JABATAN KERJA RAYA MALAYSIA
CAWANGAN KEJURUTERAAN ELEKTRIK
UNIT PENSIJILAN BAHAN & STANDARD

TECHNICAL INFORMATION — **LV SWITCHBOARD**

A. COMPANY INFORMATION			
COMPANY / MANUFACTURER NAME :			
ADDRESS :		**TELEPHONE NO :**	
		FAX NO :	
		COMPANY EMAIL :	

ISO CERTIFIED COMPANY (To attached a copy of company ISO certificate)			**REGISTRATION NO:**	**SCOPE:**
1. ISO 9001	☐ YES	☐ NO	.....	.....
2. ISO 14001	☐ YES	☐ NO	.....	.....
3. ISO 50001	☐ YES	☐ NO	.....	.....
4. ISO	☐ YES	☐ NO	.....	.....

B. PRODUCT INFORMATION		
BRAND NAME :		
MODEL : 1.	4.	
2.	5.	
3.	6.	
STANDARD NO.: (MS IEC/IEC/etc.)		
CERTIFICATE OF APPROVAL : (SURUHANJAYA TENAGA, if any)	**DATE OF ISSUE:**	
	VALID UNTIL:	
	VOLTAGE RESTRICTION:	
PRODUCT CERTIFICATION : LICENSE (SIRIM/OTHER)	**DATE OF ISSUE:**	
	VALID UNTIL:	
TEST REPORT NO.:	**TESTING LABORATORY:**	
	DATE OF ISSUE:	
REGISTRATION WITH LOCAL AUTHORITY: (To attached a copy of Lesen Perniagaan Bandaraya / Majlis Perbandaran / Majlis Daerah)	**DATE OF ISSUE:**	
	VALID UNTIL:	
FACTORY ADDRESS :		

C. COMPETENT PERSONNEL

(Note: To attached copy of competency certificate)

(for JKR use)

C1. Designer ☐ Yes ☐ No

C1.1. Name : .....

C1.2. Qualification : .....

C1.3. BEM Reg. No. (If Any) : .....

C1.4. Copy of Competency Certificate:Attached? ☐ Yes ☐ No

C2. Chargeman ☐ Yes ☐ No

C2.1. Name : .....

C2.2. Restriction : .....

C2.3. Competency Certificate No. : .....

C2.4. Competency Certificate Copy: Attached? ☐ Yes ☐ No

C3. Wireman ☐ Yes ☐ No

C3.1. Name : .....

C3.2. Restriction : .....

C3.3. Competency Certificate No. : .....

C3.4. Competency Certificate Copy: Attached? ☐ Yes ☐ No

D. SWITCHBOARDS

D1. COMPLIANCE

D1.1. SURUHANJAYA TENAGA ☐ Yes ☐ No

D1.2. IEC / MS IEC 60439-1 ☐ Yes ☐ No

D1.3. IEC / MS IEC 61439-1 and 2 ☐ Yes ☐ No

D1.4. IEC 60439-5 ☐ Yes ☐ No

D1.5. Others (please state) : .....

D2. TYPE TESTED/VERIFICATION TEST

(Note: i) New Application - To enclosed copy of Certificate and Complete Test Report ;
ii) Renewal Application - To enclosed copy of Certificate and front page of Test Report)

D2.1. Type Test / Partial Type Test ☐ Yes ☐ No
(If yes, please complete section C2.7)

D2.2. Verification Test ☐ Yes ☐ No
(If yes, please complete section C2.8)

D2.3. Name of Testing Lab : .....

(for JKR use)

D2.4. Certificate No : .....

.....

.....

D2.5. Reference Standard : .....

.....

D2.6. Clause/Clauses : .....

.....

.....

D2.7. For Type Test/Partial Type Test Report of Switchboard only, as per MS IEC 60439, please complete table below.

Clause	Verification Of:	Current Rating (A)			
		<600	>600 and <2000	>2000 and <3150	>3150
8.2.1	Temperature Rise Limit	Yes / No	Yes / No	Yes / No	Yes / No
8.2.2	Dielectric Properties	Yes / No	Yes / No	Yes / No	Yes / No
8.2.3	Short Circuit Withstand Strength: a. 50kA for 1sec	Yes / No	Yes / No	Yes / No	Yes / No
	b. 30kA for 1sec	Yes / No	Yes / No	Yes / No	Yes / No
8.2.4	Continuity of Protective Circuit	Yes / No	Yes / No	Yes / No	Yes / No
8.2.5	Clearance and Creepage Distance	Yes / No	Yes / No	Yes / No	Yes / No
8.2.6	Mechanical Operation	Yes / No	Yes / No	Yes / No	Yes / No
8.2.7	Degree Of Protection	Yes / No	Yes / No	Yes / No	Yes / No
8.2.8	Electromagnetic Compatibility (EMC) Test	Yes / No	Yes / No	Yes / No	Yes / No
8.2.9	Resistance of Insulating Materials to Abnormal Heat and Fire	Yes / No	Yes / No	Yes / No	Yes / No

(Note: Circle Yes/No where applicable)

(for JKR use)

D2.8. For Verification Test Report of Switchboard by **testing** only, as per MS IEC 61439, please complete table below.

Clauses or Subclauses	Characteristic to be verified:	Current Rating (A)			
		<600	>600 and <2000	>2000 and <3150	>3150
10.2	Strength of material and parts:				
10.2.2	Resistance to corrosion	Yes / No	Yes / No	Yes / No	Yes / No
10.2.3	Properties of insulating materials:				
10.2.3.1	Thermal stability	Yes / No	Yes / No	Yes / No	Yes / No
10.2.3.2	Resistance of insulating materials to normal heat	Yes / No	Yes / No	Yes / No	Yes / No
10.2.3.3	Resitance to abnormal heat and fire due to internal electric effects	Yes / No	Yes / No	Yes / No	Yes / No
10.2.4	Resistance to ultra-violet(UV) radiation	Yes / No	Yes / No	Yes / No	Yes / No
10.2.5	Lifting	Yes / No	Yes / No	Yes / No	Yes / No
10.2.6	Mechanical impact	Yes / No	Yes / No	Yes / No	Yes / No
10.2.7	Marking	Yes / No	Yes / No	Yes / No	Yes / No
10.3	Degree of protection of enclosures	Yes / No	Yes / No	Yes / No	Yes / No
10.4	Clearances	Yes / No	Yes / No	Yes / No	Yes / No
10.4	Creepage distances	Yes / No	Yes / No	Yes / No	Yes / No
10.5	Protection against electric shock and integrity of protective circuits:				
10.5.2	Effective continuity between the exposed parts of the ASSEMBLY and the protective circuit.	Yes / No	Yes / No	Yes / No	Yes / No
10.5.3	Effectiveness of the assembly for external faults	Yes / No	Yes / No	Yes / No	Yes / No
10.6	Incorporation of switching devices and components*(verification by design rules)*	Yes / No	Yes / No	Yes / No	Yes / No
10.7	Internal electrical circuits and connection *(verification by design rules)*	Yes / No	Yes / No	Yes / No	Yes / No
10.8	Terminals for external conductors *(verification by design rules)*	Yes / No	Yes / No	Yes / No	Yes / No
10.9	Dielectric properties:				
10.9.2	Power-frequency withstand voltage	Yes / No	Yes / No	Yes / No	Yes / No
10.9.3	Impulse withstand voltage	Yes / No	Yes / No	Yes / No	Yes / No
10.10	Temperature-rise	Yes / No	Yes / No	Yes / No	Yes / No
10.11	Short-circuit withstand strength	Yes / No	Yes / No	Yes / No	Yes / No
10.12	Electromagnetic compatibility (EMC)	Yes / No	Yes / No	Yes / No	Yes / No
10.13	Mechanical operation	Yes / No	Yes / No	Yes / No	Yes / No

(Note: Circle Yes/No where applicable)

E. TESTING EQUIPMENT AND MACHINERY

*(Note: To attached proof of ownership for **New Application**)*

E1. TESTING EQUIPMENT

(Note: i) To attached calibration certificate;
ii) The maximum calibration interval should not more than 2 years)

(for JKR use)

E1.1. PRESSURE TEST EQUIPMENT/ WITHSTANDING VOLTAGE TESTER

i)	Brand	:	.....
ii)	Model	:	.....
iii)	Serial No.	:	.....
iv)	Max. of AC Testing Voltage	:	..... **Vac**
v)	Name of Calibration Lab	:	.....
vi)	Calibration Due Date	:	.....

E1.2. INSULATION RESISTANCE TESTER

i)	Brand	:	.....
ii)	Model	:	.....
iii)	Serial No.	:	.....
iv)	Max. of DC Testing Voltage	:	..... **Vdc**
v)	Name of Calibration Lab	:	.....
vi)	Calibration Due Date	:	.....

E1.3. OTHERS

i)	Brand	:	.....
ii)	Model	:	.....
iii)	Serial No.	:	.....
iv)	Max. of DC Testing Voltage	:	..... **Vdc**
v)	Name of Calibration Lab	:	.....
vi)	Calibration Due Date	:	.....

E2. MACHINERY

E2.1. CUTTING MACHINE

i) Brand : .....

ii) Model : .....

iii) Serial No. : .....

E2.2. PUNCHING MACHINE

i) Brand : .....

ii) Model : .....

iii) Serial No. : .....

E2.3. BENDING MACHINE

i) Brand : .....

ii) Model : .....

iii) Serial No. : .....

E2.4. OTHERS

i) Brand : .....

ii) Model : .....

iii) Serial No. : .....

F. SWITCHBOARD CONSTRUCTION REQUIREMENTS / SPECIFICATION

F1. Please fill form **CKE.ITP.01.35.(00).2012** - FACTORY ACCEPTANCE TEST - CHECKLIST FOR VISUAL INSPECTION OF LOW VOLTAGE SWITCHBOARDS
Form **CKE.ITP.01.35.(00).2012** completed and attached? ☐ Yes ☐ No *(for JKR use)* ☐

F2. To attached latest Busbar Mill Certificate. ☐ Yes ☐ No ☐

G. PARTS LIST FOR SWITCHBOARD ☐ Yes ☐ No ☐

Manufacturer shall only use material approved by Cawangan Kejuruteraan Elektrik IPJKR Malaysia as follows:

a. Circuit Breaker
b. Protection Relay
c. Fuse Switch
d. Surge Protective Device
e. Capacitor for P.F Correction
f. Power Factor Regulator
g. Residual Current Device
h. Isolator
i. Switching Contactor
j. Cable
k. etc

(Note : This list of mandatory items is not limited to this as it will be upgrading from time to time.)

The list of approved material can be access via JKR website:

i. **http://www.jkr.gov.my**
(click JMAL (JKR Material Approval List))

H. SWITCHBOARD TEST CERTIFICATE

H1. Does Every Switchboard Produced has a Switchboard Certificate? ☐ Yes ☐ No ☐

H2. Sample of Switchboard Test Certificate attached: ☐ Yes ☐ No ☐

*(**Note**:- Routine Test : **1)** The main and the auxilliary circuits shall be tested to verify dielectric properties with power frequency test voltage of **2500Vac for 1 minute** and insulation resistance under test voltage of **1000Vdc;***
***2)** Wiring, operational performance and function.)*

I. FACTORY AND QUALITY CONTROL.

I1. Name of person in-charge of :
I1.1. Factory : .....
I1.2. QA/QC : .....

I2. To enclosed floor layout of the factory/assembly line ☐ Yes ☐ No ☐

I3. To enclosed flow chart c/w colour picture of the whole manufacturing process ☐ Yes ☐ No ☐

I4. All process is done at factory as per declared address? ☐ Yes ☐ No ☐

I4.1. If No, please list and attached agreement with particular third party.

Name of Process : .....

Agreement attached? ☐ Yes ☐ No ☐

I5. Routine Test and Acceptance Criteria ☐ Yes ☐ No ☐

J. **SWITCHBOARD CONSTRUCTION DRAWING**

(Note : Switchboard shall be designed to meet JKR specification)

J1. To enclosed a sample of complete construction drawing as per JKR specification and best practices including detail view and information on busbar size and arrangement (busbar creepage distance) of the switchboard on **A3** size paper.

(for JKR use)

☐ Yes ☐ No ☐

K. Any other information need to be highlighted by manufacturer? Please state below:

.....

.....

.....

L. Any changes as compared from previous registration (for renew application only)

.....

.....

M. **MANUFACTURER'S DECLARATION**

I ..... hereby declare that all information in
(name)
this form regarding my company and my product is true, nothing false except all of them is true. I also declare that I shall design and construct my product as per JKR specification and best practice as instructed by S.O's Representative. If I, in any condition have been found given false information or declaration, an action can be taken by JKR including denying my application or withdrawing my registration.

Company Official Stamp:

Signature	:	.....
Name	:	.....
Position	:	.....
Date	:	.....

*Note: This checklist is developed from **L-S1, SPECIFICATION FOR LOW VOLTAGE INTERNAL ELECTRICAL INSTALLATION** - Revision No.4 Jun 2016 - Section 2.0 as per attachment for reference. Also attached is Form CKE.ITP.01.35.(00).2012 (to be completed by applicant, stamped company and initial on every page).*

N. **JKR'S COMMENT (For Office Use Only):**

.....

.....

.....

.....

.....

.....

JKR Officer's Signature : .....

[JKR Officer's official stamp here]

Date : .....

For JKR processing officer, to be filled as follows:	
☐ Comply	☐ Not Comply

2.0 SWITCHBOARDS

2.1 TYPES OF SWITCHBOARD

2.1.1 The types of switchboard shall be as specified in the Bill of Quantities and/or Drawings and shall be of the following types: -

2.1.1.1 Self-contained, floor mounted, flush fronted, metalclad cubicle type suitable for front and rear access;

2.1.1.2 Self-contained, floor mounted, flush fronted, metalclad cubicle type suitable for front access;

2.1.1.3 Wall mounted metalclad type suitable for front access.

2.1.2 The switchboards shall house their air circuit breakers, moulded case circuit breakers, fuse switches, switch fuses, isolators, contactors, busbars, meters, protective relays, selector switches, indicating lamps, current transformers, cable terminating boxes, cable glands, anti-condensation heaters complete with automatic thermostats and isolators and all other necessary items of equipment whether specified hereinafter or in the Drawings or not, suitable for operation on a 240/415V, 3 phase, 4 wire, 50Hz. system with solidly earthed neutral. Unless otherwise specified elsewhere, the switchboards shall be capable of withstanding fault condition of not less than 50kA at 415V for 1 second as defined in MS IEC 60439-1. The switchboards shall comply with MS IEC 60439-1 and the degree of protection shall be IP41 in accordance to MS IEC 60529.

2.1.3 Outdoor switchboards shall also comply with MS IEC 60439-5 with protection degree of IP54 in accordance to MS IEC 60529.

2.1.4 Type testing for switchboard as per categorization shall be as per Table 2A below:

Category	Current Rating	Registration & Type Test Report
I	I ≤ 600A	Suruhanjaya Tenaga
II	600A < I ≤ 2000A	Suruhanjaya Tenaga & Partial Type Test in accordance with MS IEC 60439-1 (i) Short Circuit Test (Clause:8.2.3) (ii) Temperature Rise Test (Clause:8.2.1)
III	I > 2000A	Suruhanjaya Tenaga & Full Type Test in accordance with MS IEC 60439-1

Table 2A : Type testing for switchboard as per categorization

2.1.5 Routine tests on the switchboard shall be carried out before delivery to site. The main circuits and the auxiliary circuits shall be tested to verify dielectric properties with power-frequency test voltage of 2500V*ac* for 1 minute and insulation resistance under test voltage of 1000V. Routine tests shall include inspection and checking of wiring, electrical continuity of the protective circuits, connections and effectiveness of mechanical actuating elements and interlock. Test Results or Certificate duly certified by Competent Person as in Electricity Regulations 1994 shall be issued for every switchboard supplied and installed.

2.2 ENCLOSURES

2.2.1 SELF-CONTAINED FLOOR MOUNTED CUBICLE SWITCHBOARDS

2.2.1.1 The framework of the switchboard shall be fabricated from rolled steel sections of thickness not less than 2.5mm and shall be self-supporting when assembled, uniform in height and depth from front to back. The rigid construction shall be designed to withstand without any sag, deformation or warping, the loads likely to be experienced during normal operating, maintenance or maximum fault condition.

2.2.1.2 The front shall be provided with covers/doors of box formation. The rear shall be provided with hinged removable doors of box formation. The rear doors shall be of double-leaf type with rebated edges and each leaf should preferably not be wider than 450mm. Each leaf of door shall have 2 pairs of approved hinges. The door shall be fitted with approved type of surface-mounted espagnolette or cremone bolts complete with approved locking device operated by a satin chrome lever handle at the centre fixing. The top and sides shall be of removable panels.

2.2.1.3 Cover plates with openings for cable entry shall be provided at the base of the switchboard. All panels, covers and doors shall be fabricated from sheet steel of thickness not less than 2.0mm and so constructed as to provide a clear, flush and pleasing appearance. The panels, covers and front doors shall be secured to the enclosure by means of chromed type of screws with cylindrical knurled head complete with retaining clips. Welded cross struts shall not be used.

2.2.1.4 The switchboard shall be dust and vermin proof. All covers and doors shall be provided with grommets and dust seals to exclude dust and dirt. Louvres or ventilation vent with filter shall be provided at the sides and back for adequate ventilation. Precaution shall be taken to prevent overheating due to hysteresis and eddy current using non ferrous plate (for single core cable). All edges shall be rounded. Serrated star washers shall be fitted to ensure satisfactory earthing of the front cover.

2.2.1.5 Unless otherwise specified in the drawings and/or bill of quantities, the switchboards shall be of Form 2b and comply with MS IEC 60439-1. The busbars shall be separated from the switchgears/functional units and the incoming and outgoing terminals. The form of separation shall be achieved by metallic or non-metallic rigid barriers/partitions. All switchgears shall be mounted so as to give adequate clearance for cable and busbar connections.

2.2.1.6 Switchgears shall be mounted on insulation runners where connected to busbars and on steel supports where cable connection are made. The insulation runners shall be of minimum 10mm thickness and mounted on steel support or back panel of the enclosure whichever is more appropriate.

2.2.1.7 Cables connection between the busbars and the switchgears shall be neatly arranged and mounted on cable runner. The terminals of the switchgears for external cable connections shall be at least 200mm above the base of the switchboards and, moreover, so placed that the cables can be easily connected to them. Withdrawable type of switchgears shall be mounted on the framework assembly, including the runner rails and fixed rear isolation contacts, which shall be supplied as a part of the switchgear assembly. Each withdrawable switchgear shall be housed in its own compartment with rear connected busbars.

2.2.1.8 All indicating instrument which need to be read by the operator shall not be located higher than 2m above the base of the switchboard. All operating devices such as handle, push buttons, etc., shall be located at such a height that they can easily be operated, and in general, the centerline shall not be higher than 2m above the base of the switchboard. In the case where building automation devices, transducers and relays are provided, they shall be separately housed in a compartment of the section of the switchboard. All wiring from the devices, transducers and relays shall be neatly arranged and connected to the terminal blocks with removal links mounted on rail. Terminals shall be identified and labelled in accordance with IEC 60445.

2.2.1.9 Where surge protective device is specified, the device and its associate equipment shall be totally compartmentalized with clear transparent cover at immediate lower subsection where the incoming switchgear is connected. A lockable tool compartment with keys and opening handle shall be provided at the lowest subsection of the switchboard. The switchboard shall undergo de-rusting treatment, anti-rust treatment with the exterior finished with epoxy dry-powder and oven baked semi-gloss beige colour and interior finished matt white. The switchboard shall be bolted to mild steel channel base or over concrete trench. The channel shall be anti-rusted and painted with a primer. There shall be a readily installed cable tray on the interior of both side panels for outgoing cable. All cables shall be rigidly secured using cable support bracket of non rotting material, before termination.

2.2.1.10 Where top entry is specified or required, there shall be a readily installed cable box for top entry cable.

2.2.1.11 Where the incoming feeder circuit breaker in the switchboard is 2500A and above, the switchboard shall be equipped with an arc protection system. The arc protection shall be installed against the internal arc in the switchboard in order to improve personnel safety to minimize damage to the switchgears in case of internal arc faults, thus improving the availability of the electricity service. The arc protection shall be integrated with protection relays or of stand alone type. The relays shall be in accordance to the requirements in Section 5.0. Only a simultaneous occurrence of over-current and arc incidence(s) shall activate the trip signal in the relay.

2.2.1.12 Arc sensors shall be mounted in the switchboard. The arc sensors for detecting the arc shall be of photo transistor or lens sensors. The arc sensors shall in practice be installed within the cable compartment of the outgoing feeder, main incoming circuit breaker and busbar compartment. The arc protection system shall include a self-supervision function covering all equipment, including the arc sensors. All internal faults shall be indicated on the arc protection unit and an alarm contact shall be activated. The arc-monitoring unit shall contain a display capable of indicating the exact compartment of the fault after the tripping.

2.2.1.13 All outgoing MCCBs in the switchboard where the incoming feeder circuit breaker is rated 400A and above shall be provided with panel mounting external operating handle with padlocking facilities.

2.2.2 WALL MOUNTED SWITCHBOARDS

2.2.2.1 The switchboard shall be fabricated from sheet steel of thickness not less than 2.0mm. The enclosure shall be of all welded construction with sheets bent where possible so as to minimise the number of welded joints. The four sides of the enclosure shall be returned at the front to facilitate fixing of front cover plates. The front cover plates or doors shall be of box formation and flanged to facilitate fixing to the enclosure.

2.2.2.2 The front cover of the switchboard shall be provided with grummets and dust seal to exclude dust and dirt. Meshed louvre or ventilation vent with filter shall be provided at both sides for ventilation. All edges shall be rounded. Serrated star washers shall be fitted to ensure satisfactory earthing of the front cover. The switchboard shall undergo de-rusting treatment, anti-rust treatment and be finished with epoxy dry-powder and oven baked semi-gloss beige colour.

2.2.2.3 The switchboard shall not be mounted directly to the wall or structure. It shall be firmly bolted/welded on to galvanised C-channel brackets which in turn shall be bolted to the wall or structure by means of bolts and nuts. The top of the switchboard shall not be higher than 2100mm and the bottom shall not be lower than 900mm from the floor.

2.3 BUSBARS

2.3.1 Busbars shall conform to BS EN 13601 and shall be tinned hard drawn high conductivity copper with an adequate uniform rectangular cross section to carry continuously their rated current without overheating. They shall be rigidly mounted on non-hygroscopic insulators so as to withstand any mechanical stresses to which they may be subjected under maximum fault condition.

2.3.2 Busbar sizes must not be less than that specified in the Drawings. However if the busbar sizes are not specified, then the busbar rating shall be based on a current density of not more than 1.5 A/sq. mm. In any case, the main busbars rating shall not be less than the rating of the incoming switchgear (I_n). All busbars whether horizontal or vertical, shall be of the same size.

2.3.3 The main busbars shall be run for the full length of the switchboard without reduction in size. Neutral busbar shall be of full size and full length as the phase busbars. Connections shall be made up with bronze or other copper alloy and nuts utilising tension washers on both outer faces. Where multiple parallel bars are used, they shall be separated by tinned copper spacers at spacing equal to the busbar thickness.

2.3.4 The main busbar shall be arranged in a horizontal plane in the order neutral-blue-yellow-red, viewed from the rear of the switchboard. Busbars shall be painted at appropriate points with colours red, yellow, blue and black to denote the phases.

2.3.5 Tinned copper earthing bar of cross sectional area not less than 50mm x 6mm shall run along the switchboard for its entire length. This switchboard earthing bar shall be fastened and bonded at the base to each vertical frame member of the switchboard. At least one earthing bar of similar cross sectional area shall run the full height of the switchboard and connected to the main earthing bar. All earthing bars shall be identified with green and yellow (twin-coloured) colour.

2.3.6 Distribution busbars shall be sized in accordance with the maximum outgoing switchgear rating. Connections from busbars to the switchgears shall be effected by means of copper conductors securely clamped to the busbars and colour coded to identify the phase and neutral conductors. Copper conductor either bare tinned busbars or insulated cable shall be rated in accordance with the current rating of the switchgear. Neutral conductor shall be of full size as phase conductor. Coloured cable sleeve shall be shrouded for cable end termination.

2.4 METER PANELS

2.4.1 The metalclad, mild steel or other approved material with thickness not less than 1.5mm meter panel of box formation shall be installed adjacent to, but physically separated from the main switchboard. Suitable flexible and/or rigid galvanised steel conduit with approved adaptors shall be supplied and fitted between the main switchboard and the meter panel. The design, construction and method of installation of the meter panel shall be to the requirement of Supply Authority or Licensee.

2.5 OTHERS

2.5.1 All secondary wiring shall be of not less than 1.5 sq. mm. section insulated with PVC and shall be fixed securely without strain by cleats of the compression type. All screws, locknuts, washers, bolts etc. shall be of copper alloy type.

2.5.2 Indicating lights shall be long life coloured LED type. All indicating lights shall be adequately ventilated and easily be replaced from the front of the panel without the use of extractors.

2.5.3 Instruments, meters, relays, protective fuses etc. located on the front of the switchboard shall be so positioned that as far as possible, each instrument, meter, relay, protective fuse etc. is adjacent to the unit which it is associated. All relays shall be of heavy duty type, unaffected by external vibration and capable of operation in any position. All instruments, meters, relays, equipment etc. shall be fully tropicalised.

2.5.4 One number approved anti-condensation heater shall be installed for every two sections at the switchboards. Each heater shall be complete with automatic thermostat control, ON-OFF switch and indicating lamp.

2.5.5 Engraved labels with white lettering on a black background shall be fastened or riveted on the front panels of each switchgear and item of equipment. The wording shall be approved by the S.O.'s Representative. Engraved name plate showing the relevant earth fault setting, overcurrent setting, current transformer ratio, fuse rating, name of the circuit to which it is connected, etc. shall be fixed to switchgear panels to which it refers.

17.3 SWITCH BOARDS (DISTRIBUTION BOARD, SUB-SWITCH BOARD AND MAIN SWITCH BOARD)

17.3.1 All switch boards shall be installed within enclosed electrical service rooms.

17.3.2 All switch boards shall be of stainless steel material (Grade SS 316).

17.3.4 All screws and nuts used shall be made from brass/stainless steel.

17.3.5 Special Treatment For Housings Of Electrical Items Used In Salt-Sprayed Environment as per 17.7 shall be applied.

17.4 SWITCHES AND SOCKET OUTLETS

17.4.1 For concealed installation, metal back boxes shall be of galvanised sheet steel or non ferrous type e.g. anodised aluminium.

17.4.2 For surface and outdoor installation, switches and socket outlets shall be of sealed or anti corrosive type.

JKR	**FACTORY ACCEPTANCE TEST** **CHECKLIST FOR VISUAL INSPECTION OF LOW VOLTAGE ELECTRICAL BOARDS**	**CKE.ITP.01.35.(00).2012** **Date Issued : 16th January 2012** **Revision : -** **Revision Date : -** **Page : 1 / 5**

PROJECT NAME :	
MANUFACTURER NAME :	

Notes:

1. This form is to be used as a checklist for visual inspection acceptance only. Other acceptance criteria such as dielectric properties test, insulation resistance test and functional test shall use the forms provided by the manufacturer. S.O Rep is advised to begin the FAT with the visual inspection test ahead.

2. Prior departure to the factory, SO Representatives (SORs) are recommended to bring together: ☐
   - Documents : Approved Shop Drawing of Switchboard, BQ & Material List as per contract
   - Tools : Digital Caliper, Measuring Tape, Torchlight, Digital Camera ☐

3. Upon arrival and prior of any testing, SO Representatives are required to check/ensure:
   a. Date of calibration status of the instruments to be used for testing. (Calibration validity: 2 years) ☐
   b. Certificate of the manufacturer's competent person who will in charge for the testing. (Min. AO) ☐
   c. Brand & Model of the material installed had been approved during construction stage as referred to material approval list (comply to J-MAL and material list as per contract). ☐
   d. Inspect thoroughly compliance of the manufactured switchboard with the approved shop drawing particularly on the following criteria: ☐
      - Rating, Number of Poles & Arrangement of **EACH** Switchgear and terminals

NO.	DESCRIPTION	SPECIFICATION/JKR REQUIREMENT	COMPLIANCE [√ Yes, X : No, - : Not Applicable]				REMARKS
A) Self-Contained <u>Floor Mounted</u> Cubicle Switchboard		Board Name:					Also applicable to PFC Board and GSC Board
1	Form of Separation	Form 2B					Minimum Requirement.
2	Frame Thickness	Switchboard ≥ 2.5 mm					
3	Panels, Covers & Doors Thickness	≥ 2.0 mm					
4	Panel (Top & Sides)	Removable					
5	Panels, Covers & Front Doors	Cylindrical knurled head (chromed type) c/w retaining clip					
6	Serrated Star Washer	At front cover					
7	Material for Frame	Rolled Steel					
8	Anti Rust Treatment	Epoxy dry powder					
9	Color	Enamel Grey (Exterior) Matt White (Interior)					
10	Base Cover Plates	Provided					
11	Door	Espagnolette/cremone bolt, locking device & satin chrome lever handle at the center fixing					
12	Rear Door	Hinged removable & double-leaf type					
	12.1 Width of Each Leaf	≤ 450 mm					
13	Louvers with filter	Sides & back					
14	Withdrawable switchgear	Own compartment with rear connected busbars					
15	Height of indicating instrument	≤ 2000 mm (above the base)					
16	Building automation devices, transducers, relays	Separately housed in a compartment					
17	SPD	Separate compartment at immediate lower subsection & totally compartmentalize					
18	Tool Compartment	Located at the lowest subsection c/w lockable with key					
19	All secondary wiring	Neat Properly labelled with number sleeves					

NO.	DESCRIPTION	SPECIFICATION/JKR REQUIREMENT	COMPLIANCE [√ Yes, X No, - : Not Applicable]	REMARKS
B) Wall Mounted Switchboard				
1	Material	Sheet steel		
2	Thickness	≥ 2.0 mm		
3	Portion of the Front Cover (cut-out & meter)	Fibre type		
	3.1 Thickness	≥ 5.0 mm		
4	Louvers with filter	Both sides		
5	Serrated Star Washer	At front cover		
6	Anti Rust Treatment	Epoxy dry powder		
7	Color	Enamel Grey		
8	Panels, Covers & Front Doors	Cylindrical knurled head (chromed type) c/w retaining clip		
9	All secondary wiring	Properly labelled with number sleeves		
C) Busbars				
1	Mounting	Non-hygroscopic insulator		
2	Busbar	Tinned hard drawn high conductivity copper		
3	Horizontal Busbar & Vertical Busbar Size (at main incoming supply) Size	Drawing requirement: Tender (mm) / Working (mm) R Y B N	Compliance:	Horizontal & Vertical Busbar Size (at main incoming supply) should be the same. Size as installed is similar or more than as in the approved shop drawing.
4	Distrubution Busbar Size similar as approved shop drawing (Vertical at each outgoing)	Drawing requirement: Tender (mm) / Working (mm) R Y B N	Compliance:	Size at each Distribution Busbar shall be less than or equal to the maximum size of outgoing circuit breakers connected to it.
5	Multiple Parallel Busbars	Separated by tinned copper spacers (at spacing equal to the busbar thickness)		Spacing=busbar thickness
6	Main Busbar Arrangement	R-Y-B-N (from back to front)		Front Back R - Y - B - N
7	Phase Indication/ Identification	Painted with colour at appropriate points to denote the phase		
8	Switchboard Earthing Bar	Tinned copper		
	8.1 Size	50 mm x 6 mm Or else otherwise specified		
9	Earthing Bar Identification	Painted with green at appropriate points		
D) Conductors				
1	Sizes	As per approved drawing		
2	Cabling	Neat and tighten		
3	Coloured Cable	For ≤ 25mm^2 cable: shall be colour coded to identify the phase &neutral conductors		
4	Cable End Termination	Coloured cable sleeve to identify the phase and neutral conductors		
E) Others				
1	Indicating Lamps	Easily be replaced from the front of the panel. LED type		
2	Anti Condensation Heater	Installed for every 2 sections, excluding busbar compartment. Heater c/w enclosure		
	2.1 Heater	c/w automatic thermostat control, ON-OFF switch & indicating lamp.		
3	Labels	Engraved with white lettering,black background & fastened or riveted		

NO.	DESCRIPTION	SPECIFICATION/JKR REQUIREMENT	COMPLIANCE [√ Yes, X No, - : Not Applicable]				REMARKS
F) Switchgears							
1	Switchgears	Current rating are accordance with drawing and/or BQ					
2	ACBs	Withdrawable metal clad, flush mounted & horizontal drawout isolation, c/w shutter					
	2.1 No. of poles	3 or 4					
	2.2 Icw	Minimum 50 kA at 415V for 1 sec. or otherwise specified					
	2.3 Copper tape/bar from frame (metal) of ACB to SEB	Tinned copper					
	2.4 Used as Bus-coupler	4 pole					
3	MCCBs	No. of poles are accordance with drawing and/or BQ					
	3.1 Icu	Minimum 50 kA at 415V for 1 sec. or otherwise specified					
	3.2 Incoming Feeder Circuit Breaker ≥ 400A	Provided with panel mounting external operating handle with padlocking facilities and door interlocking facilities					If required
G) Current Transformers							
1	Secondary Rating	5 A					
2	Rating	≥ 15 VA					
3	Accuracy (for measuring & metering)	Class 1.0 or otherwise specified					
4	Accuracy (for protection)	Class 10P10 or otherwise specified					
H) Surge Protection Device							
1	Connecting Leads	as short as possible					Preferably not exceeding 0.5m for the total length.
2	2.1 Isolation of SPD : MCCB / Fuse	4 pole MCCB or fuses or otherwise specified					
	2.2 Isolation of SPD : Compartment	Separate compartment for SPD					
3	Transparent Window for viewing the SPD indicator	At front cover of the SPD's compartment for viewing the SPD indicator					
4	Label "Amaran" at SPD compartment	Sentences as in L-S1 with red lettering on a white background					
I) Distribution Board							
1	Material	Sheet steel					
2	Thickness	1.2mm to 1.5 mm					
3	Serrated Star Washer	At front cover					
4	Anti Rust Treatment	Epoxy dry powder					
5	Color	Enamel Grey					
6	Panels, Covers & Front Doors	Cylindrical knurled head (chromed type) c/w retaining clip					
7	Comb / Fork Busbar	Insulated type					

NO.	DESCRIPTION	SPECIFICATION/JKR REQUIREMENT	COMPLIANCE [√: Yes, X : No, - : Not Applicable]	REMARKS
Note : For item J, K & L, the compliance of specification & JKR requirement for item Self-Contained Floor Mounted Cubicle Switchboard and item Busbar are similar as LV Switchboard above. i.e: Thickness, size, material, etc.				
J) Power Factor Correction Board (PFCB)				
1	Enclosure	Not form part of the switchboard it is connected to (independent) but match the height and depth.		
	1.1 Icu of MCCB / ACB	Minimum 50 kA at 415V for 1 sec. or otherwise specified	Icu: Ics:	
	1.2 Access	Front & rear		
2	Capacitor			
	2.1 Category	C (min. 40°C)		
	2.2 Rated Voltage	525V, 50Hz		
	2.3 Housing/Container	Heavy metal sheet steel		
	2.4 Separation between capacitors	Min. 80mm		
3	Reactor	Installed in separate compartment of PFCB c/w rubber pad to reduce noise due to vibration etc.		
	3.1 Class	H		
	3.2 kVAR Rating (Reactance)	Min. 6%		
	3.3 Rated Voltage	440V		
4	MCCB			
	4.1 Icu of MCCB / ACB	Minimum 50 kA at 415V for 1 sec. or otherwise specified. Ics = 100% Icu	Icu: Ics:	
	4.2 Minimum Continuous Current Ratings	Min. 155% of rated capacitor currents		
5	Switching Contactor			
	5.1 Utilization Category	AC-6B		
	5.2 Minimum Continuous Current Rating	Min. 135% of rated capacitors currents		
	5.3 Ventilation Van	Heavy duty type* c/w filter and automatic shutter		*Air Exchange : Min.200 cubic meter perhour
6	All secondary wiring	Properly labelled with number sleeves		
K) Generator Set Switchboard [Essential Board]				
1	Enclosure	Not form part of the switchboard it is connected to (independent) but match the height and depth.		
2	Automatic Transfer Switching Equipment (ATSE)	Transparent protection screen of full compartment size shall be provided in front of automatic changeover contactors / ATSE		
	2.1 Contactor Utilization Category	AC-33B		
	2.2 MCCB / ACB type	4 pole		
3	Tinned Copper Earthing Bar	25mm x 6mm		
4	All secondary wiring	Properly labelled with number sleeves		
L) Generator Set Control Board (GSCB) [AMF Board]				
1	Enclosure	Not form part of the switchboard it is connected to (independent) but match the height and depth.		
2	Emergency Stop Push-Button	Provided and c/w self-latching mushroom head type		
3	Alarm Bell	Min.250mm diameter		
4	All secondary wiring	Properly labelled with number sleeves		

COMMENTS (IF ANY)

CHECKED BY [S.O. Representative)

Signature :		Position :	
Name (CAPITALS) :		Date :	
On behalf of :			

WITNESSED BY [JKR] **if applicable*

Signature :		Position :	
Name (CAPITALS) :		Date :	
On behalf of :			

ELECTRICAL CONTRACTOR

Signature :		Position :	
Name (CAPITALS) :		Date :	
On behalf of :			

MANUFACTURER

Signature :		Position :	
Name (CAPITALS) :		Date :	
On behalf of :			