

TECHNICAL SPECIFICATION

WIRING ACCESSORIES

SWITCH 6A:

Flush type switch - 6 A to operate on AC single phase 240V, 50 Hz supply conforming to IS 3854/latest. Switches controlling fans and plug points shall have engraved letters 'F' and 'P' respectively as applicable/available for the category.

WIRING CABLE:

Cable PVC insulated (FR) single core, copper conductor multi-strand of various sizes 6 sqmm, 4 sqmm, 2.5 sqmm and 1.5 sqmm, 1100V grade and conforming to IS 694/latest. The PVC cable should comply with relevant category of IS 694 /latest for improved fire performance.

PVC PIPE:

TYPE & SIZE OF PVC PIPES: All PVC pipes for wiring shall be conforming to IS 9537/P3/1983 with grey colour. No PVC pipe less than 20mm +/- 0.2mm in diameter with wall thickness of 2mm shall be used. The number of insulated conductors that can be drawn into PVC pipes should be as per table III of IS:732/1963 and should be easy to pull at the time of rewiring. Conduit inspection type coupler at reasonable interval shall be provided. Scope includes supply of couplers, joint box, bends etc. at contractor's cost.

FIXING / CONCEALING OF CONDUIT: Conduits shall be laid inside roof slab or wall for concealed wiring. Replastering shall be done after laying the conduits in the wall / roof. Conduits shall be attached with existing PVC pipe if already laid in roof.

FIXING OF CONDUIT:

If surface wiring involves, conduit shall be fixed by heavy duty PVC saddles secured to suitable wooden plugs/phil plug compound with screws in manner at an interval of not more than 60 cms. but on either side of couplers/bends/joint box in similar fittings saddles shall be fixed at a distance of 30 cm from the centre of such fittings. Fixing of PVC double locked casing and capping shall be as per standard wiring practice. Casing and capping shall be white or ivory in colour. When the wiring is to be drawn in shelter/sheds the PVC pipe shall be secured to the steel members of shelters/sheds with suitable clamps made out of MS flats 25mm wide and 3mm thick.

Before commissioning the installations the following tests shall be conducted and the results shall conform to the values specified and shall be certified by the person whose competency certificate has been attached.

1. Insulation resistance test
2. Testing of polarity of non-linked single pole switches
3. Earth continuity path (Bell tester)
4. Earth resistance value
5. Any other test as desired by Engineer-in-charge on safety point of view.

MINIATURE CIRCUIT BREAKER (MCB):

MCB DP/SPN/SP/FP of rating as specified in the schedule, 240 V/415V, 50 Hz. to automatically isolate the electrical circuit under sustained overloads or short circuits and comply to IS 8828/96 latest. MCB DB shall be powder coated made of 16SWG CRCA sheet with all internal accessories. All MCBs shall be of 10 KA breaking capacity with 'C' curve characteristics.

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SPECIFICATION FOR FIXING OF LIGHT FITTINGS ON POLE

The contractor shall assemble the fitting and fix on Canopy assembly with pipe bracket, on the Post. The wiring to Light Point should be drawn from junction box from inside of Octagonal post by providing suitable grommets at cable entry points. Junction box shall be provided with entry for two cables (max 4cx16sqmm -2nos) from bottom with proper rigid sealing/ glanding as suitable. Supply of post shall be inclusive of base plate suitable for 9mtr pole as approved by Engr. in charge. The location for fixing of fitting shall be decided by site Engineer In charge. Arm bracket shall be attached with suitable base plate welded to pipe for support. Canopy and Bracket assembly should be painted same as that of the pole.

30.SPECIFICATION FOR Loop In Loop Out Box FRP Loop-In-Loop-Out Box outdoor type for Lighting poles.

BOX:

Made from Poly Carbonate ideal for outdoor application. Inclined roof for water run out. Single door with proper hinges, side opening and Ball Catch locking system.

Cable Entry:

This is through 3 Holes with grommets at equal distances provided below the box suitable for 16sqmm cable, Provision should be made for Light fittings wires to run through the channel behind the box.

Fixing:

5mm Thick M.S. strip 2 Nos for pole mounting should be provided within the box with suitable holes to avoid rusting of MS strip.

Box size (Minimum): 330 (H) x 250 (W) x 130 (D) mm, Wall Thickness of box = 3mm.

Accessories:

- (1) Fuse cut out 16 Amps-1 No,
- (2) 32 Amps 6 way terminal block-1No,

(3) 16 Amps neutral Link

All Mounted-on Poly carbonate base of thickness not less than 4mm of FR Grade.

Properties of Box Material: Poly Carbonate

- Non rusting/non corrosive
- Shockproof/ non-reactive to weather changes.
- Non-sparking, /Resistant to propagation of fire.
- MAKE: Similar to HENSEL

GALVANIZED OCTOGONAL POLE 5.5 mtr / 9 mtr LONG (SINGLE / DOUBLE ARM BRACKET)

The octagonal pole shall be made of hot dip galvanized 3 mm thick steel sheet, Top 70 mm A/F and Bottom 130mm A/F with base plate 250X250X12mm for 5.5 mtr Octagonal Pole & Top 70 mm A/F and Bottom 155mm A/F with base plate 260X260X16mm for 9 mtr Octagonal Pole and inbuilt junction box with single/double arm bracket. Each bracket not less than 1 1/4th dia, B glass GI pipe Bracket of 350mm (5.5 mtr pole) & 1000mm (9mtr pole) long for mounting of light fitting. The Octagonal pole shall be erected by excavating a pit and concreting the foundation in all kinds of soil with plastering above ground level, with base plate , installed by means of foundation bolts/nuts/check nuts and provided with inbuilt junction box and suitable power strip connector and 16A cut out for each light shall be provided inside the box and suitable power strip connector and 16A cut out for each light shall be provided inside the box. After hot dip galvanized the pole and mounting pipe shall be painted with double coat aluminium paint. RCC foundation of size 1m depth X 0.5m width X 0.5m breadth and 1.5m depth X 0.6m width X 0.6m breadth shall be provided for erecting the 5.5 mtr pole and 9 mtr pole respectively . Steel reinforcement to the foundation shall be provided within scope of erection of pole. Excavation and clearing the balance soil shall be in contractors' scope of work. Foundation above ground level shall be adjusted as per the instruction of engineer in charge as per site condition. PVC pipe shall be provided for cable entry while casting the foundation. For pole with double arm bracket, second bracket shall be provided exactly opposite to first bracket arm with same fixing angle.

SPECIFICATION FOR FIXING OF LIGHT FITTINGS ON POLE

The contractor shall assemble the fitting and fix on Canopy assembly with pipe bracket, on the Post. The wiring to Light Point should be drawn from junction box from inside of octagonal post by providing suitable grommets at cable entry points. Junction box shall be provided with entry for two cables (max 4cx16sqmm -2nos) from bottom with proper rigid sealing/ glanding as suitable. Supply of post shall be inclusive of base plate suitable for 5.5/9mtr pole as approved by Engr. in charge. The location for fixing of fitting shall be decided by site Engineer In charge. Arm bracket shall be attached with suitable base plate welded to pipe for support. Canopy and Bracket assembly should be painted same as that of the pole.

CABLE LEADING/PROTECTING PIPE:

The cable protecting pipe shall be rigid PVC pipe of dia given in the schedule. The pipe shall be secured with either walls or posts using clamps made out of MS flats of 25mm wide and 6mm thick, spaced not more than 1.0M apart. The clamps shall be applied with one coat of red oxide and two coats of aluminium paint. The top of the leading pipe shall be sealed with sealing compound to prevent entry of water. The PVC pipe shall conform to IS 4985-2000, latest and shall be capable of withstanding 6 kgf / sqcm pressure.

METHODS OF LAYING OF LT CABLES:

When the cable is to be laid in trenches, two layers of sand coarse of 150mm and 150mm thickness respectively shall be provided on both bottom and top of the cable. When the cable is to be run on members of supporting structures /shelters/ wall, the same shall be clamped with MS clamps made out of 25mmx3mm thickness flats, spaced not more than 1.0M apart and cost shall be borne by the contractor. The minimum internal dia of bends of multicore PVC/XLPE insulated LT cables shall not be lesser than 15D where D is the dia meter of the cable to be laid. When cable laying is involved, termination of the same on its either ends shall also be carried out.

EXCAVATION OF CABLE TRENCH:

a) Trench for cable on either sides of track: The trench shall be of 0.3 M width and 1.0 M depth for LT cables (if available in schedule). A bed of river sand of 150mm is spread for entire width at the bottom of the trench and method of cable laying in the trench shall be as per drawing No.DEE/CN/MISC/1/2000. The excavated earth is filled up in the trench and the trench is made to the original ground level by watering and ramming processes.

b) Trench for cable underneath the track/road: HT/LT cables shall be drawn through HDPE pipe as per drawing No.DEE/CN/MISC/4/99 if available in schedule. (except for trenchless cutting)

Note: HDPE pipe used for cable protection shall be of PE 80, PN6 category both for manual as well as trenchless method of cable laying with HDPE pipe.

Trench to accommodate HDPE pipe shall be of suitable width and excavated at 1.5 M below the formation level. No sand cushioning and spreading of bricks are required. But once the pipes are laid in the trench, it should be made to its original formation level by filling it up with excavated earth by watering and ramming process and resetting the ballast of track to its original level. Similarly wherever road has been dug for laying the cable the same should be filled, rammed and asphalted and brought to original condition.

Note: 1. Excavation means, earthwork for laying of cable, erection of structures, stay, strut etc., irrespective of soil condition.

2. If any tar road requires to be excavated, it will be classified under Item (b) above.

CABLE ROUTE INDICATOR:

The description of cable route indicator (cable marker) is detailed in the schedule. Construction of cable marker and other details shall be as per Drg No. CSTE/CN/OFC/1 and lettering shall be as specified in schedule. It shall be spaced not more than 25m apart. It should be placed at the following places also. (Drawing shall be collected from Railways).

1. On either side of track/road exactly at points where HDPE pipe ends.
2. At points where there are changes in the route of cable laying.

CABLES AND METHOD OF LAYING:

a) Method of laying cables in trenches: Cables shall be laid in the trench on the first bed of river sand on which second bed of river sand and bricks are placed. It should be ensured that no injury to the cable takes place, which can cause not only damage of insulation but also loss of electrical continuity.

b) Raising of cables on terminal structure: Cables shall be raised on terminal structures as well as in deep cuttings through PVC pipes of 40/50mm/75mm /100/150mm inner dia (as in schedule) 3.0 M long, of which 1 M is buried in the ground. The pipe shall be fixed to the terminal structure with clamps made out of flats of size 25mm width and 6mm thick with suitable bolts and nuts spaced not more than 1 metre apart. The diameter of bends in cable should not be lesser than 20 d for HT & 15d for LT where 'd' is the diameter of the cable (Supply of PVC pipe is separate schedule item). The top of the pipe shall be filled with sealing compound to prevent entry of water.

SINGLE POLE STRUCTURE WITH CROSS ARM FOR THE LT LINE:

The S.P structure is made out of RCC poles of 9 Mtr. long 145 Kgs working load or with PSCC poles of 9.10mtr long 280kgs working load category and 4 way cross arm of 65mm x 65mm x 6mm size including back clamp of size not less than 50 X 10 mm (However flat size equivalent available commercially is acceptable) and fasteners.

The structure shall be erected in concrete foundation of mix 1:3:6 with coping of 0.3M x 0.3M x 0.3M size of 1:3:6 smoothly finished. Size of foundation shall be 0.6M x 0.6M & depth shall be 1.65 Mtr. Painting shall be carried out with fasteners fixed on to the cross arm. SP Structure includes 4 nos. shackle/pin insulators complete with fasteners fixed on to the cross arm. (Refer drawing No. DEE/CN/Misc/2/99/A) plastering of coping & muffing above GL is included in the scope of erection of pole.

ERECTION OF STAY SET:

The stay shall be erected in a pit for foundation of size 1.2m longx0.6M width and 1.3M depth in a mass concrete of 1:3:6 mix, coping of 0.3mx0.3mx0.3m, smoothly finished. The stay set should comprise of stay rod, base plate of size 300x300x10mm, stay wire, stay insulator and stay clamp of size not less than 50mmx10mm size. The stay wire shall be of 45T quality, 7/11 SWG size steel galvanised, complete with stay tightner. All metallic parts shall be applied with one coat of primer red oxide and two coats of aluminium paint. For 11KV and 33KV application same arrangement shall be adopted.

SINGLE POLE STRUCTURE WITH CROSS ARM FOR THE 11KV HT LINE:

The S.P structure is made out of RCC poles of 9 Mtr. long 145 Kgs working load or with PSCC pole of 9.10mtr long 280kgs working load category. The structure shall be erected in concrete foundation of mix 1:3:6 with coping of 0.3M x 0.3M x 0.3M size of 1:3:6 mix smoothly finished. Size of foundation shall be 0.6M x 0.6M & depth shall be 1.65 Mtr. plastering of coping & muffing above GL is included in the scope of erection of pole.

Painting shall be as in DP structure. Scope includes 11 KV cross arm, pin insulators, clamp with bolts (similar in LT) etc. and HT single top support. (Refer drawing No. Dy CEE/CN/Misc/6/2002)

DOUBLE POLE TERMINAL STRUCTURE (11KV):

DP structure is made out of RCC poles of 9 Mtr. long or with PSCC poles of 9.10mtr long 280kgs working load category and cross bracings arrangement shall be with 65 x 65 x 6mm angles. The flats used for the manufacture of clamps shall not be lesser than 50mm x 10mm size (However flat size equivalent available commercially is acceptable). The structure shall be erected in concrete foundation of 1:3:6 mix with coping of 0.4M x 0.4M x 0.3M size of 1:3:6 mix smoothly finished. One coat of red oxide paint and two coats of aluminium paint should be applied for the MS items. Signal red colour band painted to a height of 150mm should be applied just below the Anti- climbing device on each pole.

Refer Drawing No.Dy.CEE/CN/Misc/1/2004/Alt-1 for further details. Size of foundation shall be 0.8 x 0.8 m & depth shall be 1.75 Mtr. The assembly includes supply & erection of fasteners, supply & erection of 11 KV disc insulators 3 Nos with channel cross arm 100x50mm., Danger board 2 Nos. and standard anti- climbing device-2Nos etc.

Scope includes supply and fixing of 75x40mm channel cross arm, as required as per case/location, for fixing HT switch /control gears. Supply and fixing of angle cross arm for fixing HT pin insulators (Supply of pin insulator not under this scope), if required, to be provided as per site condition under this scope. Plastering of coping & muffing above GL is included in the scope of erection of pole.

LIGHTNING ARRESTOR (11KV):

Lightning arrestors shall be nonlinear resistance distribution type suitable for 11 KV system of grade 9KV 5 KA type conforming to ISS 3070 Part-I latest.

GANG OPERATED SWITCH (11KV): (GOS)

It is a triple pole Air Break Gang Operated Switch, 200A /400A cap. as in schedule for HT suitable for operation on AC, 3 phase, 50Hz, 11000 V outdoor type with 2 insulators per phase, horizontal mounting tilting type jaw control, self-aligning and having positive wiping action of copper alloy and lever action to prevent undue heating. Minimum size of moving contact shall not be less than 6 mm.

The switch shall be supplied with all accessories such as operating pipe of required length (for DP structure as applicable) and drop rod of 25mm dia 'A' class GI pipe of 5 M long or suitable length (without joint) and guide in the middle, arcing horn connectors and locking arrangements in "OFF" and "ON" position, conforming to ISS No.1818/72 (or) latest. Supporting frame/ hardware parts attached to the structure should be earthed by means of 25x3mm GI strip and the operating handle should be earthed with GI wire of 8 SWG. Support frame for GOS is included in the scope of supply of GOS and the GOS shall be mounted on base frame M S channel of size 75x40x6mm and fitted with supporting Angle of size 65x65x6mm.

DROP OUT FUSE (11 KV):

Drop out fuse shall be out door expulsion type fuse cut out 11 KV 200 A capacity single phase with 2 Nos. of post type insulators mounted on M S Channel of size 75x40mm with clamp

of size 50x10mm on DP structure. All hard ware parts shall be hot dip galvanised. The DOLO set of fuse unit will have three Nos of single-phase fuses to cater for three phases.

OUTDOOR CABLE JOINTING KIT FOR HT UG CABLES (11 KV):

HT, 11 KV, Outdoor, cable jointing kit to suit 3 core, XLPE cable of size as indicated in the schedule with complete kit for termination on DP structure. This comprises of supply including fixing of cable jointing kits and jointing of cables to the OH lines. The jointing kit shall be tested as per IS:13573 (with latest amendment) also necessary test certificates shall be submitted with supply of this item. HT/LT Jointing kit shall be heat shrinkable type. In case of LT pot head fitting, it shall be of complete set with filling compound.

EARTHING ARRANGEMENTS:

Perforated steel galvanised pipe of 'C' class of 50mm dia and 2920mm long shall be erected in an earth pit as shown in drawing. The earth wire used shall be of GI strip of size 25mmx3mm for HT and 8 SWG GI wire for LT with suitable clamping of size not less than 25x3mm on to the terminal structure and embedded in concrete for raising to the top of terminal structure. Both ends of the GI strip/GI wire should be fixed with GI bolts, nuts and spring washer. A square RCC box/Brick masonry as indicated in Drg.No.DEE/CN/MISC/163/A shall be fixed. An RCC slab of size 450x450x40mm thick is to be placed over RCC box/brick masonry work. Earth box shall be painted above the ground level to facilitate painting of earth values. The earth pit shall be filled with alternate layers of charcoal and salt each of thickness 150 mm and 200mm surrounding the pipe. The earth value when measured individually and combined should be less than 10 ohms. 8 SWG GI earth wire shall be used for earthing single pole structure. In the ground GI wire shall be buried at a depth of 0.5m and connected to the earth terminal. Earth resistance value in ohms, earth pit No. and date of testing to be painted in the plinth by white paint. Supply of GI pipe and all accessories for earthing (excluding GI wire/ flat) is included in the scope of work for earthing arrangements.

HIGH TENSION UNDER GROUND CABLE (11 KV):

HTUG cable to supply shall be high tension 11KV cable , size as in schedule, Dry Curing & Dry Cooling with true triple extrusion, simultaneously through a single common head, 3 core underground XLPE(E) cable having stranded compact circular aluminium conductor, screened insulated, insulation screened with extruded semiconducting compound in combination with copper tape, core laid up extruded inner sheathed of Round wire armoured and over all PVC sheathed as per IS-7098 (Part-2) Armouring wires dia and Resistivity as per IS-3975 with latest amendments & conforming to the (Guaranteed technical particular) GTP with over all satisfactory performance for minimum period of 5 years.

The cable should be suitable for AC 3 phase, 50 Hz., earthed system and shall conform to ISS 7098/P1/88,P2/85,P3/93 (or) latest with upto date amendments in all respects and the "HT" cable armoured should be earthed by GI flat to the nearest GI flat main which is about 3-4 mtr. In length.

EXCAVATION OF CABLE TRENCH:

a) Trench for cable on either sides of track: The trench shall be of 0.4 M width and 1. 2 M depth for HT 33KV cables (if available in schedule). A bed of river sand of 150mm is spread for entire width at the bottom of the trench and provided with bricks over and across the the line of running

of cable. The excavated earth is filled up in the trench and the trench is made to the original ground level by watering and ramming processes.

b) Trench for track crossing- HDPE pipe of size as given in the schedule shall be provided inside the trench underneath the track / road as required through which cable to be laid as per the instruction of Engineering – in- charge of Railways.

Note: 1. Excavation means, earthwork for laying of cable, erection of structures, stay, strut etc., irrespective of soil condition.

CABLES AND METHOD OF LAYING

a) Method of laying cables in trenches: Cables shall be laid in the trench on the first bed of river sand on which second bed of river sand and bricks are placed. It should be ensured that no injury to the cable takes place, which can cause not only damage of insulation but also loss of electrical continuity.

b) Raising of cables on terminal structure: Cables shall be raised on terminal structures as well as in deep cuttings through PVC pipe of 150mm inner dia as given in the schedule 3.0 M long, of which 1 M is buried in the ground. The pipe shall be fixed to the terminal structure with clamps made out of flats of size 25mm width and 6mm thick with suitable bolts and nuts spaced not more than 1 metre apart. The diameter of bends in cable should not be lesser than 20 d for HT & 15d for LT where 'd' is the diameter of the cable. The top of the pipe shall be filled with sealing compound to prevent entry of water.

c) Method of laying of cables in loose coil cable pits: A coil of cable coiled along the circumference of the loose coil cable pit shall be placed on the first bed of river sand of 100mm thickness over which second bed of river sand of 200mm thickness is spread. One layer of bricks shall be placed in the entire excavated pit. The bricks shall be placed with its width 4 ½" resting flat on the ground. The diameter of the cables should not be less than 20 D where 'D' is the diameter of the cable.

It should also be ensured that development of heat in coil of cable due to induction effect. If at all such a circumstance arise, a layer of bricks shall be introduced between successive layer of cable.

9 METER POLE

While Supplying of the 9-meter baseplate shall be provided as per required at site cost shall be borne by the contractor.

SPECIFICATION FOR LED TYPE (INDOOR/OUTDOOR) LIGHT FITTINGS

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1. General requirements of LED Type (INDOOR/OUTDOOR) light fitting.

1	LED Make	NICHIA / OSRAM / SEQUL / PHILIPS LUMILEDS / CREE / LEDNIUM / AVAGO
2	Type of LED	High Power, SMD (Surface Mounting Device) LED
3	Lumen Output/Efficiency	> 100 Lumens / Watt
4	Lumen Output at fitting level/ Efficiency	> 75 Lumens / Watt
5	LED Life	> 50,000 burning hours
6	Depreciation	30% max, after 50,000 burning hours
7	Color Rendering Index (CRI)	> 75
8	Nominal Voltage	220 V AC
9	Input Operating Voltage	105-295 V AC
10	Power Factor	> 0.9
11	Protections	
	i. Surge protection	1.5 KV for 50 micro seconds
	ii. Over voltage protection	300 V AC for 2 minutes
	iii. High voltage protection	1.72 KV AC for 1 minute
	iv. Insulation Resistance	Minimum 2 mega ohms with 500 V megger
12	Driver Type	Constant Current driver with short circuit protection
13	Driver Components	Industrial grade only
14	THD	< 20%
15	Efficiency of Driver Electronic	Efficiency of driver > 85%
16	Construction of Housing	Pressure die cast aluminium or CRCA or Extruded aluminium
17	Finishing	Power coated / anodized
18	Lamp Cover	Toughened glass of min. 0.8 mm thickness of sufficient strength of high transmittance efficiency (min.90% Acrylic diffuser as per need of fitting)
19	Secondary optics	Polycarbonate reflector / polycarbonate lence
20	Mounting	Indoor : Suitable for Surface / Recessed / Hung Type Outdoor : Suitable for Existing pole etc.,
21	Ingress Protection	IP 20 – Indoor IP 65 – Outdoor

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NOTE:

- Supplied LED Luminaires shall conform to BIS:16107 or IEC 62722 and LEDs to BIS:16103 or IEC: 62717
- LED Luminaires shall also conform to LM- 79 (For quoted fitting) and LM- 80 for LEDs used.
- Firms have to submit LM80& LM79 test certificate from National/International accredited

Laboratory and OEM certificate for compliance of BIS/IEC along with offer.

4 Firms have to submit warranty certificate for 5 (five) years along with supply.

1. following information's are to be mentioned by consignee in indent description.

- a) Type of luminaire: Like Street light, Flood light, Focus light, Retrofit (for retrofit type luminaire, this specification may be referred wherever applicable)
- b) Total wattage of LED luminaire
- c) Arrangement of LED : Single LED/ Multi LED
- d) Dimensions if required.
- e) Indoor/ Outdoor
- f) Mounting type: i.e. Indoor: Suitable for Surface / Recessed /Hung Type outdoor: Suitable for Existing Pole etc.

		Approved By
		SD
		Chief Electrical Engineer South Western Railway, Hubli/Bangalore cantonment

This specification supersedes earlier General specification for LED Luminaires No. SWR/Spec/LED Dt. 12-06-2015.

70/72W LED STREET LIGHT FITTING

Fitting shall be of any approved make complete set with driver circuit and all accessories as per CEE/SWR specification.

45 W/32W LED STREET LIGHT FITTING

Fitting shall be of any approved make complete set with driver circuit and all accessories, water proof, IP.65, as per CEE/SWR specification. Street light LED fitting shall, be similar to Havells make Model No. ENDURASUNDOWNSL45WLED765PASYBOPC or equivalent.

When the 45 W fitting is mounted on pipe bracket, 25x6mm size GI clamps with fasteners shall be used for fixing the fitting on the wall / on RCC pole. Wiring shall be extended from ceiling rose/from OH line/junction box with 1.5sqmm copper wires as part of fixing of fitting which included in fixing cost.

For fixing of fitting on tubular pole, wiring to street light fitting shall be done by means of 3runs x 1.5sqmm stranded copper wires from junction box.

20W/24 W LED BATTEN LIGHT FITTING

Fitting shall be of any approved make complete set with driver circuit and all accessories, as per CEE/SWR specification. LED fittings on the wall shall be mounted on suitable PVC round blocks - 2 Nos fixed as per standard wiring practice. Extension of wiring from ceiling rose shall be made by means copper wire for phase, neutral and earth, of suitable capacity.

Description:

Energy Efficient Brush Less DC Motor (BLDC) Ceiling Fan Technical Specification

1. Sweep 1200 mm
2. BEE Rating 5 star
3. Rated Power 28 Watts (Maximum), tolerance as per IS 302 part 1 or latest.
4. Operating Voltage 140-290 V , Single Phase AC
5. Frequency 48-52 Hz
6. Air Delivery 210 M³/Min
7. Harmonic Distortion 5% Max
8. Speed Control Regulator and IR Remote
9. Blade Thickness 1.1 MM
10. Blade Material Aluminium
11. Bearing Double ball bearings
12. Down rod size (without shackle) 300 mm
13. Shank & Shackle Thickness 2 mm (minimum)
14. Canopy 2 Nos
15. Color Standard White
16. 1 Warranty 5 Years
17. Conforming to: (a) IS :616/2010 or latest for safety requirement for electronic equipment. (b) performance test for Air Delivery as per IS:374/2019 or latest. (c) IS 374/2019 or latest.
18. Test Report: The firm has to submit type test report from government accredited test labs like NABL/CPRI etc.

CABLE LEADING/PROTECTING PIPE:

The cable protecting pipe shall be rigid PVC pipe of dia given in the schedule. The pipe shall be secured with either walls or posts using clamps made out of MS flats of 25mm wide and 6mm thick, spaced not more than 1.0M apart. The clamps shall be applied with one coat of red oxide and two coats of aluminum paint. The top of the leading pipe shall be sealed with sealing compound to prevent entry of water. The PVC pipe shall conform to IS 4985-2000, latest and shall be capable of withstanding 6 kg / sqmm pressure.

CABLE ROUTE INDICATOR:

The description of cable route indicator (cable marker) is detailed in the schedule. Construction of cable marker and other details shall be as per Drg No.CSTE/CN/OFC/1 and lettering shall be as specified in schedule. It shall be spaced not more than 25m apart. It should be placed at the following places also.

1. On either side of track/road exactly at points where HDPE pipe ends.
2. At points where there are changes in the route of cable laying.

CLS Panel 63A/35Amps

Latest RDSO Guildlines should be followed before supplying the materials.

COMPLETION DRAWING:

Any deviation to the layout of wiring, necessary for carrying out the work, shall be submitted and got approved from the Engineer-in-charge before execution of work. After completion of work, the contractor shall submit 3 copies of "as erected" AutoCAD drawings in A3 size (completion drawings) for each location along with editable soft copy in rewritable pen drive duly indicating all the details clearly such as cable layout, location of electrical equipment, accessories, size & make of cables, cable route indicators etc., in line with the tender schedule. The drawings shall be duly signed by the contractor.

NOTE:

- i. All switches should have markings such as fans, light and plug points etc. as applicable. The leads of phases, neutral and earth of different circuits should be collectively taken, bunched and routed as below inside the control boards.
- ii. a. All phase leads to be taken on the left-hand side of the board.

b. All neutral leads to be taken in the centre of the board and all earth leads to be taken on the right-hand side of the board.

iii. Earth lead shall be terminated on a bolt fixed onto the board & all earth tapping should be done only from this earth bolt/stud.

iv. Separate colour code scheme has to be adopted for live, return and earth leads.

v. Any steel member used for the work, if not specifically mentioned, shall be painted with one base coat of red oxide and one coat of enamel grey paint.

vi. All the MS boxes shall be of minimum 16 gauge thick and metal boxes which are having screws for front doors shall be internally welded with suitable nuts for screw tightening.

vii. Electrical equipment's supplied shall conform to BEE standards of star ratings and electrification of buildings shall be as per standard building code.

viii. If necessary, Sketch for plan of work incorporating location of structures, cable routes etc of the crossing/installations has to be prepared by contractor to aid execution of work and execution shall be in coordination with Supervisor in charge. Supply of materials shall be affected after ascertaining the requirement at site. If further clarification is needed in execution, the sketch in this regard has to be furnished by the contractor for obtaining guidance from Engineer in charge.
- ix. **For Approval from Electrical Inspectorate (State Govt.) / Supply Authority, necessary drawings and details as required shall be furnished by contractor duly liaison with the authorities. Scope of work includes obtaining of EIG approval before commissioning as applicable for the installations provided as part of tender work by the contractor.**
- x. **Manuals for HT/LT equipment's, test certificates etc. shall be submitted to Railways as required. Copies of the same shall be furnished by the contractor to other Govt. Authorities, if required, for Ascertaining the quality of materials used or in case of seeking approvals in connection with the work.**
- xi. THOSE WHO PARTICIPATE IN E-TENDER, ARE REQUESTED TO CONTACT Dy. CHIEF ELECTRICAL ENGR.(CONSTRUCTION), S.W.RLY, No.18, MILLERS ROAD, BANGALORE-46,

PH:23431019/23542418 WITH REMITTANCE PARTICULARS OF COST OF TENDER DOCUMENT, IF THEY WISH TO OBTAIN THE DRAWINGS RELATED TO THE DOCUMENT FOR REFERENCE.

NOTE: All material supplied shall conform to latest IS Specifications as applicable.

ON GRID SOLAR TECHNICAL SPECIFICATION

1. Scope of work in brief:

- The scope of the Project shall mean and include Design, procurement, construction and commissioning of the rooftop solar generation project development as per the scope defined at sites specified in conformity with the Technical Specifications , Standards set forth herein and Interconnection requirements set forth herein.
- This includes Supply and provision of ON GRID roof top solar photo voltaic power generating system with net metering system with all accessories as per specification.

2. Locations for Execution of Work

Location / Station (Tentative)- Locations and capacity are tentative and are subject to changes as per site condition.

Tentative locations Solar roof top plants at Service buildings

SN	Section/ Location	Service buildings	Approx. Solar in kWp
1	PAVAGADA	Office of Area/Manager	15
2	PAVAGADA	Office of SSE/P.WAY	15
3	PAVAGADA	Office of SSE/Works	15
4	PAVAGADA	Office of SSE/S&T	15
5	PAVAGADA	Office of SSE/Electrical	15
6	PAVAGADA	One officers Rest House	15
7	PAVAGADA	One Supervisors Rest House	15

3. Special conditions of contract for Solar works

I) Solar panels systems shall be provided as per latest MNRE specifications and MNRE approved makes.

- a) Warranty for the entire system shall be for 3 years from the date of commissioning. The date of commissioning will be assigned on the date of achieving successful performance test.

Pre- Acceptance Test.

- a) CUF of the Rooftop solar system shall be a minimum 15 %.
- b) "Performance Test" shall be conducted on mutually agreed dates between the Contractor/Sub contractor/authorised person to the contractor and Railway representatives after installation of the system. Field units to draw site-specific criteria (viz. irradiation etc.) for pre-acceptance test as per CERC/Concerned State Regulatory Commission norms for the zone of installation.
- c) Performance test shall be conducted for a period of 15 days and the power generation shall be recorded jointly by Railway and Contractor. CUF will be derived for the above test period. If CUF is not achieved at a minimum of 15 %, performance test shall be repeated as above. If contractor desires for any modification/rectification, at his own cost for the system to achieve CUF, Contractor/Sub contractor/authorised person to the contractor shall be permitted before to the second performance test.

- d) If the Contractor fails to prove the performance test at all sites/locations. The continuous Performance not satisfied by the Site with in 3 year the amount of the Schedule item will be recovered.
- e) The date of commissioning will be assigned on the date of achieving successful performance test.
- f) The commissioning date for multiple solar plants in the specified project will be established after the successful completion of performance tests at all locations of solar plant within the scope of the work.
- g) Project/Contract will be considered as partially commissioned when 75% of the contracted solar capacity/ location have successfully passed the performance tests. In case 75% number is in decimal, lower rounded of whole number will be considered. For example, if no. of contracted locations is 18, 75% of 18 shall be 13 (13.5 rounded of to 13). Similarly if contracted solar capacity is 18 kWp, 75% of 18 kWp shall be 13kWp (13.5 rounded of to 13). If partial commissioning occurs, payment will be made only for the commissioned portion of the work. Recovery of supply cost for rejected capacity shall be made from balance payments to the contractor including PG & SD. The contractor shall clear all erections/installations made for the rejected solar capacity/ location. All expenditure incurred for clearing the site shall be borne by the contractor. Railway shall not be liable to pay any amount to the contractor for clearing the site.

4. Monitoring of Performance of the system.

- a) Subsequent to successful commissioning of the system, performance shall be monitored during the warranty period for achieving minimum CUF. Performance of the rooftop solar system shall be reviewed at the end of each month and advise the contractor/Authorised person to the contractor for any shortfall in performance.
- b) In any year during the warranty period, if the contractor has not been able to supply minimum energy of kWh as per minimum CUF 15% discounting deration as per CERC/Concerned State Regulatory Commission guidelines on reasons solely attributable to the contractor, contractor shall be liable to pay the penalty, the contractor has to pay penalty at par with ESCOM rates as per norms (unit cost of energy will be considered at par with ESCOM rates as at the place of installation)
- c) The penalty shall be applied to the amount of shortfall in generation discounting deration factor during the warranty period. Penalty can be deducted from the amount payable to contractor including Security Deposit.

Note: - The CUF shall be calculated based on the annual energy injected and metered at the Delivery Point. In any Contract Year, if 'X' MWh of energy has been metered out at the Delivery Point for 'Y' MW Project capacity, $CUF = (X \text{ MWh} / (Y \text{ MW} * 8766)) * 100\%$

5. Maintenance Period:

The contractor to the contractor shall ensure satisfactory working of the installations erected by him for a period of Three (03) year beginning from date of issue of completion certificates.

During this period, the contractor to the contractor shall keep all materials, tools and other requisite equipment readily available and shall carryout at his own expense all modification, additions or substitutions that may be considered necessary for satisfactory working of the contracted work or equipment's. Final decision in respect of unsatisfactory working of the contract work or equipment's or faulty use of designs or workmanship etc., shall rest with the Duty Chief Electrical Engineer, South Western Railway, Bangalore and the same shall be binding on the contractor. During the aforesaid period of maintenance, the contractor to the contractor shall be liable at his own cost for all repairs or replacements of any parts that may be found defective in the contract work or equipment's irrespective of whether any defect arising as a result of faulty design, materials, workmanship, installation or otherwise. Such defective parts if are not repairable at site are to be promptly removed by contractor for repairs if so required by them and such defective parts should be replaced by them by new ones at their own expenses. In case minor repairs are carried out by the Railway at site, the cost of such repairs plus departmental charges shall be borne by the contractor.

6. Attending to Defects:

The contractor shall rectify defects that may arise in the work executed, for a period of Three (03) year after completion of the work, such defects being due to bad workmanship on the part of the contractor. Should any dispute arise as to the correctness of the defect pointed out, the engineer's decision in this regard is final and binding.

The downtime of the solar PV system installed at each location shall not be more than 72 hours. If the defects in the solar PV system are not rectified within a period of 72 hours, maintenance period of 36 months will be extended accordingly. After completion period. 5% of the Schedule item No.K91 value will be retained as deposit 3 years for releasing SD.

7. Quality Of Materials and Quality Control:

All the materials used in the execution of the contract shall conform to the specification stipulated and shall be of the best quality and have the class most suited for the purpose specified. Components, assemblies and equipments to be obtained from sub-contractors should be from proven source, chosen from the approved makes only indicated in this tender document. The work shall also conform to the following Acts, Rules and Standard Code of Practices: -

- i) Indian Factories Act.
- ii) Indian Explosive Act.
- iii) Indian Electricity Rules.

All the equipments/materials covered by this contract shall comply with the Technical Specifications enclosed of Tender Documents and relevant I.S. and B.I.S. as referred to therein in all respects and shall be adequate to perform the duties for which they are designed.

All erection work shall be of the best quality to the entire satisfaction of the Railways. The contractor shall ensure that the equipments and services under the scope of this contract, whether manufactured or performed within the contractor's premises or at his sub-ordinate's premises or at the Railway's site or at any other place are strictly in accordance with the provisions of this contract. For this purpose, the contractor shall adopt necessary quality assurance programme to control such activities at all stages.

NOTE:

1. contractor should submit qualification certificates of technical staff before execution of work. SSE in-charge should verify this before execution of work.
2. Concerned supervisor while recording in measurement books for each CC bills should record details of Technical staff i.e. number of staff deployed with their qualification and period of deployment and same should be cross checked by test check conducting officials.

8. Inspection of Materials:

For purpose of inspection of the materials by RITES/ RDSO/Railways, the contractor shall give one week notice to Dy.CEE/CN/BNC with a copy of the list of materials and quantity ready for inspection

- a. All the documents along with QAP and type test certificates necessary for inspection by RITES/RDSO shall be prepared by the successful tenderer contractor and got signed from the competent authority.
- b. Inspection certificate granted by RITES/RDSO to be obtained by the contractor person to the contractor and is to be submitted to Railways for all items costing above 5 Lakhs. Payment of all charges that arise in connection with inspection by RITES/RDSO shall be borne by the contractor.

Sl. No	Items	Inspection Authority
1	Solar panels	RITES/RDSO
2	Structures and hardware complete with accessories	RITES/RDSO
3	Inverter	RITES/RDSO
4	DCDB, ACDB, Earthing, Cables, Junction boxes and other items.	RITES/RDSO

c. The Inspection Officer(s) for the Railways shall be nominated by Dy.CEE/CN/BNC.

Acceptance Test Plan is as attached below. It is advised to submit the test plan for inspection by RITES/RDSO as per the attached format.

a) for On-Grid Inverters

Sr. No.	Parameters	Standard Requirement Value	Check
1	LCD Display	Visual check for parameters like DC input voltage, DC current, AC Voltage (all 3 phases), AC current (all 3 phases), Frequency, Ambient Temperature, Instantaneous power, Cumulative output energy, Cumulative hours of operation, Daily DC energy produced etc As per the user manual	Physical verification when inverter is ON
2	AC Over Voltage(P-N)	Inverter trip above 270V – Phase to Neutral	Test to be conducted
3	AC Under Voltage (P-N)	Inverter trip below 185 V	Test to be conducted
4	Automatic Reconnection	When voltage reaches in range 185V-270V inverter reconnects again	Test to be conducted
5	DC Input Voltage Working Range (3ph)	200-1000V	Test to be conducted for range of 200- 500 V DC. For 500V to 1000V range IEC certificate to be verified
6	THD (Total Harmonic Distortion)	less than 3%	Test to be conducted above 70% load
7	Power Factor	>0.90	Test to be conducted
8	IEC 62109, IEC 60068, IEC 61683, IEC 62116	As per IEC type test certificates	IEC type test certificates to be verified.
9	Manufacturer test certificates	As per Manufacturer test certificates	Manufacturer test certificates to be verified

b) For Solar PV Module

Sr. No.	Parameters	Standard Requirement Value	Check
1	Mechanical dimension	Dimensions as per manufacturers certificates	Physical measurement to be checked.
2	Solar Panel Power verification	As per Manufacturer test certificates	Test to be conducted.
3	Mechanical damage inspection	Visual inspection	Physical inspection on damages if any, on frame, cells & other parts
4	IEC 61215 Part 1 and 2	As per IEC type test	IEC type test certificates

	IEC 61730 Part 1 and 2 IEC 61853	certificates	to be verified.
5	Manufacturer test certificates	As per Manufacturer test certificates	Manufacturer test certificates to be verified

Inspection plan for other items to be submitted and approval to be obtained.

9. Facilities for Test and Examination:

The contractor shall provide, without any extra cost, to the Railway all materials, equipments, tools, labours and maintenance of every kind with necessary testing facilities which the Railway or the Inspecting Officer may consider necessary for any test and examination to be made at the Contractor's or sub-contractor's premises and at site and shall pay all cost thereon.

10. Certificate Of Inspection and Approval:

The Inspecting Officer or his authorised representative shall have, at all reasonable times, access to the contractor person to the contractor premises and shall have power to-

- a. Certify before any equipment is submitted for inspection that it cannot be in accordance with the contract owing to unsatisfactory method employed;
- b. Reject any part of the work submitted by the contractor as not being in accordance with the contract;
- c. Reject the whole of the work including equipment tendered for inspection if, after the inspection of such portion as he may, in his discretion, think fit, he is satisfied that the same is unsatisfactory;
- d. Mark the rejected equipment with a rejection marks so that the same may be easily identified;
- e. Re-inspect at the time of erection, at site, any equipment both previously inspected and approved by the Inspecting Officer at the Contractor's or sub-contractor's premises. Notwithstanding any approval given earlier, the Contractor shall make good such rejections made, based on such re-inspection at site to the satisfaction of the Engineer.

The decision of the Inspecting Officer in regard to the acceptance or rejection of the equipment/work shall be final and is binding on the contractor.

11. CONSEQUENCE OF REJECTION:

- i. On the equipment/work being rejected by the Inspecting Officer or the Railway at destination, the contractor shall replace such rejected equipment/portion of the work forthwith but, in any event, not later than a period of 4(four) weeks in the case of minor equipments and 8(eight) weeks in the case of major equipments from the date of rejection. The contractor shall bear all the cost of such replacement including freight etc., but without being entitled to any extra time on this account. The decision as to whether the equipment is to be classified as minor or major for the purpose of this clause shall be that of the Engineer and it shall not be called into question on any account.
- ii. The contractor to the contractor shall, if the equipments(s)/work are rejected at the destination by the consignee be liable, in addition to his other liabilities including refund or price recoverable in respect of the equipment/work so rejected to reimburse to the Railway, the freight.

The contractor shall provide without any extra charges, all materials equipments, tools and labour of every kind for which the Rly nominee may consider necessary for any test and examinations which they shall require to be made on the contractors' premises and shall

pay all costs attendant thereupon. The contractor shall also provide and deliver free of charge at such place as the Rly nominee may nominate, such materials such as they may require for the independent testing organization.

No stores will be considered ready for delivery until the inspecting officer nominated certifies in writing that they have been inspected and approved by them.

12. WARRANTY:

- i. The contractor shall warrant that everything to be executed under this contract shall be new and free from all defects and faults in materials, design, workmanship and manufacture and shall be of the highest grade and consistent with the established and accepted standards for work of the type contracted for and in full conformity with technical specifications, drawings and other contract stipulations.'
- ii. This warranty shall survive inspection of, payment for, and acceptance of the work for THREE (03) years from the date of acceptance of the completed work by the Railway in respect of complaints, defects and/or claims notified to the contractor before the expiry of the warranty period.
- iii. Any approval or acceptance by the Railway at any stage of the work contracted for, shall not, in any way, limit the contractor's liability under this warranty.
- iv. The contractor's liability in respect of any complaint defect or claim shall limited to the execution, installation and erection of replacement parts free of any charges, or the repair of defective parts only to the extent that such replacement or repairs are attributable to or arise from faulty workmanship or design or material in the manufacture of the equipment/stores and/or negligence in any manner and also in the event of failure of the equipment to perform as intended.
- v. The contractor shall, if required, replace, repair, execute and/or install the goods or such portion thereof as is rejected by the Railway, the contractor shall pay to the Railway the value thereof and such other expenditure and damage as may arise by reason of the breach of the conditions herein specified.
- vi. All replacement and repairs that the Railway shall call upon the contractor to deliver or perform under this warranty shall be delivered and performed by the contractor within a period of 21 (Twenty one) days promptly from the date of receipt of advice to that effect from the Engineer. In case where such replacement, repair, execution and/or installation takes place during the warranty period, the provision of this warranty clause shall apply to that portion to replace or renew until the expiration of one (01) year from the date of such replacement, repair, execution and/or installation. This extended period shall hereinafter be referred to as "EXTENDED WARRANTY PERIOD".
- vii. If any defect were not remedied satisfactorily within the above mentioned 21 days, the Railway may proceed to do the work at the contractor's risk and cost and also without prejudice to any other rights of the Railway under this contract.
- viii. If the contractor so desire, the old parts which were replaced under warranty can be taken over by him or his representative for disposal as he deems fit within a period of 3 (Three) months from the date of replacement of goods/parts. At the expiry of this period, no claim, whatsoever shall lie on the Railway.
- ix. Moreover, the Railway may, at its discretion recover the ground rent for the goods/parts which have been rejected during the warranty period for the specified period of 3 (Three) month, if the rejected materials are not taken over within that period 3 (Three) months, by the contractor or his representative.
- x. The warranty herein contained shall not apply to any material which shall have been repaired or altered by the Railway or on its behalf in any way without the consent of the contractor so as to affect its strength, performance or reliability or to any defects to any part due to misuse, negligence or accident and to items of normal wear and tear to be specifically mentioned by the contractor in his offer and got accepted by the Railway. The decision of the Railway in regard to contractor's liability and the money if any payable,

under this warranty shall be final and conclusive.

Supplied Materials are to be accounted as per extant procedure by the SSE in-charge.

Released materials, if any, are to be handed over to the SSE in-charge and are to be accounted as per extant procedure. Necessary certification to this effect shall be produced from the engineer in charge along with claim for payment.

13. Materials to be supplied by the Railways as per the requirement: (Approx. Qty.)

Instructions to Contractor:

Materials supplied by Railways should be transported to the respective work sites, in parts or full, by the contractor at their own cost. Transportation of materials includes all the machineries, tools and tackles etc., loading and unloading and man power required for the transportation of all such items. Necessary gate pass should be obtained by the contractor from the SSE in-charge for the same. The quantity and items mentioned above is tentative only. The contractor has to transport all the required materials supplied by Railways as per the site condition, for the satisfactory completion of the above work as required.

14. Materials to be supplied by the contractor:

Procurement of materials is to be done as per schedule in consultation with Engineer in charge of work.

Supply of Materials by Contractors–

Material Supply will be taken by the Railways in part or full as per the site conditions as per the instructions of the Engineer in-charge. Contractors are bound to adhere to the instructions of Engineer In Charge regarding the supply of materials.

The material mentioned in the schedule shall be supplied in the stores of the SSE/Ele depot as applicable subsequently it will become Railway property. The material required for work at site will be issued to the contractor by store in charge.

The transportation of material from stores to site of work will be the responsibility of contractor. The contractor will be responsible for the safety of the material at site from the date of issue of the material to till the date of commissioning of the system.

The supply of materials as per actual site requirement and the principle of JIT or “Just in time” needs to be followed to the extent possible to prevent unnecessary blockage of capital as well as to avoid blocking of space and possibility of damaged to the material due to prolonged storage.

Delivery of material should be planned in coordination with the contractor duly ensuring just in time delivery to the extent possible so that there is minimum time gap between receipt of material and its utilization for the work for which it is procured.

After receipt of the materials, it has to be taken into custody of Railways and never kept in the custody of the contractor. If there are compelling reasons to Hand over the materials to the contractor, it should be done only after taking approval of the competent authority who in turn has to ensure that financial securities of the value of the cost of the materials and indemnity bonds have been furnished by the contractor.

NOTE : Materials to be supplied by Railways if any, shall be collected by the contractor own cost duly giving a requisition letter to Engineer in Charge

15. LIAISON WITH EB AUTHORITIES:

The contractor shall ensure proper liaison with BESCO, LOCAL BODIES and any other authorities for obtaining all statutory approvals and to co-ordinate with BESCO /KPTCL/ LOCAL BODIES /any other authorities for timely inspections, quality control inspections. Payments for all inspection charges shall be borne by the contractor. Applications in this regard shall be prepared by the contractor and signature of Railway authorities shall be obtained. Responsibility of resolving of Right of Way (ROW) issues during execution of the work lies with the contractor.

- a) Railway shall be responsible for payment of
 - I. Availing of new supply connection charges/deposit
 - II. Testing/ Supervision charges based on s estimate of ESCOM / KPTCL.only after receiving the written advice from supply authority to obtain the sanction for commencing the work / electrical installations.
- b) All the other incidental charges payable to ESCOM / KPTCL/Local authorities/ Electrical Inspectorate charges (State Govt.), charges for stamp duties/ agreements, inspection charges, statutory amount to remit for approval from local bodies etc. (other than meter charges, supervision charges/deposits) in connection with the work shall be paid by the contractor as part of the tender work. Claim for such payment shall not be entertained by Railways.

16. Joint Procedure Order (JPO) communicated vide HQ letter No. EL/P-General Policy part 2 (E-file 124476) Dated: 12.04.2024, attached in IREPS NIT, forms an integral part of this tender document which involves earthwork for undertaking digging work in the vicinity of underground signalling, electrical and telecommunication cables along the Railway Track/Railway Area etc. The same has to be strictly adhered to, by the contractor while executing the works.

A. SPECIFICATIONS- GENERAL REQUIREMENTS:

- i. The work to be governed by this contract shall cover designing, manufacturing, transporting till site, safe custody at site, insurance if required, erection, and commissioning of equipments as detailed in schedule, technical specifications/ explanatory notes and in the scope of Work of tender documents. All the materials and workmanship shall strictly conform to the provision of this specification primarily and to the related Indian Standard Specification and code of practice mentioned in the specifications. All items to be supplied / provided shall conform to relevant IS/IEC standards with latest amendments and correction slips.
- ii. All the materials brought to site for use on this work shall be new of the best quality of approved makes/manufacture as per list of approved makes of equipments/materials enclosed as per Schedule and conforming to the relevant BIS specifications.
- iii. All the cable routes, locations of relevant items of work shall be first shown in drawing and marked at site and approval of the Engineer-in-charge obtained for the same before starting the work. Such drawings shall be based on the drawings issued and further based on the changes made at site by the Engineer-in-charge through instructions to the site representative of the contractor.
- iv. The rates quoted shall also include the cost of any civil works connected with the relevant items of works.
- v. All dimensions mentioned in diameter for all types of GI/MS pipes shall be Nominal Bore (NB).
- vi. The rates quoted shall also provide for handing over the necessary completion drawings together with the test results of commissioning tests carried out by the contractor, in accordance with relevant standards before the installation is handed over to the Railways.
- vii. The contractor is bound by the opinion of the Engineer-in-charge in accepting whether the work is carried out in accordance with the provisions of these specifications or not and shall take steps to rectify or replace such parts of the materials and installations as in the opinion of the Engineer-in-charge which are unsatisfactory in relation to these specifications.
- viii. All Drawings, tests and measurements, readings and documentation & pre-commissioning tests required for EIG approval shall be arranged and prepared by the contractor without any extra cost.
- ix. Substation shall be completed in full compliance with CPWD specification Part IV for substations and in full compliance with BESCO standard practice.
- x. All works pertaining to BESCO shall be completed as per the standard practice of BESCO and to the satisfaction of engineers in-charge of BESCO and Railways as well.
- xi. **STANDARDS FOR EQUIPMENTS AND WORKMANSHIP:**
 - a) The materials and equipments to be supplied and installed under this contract shall conform to the requirements of these specifications.
 - b) In further support of what is contained in these specifications, the materials and equipments as well as workmanship shall satisfy the requirements.
 - c) All the materials and equipments shall conform to the Standards not less than those stipulated under the current Indian Standard Specifications.
- xii. For such of the materials and methods of construction for which BIS have not been published, British Standards shall be followed subject to the approval of the Engineer-in-charge.
- xiii. In addition to the above, the equipment and workmanship shall satisfy the requirements of the following:-

- a) Method of construction approved by the Electrical Inspectorate.
- b) Indian Electricity Acts and Rules.
- c) Fire Insurance Regulations.
- d) I.E.E. wiring regulations.
- e) Instructions of the Engineer-in-charge based on the site conditions and revised requirements, if any.

xiv. Electrical Safety: -

- a) The work is to be done in compliance with the National Electrical Code-2011 or the latest issued by BIS.
- b) The work done to comply with the provision of CEA (Measures relating to safety and electric supply) regulation, 2010.
- c) Only items confirming relevant BIS to be used if issued by BIS in compliance of CEA (Measures relating to safety and electric supply) regulation, 2010. In case no specification is mentioned then the contractor is restricted to use the material in conformity with BIS in vogue. In such case contractor is to obtain approval of tender issue authority or Sr.DEE in advance.
- d) Contractor is advised to train/counsel or use only trained workers having the competency to work in the LV system and are aware of electrical safety.
- e) Safety shall be ensured as per provisions of National Electrical Code 2023, National Building Code 2016 (or latest), IR manual of Electrical General Service Volume-I (Power Supply)-2022(or latest), IR manual of AC Traction with all amendments, various publications of IR-CAMTECH on Electrical Safety and CEA (Measures relating to Safety and Electric Supply) Regulation, 2022 (or latest) and IE Act (As amended/superseded time to time).

NOTES

- I. All safety precautions are to be ensured by the contractor while execution of work and no work has to be carried without the permission of Engineer in charge. Also, the execution of work should not infringe the train moving dimension as per permanent way manual nor affect the train traffic in any way. Contractor shall request for line/ power block wherever required through engineer in-charge for carrying out the works. The Railway will arrange for necessary Line/Power block for execution of the work at specified timings as per request of the contractor.

General guidelines to ensure electrical safety. The following shall be ensured during the execution of the work.

1. All places where electrical cables/wires crossing/running parallel, touching metallic structure to be connected strongly to earthing by earthing wire of requisite cross section.
2. All passenger tickets process information displays in UTS/PRS windows mounted on MS/aluminum section grills to be attended. All such MS/Aluminum section grills to be connected to Earthing and their continuity to be checked regularly.
3. All doorbell/Call bell switches mounted on the MS Grill/or their wire crossing MS grills to be connected to earth.
4. All water pipe lines of GI/MS at offices/Houses to be connected to earthing by GI wire of requisite cross section.
5. All metallic conduits/Metallic cable trays to be connected to earthing by GI wire of requisite cross section.
6. All metallic structure through which/running parallel with electrical cables like FOB/Passengers walkway, MS/GI/Aluminum Alloy sheds also to be connected to earthing by GI wire of suitable cross section.
7. All high mast light body and its protection structures to be connected with two separate earthing by GI wire/ MS Flats of suitable cross section.
8. All DG sets/ motors/motors operating pumps to be connected with two earthing separately by GI wire of suitable cross section.
9. All lights pole on platforms and in colonies or in Railway Premises to be connected by earthing as per CEA (measure relating to safety and power supply) regulation, 2023 or latest, i.e there must be GI wire connecting each pole solidly via looping & connection always visible with three earthing electrode connection for 1 km length or part thereof.

10. All overhead wires crossing roads, premises of official houses, play grounds, public utility place to be provided with earth guard wire mesh which is rigidly connected to overhead structure which are metallic.
11. All guy wires to be provided with separating porcelain insulator after one feet from pole top connection.
12. All light poles non conducting like RCC/wood/Composite material supporting light assembly or overhead supporting structure. Such light assembly body/structure to be connected to earthing by MS flat.
13. All junction boxes of light poles to be place opposite to platform/country side making their access difficult to passengers/public and their cover to be sealed locked. The condition of junction boxes to be good without any crack/defective locking/dangling and no loose wire. They should have fuses to light assembly wire and to have connection on terminal block with way of bolt with spring washer and to lugs. No loose joints/ exposed joints not tapped by insulation to conductors be in the junction box, No bare conductor to be left in the junction box.
14. All light poles on platform colonies/ public place or junction box to be provided with Danger sign with voltage level (i.e 230 V or 440V) with bone and skull sign on MS Plate/ Aluminum plate with caution in Hindi, English and vernacular languages.
15. Electrical control panels/meter boxes/junction box etc with only MS/Aluminum plate danger boards to be provided.
16. All motors/Generators/Panels/Transformers to be provided with danger board as details in S.N(14) above.
17. All lights poles and panels at LCs to be protected as detailed in S.N(13) and (14).
18. All motors of electrically operated LC boom to connected with two separate earthing with GI wire/MS flat rigidly as per CEA (measure relating to safety and power supply) regulation, 2023 or latest.
19. All light poles/overhead poles should be made non climbable to public as defined in CEA (measure relating to safety and power supply) regulation, 2023 or latest. Rail pole/tubular poles do come in category of non-climbable.
20. The junction boxes meter panels/electrical panels on light poles should be on height and non-accessible to children.
21. All Substations should with gate and gate to be kept under lock. The substation boundary to be such that no unauthorized person get access to substation. Danger boards to be provided on transformers, panels, control gears etc.
22. Earthing in substation to be provided as prescribed. All equipment/ panels/metallic switches bodies to be connected to individual earthings and all earthings to be interconnected.
23. All metallic fencing and gate to be inter connected and to be connected to earthing by GI wire/MS flat rigidly.
24. All metallic doors/gates and door frames/supports are to be connected with earthing and flexible shunts between them so all the time door is connected with earthing.
25. All operating handles are to be connected with flexible shunts, painted red and mounting structure to be connected to earthing. Only authorized competent staff to operate handle putting rubber gloves. All station masters and operating staff/other department staff are also to be trained to put rubber gloves capable to withstand 11/33/66 kV voltage level and confirm to relevant BIS while operating handles.
26. All appliances/accessories/items in the electrical use must be as per relevant BIS if applicable in order to prevent any leakage current and failures leading to electrical accidents. Substation to be provided with stones chips of requisite size and up to sufficient depth level to provide electrical resistance to staff working in switching area.
27. All armored cables are to be connected to separate earthing and connected with it rigidly by GI wire/MS flat with sufficient cross-section.
28. Appliances/Accessories are not to be connected with loose wire but proper wiring is to be done following standard procedure. All appliances/accessories are to be connected with 3 wire plug/5 wire plug sockets in which one is earth wire connecting to the body of appliances/accessories. Earth wire of wiring should have continuity and to be connected to earthing rigidly.
29. All water coolers, Geysers, Heaters, ticket vending machines, operating switch cubicles and protection metallic mesh to be connected with separate earthing with GI wire or MS flat of suitable cross-section rigidly.
30. Competency certificate to be given by Sr.DEE to all staff working on electrical equipment, electrical assets as per voltage level and periodically renewed as prescribed.

31. Public address system equipment's body to be connected to earthing and if with flexible connection from nearest switchboard then with 3 pins top socket arrangement in which earth wire gets connected to the body of the system equipment. In no case 2 wire plug top socket to be used.
32. All Geysers, water heaters and steamers / steam generator are to be connected to water pipelines with flexible PVC pipes, such that there will not be any conducting connection with their bodies.
33. Rubber mats of suitable thickness as per BIS specification only to be provided along with control panel so that staff can stand on them and work.
34. While working on overhead electrical lines it must be ensured that the work section is connected with earthing by discharged rod from both sides of the work section.
35. The Quarters/offices/station distribution board to be provided with RCCB of suitable rating so as to detect any leakage of the current from the closed circuit and ensure timely disconnection of such circuits.
36. Selection of proper size of the OCPD is the key for ensuring their timely operation in case of short circuit and earth fault. Proper rated MCBs/MCCBs are to be provided, the current rating of the MCB connected to a circuit should be at par or one higher to the connected load.
37. Raising of cable through GI pipe shall be carefully done, by ensuring that no mechanical damage is caused to the cable by the raising pipe. It is to be ensured that there are no sharp edges in the raising pipe which damages the insulation of the cable. Bitumen shall be provided in both top and bottom of the raising pipe. The cable through the raising pipe should be free from any kind of mechanical stress. Insulating sleeves or any similar material shall be provided to prevent cable damage due to raising pipe.
38. Cable termination and dressing should have high quality standard and workmanship and it should be ensured that electrical safety is not compromised in any aspect.
39. The insulation resistance shall be measured between live conductors and the earthing conductor connected to the earthing arrangement.

Circuit voltage	Test Voltage	IR M ohm
Safety extra-low voltage	250	≥ 0.5
Up to and including 500V	500	≥ 1.0
Above 500V	1000	≥ 1.0

40. All electrical control panels, DG sets, Substations equipment, ATVM's, Water coolers, High Mast lights, Metallic poles carrying electrical lights/wires, LC booms, Motor/DG sets in the public area, etc. to be rigidly connected to their independent earthing with suitable metallic earth wire/earth flats of prescribed material and requisite cross-section to handle fault current.
41. The cross-section of earth wire/earth flat to be such that it will not break/melt/give up while being subjected to maximum fault current otherwise, in such a situation the protected installation/equipment will become floating and fatal to humans & animals. Even it may lead to an electrical fire. This should be taken care of.
42. All equipment/installations to be protected against leakage current by suitable capacity RCCB
43. The earthing value is to be measured in prescribed periodicity in the dry season and to be kept within limits. Even if needed more earthing can be provided in parallel connection mode to keep earthing value well within limits. The measured data and measured value to be recorded in the register as well as on the earth pit chamber.
44. While deciding/designing /erecting earthing it should be ensured that it should be as below as possible w.r.t earthing value limit prescribed

B. TECHNICAL SPECIFICATIONS

A. EXPLANATORY NOTES

1. Definition of terms

- a) **“Applicable Laws”** means, with respect to any Person, any constitutional provision, law, statute, rule, regulation, ordinance, treaty, order, decree, judgment, decision, certificate, holding, injunction, registration, license, franchise, permit, authorization, guideline, Governmental Approval, consent or requirement of any Governmental Authority in India having jurisdiction over such Person or its property, enforceable by law or in equity, including the interpretation and administration thereof by such Governmental Authority;
- b) **“Approvals”** means all permits, clearances, licenses, consents, authorizations, approvals, registrations, waivers, privileges, acknowledgements, agreements, or Agreements required to be obtained from or provided by any concerned authority for the purpose of setting up of the solar power project and/ or for supply of power pursuant to this Agreement;
- c) **“Commissioning Tests”** means the tests to be carried out to determine the Commissioning of the Unit or Facility, as the case may be, in accordance with the Testing Procedures specified and as defined in this document.
- d) **“Delivery Point”** shall be the interconnection point at which the railway metering point is located;
- e) **“Document”** or **“Documentation”** means documentation in printed or written form, or in tapes, discs, drawings, computer programs, writings, reports, photographs, films, cassettes, or expressed in any other written, electronic, audio or visual form;
- f) **“Drawings”** means all of the drawings, calculations and documents pertaining to the Project. This shall include both the electrical and civil drawing(s);
- g) **“Interconnection Facilities”** means all the facilities installed by the contractor at the Relevant Premises to enable Railways to receive the Delivered Energy from the Project at the Delivery Point, including transformers, and associated equipment, relay and switching equipment, protective devices and safety equipment;
- h) **“Metering System”** means the meters and other applicable devices/instruments installed and used for measurement of Electricity, delivered from the Electricity generated by Units comprising the Facility, as per the specifications provided.
- i) **“Main Meter”** means for each Unit, the Metering System which would primarily be used for accounting and billing of Electricity generated by Units comprising the Facility to be installed at the Delivery Point
- j) **“Solar Rooftop Power System/Project”** includes a solar PV panel power generation facility to be established by the contractor on the Relevant Premises, located within Railway’s license area, having an Installed Capacity and includes the integrated assembly of photovoltaic panels, mounting assemblies, inverters, converters, metering, lighting fixtures, transformers, ballasts, disconnects, combiners, switches, wiring devices and wiring, and all other material comprising the Installation Work, including protection equipment and the like necessary to deliver the Electricity generated by it to Railways at the relevant Delivery Points;
- k) **“Testing Procedures”** as specified in this document.

The Scope of Work of the contractor includes, but is not limited to, the following:

Design, develop, procure, construct and commission, roof mounted SPV power packs, which includes, but is not limited to, the following:

- a. Solar PV modules.
- b. Mounting frames, structures, array foundation (grouting on terrace), earthing grid design, and

module inter-connection.

- c. All System Junction boxes.
- d. Power Conditioning Units (PCU) with monitoring.
- e. Appropriate AC power evacuation panels or inverters, according to Project Site requirements, with bus bars (in-built or otherwise) and circuit breakers.
- f. Protection/isolation systems.
- g. Power and Control Cables.
- h. Earthing system for PV Array, DC power system, lightning protection system.
- i. Data monitoring system with remote monitoring facilities.
- j. Transportation, unloading, and loading of all equipment at Project Site.
- k. Project Management including adherence to all requisite safety practices.
- l. MPPT – Max power point tracking built in the PCU
- m. Fire fighting and fire detection systems
- n. Making arrangements for water in the plant area for module cleaning along with cleaning mechanism; The contractor shall make arrangement for regular cleaning of the solar PV modules during the maintenance period. Logbook for the same shall be jointly signed by contractors representative and SSE in-charge.
- o. Control room/ panel (which ever may be found appropriate) for the plant built in suitable material, with proper ventilation for temperature control of the equipment and serviceability within the building. Alternatively, the existing meter room can be utilized after proper designing and approvals of the building owner.

Installation and Commissioning of roof mounted SPV power packs, that includes:

- a. Design and construction of foundations / grouting for holding module mounting structures without puncturing the roof; maintaining proper drainage of rain water over terrace through the installation area; cable routings through PVC pipes not obstructing the movement on the terrace.
- b. Before commencement of work, the contractor to obtain all approvals for related drawings to be obtained from the concerned authorities.
- c. All drawings shall conform to relevant IS standards.
- d. Special care to be taken while designing all structures for modules to cater to heavy rainfall, strong winds and earthquake that may be prevalent in the area.
- e. Pre-commissioning and Commissioning of all supplied equipment.
- f. Test running of the grid-connected solar Facility including load trials at Project Site, prior to handover and commencing energy export for metering.
- g. Grid commissioning; the plant needs to be grid interactive. Interconnection points to be checked and certified by Railways for accuracy and safety.
- h. Installation of Main Meter shall be done by the contractor and the contractor shall submit

drawings for grid interface for each individual power pack and get approved prior to commencement of work on Project Site.

i. Commissioning certificate from relevant authorities for the Facility.

1.1. The following Statutory Clearances to be obtained by the contractor wherever applicable:

- a. Electrical System approval (Electrical Inspector) if required.
- b. Fire System approval (CFO) if required.
- c. All equipment, accessories, materials, civil construction & erection works should comply with statutory requirements and IS standards.
- d. All statutory requirements for working at the Project Site like Labour Registration, Workman Compensation Policy, ESIC etc. to be complied with by the Vendor before deployment of resources at the Project Site.

2. Obligations of the contractor

- (a) The contractor will Design, Engineer, Procure, Undertake Civil and Electrical works including Erection, Testing & Commissioning of the solar PV project
- (b) bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the CONTRACTOR under this document.
- (c) The contractor shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 , CEA guidelines etc.
- (d) The contractor will install the Main Metering System at the Delivery Point for the measurement of electrical energy produced by the System.
- (e) Ensure net metering with the concerned Distribution Company on the behalf of Railways. Facilitate the execution of the Net Metering agreement (including procurement & all cost related to Net Metering connection thereof) of Railways with the utility.
- (f) To apply for and obtain net metering on behalf of the Railways for the Project and bear all the costs for the same on behalf of Railways;
- (g) Procure all the Approvals specified in this document and also from other agencies unconditionally or if subject to conditions, then all such conditions required to be fulfilled by the date specified therein shall have been satisfied in full and such Approvals are in full force and effect;
- (h) Facilitate the execution of the Net Metering agreement (including procurement & all cost related to Net Metering connection thereof) of Railways with the utility
- (i) To apply for net metering related work on the behalf of Railway with the concerned DISCOM as per site condition.
- (j) To identify & finalise all required steps as per the concerned as per site condition.
- (k) Acquire and maintain in effect all approvals and clearances in order to enable it to perform its obligations under this document.
 - Governmental Approvals: While providing the Installation Work, the Solar Power and System Operations, the contractor will obtain and maintain and secure all Governmental Approvals required to be obtained and maintained and secured by the contractor and to enable the contractor to perform such obligations.
 - Interconnection Requirements: The interconnection of the rooftop solar system with the network of the Railways will be made as per the technical standards for connectivity of distributed generated resources regulations as may be notified by the competent authority.
- l) Subject to and on the terms and conditions of this document, the contractor shall, at its own cost and expense, procure finance for and undertake the design, engineering, procurement, construction and commissioning of the rooftop solar project and observe, fulfill, comply with and perform all its obligations set out in this document.
- m) The contractor shall comply with all Applicable Laws and obtain Approvals (including renewals as required) in the performance of its obligations under this document.
- (n) Procure, as required, the appropriate proprietary rights, licenses, agreements and permissions for materials, methods, processes and systems used or incorporated into the rooftop solar project;

- (o) Procure that all facilities and amenities within the solar rooftop power system are operated and maintained in accordance with Good Industry Practice
- (p) Undertake Interconnection Facilities as per the specifications and requirements laid down by the Central Electricity Authority and respective State ERCs.
- (q) Facilitate the execution of the Net Metering agreement (including procurement & all cost related to Net Metering connection thereof) of Railways with the utility
- (r) to provide water connections for the cleaning of the solar modules. The Raw Water connection point may be provided by Railways at site as available . The contractor to provide water connection by laying pipe lines and all necessary accessories from nearest water connection point made available.
- (s) The contractor shall ensure efficient operation of the Project and the associated facilities to achieve the maximum power generation from the Project. For this purpose the contractor shall engage the services of adequate number of Engineers and Technicians. Daily Management Information System (MIS) reports with generation and down time analysis data shall be made available to Railways office by E-mail.
- (t) All minor items viz. hardware items, foundation bolts, termination lugs for electrical connections etc. as required and necessary for proper working of the equipment shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.
- (u) To comply with the latest guidelines of MNRE and DISCOM in regard to Solar energy and solar plants

3. Obligations during Construction and Commissioning

The contractor will be responsible for the design, implementation and commissioning of the project. The contractor will Design, Engineer, Procure, Undertake Civil and Electrical work including Erection, Testing & Commissioning of the solar PV project

- a. The contractor shall procure the solar plant in line with the MNRE requirements on domestic content.
- b. The contractor will bear all costs pertaining to the installation and Commissioning of the systems and these costs will not be recoverable in any form from Railways.
- c. Testing Procedures: The contractor and Railways or its representative(s) shall implement the testing procedures as attached.
- d. The contractor will provide and lay down the dedicated electrical cables for transmission of Solar Power from the Project up to the metering point of Railways.

4. Obligations relating to aesthetic quality of the rooftop solar project

The contractor shall maintain a high standard in the appearance and aesthetic quality of the rooftop solar project and achieve integration of the Solar Rooftop Power System with the character of the surrounding landscape through both appropriate design and sensitive management of all visible elements. The contractor shall engage professional architects and town planners of repute for ensuring that the design of the rooftop solar project meets the aforesaid aesthetic standards.

5. Obligations of Railways

- (a) Enter into net metering agreement (Excluding the cost for net metering connection) with concerned Distribution licensee

B. Technical specifications for Solar PV system

Technical specifications - The proposed work shall be commissioned as per the technical specifications given below. Solar panels systems shall be provided as per the latest MNRE specifications and MNRE approved makes.

DEFINITION

A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and 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, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable. Solar PV system shall consist of following equipments/components.

If the full capacity of the solar plant is not executed due to space constraints/ as per DISCOM's mandates etc, the payment will be made on Pro-rata basis for the capacity solar plant installed.

- Solar PV modules consisting of required number of **Mono Crystalline** PV modules.
- Grid interactive Power Conditioning Unit with Remote Monitoring System
- Mounting structures
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

1. SOLAR PHOTOVOLTAIC MODULES:

2. The PV modules used should be made in India.
 3. The PV modules used must qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards Crystalline Silicon Solar Cell Modules IEC 61215/IS14286 or latest. In addition, the modules must conform to IEC 61730 Part-2-or latest - requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS.
 4. Building-integrated photovoltaic type (BIPV) solar panels, along with suitable structural modifications, with all necessary accessories, to be provided as per site condition at SMVB Railway station Cover Over Platforms (COP). The scope for the work is inclusive of all the necessary modifications that has to be done to the COP structure which includes and is not limited to the provision of sealant for water ingress prevention with all accessories.
- a) For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701/IS 61701 or latest.
 - b) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar mono crystalline modules of minimum **540 Wp** and above wattage.
 - c) Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided.
 - d) The module frame shall be made of corrosion resistant materials, preferably having anodized aluminum.
 - e) The bidder shall carefully design & accommodate requisite numbers of the modules to

achieve the rated power in his bid. Railway shall allow only minor changes at the time of execution.

f) Other general requirement for the PV modules and subsystems shall be the following: -

- i. The rated output power of any supplied module shall have tolerance of +/- 3%.
- ii. 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) percent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.
- iii. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP-65 rated.
- iv. I-V curves at STC should be provided by bidder.

2. Solar PV modules

5. Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used on each module. This should be inside laminate only.

- a) Name of the manufacturer of the PV module
- b) Name of the manufacturer of Solar Cells.
- c) Month & year of the manufacture (separate for solar cells and modules)
- d) Country of origin (separately for solar cells and module)
- e) I-V curve for the module Wattage, I_m , V_m and FF for the module
- f) Unique Serial No and Model No of the module
- g) Date and year of obtaining IEC PV module qualification certificate.
- h) Name of the test lab issuing IEC certificate.
- i) Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

6. Warranties:

As per special conditions of contract for solar works.

7. ARRAY STRUCTURE

- a) Hot dip galvanized MS mounting structures may be used for mounting the modules/ panels/arrays. Each structure should have angle of inclination as per the site conditions to take maximum insolation. However to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance ratio requirements.
- b) The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed. It may be ensured that the design has been certified by a recognized Lab/ Institution in this regard and

submit wind loading calculation sheet to Railway. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed.

- c) The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759.
- d) Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Aluminum structures also can be used which can withstand the wind speed of respective wind zone. Necessary protection towards rusting need to be provided either by coating or anodization.
- e) Aluminium frames should be avoided for installations in coastal areas.
- f) The fasteners used should be made up of stainless steel. The structures shall be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.
- g) Regarding civil structures the bidder need to take care of the load bearing capacity of the roof and need arrange suitable structures based on the quality of roof.
- h) The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m².
- i) The contractor may suitable decide upon the clearance keeping in view the need of heat dissipation etc.
- j) Suitable structural modification shall be carried out for BIPV type solar at SMVB COP.

8. JUNCTION BOXES (JBs)

- a) 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 JB's shall be such that input & output termination can be made through suitable cable glands.
- a) Copper bus bars/terminal blocks housed in the junction box with suitable termination threads Conforming to IP65 standard and IEC 62208 or latest with Hinged door with EPDM rubber gasket to prevent water entry. Single / double compression cable glands and provision of earthings. It should be placed at 5 feet height or above for ease of accessibility.
- b) Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs) / SPDs, suitable Reverse Blocking Diodes. The Junction Boxes shall have suitable arrangement monitoring and disconnection for each of the groups.
- c) Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification
- d) All fuses shall have DIN rail mountable fuse holders and shall be housed in thermoplastic IP 65 enclosures with transparent covers.

9. DC DISTRIBUTION BOARD:

- a) DC Distribution panel to receive the DC output from the array field.

- b) DC DPBs shall have sheet from enclosure of dust & vermin proof conform to IP 65 protection. The bus bars are made of copper of desired size. Suitable capacity MCBs/MCCB shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

10. AC DISTRIBUTION PANEL BOARD:

- a) AC Distribution Panel Board (DPB) shall control the AC power from PCU/ inverter, and should have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar while in grid tied mode.
- b) All switches and the circuit breakers, connectors should conform to IEC 60947 or latest, part I, II and III/ IS60947 part I, II and III.
- c) The changeover switches, cabling work should be undertaken by the bidder as part of the project.
- d) All the Panel's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 or 230 volts, 50 Hz
- e) The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.
- f) All indoor panels will have protection of IP54 or better. All outdoor panels will have protection of IP65 or better.
- g) Should conform to Indian Electricity Act and rules (till last amendment).
- h) All the 415 AC or 230 volts devices / equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions

Variation in supply voltage	+/- 10 %
Variation in supply frequency	+/- 3 Hz

11. PCU/ARRAY SIZE RATIO:

- a) The combined wattage of all inverters should not be less than rated capacity of power plant under STC.
- b) Maximum power point tracker shall be integrated in the PCU/inverter to maximize energy drawn from the array.

12. PCU/ Inverter:

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the "Power Conditioning Unit (PCU)". In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to the power conditioning unit/inverter should also be DG set interactive, if necessary. Inverter output should be compatible with the grid frequency. The capacity of inverter is to be designed in such a way that the capacity will suit the capacity of the solar plant executed as warranted at site. Typical technical features of the inverter shall be as follows:

Switching devices : IGBT/MOSFET

Control : Microprocessor /DSP

Nominal AC output voltage and frequency : 415V, 3 Phase, 50 Hz

Output frequency : 50 Hz
 Grid Frequency Synchronization range : + 3 Hz or more
 Ambient temperature considered : -20o C to 50o C
 Humidity : 95 % Non-condensing
 Protection of Enclosure : IP-20(Minimum) for indoor.
 : IP-65(Minimum) for outdoor.
 Grid Frequency Tolerance range : + 3 or more
 Grid Voltage tolerance : - 20% & + 15 %
 No-load losses : Less than 1% of rated power
 Inverter efficiency(minimum) : >93% (In case of 10kW or above)
 Inverter efficiency (minimum) : > 90% (In case of less than 10 kW)
 THD : < 3%
 PF : > 0.9

- a) **Three phase PCU/ inverter shall be used with each power plant system (10kW and/or above) but In case of less than 10kW single phase inverter can be used.**
- b) PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
- c) The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power, inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
- d) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
- e) **Anti-islanding** (Protection against Islanding of grid): The PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.
- f) Successful Bidder shall be responsible for galvanic isolation of solar roof top power plant (>100kW) with electrical grid or LT panel.
- g) In PCU/Inverter, there shall be a direct current isolation provided at the output by means of a suitable isolating transformer. If Isolation Transformer is not incorporated with PCU/Inverter, there shall be a separate Isolation Transformer of suitable rating provided at the output side of PCU/PCU units for capacity more than 100 kW.
- h) The PCU/ inverter generated harmonics, flicker, DC injection limits, Voltage Range, Frequency Range and Anti-Islanding measures at the point of connection to the utility services should follow the latest CEA (Technical Standards for Connectivity Distribution Generation Resources) Guidelines.
- i) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683 and IEC 60068- 2(1,2,14,30) or latest /Equivalent BIS Std.
- j) The charge controller (if any) / The MPPT units environmental testing should qualify IEC 60068-2(1, 2, 14, 30) or latest/Equivalent BIS std. The junction boxes/ enclosures should be IP 65(for outdoor)/ IP 54 (indoor) and as per IEC 529 or latest specifications.
- k) The PCU/ inverters should be tested from the MNRE approved test centres/ NABL/ BIS/ IEC accredited testing- calibration laboratories/ or NISE or UL India Pvt Ltd, or TUV Rheinland. In case of imported power conditioning units, these should be approved by international test houses.

13. INTEGRATION OF PV POWER WITH GRID:

The output power from SPV would be fed to the inverters which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid. Once the DG set comes into service PV system shall again be synchronized with DG supply and load requirement would be met to the extent of availability of power. Four pole isolation of inverter output with respect to the grid/ DG power connection need to be provided.

14. DATA ACQUISITION SYSTEM / PLANT MONITORING

- i. Data Acquisition System shall be provided for each of the solar PV plant above 10 kWp capacity.
- ii. Data Logging Provision for plant control and monitoring, time and date stamped system data logs for analysis with the high quality, suitable PC. Metering and Instrumentation for display of systems parameters and status indication to be provided.
- iii. Solar Irradiance: An integrating Pyranometer / Solar cell based irradiation sensor (along with calibration certificate) provided, with the sensor mounted in the plane of the array. Readout integrated with data logging system.
- iv. Temperature: Temperature probes for recording the Solar panel temperature and/or ambient temperature to be provided complete with readouts integrated with the data logging system
- v. The following parameters are accessible via the operating interface display in real time separately for solar power plant:
 - a. AC Voltage.
 - b. AC Output current.
 - c. Output Power
 - d. Power factor.
 - e. DC Input Voltage.
 - f. DC Input Current.
 - g. Time Active.
 - h. Time disabled.
 - i. Time Idle.
 - j. Power produced
 - k. Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency ground fault, PV starting voltage, PV stopping voltage.
- vi) All major parameters available on the digital bus and logging facility for energy auditing through the internal microprocessor and read on the digital front panel at any time) and logging facility (the current values, previous values for up to a month and the average values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.
- vii) PV array energy production: Digital Energy Meters to log the actual value of AC/ DC voltage, Current & Energy generated by the PV system provided. Energy meter along with CT/PT should be of 0.5 accuracy class.
- viii) Computerized DC String/Array monitoring and AC output monitoring shall be provided as part of the inverter and/or string/array combiner box or separately.
- ix) String and array DC Voltage, Current and Power, Inverter AC output voltage and current (All 3 phases and lines), AC power (Active, Reactive and Apparent), Power Factor and AC energy (All 3 phases and cumulative) and frequency shall be monitored.

- x) Computerized AC energy monitoring shall be in addition to the digital AC energy meter.
- xi) The data shall be recorded in a common work sheet chronologically date wise. The data file shall be MS Excel compatible. The data shall be represented in both tabular and graphical form.
- xii) All instantaneous data shall be shown on the computer screen.
- xiii) Software shall be provided for USB download and analysis of DC and AC parametric data for individual plant.
- xiv) Provision for instantaneous Internet monitoring and download of data shall be also incorporated.
- xv) Remote Server and Software for centralized Internet monitoring system shall be also provided for download and analysis of cumulative data of all the plants and the data of the solar radiation and temperature monitoring system.
- xvi) Ambient / Solar PV module back surface temperature shall be also monitored on continuous basis.
- xvii) Simultaneous monitoring of DC and AC electrical voltage, current, power, energy and other data of the plant for correlation with solar and environment data shall be provided.
- xviii) Remote Monitoring and data acquisition through Remote Monitoring System software at the railways location with latest software/hardware configuration and service connectivity for online / real time data monitoring/control complete to be supplied and operation and maintenance/control to be ensured by the supplier. Provision for interfacing these data on Railway server and portal in future shall be kept.
- xix) The bidders shall be obligated to push real-time plant monitoring data on a specified intervals (say 15 minute) through open protocol at receiver location (cloud server) in XML/JSON format, preferably. Suitable provision in this regard will be intimated to the bidders.
- xx) Data charges in this regard shall be borne by the contractor till completion of maintenance period

15. METERING (Mandatory)

- a) The bidirectional electronic energy meter (0.5 S class or as per the latest mandates by BESCOM) shall be installed for the measurement of import/Export of energy.
- b) The bidder must take approval/NOC from the Concerned DISCOM for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network and submit the same to Railway before commissioning of SPV plant.
- c) Reverse power relay shall be provided by bidder (if necessary), as per the local DISCOM requirement.
- d) Metering cubicle as per DISCOMs approved make and drawings shall be provided.

16. PROTECTIONS

The system should be provided with all necessary protections like earthing, Lightning, and grid islanding as follows:

- **LIGHTNING PROTECTION**

- a) The SPV power plants shall be provided with lightning & overvoltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc. The entire space occupying the SPV array shall be suitably protected against Lightning by deploying required number of Lightning Arrestors. Lightning protection should be provided as per IEC 62305 or latest standard. The protection against induced high-voltages shall be provided by the use of metal oxide varistors (MOVs) and suitable earthing such that induced transients find an alternate route to earth.

- **SURGE PROTECTION**

- a) Internal surge protection shall consist of three MOV type surge-arrestors connected from +ve and -ve terminals to earth (via Y arrangement).

- **EARTHING PROTECTION**

- a) Each array structure of the PV yard should be grounded/ earthed properly as per IS:3043-1987 or latest. In addition the lightning arrester/masts should also be earthed inside the array field. Earth Resistance shall be tested in presence of the representative of Railways as and when required after earthing by calibrated earth tester. PCU, AC DB and DC DB should also be earthed properly. Earthings shall be GI pipe earthing as per specifications defined in this tender document.
- b) Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earthing points are bonded together to make them at the same potential.

- **GRID ISLANDING:**

- a) 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.
- b) A manual disconnect 4 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 by the utility personnel.

17. CABLES: Cables of appropriate size to be used in the system shall have the following characteristics:

- Shall meet IEC 60227/IS 694, IEC 60502/IS1554 or latest standards
- Temp. Range: -10°C to +80°C.
- Voltage rating 660/1000V
- Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
- Flexible
- Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum (2%).
- For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core multi-stranded flexible copper cables shall be used; Multi-core cables shall not be used.
- For the AC cabling, PVC insulated and PVC sheathed single or, multi-core multi-stranded flexible copper cables shall be used; Outdoor AC cables shall have a UV-stabilized outer sheath.
- The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use. Outer sheath of cables shall be electron beam cross-linked XLPO type and black in colour.

- The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
- Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers
- All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm; the minimum DC cable size shall be 4.0 mm² copper; the minimum AC cable size shall be 4.0 mm² copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.
- Cable Routing/ Marking: All cable/wires are to be routed in a GI cable tray and suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified. In addition, cable drum no. / Batch no. to be embossed/ printed at every one meter.
- Cable Jacket should also be electron beam cross-linked XLPO, flame retardant, UV resistant and black in colour.
- All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall be solar grade copper (Cu) with XLPO insulation and rated for 1.1kV as per relevant standards only.
- The ratings given are approximate. Bidder to indicate size and length as per system design requirement. All the cables required for the plant provided by the bidder. Any change in cabling sizes if desired by the bidder/approved after citing appropriate reasons. All cable schedules/layout drawings approved prior to installation.
- Multi Strand, Annealed high conductivity copper conductor PVC type 'A' pressure extruded insulation. Overall PVC insulation for UV protection Armoured cable for underground laying. All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below: BoS item / component Standard Description Standard Number Cables General Test and Measuring Methods, PVC insulated cables for working Voltage up to and including 1100 V ,UV resistant for outdoor installation IS /IEC 69947.
- The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.
- The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%.

18. CONNECTIVITY

The maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the Distribution Code/Supply Code of the State and amended from time to time. Following criteria have been suggested for selection of voltage level in the distribution system for ready reference of the solar suppliers.

Plant Capacity	Connecting voltage
Up to 10 kW	240V-single phase or 415V-three phase at the option of the consumer
Above 10kW	415V – three phase

- a) The maximum permissible capacity for rooftop shall be 1 MW for a single net metering point.
- b) Utilities may have voltage levels other than above, DISCOMS may be consulted before finalization of the voltage level and specification be made accordingly.

19. TOOLS & TACKLES AND SPARES:

- a) After completion of installation & commissioning of the power plant, necessary tools & tackles are to be provided free of cost by the bidder for maintenance purpose.

- b) list of requisite spares in case of PCU/inverter comprising of a set of control logic cards, IGBT driver cards etc, Junction Boxes, Fuses, MOVs / arrestors, DC/AC MCB/ MCCB s etc along with spare set of PV modules be made available for maintenance. Required set of spares shall be maintained in the plant itself for the entire period of maintenance and Operation & Maintenance which upon its use shall be replenished.

20. DANGER BOARDS AND SIGNAGES:

- a) Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signage shall be provided one each at battery –cum- control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with railways.

21. FIRE EXTINGUISHERS:

The fire fighting system for the proposed power plant for fire protection shall be consisting of:

- a) Portable fire extinguishers in the control room and rooftop for fire caused by electrical short circuits
- b) Sand buckets in the control room and roof top
- c) The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing PCUs as well as on the Roof or site where the PV arrays have been installed.
- d) CO₂ or dry powder type fire extinguishes having capacity of 4.5 kg or more , suitable for electrical fire applications to be provided with the Roof or site where the PV arrays have been installed.
- e) Periodic maintenance of fire extinguishers as per the OEM s schedule have to be done by the contractor during the warranty period of 3 years. Necessary refill to be done as required during the above period.

22. DRAWINGS & MANUALS:

- a) Two sets of Engineering, electrical drawings and Installation and O&M manuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, synchronization along with protection equipment.
- b) Approved ISI and reputed makes for equipment be used.
- c) For complete electro-mechanical works, bidders shall supply complete design, details and drawings for approval to Railways before progressing with the installation work
- d) Single Line Diagrams with operation instructions indicating the interconnection of equipment shall be displayed in each location

23. PLANNING AND DESIGNING:

- a) **The bidder should carry out Shadow Analysis at the site and accordingly design strings & arrays layout considering optimal usage of space, material and labor. The bidder should submit the array layout drawings along with Shadow Analysis Report to Railways for approval.**

- b) Railways reserves the right to modify the landscaping design, Layout and specification of sub-systems and components at any stage as per local site conditions/requirements.
- c) The bidder shall submit preliminary drawing for approval & based on any modification or recommendation, if any. The bidder submit three sets and soft copy of final drawing for formal approval to proceed with construction work.

24. DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT

- a) The Contractor shall furnish the following drawings Award/Intent and obtain approval
- b) General arrangement and dimensioned layout
- c) Schematic drawing showing the requirement of SPV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
- d) Structural drawing along with foundation details for the structure.
- e) Loading calculation along with STAAD reports to be submitted.
- f) Itemized bill of material for complete SPV plant covering all the components and associated accessories.
- g) Layout of solar Power Array
- h) Shadow analysis of the roof

25. SAFETY MEASURES:

The bidder shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.

26. DISPLAY BOARD

The bidder has to display a board at the project site mentioning the following:

- a. Plant Name, Capacity, Location, Type of Renewable Energy plant (Like solar wind etc.), Date of commissioning, details of tie-up with transmission and distribution companies, Power generation and Export FY wise.
- b. Financial Assistance details from SECI/MNRE/Any other financial institution apart from loan. This information shall not be limited to project site but also be displayed at site offices/head quarter offices of the successful bidder
- c. The size and type of board and display shall be approved by Engineer-in-charge before site inspection.

The IEC standards to be mandatorily adhered are as given below:

Quality Certification, Standards and Testing for Grid-connected Rooftop Solar PV Systems/Power Plants

Quality certification and standards for grid-connected rooftop solar PV systems are essential for the successful mass-scale implementation of this technology. It is also imperative to put in place an efficient and rigorous monitoring mechanism, adherence to these standards. Hence, all components of grid-connected rooftop solar PV system/ plant must conform to the latest and updated version of relevant standards and certifications given below with latest amendments, additions and corrections:

Solar PV Modules/Panels	
IEC 61215/ IS 14286	Design Qualification and Type Approval for Crystalline Silicon Terrestrial Photovoltaic (PV) Modules
IEC 61701	Salt Mist Corrosion Testing of Photovoltaic (PV) Modules
IEC 61853- Part 1/ IS 16170: Part 1	Photovoltaic (PV) module performance testing and energy rating -: Irradiance and temperature performance measurements, and power rating
IEC 62716	Photovoltaic (PV) Modules – Ammonia (NH ₃) Corrosion Testing (As per the site condition like dairies, toilets)
IEC 61730-1,2	Photovoltaic (PV) Module Safety Qualification – Part 1: Requirements for Construction, Part 2: Requirements for Testing
IEC 62804	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation. IEC TS 62804-1: Part 1: Crystalline silicon (mandatory for applications where the system voltage is > 600 VDC and advisory for installations where the system voltage is < 600 VDC)
IEC 62759-1	Photovoltaic (PV) modules – Transportation testing, Part 1: Transportation and shipping of module package units
Solar PV Inverters	
IEC 62109-1, IEC 62109-2	Safety of power converters for use in photovoltaic power systems – Part 1: General requirements, and Safety of power converters for use in photovoltaic power systems Part 2: Particular requirements for inverters. Safety compliance (Protection degree IP 65 for outdoor mounting, IP 54 for indoor mounting)
IEC/IS 61683 (as applicable)	Photovoltaic Systems – Power conditioners: Procedure for Measuring Efficiency (10%, 25%, 50%, 75% & 90-100% Loading Conditions)
BS EN 50530 (as applicable)	Overall efficiency of grid-connected photovoltaic inverters: This European Standard provides a procedure for the measurement of the accuracy of the maximum power point tracking (MPPT) of inverters, which are used in grid-connected photovoltaic systems. In that case the inverter energizes a low voltage grid of stable AC voltage and constant frequency. Both the static and dynamic MPPT efficiency is considered.
IEC 62116/ UL 1741/ IEEE 1547 (as applicable)	Utility-interconnected Photovoltaic Inverters - Test Procedure of Islanding Prevention Measures
IEC 60255-27	Measuring relays and protection equipment – Part 27: Product safety requirements
IEC 60068-2 (1, 2, 14, 27, 30 & 64)	Environmental Testing of PV System – Power Conditioners and Inverters a) IEC 60068-2-1: Environmental testing - Part 2-1: Tests - Test A: Cold b) IEC 60068-2-2: Environmental testing - Part 2-2: Tests - Test B: Dry heat c) IEC 60068-2-14: Environmental testing - Part 2-14: Tests - Test N: Change of temperature d) IEC 60068-2-27: Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock e) IEC 60068-2-30: Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) f) IEC 60068-2-64: Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance
IEC 61000 – 2,3,5 (as applicable)	Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) testing of PV Inverters
Fuses	

General safety requirements for connectors, switches, circuit breakers (AC/DC): a) Low-voltage Switchgear and Control-gear, Part 1: General rules b) Low-Voltage Switchgear and Control-gear, Part 2: Circuit Breakers c) Low-voltage switchgear and Control-gear, Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units d) EN 50521: Connectors for photovoltaic systems – Safety requirements and tests	General safety requirements for connectors, switches, circuit breakers (AC/DC): a) Low-voltage Switchgear and Control-gear, Part 1: General rules b) Low-Voltage Switchgear and Control-gear, Part 2: Circuit Breakers c) Low-voltage switchgear and Control-gear, Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units d) EN 50521: Connectors for photovoltaic systems – Safety requirements and tests
IEC 60269-6	Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems
Surge Arrestors	
IEC 62305-4	Lightening Protection Standard
IEC 60364-5-53/ IS 15086-5 (SPD)	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control
IEC 61643-11:2011	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control
Cables	
IEC 60227/IS 694, IEC 60502/IS 1554 (Part 1 & 2)/ IEC69947	General test and measuring method for PVC (Polyvinyl chloride) insulated cables (for working voltages up to and including 1100 V, and UV resistant for outdoor installation)
BS EN 50618	Electric cables for photovoltaic systems (BT(DE/NOT)258), mainly for DC Cables
Earthing /Lightning	
IEC 62561 Series (Chemical earthing)	IEC 62561-1 Lightning protection system components (LPSC) - Part 1: Requirements for connection components IEC 62561-2 Lightning protection system components (LPSC) - Part 2: Requirements for conductors and earth electrodes IEC 62561-7 Lightning protection system components (LPSC) - Part 7: Requirements for earthing enhancing compounds
Junction Boxes	
IEC 60529	Junction boxes and solar panel terminal boxes shall be of the thermo-plastic type with IP 65 protection for outdoor use, and IP 54 protection for indoor use
Energy Meter	
IS 16444 or as specified by the DISCOMs	A.C. Static direct connected watt-hour Smart Meter Class 1 and 2 — Specification (with Import & Export/Net energy measurements)
Solar PV Roof Mounting Structure	
IS 2062/IS 4759	Material for the structure mounting

Note- Equivalent standards may be used for different system components of the plants.
In case of clarification following person/agencies may be contacted.

- Ministry of New and Renewable Energy MNRE (Govt. of India)
- National Institute of Solar Energy
- The Energy & Resources Institute
- TÜV Rheinland
- UL

In addition to the above specifications following are also required to be provided:

Remote Display

Contractor will arrange to install LED based display screens along with relevant hardware at each stations/service building and will develop relevant software programs which will display real time generation on a minute, hourly, daily, monthly and annual basis. The cost of development of these systems will have to be borne by the contractor. In addition, the system has to send SMS regarding Solar generation at each location to the selected officials of Railways on Daily basis.

The contractor shall provide and maintain perimeter fencing or other suitable protection around the rooftop solar project and shall be responsible for the security arrangements, which also includes providing & maintaining necessary equipment at the entry, exit and within the rooftop solar project in order to maintain orderly conduct of its business and the security thereof.

Bird spikes

Bird spikes to be provided throughout the periphery of solar module structure at each location.

Interconnection Scheme

Interconnection Requirements: Scope of Work for the contractor

A. All work must be carried out as per the following:

- ✓ Indian Electricity Act and rules therein
- ✓ Indian Electricity Grid Code
- ✓ Regulations of Chief Electrical Inspector

Besides the above measures, certain precautions prescribed by the CEA shall also be incorporated into the solar PV system design:

- PV systems shall be provided with adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC) side for overload and short circuit protection as well as disconnecting switches to isolate the DC and AC system for maintenances.
- Fuses of adequate rating shall also be provided in each solar array module to protect them against short circuit.
- Compliance of Clause 121- "Safety requirement for solar installations" of CEA regulation 2023 "Measures relating to safety and electrical supply" to be ensured while installation and this is to be certified jointly by SSE and contractor.

B. Phase Imbalance:

- Phase imbalance can occur due to varied power injected into different phases of the grid. Whenever solar power plants (SPPs) of lower capacities with single phase inverters are used to feed power into the grid using a single phase injection point, they tend to induce imbalance. This imbalance can be resolved simply by connecting / injecting power to different phases in the same grid.
- The developer shall have to follow the phase imbalance limits imposed by the Off Taker and shall also have to follow the guidelines before connecting such limits to the grid.
- The injection phase for each system to be injected into a single phase shall be approved by the Off Taker.

a) Statutory clearances to be arranged by the contractor.

- a) Building and Architectural Drawings approval
- b) Factory Inspector approval on drawings, wherever necessary
- c) Electrical System approval (Electrical Inspector), if required.
- d) Fire System approval (CFO), if required.
- e) All statutory requirements for working at the Project Site like Labour Registration, Workman Compensation Policy, ESIC etc.
- f) Documents required for statutory approval from any authority shall be prepared by the contractor and has to be submitted to Railways for approvals.

All the documents necessary for obtaining statutory clearances/ permissions/authorisations by various government organisations/ other agencies shall be collected and prepared by the successful tenderer, without any extra cost and got signed from the competent authority of Railways.

TESTING PROCEDURE

The contractor shall adhere to the Testing Procedures given in this document.

Mandatory check before and after connecting the SPV system with DISCOM Network and steps for maintenance of network shall be ensured. The following shall be provided by the contractor and ensured.

1. Mandatory safety precautions / features:

The following are mandatory safety precautions which will be taken care before and after commissioning of grid connected Solar PV system.

- (a) An inbuilt Inverter relay which trips on DISCOM / Railway supply failure and thus prevents any solar power injection to the DISCOM / Railway Network when there is no power from DISCOM / Railways. The anti-islanding protection shall be tested by respective Railway Engineer and the contractor during the release of connection.
- (b) The Solar PV system should be separately grounded / earthed.

There must be at least five different earth pits, with minimum distance of 3 meters between any two, for each PV system as follows.

For DC side (Panels and Structure), - 02 Nos. (to be interconnected)

For AC side (AC DB and inverter) (also called as neutral earthing) – 02 No. (to be interconnected. Required cables for inter connection of ACDB/DCDB to inverters and to ON Grid metering shall be the scope of agency.

Lightning arrestor – 01 No.

Additionally inverter body must be earthed as per instructions from inverter manufacturer.

Combined resistance shall be measured for AC side earths and DC side earths, separately.

- (c) A properly designed Lightning Protection System (including arrestors as necessary) also must be provided for SPV.
- (d) Manual isolator switch, at an easily accessible location with locking facility, shall be provided between inverter AC output and grid interconnection.
- (e) Caution Stickers shall be used with the green background and the text “Solar PV Systems” written in white letters. The size of these stickers shall be 10 CM (width) x 7 CM (height) with the text clearly printed in the center of the sticker.
- (f) All SPV systems should have a mandatory sign board fitted near the existing meter reading terminal stating that “This service is fitted with a LT grid connected SPV plant”. The Solar PV system Caution Stickers shall be fixed under the supervision of Railway Engineer and the contractor in the following locations.
 - i. On or near to meter of service with grid connected solar PV system;
 - ii. On The Consumer main switch, of a service connected with a grid connected Solar PV System;
 - iii. On LT poles with grid connected Solar PV Systems at height of about 1.50 meter from the ground;

- iv. On LT feeder pillars with grid connected Solar PV System on the street-facing door of the feeder pillar.
 - v. On each of the LT take off poles of a Distribution Transformer to which Solar PV Systems are connected.
 - vi. On substation end of HT feeder having Solar PV System.
 - vii. A List of service connected with grid connected Solar PV Systems shall be available at the Railway office.
- (g) During planned / forced maintenance work on DISCOM network, before taking up the work in hand, besides ensuring all other provisions such as line earthing, de-energizing the line section where the work is to be carried out as per prevailing norms, it should also be ensured that supply from such small solar roof-top PV power plants are not back-feeding and supply should also be disconnected by manual isolating switch with locking facility installed in the premises of such consumers and ensuring proper earthing.

a) List of Materials /Approved Brands

The make of materials shall be any one of the following approved make. Materials as required as per the tender schedule shall be provided.

Sl. No.	Description	Approved makes
1	Solar Panel	MNRE approved makes with type test Certificates from NABL approved or/ILAC member body certified labs or NISE or UL India Pvt Ltd, or TUV Rheinland shall be provided.
2	PCU/ Inverter	The PCU/ inverters makes should be tested from the MNRE approved test centres/ NABL/ BIS/ IEC accredited testing-calibration laboratories/ or NISE or UL India Pvt Ltd, or TUV Rheinland. In case of imported power conditioning units, these should be approved by international test houses.
3	Bi directional meter	BESCOM approved