be provided. Providing common vertical bus bar compartment for two adjacent vertical sections is not acceptable.
8. In the case of double front design, separate vertical bus bar shall be provided for each front. Providing common vertical bus bar compartment for both fronts is not acceptable.
9. In the case of single front design, the rear side shall be provided with removable cover. The cover shall be provided with slotted head screws.
10. The Panel should be provided with the lifting angle throughout the length of panel which shall bear entire weight of the panel.
11. The sheet steel used for Enclosure should be of minimum (2mm) 14 swg CRCA except that the doors and covers may be of (1.6mm) 16 swg CRCA. Stiffeners' should be provided wherever necessary. The gland plate thickness should be at least 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. The Enclosure shall be of dust and vermin proof. All cut-outs should be provided with synthetic rubber gaskets.
12. The Enclosure should be designed such that minimum clearance between phase to phase and phase 25.4mm and phase to Neutral/earth is 19 mm.

13. The Enclosure height shall not be more than 2450 mm
14. The Enclosure should be having separate horizontal chamber separated by perforated sheet for all auxiliary power and control bus. Vertical cable alley covering entire height and min. 250mm and shall have hinged door.
15. The Enclosure shall be designed such that the adjacent switchgear cubicles shall be provided with side sheets on either side to ensure complete isolation. The Enclosure shall be easily extendable on both sides by the addition of vertical sections
16. The bottom of the Enclosure shall be fully covered by sheet steel with opening for fixing gland plates.
17. Removable gland plates shall be provided with power and control cables. The gland plates shall be 3mm thick for all multi core cables. The gland plate for single core cables shall be 4mm non-magnetic material. The gland plate shall be provided with a rubber gasket of at least 4.0 mm.
18. Each panel should be provided with the following
 - a) Horizontal chamber at top accommodating power & control buses.
 - b) Vertical busbar (droppers) to feed functional units.
 - c) Vertical cable alley to permit cable entry to each compartment for MCC with cable supporting provisions.
 - d) Possibility of extension on either end of MCCs including BUSBAR extensions.
 - e) Removable lifting facilities, for each transport unit.
19. Each panel should be fully separated from the adjacent panels by sheet steel partition except for the openings in the horizontal chambers at top and bottom to enable buses and cables/wires to pass through.
20. Panel should be of double front design. All components should be accessible from the front. All wiring shall be from the front.
21. The top and bottom horizontal chambers housing busbars etc. should be provided with separate, properly secured, removable covers at the front and at the top.
22. Feeder & cable alley doors shall be designed such that ample working space is available.
23. Gaskets should be provided for all doors and covers and for all partitions between adjacent units.
24. Sheet steel surfaces provided should be free from dents and hammer marks. All opening and cut-outs shall be machine made and shall be free from burrs.
25. At least two concealed hinges shall be provided for each module door.

B. Form IVB TYPE 7 REQUIREMENTS:

(For enclosures where there is no requirement of Form IV design this clause will not be applicable)

Additional requirements of MCCs with Form 4b as per IEC 60439 part-I are as under:

1. Separation of Bus bars from all functional units.
2. Separation of all functional units from one another.
3. Separation of Terminals for external conductor associated with a functional unit from those of any other functional units and Bus bars.
4. Outgoing terminals shall not be in the same compartment as associated functional units.
5. It shall be possible to make the cable connections to any module while the other modules are live. In all such cases there shall be a positive interlock to ensure that the module which is being cabled has switch in the off position. In other words it shall not be possible to cable any module while its switch is 'ON' position.
6. There shall be a mechanism to ensure that it shall not be possible to switch-on the module after termination of the cables without covering the terminals.

C. Bus bars

1. The bus bars in LT switchgear panel shall be of Aluminium alloy 63401WP (E91E) as per IS: 5082. Make shall be Hindalco/Jindal.
2. The bus bars shall be provided with close fitting heat shrunk PVC sleeves Red/Yellow/Blue colour corresponding to RYB phases. The Neutral bus bar shall be provided with Black coloured sleeve. The horizontal bus bars shall have uniform cross section throughout the length of PMCC/MCC. The practice of providing different cross section of bus bars for ACB Panel and

MCC panel in the same PMCC is not acceptable. Vertical bus bars of all verticals shall have same cross section.

3. The horizontal bus bars shall run on the top side of the PMCC and shall be fully accessible after opening the bus bar chamber cover from the front and the rear side.
4. The horizontal bus bars shall also be accessible from the top after removing the top plate for periodic maintenance.
5. The practice of running horizontal bus bars behind the vertical bus bars is not acceptable.
6. The horizontal bus bars shall be adequately braced and supported on SMC supports to withstand the stresses arising out of full system fault current as specified for a period of 1 sec.
7. It is preferable that the horizontal bus bars are supported on the SMC supports without being bolted to the supports. The bus bars shall not be drilled for any purpose other than for making Fish plate joints or vertical top offs. The entire tap offs & Fish plate joints (where the sleeves are removed for making the connections) are covered by clip on type epoxy/SMC shrouds.
8. These joints shall be accessible from the front after opening the front/rear cover, when the PMCC is fully cabled with external power & control cables and in service for routine maintenance.
9. The horizontal bus bar chamber shall be fully separated from the module space. There shall not be any access from the module space to horizontal bus bars when the draw out module of the top most compartments has been taken out for maintenance.
10. The vertical bus bars shall run behind the module compartments, the vertical bus bar space will be fully separated from the cable alley such that it will not be possible to access the VBB from the cable alley. The vertical bus bar space will also be fully separated from the feeder compartment except for the openings through which the power draw out contacts will engage.
11. When the feeder module is drawn out for maintenance the opening will automatically be closed through safety shutters.
12. The vertical bus bars shall be supported on SMC supports without having to be bolted to the supports.

13. The vertical bus bars also shall be rated to withstand the system fault level for 1sec. and fully sleeved as applicable for horizontal bus bars.
14. The vertical bus bars of all the vertical sections will have the same shape and same cross section, the material of the vertical bus bar shall be same as that of horizontal bus bars. Copper vertical bus bars are also acceptable if the same is manufacturer's standard. In case of Copper VBB, the tap off joints (HBB-VBB joints) will be provided with bimetallic strips and the copper part of the joint is silver/Tin plated.

D. MODULES, POWER CONTACTS & CONTROL CONTACTS:

1. The modules of the draw out MCC shall move on sliding rails provided with ball bearings.
2. The sizes of the draw out modules will be multiple of basic size. The modules of similar size and rating shall be totally interchangeable.
3. The minimum rating of power draw out contacts shall be 125A. These shall be of Copper and adequately silver plated.
4. The shape of the power contacts shall be such that during the short circuit, the contact pressure shall increase.
5. The power draw out contacts shall be clamped to the vertical bus bars without the use of nuts and bolts. Vertical bus bars with pre-punched holes at regular intervals for mounting the power drawout contacts are also acceptable.
6. The male-female power connections in the draw out modules will take place in enclosed area, enclosed by epoxy/SMC shrouds. The power draw out contacts of difference phases shall be separated from each other by these epoxy/SMC shrouds so that in case of overheating of the power draw out contacts, arc from one phase does not travel to other phase.
7. The modules shall have 3 distinct positions: service – Test – Isolated.
8. Effective earthing of the modules will be established before the module is taken to Test position from isolated position.
9. Control draw out contacts provided in the draw out modules (wherever required) shall be self-isolating, sliding type. These contacts shall be of copper duly silver plated. Anti-tracking barrier shall be provided between adjacent contacts. The control draw out contacts shall be individually convertible between
 - a) The contacts which make contact only in Service position.

- b) The contacts which make contact both in service & test position.
- c) The contacts which make contact only in Test position.

10. To ensure that the control draw out contact alignment is not disturbed during the termination of external control cables, the connection from the control draw out contacts shall be brought to external row of stud type terminals and the external cable will be terminated on this separate row of terminals only. The terminals for external cable termination and control draw out contacts shall be physically separate and shall not be part of common moulding.
11. Manually isolable plug – socket type of control contacts are also acceptable subject to the end customer's approval

Rack In/Out Mechanism

1. Rack in/Out mechanism should be accident free. If any tool is used for the same guide should be covered with canopy such that it will not touch any other parts of the module.

Instrument Plate

1. The with drawable modules shall be provided with a swing-out instrument plate at suitable place, It shall hinged to provide access to the components mounted behind it. The plate shall be opened upto an angle of 110 deg.. A cut-out shall be provided in the compartment door to enable the operator to read the flush-mounted meters, reset the overload relay, etc

Trolley Earthing

1. phosphor-bronze earthing/ equivalent system shall be used to provided positive double earthing. The contacts shall scrape against the electro-plated earth plate connected to earth bus. The system shall ensure earthing before the main contacts make and breaking after the main contacts break.

GENERAL SAFETY FEATURES REQUIREMENT IN ENCLOSURE:

1. An earth bus bar of copper or Aluminium or galvanized Mild Steel having a minimum cross-sectional area as specified shall be provided at the bottom for the entire length of the switchboard.
2. Every metal part other than those forming parts of an electrical circuit shall be connected to the earth bus by means of high conductivity copper wire.

3. The cores of transformer (bus potential transformer, control transformer, 24V winding heating transformer etc.) shall also be earthed through copper wire.
4. Metallic cases of instruments, relays, switches and other associated components mounted in the switchboard shall be connected to the earth busbar by copper conductors of not less than 2.5 sq. mm. cross-sectional area. Instruments having metallic cases shall be fitted with earthing terminals.
5. The metal parts of withdrawable units shall positively & independently get earthed before the primary connections are made. Scraping earth contact shall be fitted on withdrawable equipment and shall be designed to ensure positive earthing. Mere sheet steel contacts between two parts shall not be considered as earthing bondage.
6. The earthing of circuit breaker shall be achieved through a robust spring loaded, tinned copper contact of sliding type. One side of the contact shall be connected to the main earth bus bar.
7. Doors shall have a copper wire for earth connection to fixed unit.
8. Arrangement shall be provided for connecting the internal earth bar to the external earthing station.
9. Switchboard covers (including doors without interlock) shall be bolted on type, shall be designed to give access to individual circuits without exposing other circuits, which may be live. Alternatively, circuits exposed by the removal of the cover shall be individually shrouded.
10. The switchboards shall be designed to prevent contact with live parts both within the modules and in the cable alley.
11. Shrouds shall be provided between vertical busbars and modules. All live parts shall be shrouded to prevent inadvertent access and accident.
12. Interlock between compartment door and modules shall be provided such that the door cannot be opened without switching off the power supply to the module. Defeat interlock shall be provided for the units comprising of switch or MCCB or MPCB as a means of isolation, such that it is possible to open the door

with device ON and the unit in SERVICE position. The following shall apply under these conditions:

- a) It shall not be possible to close the door till the interlock has been reinstated.
 - b) Attempted withdrawal of the unit under such conditions shall be cautioned against by providing Warning Label affixed at an appropriate place.
13. With the draw out module fully removed from its housing, live parts exposed shall either be shrouded by automatic safety shutters or shall have means to shroud them totally to prevent contact. Suitable add-on type shrouds in loose to cover the opening on the compartment door when the module is taken out for maintenance shall be provided where automatic shutters or inbuilt shrouds are not provided.
 14. Safety Shutters shall be provided to completely shroud all the fixed isolating contacts of the circuit breaker both on busbar & circuit sides.
 15. Shutters shall be opened and closed automatically by the movement of the circuit breaker carriage and shall prevent access to the fixed isolating contacts when the circuit breaker is withdrawn.
 16. Locking facilities shall be provided to prevent the closing of circuit breaker when it is open and from being manually tripped when it is closed. In case it is not possible to provide locking facility to prevent manual tripping suitable shroud or flap shall be provided on the manual trip actuator to prevent its inadvertent operation. Provision shall be made to ensure that when manual-operating mechanism for maintenance purpose is being used, it shall not be possible to electrically close the breaker.
 17. The fixed contact of SFU shall be so shrouded that maintenance of the unit can be carried out in safety with the busbars live.
 18. Interphase barriers shall be provided to prevent possibilities of phase-to-phase fault in the switch. The switch shall also be shrouded from all sides to prevent access to live parts on the switch after opening the unit door. The barriers and shrouding shall extend upto the height of switch to fully enclose both the bus and the load side terminals of the device. The arrangement shall permit easy maintenance.

19. Where one isolating switch is used as the incoming device, the incoming side fixed contacts shall be shrouded to ensure that maintenance can be carried out with the remote fuse and switch closed.
20. MCCB, MPCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
21. Live terminals of fuse bases shall be shrouded to prevent contact with personnel where fuse links are not mounted in carriers and are directly plugged into the fuse base. Interphase barriers extending throughout the length of the fuse base shall be provided to prevent interphase short circuit. They shall be shrouded from all sides to prevent accidental contact.

PAINTING

1. All sheet steel works to be painted shall be pre treated in seven – tank process as per IS 6005(Class 'C').
2. Powder coating of shade, as per drawing, shall be applied. A minimum, of 80 Microns thickness shall be uniformly achieved. The painting shall be done by spray/ electrostatic painting and shall be stove enabled.
3. All bolts, nuts, and washer shall be cadmium / chromium plated / Zinc plated and di-chromate treated.