





INDEX SHEET

Doc/Drg NO.	DRAWING DESCRIPTION	NO. OF SHEETS	REV
638490-E-VD-0055	Comment Resulation Sheet	1	1
638490-E-VD-0055	GA, datasheet, BOM and scheme for rooftop solar system	70	1

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<b>OWNER :</b>	 <b>INDIAN OIL CORPORATION LIMITED</b>		
<b>EMPLOYERS CONSULTANT :</b>			
<b>CONTRACTOR :</b>	 <b>L&amp;T ELECTRICAL AND AUTOMATION CONTROL AND AUTOMATION</b>		
<b>PROJECT :</b>	LPG BOTTLING PLANT AT SITARGANJ, UTTARAKHAND		
<b>JOB NO :</b>	638490	<b>S.O.R. Item No.</b>	AA26
<b>DOC TITLE :</b>	GA, datasheet, BOM and scheme for rooftop solar system	<b>REV</b>	2
<b>DOCUMENT NO. :</b>	638490-E-VD-0055	<b>DATE</b>	09-04-2020

<b>Client:</b> INDIAN OIL CORPORATION LIMITED		<b>Project:</b>	LPG BOTTLING PLANT AT SITARGANJ, UTTARAKHAND
<b>Owner's Consultant:</b> NA		<b>Title:</b>	ROR for GA, datasheet, BOM and scheme for rooftop solar system
<b>EPC Contractor:</b> Larsen & Toubro Ltd		<b>Doc No.:</b>	638490-E-VD-055
		<b>ROR Date :</b>	30-03-2020
<b>ROR for GA, datasheet, BOM and scheme for rooftop solar system</b>			
	<b>Old. Rev.</b>	:	P0
	<b>Approval Code</b>	:	-
	<b>New. Rev.</b>	:	P1
<b>S.No</b>	<b>Holtec Comments/Reference</b>	<b>Incorporated YES / NO</b>	<b>L&amp;T Compliance</b>
1	Vendor shall strictly follow specification requirement under attachment-2 of Annexure-10	Yes	Drawings & calculation has been prepared based on that tender document only
2	Incorporate all protection as per specification	Yes	Protection details has been mentioned in SLD & LA details also mentioned in the layout drawing
3	Furnish SLD	Yes	Attached
4	Please elaborate on cleaning system of PV module	Yes	Attached the Plumbing layout named as " <b>Plumbing layout-IOCL-60KW</b> "
5	Please furnish fire fighting measures	Yes	Attached as document carrying " <b>Fire fighting details</b> "
	Please furnish detailed list, comprising of the following:	Yes	
6	a. List building, where solar rooftop system will be installed	Yes	1. PMCC Room 2. Control Room
	b. Space required for installation in each building	Yes	380Sqm. for PMCC Room and 120Sqm. for Control Room
	c. Civil assignment drawing indicating load details	Yes	Attached
8	Fill factor should be mentioned	Yes	Definition of fill factor is $(V_{mp} \times I_{mp}) / (V_{oc} \times I_{sc})$ & same is 0.77
9	Incorporate all data as per specification page no-28 of Attachment-2 of Annex-10 of Tender Spec.	Yes	Already maintained & balance attached
10	Clarify the basis of inverter selection	Yes	Inverter selected as per solar installation capability based on the available space in 2 buildings i.e Control Room and PMCC Room
11	Clarify the basis of 10 sqmm earthing cable selection	Yes	It has been replaced by 25mmX3mm GI strip & same is Elaborated in the " <b>Earthing Calculation</b> "
12	Furnish earthing layout drawing no. as reference.	Yes	<b>Earthing Layout-PMCC &amp; Earthing layout-Control Room</b>

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	<b>Old. Rev.</b>	:	P1
	<b>Approval Code</b>	:	-
	<b>New. Rev.</b>	:	P2
<b>S.No</b>	<b>Holtec Comments/Reference</b>	<b>Tender Description</b>	<b>L&amp;T Compliance</b>
1	All the Protection as per spec shall be clearly mentioned	Following more protections mentioned in the inverter section 1. Reverse polarity Protection 2. Array Ground Fault 3. Earth leakage Current protection 4. Lightning Induced surge protection 5. Surge Voltage Protection 6. I/p & O/P isolation	clearly mentioned in the inverter datasheet attached as " <b>Compliance-Inverter</b> " & highlighted in yellow colour
2	Incorporate all data as per specification page no. 28 of attachment 2 of annexure 10 & same not found	1. O/P frequency 50HZ ± 0.5% HZ	Mentioned in page no. 4 & 6 of "Compliance-Inverter"
		2. Maximum I/P voltage is 100V	It's mentioned in page no. 4 & 6 as <=1100V & same can cater 1000V easily
		3. Inverter Output Voltage 415 V ± 1%, three phase, 4-wire output Nominal voltage could be adjusted ± 5% via system set points. Inverter should work in extremes of the limits in each phase without getting interrupted	Mentioned in page no. 4 & 6 as "Rated AC Voltage" of "Compliance-Inverter"
		4. Power factor control range: >= 0.9 lead or lag	Mentioned in page no. 4 & 6 as "Adjustable power factor" of "Compliance-Inverter"
		5. No load losses : <1% of rated power and maximum loss in sleep mode shall be less than 0.05%	Mentioned in page no. 9 of "Compliance-Inverter"
		THD(Current): less than 3%	Mentioned in page no. 4 & 6 of "Compliance-Inverter"
		Ambient temperature: -10°C to +60°C	Mentioned in page no. 4 & 6 as operating temperature range of "Compliance-Inverter"
		Humidity: 95% non-condensing	Mentioned in page no. 4 & 6 as relative humidity range of "Compliance-Inverter"
		Enclosure( type): IP 32 or better (Indoor rated) IP 65 (Outdoor rated)	Mentioned in page no. 4 & 6 as IP rating of "Compliance-Inverter"
		Overload Capacity: 125% for 10 min and 150% for 1 min; 120% at 250C continuous on DC side	Mentioned in page no. 9 of "Compliance-Inverter"
		DC Injection: Less than 0.5% of nominal load current	Mentioned in page no. 4 & 6 as DC current injection of "Compliance-Inverter"
		Electromagnetic Compatibility : As per IEC 61000	IEC 61000 certificate of OEM attached in page no. 12 of "Compliance-Inverter"
		Noise level Less than 85 dB at 1 mt.	Mentioned in page no. 4 & 6 as Noise of "Compliance-Inverter"
The combined efficiency of the PCU shall be at least 97% at 75% load. The conversion efficiency for PCU at different loads – 10%, 25%, 50%, 75%, 100%, 120% shall be specified in the offer. Above efficiencies are when measured without output inverter transformer.	Mentioned in page no. 9 of "Compliance-Inverter"		
PCU shall have Low Voltage Ride-Through (LVRT) feature to provide support during grid fault/ disturbance. Inverter / PCU should also automatically synchronize with the DG set installed when the DGs are available and continue to work at different loads of the site without being switched off / damaged.	Mentioned in page no. 9 of "Compliance-Inverter"		
Other details mentioned in the Tender	Mentioned in "Compliance-Inverter"		
3	For Technical details of cable ci. No. 3.11 of attachment 2, annexure 10 ,page no. 51 shall be followed	The DC Cable shall be 1.5kV (DC) grade, heavy duty, compacted aluminium/copper conductor, UV resistant XLPE insulated, PVC inner-sheathed, galvanized steel wire/strip armored, fire/flame retardant low smoke FRLS PVC outer sheathed. The cables shall in general conform to IS 7098 (Part-I).	Complied as Cable datasheet shared earlier & TUV certificate attached
		The power cable shall be 1.1kV grade, heavy duty, stranded copper conductor, UV resistant (for outdoors) PVC type-A insulated, galvanized steel wire/strip armored, fire/flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general, conform to IS 1554 Part-I&II and other relevant standards.	Complied as Cable datasheet shared earlier

Noted.

Noted.

Noted.



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		Control Cables: The cable shall be 1.1kV grade, heavy duty, stranded copper conductor, PVC type-A insulated, galvanized steel wire/strip armored, flame retardant low smoke (FRLS) extruded PVC type ST-1 outer sheathed. The cables shall, in general, conform to IS 1554 Part-I & other relevant standards.	Complied
		Technical requirements	Will be followed during execution
4	As the capacity of cleaning pump is very small considering firefighting requirement, we suggest proper extension of building internal hydrant line upto building roof along with 2 no.s of 32mmX36mhose reels for building roof		It's in the scope of IOCL
5	Fire Fighting : Separate Hose reel shall be provided at building roof		It's in the scope of IOCL
6	Fire Fighting: Please indicate quantity of each type of extinguisher Provided for control room & PMCC room		single no.s of each type for each building will be provided for solar only
7	Lughtrning Arrestor: Furnish LA foundation & GA		"LA Details" attached
8	Lightning Arrestor: Is this zone is lightning protecetd? Please provide supporting document		Yes, "LA Details" atached

Noted.

Noted.

Necessary extension of hydrant line and provision of hose box will be considered in fire fighting package.

Use of ESE as lightning protection item is subject to IOCL approval.



## **Design & Development of 60 KW ON Grid Solar Power Plant**

Document No. AVO-L&T-EDR-02-R2

Project Name: 60 KWp Solar Power Plant

Client Name: IOCL

EPC Name: L&T

Solar EPC By: Switching AVO Electropower Limited

## **1.0 Purpose**

The purpose of this calculation is to determine the Module connection, cross section of DC & AC cables to be installed in the PV plant.

## **2.0 References**

- 2.1 Technical Specification of the cable
- 2.2 Single Line Diagram
- 2.3 IS 7098
- 2.4 IS 3961

## **3.0 Basis of Calculation**

- 3.1 Continuous Current Rating
- 3.2 Voltage Drop
- 3.3 Short circuit current rating

## **4.0 General**

- 4.1 Current Carrying capacities of the cable have been taken from cable supplier catalogue
- 4.2 UV protected solar cable has been considered for DC cabling.
- 4.3 Copper armoured cable has been considered for cabling sizing in AC transmission.

## **5.0 Datasheet**

- 5.1 Solar PV Module Datasheet (Waree Solar)
- 5.2 Inverter Datasheet (Thea)
- 5.3 DC cable datasheet (Polycab)
- 5.4 AC Cable Datasheet (Polycab)

## **6.0 Average Voltage Drop Calculation**

- 6.1 String to Inverter Voltage Drop calculation
- 6.2 Inverter to ACDB Voltage Drop calculation
- 6.3 ACDB to Building existing LT panel voltage drop calculation

### Photovoltaic Module Data

Make	Waree Solar	
Power at STC (Pmax)	330	W
Open Circuit Voltage (Voc)	45.6	V
Optimum Operating Voltage (Vmp)	36.55	V
Short Circuit Current (Isc)	9.4	A
Optimum Operating Current (Imp)	9.03	A
Module Efficiency	17.01	%
Temperature Co-efficient (Voltage/degC)	-0.26	
Fill Factor Min.	0.75	

### String Inverter Data

<b>Make</b>	Thea	
<b>Input</b>		
Maximum DC Power	50000	W
Maximum DC Voltage	1100	V
MPPT Operating voltage range	620-850	V
Min Dc Voltage/Start voltage	250	V
No. of MPPT Trackers	4	
Max. input current/Per MPPT tracker input	110	A
<b>Output</b>		
AC Nominal Power	50000	W

<b>Make</b>	Thea	
<b>Input</b>		
Maximum DC Power	10000	W
Maximum DC Voltage	1000	V
MPPT Operating voltage range	470-800	V
Min Dc Voltage/Start voltage	200	V
No. of MPPT Trackers	2	
Max. input current/Per MPPT tracker input	22	A
<b>Output</b>		

AC Nominal Power	10000	W
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**String Sizing:**

The PV Generator consists in solar modules that are connected together. These are arranged in series called string to achieve the operating voltage of the inverter. Once these are defined, these strings are connected parallel to achieve the desired power.

The photovoltaic installation is defined by the peak power of the generator, which is produced under a standard measure of radiation 1000 W /M<sup>2</sup>, Air Mass of 1.5 & ambient temperature of 25 deg C.

Following formulae have been used for string sizing for 50KW

String Sizing

Nmax(1)	$V_{max}/((1+((T_{min}-25)Xk_v)/100)Xv_{oc})$
Nmax (2)	$V_{mp}/((1+((T_{min}-25)Xk_v)/100)Xv_{mp})$
Nmin	$V_{min}/((1+((T_{min}-25)Xk_v)/100)Xv_{mp})$

Where, N= No. of modules

Vmax= Maximum DC voltage=1100V

T min = 0 degree C=0

Kv= Voltage Temperature coefficient of solar module=-0.26

Using the same formulae, following results has come

Nmax (1)	23	no's
Nmax (2)	22	no's
Nmin	6	no's

Following formulae have been used for string sizing for 10KW

String Sizing

Nmax(1)	$V_{max}/((1+((T_{min}-25)Xk_v)/100)Xv_{oc})$
Nmax (2)	$V_{mp}/((1+((T_{min}-25)Xk_v)/100)Xv_{mp})$
Nmin	$V_{min}/((1+((T_{min}-25)Xk_v)/100)Xv_{mp})$

Where, N= No. of modules

$V_{max}$ = Maximum DC voltage=1000V

$T_{min}$  = 0 degree C=0

$K_v$ = Voltage Temperature coefficient of solar module=-0.26

Using the same formulae, following results has come

$N_{max}$ (1)	21	no's
$N_{max}$ (2)	21	no's
$N_{min}$	5	no's

**Detailed worksheet also attached.**

Results implies that we can connect the modules in each string is from 6 nos. to 23 nos. for 50kw and 5 nos. to 21 nos. for 10kw and each string should have same no. of modules. As we are having 182 no.s of 330 Wp module, 15/19 no.s has been taken to get all the strings in equal size & considering better generation in lower irradiation & morning time.

Each String Size considered is 19 no's of solar modules & there are total 8 no's of strings for 50 KW Inverter.

Each String Size considered is 15 no's of solar modules & there are total 2 no of string for 10 KW Inverter.

**Cable Sizing:**

**String to Inverter (4 sqmm copper cable)**

Module Rated current ( $I_{mpp}$ ) (as per datasheet) = 9.03 A

Optimum Operating Voltage ( $V_{mpp}$ ) = 36.55 V

Full Load Current =9.03 A

Length of the cable (average) = 40 mtr max ( as per site survey)

Continuous current rating of the selected cable in air = 30 A

Cable Derating factor due to ambient temperature (50 degC)=0.71 (IEC 60364-5-52, Page no.-53)

Derated cable current =  $30 \times 0.71 = 21.3$  A

Resistance of selected cable ® ohm/km (@20 degC) = 4.61 Ohm/Km

Calculation for No. of Runs =  $\frac{\text{Actual Current}}{\text{Derated Current}} = \frac{9.03}{21.3} = 0.42$

**Hence, we have selected single run of copper cable**

% Voltage Drop (%Vd) =  $(IFL \times L \times R) \times 100 / (N \times V)$

Where, IFL= Full Load Current= 9.03 A

N = No. of runs of cable= 1 run

R= Resistance of cable in Ohm/km= 4.61

L= Length of the cable in Km= 0.04 Km

V= System Voltage=  $36.55 \times 20 = 731 \text{V}$

% Voltage Drop =  $(9.03 \times 0.04 \times 4.61 \times 100) / (1 \times 731) = 0.23\%$

**Drop of voltage is within permissible limit.**

#### **Area of Cross Section Calculation:**

$$\frac{I}{S} = K \times 1 / \sqrt{t}$$

Where,

S= Cross Sectional area in sqmm

I= value of fault current in KA = 0.01 (IEC 60364-5-52, LT cable current carrying section)

t= time of current flow in seconds = 1 second

k= factor depending on the material of protective conductor= 0.09 for copper conductor (IEC 60364-5-52)

Using the formula,

Cable Size S = 0.11

**Hence 1 run 4 sqmm copper cable has been selected.**

#### **50KW Inverter output to ACDB panel cable (single run 3.5 core 25 sqmm Copper conductor)**

Maximum output Power of each Inverter is 50 KW

$$P = V \times I \times \cos \Phi$$

Where,

P= Power Output= 50000 W



V = Output Voltage= 380 Volt (380-415V, Lower side considered)

I = load current = to be derived

Cos  $\Phi$ = power factor = 0.8

Based on the above formula, output current of each inverter = 94.96A

No. of tray:1 No.

Distance b/w cables: NIL

No. of runs of selected cable: 1

Cable Laying Depth: 1 (in air only)

Type of cable: LT XLPE armoured

Allowable voltage drop: 2%

According to the datasheet of AC cable manufacturer = current carrying capacity of 25 sqmm Copper cable is 108A in duct.

Ambient temperature correction factor(K1)= 0.95

Ground temperature correction factor (K2)= 1, in air only

Group factor for ground(K3)= 1, single run in air

Cable installation factor(K4)= 1

Cable grouping factor(K5)= 1

Derated cable current= 102.6

**Hence cable selection is ok**

So, higher rated cable selected (**proposed cable will be routed through a flexible pipe**)

% Voltage Drop

$$\% Vd = \% Vd = I X R X L / (N X V)$$

Where, Impedance=  $((R^2 + (\text{reactance-capacitance})^2)^{0.5})$

Cable resistance(Ohm)= 0.93 ohm/km

Cable reactance = 0.0805 ohm/km

Resultant Impedance $(R^2 + X^2)^{1/2}$ = 0.933 ohm/km

L = length of the cable b/w Inverter & ACDB panel= 5mtr

V= Supply Voltage = 380 V

N = No. of runs =1

I = Load current = 94.96

Using the formula Voltage Drop = 0.12 %

**Hence cable selection is OK**



### 10KW Inverter output to ACDB panel cable (single run 4 core 10 sqmm Copper conductor)

Maximum output Power of each Inverter is 10 KW

$$P = V \times I \times \cos \Phi$$

Where,

P= Power Output= 10000 W

V = Output Voltage= 380 Volt (380-415V, Lower side considered)

I = load current = to be derived

cos  $\Phi$ = power factor = 0.8

Based on the above formula, output current of each inverter = 18.99A

No. of tray: 1 No.

Distance b/w cables: NIL

No. of runs of selected cable: 1

Cable Laying Depth: 1 (in air only)

Type of cable: LT XLPE armoured

Allowable voltage drop: 2%

According to the datasheet of AC cable manufacturer = current carrying capacity of 10 sqmm Copper cable is 45A in duct.

Ambient temperature correction factor(K1)= 0.95

Ground temperature correction factor (K2)= 1, in air only

Group factor for ground(K3)= 1, single run in air

Cable installation factor(K4)= 1

Cable grouping factor(K5)= 1

Derated cable current= 42.75A

**Hence cable selection is ok**

So, higher rated cable selected (**proposed cable will be routed through a flexible pipe**)

% Voltage Drop

$$\% Vd = \% Vd = \frac{I \times R \times L}{N \times V}$$

Where, Impedance=  $((R^2 + (\text{reactance-capacitance})^2)^{0.5})$

Cable resistance(Ohm)= 2.34 ohm/km

Cable reactance = 0.0837 ohm/km

Resultant Impedance $(R^2 + X^2)^{1/2} = 2.341$  ohm/km

L = length of the cable b/w Inverter & ACDB panel= 70mtr

V= Supply Voltage = 380 V

N = No. of runs =1

I = Load current = 18.99

Using the formula Voltage Drop = 0.82 %

**Hence cable selection is OK**

**ACDB to LT panel (single run 3.5 core 35 sq mm Copper cable)**

Inverter output current pass through ACDB, so output current of solar ACDB Panel = 113 A

According to the datasheet of AC cable manufacturer = current carrying capacity of 35 sqmm Copper cable is 132A in duct.

So same cable size i.e 35 sq mm Copper cable is suitable.

**Earthing Details:**

All the equipments will be connected to earth via 25X3 sqmm GI Earth Strip & dedicated chemical earthing will be provided for Solar Module, structure, Inverter & ACDB. Elaboration on earthing connection is given in the earthing layout also.



## Fire Fighting System-60 kW solar project

All the equipments to be installed at 60KW rooftop solar power plant are fire resistant, still to avoid any hindrance for fire incident in the premises, following measures have been taken except General firefighting arrangement of IOCL own arrangement for total premises.

- **DC & AC Disconnect Switch:** There will be disconnect switch for both ends as described in the SLD. It has been provided to de-energize the solar plant in case of fire or any hazardous incident.
- **Plumbing Network:** There will be plumbing network throughout the array yard with a pressure pump for module cleaning. Same can be used as firefighting purpose in case of any such incidents.
- **Fire Buckets:** There will be sand buckets with stand to be installed as a safety & precautionary measurement of firefighting.
- **Hose pipe of building:** There will be hose pipe point as a fire fighting measure & same can be used as a firefighting measure.
- **Fire Extinguisher:** There will be 3 types of fire extinguisher supplied & installed in the PV area.
  1. ABC type fire extinguisher.
  2. Foam type fire extinguisher.
  3. CO2 type fire extinguisher.

# MODULE CLEANING SYSTEM

Dirt built-up over the solar arrays can substantially affect system performance. It is essential to clean the modules regularly to maximize energy output from a solar power plant. However, wrong cleaning practices, bad quality water and use of inappropriate cleaning agent may damage modules and other array components and lower system performance as well. It is also essential to train the cleaning personnel on proper cleaning methods and use of appropriate cleaning tools.

Specific cleaning procedures will be based on module manufacturer's instructions, site condition, quality of water and cleaning mechanism used.

**Safety of personnel:** Solar modules are connected in series and it generates upto 1000V DC. Cracks in modules or damaged cable or joints in a string are extremely dangerous for cleaning person particularly when the modules are wet. Even during low level of sunlight the array will generate lethal voltage and current. Therefore, it is important to inspect modules thoroughly for cracks, damage, and loose connections before cleaning.

## Important Parameter:

**Cleaning time:** The recommended time for cleaning modules is during low light conditions when production is lowest. The best time to clean modules is from dusk to dawn when the plant is not in operation and risk of electrical shock hazard is minimum.

**Quality of water:** De-ionized water should be used to clean the modules. If de-ionized water is not available, rainwater or tap water can be used. Tap water must be of low mineral content with total hardness less than 75ppm. In case mineral content of water used is more than 75ppm but less than 200ppm the water must be squeezed off to prevent scale build up over module surface. Water with mineral content of more than 200ppm should NOT be used. Water must be free from grit and physical contaminants that could damage the panel surface.

**Use of cleaning agent:** A mild, non-abrasive, non-caustic detergent with deionized water may be used. Abrasive cleaners or de-greasers should not be used. Acid or alkali detergent must not be used.

**Removing stubborn marks:** To remove stubborn dirt such as birds dropping, dead insects, tar etc., use a soft sponge, micro-fiber cloth or non-abrasive brush. Rinse the module immediately with plenty of water.

**Water temperature:** Temperature of water used for cleaning should be same as ambient temperature at the time of cleaning. Cleaning should be carried out when the modules are cool to avoid thermal shock which can potentially cause cracks on the modules.

## Process:

**Pump Installation:** First finalize the location for pump installation. It should be nearest to water supply. Installation procedure as follow:

1. Checking whether the pump and accessories are complete and have not been damage during transport.
2. Checking whether the foundation is in compliance with the foundation plan.
3. Placing the pump on the foundation and inserting the anchor bolts.
4. Aligning the pump.
5. Grouting the anchor bolt holes in the foundation.
6. Tightening the anchor bolts after setting the motar.
7. Grouting the baseplate/frame/ foundation ring with motar.
8. Positioning the piping ready for connection.

9. Checking and verifying that the piping connections are not subject to stresses or strains.
10. Re-aligning the pipe connection, if required.
11. Checking the rework defined under 10.
12. Connecting the piping to the pump.
13. Precision alignment of the coupling and completing as per datasheet.
14. Inspection and acceptance of the coupling alignment.
15. Making the pump ready for operation filling in oil and checking shaft seal.
16. Connecting the power supply cable (if required, uncouple motor beforehand)
17. Checking the direction of rotation of the motor, electrical preparation carried out by customer.
18. Connecting the electric motor to the pump, fitting the coupling guard.
19. Final installation inspection and commissioning.

**Routing Plan:** Measure the distance between pump to solar module. Identifying the rout of pipe and select the pipe gauge with proper accessories as well.

**Pipe Fitting:** Different size of pipe is used for this system depending upon the distance. Maintaining the water pressure delivery pipe install with proper valve, reducer, nozzle. Checking the alignment of pipe and inspection properly.

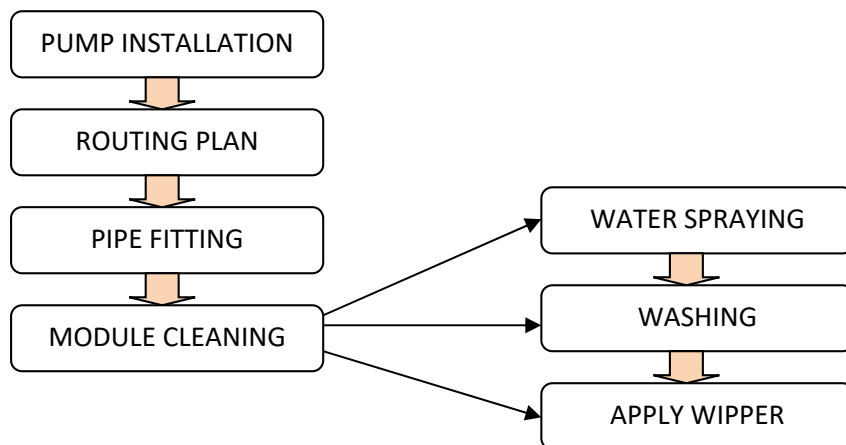
**Module Cleaning:** If there are colored substances such as bird droppings, plant juices, etc., on the module surface, or dust that cannot be whisked off due to high indoor humidity, the colored substances need to be removed by cleaning. The colored substances are generally removed with clean water by spraying the clean water onto the region with pollutants and scraping with a hair brush. After cleaning of module with water, wipe the water properly from the module surface by a wiper or rubber squeegee, Wipe the module surface from the top downwards to remove any residual water from the panel glass, but pay attention that any leftover grains of dirt or sand do not scratch the surface of the panel.

#### **DO & DON'TS**

- Do ensure proper handling of module
- Do not use high pressure water jet for cleaning
- Do not use cold water when the module glass temperature is high. Glass surface Temperature and the water temperature can result in fracturing or breaking of the glass.
- Do not use hot water to clean cold panel. Glass surface temperature and the Water temperature can result in fracturing or breaking of the glass.
- Do not clean with bare hands. Clean after wearing gloves.
- Do not use harmful chemicals for solar panel cleaning.
- Don't use tools like Knife, Blade, Wire brush etc. for cleaning.
- Don't stand on the panels for cleaning.
- Do not wear metal accessories such as jewellery, watches etc. while cleaning the modules
- Never spray the water on broken module, it will give electric shock.
- Keep hand and Body clear when operating module cleaning Machine, Always Maintain a safe distance from Moving parts.
- Wear rubber sole shoes with good grip to prevent slip and falls.

- When working at heights, use fall safe and personal protection measures throughout the cleaning process.
- If cleaning solar modules from the ground is not possible, do not attempt to access your rooftop or ground mounted panel unless you have the appropriate safety equipment and training.
- Spraying cleaning water on junction box, cable tray, combiner box etc. is strictly prohibited.
- Never at any point stand on, walk on, lean on or apply pressure to the panels as this can cause both visible and non-visible damage to the panel.
- The use of pressure or steam cleaners and high pressure hoses, knives, blades and metallic sponges is not permitted.

## PROCESS AT A GLANCE



### DESIGN CONSIDERATION

#### ➤ Ares of solar system to be cleaned

Total No. of solar modules to be installed = 182

Area of each module =  $1.95 \times 0.99 = 1.93$  sqmtr

Total area of solar module =  $1.93 \times 182 = 351.26$  sqmtr

#### ➤ Water requirement for cleaning of solar module

Consider Data,

One no. of solar module will require 3 ltrs of water for complete cleaning

Quantity of water required for complete cleaning of each cycle =  $3 \times 182 = 546$  ltr = 0.546

Cmtr

**Total 4 cycles required for each month in an interval of one week**

Water requirement for each month =  $4 \times 546 = 2184 \text{ ltr} = 2.184 \text{ cmtr}$

➤ **Time Period for cleaning**

Cleaning of a solar module will take 0.5 minutes of time at an average

Total time required = 180 minutes = 3 hours

➤ **Design of piping system**

➤ Capacity of Pump has been considered as 0.5 HP Centrifugal Pressure Pump

**As per the datasheet of the Pressure Pump,**

Discharge rate of the water after a head of 20 mtr = 20 ltr/min

$$= 0.02 \text{ m}^3/\text{min}$$

$$= 1.2 \text{ m}^3/\text{hour}$$

$$\text{Area of the pipe} = 0.36 / (1.5 \times 3600) = 0.0000333$$

Now, to calculate the diameter of the pipe @ Velocity of 1.5m/sec

$$\text{Area of the pipe} = 1.8 / (1.5 \times 3600) = 0.000333 \text{ m}^2$$

$$\text{Area of the pipe (A)} = \pi * (D/2)^2$$

Where, D = Diameter of the pipe in (m)

$$\text{Therefore, D} = 0.020$$

$$= 20.5 \text{ mm}$$

$$\text{Dia. Of the Pipe to be provide} = \mathbf{25 \text{ mm}}$$

Reducer considered = **19 mm**

## Grid-Connected System: Simulation parameters

**Project :** **IOCL-Sitarganj**

<b>Geographical Site</b>	<b>R mpura</b>	Country	<b>India</b>	
<b>Situation</b>	Latitude	28.92° N	Longitude	79.70° E
Time defined as	Legal Time	Time zone UT+5.5	Altitude	205 m
	Albedo	0.20		
<b>Meteo data:</b>	<b>R mpura</b>	Meteonorm 7.2 (1981-2010), Sat=100% - Synthetic		

**Simulation variant :** **New simulation variant**

Simulation date 25/02/20 13h22  
**Simulation for the 1st year of operation**

<b>Simulation parameters</b>	System type	<b>No 3D scene defined, no shadings</b>	
<b>Collector Plane Orientation</b>	Tilt	21°	Azimuth 0°
<b>Models used</b>	Transposition	Perez	Diffuse Perez, Meteonorm
<b>Horizon</b>	Free Horizon		
<b>Near Shadings</b>	No Shadings		
<b>User's needs :</b>	Unlimited load (grid)		

### PV Arrays Characteristics (2 kinds of array defined)

<b>PV module</b>	Si-poly	Model	<b>WS-330</b>		
Custom parameters definition	Manufacturer	Waaree			
<b>Sub-array "Sub-array #1"</b>					
Number of PV modules	In series	19 modules	In parallel	8 strings	
Total number of PV modules	Nb. modules	152	Unit Nom. Power	330 Wp	
Array global power	Nominal (STC)	<b>50.2 kWp</b>	At operating cond.	44.4 kWp (50°C)	
Array operating characteristics (50°C)	U mpp	641 V	I mpp	69 A	
<b>Sub-array "Sub-array #2"</b>					
Number of PV modules	In series	15 modules	In parallel	2 strings	
Total number of PV modules	Nb. modules	30	Unit Nom. Power	330 Wp	
Array global power	Nominal (STC)	<b>9.90 kWp</b>	At operating cond.	8.74 kWp (50°C)	
Array operating characteristics (50°C)	U mpp	502 V	I mpp	17 A	
<b>Total</b>	Arrays global power	Nominal (STC)	<b>60 kWp</b>	Total	182 modules
		Module area	<b>353 m<sup>2</sup></b>		

<b>Sub-array "Sub-array #1" : Inverter</b>	Model	<b>SE-TH 50.0 TL3</b>		
Original PVsyst database	Manufacturer	G P Tronics		
Characteristics	Operating Voltage	200-980 V	Unit Nom. Power	50.0 kWac
			Max. power (=>25°C)	55.0 kWac
Inverter pack	Nb. of inverters	4 * MPPT 25 %	Total Power	50 kWac
			Pnom ratio	1.00

<b>Sub-array "Sub-array #2" : Inverter</b>	Model	<b>12 kWac inverter with 2 MPPT</b>		
Original PVsyst database	Manufacturer	Generic		
Characteristics	Operating Voltage	350-600 V	Unit Nom. Power	12.0 kWac
Inverter pack	Nb. of inverters	1 units	Total Power	12.0 kWac
			Pnom ratio	0.83

<b>Total</b>	Nb. of inverters	2	Total Power	62 kWac
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### PV Array loss factors



### Grid-Connected System: Simulation parameters

Array Soiling Losses

Average loss Fraction 3.0 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%

Thermal Loss factor	Uc (const)	20.0 W/m <sup>2</sup> K	Uv (wind)	0.0 W/m <sup>2</sup> K / m/s
Wiring Ohmic Loss	Array#1	159 mOhm	Loss Fraction	1.5 % at STC
	Array#2	494 mOhm	Loss Fraction	1.5 % at STC
	Global		Loss Fraction	1.5 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	3.0 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Strings Mismatch loss			Loss Fraction	0.10 %
Module average degradation	Year no	1	Loss factor	0.4 %/year
Mismatch due to degradation	Imp RMS dispersion	0.4 %/year	Vmp RMS dispersion	0.4 %/year
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05
System loss factors	Wires: 3x35.0 mm <sup>2</sup>	20 m	Loss Fraction	0.4 % at STC
Unavailability of the system	7.3 days, 3 periods		Time fraction	2.0 %
Auxiliaries loss	constant (fans)	200 W	... from Power thresh.	0.0 kW

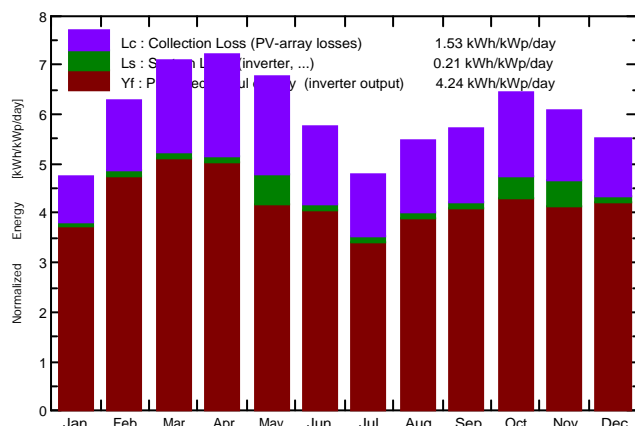
### Grid-Connected System: Main results

**Project :** IOCL-Sitarganj  
**Simulation variant :** New simulation variant  
 Simulation for the 1st year of operation

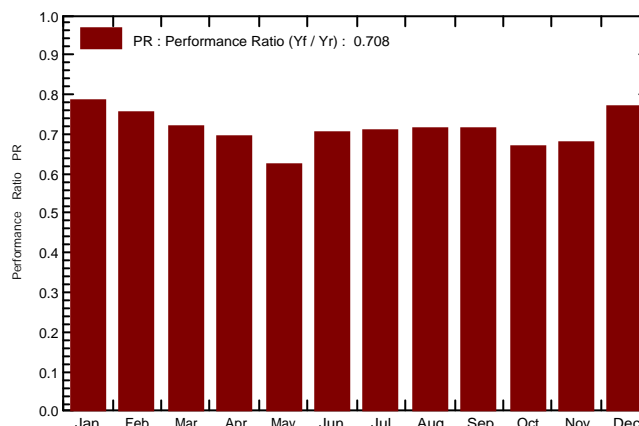
<b>Main system parameters</b>	System type	<b>No 3D scene defined, no shadings</b>		
PV Field Orientation	tilt	21°	azimuth	0°
PV modules	Model	WS-330	Pnom	330 Wp
PV Array	Nb. of modules	182	Pnom total	<b>60.1 kWp</b>
Inverter	Model	SE-TH 50.0 TL3	Pnom	50.0 kW ac
Inverter	Model	12 kWac inverter with 2 MPPT		12.00 kW ac
Inverter pack	Nb. of units	2.0	Pnom total	<b>62.0 kW ac</b>
User's needs	Unlimited load (grid)			

**Main simulation results**  
 System Production **Produced Energy 92.97 MWh/year** Specific prod. 1548 kWh/kWp/year  
 Performance Ratio PR **70.81 %**

Normalized productions (per installed kWp): Nominal power 60.1 kWp



Performance Ratio PR



New simulation variant  
 Balances and main results

	GlobHor kWh/m <sup>2</sup>	DiffHor kWh/m <sup>2</sup>	T_Amb °C	GlobInc kWh/m <sup>2</sup>	GlobEff kWh/m <sup>2</sup>	EArray MWh	E_Grid MWh	PR
January	110.7	41.8	13.86	147.8	139.4	7.140	6.959	0.784
February	138.8	34.1	17.74	176.0	166.7	8.164	7.967	0.754
March	191.1	44.0	23.75	220.2	208.5	9.763	9.534	0.721
April	207.1	65.0	29.61	216.4	204.4	9.261	9.036	0.695
May	214.0	91.6	33.16	209.3	197.1	8.898	7.811	0.621
June	181.6	103.0	32.48	172.7	162.1	7.519	7.305	0.704
July	154.9	94.9	31.59	148.8	139.5	6.550	6.345	0.710
August	168.7	89.2	30.47	169.6	159.3	7.479	7.267	0.714
September	158.3	72.3	28.97	171.6	161.5	7.587	7.386	0.716
October	164.2	42.6	26.17	200.4	189.9	8.852	8.038	0.668
November	134.1	26.4	20.24	182.9	173.0	8.379	7.436	0.677
December	119.1	27.4	15.50	170.5	161.1	8.076	7.885	0.770
Year	1942.7	732.3	25.33	2186.2	2062.5	97.669	92.970	0.708

Legends: GlobHor Horizontal global irradiation  
 DiffHor Horizontal diffuse irradiation  
 T\_Amb Ambient Temperature  
 GlobInc Global incident in coll. plane  
 GlobEff Effective Global, corr. for IAM and shadings  
 EArray Effective energy at the output of the array  
 E\_Grid Energy injected into grid  
 PR Performance Ratio

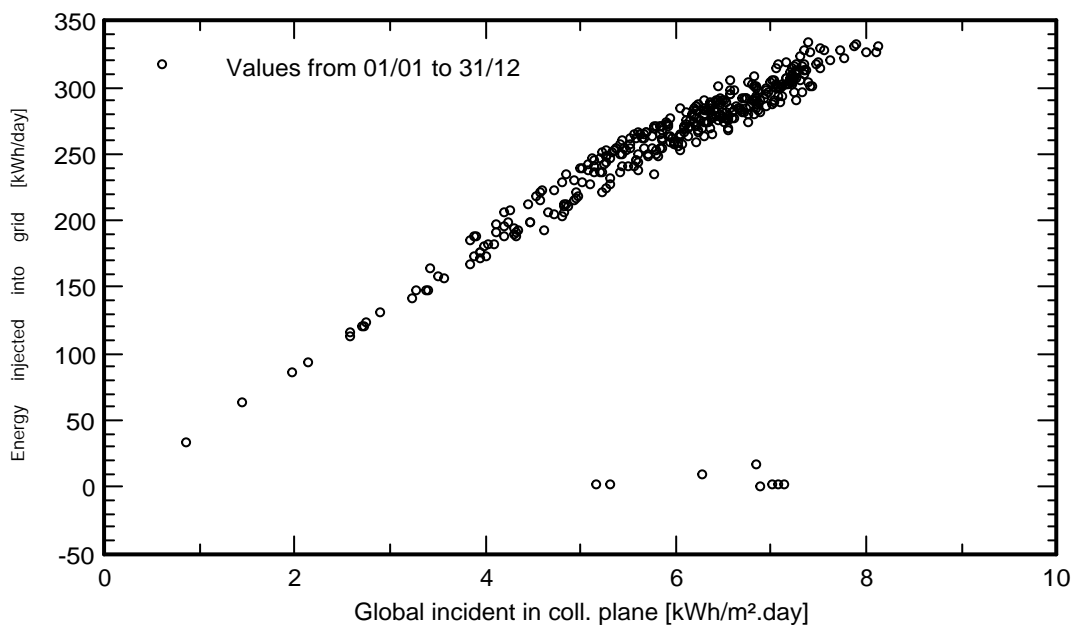
## Grid-Connected System: Special graphs

**Project :** IOCL-Sitarganj  
**Simulation variant :** New simulation variant  
 Simulation for the 1st year of operation

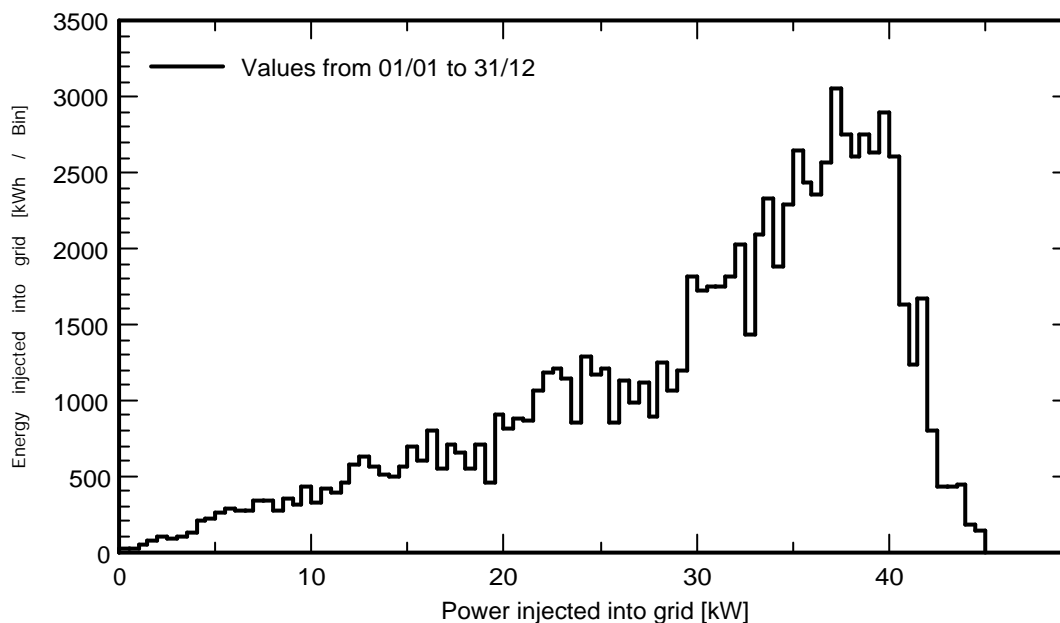
**Main system parameters**

	System type	<b>No 3D scene defined, no shadings</b>	
PV Field Orientation	tilt	21°	azimuth 0°
PV modules	Model	WS-330	Pnom 330 Wp
PV Array	Nb. of modules	182	Pnom total <b>60.1 kWp</b>
Inverter	Model	SE-TH 50.0 TL3	50.0 kW ac
Inverter	Model	12 kWac inverter with 2 MPPT	12.00 kW ac
Inverter pack	Nb. of units	2.0	Pnom total <b>62.0 kW ac</b>
User's needs	Unlimited load (grid)		

### Daily Input/Output diagram



### System Output Power Distribution

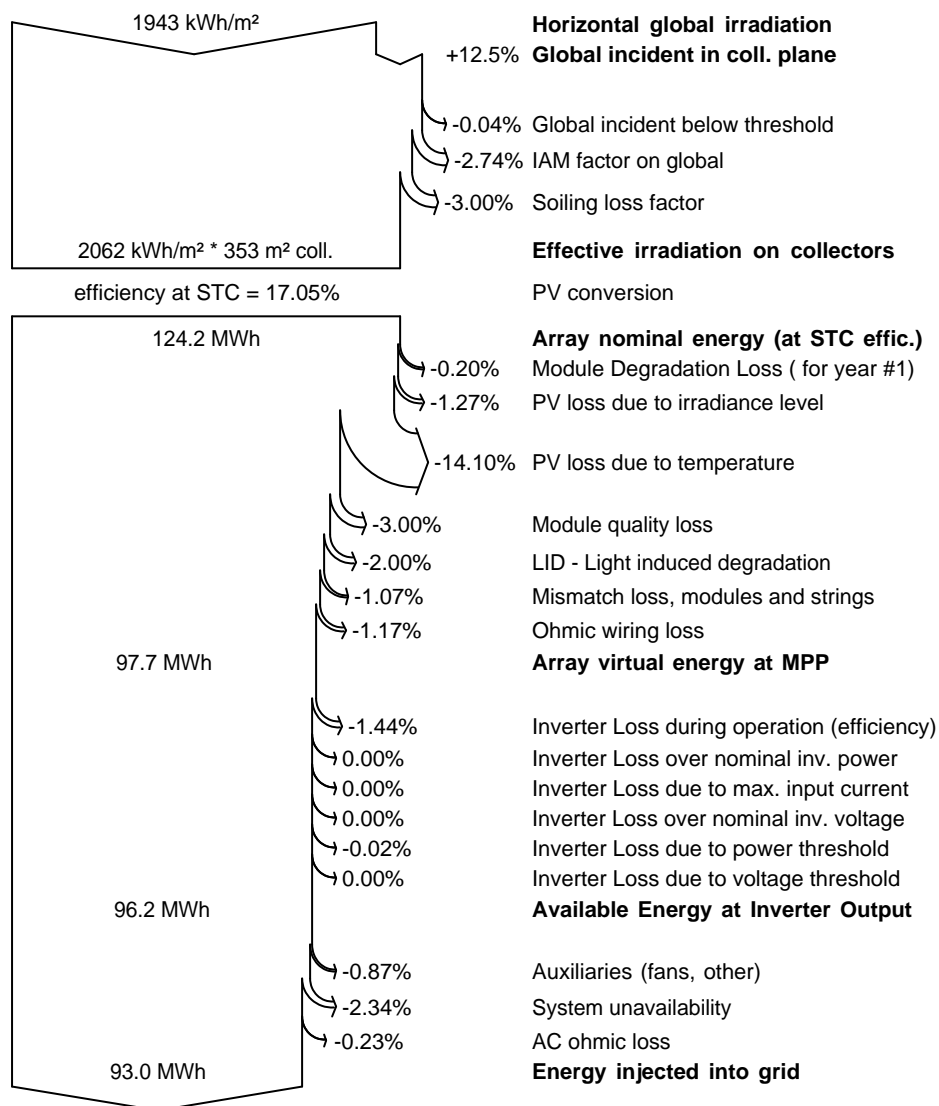


## Grid-Connected System: Loss diagram

**Project :** IOCL-Sitarganj  
**Simulation variant :** New simulation variant  
 Simulation for the 1st year of operation

<b>Main system parameters</b>	System type	<b>No 3D scene defined, no shadings</b>	
PV Field Orientation	tilt	21°	azimuth 0°
PV modules	Model	WS-330	Pnom 330 Wp
PV Array	Nb. of modules	182	Pnom total <b>60.1 kWp</b>
Inverter	Model	SE-TH 50.0 TL3	50.0 kW ac
Inverter	Model	12 kWac inverter with 2 MPPT	12.00 kW ac
Inverter pack	Nb. of units	2.0	Pnom total <b>62.0 kW ac</b>
User's needs	Unlimited load (grid)		

### Loss diagram over the whole year



## Grid-Connected System: P50 - P90 evaluation

**Project :** IOCL-Sitarganj  
**Simulation variant :** New simulation variant  
 Simulation for the 1st year of operation

Main system parameters	System type	No 3D scene defined, no shadings	
PV Field Orientation	tilt	21°	azimuth 0°
PV modules	Model	WS-330	Pnom 330 Wp
PV Array	Nb. of modules	182	Pnom total <b>60.1 kWp</b>
Inverter	Model	SE-TH 50.0 TL3	50.0 kW ac
Inverter	Model	12 kWac inverter with 2 MPPT	12.00 kW ac
Inverter pack	Nb. of units	2.0	Pnom total <b>62.0 kW ac</b>
User's needs	Unlimited load (grid)		

### Evaluation of the Production probability forecast

The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices:

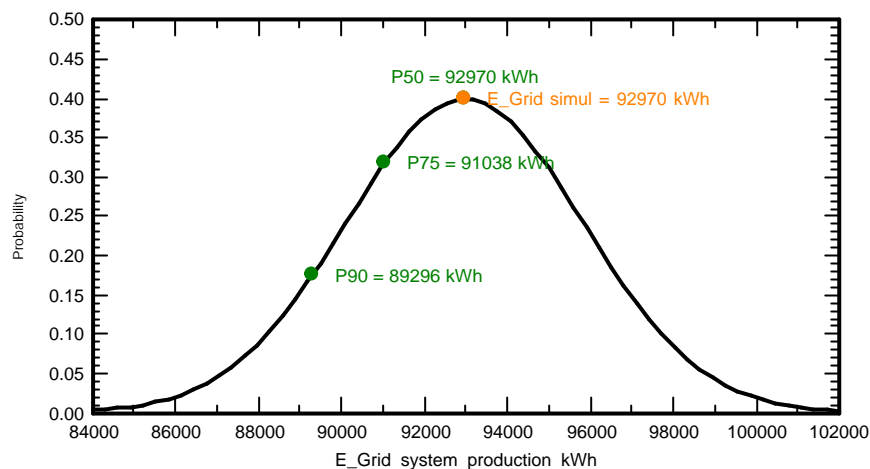
Meteo data source	Meteonorm 7.2 (1981-2010), Sat=100%		
Meteo data	Kind	Not defined	Year 1995
Specified Deviation	Year deviation from aver.	3 %	
Year-to-year variability	Variance	2.5 %	

The probability distribution variance is also depending on some system parameters uncertainties

Specified Deviation	PV module modelling/parameters	1.0 %	
	Inverter efficiency uncertainty	0.5 %	
	Soiling and mismatch uncertainties	1.0 %	
	Degradation uncertainty	1.0 %	
Global variability (meteo + system)	Variance	3.1 %	(quadratic sum)

Annual production probability	<b>Variability</b>	<b>2.87 MWh</b>
	<b>P50</b>	<b>92.97 MWh</b>
	<b>P90</b>	<b>89.30 MWh</b>

**Probability distribution**



# WattmonMINI2

Remote Monitoring & Control Solution



## Specifications

### Communication

- RS-485 Modbus RTU port for communication with up to 5 Slaves
- Modbus TCP Client mode for communication with up to 5 Servers
- Modbus TCP Server mode to interface with SCADA systems

### Power

- Input voltage range: 8-24V DC
- Low Power Consumption of < 2 Watts

### Network

- 100 Mbit Ethernet
- 3G and 4G LTE (via external USB Stick)

### Storage

- 512 KB RAM
- 16 GB MicroSD Card

### Data Collection & Export

- CSV format
- HTTP / HTTPS / FTP / SFTP / MQTT / MQTTS

## Applications

- **Inverter Monitoring**  
Inspect generation and efficiency of grid-tie and hybrid inverters
- **AC Power Monitoring**  
Supervise load and performance of substations and mini-grids
- **Weather Station Monitoring**  
Observe irradiation, temperature and other atmospheric conditions
- **Zero Feed-In & DG Protection**  
Reduce active output power of multiple inverters to regulate energy generation

## Characteristics

Cover Material	ABS (Light Gray)
Base Material	Nylon (Light Gray)
Degree of Protection	IP20 (Finger Protected)
Operating Temperature	0-60 °C
DIN Standard Mount	EN 60 715 TS35, TS15,G32
Dimensions (L x W x H)	134 x 40 x 90 mm
Weight	160 g

## Introduction

The Wattmon hardware and software platform is the most flexible in the industry. It can be used for monitoring Grid-Tie, Hybrid and Off-Grid setups, Solar Water Pumping, Building Loads, and features a Zero Feed-In and DG Protection solution that is compatible with leading manufacturers.

The WattmonMINI2 is a Modbus Master (Client in Modbus TCP) that can interface with up to 5 RTU Slaves and 5 TCP Servers. It may also be configured as a Modbus TCP Server to interface with a SCADA system. A quick configuration tool allows for the setting up of the device for a range of inverters, energy meters and sensors.

It supports the following data types:

- IEEE754 Float (Big and Little Endian)
- INT32 (Big and Little Endian)
- UINT32 (Big and Little Endian)
- INT16

## Benefits

- **Versatile**  
Configurable by anyone using the built-in *EZConfig* function
- **Multilingual**  
Features an interface in English, Español, Deutsch, Français, हिन्दी, தமிழ்
- **Remotely Accessible**  
Log into the device remotely through the Wattmon Proxy server using a 3G/4G USB dongle or via Ethernet
- **Industry Compliant**  
Integrate new and existing devices over Modbus RTU/TCP with the on-board device driver creator
- **Local Storage**  
Securely store several years worth of data locally in CSV format and control who can view it
- **Programmable**  
Write scripts in the built-in editor using the uPHP language or the *Visual Script Builder*

## Zero Feed-In & DG Protection

The Wattmon Power Control Solution can throttle the active power output of inverters on sites with no Net Metering or with Diesel Generators, securing against grid export or reverse-feeding and over-frequency damage. The supported brands are :

- ABB
- Delta
- Emerson
- Fronius
- Goodwe
- Growatt
- Huawei
- Ingeteam
- Kaco
- Kstar
- Polycab
- Refusol
- SofarSolar
- Schneider
- SMA
- SolarEdge
- Solis Ginlong
- Sungrow
- Zegersolar
- *and more...*

## Energy Monitoring Solution (EMS)

The WattmonMINI2 is capable of storing several years worth of data on the MicroSD card. It can also upload the logged data to the Wattmon Energy Monitoring Solution (EMS), a highly customizable cloud portal that displays real-time data in the form of graphs and widgets, allowing users to select the parameters they wish to monitor, and create separate accounts for individual clients.

## Conformity

Emissions	
Electrostatic Discharge	
Electrical Fast Transient	
Surge Immunity	

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605 101 Tamil Nadu, India  
Phone: +91 413 262 2059  
Website: <http://www.wattmon.com>

What a  
**SOLAR INVERTER**  
aspires to be ...



IMPROVING LIVELIHOOD WITH SUSTAINABLE ENERGY.



## ABOUT THEA

### Thea Solar Inverters.. State of Art Technology backed by a Country Wide Support Network

Thea Energy Pvt Ltd has been promoted by a team of Technocrats having decades of experience in the Power Electronics Industry. With a group team strength of more than 600, mostly engineers, we take pride in having successfully promoted multiple Brands in the Power Industry over the years. We have offices all across the country to support thousands of our customers and are respected for customer services in the power industry.

The promoters have always endeavored to offer a product with unmatched quality and backed by a very reliable and prompt service network. THEA Grid Connected Solar Inverters shall raise the benchmark in the Indian Renewable Energy sector and offer the most fulfilling user experience right from design of the Solar plant, optimal performance and the best in class post sales support practice. THEA Inverters are being produced at an ISO 9001 - 2015 and 14001 - 2009 certified green factory at Kolkata, India, the carbon neutral factory uses captive solar power to produce and test its entire production range.



## USP

- Elite team of THEA has experience of over 2 decades & 150MW of Solar Projects across the country.
- We offer solutions as a package, so relax leave the optimization to us
- PAN India sales & service network.
- Widest range of product portfolio in industry..... 2kW - 60kW range
- Most inverters with multiple MPPT to ensure enhanced generation at any site condition making the project more economically viable.
- Inbuilt DC & AC side protection through SPDs, Type II and fuses (check model).
- Inbuilt string level monitoring (check model).
- All Inverters are Bluetooth enabled for easiest configuration, software upgrades & data download.
- Use our app theatouch for the fastest and easiest configuration, remote monitoring and firmware updates.
- Cast Aluminum body combines robustness with appealing looks with omission of moving components like fan in most of the models thereby ensuring high reliability factor.
- All our products are made with Tier A components for the highest reliability

Model	SE-TH 2.0 TL1	SE-TH 3.0 TL1	SE-TH 5.0 TL1
<b>EFFICIENCY</b>			
Max. Efficiency	97.80%	97.80%	98.00%
<b>INPUT(DC)</b>			
Max. Input Power	2,200W	3,300W	5,500W
Max. Input Voltage	600V	600V	600V
Max. Input Current	12.5A	12.5A	20.8A (2*10.4A)
Start Operating Voltage / MPPT Voltage Range	90V/70V-580V	90V/70V-580V	90V/70V-580V
MPPT Operating Voltage Range (Full-Load)	200V-520V	240V-520V	240V-520V
No. of MPPT/ String per MPPT	1/1	1/1	2/2
<b>OUTPUT(AC)</b>			
Rated AC Active Power	2,000W	3,000W	5,000W
Max. AC Apparent Power	2,100VA	3,150VA	5,250VA
Max. AC Active Power (PF=1)	2,100W	3,150W	5,250W
Max. AC Output Current	9.5A	14.3A	23.6A
Rated AC Voltage with Voltage Range	230V (+/- 20%)	230V (+/- 20%)	230V (+/- 20%)
Rated Grid Frequency	50Hz	50Hz	50Hz
THDI	<3%	<3%	<3%
DC Current Injection	<0.5In	<0.5In	<0.5In
Adjustable Power Factor	> 0.99 Rated power (adjustable range 0.8 lead - 0.8 lag)		
<b>PROTECTION</b>			
(i) Input DC switch (ii) Anti-islanding protection (iii) AC overcurrent protection (iv) AC short circuit protection (v) DC reverse connection (vi) AC & DC surge protection (vii) Insulation resistance detection (viii) Leakage current detection			
<b>GENERAL</b>			
Topology	Transformerless		
IP Rating	IP65		
Cooling	Natural cooling		
Operating Temperature Range	-25°C to 60°C		
Relative Humidity Range	0-100%		
Max. Operating Altitude	4000m		
Noise	<25dB		
Dimensions (W*H*D)	285 mm* 336 mm*125 mm	335mm*426mm*125mm	
Weight	8.8KG	12.8KG	
<b>HMI &amp; COM</b>			
Display	Blue-tooth & LED indicator		
Communication	RS485(optional), WIFI (optional), GPRS(optional)		
<b>CERTIFICATION</b>			
Safety	IEC61727, IEC62116, IEC62109		
Indian Certifications	IEC61683, IEC60068		

Model	SE-TH 6.0 TL3	SE-TH 10.0 TL3	SE-TH 15.0 TL3
<b>EFFICIENCY</b>			
Max. Efficiency	98.00%	98.30%	98.40%
<b>INPUT(DC)</b>			
Max. Input Power	7,200W	12,000W	18,000W
Max. Input Voltage		1000V	
Max. Input Current	2 x 11A	2 x 11A	(11A + 2x11A)
Start Operating Voltage / MPPT Voltage Range		200V,160V-850V	
MPPT Operating Voltage Range (Full-Load)	300V-800V	470V-800V	470V-800V
No. of MPPT/ String per MPPT	2/(1/1)	2/(1/1)	2/(1/2)
<b>OUTPUT(AC)</b>			
Rated AC Active Power	6,000W	10,000W	15,000W
Max. AC Apparent Power	6,600VA	11,000VA	16,500VA
Max. AC Active Power (PF=1)	6,600W	11,000W	16,500W
Max. AC Output Current	10A	16A	23A
Rated AC Voltage		400V (+/- 20%)	
Rated Grid Frequency		50Hz	
THDI		<3%	
DC Current Injection		<0.5%In	
Adjustable Power Factor	> 0.99 Rated power (adjustable range 0.8 lead - 0.8 lag)		
<b>PROTECTION</b>			
(i) Input DC switch (ii) Anti-islanding protection (iii) AC overcurrent protection (iv) AC short circuit protection (v) DC reverse connection (vi) AC & DC surge protection (vii) Insulation resistance detection (viii) Leakage current detection (ix) PV string fault detection			
<b>GENERAL</b>			
Topology	Transformerless		
IP Rating	IP65		
Cooling	Natural cooling		
Operating Temperature Range	-25°C to 60°C		
Relative Humidity Range	0-100%		
Max. Operating Altitude	4000m		
Noise	<25dB		
Dimensions (W*H*D)	385mm x 490mm x 190mm		
Weight	19.8kg	19.8kg	21kg
<b>HMI &amp; COM</b>			
Display	Blue-tooth & LED indicator, LCD		
Communication	RS485, WIFI (optional), GPRS (optional)		
<b>CERTIFICATION</b>			
Safety	IEC61727, IEC62116, IEC62109		
Indian Certifications	IEC61683, IEC60068		

Model	SE-TH 20.0 TL3	SE-TH 33.0 TL3
<b>EFFICIENCY</b>		
Max. Efficiency	98.80%	98.90%
<b>INPUT(DC)</b>		
Max. Input Power	24,000W	33,800W
Max. Input Voltage	1000V	1000V
Max. Input Current	69A (3 x 23A)	69A (3 x 23A)
Start Operating Voltage / MPPT Voltage Range	250V/200V-950V	250V/200V-950V
MPPT Operating Voltage Range (Full-Load)	480V-850V	480V-850V
No. of MPPT/ String per MPPT	3/(2/2/2)	3/(2/2/2)
<b>OUTPUT(AC)</b>		
Rated AC Active Power	20,000W	30,000W
Max. AC Apparent Power	22,000VA	33,000VA
Max. AC Active Power (PF=1)	22,000W	33,000W
Max. AC Output Current	32A	48A
Rated AC Voltage	400V (+/- 20%)	
Rated Grid Frequency	50Hz/60Hz	
THDI	<3%	
DC Current Injection	<0.5In	
Adjustable Power Factor	> 0.99 Rated power (adjustable range 0.8 lead - 0.8 lag)	
<b>PROTECTION</b>		
(i) Input DC switch (ii) Anti-islanding protection (iii) AC overcurrent protection (iv) AC short circuit protection (v) DC reverse connection (vi) AC & DC surge protection SPD type II (vii) Insulation resistance detection (viii) Leakage current detection (ix) PV string fault detection		
<b>GENERAL</b>		
Topology	Transformerless	
IP Rating	IP65	
Cooling	Natural cooling	
Operating Temperature Range	-25°C to 60°C	
Relative Humidity Range	0-100%	
Max. Operating Altitude	4000m	
Noise	<30dB	
Dimensions (W*H*D)	550mm x 715mm x 284mm	
Weight	53kg	53kg
<b>HMI &amp; COM</b>		
Display	Blue-tooth & LED indicator, LCD	
Communication	RS485, Inbuilt string monitoring, WIFI (optional), GPRS (optional)	
<b>CERTIFICATION</b>		
Safety	IEC61727, IEC62116, IEC62109	
Indian Certifications	IEC61683, IEC60068	

Model	SE-TH 50.0 TL3	SE-TH 60.0 TL3
<b>EFFICIENCY</b>		
Max. Efficiency	98.50%	98.50%
<b>INPUT(DC)</b>		
Max. Input Power	60,000W	72,000W
Max. Input Voltage	1100V	1100V
Max. Input Current	110A (33A/33A/22A/22A)	132A (33A/33A/33A/33A)
Start Operating Voltage / MPPT Voltage Range	250V/200V-960V	250V/200V-960V
MPPT Operating Voltage Range (Full-Load)	620V-850V	620V-850V
No. of MPPT/ String per MPPT	4(3/3/2/2)	4(3/3/3/3)
<b>OUTPUT(AC)</b>		
Rated AC Active Power	50,000W	60,000W
Max. AC Apparent Power	55,000VA	66,000VA
Max. AC Active Power (PF=1)	55,000W	66,000W
Max. AC Output Current	83A	92A
Rated AC Voltage	400V (+/- 20%)	
Rated Grid Frequency	50Hz	
THDI	<3%	
DC Current Injection	<0.5%In	
Adjustable Power Factor	> 0.99 Rated power (adjustable range 0.8 lead - 0.8 lag)	
<b>PROTECTION</b>		
(i) Input DC switch (ii) Anti-islanding protection (iii) AC overcurrent protection (iv) AC short circuit protection (v) DC reverse connection (vi) AC & DC surge protection SPD type II (vii) Insulation resistance detection (viii) Leakage current detection (ix) GFCI protection (x) PV string fault detection (xi) String Fuse protection		
<b>GENERAL</b>		
Topology	Transformerless	
IP Rating	IP65	
Cooling	Intelligent convection	
Operating Temperature Range	-25°C to 60°C	
Relative Humidity Range	0-100%	
Max. Operating Altitude	4000m	
Noise	<50db	
Dimensions (W*H*D)	855mm x 555mm x 275mm	
Weight	65kg	67kg
<b>HMI &amp; COM</b>		
Display	Blue-tooth & LED indicator, LCD	
Communication	RS485, Inbuilt string monitoring, WIFI (optional), GPRS (optional)	
<b>CERTIFICATION</b>		
Safety	IEC61727, IEC62116, IEC62109	
Indian Certifications	IEC61683, IEC60068	

## MONITORING

The Smart Phone revolution is taking over the world. Apps are changing the way we interact with our customers, bankers, friends and the world. We decided to join in the revolution by changing the way we interact with our inverters.

Our engineers realized the dream developing thea touch a standalone app which revolutionizes your interaction with your Thea inverters.

The thea touch app is the MMI (man machine interface) between you and your thea inverters. This unique MMI allows you to connect to your Thea inverters either locally through Bluetooth or through the remote monitoring portal.

Locally over blue tooth you can see the live generation AC and DC Voltages, currents, fault status etc. You can even configure your inverter to change high/low voltage cut off, change the power factor of the inverters, reduce / increase power. Yes you can even download the history data of the Inverter, the fault status and update the firmware of your inverter.

The remote portal from the same app gives you access to the generation data and also in the near future will allow you to update firmware remotely. Control your solar Inverters from the remote portal with just a click of a button, real time generation of unique key send to your email ID ensures that there is no misuse by somebody else.

Easy monitoring through WIFI / BLUETOOTH / GPRS / RS 485 based Data Logger - yes we have all options available.

Enjoy the combination of thea touch and thea inverters - unleash the power of your solar PV power plant.



## PRODUCT RANGE



Registered Office:

**THEA ENERGY PVT. LTD.**

502 C Kamalalaya Centre, 156 A Lenin Sarani, Kolkata 700013

## CONTACT

mail to: [contact@thea-energy.com](mailto:contact@thea-energy.com)

Web: [www.thea-energy.com](http://www.thea-energy.com)



Ref : THEA/AVO/Technical Confirmation  
Dated : 06.04.2020

Switching AVO Electropower Limited  
Kolkata

Dear Sir,

With reference to your mail dated 03.04.2020 regarding technical queries request to note our replies pointwise –

1. No Load Losses – This is less than 1% for both SE-TH 10.0TL3 & SE-TH 50.0TL3 model.
2. Over capacity – Upto 150% of DC overload is allowed however inverter will limit output AC power to its rated capacity. This is applicable for both mentioned models.
3. Electromagnetic Compatibility – IEC 61000 is available for both models & attached separately.
4. Efficiency at different loads for both models –

Rated Load	10%	20%	50%	75%	100%
Efficiency for SE-TH 10.0TL3 model	96.61%	97.79%	98.27%	98.26%	98.22%
Efficiency for SE-TH 50.0TL3 model	97.4%	98.06%	98.47%	98.49%	98.34%

**Note –**

- (a) We have measured efficiency at 20% of rated load instead of 25%.
- (b) We have no data for efficiency measurement over 100% rated load. This is not required for solar inverter as per IEC 61683 norms.

5. Low Voltage – The voltage tolerance is +/- 30%. LVRT is available.

Thanking you  
Yours truly

Hirak Mitra  
(Authorized Signatory)



**G P Tronics Pvt. Ltd.**  
502 Kamalalaya Centre,  
156 A Lenin Sarani, Kolkata 700013  
West Bengal, India.  
Phone: +91 33 2215 4705 / 0301  
Fax: +91 33 2225 1273  
sales@gptronics.com  
www.gptronics.com

State Bank Of India  
Bank Account No.: 30290692186  
IFSC Code: SBIN0004833  
MICR Code: 700002197  
VAT: 19541160027  
CST: 19541160221  
PAN: AACCG1313K  
Service Tax: AACCG1313KST001



**C E R T I F I C A T E**  
of Conformity  
EC Council Directive 2014/30/EU  
Electromagnetic Compatibility

Registration No.: AE 50447685 0001

Report No.: 50295414 001

Holder: G P Tronics Pvt Ltd  
502 Kamalalaya Centre,  
156A Lenin Sarani Kolkata  
700013  
India

Product: PV-Inverter  
(Solar (PV) Grid Inverter)

Identification: Type Designation: SE-TH 6.0 TL3 SE-TH 10.0 TL3  
SE-TH 15.0 TL3  
Serial No.: n.a.  
Remark: Refer to above-listed test report for details.

Tested acc. to: EN 61000-6-1:2007  
EN 61000-6-2:2005  
EN 61000-6-3:2007+A1  
EN 61000-6-4:2007+A1

This certificate of conformity is based on an evaluation of a sample of the above mentioned product. Technical Report and documentation are at the Licence Holder's disposal. This is to certify that the tested sample is in conformity with all provisions of Annex I of Council Directive 2014/30/EU. This certificate does not imply assessment of the production of the product and does not permit the use of a TÜV Rheinland mark of conformity. The holder of the certificate is authorized to use this certificate in connection with the EC declaration of conformity according to the a.m. Directive.



Certification Body

Date 20.09.2019

Dipl.-Ing. Univ. S. O. Steinke

TÜV Rheinland LGA Products GmbH - Tillystraße 2 - 90431 Nürnberg

CE The CE marking may only be used if all relevant and effective EC Directives are complied with. CE

G P Tronics Pvt Ltd

Date : 20.09.2019  
Our ref. : AOFEL 02  
Your ref.:

502 Kamalalaya Centre,  
156A Lenin Sarani Kolkata  
700013  
India

**Ref : AE Certificate of Conformity EMC**

Type of Equipment : Solar (PV) Grid Inverter  
Model Designation : See Certificate  
Certificate No. : AE 50447685 0001  
Report No. : 50295414 001

Dear Ladies and Gentlemen,

We herewith confirm that a sample of the above mentioned technical equipment has been tested and was found to be in accordance with the relevant requirements.

Enclosed please find your Certificate of Conformity.

We appreciate your kind support and would like to offer our assistance and continuous services in the future.

With kind regards,

Certification Body

Dipl.-Ing. Univ. S. O. Steinke

Enclosure

证书的详细资料请登陆[www.certipedia.com](http://www.certipedia.com)查阅,或拨打我司客服热线800 999 3668 / 400 883 1300咨询





CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.

## ***Attestation of conformity***

**CERTIFICATE NO.: SET2019-03355**

**Product:** Solar (PV) Grid Inverter

**Model:** SE-TH 50.0 TL3, SE-TH 60.0 TL3

**Applicant:** G P Tronics Pvt. Ltd.

**Address:** 502 Kamalalaya Centre, 156A Lenin Sarani Kolkata 700013 India

This is to certify that, on the basis of the tests undertaken as per Report No. **SET2019-03355**, the submitted sample of the above item complies with:

EN 61000-6-2:2005

EN 61000-6-4-2007+A1:2011

and fulfils testing requirement of the EMC directive 2014/30/EU



Signed for and on behalf of

**CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.**

*Zhao Yanni*

Zhao Yanni, Vice Director



Date of Issue: Apr, 02, 2019

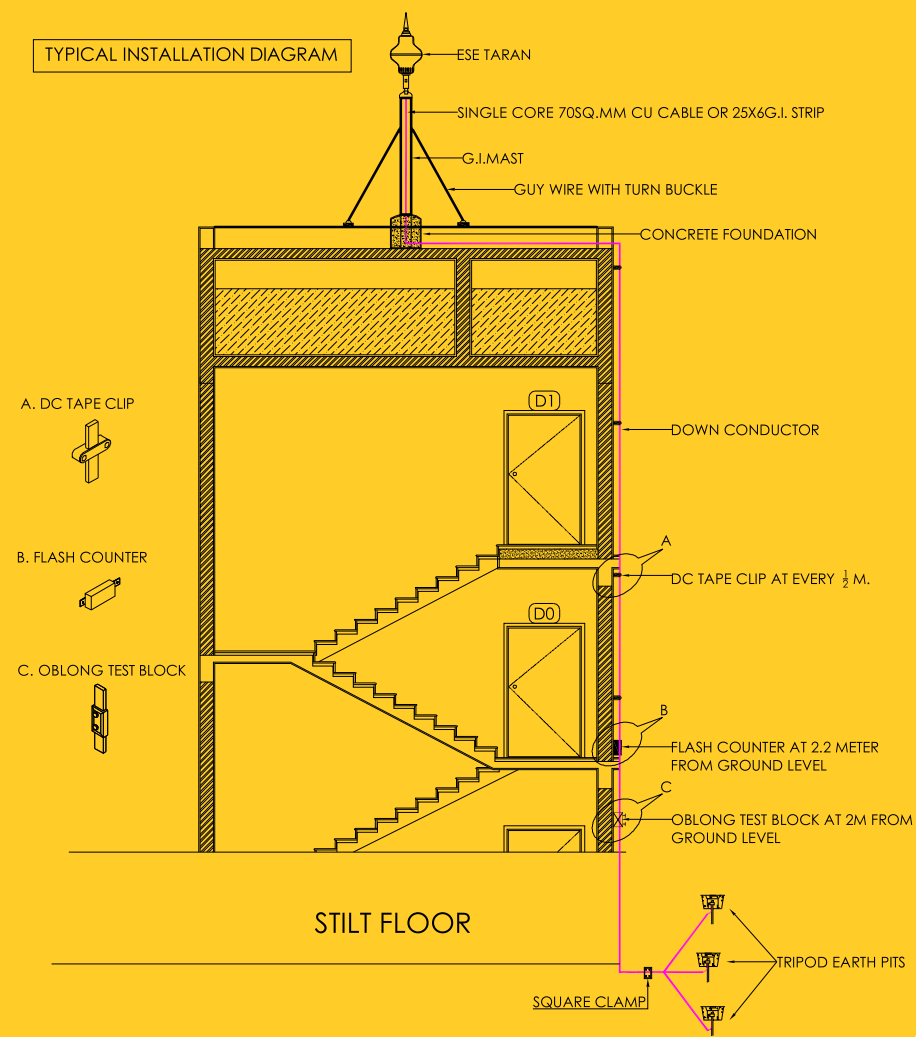
**CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.**

Electronic Testing Building, No. 43 Shahe Road, Xili Jiedao, Nanshan District, 518055

Shenzhen, Guangdong, China

Tel: 86-755-26627338 Fax: 86-755-26627238 <http://www.ccic-set.com>





Because so much is precious around us.

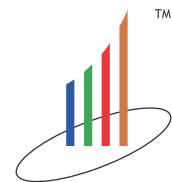


**SGI Engineers**

**A DUTY TO PROTECT**

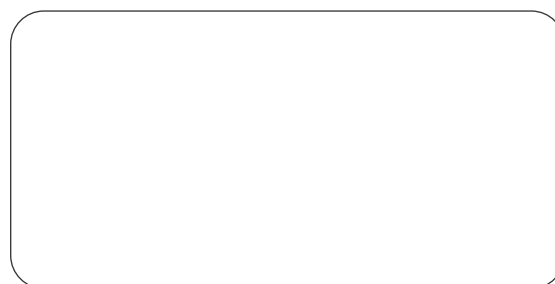
SGI Engineers Pvt. Ltd. has been at the helm of pushing the boundaries of earthing and lightning protection technology for over 15 years. Providing the very best in the design of these solutions, the Company is committed to managing all aspects of physical phenomena associated with lightning and electrical energy.

SGI Engineers partners its customers and associates in its long term goals to develop and build future viable technologies.



**SGI Engineers Pvt.Ltd.**  
 #1031/14, 1<sup>st</sup> & 2<sup>nd</sup> Floor, 39<sup>th</sup> Cross, 26<sup>th</sup> Main Road  
 4<sup>th</sup> 'T' Block, Jayanagar, Bengaluru - 560 041, Karnataka, India  
 Tel: +91 80 4121 0467, Fax: +91 080 4157 5792  
 Email : info@sgihouse.in, sgiindia@gmail.com  
 Website : www.sgihouse.in

Associate



**THE PROTECTION**

India's first indigenous lightning conductor adapted to Indian conditions. With French Standards



**STOP THE DANGER!**

# Lightning in thunderstorms are very serious threats to property and life.

According to statistics, more than 1900 lightning flashes occur every minute all over the earth's surface. The effect, when lightning strikes is devastating and irreversible! Owners are urged to strongly consider the merits of this brochure for their respective properties as the way to pre-empt 'an act of God'.



India's first indigenous lightning conductor adapted to Indian conditions. With French Standards

Designed as an active lightning conductor, Taran incorporates / emits a local electrostatic field that develops naturally around the shaft as a thunderstorm begins to gather.

When forked lightning descends, high - tension pulses are generated from an in-built triggering device at Taran's tip. This causes a 'corona effect'. As the downward leading shaft or lightning tracer approaches the ground, powerful upward streamers are triggered off in the Taran Lightning Protection System. This is aided by a strong 'Venturi Effect', inbuilt in Taran.

There is thus a quick a synchronization between downward (lightning bolt) and upward leaders (streamers from Taran), rendering the lightning harmless. Taran meets the Triggering Advance Timing (AT) as laid down by the French Standard NFC 17-102.

## Where is Taran useful?

Taran ESE Lightning Protection System is an absolute necessity where both human life and property are together in proximity. A single Taran conductor can protect several blocks. As such, it is highly recommended in:

- **Real Estate Complexes** - High Rise Towers/Buildings/Studio Complexes
- **Community Centres** - Schools/Malls/Education Complexes/Hotels/Hospitals
- **High Security Defense Area** - Air Force Station/Radars/Hangars/Airports/Infrastructures
- **Government/Public Sectors** - High Courts/Legislative Assemblies/Mints/Offices
- **Telecom/IT Complexes**
- **Power Sector** - Solar Power/Wind - Turbines, Sub Stations - Switch Yards
- **Industrial Plants** - Cement, Steels and Gas Plants, Factory Sheds, Warehouses, Factories having PLC-Based Controls for critical plant and machinery
- **Petroleum/Chemical Plants** - Oxygen Plants, Storage Tank Complexes
- **Public Area** - Hospitals, Cinema Halls, Museums, Heritage Monuments



## CPRI TEST REPORT



## Calculation of Taran Protection Radius (NF C 17-102 S 2.2.3.2)

$$R_p = \sqrt{h(2D-h) + \Delta L(2D+\Delta L)} \text{ for } > 5m.$$

$R_p$  : ESE protected radius  
 $h$  : Height of Protector tip above the area to be protected.

$D$  : Triggering distance defined  
 By NF C 17-102,  $D(m) = 10.1^{2/3}$  that is:  
 20 m at Level 1 (high protection)  
 45 m at Level 2 (improved protection)  
 60 m at Level 3 (standard protection)

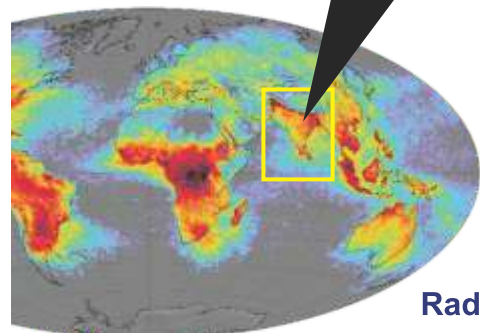
$\Delta L$  : upward leader length gain

$$\Delta L_{(m)} = V_{(m/\mu s)} \times \Delta T_{(m/\mu s)}$$

$\Delta T$  : Triggering advance

Protection levels are specified in Annex B of standard NFC 17-102

Isokeraunic map of the world (India inset) showing 'lightning hotspots'.



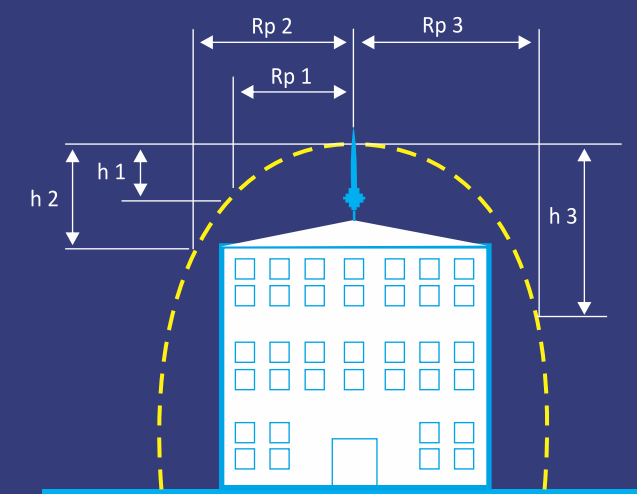
Radii of Protection (m)

Taran provides a wide range of zonal protection and meets the norms of various levels of protection as defined in the Standard NF C 17 102 (Chapter 2.2.3.2 and Appendix B Table 10)

Taran	h=tip height (m)									
	2	3	4	5	6	10	15	20	45	60
Level I Protection	32	48	64	79	79	79	80	80	80	80
Level II Protection	40	59	78	97	97	99	101	102	105	105
Level III Protection	44	65	87	107	107	109	111	113	119	120

## Taran: Features

- Taran is an ESE type of 'active' lightning conductor that provides zonal protection in accordance with the defined French Standard
- Taran lightning conductor is a sturdy, robust device of high quality stainless steel. This is highly resistant against impact, corrosion and chemical agents. Ideal in exposed industrial area and climates of high humidity
- Maintenance - free; easy to install
- External power source is not required
- Two-year warranty
- Tested by CPRI, India





## 330 Wp SPV MODULE

### Electrical Characteristics\*

Nominal Maximum Power (P <sub>m</sub> ) in Watts	330
Power tolerance	0 / + 5 W
Open Circuit Voltage (V <sub>oc</sub> ) in Volts	45.60
Short Circuit Current (I <sub>sc</sub> ) in Amps	9.40
Voltage at Maximum Power (V <sub>mp</sub> ) in Volts	36.55
Current at Maximum Power (I <sub>mp</sub> ) in Amps	9.03
Maximum System Voltage in Volts	1000
Module Efficiency (%)	17.01
Maximum Series Fuse Rating (A)	15

\*Under Standard Test Conditions (STC) of 1000 W/m<sup>2</sup> irradiance, AM 1.5 spectrum and 25°C cell temperature.

### Mechanical Characteristics

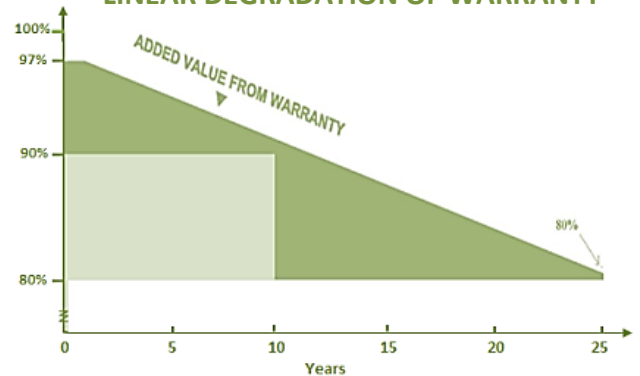
Length x Width x Thickness (L x W x T) - mm	1960 x 990 x 40
Mounting Holes Pitch (Y) – mm	1060
Mounting Holes Pitch (X) – mm	942
Weight (kg)	22.50
Solar Cells per Module (Units) / Arrangement	72 / (12*6)
Solar Cell Type	Mono Crystalline Silicon
Front Cover (Material / Thickness)	Tempered & Low Iron Glass / 3.2mm / 4mm
Encapsulate	Ethylene Vinyl Acetate
Frame Material	Anodized Aluminum Alloy
Junction Box (Material / Type)	Weatherproof PPO / IP67 enclosure with bypass diodes
Connector (Protection degree / Type)	IP67 rated / MC4 compatible
Cable cross-section	4 mm <sup>2</sup>

- Positive tolerance Modules
- Excellent generation performance with reasonable cost
- Undergoes rigorous quality control and in-house testing
- 100% Electroluminescence test to ensure error free Modules
- Heavy duty anodized Aluminum frames with pre-drilled holes for quick installation
- Salt mist corrosion resistance and Ammonia corrosion resistance
- Long lasting and high efficiency modules
- Withstands hail, snow and ice storms

### Warranty

- 10 years Limited Product Warranty
- 25 years Limited Power output Warranty:
  - Minimum 90% at the end of 10 years
  - Minimum 80% at the end of 25 years

#### LINEAR DEGRADATION OF WARRANTY



### Certifications



IEC 61215



IEC 61730-1 & 2



IEC 61701



IEC 62716



ISO 9001:2008



ISO 14001:2004

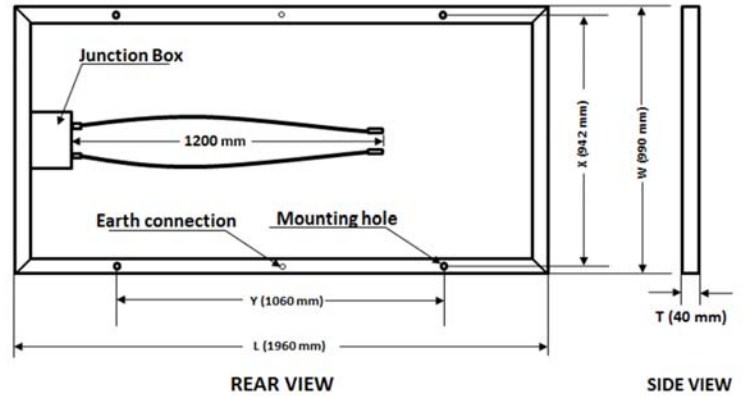


OHSAS 18001:2007

Design specifications

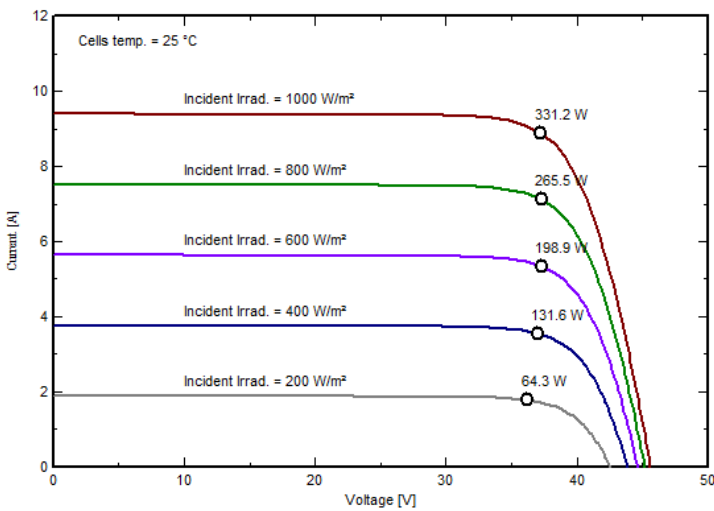
Thermal Characteristics

Temperature coefficient of Current ( $I_{sc}$ , $\alpha$ (%/°C)	0.0118
Temperature coefficient of Voltage ( $V_{oc}$ , $\beta$ (%/°C)	-0.2627
Temperature coefficient of Power ( $P_m$ , $\gamma$ (%/°C)	-0.3677
NOCT (°C)	46 ± 2
Operating temperature range (°C)	-40 to 85



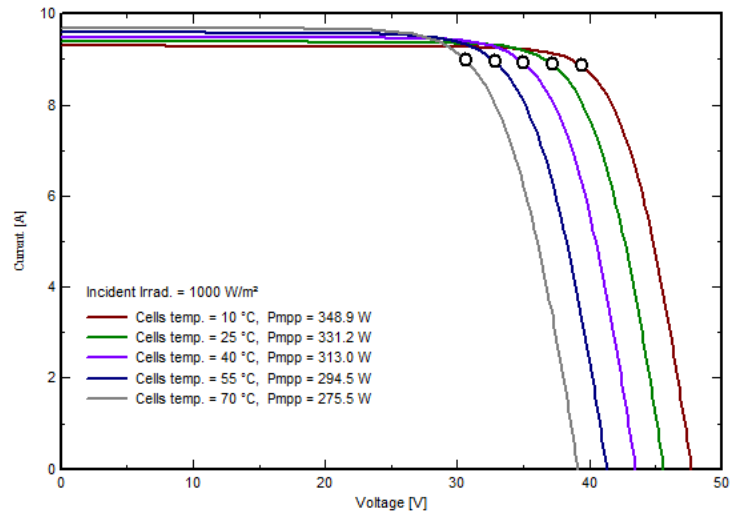
I-V Curve Variation with Irradiance

PV module: Waaree, WSM-330



I-V Curve Variation with Temperature

PV module: Waaree, WSM-330



About Waaree:

WAAREE is one of India's leading multi-technology companies, headquartered at Mumbai. Founded in 1989, WAAREE successfully developed cutting edge technologies to become one of the most preferred brands in the field of Instrumentation. The company has transformed itself from a single business into a multi-technology organization, diversifying into exciting areas of Solar Energy, Industrial Valves, Petroleum Equipment's and Process control Instrumentation. WAAREE has a presence in over 68 countries, serviced through its 20 sales offices in India & Dubai, and more than 105 global channel partners. WAAREE has a huge list of satisfied customers over the years. WAAREE is committed to supply the best quality products & technology to its customers. WAAREE's products are manufactured at its state-of-the-art manufacturing facilities and is committed to excel in providing the society with world class quality products.

Contact: WAAREE ENERGIES LIMITED

602, Western Edge-I, Off. Western Express Highway,  
Borivali (E), Mumbai 400066, Maharashtra  
Ph.: +91-22-66444444, Fax: +91-22-66444400, Email: [waaree@waaree.com](mailto:waaree@waaree.com)

○ The specifications in this datasheet are subject to change without prior notice.



## Design Calculation-Earthing System

### Inputs:

Particulars	Value	UOM
No. of modules in series per string	19	No's
No. of Strings/Inverter	8	No's
Short Circuit current in each string (Isc) ( Ref: module datasheet)	9.25	Ampere
Total no. of strings	8	No's
Total short circuit current	74	A
Fault Current*	92.5	A
Fault clearing time	1	sec
Diameter of earth electrode considered	5	cm
Length of earth electrode considered	300	cm
Earth Electrode material & type	Copper bonded earth electrode	
Total periphery of site under protection	108	mtr
No. of earthpits as per standarad calculation	18	No's
Spacing of Electrodes	50	mtr

\* as per NEC 690.8

For each Rod/Pipe type earth electrode, the Resistance can be represented as,

$$R = \frac{100 \rho}{2 \pi l} \log_e \frac{2l}{d} \text{ ohms}$$

(as per IS 3043 : 1987, Cl. No. 9.2.2, Amendment No. 1, Jan 2010), Cl. No. 9.2.2))

**Where,**

R = Earth Electrode resistance in  $\Omega$ .

$\rho$  = Soil resistivity in  $\Omega$ -Mtr(122.17  $\Omega$ -Mtr based on the actual measurement)

l = Length of earth electrode burried in soil (300 cm)

d = Diameter of the earth electrode (5 cm)

**Resistance for each earth electrodes (R) = 30.97 ohm**





## Design Calculation-Earthing System

Total resistance for 18 no's of electrode

$$R_n = R \left( \frac{1 + \lambda a}{n} \right)$$

Where

$$a = \frac{\rho}{2 \pi R S}$$

R = Resistance of single earth electrode (in isolation) in  $\Omega$

S = Earth Electrode spacing in Meter=50 mtr

$\rho$  = Soil resistivity in  $\Omega$ -M

$\lambda$  = multiplying factor (9.44 as per table)

a = 0.0125

n = number of earth electrodes=18

Equivalent Resistance (R18) = 1.92 Ohm

### Cross Section of Earth Conductor

Conductor Size (S) in  $\text{mm}^2 = I \times \sqrt{t} / K$  (as per clause 12.2.2.1 of IS-3043)

Material Constant (K)= 80 as per table 6A of IS-3043

Time (t)= 1 sec

Fault Current (I) = 92.5A

Safety Factor = 1

Allowance for Corrosion per year = 0.60% (considered, as per IS 3043:1987, Cl. 8.6.1)

Number of Year before replacement say = 20 Years

Min. cross section area of earth conductor reqd. =  $0.88 \times 20 \times 0.66 = 11.73 \text{ sqmm}$

Area of Earthing Conductor selected is = 75 sqmm (25mm width & 3 mm thick)

Therefore the earthing conductor selected (25 mm x 3 mm) is considerable

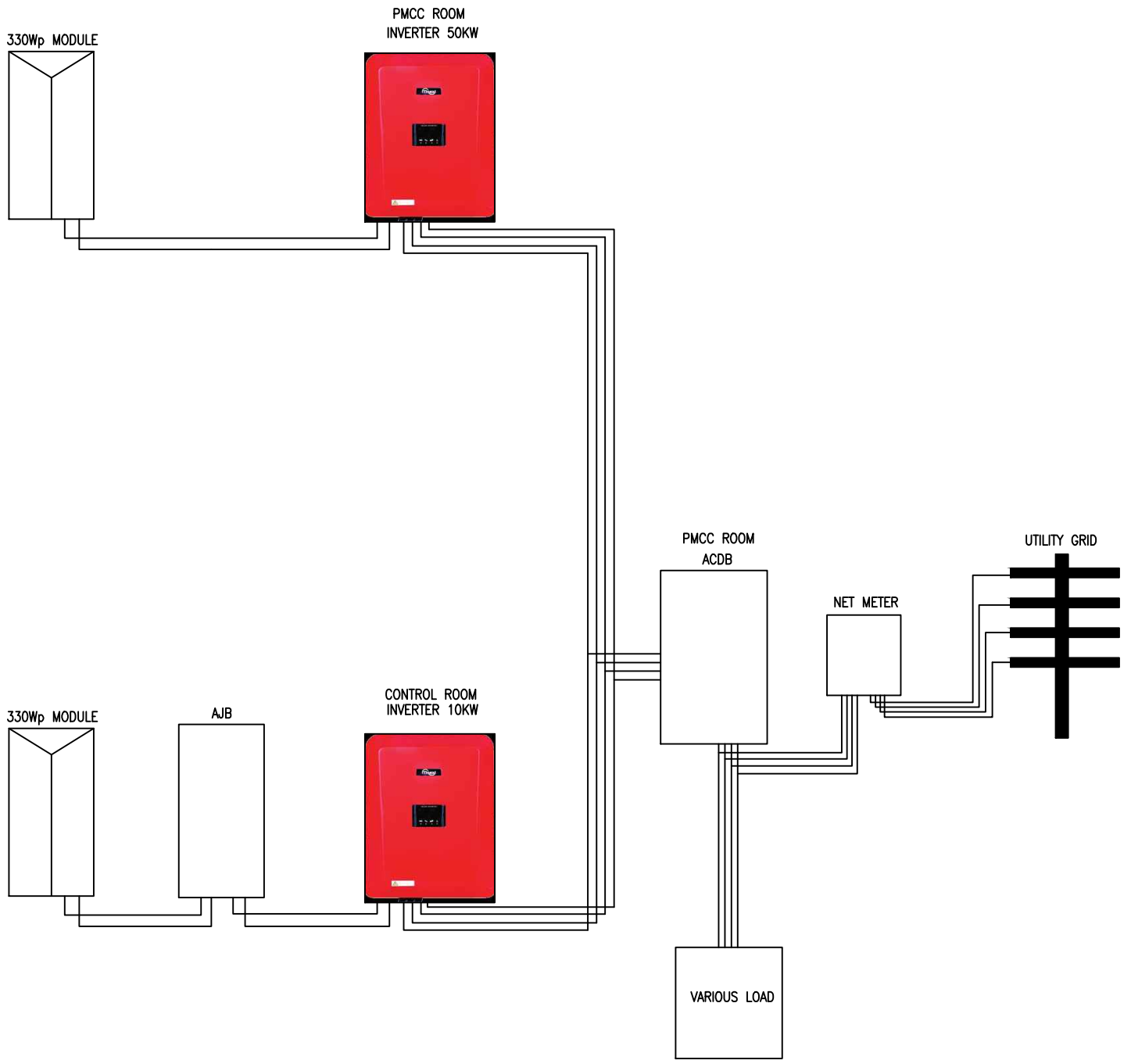


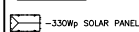



## Design Calculation-Earthing System

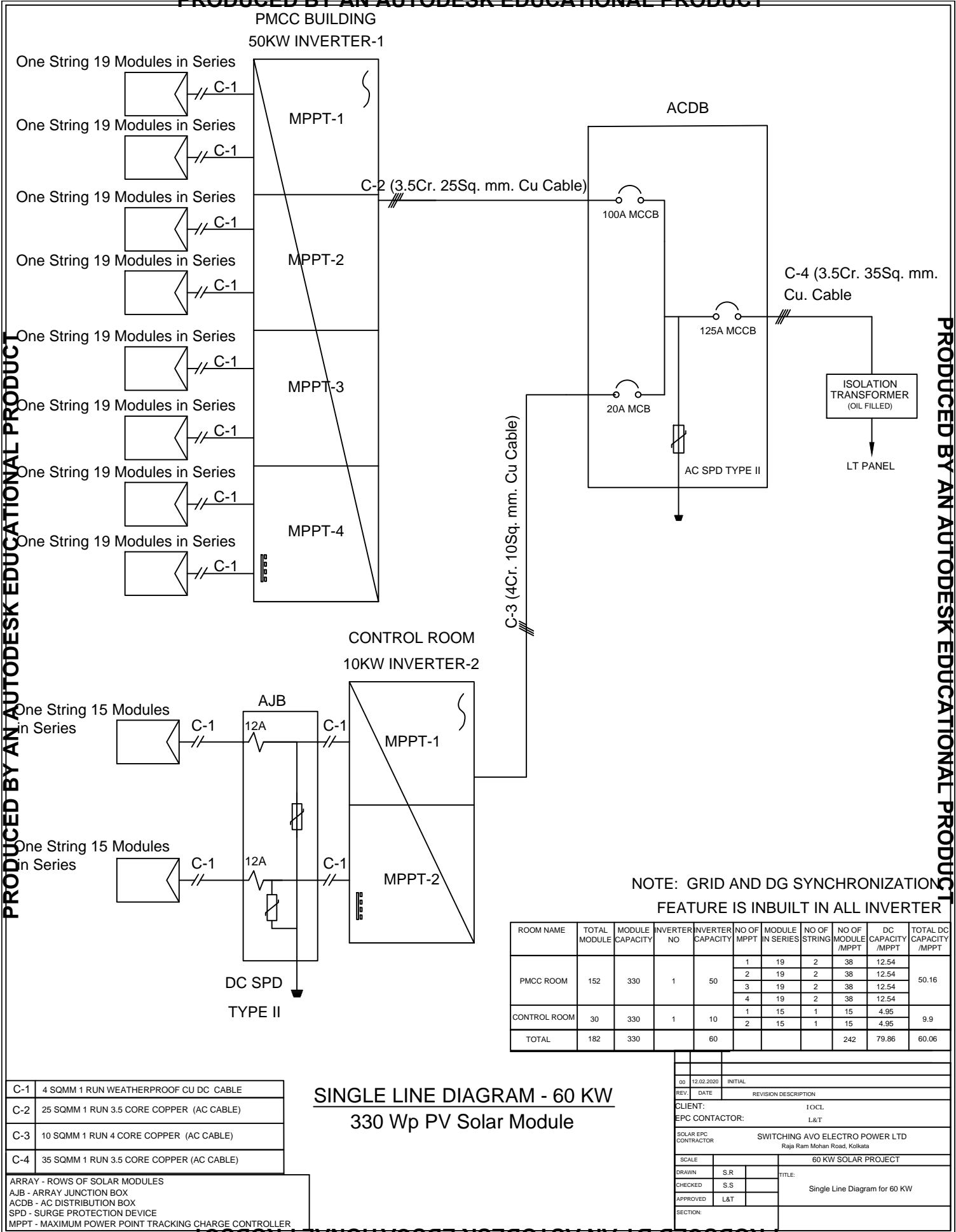
Summary	
Soil Resistivity	138.98 Ohm-Mtr
Fault Current	92.5A
No. of earth pits required for fault current	18
Diameter of the earth electrodes	50 mm
Length of the earth electrodes	3000 mm
Combined Resistive value of the earth electrodes	1.92 Ohm
Conductor size required with 5 % corrosion per year for 20 years	25mmX3mm
Total earth conductor length	900 mtr
Approx spacing of earth pits	50 mtr
<b>Remarks</b>	<b>Due to unavailability of 900mtr perimeter in solar installation premises, 6 no.s of earth pits will be installed &amp; same will be connected with the existing earth busbar of building premises</b>

Earthing Resistance measurement Table:

Sl. No.	Distance b/w Probes	Point No.	Direction	Soil Resistance in Ohm	Soil resistivity in ohm-mtr
1	0.5	1	North-South	13.05	41.01
2	1			12.65	79.51
3	2			11.05	138.91
4	3			9.35	176.31
5	4			7.08	178.01
1	0.5	2	East West	13.01	40.89
2	1			12.64	79.45
3	2			11.03	138.66
4	3			9.3	175.37
5	4			6.95	174.74
1	0.5	3	East-South	13.03	40.95
2	1			12.63	79.39
3	2			11.08	139.29
4	3			9.25	174.43
5	4			7.05	177.26
1	0.5	4	West-South	12.9	40.54
2	1			12.58	79.07
3	2			10.95	137.66
4	3			9.2	173.49
5	4			7.1	178.51
<b>Average</b>				10.59	122.17



<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 182 Nos		<b>SYMBOLS :-</b>  330Wp SOLAR PANEL	
REV.	DATE	REVISION DESCRIPTION	
00	13.02.2020	FIRST ISSUE	
<b>CLIENT:</b>  INDIAN OIL CORPORATION LTD. MUMBAI			
<b>EPC CONTRACTOR:</b>  L & T CONSTRUCTION			
<b>SOLAR EPC CONTRACTOR:</b>  SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata			
SCALE	NTS	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR <b>UTTARAKHAND 60KW PROJECT</b>  TITLE: NET METERING SYSTEM	
DRAWN	S.R		
CHECKED	S.S		
APPROVED	L & T		
Sheet No - 01 of 01		DRG NO: SAVO/IOCLL&T/NMS/01	A4



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

NOTE: GRID AND DG SYNCHRONIZATION FEATURE IS INBUILT IN ALL INVERTER

ROOM NAME	TOTAL MODULE	MODULE CAPACITY	INVERTER NO	INVERTER CAPACITY	NO OF MPPT	MODULE IN SERIES	NO OF STRING	NO OF MODULE /MPPT	DC CAPACITY /MPPT	TOTAL DC CAPACITY /MPPT
PMCC ROOM	152	330	1	50	4	1	19	2	38	12.54
						2	19	2	38	12.54
						3	19	2	38	12.54
						4	19	2	38	12.54
CONTROL ROOM	30	330	1	10	2	1	15	1	15	4.95
						2	15	1	15	4.95
TOTAL	182	330		60				242	79.86	60.06

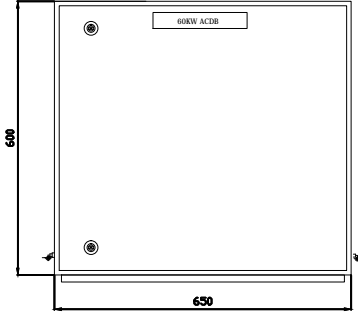
C-1	4 SQMM 1 RUN WEATHERPROOF CU DC CABLE
C-2	25 SQMM 1 RUN 3.5 CORE COPPER (AC CABLE)
C-3	10 SQMM 1 RUN 4 CORE COPPER (AC CABLE)
C-4	35 SQMM 1 RUN 3.5 CORE COPPER (AC CABLE)

ARRAY - ROWS OF SOLAR MODULES  
 AJB - ARRAY JUNCTION BOX  
 ACDB - AC DISTRIBUTION BOX  
 SPD - SURGE PROTECTION DEVICE  
 MPPT - MAXIMUM POWER POINT TRACKING CHARGE CONTROLLER

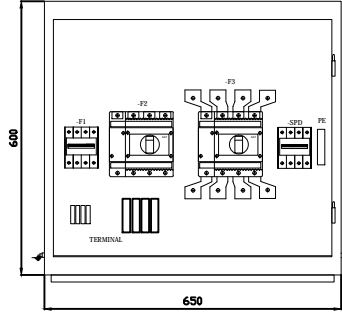
**SINGLE LINE DIAGRAM - 60 KW**  
**330 Wp PV Solar Module**

REV. 00	DATE 12.02.2020	INITIAL
REVISION DESCRIPTION		
CLIENT: IOCL		
EPC CONTRACTOR: L&T		
SOLAR EPC CONTRACTOR: SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata		
SCALE	60 KW SOLAR PROJECT	
DRAWN	S.R	TITLE: Single Line Diagram for 60 KW
CHECKED	S.S	
APPROVED	L&T	
SECTION:		

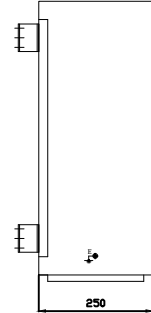
FRONT VIEW WITH DOOR



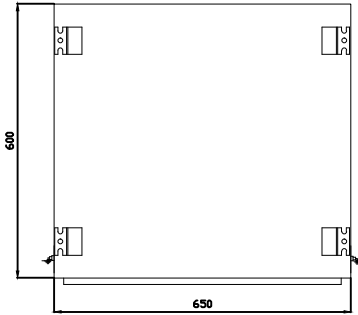
FRONT VIEW WITHOUT DOOR



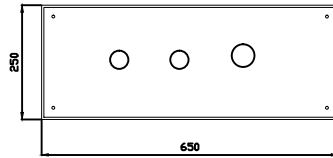
SIDE VIEW



REAR VIEW



BOTTOM VIEW



GENERAL LAYOUT - 60 KW

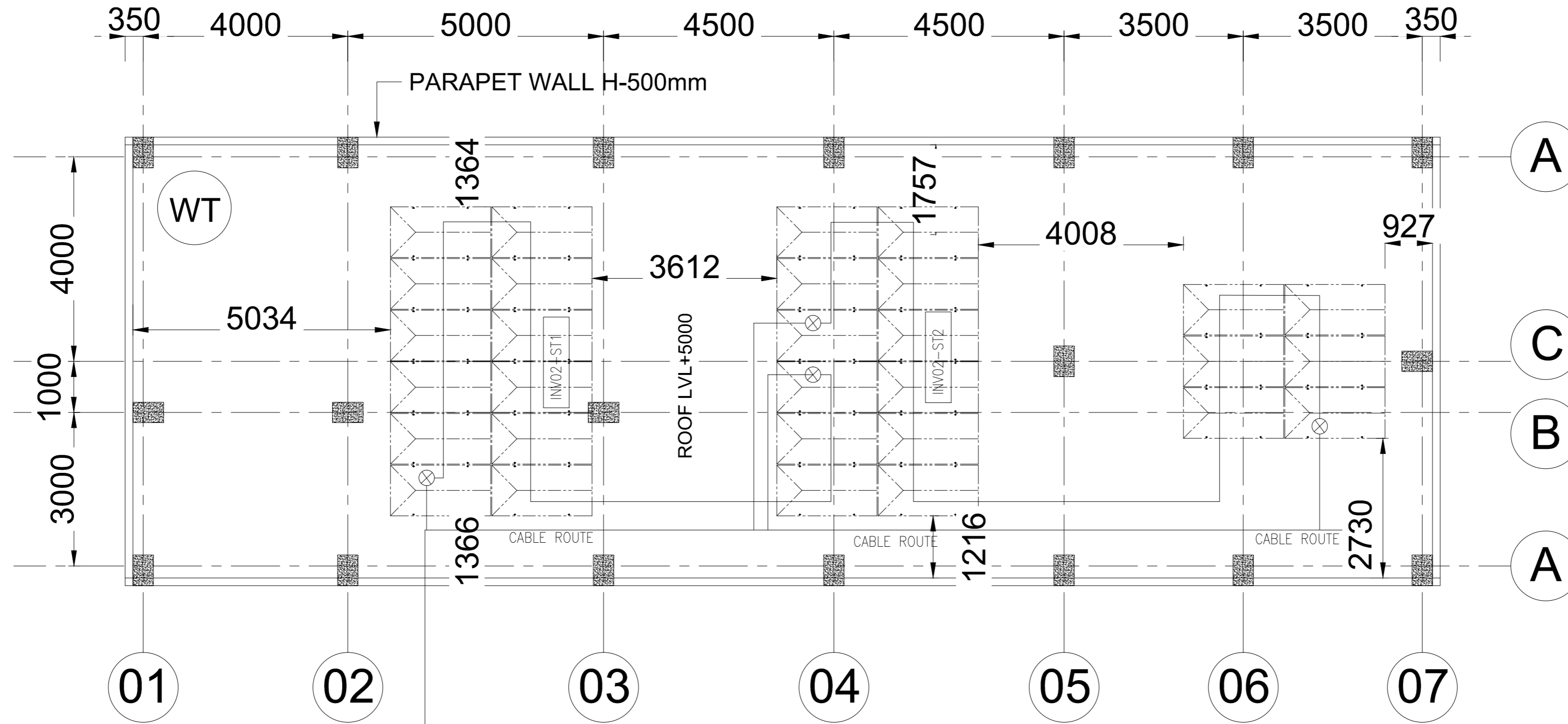
Metal Box

Dimension(+/-10to 20%) may changed during execution stage

00	12.02.2020	INITIAL
REV.	DATE	REVISION DESCRIPTION
CLIENT:		IOCL
EPC CONTRACTOR:		L&T
EPC CONTRACTOR		SWITCHING AND ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata
SCALE		60 KW SOLAR PROJECT
DRAWN	S.R	TITLE:
CHECKED	S.S	GENERAL LAYOUT
APPROVED	IDCL	
SECTION#		

**BOM-60 KW -UK Project**

SI No.	Item Description	Make	Nagpur	UOM
1	330 Wp solar Photovoltaic module	Waaree	242	No.s
2	10 KW String Inverter	THEA	1	No.
3	50 KW string inverter	THEA	1	No.
4	Module Mounting Structure	Essar steel	1	Lot
5	10 KW array junction Box	AVO	1	No.
6	60 KW AC Distribution Box	AVO	1	No.s
7	4 sqmm solar DC cable (C1)	Polycab	900	mtr
8	4CX10 sqmm cu cable (C3)	Polycab	80	mtr
9	3.5CX25 sqmm Cu cable (C2)	Polycab	10	mtr
10	3.5CX35 sqmm Cu cable (C4)	Polycab	5	mtr
11	10 Sqmm Single Core Al Cable	Polycab	42	mtr
12	GI earthing with enclosure	SGL/OBO	8	No.s
13	Earthing strip(25mmX3mm)M GI Flat	Reputed make	300	mtr
14	Weather monitoring system	Wattmon	1	set
15	MC4 Connector	Nimbos	24	Pair
16	BOS items (lug,saddle,tie etc.)	Reputed	1	Lot
17	DC Surge Protection Device	Citel/OBO	2	No.s
18	AC Surge Protection Device	Citel/OBO	1	No.



**CABLE LAYOUT PLAN**  
LOCATION - CONTROL ROOM

INVERTER-2  
10KW

AJB

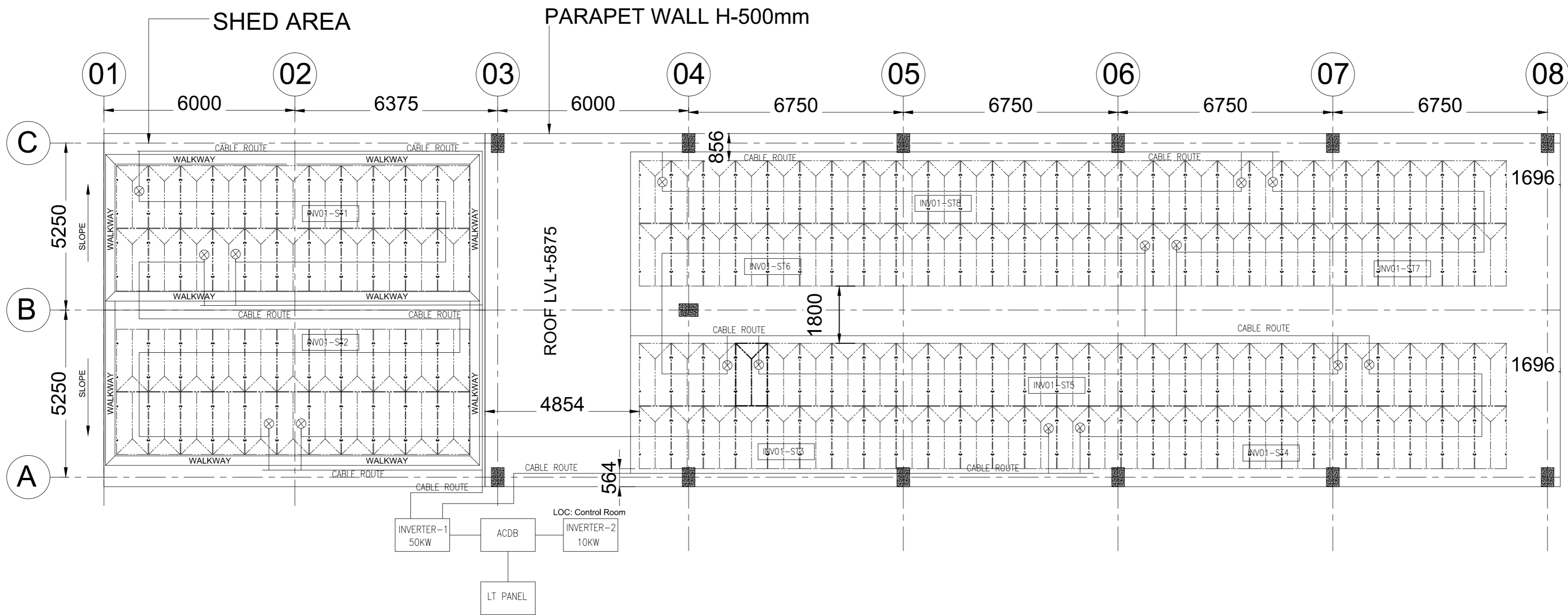
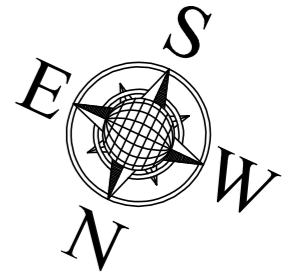
**TOTAL NO OF MODULES - 30 NOS**

Symbol	Description
	4SQ. MM CU DC CABLE

**NOTES :-**  
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
Project Capacity- 10 KW  
No of Modules - 30 Nos

**SYMBOLS :-**  
 -330Wp Waaree SOLAR PANEL

00	12.02.2020	FIRST ISSUE	
REV.	DATE	REVISION DESCRIPTION	
CLIENT:		INDIAN OIL CORPORATION LTD. MUMBAI	
EPC CONTRACTOR:		L & T CONSTRUCTION	
SOLAR EPC CONTRACTOR:		SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata	
SCALE	1 : 75	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS	
DRAWN	S.R		
CHECKED	S.S		
APPROVED	L & T		
Sheet No - 02 of 02		DRG NO: SAVO/IOCL/L&T/UK/CR/CLP/01	A2



## CABLE LAYOUT PLAN

### LOCATION - PMCC BUILDING

Shed Area - 44 Nos  
 Roof Area - 108 Nos  
**TOTAL NO OF MODULES - 152 NOS**

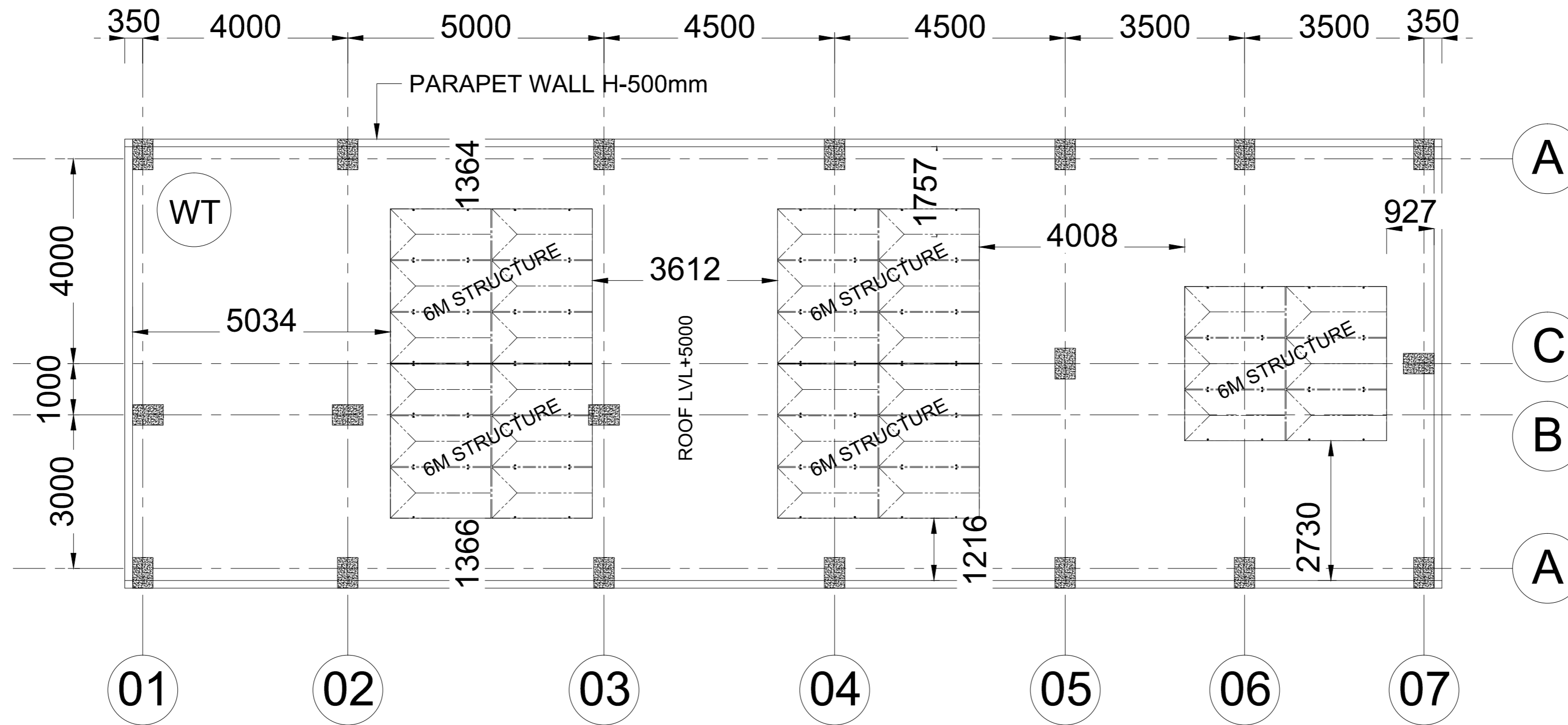
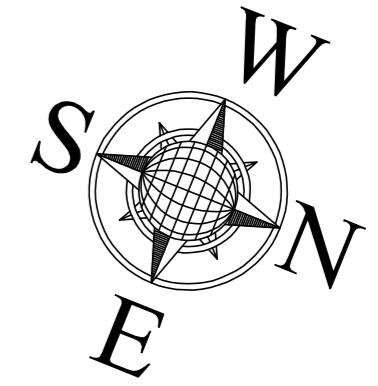
Symbol	Description
	10SQ. MM CU CABLE
	EARTH STRIP 25x3

<b>NOTES :-</b>		<b>SYMBOLS :-</b>	
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.			
Project Capacity- 50 KW		-330Wp Warea SOLAR PANEL	
No of Modules - 152 Nos		300mm Walkway	

REV.	DATE	REVISION DESCRIPTION
00	12.02.2020	FIRST ISSUE
CLIENT:		INDIAN OIL CORPORATION LTD. MUMBAI
EPC CONTRACTOR:		L & T CONSTRUCTION
SOLAR EPC CONTRACTOR:		AVO SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata

SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 01 of 02		DRG NO: SAVO/IOCL/L&T/UK/PMCC/CLP/01
		A2

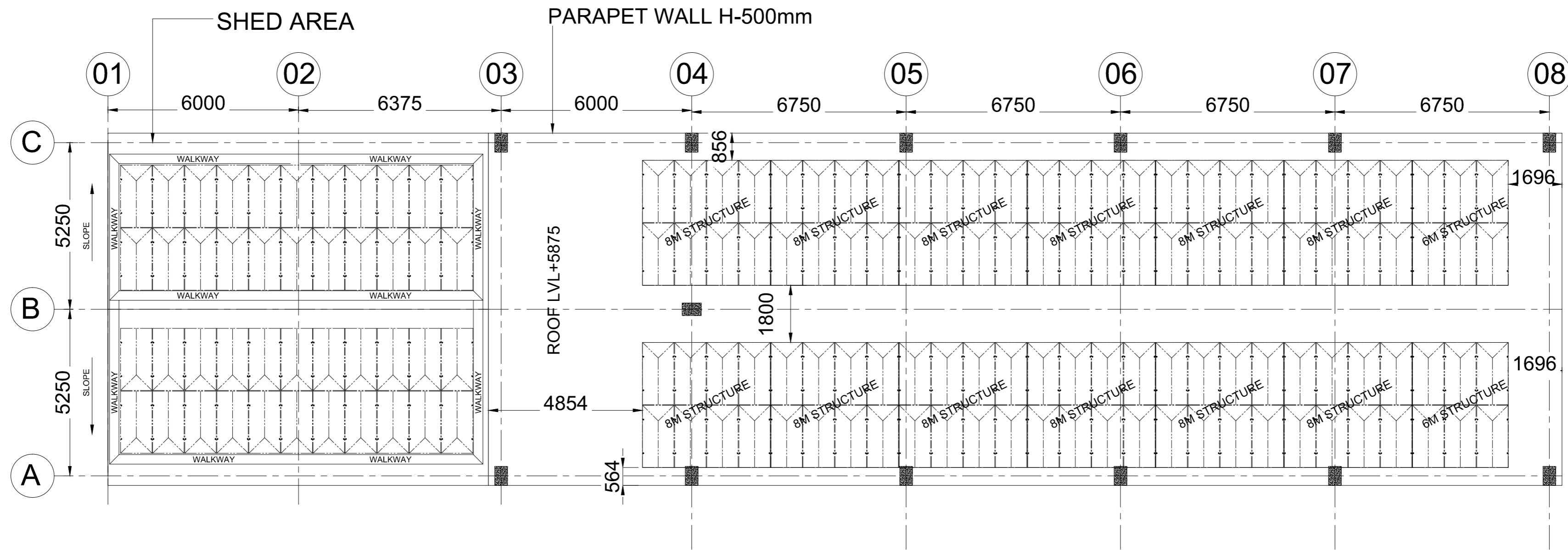
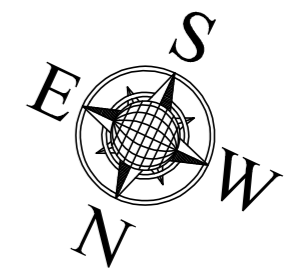




**COLUMN ARRANGEMENT PLAN**  
**LOCATION - CONTROL ROOM**

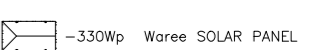

6 MODULE STRUCTURE - 05 NOS  
 TOTAL NO OF MODULES - 30 NOS

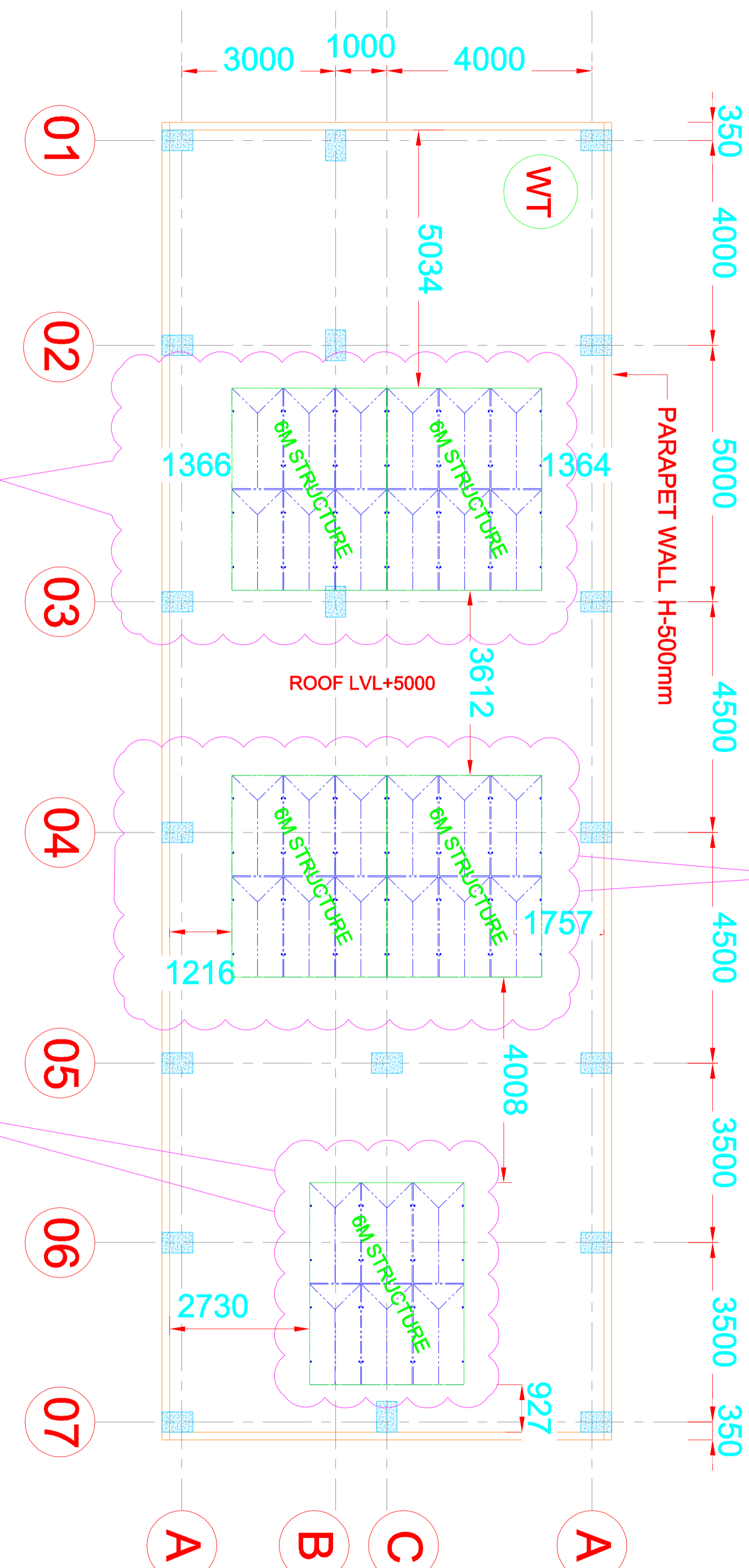
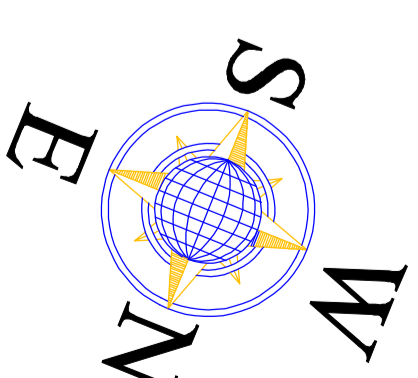
<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 30 Nos		<b>SYMBOLS :-</b> -330Wp Warea SOLAR PANEL
REV.	DATE	REVISION DESCRIPTION
00	08.02.2020	FIRST ISSUE
<b>CLIENT:</b> INDIAN OIL CORPORATION LTD. MUMBAI		
<b>EPC CONTRACTOR</b> L & T CONSTRUCTION		
<b>SOLAR EPC CONTRACTOR</b> SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata		
SCALE	1 : 75	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS <b>TITLE:</b> COLUMN ARRANGEMENT PLAN CONTROL ROOM
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 02 of 02		DRG NO: SAVO/IOCL/L&T/UK/CR/SLP/01
		A2



**COLUMN ARRANGEMENT PLAN**  
 LOCATION - PMCC BUILDING

8 MODULE STRUCTURE - 12 NOS  
 6 MODULE STRUCTURE - 02 NOS  
 Shed Area - 44 Nos  
 Roof Area - 108 Nos  
 TOTAL NO OF MODULES - 152 NOS

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 152 Nos		<b>SYMBOLS :-</b>  -330Wp Warea SOLAR PANEL  300mm Walkway	
REV.	DATE	REVISION DESCRIPTION	
00	08.02.2020	FIRST ISSUE	
<b>CLIENT:</b>		INDIAN OIL CORPORATION LTD. MUMBAI	
<b>EPC CONTRACTOR</b>		L & T CONSTRUCTION	
<b>SOLAR EPC CONTRACTOR</b>		AVO SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata	
SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS	
DRAWN	S.R	<b>TITLE:</b> COLUMN ARRANGEMENT PLAN PMCC BUILDING	
CHECKED	S.S		
APPROVED	L & T		
Sheet No - 01 of 02		DRG NO: SAVO/IOCL/L&T/UK/PMCC/SLP/01	A2



TOTAL MODULES WEIGHT - (22.50Kgs X 12 Nos ) - 270 Kgs  
 TOTAL PCC BLOCK WEIGHT - (64.8Kgs X 08 Nos ) - 518.4 Kgs  
 TOTAL STRUCTURE WEIGHT - (104.48 Kgs + 104.48Kgs ) - 208.96 Kgs  
 TOTAL EFFECTIVE WEIGHT ON ROOF - 997.36 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON ROOF - 9.78 KN

TOTAL MODULES WEIGHT - (22.50Kgs X 12 Nos ) - 270 Kgs  
 TOTAL PCC BLOCK WEIGHT - (64.8Kgs X 08 Nos ) - 518.4 Kgs  
 TOTAL STRUCTURE WEIGHT - (104.48 Kgs + 104.48Kgs ) - 208.96 Kgs  
 TOTAL EFFECTIVE WEIGHT ON ROOF - 997.36 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON ROOF - 9.78 KN

TOTAL MODULES WEIGHT - (22.50Kgs X 06 Nos ) - 135 Kgs  
 TOTAL PCC BLOCK WEIGHT - (64.8Kgs X 04 Nos ) - 259.2 Kgs  
 TOTAL STRUCTURE WEIGHT - (104.48 Kgs ) - 104.48 Kgs  
 TOTAL EFFECTIVE WEIGHT ON ROOF - 498.68 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON ROOF - 4.89 KN

6 MODULE STRUCTURE - 05 NOS  
 TOTAL NO OF MODULES - 30 NOS

## ARRAY ARRANGEMENT PLAN

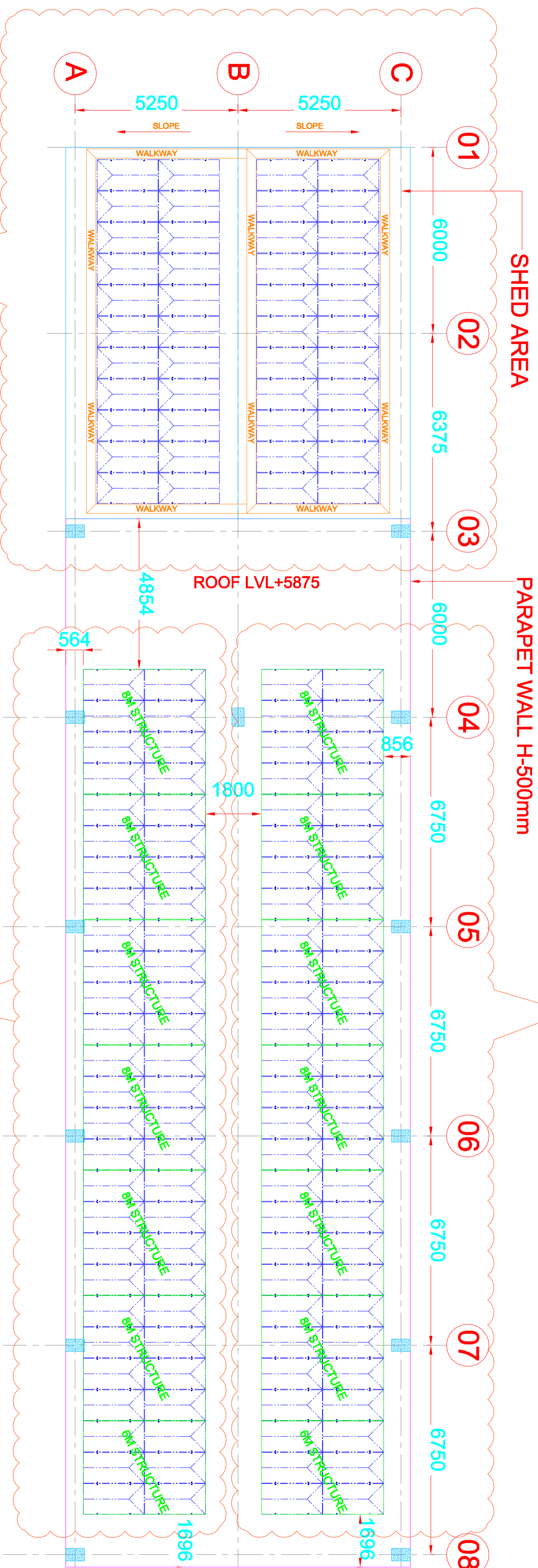
### LOCATION - CONTROL ROOM

**NOTES :-**  
 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
 Project Capacity - 60 KW  
 No of Modules - 30 Nos

**SYMBOLS :-**  
 - 30WP Mono SOLAR PANEL

00	08.02.2020	FIRST ISSUE	
REV.	DATE	REVISION DESCRIPTION	
<b>CLIENT:</b> INDIAN OIL CORPORATION LTD. UTTRAKHAND			
<b>EPC CONTRACTOR:</b> L & T CONSTRUCTION			
<b>SOLAR EPC CONTRACTOR:</b> SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata			
<b>SCALE:</b> 1 : 75		<b>TITLE:</b> COLUMN ARRANGEMENT PLAN	
<b>DRAWN:</b> S/R		<b>CHECKED:</b> S/S	
<b>APPROVED:</b> L & T			
Sheet No - 02 of 02		DRG NO: SAVOIOOCL&TUKICRMLP/01	





TOTAL MODULES WEIGHT - (22.50kgs X 44 Nos ) - 990 Kgs  
 TOTAL EFFECTIVE WEIGHT ON SHED - 990 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON SHED - 9.71 kN

TOTAL MODULES WEIGHT - (22.50kgs X 54 Nos ) - 1215 Kgs  
 TOTAL PCC BLOCK WEIGHT - (64.8kgs X 40 Nos ) - 2592 Kgs  
 TOTAL STRUCTURE WEIGHT - (1800kgs + 208.96kgs ) - 2008.96 Kgs  
 TOTAL EFFECTIVE WEIGHT ON ROOF - 5815.96 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON ROOF - 558.94 kN

TOTAL MODULES WEIGHT - (22.50kgs X 54 Nos ) - 1215 Kgs  
 TOTAL PCC BLOCK WEIGHT - (64.8kgs X 40 Nos ) - 2592 Kgs  
 TOTAL STRUCTURE WEIGHT - (1800kgs + 208.96kgs ) - 2008.96 Kgs  
 TOTAL EFFECTIVE WEIGHT ON ROOF - 5815.96 Kgs  
 TOTAL EFFECTIVE DEAD LOAD ON ROOF - 558.94 kN

## ARRAY ARRANGEMENT PLAN

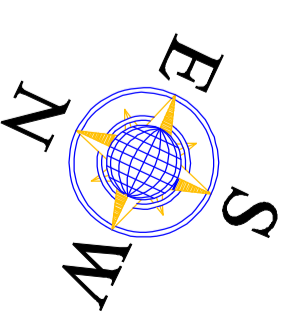
LOCATION - PMCC BUILDING

8 MODULE STRUCTURE - 12 NOS  
 6 MODULE STRUCTURE - 02 NOS

Shed Area - 44 Nos

Roof Area - 108 Nos

TOTAL NO OF MODULES - 152 NOS



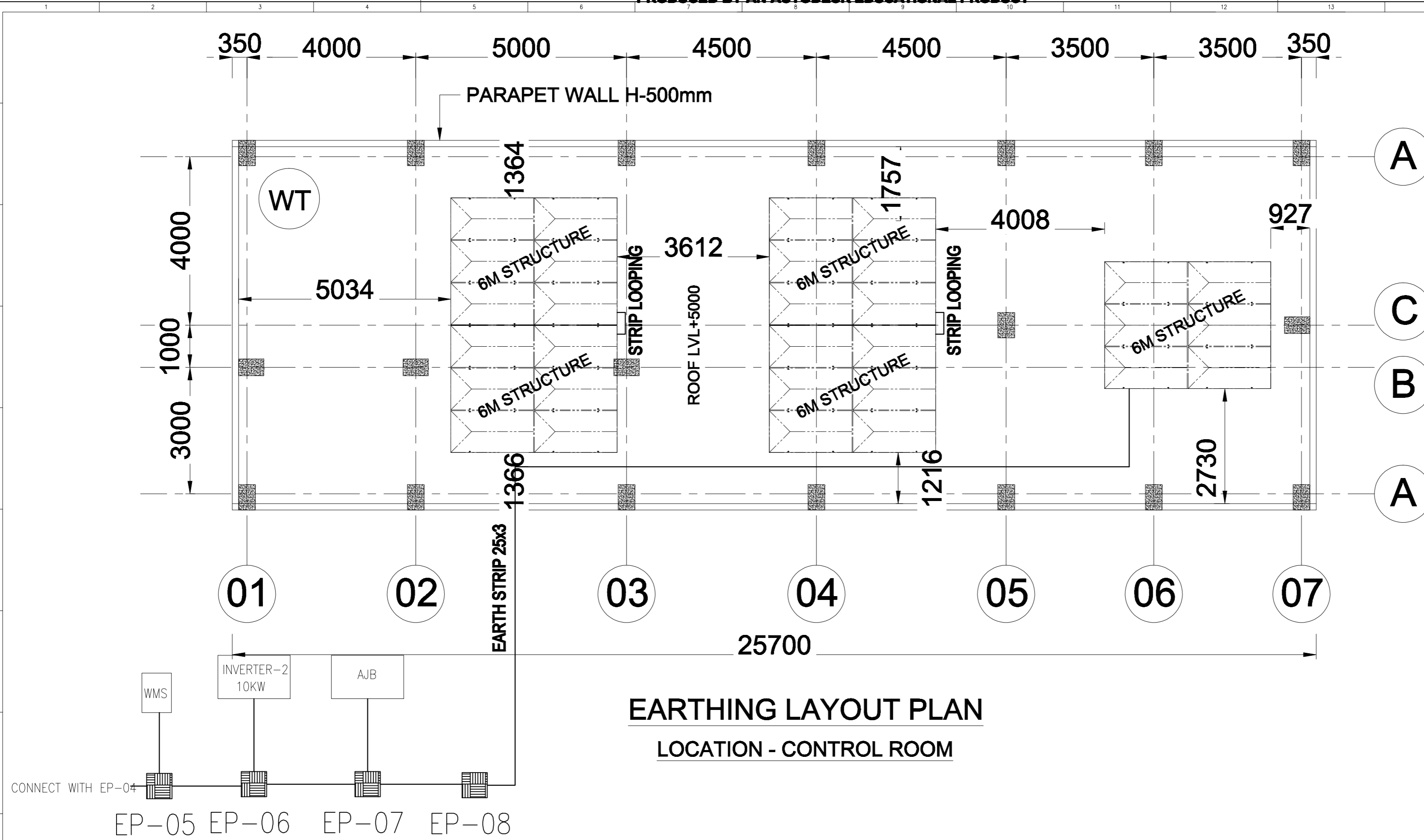
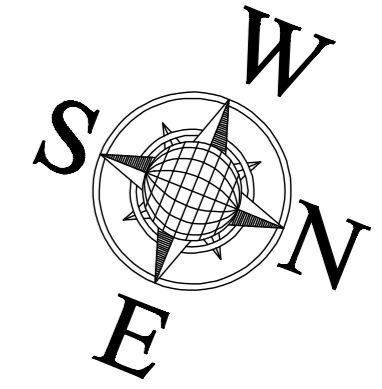
**NOTES :-**  
 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
 Project Capacity - 60 KW  
 No of Modules - 152 Nos

**SYMBOLS :-**  
 - 350Wp Waiver SOLAR PANEL  
 - 300mm Walkway

REV. 00	DATE 08.02.2020	FIRST ISSUE	REVISION DESCRIPTION
CLIENT: INDIAN OIL CORPORATION LTD.		UTTRAKHAND	
EPC CONTRACTOR: HindenOil		L & T CONSTRUCTION	
SOLAR EPC CONTRACTOR: SWITCHING AVO ELECTRO POWER LTD		Raja Ram Mohan Road, Kolkata	
SCALE: 1 : 100	EPC SERVICES OF LPG BOTTLING PLANTS, FOR UTTRAKHAND 60KW PRODUCTS		
DRAWN: S/R	TITLE: ARRAY ARRANGEMENT PLAN		
CHECKED: S/S	PMCC BUILDING		
APPROVED: L & T	DRG NO. SAV/OI/CL&T/UP/PMCC/MAL/P/01		
Sheet No - 01 of 02		A2	

**Earthing BOM-60 KW -UK Project**

<b>SI No.</b>	<b>Item Description</b>	<b>Make</b>	<b>Quantity</b>	<b>UOM</b>
1	GI earthing pit	SGI/OBO	8	No.s
2	Earthing cover	SGI/OBO	8	No.s
3	Nut and bolts	Reputed	1	Lot
4	Cleat	Reputed	1	Lot
5	Earthing strip(25mmX3mm)M GI Flat	Reputed	1	Lot



**EARTHING LAYOUT PLAN**  
LOCATION - CONTROL ROOM

CONNECT WITH EP-04  
WMS  
INVERTER-2 10KW  
AJB  
EP-05 EP-06 EP-07 EP-08

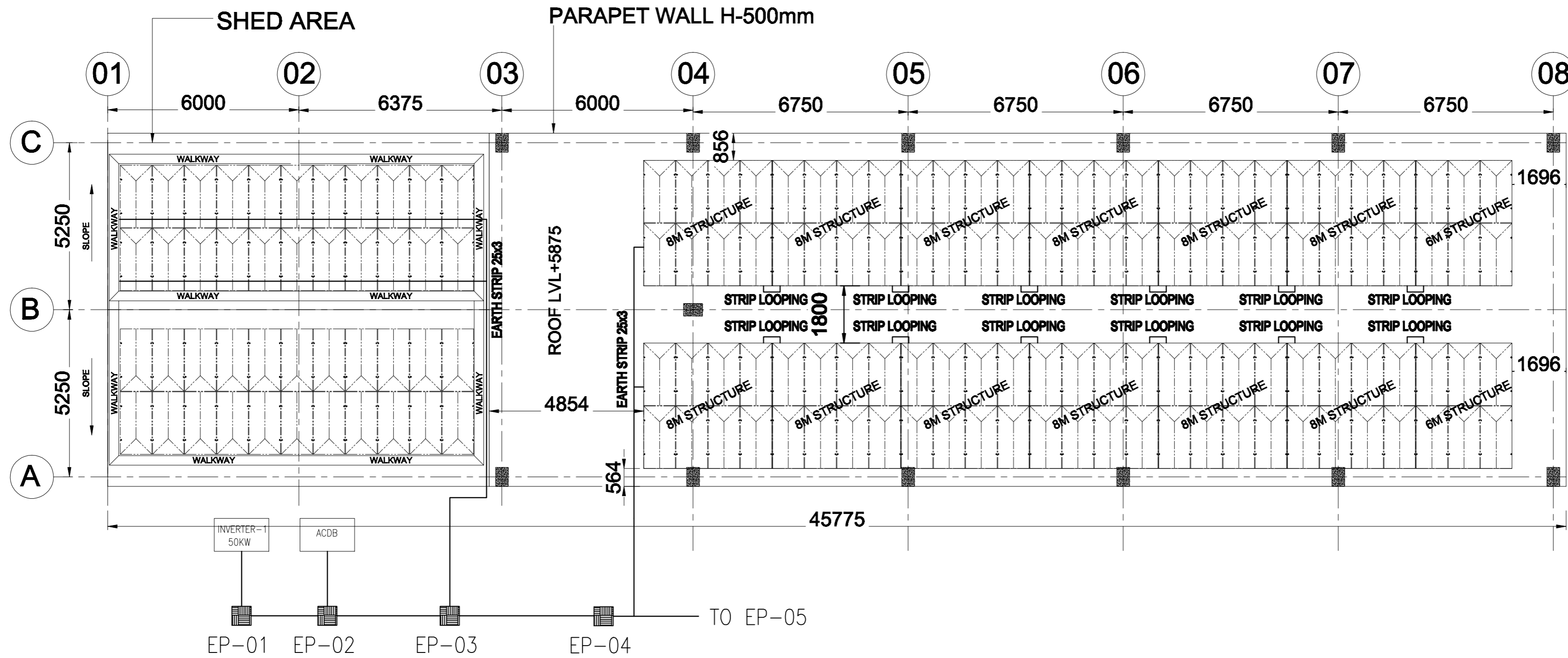
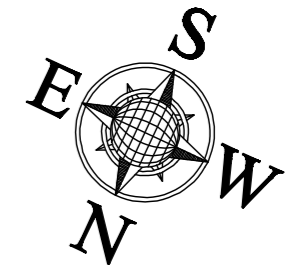
**TOTAL NO OF MODULES - 30 NOS**

Symbol	Description
	EARTH STRIP 25x3

Symbol	Description
	WMS
	INVERTER
	AJB
	MODULE

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 10 KW No of Modules - 30 Nos		<b>SYMBOLS :-</b> -330Wp Waaree SOLAR PANEL
01	28.03.2020	AS MAILED ON 17.03.20
00	12.02.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
<b>CLIENT:</b> <b>INDIAN OIL CORPORATION LTD. MUMBAI</b>		
<b>EPC CONTRACTOR</b> <b>L &amp; T CONSTRUCTION</b>		
<b>SOLAR EPC CONTRACTOR</b> <b>SWITCHING AVO ELECTRO POWER LTD</b> Raja Ram Mohan Road, Kolkata		
SCALE	1 : 75	<b>TITLE:</b> EARTHING ARRANGEMENT PLAN CONTROL ROOM
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 02 of 02		DRG NO: SAVO/IOCL/L&T/UK/CR/ELP/01





### EARTHING LAYOUT PLAN

LOCATION - PMCC BUILDING

EARTH STRIP CONNECTION IN SHED ROOF

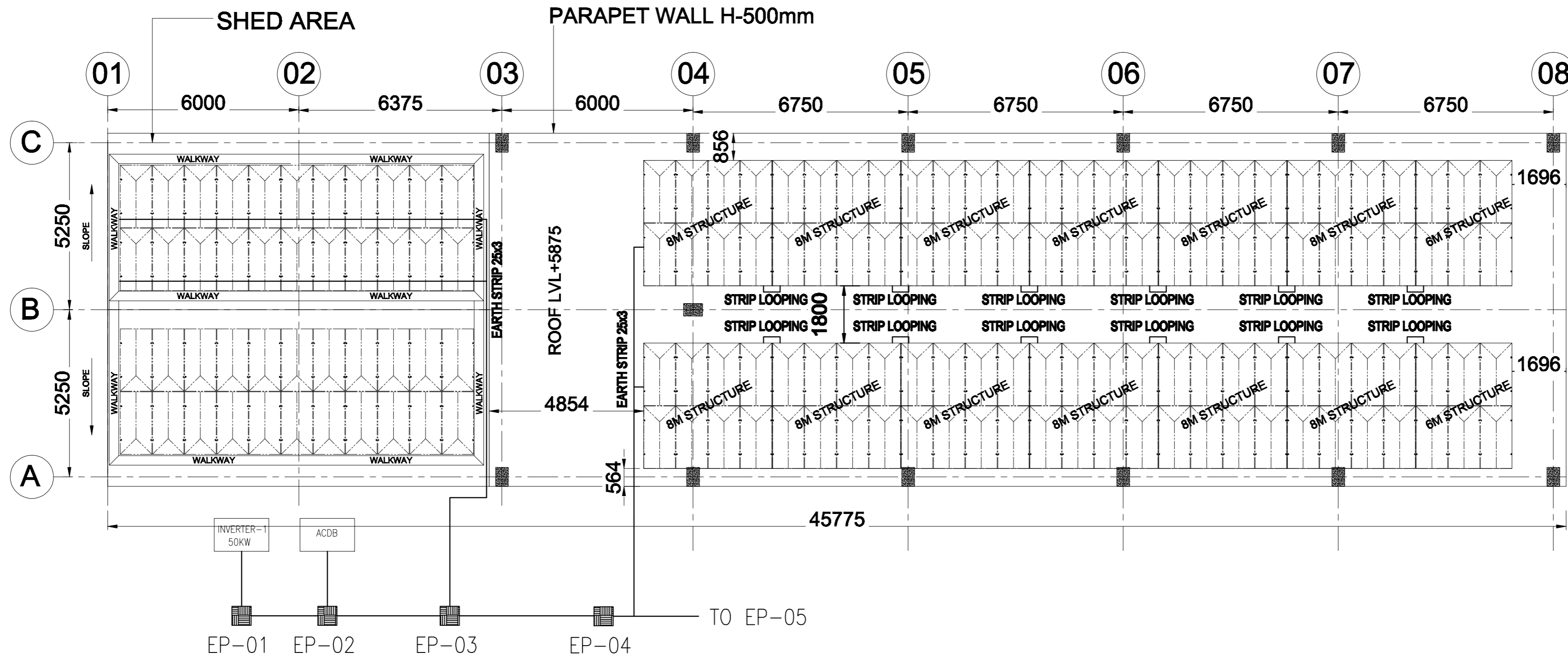
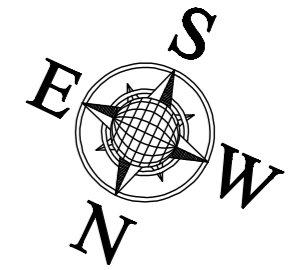


Shed Area - 44 Nos  
 Roof Area - 108 Nos  
 TOTAL NO OF MODULES - 152 NOS

Symbol	Description
	EARTH STRIP 25x3

Symbol	Description
 EP-01	INVERTER
 EP-02	ACDB
 EP-03	MODULE
 EP-04	MODULE

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 50 KW No of Modules - 152 Nos		<b>SYMBOLS :-</b> -330Wp Warea SOLAR PANEL 300mm Walkway
01	28.03.2020	AS MAILED ON 17.03.20
00	12.02.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
CLIENT: <b>INDIAN OIL CORPORATION LTD. MUMBAI</b>		
EPC CONTRACTOR: <b>L &amp; T CONSTRUCTION</b>		
SOLAR EPC CONTRACTOR: <b>SWITCHING AVO ELECTRO POWER LTD</b> Raja Ram Mohan Road, Kolkata		
SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS
DRAWN	S.R	TITLE: <b>EARTHING ARRANGEMENT PLAN PMCC BUILDING</b>
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 01 of 02		DRG NO: SAVO/IOCL/L&T/UK/PMCC/ELP/01 <b>A2</b>



### EARTHING LAYOUT PLAN

LOCATION - PMCC BUILDING

EARTH STRIP CONNECTION IN SHED ROOF



Shed Area - 44 Nos  
 Roof Area - 108 Nos  
 TOTAL NO OF MODULES - 152 NOS

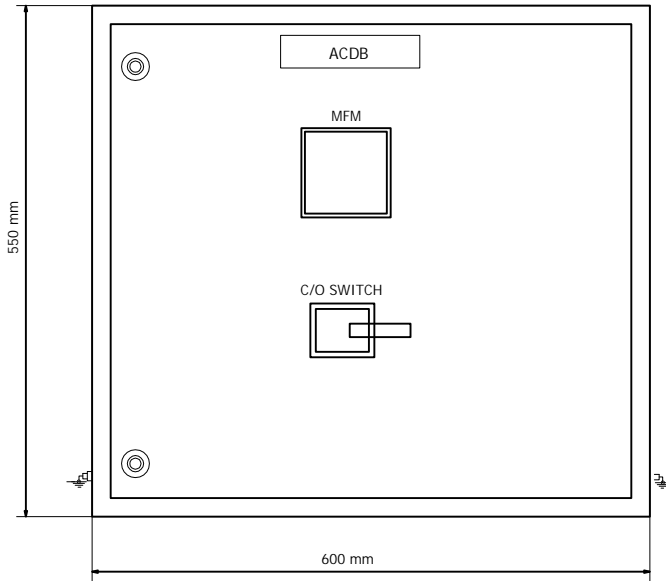
Symbol	Description
	EARTH STRIP 25x3

Symbol	Description
EP-01	INVERTER
EP-02	ACDB
EP-03	MODULE
EP-04	MODULE

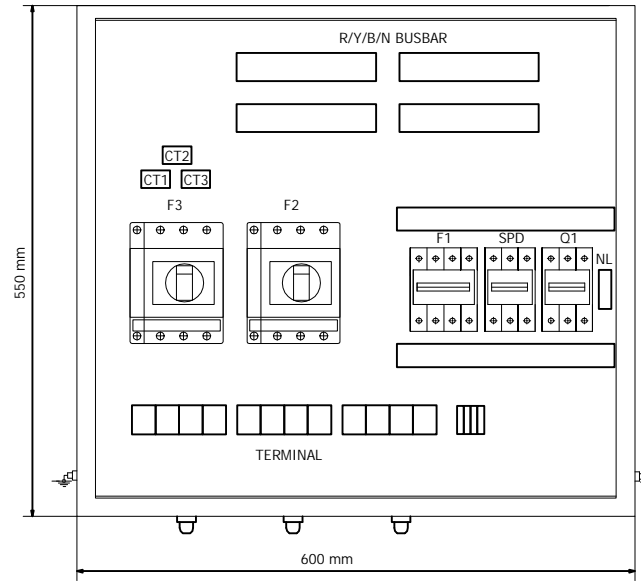
<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 50 KW No of Modules - 152 Nos		<b>SYMBOLS :-</b> -330Wp Warea SOLAR PANEL 300mm Walkway
01	28.03.2020	AS MAILED ON 17.03.20
00	12.02.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
CLIENT: <b>INDIAN OIL CORPORATION LTD. MUMBAI</b>		
EPC CONTRACTOR: <b>L &amp; T CONSTRUCTION</b>		
SOLAR EPC CONTRACTOR: <b>SWITCHING AVO ELECTRO POWER LTD</b> Raja Ram Mohan Road, Kolkata		
SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS
DRAWN	S.R	TITLE: <b>EARTHING ARRANGEMENT PLAN PMCC BUILDING</b>
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 01 of 02		DRG NO: SAVO/IOCL/L&T/UK/PMCC/ELP/01 <b>A2</b>



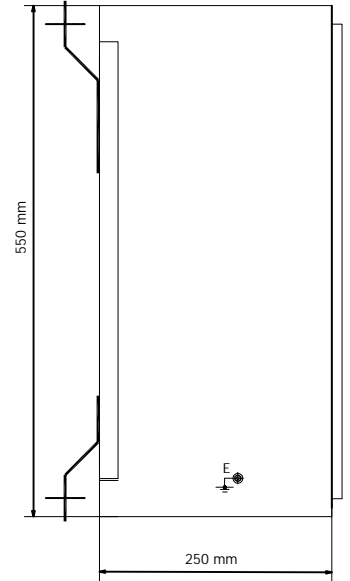
EXTERNAL FRONT VIEW



INTERNAL FRONT VIEW



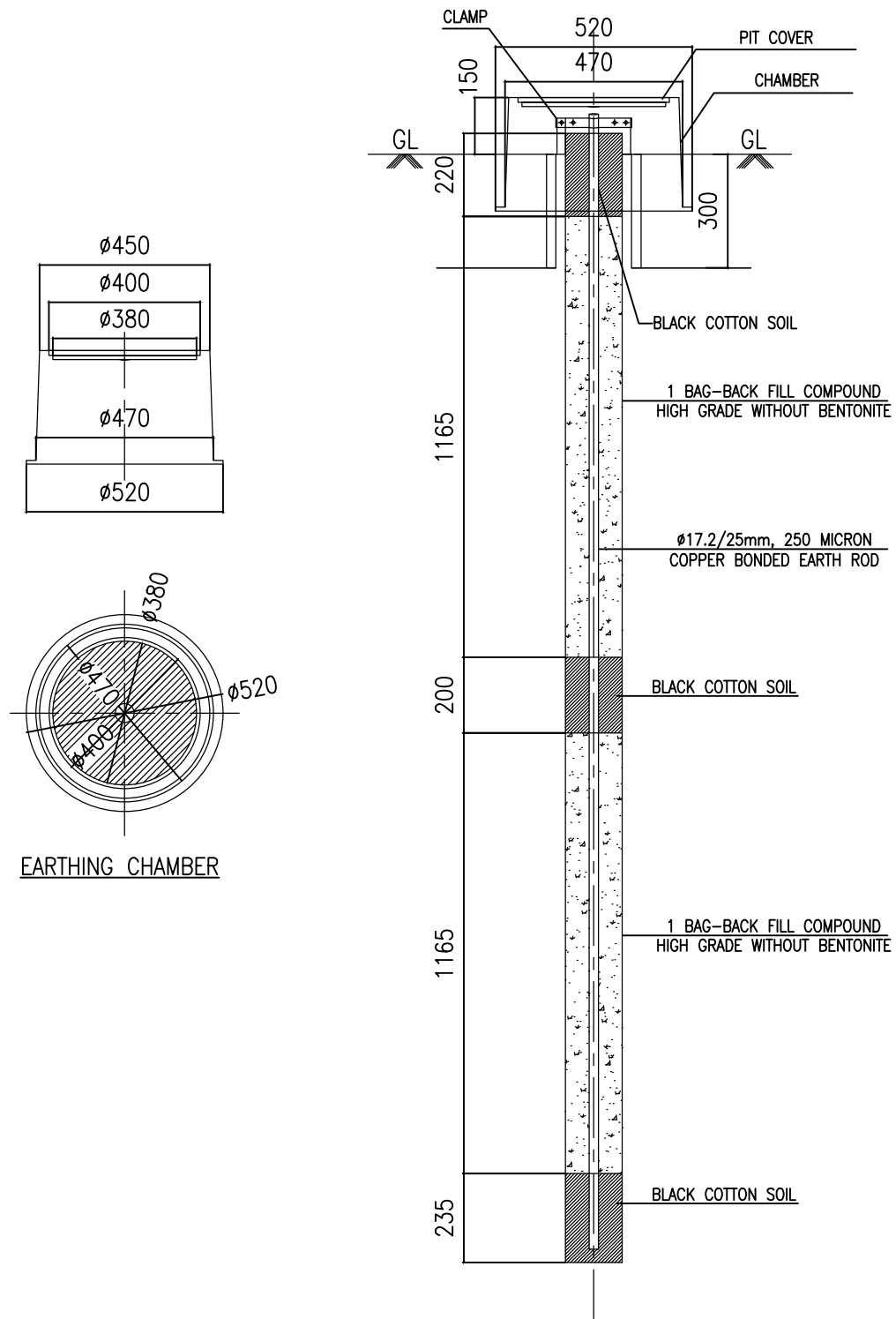
SIDE VIEW



GENERAL LAYOUT  
LOCATION - PMCC BUILDING

<b>NOTES :-</b>		
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.		
00	28.03.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
CLIENT:		INDIAN OIL CORPORATION LTD. UTTARAKHAND
EPC CONTRACTOR:		L & T CONSTRUCTION
SOLAR EPC CONTRACTOR:		SWITCHING AND ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata
SCALE:	1 : 5	TITLE: GENERAL LAYOUT OF ACDB
DRAWN:	S.R.	
CHECKED:	S.S.	
APPROVED:	L & T	
Sheet No - 01 of 01		DRG NO: SAVD/IDCL/L&T/UK/ACDB/01 A4

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



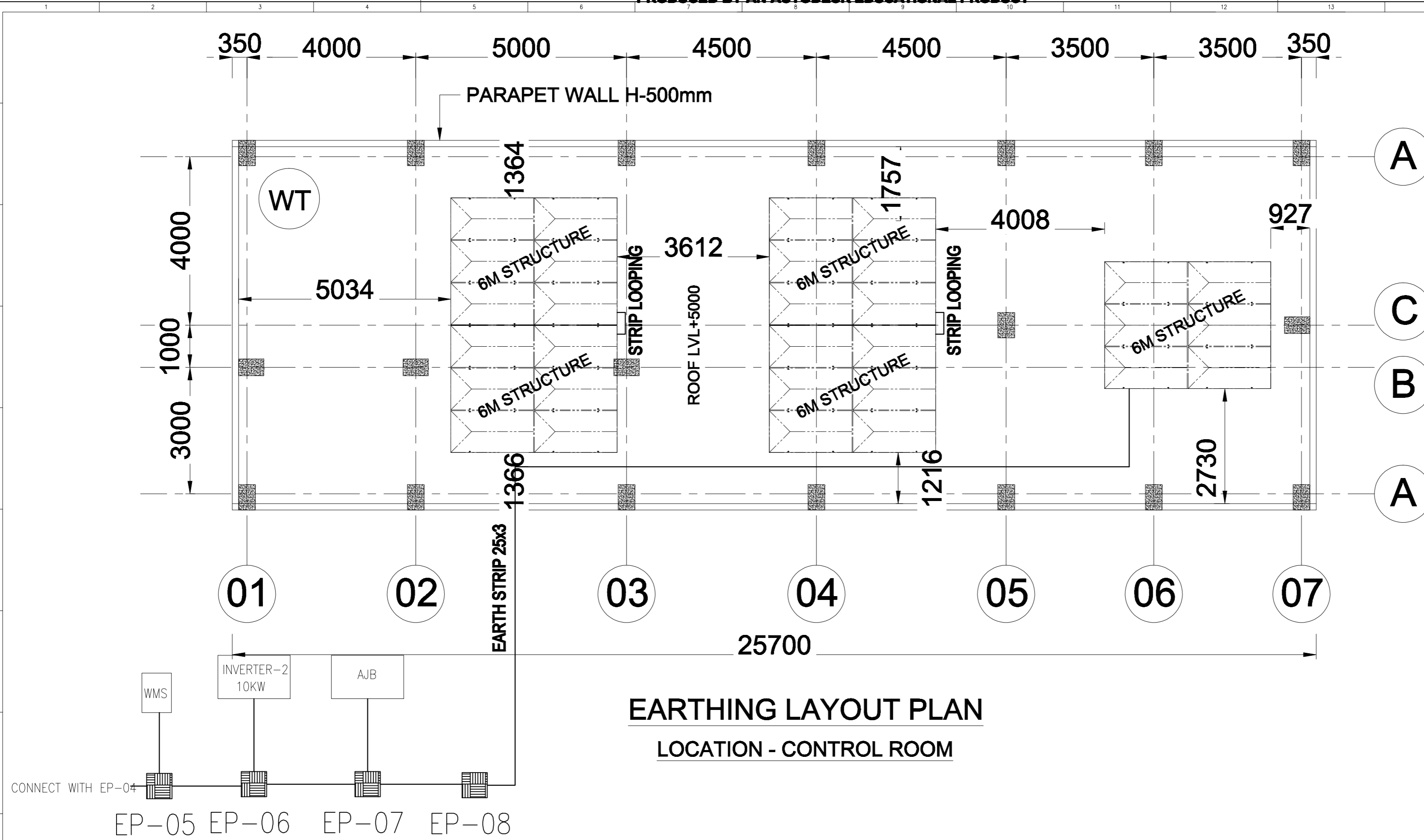
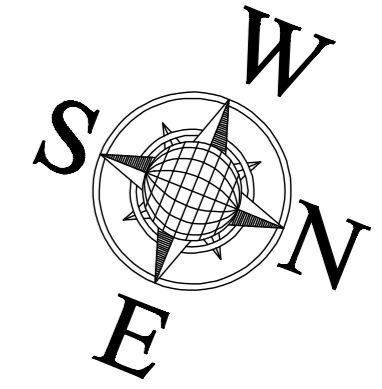
EARTHING PIT GENERAL ARRANGEMENT VIEW

**BOQ FOR 1 EARTH PIT**

SL. NO	DESCRIPTION	QTY
1	CHAMBER (500X500 MM)	1 NO.
2	CHEMICAL COMPOUND	1 LOT
3	25MM COPPER EARTH ROD,	3 MTR.
4	CLEAT	1 LOT
5	PIT COVER	1 NO.

**TOTAL 8SETS EARTH PIT REQUIRED**

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 182 Nos		<b>SYMBOLS :-</b> -330wp SOLAR PANEL
REV.	DATE	REVISION DESCRIPTION
00	12.02.2020	FIRST ISSUE
<b>CLIENT:</b> INDIAN OIL CORPORATION LTD, MUMBAI		
<b>EPC CONTRACTOR:</b> L & T CONSTRUCTION		
<b>SOLAR EPC CONTRACTOR:</b> SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata		
SCALE	1 : 175	EPMC SERVICES OF LRG BOTTLING PLANTS, FOR <b>UTTARAKHAND</b>
DRAWN	S.R	
CHECKED	S.S	TITLE:
APPROVED	L & T	EARTHING PIT GENERAL ARRANGEMENT VIEW
Sheet No - 01 of 01		DRG NO: SAVOIOCLL&T/UP/EP/01



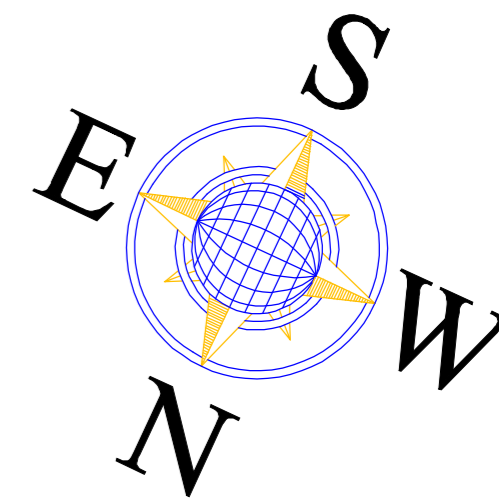
**EARTHING LAYOUT PLAN**  
LOCATION - CONTROL ROOM

TOTAL NO OF MODULES - 30 NOS

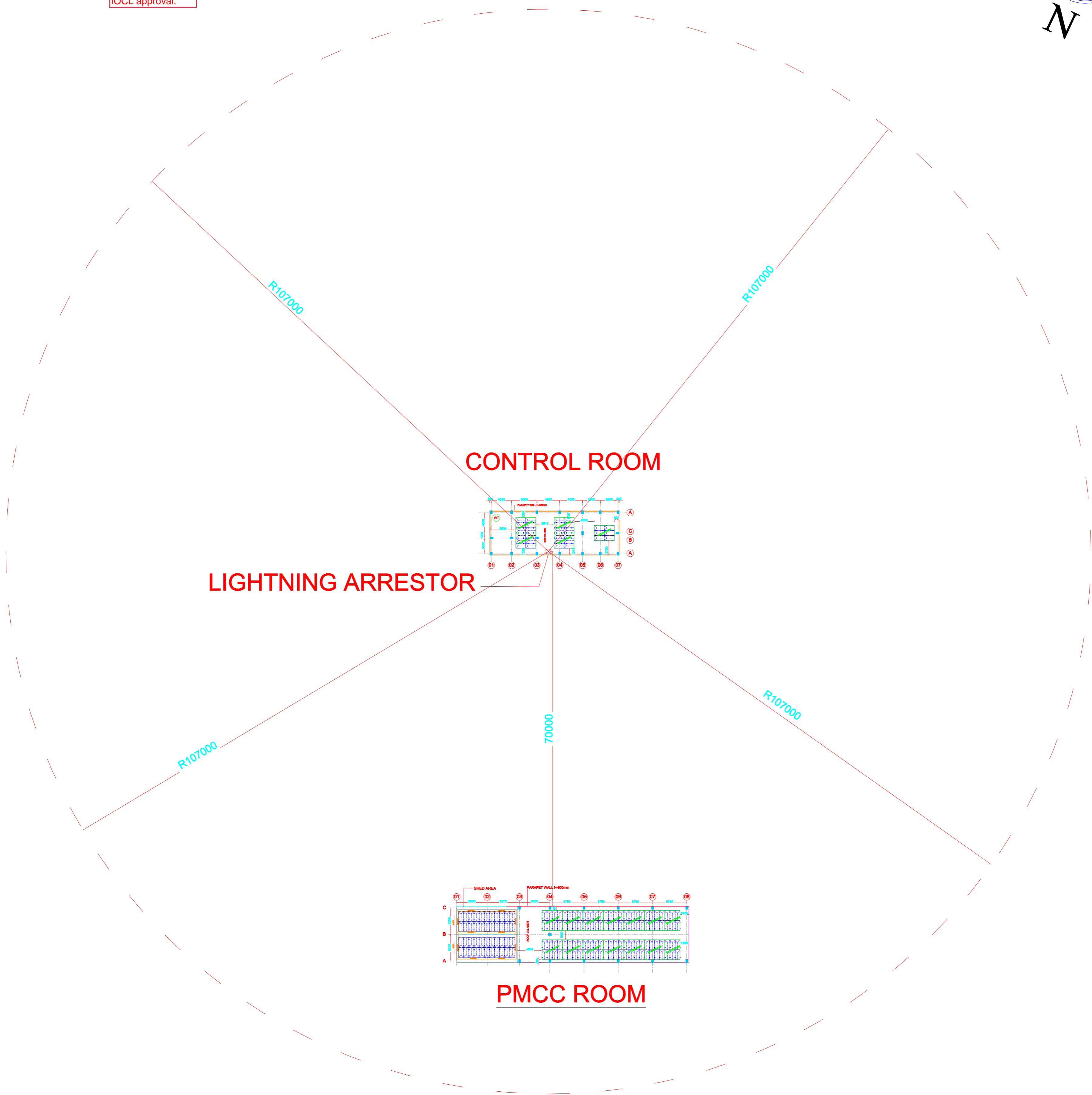
Symbol	Description
	EARTH STRIP 25x3

Symbol	Description
	WMS
	INVERTER
	AJB
	MODULE

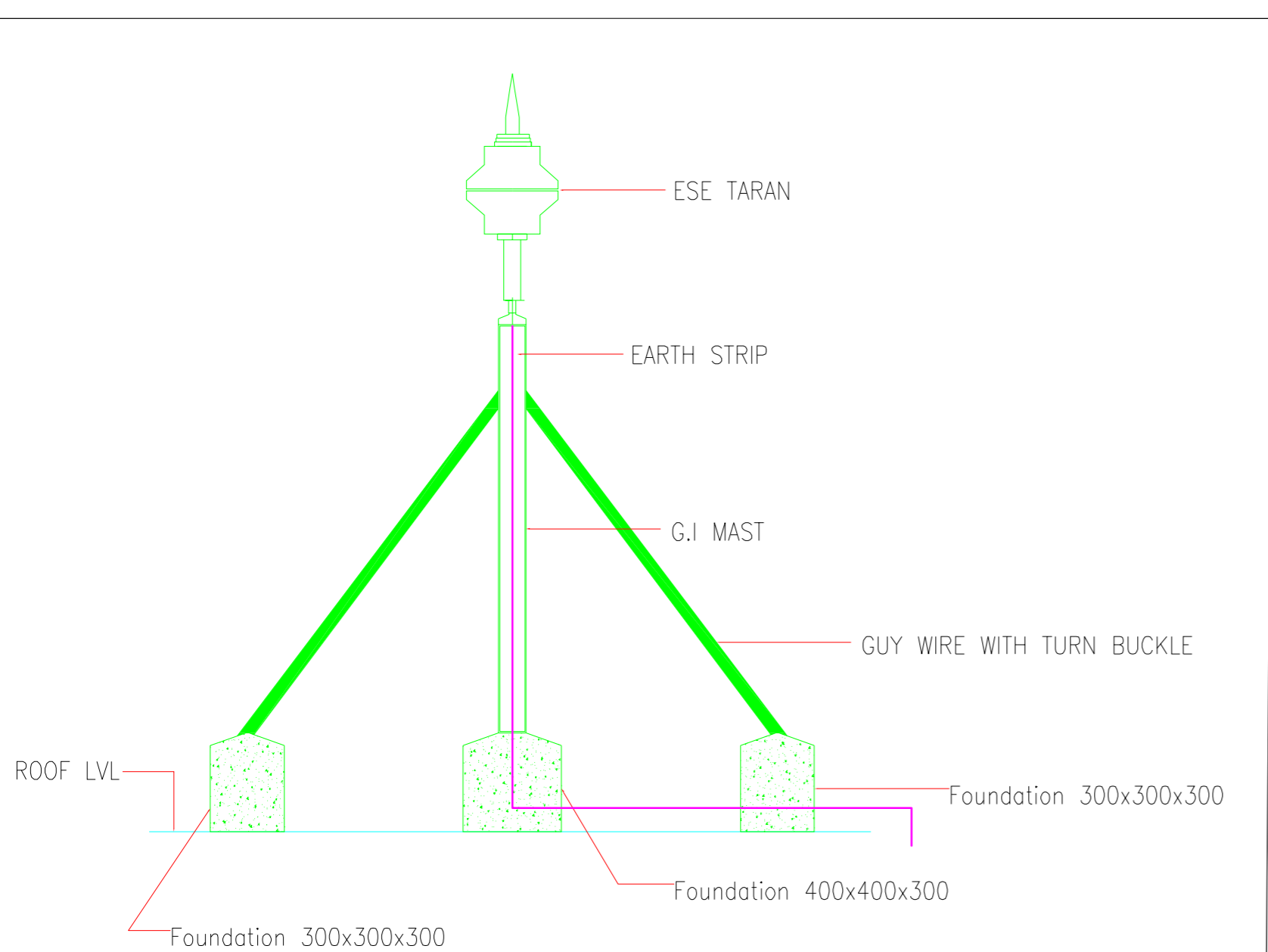
<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 10 KW No of Modules - 30 Nos		<b>SYMBOLS :-</b> -330Wp Waaree SOLAR PANEL
01	28.03.2020	AS MAILED ON 17.03.20
00	12.02.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
<b>CLIENT:</b> <b>INDIAN OIL CORPORATION LTD. MUMBAI</b>		
<b>EPC CONTRACTOR</b> <b>L &amp; T CONSTRUCTION</b>		
<b>SOLAR EPC CONTRACTOR</b> <b>SWITCHING AVO ELECTRO POWER LTD</b> Raja Ram Mohan Road, Kolkata		
SCALE	1 : 75	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS  <b>TITLE:</b> EARTHING ARRANGEMENT PLAN CONTROL ROOM
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 02 of 02		DRG NO: SAVO/IOCL/L&T/UK/CR/ELP/01



Use of ESE as lightning protection item is subject to IOCL approval.



**LIGHTNING LAYOUT PLAN  
PMCC BUILDING & CONTROL ROOM**

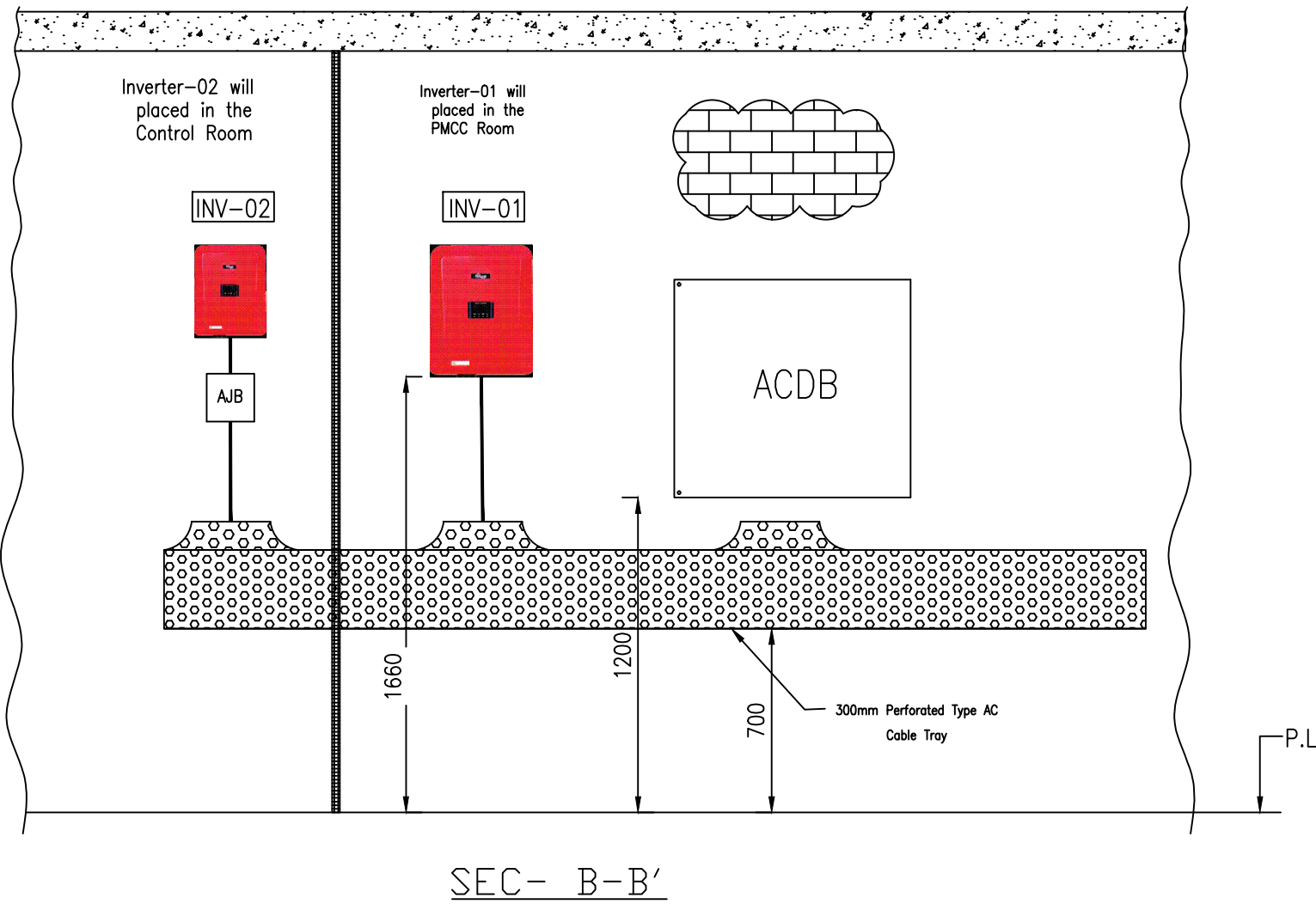


LA Specs- Level III Protection- 6mtr Height- LA Radius 107 Mtrs

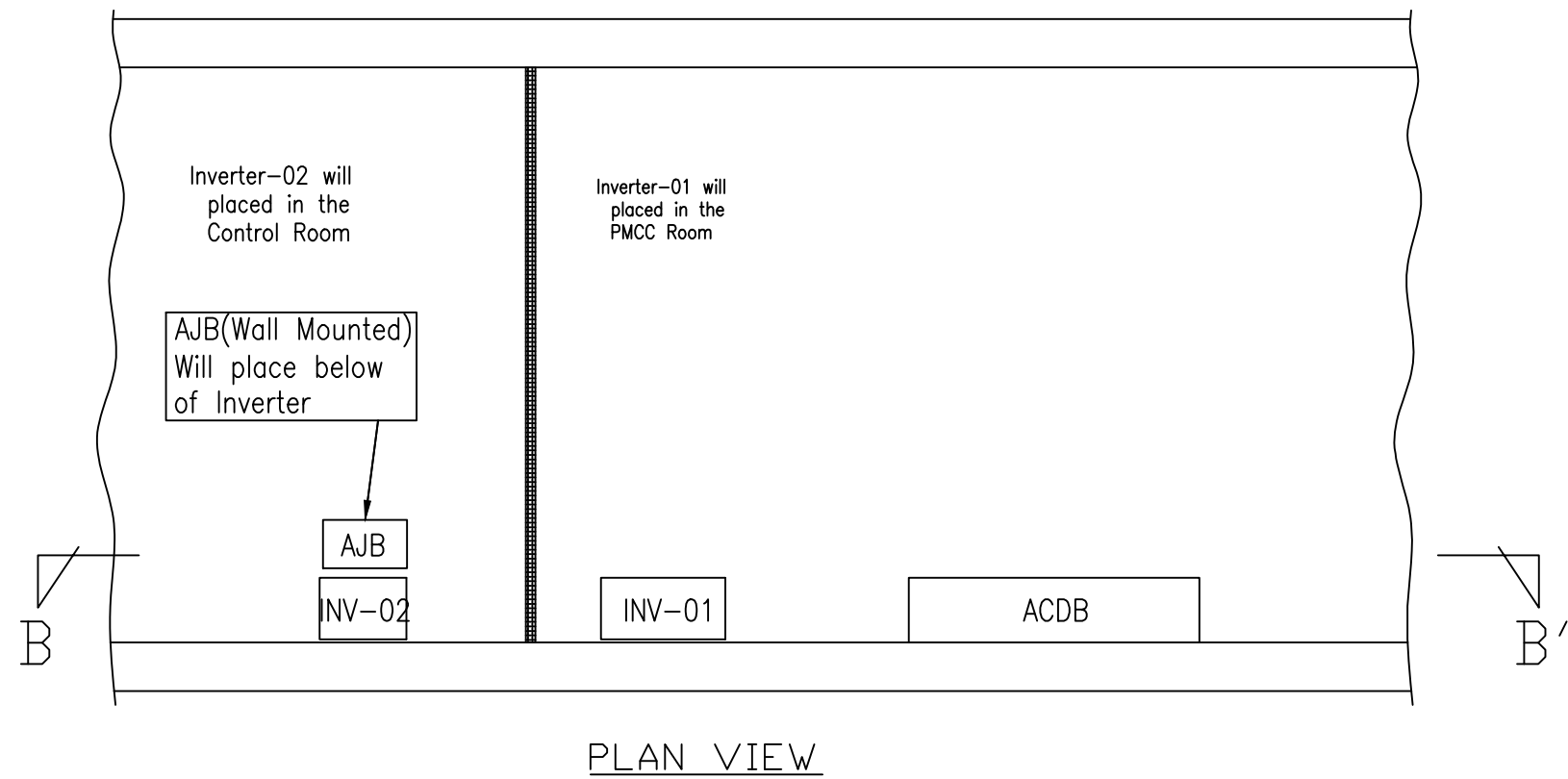
**NOTES :-**  
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
Project Capacity- 60 KW  
No of Modules - 152 Nos

**SYMBOLS :-**  
-330Wp Woree SOLAR PANEL  
300mm Walkway

00	08.02.2020	FIRST ISSUE
REV.	DATE	REVISION DESCRIPTION
CLIENT:		INDIAN OIL CORPORATION LTD. UTTARAKHAND
EPC CONTRACTOR		L & T CONSTRUCTION
SOLAR EPC CONTRACTOR		SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata
SCALE	NTS	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
TITLE:		LIGHTNING LAYOUT PLAN PMCC BUILDING & CONTROL ROOM
Sheet No - 01 of 01		DRG NO: SAVO/IOCL/L&T/UK/LAP/01
		A2



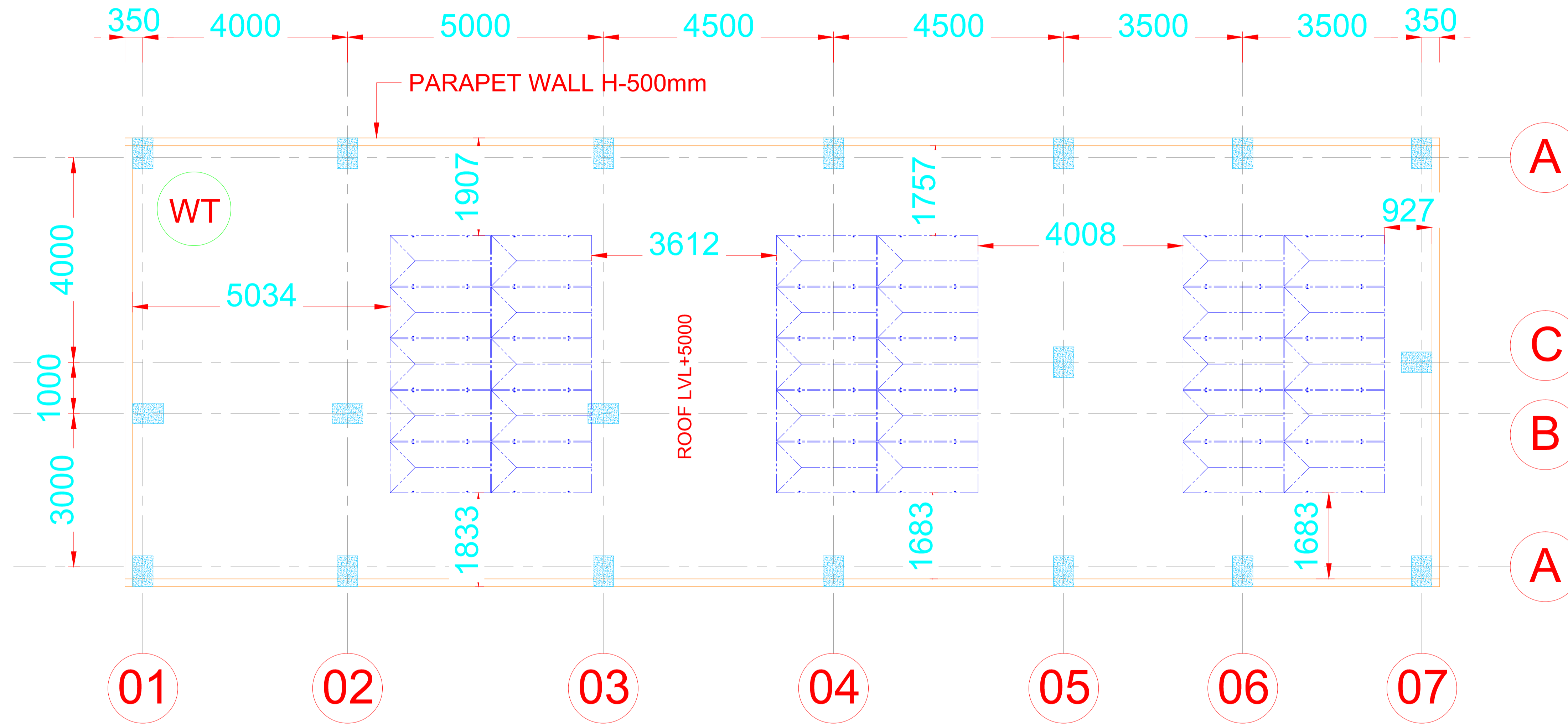
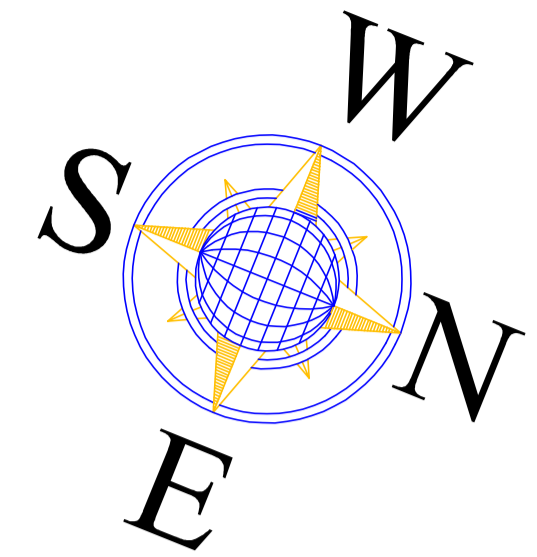
Note: Inverter will be placed in separate building room as mentioned in above drawing. This is a typical view of inverter & other equipment like AJB, ACDB arrangement. ACDB will be placed in PMCC Room.



Drawings can be best viewed in A3 print only

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 182 Nos		<b>SYMBOLS :-</b> ☐ -330Wp SOLAR PANEL
REV.	DATE	REVISION DESCRIPTION
00	13.02.2020	FIRST ISSUE
CLIENT:		INDIAN OIL CORPORATION LTD. MUMBAI
EPC CONTRACTOR:		L & T CONSTRUCTION
SOLAR EPC CONTRACTOR:		SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata
SCALE	NTS	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND
DRAWN	S.R	TITLE: INVERTER POSITION PLAN
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 01 of 01		DRG NO: SAVD/IDCL/L&T/INVPP/01

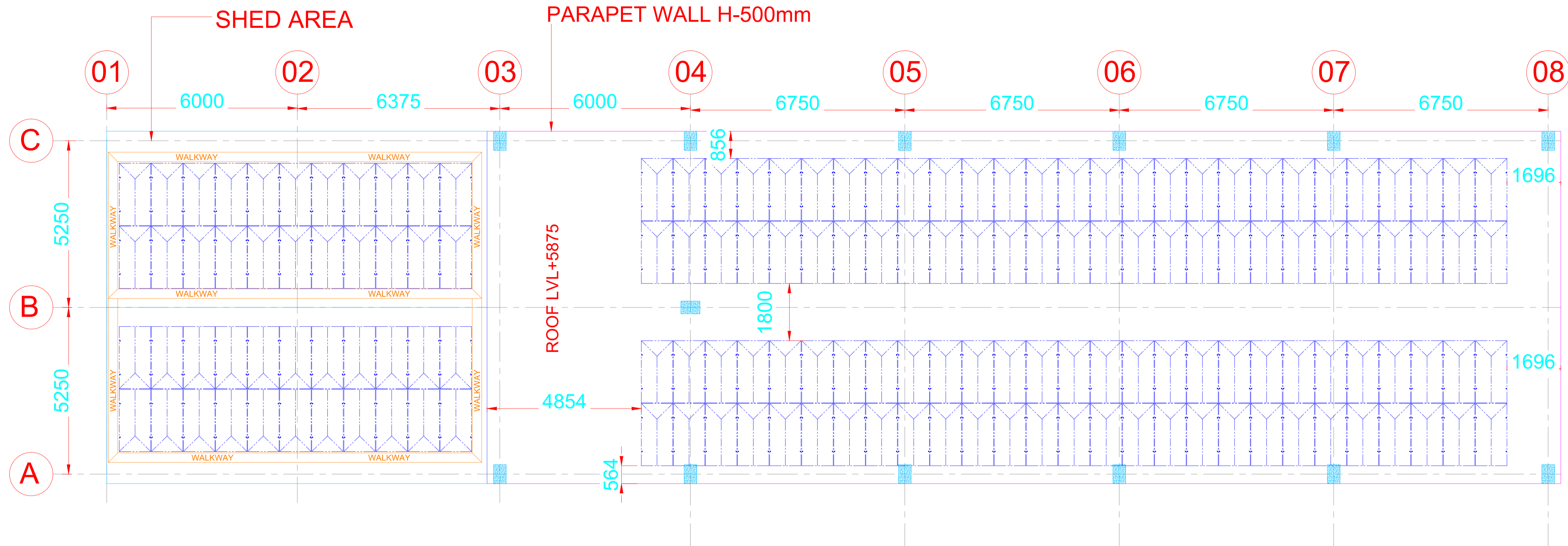
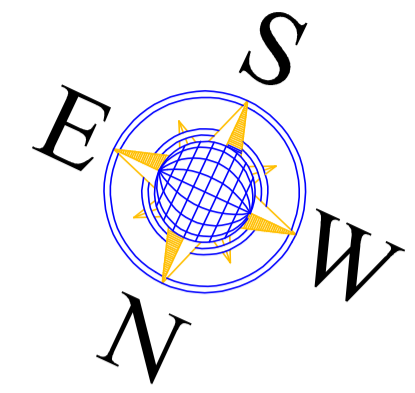




**MODULE LAYOUT PLAN**  
LOCATION - CONTROL ROOM

**TOTAL NO OF MODULES - 30 NOS**

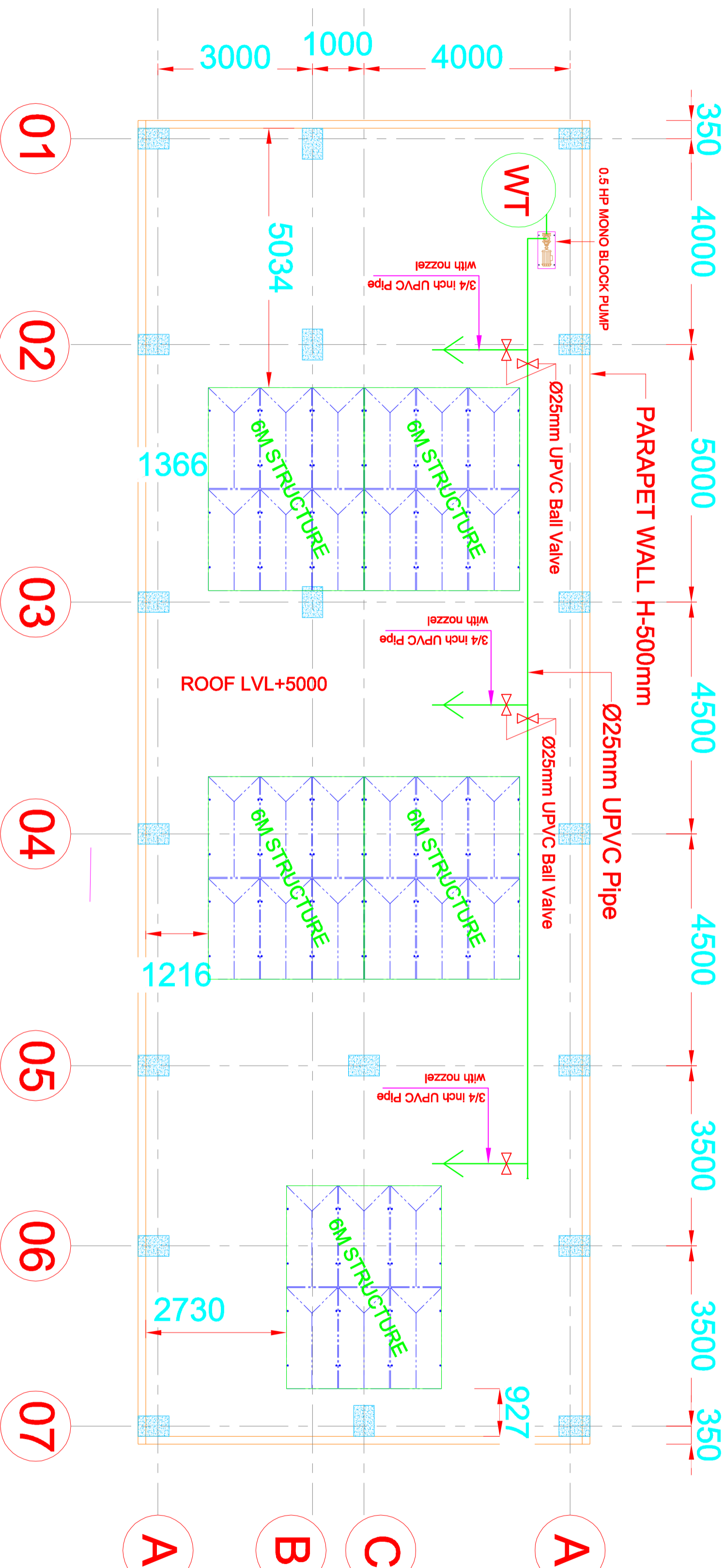
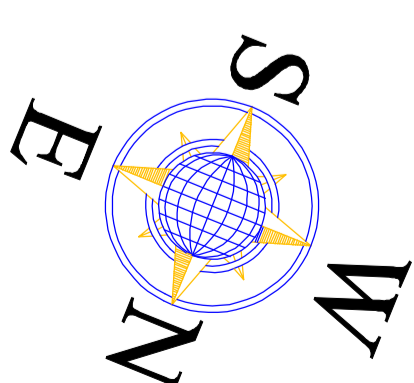
<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 160 KW No of Modules - 30 Nos		<b>SYMBOLS :-</b> -330Wp SOLAR PANEL	
REV.	DATE	REVISION DESCRIPTION	
00	08.02.2020	FIRST ISSUE	
<b>CLIENT:</b>		INDIAN OIL CORPORATION LTD. MUMBAI	
<b>EPC CONTRACTOR</b>		L & T CONSTRUCTION	
<b>SOLAR EPC CONTRACTOR</b>		SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata	
SCALE	1 : 75	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND	
DRAWN	S.R	TITLE: MODULE ARRANGEMENT PLAN CONTROL ROOM	
CHECKED	S.S		
APPROVED	L & T		
Sheet No - 02 of 02		DRG NO: SAVO/IOCL/L&T/UK/CR/MLP/01	A2



**MODULE LAYOUT PLAN**  
**LOCATION - PMCC BUILDING**

Shed Area - 44 Nos  
 Roof Area - 108 Nos  
**TOTAL NO OF MODULES - 152 NOS**

<b>NOTES :-</b> ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED. Project Capacity- 60 KW No of Modules - 152 Nos		<b>SYMBOLS :-</b> - 330Wp SOLAR PANEL - 300mm Walkway	
REV.	DATE	REVISION DESCRIPTION	
00	08.02.2020	FIRST ISSUE	
<b>CLIENT:</b>		INDIAN OIL CORPORATION LTD. MUMBAI	
<b>EPC CONTRACTOR</b>		L & T CONSTRUCTION	
<b>SOLAR EPC CONTRACTOR</b>		SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata	
SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND	
DRAWN	S.R	<b>TITLE:</b> MODULE ARRANGEMENT PLAN PMCC BUILDING	
CHECKED	S.S		
APPROVED	L & T		
Sheet No - 01 of 02		DRG NO: SAVO/IOCL/L&T/UK/PMCC/MLP/01	A2



**NOTES :-**  
 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
 Project Capacity - 60 KW  
 No of Modules - 30 Nos

**SYMBOLS :-**  
 - 30WP Mono SOLAR PANEL

00	08.02.2020	FIRST ISSUE	
REV.	DATE	REVISION DESCRIPTION	
<b>CLIENT :</b> INDIAN OIL CORPORATION LTD. UTTARAKHAND			
<b>EPC CONTRACTOR :</b> L & T CONSTRUCTION			
<b>SOLAR EPC CONTRACTOR :</b> SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata			

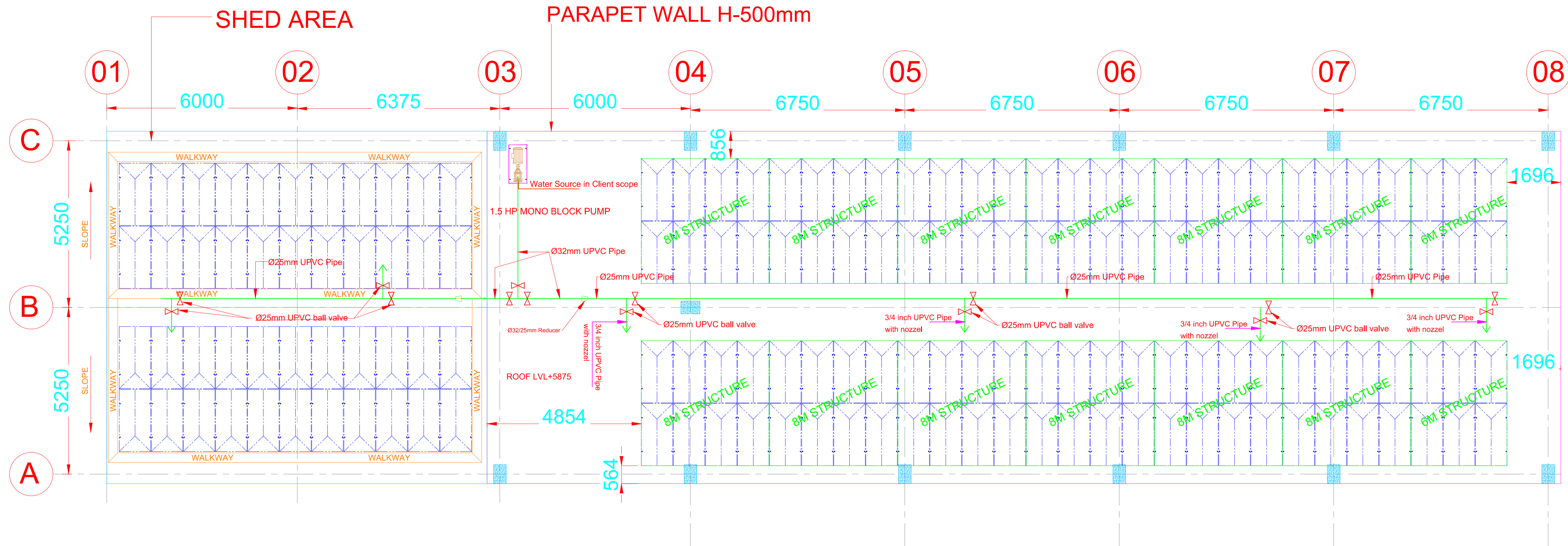
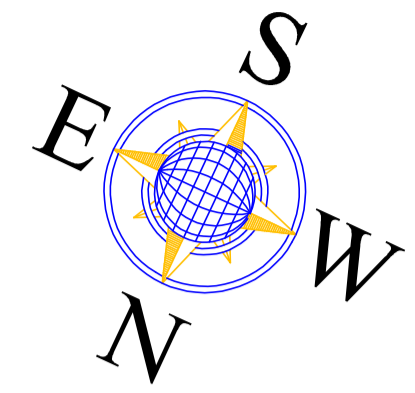
**PLUMBING LAYOUT PLAN**  
**LOCATION - CONTROL ROOM**

**TOTAL NO OF MODULES - 30 NOS**

**PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT**

<b>SCALE</b>	1 : 75	<b>TITLE :</b>	PLUMBING LAYOUT PLAN CONTROL ROOM
<b>DRAWN</b>	S.R	<b>DRG NO :</b>	SAVON/OCL&T/UCR/PLP/01
<b>CHECKED</b>	S.S	<b>SHEET NO :</b>	02 of 02
<b>APPROVED</b>	L & T	<b>DATE :</b>	





## PLUMBING LAYOUT PLAN

### LOCATION - PMCC BUILDING

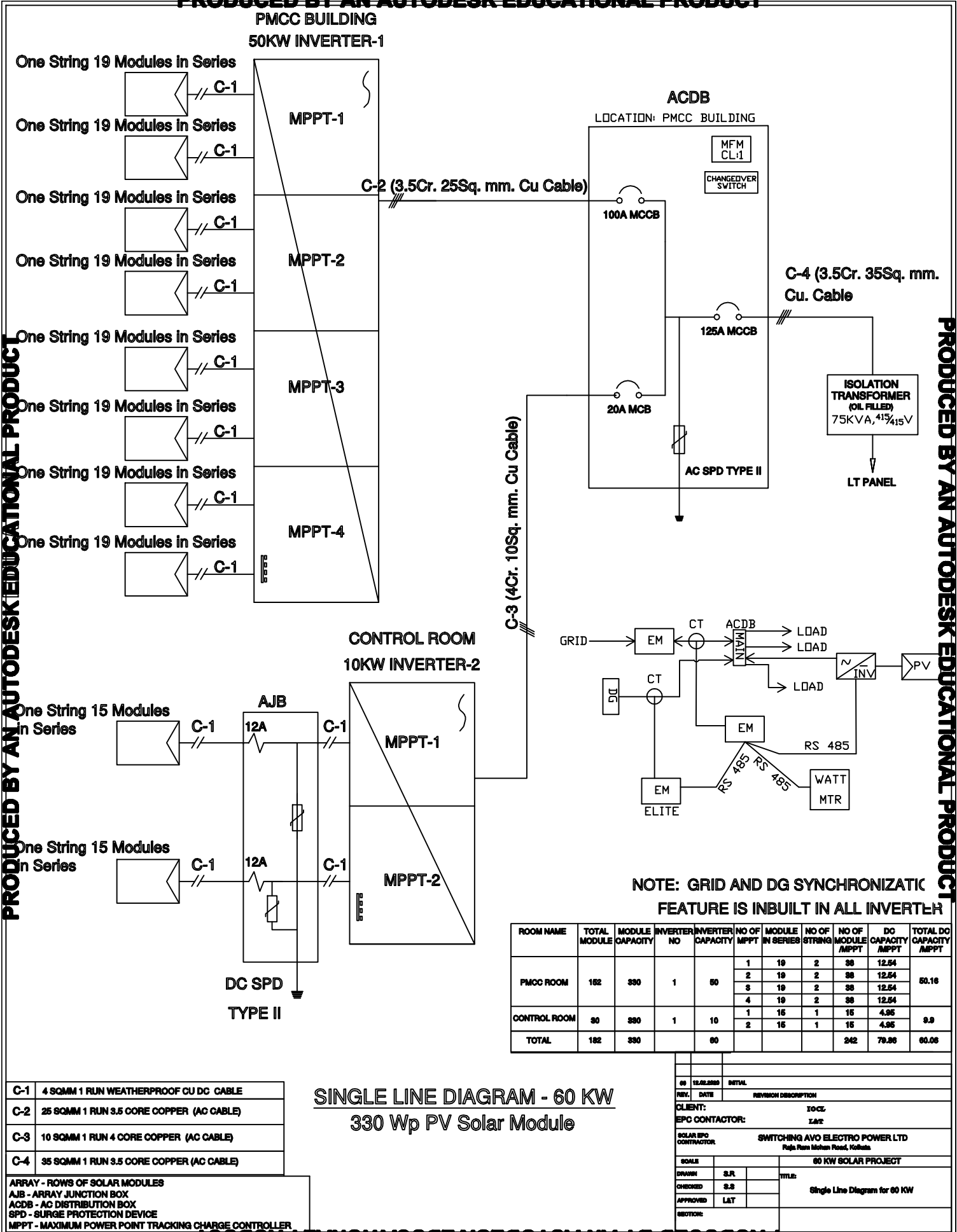
Shed Area - 44 Nos  
 Roof Area - 108 Nos  
**TOTAL NO OF MODULES - 152 NOS**

<b>NOTES :-</b>		<b>SYMBOLS :-</b>	
ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.			
Project Capacity- 60 KW		- 330Wp Warea SOLAR PANEL	
No of Modules - 152 Nos		- 300mm Walkway	

00	08.02.2020	FIRST ISSUE
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REV.	DATE	REVISION DESCRIPTION
CLIENT:  INDIAN OIL CORPORATION LTD., UTTARAKHAND		
EPC CONTRACTOR:  L & T CONSTRUCTION		
SOLAR EPC CONTRACTOR: SWITCHING AVO ELECTRO POWER LTD Raja Ram Mohan Road, Kolkata		

SCALE	1 : 100	EPMC SERVICES OF LPG BOTTLING PLANTS, FOR UTTARAKHAND 60KW PROJECTS
DRAWN	S.R	
CHECKED	S.S	
APPROVED	L & T	
Sheet No - 01 of 02		TITLE: PLUMBING LAYOUT PLAN PMCC BUILDING
		DRG NO: SAVO/IOCL/L&T/UK/PMCC/PLP/01
		A2



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

**SINGLE LINE DIAGRAM - 60 KW**  
330 Wp PV Solar Module

NOTE: GRID AND DG SYNCHRONIZATIC FEATURE IS INBUILT IN ALL INVERTER

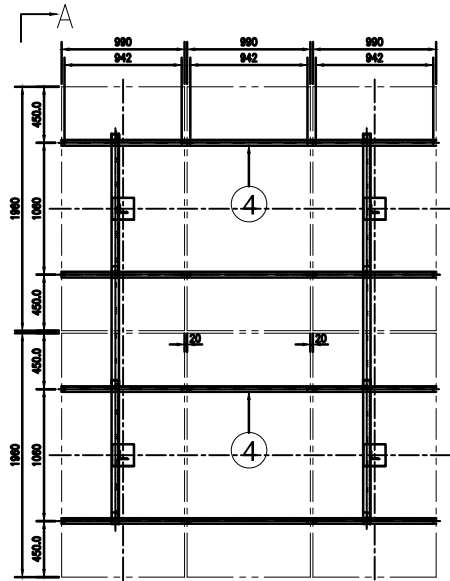
ROOM NAME	TOTAL MODULE	MODULE CAPACITY	INVERTER NO	INVERTER CAPACITY	NO OF MPPT	MODULE IN SERIES	NO OF STRING	NO OF MODULE /MPPT	DC CAPACITY /MPPT	TOTAL DC CAPACITY /MPPT
PMCC ROOM	182	330	1	50	1	19	2	38	12.54	50.16
					2	19	2	38	12.54	
					3	19	2	38	12.54	
					4	19	2	38	12.54	
CONTROL ROOM	30	330	1	10	1	15	1	15	4.95	9.9
					2	15	1	15	4.95	
<b>TOTAL</b>	<b>182</b>	<b>330</b>						<b>242</b>	<b>79.86</b>	<b>60.06</b>

C-1	4 SQMM 1 RUN WEATHERPROOF CU DC CABLE
C-2	25 SQMM 1 RUN 3.5 CORE COPPER (AC CABLE)
C-3	10 SQMM 1 RUN 4 CORE COPPER (AC CABLE)
C-4	35 SQMM 1 RUN 3.5 CORE COPPER (AC CABLE)

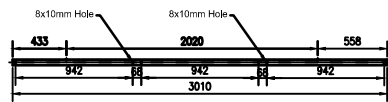
ARRAY - ROWS OF SOLAR MODULES  
 AJB - ARRAY JUNCTION BOX  
 ACDB - AC DISTRIBUTION BOX  
 SPD - SURGE PROTECTION DEVICE  
 MPPT - MAXIMUM POWER POINT TRACKING CHARGE CONTROLLER

REV. NO	12.02.2020	INITIAL
REV. DATE		REVISION DESCRIPTION
CLIENT:	TOCE	
EPC CONTRACTOR:	I&E	
SOLAR EPC CONTRACTOR:	SWITCHING AVO ELECTRO POWER LTD Pulje Pura Mohan Road, Kolkata	
SCALE:	60 KW SOLAR PROJECT	
DRAWN:	S.R.	TITLE:
CHECKED:	S.S.	Single Line Diagram for 60 KW
APPROVED:	LAT	
SECTION:		

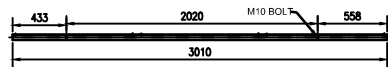
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



PLAN



Top View

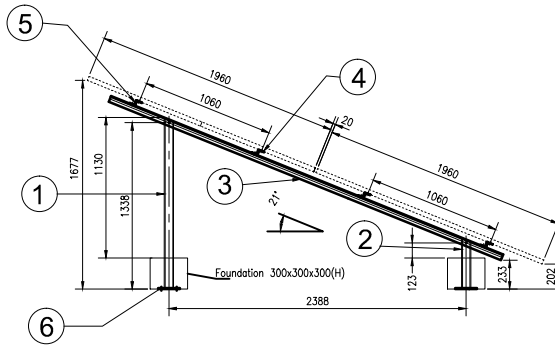


Front View

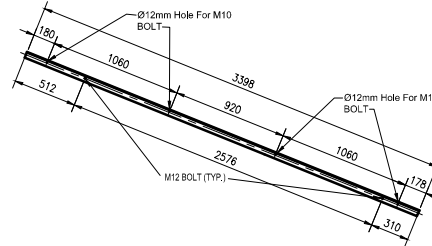
ITEM NO.4

BILL OF MATERIALS

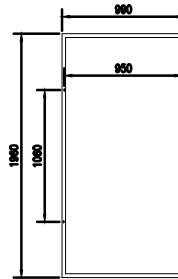
Item No	Description	Unit Wt (in Kgs)	Quantity	Wt in Kgs
1	ISMC 75 Length 1365	6.8	2 Nos	18.56
2	ISMC 75 Length 401	6.8	2 Nos	5.45
3	Cross Member 50x50x6 Length 3398	4.5	2 Nos	30.58
4	Module Fixing 45x45x5 Length 3010	3.4	4 Nos	40.93
5	Angle Cleat 45x45x5	3.4	8 Nos	1.36
6	Base Plate 175x175x8	1.9	4 Nos	7.6
Total				104.16 Kgs



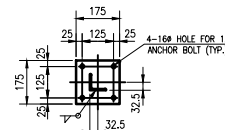
SIDE VIEW



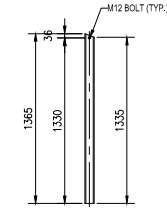
ITEM NO - 3



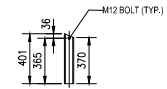
Waree Solar 330Wp



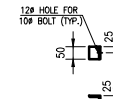
ITEM NO. 6  
BASE PL. 8 THK.



ITEM NO - 1



ITEM NO - 2



ITEM NO.5  
L45x45x5

07 Sets Required

NOTES :- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
Drawings can be best viewed in A3 print only

01	22.07.2019	QUANTITY CHANGED
00	18.07.2019	FIRST ISSUE

REV. DATE REVISION DESCRIPTION

CLIENT: INDIAN OIL CORPORATION LTD.  
UTTRAKHAND

EPC CONTRACTOR: L & T CONSTRUCTION

SOLAR EPC CONTRACTOR: SWITCHING AVO ELECTRO POWER LTD  
Raja Ram Mohan Road, Kolkata

SCALE: 1 : 35  
DRAWN: S.R.  
CHECKED: S.S.  
APPROVED: L & T

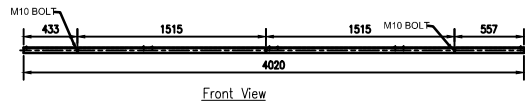
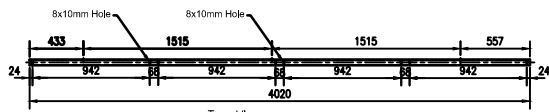
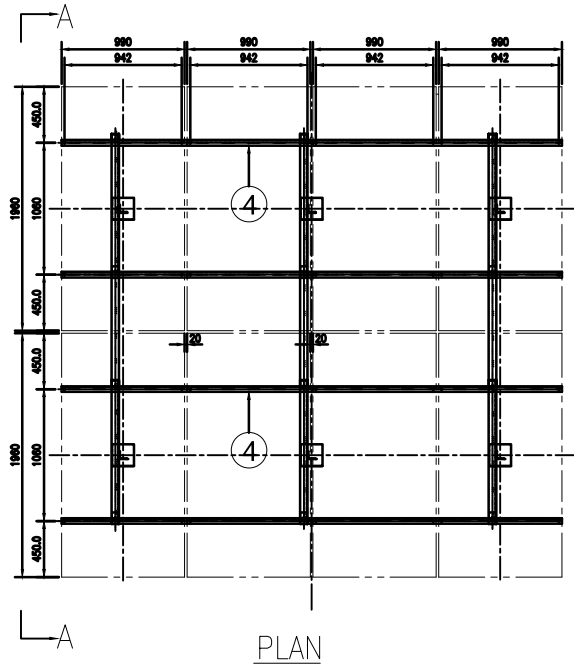
EPMC SERVICES OF LPG BOTTLING PLANTS, FOR  
UTTRAKHAND 60KW PROJECTS

TITLE:  
GA OF 6 MODULE STRUCTURE LAYOUT

Sheet No. - 01 of 01

DRG NO: SAVOIOCLL&TU/6/MS/GA/01

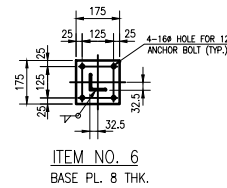
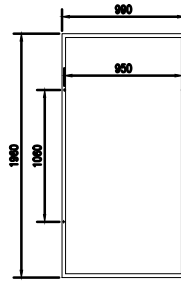
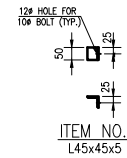
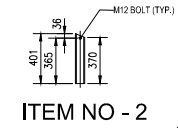
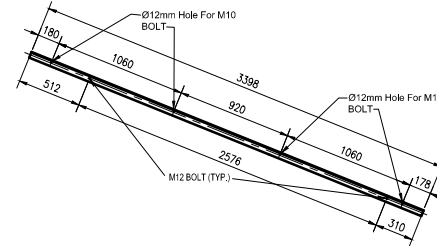
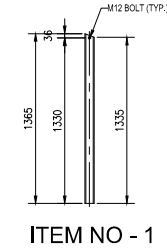
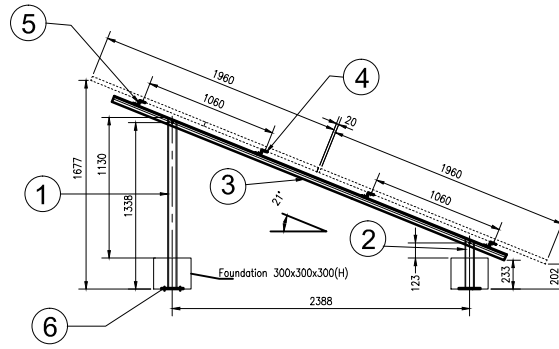
A4



ITEM NO.4

**BILL OF MATERIALS**

Item No	Description	Unit Wt (in Kgs)	Quantity	Wt in Kgs
1	ISMC 75 Length 1365	6.8	3 Nos	27.84
2	ISMC 75 Length 401	6.8	3 Nos	8.18
3	Cross Member 50x50x6 Length 3398	4.5	3 Nos	45.87
4	Module Fixing 45x45x5 Length 4020	3.4	4 Nos	54.67
5	Angle Cleat 45x45x5	3.4	12 Nos	2.04
6	Base Plate 175x175x8	1.9	6 Nos	11.4
Total				150.06



12 Sets Required

NOTES :- ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.  
Drawings can be best viewed in A3 print only

01	22.07.2019	QUANTITY CHANGED
00	18.07.2019	FIRST ISSUE

REV. DATE REVISION DESCRIPTION

CLIENT: INDIAN OIL CORPORATION LTD.  
UTTRAKHAND

EPC CONTRACTOR: L & T CONSTRUCTION

SOLAR EPC CONTRACTOR: SWITCHING AVO ELECTRO POWER LTD  
Raja Ram Mohan Road, Kolkata

SCALE: 1 : 35  
DRAWN: S.R.  
CHECKED: S.S.  
APPROVED: L & T

EPMC SERVICES OF LPG BOTTLING PLANTS, FOR  
UTTRAKHAND 60KW PROJECTS

TITLE:  
GA OF 8 MODULE STRUCTURE LAYOUT

Sheet No. 02 of 02 DRG NO: SAVOIOCLL&TU/UK/8MS/GA/01 A4