Gujarat Biotechnology University

CONSTRUCTION OF STORAGE UNIT & FAÇADE ON TERRACE WITH OTHER AMENITIES.

Electrical Tender Specification

A. DISTRIBUTION BOARDS:

1.0 SPECIFICATIONS

Distribution boards shall be fabricated from 18-gauge M.S. sheet or shall be readymade as specified in the make of material list. It shall be of double door type with hinged (lockable if required) door suitable for recessed mounting in wall. Distribution boards shall be powder coated with 7-tank process application.

The distribution boards shall be provided with phase barriers, wiring channels to accommodate wires and individual per phase neutral links. There shall be separate or individual earth link as per requirement. Proper arrangement shall be made for mounting of MCB's and other accessories.

Distribution boards shall meet with the requirements of IS 2675 and marking arrangement of bus bars shall be in accordance with I.S. standards.

Bus bars shall be suitable for the incoming switch rating and sized for a temperature rise of 35° C over the ambient. Each board shall have two separate earthing terminals. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as instructed. One earthing terminal for single phase and two terminals for 3 phase DB's shall be provided with an earth strip connecting the studs and the outgoing ECU earth bar.

The top and the bottom faces of the D.B. shall be provided for conduit entry of minimum 1" dia. The faces if asked shall be kept detachable.

All outgoing feeders shall terminate on a terminal strip which in turn is interconnected to the MCB/Fuse base by means of insulated single conductor copper wires as follows

Up to 15 A	2.5 sq.mm.	40 A	10 sq.mm.
25 A	4.0 sq.mm.	63 A	16 sq.mm.
32 A	6.0 sq.mm.		

Each DB shall have indicating lamps preferably neon type denoting power availability in the board after the switch indicating lamps shall be complete with fuses.

MINIATURE CIRCUIT BREAKERS (MCB):

MCB's shall have quick make and break non-welding self-wiping silver alloy contacts for 10 KA short circuit both on the manual and automatic operation. Each pole of the breaker shall be provided with inverse time thermal over load and instantaneous over current tripping elements, with trip-free mechanism. In case of multi-pole breakers, the tripping must be on all the poles and operating handle shall be common. Breakers must conform to BS 3871 with facility for locking in OFF position. Pressure clamp terminals for stranded/solid conductor insertion are acceptable up to 4 sq.mm. aluminium or

2.5 sq.mm. copper and for higher ratings, the terminals shall be suitably shrouded. Wherever MCB isolators are specified they are without the tripping elements.

RCCB / ELCB

The RCCB should suffices all the requirements of IS as per code IS - 12640 - 1988. The RCA should be current operated and not on line voltage.

The RCCB should ensure mainly the following functions:

i) Measurement of the fault current value.
ii) Comparison of the fault current with a reference value.
iii) The RCCB should have a torroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero.
iv) All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant.
v) It should be truly current operated.
vi) It should operate on core balance torroidal transformer.
vii) Its accuracy should be ± 5 %.
viii) It should operate even in case of neutral failure.
ix) It should trip at a present leakage current within 100 mA
x) Its enclosure should be as per IP 30.
xi) Its mechanical operation life should be more than 20,000 operations.
xii) It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule1956.
xiii) It should conform to all national and international standards like IS: 8828-1993, IS: 12640-1988, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

1.1 WORKMANSHIP

The D.B. shall be properly grouted in the wall in concealed manner taking care that the powder coating is not scratched and dents are not formed on the D.B. The MCBs and ELCBs. In the distribution boards shall be fixed as per the circuit details provided. All the wires terminating in the MCBs and the ELCBs shall be lugged for proper contact and ferrules depicting the circuit nos shall be provided. D.B.s mounted in concealed manner shall have a groove around it so as to save the finish of the plaster and colour during future opening of the door. The distribution boards shall have circuit chart tagged on the door for future maintenance. Danger notice plates shall be fitted to the distribution boards with screws and not stuck so as to assure its presence for a longer duration.

1.2 MODE OF MEASUREMENT

The distribution boards shall be measured in nos and the MCBs and ELCBs shall be measured in numbers separately.

Note:

All material and workmanship have to be as per latest IS / International standards.

B. 1.1 KV GRADE L.T. CABLES AND CABLE TERMINATION:

1.0 SPECIFICATIONS

2.0

L. T. XLPE CABLE*:*

GENERAL:

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in the original drums with manufacturer's name, size and type clearly written on the drums.

All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.
The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.
The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

CONDUCTOR:
Uncoated, annealed copper / aluminium, of high conductivity, upto 4 mm^2 size the conductor shall be solid and above 4 mm^2 the conductors shall be concentrically stranded as per IEC: 228.

INSULATION:
Cross link polyethylene (XLPE) extruded insulation rated at 70^oc.

CORE INDENTIFICATION:

Two cores	:	Red and Black
Three cores	:	Red, Yellow and Blue
Four cores	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing.

Black shall always be used for neutral.

ASSEMBLY:
Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

ARMOUR:
Galvanized steel flat strip / round strips applied helically in single layers complete with covering the assembly of cores.
For cable size upto 10 sq mm : Armour of 1.4 mm dia G.I. round wire

For cable size above 10 sq mm : Armour of 4 mm wide 0.8 mm thick GI strip

SHEATH:

ST -2 PVC along with polypropylene fillers to be provided.

Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables. Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. of 50^{o}c and operating temperature of cables. The sheath shall be resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.

Sequential length marking along with size and other standard parameters shall be required at every 1.0 mtr on the outer sheath.

TESTING:

Finished cable tests at manufacturers works: The finished cables shall be tested at manufacturer's works for all the routine tests for all the length and size of cables to be delivered at site and the certificate for the same shall be furnished to client. If required the cables shall be tested in presence of the client's representative.

Voltage test: Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

Conductor resistance test: The D.C. resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20^{o}c to check the compliance with the values specified in the Is 8130 – 1976.

Cable tests before and after laying cables at site:

Insulation resistance test between phases, phase to neutral and phase to earth.

Continuity test of all the phases, neutral and earth continuity conductor.

Earth resistance test of all the phases and neutral.

All the tests shall be carried out in accordance with the relevant IS code of practice and Indian Electricity Rules. The bidder shall provide necessary instruments, equipments and labour for conducting the above tests and shall bear all the expenses in connection with such tests. All tests shall be carried out in the presence of client and the results shall be prescribed in forms and submitted.

CABLE MARKING:

The outer sheath shall be legibly embossed at every meter with following legend:

ELECTRIC CABLE: 1100 V, SIZE: ___C X ____ MM^2 with Manufacturers name, year of manufacturing and ISI symbol.

SEALING DRUMMING AND PACKING:

After tests at manufacturer's woks, both ends of the cables shall be sealed to prevent the ingress of moisture during transportation and storage.

Cable shall be supplied in length of 500 mtrs or as required in non-returnable drums of sufficiently sturdy construction.

Cables of more than 250 meters shall also be supplied in non-returnable drums.

The spindle hole shall be minimum 110 mm in diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the Englist literature, a distinguishing number, the manufacturer's name and particulars of the cable i.e. voltage grade, length, conductor size, cable type, insulation type, and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow. The drum flange shall also be marked with manufacturer's name and year of manufacturing etc.

CABLE TERMINATION:

Cable terminations shall be made with aluminium crimped type solder less lugs for all aluminium cables and stud type terminals. For copper cables copper crimped solder less lugs shall be used.
Crimping shall be done with the help of hydraulically operated crimping tool.
For joints where by cable is with aluminium conductor and busbars are aluminium, bimetallic lugs shall be used with compound. CUPAL type of washers shall be used.
Crimping tool shall be used for crimping any size of cable.

CABLE GLANDS*:*

Cable glands shall be of brass single compression type. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations.

FERRULES:

Ferrules shall be of self-sticking type and shall be employed to designate the various cores of the control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

CABLE JOINTS:

Kit type joint shall be done and filled with insulating compound. The joint should be for 1.1 KV grade insulation.

1.1 WORKMANSHIP

Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the Contractor shall mark it out on the drawings and also on the site and obtain the approval of the CLIENT AND/OR ITS ARCHITECT before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.

Cables shall be laid on walls, cable trays, inside shafts or trenches. Saddling or support for the cable shall not be more than 500 mm apart. Plastic identification tags shall be provided at every 30 m.

Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.

In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc unless marked on drawing by architect / consultant. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 10 meters and at all loop points.

All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid. Cable termination for conductors up to 4 sq.mm. may be insertion type and all higher sizes shall have compression type lugs. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armouring shall be earthed at both ends.
In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position, so that no rainwater may enter the building. After the cables are tested the pipes shall be sealed with M. seal & then tarpaulin, shall be wrapped around the cable for making the entry watertight.

Testing: MV cables shall be tested upon installation with a 500 V Meggar and the following readings established:
Continuity on all phases.
Insulation Resistance.
between conductors.
all conductors and ground.
All test readings shall be recorded and shall form part of the completion documentation.
Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool. Proper insulation tape shall be applied at the cable and lug joint.

Format for cable testing certificate:

a. Drum no. from which cable is taken :
b. Cable from _____ to _____
c. Length of run of this cable _____ mtr

d. Insulation resistance test

Between core 1 to earth _____mega-ohm

Between core 2 to earth _____mega-ohm

Between core 3 to earth _____mega-ohm

Between core 1 to core 2 _____mega-ohm

Between core 2 to core 3 _____mega-ohm

Between core 1 to core 3 _____mega-ohm

Duration used:

e. High voltage test: Voltage Duration

Between core and earth Between individual cores

Note:

All material and workmanship have to be as per latest IS / International standards.

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C. INTERNAL WIRING

1.0 SPECIFICATIONS

RIGID PVC AND FLEXIBLE PVC FRLS LHSFT CONDUITS:

All conduits shall be rigid PVC alloy low in halogens pipe having minimum wall thickness of medium gauge 1.6 to 2.0 approved by F.I.A. & I.S.I. and shall confirm to IS 9537 part 3 and complying with fire safety standards classification V-0. The temperature stability shall be from –20°c - +80°c and also shall be uV stabilized.

Up to 38 mm diameter in slab - minimum 1.8 mm. wall thickness.

Up to 38 mm diameter in floor - minimum 2.0 mm. wall thickness.

Above 40 mm. diameter - minimum 2.2 mm. wall thickness.

Flexible conduits shall be formed from a continuous length of spirally wound interlocked steel strip with a fused zinc coating on both sides. The conduit shall be terminated in brass adapters.

ACCESSORIES:

PVC conduit fittings such as bends, elbows, reducers, chase nipples, split couplings, plugs etc. shall be specifically designed and manufactured for their particular application. All conduit fittings shall conform to IS: 2667-1964 and IS: 3857-1966. All fitting associated with galvanized conduit shall also be galvanized.

WIRES:

All wires shall be single core multi-strand/ flexible copper or single strand Copper (if specified in BOQ), PVC insulated **HFFR** grade as per IS: 694 and shall be 660 V\1100 V.

All wires shall be colour coded as follows:

Phase	**Colour of wire**
R	Red
Y	Yellow
B	Blue
N	Black
Earth	Green (insulated)
Control (If any)	Grey
All off wires	Same as Phase wire

SWITCHES & SOCKETS:

Switches shall be modular type with silver-coated contacts. Sockets shall be 5 pins with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes.

For heavy duty, metal clad sockets with M.C.B / Isolator mounted in a galvanized steel box shall be provided.

SWITCH PLATE AND BOX:

Plates of the same make, as that of switches shall be used with the modular range. Also M.S. boxes shall be taken as switch boxes.

1.1 WORKMANSHIP

The size of conduit shall be selected in accordance with the number of wires permitted under table given below. The minimum size of the conduit shall be 25 mm diameter unless otherwise indicated or approved. Size of wires shall not be less than 1.0 sq.mm. Copper or 2.5 sq.mm. Aluminium.

Nominal Dia of wires (mm)	Nominal Cross sec. Area (mm^2)	20 mm		25 mm		32 mm		38 mm	
		S	B	S	B	S	B	S	B
1/2.40	1.50	4	3	8	6	15	9	--	--
1/1.80	2.50	4	2	6	4	10	8	--	--
1/2.24	4.00	2	2	4	3	8	6	--	--
1/2.80	6.00	1	--	4	3	6	6	--	--
1/3.55	10.00	1	--	3	2	5	4	6	5

S - runs of conduits which have distance not exceeding 4.25 m. between draw boxes & which do not deflect from the straight by an angle more than 15 degree.

B - runs of conduits, which deflect, from the straight by more than 15°.

Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 300 mm distance between telephones, TV & Computer piping.

Separate conduits/raceways shall be used for:

Normal lights and 5 A 3 pin sockets on lighting circuit.

Separate conduit shall be laid from D.B. to switch board.

Power outlets - 15 A 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.

Emergency lighting.

Telephones.

Fire alarm system.

Public address system & Music system.

For all other voltages higher or lower than 230 V.

T.V. Antenna.

Water level guard.

Computer Wiring

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25 m.

Conduits run on surfaces shall be supported on metal 12 mm. thick G.I. pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building. Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm. intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but the building Contractor will do final finish.

Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the CLIENT AND/OR ITS ARCHITECT, before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete suitable fish wires shall be drawn in all conduits before they are embedded.

Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.

Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal. All junction and switch boxes shall be covered by 6 mm clear plate. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.

Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in. Conduits should terminate in junction boxes of not less than 32 mm. deep.

An insulated earth wire of copper rated capacity shall be run in each conduit.

Power Wiring:

All final branch circuits for lighting and appliances shall be single conductor/ stranded/ flexible wires run inside conduits. The conduit shall be properly connected or jointed into sockets, bends, and junction boxes.

Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.

All circuits shall preferably be kept in a separate conduit up to the Distribution Board. No other wiring shall be bunched in the same conduit except those belonging to the same phase. Each lighting branch circuit shall not have more than ten outlets or 800 watts whichever is lower. Each conduit shall not hold more than three branch circuits.

Flexible cords for connection to appliances, fans and pendants shall be 650/1100 V grade (three or four cores i.e. with insulated neutral wire of same size) with tinned stranded copper wires, insulated, twisted and sheathed with strengthening cord. Colour of sheath shall be subject to the CLIENT AND/OR ITS ARCHITECT'S approval.

Looping system of wiring shall be used. Wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors. No such joints shall be made unless the length of the sub-circuit, sub-main or main is more than the length of the standard coil.

Control switches shall be connected in the phase conductors only and shall be `ON' when knob is down. Switches shall be fixed in 3 mm. thick painted or galvanized steel boxes with cover plates as specified. Cadmium plated brass screws shall be used.

Power wiring shall be distinctly separate from lighting wiring. Conduits not less than 25 mm. and wires not less than 2.5 sq.mm. copper shall be used.

Every conductor shall be provided with identification ferrules at both ends matching the drawings.

Testing: the entire installation shall be tested for :

Insulation resistance.

Earth continuity.

Polarity of single pole switches.

General: All the wiring switch board, outlet points shall be done in a concealed manner in wall & slab in PVC conduit of minimum 25 mm dia. (medium gauge) & with 650v / 1100v grade PVC insulated flexible copper conductor wire. The switches should be modular with moulded cover plates, blank plates for outlet boxes. The accessories, connectors, sockets, should be fixed with brass chrome / cadmium plated machine screw. For fan points the rates should be with hum -free type 300 W regulators as required to complete the point wiring. The wiring shall be as per IS: 732 and IS: 4648. The wiring shall be done in a looping manner so as to avoid junction boxes at any place. All the looping shall be done only in the switchboard and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed.

The size of wires shall as follow:

25-32 Amp. metal clad points:

Phase / Neutral 4.0 mm^2

Earth 2.5.0 m m^2

20 Amp. out let points :

Phase / Neutral 4.0 m m^2

Earth 2.5 m m^2

Two nos. of 15 Amps. socket out let connected in parallel

from DB to first outlet

Phase / Neutral 4.0 m m^2

Earth 2.5 m m^2

from first outlet to second outlet.

Phase / Neutral 2.5 m m^2

Earth 2.5 m m^2

Light, fans, exhaust fan, 5 Amp. On board plug point, two way light points, bell point etc from switch to outlet.

Phase / Neutral 1.5 m m^2

Earth 1.0 m m^2

From D.B. to switch board – lighting / 5 A socket etc – i.e. circuit mains part of point wiring

Phase / Neutral 2.5 m m^2

Earth 1.5 m m^2

15/20 Amps. Socket outlet for AC (Single Phase/Three Phase) / Geyser

Phase / Neutral 2.5 m m^2

Earth 1.5 m m^2

15/20 Amps. Socket outlet for appliances or looped from sockets with 4 sq mm ckt.

Phase / Neutral 2.5 m m^2

Earth 2.5 m m^2

Separate pipes shall be laid for off wires and circuit mains.

Circuit mains of same phase shall be drawn in one pipe with prior permission/discussion with the consultant.

Separate phase, neutral and earthing wire of sizes recommended by consultant shall be drawn for each and every circuit mains.

Mains for lighting and on board plug points shall be of one-size higher wires than those used in off.

The point definition shall be conduiting and wiring from D.B. to S.B. and there from to final outlet point including switches and accessories, junction boxes, fan boxes, zarri work with cement –sand etc of approved make.

Note:

All material and workmanship has to be as per latest IS / International standards.

D. LED LIGHT FIXTURES & FANS

1.0 SPECIFICATIONS

General Purpose Led Luminaries suitable for Office /Industry / Street Light applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC, and operational from 170-280 V without significant drop in output. The LED modules should be from Cree/Nichia/Philips Lumi Leds Only with efficiency of a min 130 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures, built with Integral driver. The Min degree of Protection for Indoor Fixtures should be IP20 and IP65 for Outdoor/ Semi Indoor Fixtures. The THD of Fixtures should be strictly <10 % and drivers should be compulsorily provided with miswiring/ overload and short circuit protections. For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, out door fixtures should be with die aluminum / extruded aluminum housing only. The Fixtures should be prewired upto the terminal block and easy to mount and install and maintain if necessary. The fixture should comply LM79-08 certification criteria and also module should be backed with LM80-08 Certificate from the OEM. The fixtures should be warranted for a period of 3yrs from the date of Installation . The fixtures should have some kind of embossing/ engraving to identify the brand name. The manufactures should provide all kind of test report, technical details as and when called for. The fixture may be tested from govt approved Lab for Claimed parameters by the manufacturer.

1.1 WORKMANSHIP

The fixture shall be installed on wall / ceiling as directed and as per manufacturer's instruction, with necessary accessories for surface, concealed, suspended from ceiling, bracket mounting etc. The job also includes connection of fixture with respective outlet point with heat resistant wires through heat resistance sleeve and PVC connector. The exhaust fan shall be installed complete with M.S. angle iron mounting frame/ ring, G.I. louvers, wire mesh and plug at the end of the cord including wiring & earthing etc. Proper earthing shall be provided to the fixtures.

1.2 MODE OF MEASUREMENT

The unit rate shall be considered for fitting one fixture. The rate shall include following
All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.
Supplying and fixing Ball and socket joints wherever required.
Earthing of fittings.
Electrical connections to fittings/fans from the junction box/ceiling rose.
Installation and interconnection of Electronic regulators for ceiling fans.
Supplying and fixing 300 mm. GI down rod for ceiling fans.

Note:

All material and workmanship has to be as per latest IS / International standards.

E. TECHNICAL SPECIFICATION FOR LIFT

1. GENERAL

This specification covers manufacturer, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installation, commission putting into operation of Lifts.

2. The work shall be executed as per CPWD General Specifications for Electrical Works Part III Lifts & Escalators -2003) as per relevant IS and as per directions of Engineer-in- charge. These additional specifications are to be read in conjunction with above and in case of variations. Specifications given in this additional condition shall apply. However, nothing extra shall be paid on account of these additional specifications & conditions as the same are to be read along with schedule of quantities for the work.

4. The tenderer should in his own interest visit the site and familiarizes himself with the site conditions before tendering.

5. No T & P shall be issued by the Department and nothing extra shall be paid on account of this.

6. COMPLETENESS OF THE TENDER

All sundry equipments, fittings, assemblies, accessories, hardware items foundation bolts, supports, termination lugs for electrical connections, cable glands, junction boxes and all other sundry items for proper assembly and installation of the various equipments and components of the work shall be deemed to have been included in the tender, irrespective of the fact that whether such items are specifically mentioned in the tender documents or not.

For item/equipment requiring initial inspection at manufacturer's works' the contractor will intimate the date of testing of equipments at the manufacturer's works before dispatch. The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make the arrangement for the same. The successful tenderer shall give sufficient advance notice regarding the dates proposed for such tests/inspection to the department's representative(s) to facilities his presence during testing/fabrication. The Engineer-in-charge at his discretion may witness such testing/fabrication. The cost of the Engineer-in-charge's visit to the factory will be borne by the Department. Also equipment may be inspected at the Manufacturer's premises, before dispatch to the site by the contractor.

7 STORAGE AND CUSTODY OF MATERIALS

The lift machine room may be used for storage of sundry materials and erection equipments if available or else the agency has to make his own arrangements. No separate storage accommodation shall be provided by the department. Watch and ward of the stores and their safe custody shall be the responsibility of the contractor till the final taking over of the installation by the department.

8. CARE OF THE BUILDING

Care shall be taken by the contractor while handling and installing the various equipments and components of the work to the building. He shall be responsible for repairing all such damages and restoring the same to the original finish at his cost. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

9. COMPLETION PERIOD

The completion period indicated in the tender documents is for the entire work of planning, designing, supplying, installation, testing, commissioning and handing over of the entire job to the satisfaction of the Engineer-in-Charge.

10. PERFORMANCE GUARANTEE

The tender shall guarantee among other things, the following.

(a) Quality, Strength and performance of the materials used.
(b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.
(c) Satisfactory operation during the maintenance period.

11. GUARANTEE

All equipments shall be guaranteed for a period of 12 months, from the date of taking over the installation by the department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-in-charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & building on the contractor.

12. DATA MANUAL AND DRAWINGS TO BE FURNISHED BY THE TENDER

With Tender: The tenderer shall furnish along with the tender, detailed technical literature, pamphlets and performance data for appraisal and evaluation of the offer.

13. AFTER AWARD OF WORK

The contractor shall submit the following drawing within a month of the award of the work for approval by the department.

(i) All general arrangement drawings.
(ii) Details of foundations for the equipment, load data, location etc. of various assembled equipment as may be needed generally by other agencies for purpose of their work. The data will include breaking load on guides, reaction of baffles on lift pits reaction on support points in machine room, lift well etc.
(iii) Complete layout dimensions for every unit/ group of units with dimensions required for erection purposes.
(iv) Any other drawing/information not specifically mentioned above but deemed to be necessary for the job by the contractor.

14. The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance including preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue etc. all in triplicate.

15. EXTENT OF WORK

(i) The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications by all incidental sundry components

necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract as this is a turnkey job.

(ii) Minor building works necessary for installation of equipment, foundation, making of opening in walls or in floors and restoring to their original condition, finish and necessary grouting etc. as required.

(iii) Maintenance (Routine & preventive) for One year from date of completion and handing over.

(iv) The work is turn key project. Any item required for completion of the project but left inadvertently shall be executed with-in the quoted rates.

(v) Provision of supports/clamps for equipments etc wherever required.

(vi) Tools and tackles required for handling and installation.

(vii) Necessary testing equipments for commissioning.

(viii) Watch and Ward of materials and/or installation and equipments till their handing over to the department.

16. INSPECTION AND TESTING

(i) Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in- charge and consignee.

(ii) After completion of the work in all respect the contractor shall offer the installation for testing and operation.

17. COMPLIANCE WITH REGULATIONS AND INDIAN STANDARDS

All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specifications. In particular, the equipment and installation will comply with the following :

i) Factories Act.

ii) Indian Electricity Rules.

iii) I.S. & BS Standards as applicable.

iv) Workman's compensation Act.

v) Statutory norms prescribed by local bodies like CEA, NDMC etc.

Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirements would make the tenderer liable for penalty of Rs. 50/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

INDIAN ELECTRICITY ACT AND RULES

All electrical works in connection with installation of electric lifts shall be carried out in accordance with the provision of Indian Electricity Act 1910 and Indian Electricity Rules 1956 amended upto date. The electrical works shall also conform to CPWD General Specifications for Electrical Works Part – I (Internal) 2013 and Part – II (External) 1994 and Part-III (Lifts &Escalators) 2003 as amended uoto date wherever relevant.

18. SAFETY CODES AND LABOUR REGULATIONS

The contractor shall at his own expenses arrange for the safety provisions as per the statutory regulations, IS recommendations, regulations under factory Act etc. , where applicable and instructions issued from time to

time in respect of all labour employed by him directly or indirectly for the installation of the lift.
The contractor shall provide necessary barriers, warning signs and other safety measures etc., wherever necessary so as to avoid accident. In addition all safety procedures as outlined in Appendix 'VI' shall be complied with.

19. CONFORMITY WITH STATUTORY ACTS, RULES, REGULATIONS, STANDARDS AND SAFETY CODES

The installation shall be carried out in conformity with the local lifts Act and Rules. For example the Bombay lifts Act of Bombay, the West Bengal lifts and Escalators Act for West Bengal, the Bombay lifts Act as extended to Delhi for Delhi etc. At other places where no local lifts Act is in force the Bombay lift Act shall be followed. The installation shall also conform to requirements of local Municipal Bylaws.
Extracts of Bombay lift Act and Rules as applicable for Delhi are appended at Appendix 'IV'.

20. FIRE REGULATIONS

The installation shall be carried out in conformity with the local fire regulations and rules there under wherever they are in force.

21. INDEMNITY

The successful tenderer shall at all times indemnify the department, consequent upon this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulation for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there from on the department during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk, No extra payment would be made to the successful tenderer on account of the above.

22. ERECTION TOOLS

No tools and tackles either for unloading or for shifting the equipments for erection purposes would be made available by the department. The successful tenderer shall make his own arrangement for all these facilities.

23. COOPERATION WITH OTHER AGENCIES

The successful tenderer shall co-ordinate with other contractors and agencies engaged in the construction of buildings, if any and with the Client Department, and exchange freely all technical information so as to make the execution of this work/contract smooth.
No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the work has to be dismantled and redone for want of cooperation and coordination by the tenderer during the course of work, such expenditure incurred will be recovered from the successful tenderer if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by the tenderer himself.

24. MOBILIZATION ADVANCE

No mobilization advance shall be paid for this work.

25. INSURANCE AND STORAGE

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor.

The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

26. VERIFICATION OF CORRECTNESS OF EQUIPMENT AT DESTINATION

The contractor shall have to produce all the relevant records to certify that the genuine equipments from the manufacturers has been supplied and erected.

27. PAINTING

This shall include cost of painting of the entire exposed iron work complete in the installation. All equipments works shall be painted at the works before dispatch to the site.

28. TRAINING

The scope of works includes the on job technical training of two persons of Department at site. Nothing extra shall be payable on this account.

29. TESTING OF LIFT INSTALLATION

Testing of lift installation shall be carried out as per section IV (Testing of Lift Installations) of specification.

30. Liasoning for arrangement errection permit and subsequently working permit from Local authority of Lift and Escalator will be responsibility of the contractor. Also for lift Inspection report from local authority will be responsibility of the firm.

31. MAINTENANCE:

i) Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of one year from the handling over of the installation.

ii) The maintenance, routine as well as preventive, for one year from the date of taking over the installation as per manufacturers recommendation shall be carried and the record of the same shall have to be maintained.

32. ALL INCLUSIVE MAINTENANCE PERIOD

A. Routine Preventive Maintenance Schedule to be submitted

i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).

ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.

iii. Monthly status report.

B. Uptime during maintenance period

i. 95% uptime of all systems.

ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.

iii. Break-downs shall be attended to within two hours of reporting.

C. Shut Downs

i. Routine shut downs shall be permitted only with prior permission.
ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

33. INTERPRETING SPECIFICATIONS

In interpreting the specifications, the following order of decreasing importance shall be followed in case of contradictions:

(a) Schedule of quantities
(b) Technical specification
(c) Drawing (if any)
(d) General specifications
(e) Relevant IS or other international code in case IS code is not available.

1. Pit Depth :

2. Head room :

3. Position of counter weight : Side / Back of the lift car

4. Position of machine room : All lift is machine room less

5. Position of machinery : Directly above the lift well

6. a) Type of control : Microprocessor based A.C. variable voltage variable frequency.

b) Type of operation : a) Microprocessor based V.V.V.F. simplex selective collective control with/ without attendant.

c) Potential free contacts : Potential free contacts for each floor position and up and down movement of the lift shall be provided in the controller which can be used for the building automation system.

d) Automatic : Phase Reversal Device.

e) Voltage : Stabilizer for Control System.

7. Car entrance door:

a) Number of positions of car entrance : 1 No. in FRONT only.

b) Size : As stated above

c) Type of doors : Power operated Centre opening horizontal sliding door-stainless steel with full infrared curtain.

d) Car opens in FRONT only or open: I n FRONT only.

e) Fire resistance rating : Lift landing door shall have a fire resistance rating of 1 Hour.

f) Thickness of sheet steel for car Enclosure and door :1.6 mm

8. Lift Car

a) Inter communication system :Telephone with minimum two connections one at the operators room and other at guard room and the

emergency signal with re-chargeable batteries as source of supply shall be made in the lift cars. The device used for emergency signals should incorporate a feature that gives immediate feedback to the car passengers that the device has worked properly and the signal has been passed on the intended agency. This shall be achieved by pressing of button from control room which shall give audio signal to the passengers in the car. Provision of group indicator panel in the control room shall be made to indicate working of lifts.

b) Car platform : The flooring shall be smooth and anti skid surface and shall be enough to take the rated load without any deformation or damage.

c) Emergency Power supply for lift car: This shall include suitable secondary battery with trickle /boost charge arrangement and inverter with necessary contractors for supplying the light fixtures in the lift car. The same battery shall also feed the alarm bell and communication equipment.

d) Rating and Instructions : Inside the lift car, the lift contractors shall also provide a stainless-steel metallic plate indicating the rated load and details instructions for the passengers. They shall be mounted at a suitable place.

e) Lift car interior finish : The side, rear and fascia panel shall be of hairline Finish stainless steel sheet. The flooring shall be Black Granite and anti-skid surface and shall be enough to take the rated load without any deformation or damage. The false ceiling in the lift car shall be crafted from Stainless steel or as per manufacturer standard with LED light & cabin fan as per manufacturer standard.

f) Operating panel inside the car : The car operating panel shall be of metal Flush mounted duly finished to match the car interior décor and Shall contain all the devices as may be specified depending upon the type of operation required. In addition separate illuminated panel for indicating the floor and direction may be provided on the top or the door way. All switches shall be fade proof and the devices shall be of suitable quality. Each device and its operating position shall be legible fade proof and marked.

9. Type of signal system : a) Digital floor position indicator in the car and at all landings push button box.

b) Travel direction indicator in the car and at all landings push button box.

c) Gongs & visual indication on all landings for pre arrival of the car.

d) Overload warning Audio & Visual indicator inside the car (lift sound not start on overload)

e) Battery operated alarm bell and emergency light.

f) Car operating panel with fade proof luminous buttons in car and with intercom system.
g) Luminous hall buttons at all landings.
h) Fireman's switch at ground floor.

10. Landing entrance :

a) Location of landing entrance in Different floors. : All doors on the same side.
b) Number :as above
c) Entrance :as above
d) Type of doors : Centre opening.
e) Thickness of sheet steel for Landing door : 1.6 mm
f) Lift in use/lift out of order sign : A suitable box above lift landing with LED Illuminated bilingual (in English & Hindi) Sign of " LIFT OUT OF ORDER" coming Up simultaneously at all floors.
g) Instruction : Instruction on Do's and Don'ts should be written in Hindi / English

11. Electric supply : a) Power: - 415 Volts, + /- 10% AC, 3 Phase, 50 Hz, 4 wire system.
b) Lighting: - 230 Volts, AC, 50 Hz.

iii) Safety pressure switch : Yes, to be provided
iv) Full infrared curtain : Yes, to be provided
v) Is neutral wire available for control Circuits : Yes.
vi) Environmental condition at site Of installation : Normal.
vii) Storage space provided : No.
viii) Fireman Switch at Main Lobby: Yes
ix) Leveling : Suitable floor leveling device with a separate level for automatic leveling with leveling Accuracy of + 5 mm.
x) Barrier free requirement : As per bye laws lift should have the Following features.

1. A hand rail not less than 600 mm long at 900 mm above floor level shall be fixed adjacent to the control panel.
2. Minimum space for wheel chair user should be available.
3. Control panel shall be with Braille letters or raised letters with sharp contrast from the background for persons with visual impairments, provisions of review mirror and grab bars at a height of 900 mm high from the floor.
4. It should have audio announcement system as well as with a visual display system.
5. The time of an automatically closing door should be Minimum 5 seconds & the closing speed should not exceed 0.25 m/second.
6. The braill signage will be posted outside the lifts.

7. The interior of the cage shall be provided with a device that audibly indicates the floor the cage has reached & indicates that the door of the cage for entrance /exit is either open or closed.
8. A mirror (900 mm above floor level) on the rear wall can be useful to persons using wheelchairs and other mobility aids should they need to reverse safely out of the car or view the floor numbers.
9. A grab bar 600 mm length should be provided along both sides and back wall at 900 mm above floor level.
10. Door Closing time - Minimum 5 Sec.
11. Door Closing Speed – not more than 0.25m/ sec.
12. Voice announcement system in car including floor and door status announcement.
13. Lifts should systems have both visual and audible floor level indicators.
14. Audible systems are also usually capable of incorporating additional messages such as door closing or in case of an emergency reassurance (with manual override allowing communication with lift occupants).
15. Announcement system should be of 50 decibels.

12. Automatic Rescue Device:

The ARD shall have the following specifications.

1. ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator.
2. ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.
3. In case the normal supply resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it will automatically be switched to normal power operation.
4. All the lift safeties shall remain active during the ARD mode of operation.
5. The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usage is at least 30 minutes.

Goods Lift Specifications

Rated Load: **750 kg to 1000 kg**

Rated Speed: **0.1 m/s**

Drive Type: **Chain drive, Machine above**

Numbers of Stops:	**Up to 6 stops**
Power Supply:	**415v, 3 phase, 50hz, 4-wire**
Travel:	**Up to 15 Meter**
Pit:	**Min 200mm**
Headroom:	**Clear height + 1000mm**
Car:	**Galvanised car with safety gear**
Control:	**Call and send buttons at each landing. Lift in use, car position indicator and door open buzzer at each landing.**
Door Type:	**Single or double swing hinge doors on landings.**
Shaft Encloser:	**Standard free-standing structure clad by others.**
	Note structure requires horizontal ties to the building fabric. Plumbed minimum dimensions.
Special Items:	**Light & socket in the machine room**
	Lift arrival buzzer and lift out of use indicator.
	Easily accessible from outside the lift shaft to move the platform in case of power failure.
	Fire rated landing doors.
	Galvanised non fire rated shaft cladding
	Bespoke car sizes
Standards:	**EC Machinery Directive 98/37/EC**

Note:

All material and workmanship have to be as per latest IS / International standards.

F. TECHNICAL SPECIFICATIONS SOLAR POWER GENERATION

1. This document contains the requirement of Solar Photo Voltaic (SPV) power supply Grid Tied System. Suitable size of solar photovoltaic system is to be installed at each location and has to feed the electric loads of all the areas at that location. The power conditioning unit (PCU) shall be Grid

Tied, i.e. with a priority for use of Solar power for light load and if the solar power becomes inadequate due to sun outage or the fault in solar generation system then Main/grid supply shall be used for light load.

2. A Grid Connected Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Inverter/Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT) and Controls & Protections interconnect cables and switches. PV Array is mounted on a suitable structure. Grid connected SPV power plant should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, inverters/PCUs etc. should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable.
3. GRID TIED SPV POWER SUPPLY SYSTEM: Grid tied solar inverters are suited for outdoor use and the ideal solution for small commercial building rooftop and other application. The inverters provide a wide maximum point power tracking (MPPT) voltage range on EU (European union) efficiency of 97%.
4. SPV MODULE/ARRAY:
    - SPV Module: SPV Module is the basic building block of the SPV power supply, which consists of a number of Solar cells (a Semiconductor Devices which when exposed to sunlight produces DC electricity) connected in series and hermetically sealed with a toughened and highly transparent front glass cover. These modules are connected in series and parallel to get the desired power and voltage. The Rated DC current of One module shall be 330Wp orhigher.
    - SPV Panel: SPV Modules of same rating are connected in series to form a SPV panel to get the desired voltage.
    - SPV Array: A number of panels are connected in parallel to get the desired power. This Whole combination is called an array. The SPV array is so designed that, it provides simultaneously meets the load demand, when sufficient Sunshine is available.
    - Design Features: The mechanical design and construction of SPV modules, panels and mounting structures shall be inherently robust and rigid under all conditions of operation, adjustment, storage and transport. Sharp edges shall be avoided.

5. SOLAR PHOTO VOLTAIC MODULES:

(i) The efficiency of the PV modules should beminimum18%.

(ii) Test Certificate issued by one of the IEC authorized testcenters.

(iii) Modules of any type mono/poly crystalline film can beused

(iv) The module type must be qualified as per IEC 61215 latest edition. Modules must qualify to IEC 61730 Part I and II for construction and safety qualification testing. Certificate for module qualification from IEC or equivalent to be submitted as part of the bidoffer.

(v) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum 330Wp and above wattage. Module capacity less than minimum 330 Watts shall not beaccepted.

(vi) Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall beprovided.

(vii) The module frame shall be made of corrosion resistant materials having anodized aluminum or as per manufacturerstandard.

(viii) The bidder shall carefully design & accommodate requisite numbers of the modules to achieve the ratedpower.

(ix) Other general requirement for the PV modules and subsystems shall be the following:

a) Theratedoutputpowerofanysuppliedmoduleshallhavetoleranceof±3%.

b) The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case maybe.

c) The module shall be provided with a junction box with weatherproof lid of sealed type and IP-65rated.

d) Warranties: The PV Modules must be warranted for output wattage, which should not be less than 90% at the end of 10 years and not less than 80% at the end of 25 years.

6. SOLAR PV MODULE (ELECTRICAL FEATURES)

i) Crystalline high-power cells shall be used in the Solar Photovoltaic module. Solar Module shall be laminated using laminating technology using established polymer (EVA) and Tedlar/Polyester laminate. The solar modules shall have suitable encapsulation and sealing arrangement to protect the silicon cells from the environment. The arrangement and the material of encapsulation shallbecompatible with thermal expansion properties of the Silicon cells of the module framing arrangement/ material. The encapsulation arrangement shall ensure complete moisture proofing during life of solar modules.

ii) SPV Module conversion efficiency should be greater than 18% Module shall be made of high transmissivity glass front surface giving high encapsulationgain.

iii) All materials used shall be having a proven history of reliable and stable operation in external outdoor/indoor applications

iv) Module rating is considered under standard test conditions, however Solar modules shall be deigned to operated and perform in relative humidity up to 100% with temperature between- 10Deg C and +85 Deg C and with stand guts up to 180Km/h from back side of the panel.

v) Sample modules and production processes employed in the manufacture of the offered

module shall be in accordance with the requirement of **IEC 61730 with appropriate certificate**.

vi) Each PV module used in any solar power project must use a RF (Radio frequency identification tag. The following information must be mentioned in the RFID used on each module. This can be inside or outside the laminate, but must be able to withstand harsh environmentalconditions.

a. Name of the manufacturer of PV module
b. Name of the manufacturer of Solarcells
c. Month and year of the manufacturer (Separately for Solar cell and module)
d. Country of origin (Separately for Solar cell andmodule)
e. I-V curve for themodule
f. Wattage, Im, Vm and FF for themodule
g. Unique Serial No and Model No of themodule
h. Date and year of obtaining IEC PV module qualificationcertificate
i. Name of the test lab issuing IECcertificate

7. SOLAR PV MODULE (MECHANICAL FEATURES)

Solar PV module design shall conform to following Mechanical requirement :

(i) Toughened, low ironcontent.
(ii) High transmissivity frontglass.
(iii) Anodized AluminumFrame.
(iv) Ethyl vinyl Acetate (EVA)
(v) Silicon edge sealant aroundlaminate.
(vi) Tedlar/ Polyester trilaminate backsurface.
(vii) Weather proof DC rated modular connections easier and secure, not allowing for any loose connections, Resistant to water, abrasion, hail impact, humidity & other environment factor for the worst situation at site.

8. JUNCTION BOXES (JBs):

(i) The junction boxes are to be provided in the PV array for termination of connecting cables. The J. Boxes (JBs) shall be made of GRP/FRP/Powder Coated Aluminum /cast aluminum alloy with full dust, water & vermin proof arrangement. All wires/cables must be terminated through cable lugs. The JBs shall be such that input & output termination can be made through suitable cableglands.

(ii) Copper bus bars/terminal blocks should be housed in the junction box with suitable termination threads Conforming to IP66 standard and IEC 62208. Hinged door should be used with EPDM rubber gasket to prevent waterentry.

(iii) Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs)

(semiconductor diode with resistant applied voltage)/ surge arrestors and suitable Reverse Blocking Diodes etc. The Junction Boxes shall have suitable arrangement for monitoring and disconnection for each of thegroups.

9. PV ARRAY CONFIGURATION

i) The Solar array shall be configured in multiple No. of sub- arrays, providing optimum DC power. The bidder shall submit their own design indicating configuration of PCU and respective subarrays.

ii) The PV modules should be mounted on aluminum structures powder coated of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 180 km perhour.

iii) The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPVpanels

iv) Regarding civil structures the bidder needs to take care of the load bearing capacity of the roof and to arrange suitable structures based on the quality of roof. The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m^2. Suitable civil work for installation of the structure is to be done by the EPC contractor. Civil Structure should be Neat & Clean, with proper alignment and round in shape with emphasis on proper grouting and there should not be leakage, seepage in roof after installation ofplant.

10. MODULE MOUNTING STRUCTURE

The mounting structure would be designed to sustain wind loading up to 180Kmph and shall be protected by using Eco friendly anticorrosion on structure. The entire structure including array will be earthed to an independent pit with redundant paths. Mounting Structures with fixed/adjustable tilt shall be provided. The Hardware shall be made of Stainless-Steel material or as per manufacturer standard.

(i) The structure design shall be appropriate and innovative and must follow the existing structure andprofile

(ii) Design, drawing with material selected shall be submitted for prior approval of engineer in-charge.

(iii) The structure shall be designed to allow easy replacement of anymodule.

(iv) The structure shall be designed for simple mechanical and electrical installation. It shall support SPV module at a given orientation, absorb and transfer the mechanical loads to the roofproperly.

(v) Nut & bolts supporting structure including module Mounting Structures shall have to be adequately protected with atmosphere and weather prevailing in the area; Nut & bolts shall begalvanized.

(vi) The bidder/manufacturer shall specify installation details of the PV modules and

the support structures with appropriate diagrams anddrawings.

(vii) The drawings along with detailed design shall be submitted in three sets to the engineer- in- charge for approval before starting the execution of work. The work will be carried out as per designs approved by the engineer-in- charge.

(viii) The roof top solar plant generation units shall be installed by using supporting Galvanized MS structure (mass of zinc coating shall be as per IS 4759:1996) having minimum head room clearance of 2.4 meter above the terrace level / ground level to have maximum installation. Reference image for mounting structure is shown in figbelow.

11. POWER CONDITIONING UNIT (PCU)

Power Conditioning Unit (PCU) is critical equipment in Grid Connect SPV Power Plant. This equipment converts DC power generated by SPV array, into single phase/three phase medium voltage AC to be connected to Grid. It also provides necessary protections for Grid Synchronization and Data Logging/Monitoring. The DC energy, thus produced has to be utilized to maximum and supplied to the DC bus for inverting to AC voltage with the help of Power Conditioning Unit using its Maximum Power Point tracking MPPT (The efficiency of MPPT shall not be less than 97% & shall be designed to meet the Solar PV Array capacity control) to extract maximum energy from solar array and provides 415V AC, 3-ph 50Hz to synchronize with localgrid.

a. The PCU shall have protection features such as, over current, short circuit, over temperature to name afew.
b. The PCU shall be of very high quality having high efficiency (>92%) and shall be capable of running in isolatedmode.
c. The PCU should be designed to be completely compatible with the SPV array voltage and grid supplyvoltage.
d. The PCU should be designed for continuous, reliable power supply as per specifications.
e. The PCU shall have internal protection arrangement against any sustained fault.
f. It should have user friendly LCD display for programming and view on line parameters such as DC power input, DC input voltage, DC current, AC power output, AC voltage and AC current and Powerfactor.
g. The PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified.
h. The Grid connect PCU shall incorporate latest Technological advances to provide highly reliable and efficient energy conversion from DC to AC. The PCU incorporates a new system design which uses multiple power stacks which work in tandem. The PCU should be Single phase static solid state type power conditioning units/string

invertors suitability connected & synchronized to give three phase supply output. Both AC & DC lines shall have suitable fuses/MCBs and contactors to allow safe start up and shut down of the system. Fuses/MCBs used in the DC circuit should be DC rated. The PCU shall have provision for input and output isolation. Each solid-state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of theinverter.

AC side

Nominal AC power	As per Manufacturer design
Output AC Voltage	330V/ 415V with a variation + 10% at nominal voltage
Frequency	50 c/s (Hz) + 5%
Total Harmonic Distortion	<3%
Under frequency protection	Yes
Under Voltage Protection	Yes

DC Side:

PV Power	As per Manufacturer design
Maximum DC Voltage	As per Manufacturer design
MPPT voltage range	As per Manufacturer design
Maximum DC Current	As per string rating
DC over voltage protection	Yes
DC Voltage ripple	<3%
Minimum Efficiency (MPPT)	>97%
Ambient temperature range	0-50°C
Humidity (non condensing)	30-95%
Degree of protection	IP21 for internal units and IP 66 for outdoor units
Dimensions approx (HXWXD	As per Manufacturer design
Weight	As per Manufacturer design
	Accurate displays on the front panel:
	DC input voltage

Recommended LCD Display on Front Panel	DC current
	AC Voltage (all 3phases, in case of 3 phase)
	AC current (all 3phases in case of3 phase)
	Ambient temperature
	Instantaneous & cumulative output Power
	Daily DC energy produced
	Battery Voltage (in case of Hybrid PCU)
	Solar charge current and ambient temperature,
	Individual power stage heat sink and cabinet temperature,

	Solar Radiation (with external pyranometer with inscope) - Inverteron - Gridon - Inverter under voltage/overvoltage - Inverter overload - Inverter overtemperature.
Communication interface	RS485/RS232 PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array to the power conditioning unit/inverter should also be DG setinteractive
Power Factor	> 0.9
Test Certificates	The PCU/ inverters should be tested from the MNRE approved test centers / NABL /BIS /IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses

i. The PCU shall be able to withstand an unbalanced load conforming to relevant IEC standard and Indian electricity condition. The PCU shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters – beyond the PCU s safe operating range due to iqternal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to

malfunctioning within the PCU, including commutation feature, shall be cleared by the PCU protective devices and not by the existing site utility grid service circuitbreaker.

j. The PCU shall go to shutdown/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate timedelay.

k. When the power available from the PV array is insufficient to supply the losses of the PCU, the PCU shall go to standby/shutdown mode.

l. The PCU control shall prevent excessive cycling of shut down during insufficient solar radiance.

m. Operation outside the limits of power quality should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnectionare

i. Neutral voltagedisplacement
ii. Over current
iii. Earthfault
iv. Reverse power

In each of the above cases, tripping time should be very less.

n. PCU / Inverter should be tested from the test centers / NABL / BIS / IEC accredited testing calibration laboratories.

12. WIRING

All instruments and Panel wiring shall be of heat resisting and self extinguishing type in compliance with IS. Plastic or porcelain cleats of the limited compression type shall be used for holding wiring runs. All wires shall be suitable for bending to meet the terminal studs at right angles. Metal cases of all apparatus mounted on panels shall be separately earthed. The following colour scheme of the wiring shall be used as per IS : 375.

a) AC three phasecircuits:
   i) No.1 Phase: Red. No.2 Phase: Yellow. No.3 Phase: Blue
   ii) Neutral Conductor: Black
   iii) Connection to Earth: Green
b) D.C. circuits: Grey

13. CABLE ACCESSORIES

- Only terminal cable joints shall be accepted. No cable joints to join two cable ends shall be accepted.
- Cable terminations shall be made with suitable cable lugs & sockets etc., crimped properly and passed through brass compression type cable glands at the entry and exit

point of the cubicles. The panels bottoms should be properly sealed to prevent entry of snakes/lizard etc. inside thepanel.

- The terminal end of cables and wires are to be fitted with good quality numbered ferrules of proper sizes so that the cables can be identified easily.

14. INTEGRATION OF PV POWER WITH GRID:

i) In this case, Power plant is without battery bank (i.e. with string inverter), the uni-directional meter shall be installed for gross metering of solargeneration.

ii) CEA guideline 2013 or latest for interconnecting solar power with Grid shall be followed.

iii) Certification of Islanding protection in the inverter/PCU from the manufacturer of The equipment shall be mandatory. This shall be arranged by the supplier from the manufacturer.

iv) Verification report/test report shall be issued by the Electric Supply Agency or their authorizedagency.

15. DATA MONITORING OF POWER PLANT:

PCU to log the inverter performance data and transmits the same to the Data logger. Data logger shall then gather information and monitor the performance of the inverter. It shall also supports measurements from the external sensors. The data can be acquired remotely via modem.

16. LIGHTNING & OVER VOLTAGE PROTECTION:

The SPV Power plant should be provided with Lightning and surge voltage protection connected to proper earth electrodes.

The Lightning Conductors shall be made as per applicable Indian Standards in order to protect the entire Array Yard/Shed from Lightning stroke. Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to maximum wind speed at site in future.

The lightning conductor shall be earthed through flats and connected to the Earth electrodes as per applicable Indian Standards with earth pits. Each Lightning Conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as per required provisions of IS.

The bidder shall ensure adequate lightning protection to provide acceptable degree of protection as per IS for the array Yard/Shed. If necessary, more numbers of Lightning conductors may beprovided.

For each earth pit, necessary Test Point shall have to be provided.

17. EARTHING SYSTEM:

i. Each array structure of the SPV shall be grounded properly. The array structure is to be connected to earth pits as per CPWD General Specifications. Junction boxes shall be connected to the main earthing conductor/electrode.

j. Earthing system installation shall be in strict accordance with CPWD General Specifications Part-I internal 2013 as amended up todate.

k. Necessary Test Point provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earthresistance.

l. In compliance to Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date) all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earthelectrode.

m. Earth resistance of the earth pits shall be tested in presence of the representative ofEngineer-in-charge.

n. The items for earthing protection shall be included in the scope ofwork.

18. AC Distribution Box (ACDB)

i) All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS60947 part I, II and III.

ii) The change-over switches, cabling work, Manual isolation of Inverters/Grid should be undertaken by the bidder as part of the project within quotedrates.

iii) Web based remote monitoring which shall also be linked with servers of deptt/ Board or software such as SCADA (Supervisory control and data acquisition) monitoring system must be provided by agency. If needed access to MNRE (Ministry of new renewable Energy) CREST shall also be provided.

iv) PV array energy production: Digital Energy Meters to log the actual value of AC/ DC voltage, Current & Energy generated by the PV system shall be provided.

v) All instantaneous data shall be shown on the computerscreen.

vi) The bidder must take approval/NOC from the Concerned Electricity department for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network and submit the same before commissioning of SPV plant. Nothing extra shall be

paid on thisaccount.

19. PRIORITY FOR POWER CONSUMPTION:

Grid Islanding:

In the event of a power failure on the electric grid, it is required that any independent power-producing inverters attached to the grid turn off in a short period of time. This prevents the DC-to-AC inverters from continuing to feed power into small sections of the grid, known as "islands." Powered islands present a risk to workers who may expect the area to be unpowered, and they may also damage grid-tied equipment. The Rooftop PV system shall be equipped with islanding protection. In addition, to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.

i) A manual disconnect pole isolation switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance. This switch shall be locked, if required, by the utilitypersonnel.

20. PAINTING & FINISH

i. All metal surfaces shall be thoroughly cleaned of rust, scale, oil, grease, dirt etc. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be made free from all imperfections before undertaking the finishingcoat.

ii After Phosphate treatment, two (2) coats of yellow zinc chromate primer shall be applied followed by two(2) coats of epoxy based synthetic enameledpaint.

iii. All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements, then they shall begreased.

A. BALANCE OF SYSTEM (BoS)ITEMS/COMPONENTS:

The BoS items/components of the SPV power plants/systems deployed under the work must conform to the latest edition of IEC/equivalent BIS standards as specified below :

BoS Item/component	**Applicable IEC/equivalent BIS standard**	
	Standard Description	**Standard Number**
Power conditioner/ Inverters*	Efficiency Measurements Environmental Testing	EN61000–6-3 EN 50178

MPPT units*	Design Qualification Environmental Testing	EN 50178 UL 1741 CSA 107.1
Cables	General test and measuring methods PVC insulated cables for working voltage up to and including 1100 V- Do-UV resistant for outdoor installation	IEC 60189 IS 694 / IS 1554 IS/IEC 69947
Switches/Circuit Breakers/Connectors	General Requirements Connectors - Safety	IS/IEC 60947 part I, II& III, EN 50521
Junction Boxes/ Enclosures	General Requirements	IP 65 (for outdoor)/IP 21 (for indoor) IEC 62208
SPV System Design	PV Stand-alone Systems Design verification	IEC612 15 IEC617 30 IEC61701
Installation Practices	Electrical installation of buildings requirements for SPV power supply systems	IEC 61730

*Must additionally conform to the relevant national/international electrical safety standards.

3.2 SPECIFICATION FOR SPV PANEL

Sl. No	Description	As per NIT
1	Max. output (Pmax) as per STC	320-330 Wp ± 5%
2	Voc/Isc	45.96V/8.75A
3	MPP Voltage (Vmpp) V	37.65
4	MPP current (imp) A	8.5
5	Open circuit voltage (Voc)V	45.96

6	Normal operatingcelltemperature	44± 2 °C
7	Module dimensions (LxWxH)Appx.	As permanufacturer
8	PV Moduletype	Mono/PolyCrystalline
9	No. of PV cellsperModule	As permanufacturer
10	Min. efficiencyofmodule	18%
11	Solar moduleframematerial	Aluminium
12	Weatherresistant junction	IP66
13	Glass	Toughened
14	Glassironcontent	LowIron
15	glasstransmissivity	Hightransmissivity
16	Frame	Anodizedaluminium
17	Encapsulation	Ethyl Vinyl Acetate(EVA)
18	Trilaminatebacksurface	Tedlar /Polyester
19	By-passdiode	To beprovided
20		Standard IEC 61215 / IS 14286 & IEC 61730 Part 1 &Part2
21		Performanceguarantee 10 years of 90% power output 25 years of 80% poweroutput 10 years against manufacturing defects.

3.3 SPECIFICATION OF SOLAR INVERTER (GRIDTIED)

Sl. No.	Description	As perNIT
1	Type	Gridtied
2	Max. DC ArrayInputVoltage	1000V
3		DCvoltagetolerance `-20%+15% of the DC array input voltage in Sr. No. 1above
4	Type of solarchargecontroller	MPPT based solar charge controller
5	SwitchingDevice	MOSFET / IGBTBASED
6	Continuous inverteroutputrating	Specified according tobuilding
7	Outputwave form	Pure Sine waveoutput
8	totalharmonicdistortion	< 3% with resistiveload

9	Nominal AC output voltageand frequency	415V, 3 phase, 50Hz
10	Outputfrequency	50 Hz + 0.5Hz
11	Grid frequencytolerance	`+3%
12	Grid frequencysynchronization range	`+3Hz
13	No-Loadlosses	<1%
14	Powerfactor	>0.9
15	PCUefficiency	>97 % at nominal voltage &power
16	Noiselevel	< 57 db
17	Certifications	IEC61727,CE,IEC62109-1,IEC

18	Idlecurrent	< 4 % of ratedcapacity
19	Regulation	Line regulation and loadregulation -2%
20	Overloadfeatures	150% for oneminute'
21		Cooling Forced air cooling with temperature controlledcooling
22	OperatingTemperature	(-)20°C to50°C
23	Relative Humidity	95%Maximum
24		LED/LCDdisplay Indications display shall indicate system functional parameters and protection functionalindicators.
25	Data Monitor anddisplay controls	RS 485, Ethernet or RS232 connectivity
26	Protections	1) Input overVoltage 2) Low/Highfrequency 3) ShortCircuit 4) Under/over outputvoltage 5) Over Temperature 6) Grid input under voltage/over voltage with autorecovery 7) DC disconnectdevice 8) DC reverse polarity 9) Anti Islanding protection as per thestandard
27	EnclosureProtectionSafety	IP 65 (foroutdoor) Galvanic isolation at input &output throughtransformer
28	Warranty	10years.

3.4 SPECIFICATIONS FOR PV PANEL SUPPORTSTRUCTURE

Sl. No	Description	As per NIT
1	Material	Hot dip galvanized steel
2	Thickness of member	4mm

3	Overall dimensions	As per manufacturer standard (SPV panel Supporting structure bottom to rooftop distance Min 2400mm)
4	Wind rating	180Km / hour
5	Tilt angle and adjustment	25° Potriat
6	Peach of structure	Max. 7 Mtr or as per manufacturer standard
7	Hard wears & fastener	SS 304
8	Foundation	CC 1:2:4

21. TECHNICAL PARTICULARS OF ENERGY METERS

Sl. No	Description	
1	Applicable IS	IS 13779 or IS 14679 depending upon accuracyof meters.
2	AccuracyClassIndex	0.5 or better up to 650V
3	Display	LCD/LED
4	Power factor range	Zero lag –unity- zerolead
5	Display parameters	a) Display parameters : LCD test, KWH import,KWH export, MD in KW export, MD in KW import, Date & Time, AC current and voltages and power factor (Cumulative KWH will be indicated continuously by default & other parameters through push-button)
6	Power Consumption	Less than 1 Watt & 4VA in Voltage circuit and 2 VAfor Current circuit
7	Frequency	50 Hz with + / - 5%variation
8	MD Registration	a) Meter shall store MD in every 30 min. periodalong with date & time. At the end of every 30 min, new MD shall be compared with previous MD and store whicheverishigherandthesameshallbedisplayed. b) It should be possible to reset MD automatically at the defined date (or period) or through MRI. c) Manual MD resetting using sealable push button is an optional.
9	Memory	Non volatile memory independent of batterybackup, memory should be retained up to 10 year in case of power failure.
10	Climaticconditions	a) As per IS: 13779 or IS: 14697 for climatic conditions. b)The meter should function satisfactorily in India with high end temperature as 50°C and humidity upto100%.

11	Insulation	A meter shall withstand an insulation test of 4 KVand impulse test at 8 KV
12	Battery	Lithium with guaranteed life of 10Years

(ANNEXURE-I)

22. SPECIFICATION FOR SPV PANEL

Sl. No	Description	To be provided by the firm to whom the work is awarded
1	Make	
2	Max. output (Pmax) as per STC	
3	Voc/Isc	
4	MPP Voltage (Vmp) V	
5	MPP current (imp) A	
6	Open circuit voltage (Voc)V	
7	Normal operating cell temperature	
8	Module dimensions (LxWxH) Appx.	
9	PV Module type	
10	No. of PV cells per Module	
11	Min. efficiency of solar cell	
12	Solar module frame material	
13	Weather resistant junction	
14	Glass	
15	Glass iron content	
16	glass transmissivity	
17	Frame	
18	Encapsulation	
19	Trilaminate back surface	
20	By-pass diode	
21	Standard	
22	Performance guarantee	

23. SPECIFICATION OF SOLAR INVERTER (GRID TIED)

Sl. No.	Description	To be filled bidder
1	Make	
2	Type	
3	Max. DC Array Input Voltage	
4	DC voltage tolerance	
5	Type of solar charge controller	
6	Switching Device	

7	Continuous inverter output rating	
8	Output wave form	
9	total harmonic distortion	
10	Nominal AC output voltage and frequency	
11	Output frequency	
12	Grid frequency tolerance	
13	Grid frequency synchronization range	
14	No-Load losses	
15	Power factor	
16	PCU efficiency	
17	Noise level	
18	Certifications	
19	Idle current	
20	Regulation	
21	Over load features	
22	Cooling	
23	Operating Temperature	
24	Relative Humidity	
25	LED/LCD display	
26	Data Monitor and display controls	
27	Protections	
28	Enclosure Protection Safety	

Note:

All material and workmanship have to be as per latest IS / International standards.