ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)
No.1/61-10, Plot no. 48, Ground Floor, 3rd Street, Ravi Colony, Near Kathipara, St. Thomas Mount, Chennai – 600 016.
Phone: 044-22330601, 9710204300 Email : tnagrade@gmail.com Website : www.teiea.com

ISSUE NO. 166 | VOL : No. 14/2019 | MONTHLY ISSUE NO. 12 | PRIVATE CIRCULATION ONLY | DECEMBER 2019

EDITORIAL

Dear Members, Fellow Professionals and Friends,

Greetings To One And All!

Happy Christmas Greetings!!

Advance Greetings For A Happy New Year 2020!!!

The eventful year 2019 is coming to a Happy close this month. The important events have spanned across Economical, Technological, Social, Political, Legal, Defence and other areas. Economic slowdown was reported in the country due to reduction in demands of various items, in particular automobiles, real estate, consumer goods etc, but return to normalcy seems to have commenced due Government actions and natural recovery. Over stress on EVs seems to have created a ripple in the automobile sector, but the right stress should have been for a combination of EVs and 'Hybrid' and 'Higher Efficiency' technologies.

It is indeed advocated by some of the leading names in the industry including the Indian ones that they are planning launch of only Hybrid vehicles which could also be used as EVs only, in due course of time when the technologies come of age. Economic recovery is guaranteed by good monsoon all over and this matters a lot as we are still an agricultural country and a good harvest puts money in the hands of everybody.

Chandrayan 2 was a great Indian attempt which was very successful in many ways, but for the last part. It drew the attention and praise of the world at large and put us among the prestigious group, encouraging us to go ahead with a renewed and better effort. Our space programmes are proceeding without any slackness and we have successfully launched one more Rocket recently. Like our Nuclear expertise gave a big push for our technological recognition, Chandrayan has given one more push.

We have had peaceful elections for the Lok Sabha and many States during the year establishing our firm faith in democracy and demonstrating to the world our commitment and confidence. Historical judgement on Ayodhya, bringing to an end a long standing problem and dispute very satisfactorily and bold efforts to solve Kashmir problem were seen this year. Phulvama attack and our retaliation with Balakot Air Strike were important events demonstrating our abilities and fair actions to protect our country and our commitment to fight terrorism. We have been continuously getting support from various countries of the world to fight terrorism with combined efforts.

Energy Conservation Day is being celebrated on the 14th of the month to reaffirm our commitment and actions to improve further on Energy Efficiency and improved vigor to harness Renewable Energy as we are fully aware of our great potentials. Large scale burning of agricultural wastes in states like Haryana and Punjab seems to continue unabated disturbing the environment in Delhi and various areas all round and long lasting solutions can only come from applications of appropriate waste to energy technologies, providing us with lot of 'Renewable Energy' as well.

Country is celebrating Farmers Day on the 23rd of this month and Tamilnadu will be celebrating the same during Pongal next month. We can gratefully remember the farmers of this country who have always risen to the occasion to step up the production of grains and vegetables and fruits and all other commercial crops, steadily since the time of independence meeting and exceeding the demands of increasing population. It is heartening that the Government is also stressing and initiating lot of measures to help farmers and farming. The area that needs a big push is the mechanization and application of improved technologies and to work for a second Green Revolution.

We thank all those members who have helped us by participating in the advertisement appearing for the issue Nov 2019 – Galaxy Earthing Electrodes Pvt. Ltd., Power Square Engineers (Indotech Transformers Ltd.), Ringlet, Supreme Power Equipment Pvt. Ltd., Visewham Electricals.

Editor

ELECTRICAL INSTALLATION ENGINEER

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Printer : M. VENKATARAMAN

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KNOW THY POWER NETWORK - 147

So far an attempt has been made to equip the Readers with the required skills to face the tight corner/Trade Off situations. A list of similiar topics are furnished here in for further reference and practice.

1. Selection of BEE Star Rated Electrical Equipment like Air Conditioner, Refrigerator and Electrical Fans-Should we go for Three Star Rating or above?

Sl. No.	Parameter	Three Star	Above Three Star
1.	Efficiency	Moderate	High
2.	Electricity Consumption	Moderate	Low
3.	Investment Cost	Comparatively Low	High
4.	Environmental Impacts	Moderate	Low
5.	Payback Period	Comparatively Low	High

Simple Payback period is the final deciding factor in the selection of these equipment. It should be "Three years or less".

$$\text{Simple Payback period in years} = \frac{\text{Capital Cost of the Equipment (In Rupees)}}{\text{Net Annual Savings (In Rupees)}}$$

1. **(Eg.) A New 3 Star Rated Electrical Fan costs around Rs.2,000 and it is expected to reduce the Electricity charges by 5 units/month.**

   Annaul saving at Rs.5/unit = 5 x 12 x 5 = Rs.300

   $$\text{i.e. Payback} = \frac{2000}{300}$$

   = 6.67 years

2. Installation of a New Energy Efficient Equipment in a plant is expected to reduce the annual current consumption by Rs.4,000. Its capital cost is Rs.20,000 and annual maintanence and other operating costs of a Rs.1,000.

$$\text{Expected Payback} = \frac{\text{Rs.20,000}}{\text{Rs. (4,000-1,000)}}$$

$$= \frac{\text{Rs.20,000}}{\text{Rs.3,000}}$$

= 6.67 years

Payback simply indicates the "cutoff periods" over which the investment is recovered. Though it is a crude criteria where time, value of money is ignored is commonly preferred.

Keep close to Nature's heart... and break clear away, once in awhile, and climb a mountain or spend a week in the woods. Wash your spirit clean.
– JOHN MUIR

3. "Decay Effect"

While dealing with Trade Off Situations, please make it a point to steer clear or move away from "Decay Effect" as it will force you to shift your opinion or to change your decisions to "less attractive options". This effect may be compared to Sweet coated pills. Your decision may get decayed on the advice of others or by the options that may have similar looking but less effective attractive. This method of introducing a "Dud" is generally performed to steer your way to an alternative that makes your choice to look better which is illusionary. It has the design to distract you from your objective. Now let us view two more illustrations before going for a list of topics/situations which may merit Trade-Off trails and then final remarks for the topic on hand.

4. Cooum will it be a dead river for ever or can it get back its original status – the life line of Chennai City?

We all know that Cooum was a clean river and functioned as the "Life Line" of Chennai City but we don't know how it attainted the present filth level and how to bring back its original status for glory. The mission to clean this river started in **1890** and yet to find the fulfillment of its objective.

Views for Dead River	**Views for can be Revived**
i. To revive a river, we have to make it useful again. But so far no efforts have been made in this direction.	i. The river body can saved only when people see some use in it. Then they will join together and try to bring its original status so that it is useful again.
ii. Only occasional steps were taken to clean it but met with failure.	ii. In the instant case we have to answer this question first. We should be clear in our vision that all we restoring the river for navigation/transport **or** just for beautification **or** for ecological reasons **or** for economic reasons?
iii. As we have no clear views about our end goal (viz.) its revival, it is difficult to bring back its original position.	On getting the answers, it can be revived back. Greater and sincere participation from the public is essentially required for its revival. Before this all the free flow of sewages into this river should be fully stopped.
iv. It is well high possible to revive it because we have ruined it "beyond repair".	

Let me sign off here. Till then, please stay tuned.

(To be continued…)

V. Sankaranarayanan, B.E., FIE,
Former Addl. Chief Engineer/TNEB
E-mail: vsn_4617@rediffmail.com
Mobile: 98402 07703

I feel more confident than ever that the power to save the planet rests with the individual consumer. – DENIS HAYES

GUIDELINE–ENERGY EFFICIENT STREET LIGHTING-2

Table 8: Cost information for India – Various EE Street Lighting Technologies

Type of Lamp	Luminous Efficacy	Colour Rendering Properties	Lamp Life in Hours	Remarks	Installed Cost [Only Lamp + Luminaire Supply]	Annual Energy Cost	Annual Operating Cost	Total Annualized Cost [Energy Cost + Operating Cost]
	(lm/W)				(INR)	(INR)	(INR)	(INR)
High Pressure Mercury Vapour (MV)	35-65 lm/W	Fair	5,000	High energy use, poor lamp life	465,800	805,920	43,625	849,545
Metal Halide (MH)	70-130 lm/W	Excellent	8,000	High luminous efficacy, poor lamp life	2,449,615	464,954	77,703	542,657
High Pressure Sodium Vapour (HPSV)	50-150 lm/W	Fair	15,000	Energy-efficient, poor colour rendering	1,750,286	345,394	10,512	355,906
Low Pressure Sodium Vapour	100-190 lm/W	Very Poor	15,000	Energy-efficient, very poor colour rendering	1,370,400	394,200	119,837	514,037
Low Pressure Mercury Fluorescent Tubular Lamp (T12 &T8)	30-90 lm/W	Good	5,000	Poor lamp life, medium energy use, only available in low wattages	390,857	550,629	36,041	586,670
Energy Efficient Fluorescent Tubular Lamp (T5)	100-120 lm/W	Very Good	5,000	High luminous efficacy, only available in low wattages	510,000	474,500	105,120	579,620
Light Emitting Diode (LED)	70-160 lm/W	Good	50,000	High energy savings, low maintenance, long life, no mercury. High investment cost, nascent technology	6,000,000	372,300	0 [incon -sequential]	372,300

Source: *Industry data provided by Electric Lamp and Component Manufacturers' Association (ELCOMA) of India. Assuming 7.5 m. wide, dual carriageway type, 1 km. long road*

Dimming Guidance

- *To avoid reduced lamp life, the dimming of HID lamps should not exceed:*
  - *30% for sodium vapour lamp*
  - *50% for metal halide*
- *Ideal application of dimming includes:*
  - *Non-critical street lights*
  - *Parking garages*

- *Warehouses and supermarkets*
- *Security lighting*
- *The use of HPSV/metal halide lamps on dimming systems can result in issues such as colour shift and poor lamp performance.*
- *If the supply voltage is less than 220 V after 10 pm, the dimming method may not be suitable for energy efficiency in street lighting because of public safety issues.*

Dimming High Intensity Discharge Lamps

The exact performance of any HID dimming system or lamp on the system is dependent on the specific dimming circuitry employed with specific ballasts and lamps. As there are few existing standards for the dimming of HID lighting systems, it is recommended that the user and lighting designer evaluate any new proposed combination of components as a system and test it in the field to ensure that the combined performance of the system is acceptable.

Operation & Maintenance

Energy consumption for street lighting can be reduced by incorporating good maintenance practices such as:

- Replacing defective lamps, accessories, and wires
- Early rectification of cable faults
- Making sure that cables are joined properly
- Regular maintenance of service cabinet/fuse box to avoid loose connections
- Regular cleaning of the luminaire cover to keep it free of dust/dirt and increase light output

A substantial amount of energy savings can also be achieved by installing mechanical/electronic timers and/or daylight sensors for turning street lights on and off.

Metering & Monitoring

Metering is an important component in a street lighting system to properly monitor the performance of the system and energy use, and measure and verify the energy savings in case the system needs to be updated. Defective meters should be replaced immediately to avoid average billing by electricity boards. Advanced technologies like remote monitoring of switching points in street lights can be utilized to record information such as:

- Instant energy consumption
- Trend analysis
- Patterns of energy consumption

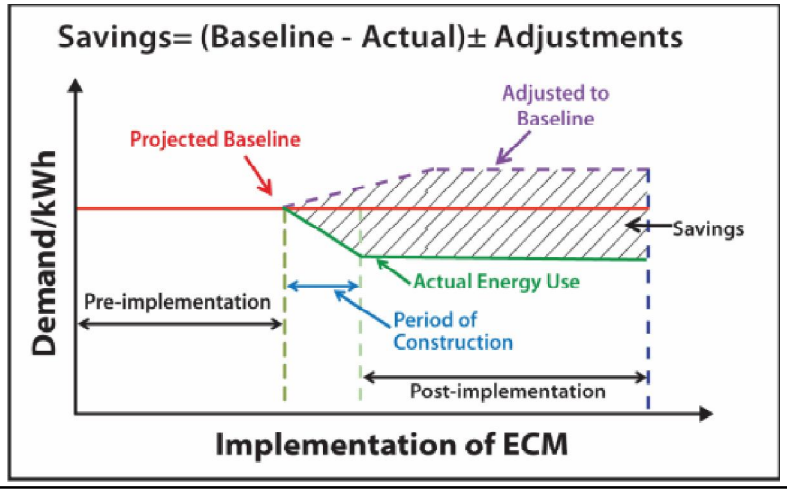
These can then be used to identify and analyze reasons for increases or decreases in energy consumption.

Measurement & Verification (M&V)

Energy efficiency street lighting projects cover energy efficiency retrofits, load shifting, load shedding, controls and automation or combinations of the above. These projects, when implemented properly, achieve reduced energy consumption and result in demand and cost savings. The objective of M&V is to provide a credible, transparent, and replicable process that can be used to quantify and assess the impacts and sustainability of implemented energy-efficiency projects. The basic principle in M&V is comparing the measured electricity consumption and demand before and after implementation to determine the electricity savings. This is demonstrated in the International Performance Measurement & Verification Protocol (IPMVP)'s equation below (Efficiency Valuation Organization, 2007) and illustrated in Figure at the bottom.

Electricity Saving: *(Pre-implementation electricity use) – (Post-implementation electricity use) ± Adjustments*

The pre-implementation electricity use conditions are described as the baseline. The baseline represents the electricity use linked to a set of conditions under which the street lighting system was operating prior to implementation. These baseline details should include baseline period, baseline energy consumption, and demand data, and all independent variables data coinciding with the energy data (e.g. operating hours, agreed burnout rate, project boundary). If the aforementioned factors remain unchanged, the post-implementation electricity use can be directly compared without any adjustments. However, baseline adjustments are necessary to bring the two time periods under the same set of operational conditions (if any of the pre-implementation conditions changed). Therefore, adjustments are made to restate baseline electricity use under post-implementation conditions. In order to determine the savings, it is essential to establish a post-implementation energy usage scenario if the efficiency intervention had not taken place. The baseline documentation typically requires well-documented audits, surveys, inspections, and/or short term metering activities. The extent of this information is determined by the measurement boundary chosen for the projects.



M&V diagram

M&V Options

M&V of savings can be calculated by following the IPMVP guidelines (Efficiency Valuation Organization, 2007). The IPMVP is the culmination of many years of development of M&V concepts and methodologies through the cooperation of international experts and practitioners. There are two basic methods for calculating savings: the retrofit isolation method and the whole facility method, and each method can be further sub-divided into two sub-options (Options A and B for retrofit isolation method and Options C and D for whole-facility method). Options A, B and C are outlined below (as Option D – Calibrated Simulation, is not suitable for this application).

The appropriate method is selected based on the needs of the utility. If an assessment of a particular retrofit is to be done, then the retrofit isolation method should be used. On the other hand, if the total energy use is to be determined, the whole facility method should be selected. The following section describes the methods and options.

Retrofit Isolation Method

Option A – Key Parameter Measurement

This option only measures the key parameter/s used in the energy computation. It is most applicable when operation conditions are either constant (operating hours can be estimated based on historical patterns of use) or variable (where measurement of operating hours will have to be done on site) and it is possible to assume parameters with a level of certainty that is acceptable to all parties. Savings are typically determined by field measurement of the key performance parameter (s) which define the energy use of the system affected by the energy conservation measure (ECM). The frequency of measurement ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period.

Example: The type of lamp fitting in a lighting installation is changed to a more efficient type while maintaining the same quality of lighting. Energy savings are determined by measuring the energy used by the old and new lighting systems. However the numbers of hours of use may have to be stipulated if the lights are controlled manually. In this case only performance (power drawn by the lighting circuit which was upgraded and in some cases lighting level measurements before and after the project implementation) is measured while operation is stipulated.

kWh (savings) = *(kWpre – kWpost) × hours*

In this case, the energy savings are achieved by reducing the installed lighting demand.

Option B – All Parameter Measurement

This option is used for a single ECM where all factors governing energy use are included. Here, both the performance and the operation should be monitored and measured. Savings are determined by field measurement

of the energy use of the system under consideration. The savings are verified by engineering calculations using short-term or continuous measurements, depending on the expected variations in the savings and the length of the reporting period.

Example: In the example above, if automatic lighting controls are included there is no point in stipulating hours of operation, as that would not allow measurement of the impact of the controls. Therefore, total consumption before and after the ECM should be measured and compared.

Examples for routine adjustments include agreed burn out, and switching on and off time. Non-routine adjustments include an increase in the agreed burn out, additional load, change of wattage, non-functioning of timers or controls, and unauthorized tapping of power.

kWh (savings) = $(kW) \times (hrs_{pre} - hrs_{post}) \pm Adjustments$

Here the operating hours are reduced by using a control device on the lighting circuit.

Whole Facility Method

Option C – Whole Facility

This option is used for either a single ECM or multiple ECMs within a whole facility or complete street lighting installation. Savings are determined by measuring energy use at the whole-facility or sub-facility level. Continuous measurements of the entire facility's energy use are taken throughout the reporting period. Both baseline and reporting period data are needed for the calculation using this option. Energy use should be measured by utility meters for 12 months of the base year and continuously throughout the post-retrofit period. The actual measured consumption in the post-retrofit period is compared with an estimate of what the consumption would have been, in the post-retrofit period, without the ECM. The post-retrofit savings are the difference between the estimated "baseline energy use" in the post-retrofit period and the actual energy measured in the post-retrofit period.

In general, Option C should be used with complex equipment replacement and controls projects where projected savings are relatively large (e.g., at least 20% of the total energy use). It is suggested that Option C be applied in cases where there is a high degree of interaction between installed ECMs or between ECMs and the rest of the facility, or when the isolation and metering of individual ECMs is difficult and costly.

kWh (savings) = $(kW_{pre} \times hrs_{pre}) - (kW_{post} \times hrs_{post}) \pm Adjustments$

This combines efficiency and control improvements.

Example: An entire street lighting system is retrofitted with various ECMs including lighting retrofits (replacements of lights and fixtures), a power conditioning unit, a dimming mechanism, and supervisory control and data acquisition (SCADA) systems. In this case the ECMs may have individual contributions to the total savings and may also interact with other ECMs (e.g., reducing lighting impacts due to controlled voltage supply); the overall effect may therefore be difficult to determine if only individual measures are taken.

Advantages of Effective Energy-Efficient Street Lighting

By adopting new and energy-efficient technologies and introducing procurement practices that promote the purchase of these technologies, large energy and cost savings can be achieved. Considering the variable power quality conditions in India, selection of lamps that operate over a wide range of power parameters would significantly reduce the replacement costs of the lamps by reducing the failure rate, although it may entail a high initial investment cost. The efficiency of street lighting can also be significantly improved by selecting appropriate optics for the luminaires as well as ensuring proper mounting height, overhang, and angle of tilt in a street lighting installation. Following these guidelines can enhance visibility and safety, and help reduce electricity consumption and costs, so as to free up resources for other pressing needs, thereby contributing to the improvement of the overall quality of life.

Advantages of Effective Energy-efficient Street Lighting (NYSERDA, 2002)

- ***Enhanced quality of life for people***
- ***Uniformly lit roads and sidewalks***
- ***Reduced glare and improved visibility***
- ***Improved safety and security***
- ***Energy savings***
- ***Capital cost savings***
- ***Maintenance cost savings***
- ***Aesthetically pleasing atmosphere***

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ELECTRICAL QUESTION & ANSWER PART - 1

1. Why ELCB cannot work if Neutral input of ELCB does not connect to ground?

- ELCB is used to detect earth leakage fault. Once the phase and neutral are connected in an ELCB, the current will flow through phase and that same current will have to return neutral so resultant current is zero.
- Once there is a ground fault in the load side, current from phase will directly pass through earth and it will not return through neutral through ELCB. That means once side current is going and not returning and hence because of this difference in current ELCB will trip and it will safe guard the other circuits from faulty loads. If the neutral is not grounded fault current will definitely high and that full fault current will come back through ELCB, and there will be no difference in current.

2. What is the difference between MCB & MCCB, Where it can be used?

- MCB is miniature circuit breaker which is thermal operated and use for short circuit protection in small current rating circuit.
- Normally it is used where normal current is less than 100A.
- MCCB moulded case circuit breaker and is thermal operated for over load current and magnetic operation for instant trip in short circuit condition. Under voltage and under frequency may be inbuilt.
- Normally it is used where normal current is more than 100A.

3. Why in a three pin plug the earth pin is thicker and longer than the other pins?

- It depends upon $R=\rho L/A$ where area (A) is inversely proportional to resistance (R), so if area (A) increases, R decreases & if R is less the leakage current will take low resistance path so the earth pin should be thicker. It is longer because the The First to make the connection and last to disconnect should be earth Pin. This assures Safety for the person who uses the electrical instrument.

4. Why Delta Star Transformers are used for Lighting Loads?

- For lighting loads, neutral conductor is must and hence the secondary must be star winding and this lighting load is always unbalanced in all three phases.
- To minimize the current unbalance in the primary we use delta winding in the primary So delta / star transformer is used for lighting loads.

5. What are the advantages of star-delta starter with induction motor?

- The main advantage of using the star delta starter is reduction of current during the starting of the motor. Starting current is reduced to 3-4 times of current of Direct online starting Hence the starting current is reduced , the voltage drops during the starting of motor in systems are reduced.

6. What is meant by regenerative braking?

- When the supply is cut off for a running motor, it still continue running due to inertia. In order to stop it quickly we place a load (resistor) across the armature winding and the motor should have maintained continuous field supply so that back e.m.f voltage is made to apply across the resistor and due to load the motor stops quickly. This type of breaking is called as “Regenerative Breaking”.

7. When voltage increases then current also increases then why we need of over voltage relay and over current relay? Can we measure over voltage and over current by measuring current only?

- No. We cannot sense the over voltage by just measuring the current only because the current increases not only for over voltages but also for under voltage (As most of the loads are non-linear in nature).So, the over voltage protection & over current protection are completely different.
- Over voltage relay meant for sensing over voltages & protect the system from insulation break down and firing. Over current relay meant for sensing any internal short circuit, over load condition, earth fault

thereby reducing the system failure & risk of fire. So, for a better protection of the system. It should have both over voltage & over current relay.

8. If one lamp connects between two phases it will glow or not?

- If the voltage between the two phases is equal to the lamp voltage then the lamp will glow.
- When the voltage difference is big it will damage the lamp and when the difference is smaller the lamp will glow depending on the type of lamp.

9. What are HRC fuses and where it is used?

- HRC stand for "high rupturing capacity" fuse and it is used in distribution system for electrical transformers

10. Mention the methods for starting an induction motor?

The different methods of starting an induction motor

- DOL: direct online starter
- Star delta starter
- Auto transformer starter
- Resistance starter
- Series reactor starter

11. What is the difference between earth resistance and earth electrode resistance?

- Only one of the terminals is evident in the earth resistance. In order to find the second terminal we should recourse to its definition:
- Earth Resistance is the resistance existing between the electrically accessible part of a buried electrode and another point of the earth, which is far away.
- The resistance of the electrode has the following components:
  a) The resistance of the metal and that of the connection to it.
  b) The contact resistance of the surrounding earth to the electrode.

12. Why most of analog o/p devices having o/p range 4 to 20 mA and not 0 to 20 mA?

- 4-20 mA is a standard range used to indicate measured values for any process. The reason that 4ma is chosen instead of 0 mA is for fail safe operation.
- For example: A pressure instrument gives output 4mA to indicate 0 psi up to 20 mA to indicate 100 psi or full scale. Due to any problem in instrument (i.e) broken wire, its output reduces to 0 mA. So if range is 0-20 mA then we can differentiate whether it is due to broken wire or due to 0 psi.

13. Two bulbs of 100w and 40w respectively connected in series across a 230v supply which bulb will glow bright and why?

- Since two bulbs are in series they will get equal amount of electrical current but as the supply voltage is constant across the Bulb (P=V^2/R). So the resistance of 40W bulb is greater and voltage across 40W is more (V=IR) so 40W bulb will glow brighter.

14. What happen if we give 220 volts dc supply to bulb or tube light?

- Bulbs or devices for AC are designed to operate such that it offers high impedance to AC supply. Normally they have low resistance. When DC supply is applied, due to low resistance, the current through lamp would be so high that it may damage the bulb element

15. What is meant by knee point voltage?

- Knee point voltage is calculated for electrical Current transformers and is very important factor to choose a CT. It is the voltage at which a CT gets saturated.

(To be continued)

QUICK REFERENCE-FIRE FIGHTING (Part-1)

Class of Fire

Class	Type of Fire	Type of fire Extinguisher
Class A	Fires involving Paper, Wood, Textile, Packing materials and the like.	Water, foam, ABC dry power and halocarbons.
Class B	Fires involving Oil, Petrol, Solvent, Grease, Paints, Celluloid and the like.	Foam, dry powder, clean agent and carbon dioxide extinguishers
Class C	Fires involving Electrical Hazards, Motor Vehicle Gaseous substance under pressure.	Dry powder, clean agent and carbon dioxide extinguishers
Class D	Fires involving Chemicals, Metal and active like Magnesium, titanium	Extinguishers with special dry powder for metal tires

Area covered by Fire Extinguisher (NBC)

Type of Fire Extinguishers	Coverage (Floor) Area
Water/ Sand Bucket	100 sq.mt.
Sprinklers	6 sq.mt.
Extinguishers (9 Liter)	600 sq.mt.
Heat Detectors	16 sq.mt.
Hydrant Riser (Outlet 100 mm dia with landing valve and First aid hose reel)	930 sq.mt
Smoke Detectors	50 sq.mt.

Water Requirement for the Fire Fighting (AS per NBC)

Q = 3000 P

Q = Fire demand in Litres/Minutes

P = Population in Thousands

Note: The above rate must be maintained at a minimum pressure of 1 to 1.5 kg / cm^2 for at least four hours.

Water Requirement for Wet Riser/Down Corner System (As per NBC -TABLE 4)

Residential Buildings	U.G. Water Storage Tank Static	Terrace Tank
15 m to 30 m	50,000 lts	10,000 lts
30 m to 45 m	1,00,000 lts	20,000 lts
Above 45 m	2,00,000 lts	40,000 lts

A true conservationist is a man who knows that the world is not given by his fathers, but borrowed from his children.

– ***JOHN JAMES AUDUBON***

Water Requirement for Wet Riser/Down Corner System (As per NBC -TABLE 5)

Residential Buildings	U.G. Water Storage Tank Static	Terrace Tank
15 m to 30 m	100000 lts (50000 lts if covered area in G.F is less than 300sq.m.)	20,000 lts
30 m to 45 m	20000 lts	20,000 lts
Above 45 m	250000 lts.	50,000 lts

Classification of fire Pumps (As per IS 15301)

Pump Size	Location of Pump Installation
450 Litre/Min	Pumps to be installed on the terrace to feed the Down Comer System.
900 Litre/Min	Pumps to be installed on the terrace to feed the Down Comer System.
2280 Litre/Min	Pumps are to be housed in the pump house.
2850 Litre/Min	Pumps are to be housed in the pump house.
4500 Litre/Min	Pumps are to be housed in the pump house.
For special risks 6700 Litre/Min	Pumps are to be housed in the pump house.

Suction and Delivery Pipe Sizes (IS 3844)

Pump Size	Pump Location	Suction	Delivery
450 Litre/min	Terrace	50 mm	50 mm
900 Litre/min	Terrace	75 mm	50 mm
1400 Litre/min	Terrace	100 mm	100 mm
2280 Litre/min	Fire Pump	150 mm	150 mm
2850 Litre/min	Fire Pump	200 mm	150 mm
4500 Litre/min	Fire Pump	250 mm	200 mm
6700 Litre/min	Fire Pump	250 mm	200 mm

Different Types of Fire Extinguishers for Different Classes of Fires (IS 2190)

Type of Extinguisher	IS	Type of Fires			
		Class A	Class B	Class C	Class D
water type (gas cartridge)	IS 940 , IS 13385	S	NS	NS	NS
water type (stored pressure)	IS 6234	S	NS	NS	NS
mechanical foam type (gas catridge)	IS 10204, IS 13386	S	S	NS	NS
mechanical foam type (stored pressure)	IS 14951,IS 15397	S	S	NS	NS
dry powder type (stored pressure)	IS 13849	S	S	S	NS
dry powder type (gas cartridge)	IS 2171 , IS 10658	S	S	S	NS
dry powder type for metal fires	IS 11833	NS	NS	NS	S

Type of Extinguisher	IS	Type of Fires			
		Class A	Class B	Class C	Class D
carbon dioxide type	IS 2878, IS 8149	NS	S	S	NS
clean agent gas type	IS 15683	S	S	S	NS
halon 1211 type	IS 4862 , IS 11108	S	S	S	NS

PRESSURE TESTING OF FIRE EXTINGUISHERS (IS 2190)

Type of Extinguisher	IS	Test Interval (Year)	Test Pressure (kg/cm^2)	Pressure Maintained for Min. (kg/cm^2)
Water type (gas cartridge)	IS 940	3	35	2.5
Water type (stored pressure)	IS 6234	3	35	2.5
Water type (gas cartridge)	IS 13385	3	35	2.5
Mechanical foam type (gas cartridge)	IS 10204	3	35	2.5
Mechanical foam type (stored pressure)	IS 15397	3	35	2.5
Mechanical foam type (gas cartridge)	IS 13386	3	35	2.5
Mechanical foam type (gas cartridge) 135 liter	IS 14951	3	35	2.5
Dry powder (stored pressure)	IS l3849	3	35	2.5
Carbon dioxide	IS 2878	5	250	2.5
Clean agent	IS 15683	3	35	2.5
Dry powder (gas cartridge)	IS2171, IS10658	3	35	2.5

LIFE OF FIRE EXTINGUISHERS (IS 2190)

Type of Extinguisher	Life Time, Year
Water type	10
Foam type	10
Powder type	10
Carbon dioxide	15
Clean agent	10

We need the tonic of wildness...At the same time that we are earnest to explore and learn all things, we require that all things be mysterious and unexplorable, that land and sea be indefinitely wild, unsurveyed and unfathomed by us because unfathomable. We can never have enough of nature. – HENRY DAVID THOREAU

RECOMMENDATIONS FOR INSTALLATION OF FIRE EXTINGUISHERS (IS 2190)

Occupancy	Type of Occupancy	Nature of Occupancy	Class of Fire	Typical Examples
Group A	Residential buildings	Low Hazard	CLASS A	Lodging or rooming, one or two family houses, private dwellings, dormitories, apartment houses, flats, up to 4 star hotels, etc.
		Low Hazard	CLASS C	Small kitchens having LPG connection, electrical heaters, etc.
		Medium Hazard	CLASS A	Multi-storied buildings, multi-risk buildings, five star hotels, etc.
Group B	Educational buildings	Low Hazard	CLASS A	Tutorials, vocational training institutes, evening colleges, commercial institutes
		Medium Hazard	CLASS A	Schools, colleges, etc.
Group C	Institutional buildings	Medium Hazard	CLASS A	Hospitals, sanatoria, homes for aged, orphanage jails, etc.
Group D	Assembly buildings-D-1	High Hazard	CLASS A	Theatres, assembly halls, exhibition halls, museums, restaurants, places of worship, club rooms, dance halls, etc. having seating capacity of over 100 persons
	Assembly buildings-D-2	High Hazard	CLASS A	Theatres, assembly halls, exhibitions halls, museums, restaurants, places of worship, club rooms, dance halls, etc. having seating capacity less than 1000 persons
	Assembly buildings-D-3	High Hazard	CLASS A	Theatres, assembly halls, exhibition halls, museums, restaurants, places of worship, club rooms, dance halls, etc. but having accommodation for more than 300 persons, but less than 1000 persons, with no permanent seating arrangement
	Assembly buildings-D-4 / D5	Low Hazard	CLASS A	Theatres, assembly halls, exhibition halls, museums, restaurants, places of worship, club rooms, dance halls, etc. but having accommodation less than 300 and those not covered under D-l to D-3
Group E	Business buildings-E-1	Special Hazard	CLASS A	Offices, banks, record rooms, archives, libraries, data processing centers, etc.
	Business buildings-E-2	Medium Hazard	CLASS B	Laboratories, research establishment, test houses, etc.
	Business buildings-E-3	Special Hazard	CLASS A	Computer installations

Occupancy	Type of Occupancy	Nature of Occupancy	Class of Fire	Typical Examples
Group F	Mercantile buildings	Medium Hazard	CLASS A	Shops, stores, markets, departmental stores, underground shopping centers, etc.
Group G	Industrial buildings	Low Hazard	CLASS A	Small industrial units
		Medium Hazard	CLASS A	Corrugated carton manufacturing units, paper cane units, packing case manufacturing units, cotton waste manufacturing units
		HH	CLASS A	Large number yards, saw mills, godowns and warehouses storing combustible materials, cold storages, freight depots, etc.
		Low Hazard	CLASS B	Demonstration chemical plants, small chemical processing plants, pilot plants, etc.
		Medium Hazard	CLASS B	Workshops, painting shops, large kitchens, industrial canteens, generator rooms, heat treatment shops, tread rubber manufacturing units, petrol bunks, tubes and Haps units, etc.
		High Hazard	CLASS B	Petroleum processing units, chemical plants, industrial alcohol plants, effluent treatment plants, etc.
		High Hazard	CLASS C	Fertilizer plants, petrochemical plants, LPG bottling plants, etc.
		High Hazard	CLASS D	All processes involving use of combustible highly flammable materials, reactive metals and alloys, including their storage
Group H	Storage buildings	Medium Hazard	CLASS B	Flammable liquid stores, storage in drums and cans in open, paints and varnishes go down
		High Hazard	CLASS B	Tank farms, chemical and petroleum bulk storage depots, large service stations, truck and marine terminals, underground LDO/furnace oil storage yards, etc.
		Medium Hazard	CLASS C	LPG distribution godown/office, distribution storage godowns/offices of D, N, H, Argon and other industrial gases
		High Hazard	CLASS C	Storage and handling of gas cylinders in bulk, gas plant, gas holders (Horton), spheres, etc.
Group J	Hazardous	–	–	Buildings used for storage, handling, manufacture and processing of highly combustible explosive materials. (Risks involved in terms of class of fire and intensity of fire has to be assessed on case to case basis and statutory authorities to be consulted, environmental factors and mutual aid facilities to be taken into account before deciding on the fire extinguisher requirements.)

RECOMMENDED EQUIPMENT TO BE INSTALLED (IS 2190)

Class of Fire	Occupancy	No of Fire Systems
CLASS A	Low Hazard	One 9 litre water expelling extinguisher or ABC 5 kg/6 kg fire extinguisher, for every 200 m^2 of floor area or part thereof with minimum of two extinguishers per compartment or floor of the building.
	Medium Hazard	Two 9 litre water expelling extinguishers or ABC 5 kg / 6 kg fire extinguisher, for every 200 m^2 with minimum of 4 extinguishers per compartment floor.
	Medium Hazard	Provision as per MH occupancy; in addition to one 50 litre water CO_2/25 kg ABC fire extinguisher for every 100 m^2 of floor area
	Special Hazard	One 4.5 kg capacity carbon dioxide or one 2/3 kg capacity clean agent extinguisher for every 100 m^2 of floor area or part thereof with minimum of two extinguishers
CLASS B	Low Hazard	One 9 litre foam extinguisher, mechanical or BC or ABC, 5 kg/6 kg fire extinguisher, for every 200 m^2 of floor area or part thereof with minimum of two extinguishers per compartment or floor.
	Medium Hazard	Two 9 litre foam extinguisher, mechanical type, or 5/6 kg dry powder extinguisher (or one of each type) for every 200 m^2 area with minimum of four extinguisher per compartment
	Medium Hazard	Provision as per MH, and in addition to one 50 litre mechanical foam type extinguisher or 25 kg BC fire extinguisher for every 100 m^2 or part thereof one l35 litre foam mechanical extinguisher for every 300 m^2 of floor area
CLASS C	Low Hazard	One 2/3 kg dry powder of clean agent extinguisher for every 20 m^2 of floor area
	Medium Hazard	One 10 kg dry powder extinguisher (stored pressure) or 6.5 kg carbon dioxide extinguisher or 5 kg clean agent for 100 m^2 of floor area or part thereof, with minimum of one extinguishers of the same type for every compartment;
	High Hazard	Dry powder extinguisher (stored pressure) of 10 kg or 6.5 kg CO_2 extinguisher, or 5 kg clean agent extinguisher for every 100 m^2 of floor area or part thereof, subject to a minimum of two extinguishers of same type per room or compartment.
CLASS D	High Hazard	One 10 kg dry powder extinguisher with special dry powder for metal fires for every 100 m^2 of floor area or part thereof with minimum of two extinguishers per compartment/room

UTTAR PRADESH TO BECOME FIRST STATE TO LAUNCH BLOCKCHAIN-ENABLED SOLAR POWER TRADING (ROOF TOP PROJECTS)

The UP government has introduced blockchain technology for its rooftop solar power segment and is the first state that has amended its regulatory framework to enable P2P energy trading in India

New Delhi: Uttar Pradesh is set to become the first state in India to launch blockchain-enabled solar power trading.

Two state-owned entities – Uttar Pradesh Power Corporation (UPPCL) and Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA) – will host the first pilot project involving energy generated from solar rooftop projects installed on state government buildings.

The pilot project is being implemented by Australian company PowerLedger in partnership with India Smart Grid Forum (ISGF), a public private partnership initiative of the power ministry.

Phase-I of the pilot project will focus on a few government buildings in Lucknow and is expected to be completed by March 2020. The results will be evaluated to formulate appropriate regulations to further promote Peer-to-Peer (P2P) trading of solar energy in the state.

"The pilot project will demonstrate the feasibility of energy trading through blockchain from rooftops with solar power to neighbouring households and buildings. Power Ledger's platform integrates with smart meter systems to enable households to set prices, track energy trading in real time and enable the settlement of surplus solar transactions," ISGF Executive Director Reena Suri said.

The Union government has set a target of installing 40 Gigawatt of rooftop solar power generation capacity across the country by 2022.

HANDBOOK ON INSTALLATION & MAINTENANCE OF SOLAR PANEL – 1

Section I - Solar energy and its applications

1.1 Introduction

The sources of conventional and non-renewable energy such as coal, petrol, diesel etc. are diminishing continuously on Earth, the formation of which is a long process. Hence a need for alternative energy sources was felt such as Wind energy, Bio-energy, Solar energy. These are called as non-conventional or renewable energy sources. Solar energy, which is abundant in nature and free of cost, is considered to be the best and most popular one.

Solar energy is obtained through the use of Solar cells. The Solar cells convert sunlight into electrical energy, based on the principle of photovoltaic effect. The electricity so obtained can directly be used to charge the batteries used for various appliances.

Indian Railways is also a consumer of electricity for general lighting, operation of rolling stock, Telecommunication and Signalling gears such as Signals, Point machines, Relays, Block instruments, Axle Counters etc. Hence solar energy has a wide range of applications in Indian Railways especially at remote or hilly places where grid supply is not available round the clock or not available at all.

1.2 Advantages and Disadvantages of Solar Panel

Advantages

- Fuel source for Solar Panel is direct and endless so no external fuels required.
- Sunlight - free of cost.
- Unlimited life of Solar Modules, fast response and high reliability.
- Can operate under high temperature and in open.
- Inherently short circuit protected and safe under any load condition.
- Pollution free.
- Minimum Maintenance
- Independent working
- Operation is simple and no electrochemical reaction and no liquid medium.
- Noise-free as there are no moving parts.
- No AC to DC conversion losses as DC is produced directly.
- No transmission losses as installed in the vicinity of the load.
- Suitable for remote, isolated and hilly places.
- Suitable for moving loads/objects
- Since it is in modular form, provision of future expansion of capacity is available.
- It can generate powers from milli-watts to several megawatts.
- It can be used almost everywhere from small electronic device to large scale MW power generation station.
- It can be installed and mounted easily with minimum cost.

Disadvantages

- Initial cost is high
- Dependent on sunlight

- Additional cost for storage battery.
- Climatic condition, location, latitude, longitude, altitude, tilt angle, ageing, dent, bird dropping, etc. affect the output.
- It has no self-storage capacity.
- Manufacturing is very complicated process.
- To install solar panel large area is required.

1.3 Utilization of Solar Power Supply System in the Indian Railways

The efficient running and control of Railway traffic in the country is sometimes seriously hampered by the irregular grid supply (by State Electricity Board) resulting in traffic congestion and other operational equipment failures also. The alternate D.G. sets pose considerable problem as it has a high maintenance cost and necessitates the use of additional D.G. sets as stand by. Again diesel oil is prone to pilferage, and moreover transportation and storage costs are involved. It also causes atmospheric pollution. Hence by harnessing the abundantly available and non-polluting by nature solar energy source for power requirements came into action after decades of research and field experience.

1.4 Application of Solar Powered System for Signalling & Telecommunications

Almost all signalling and Telecommunication gears can be run by solar power. In Indian Railway, Signalling system is Solar powered in phased manner. Priorities are given to those locations where there is no conventional power or power transmission through cables is cost effective. Some example of application of solar power for signalling and telecommunication gears are given below:

1. Semaphore signal lighting at night.
2. Charging battery to power Signal lighting and Point Machines.
3. Charging battery for Integrated Power Supply (IPS) system.
4. Charging battery for Optic Fibre Cable hut.
5. Solar powered Radio warning system/Gate Signal/HKT/TC.
6. Solar powered RRI/PI/relay operation (internal and external circuits)/ALR.
7. Charging secondary cells for Tokenless/Token block instruments.
8. Lighting Outer/Warner Signals and Distant Signal with motor operation.
9. Solar distillation plants.

1.5 Advantages of Solar Powered System for Signalling

Along with the advantages mentioned earlier the following are the additional advantages w.r.t. Signalling:

1. Totally Solid State design and highly desirable.
2. Power supply cabling from station building to the signal unit or cabin not needed, since the unit is a self contained power sources. This saves cabling cost.
3. Minimum maintenance, which can be easily done by low skilled worker.
4. Long life of whole system and the system gives trouble free performance.
5. System design suited to monsoon and low light condition thus ensuring failure free operation of the signalling gears throughout the year.

1.6 Photo Voltaic effect

Electricity can be generated directly from sunlight, by a process called photovoltaic effect, which is defined as the generation of an electromotive force as a result of the absorption of ionizing radiation. The photo voltaic effect can be observed in almost any junction of material that have different electrical characteristics, but the best performance to date has been from solar cells made of Silicon.

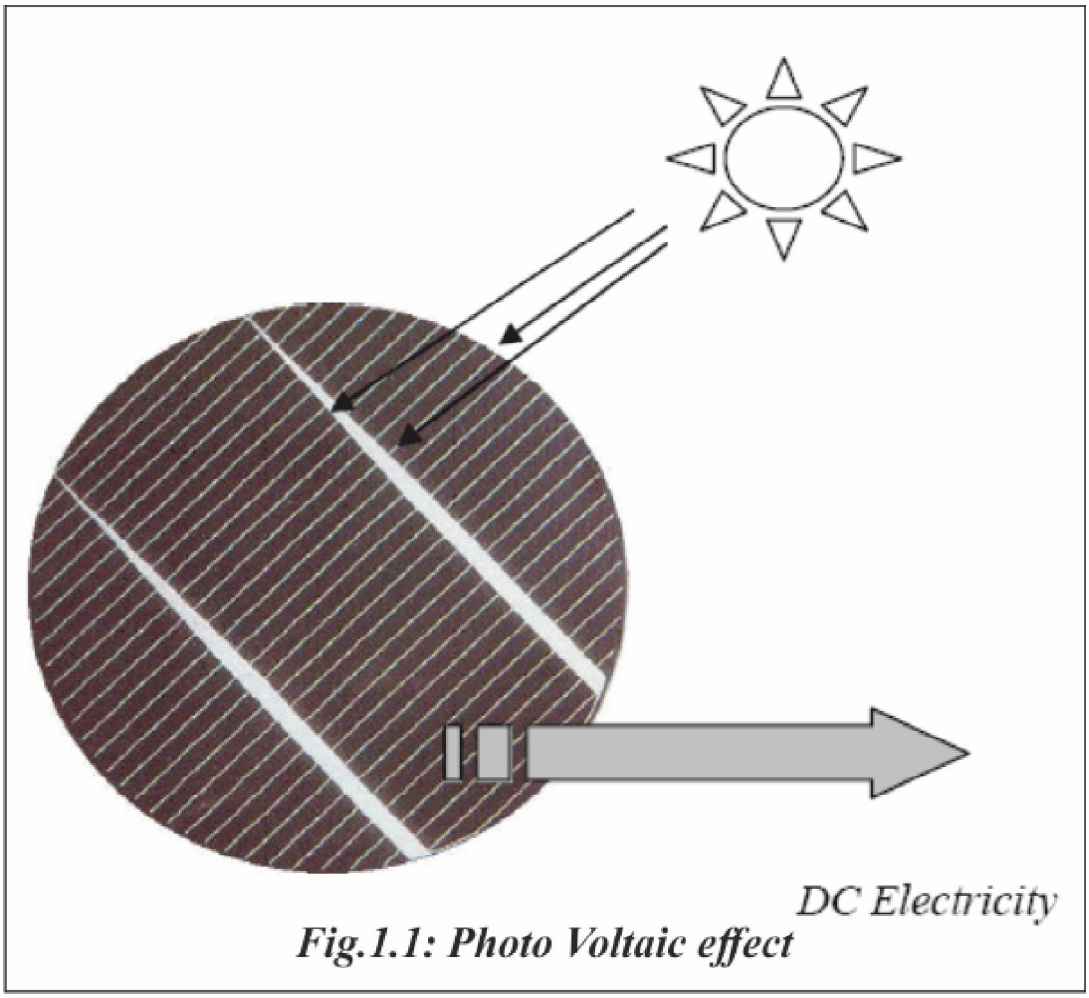


Fig.1.1: Photo Voltaic effect

1.7 Solar Cell: Construction & Working

The basic building block of a photovoltaic system is the Solar Cell, a semiconductor device having a simple p-n junction and which when exposed to sunlight produces DC electricity. The solar cell is made up of "Semi-Conductor" materials that are processed to make the device photovoltaic. The solar cell is made of single crystal silicon, polycrystalline and amorphous Silicon with an area of a few sq. centimeters to 200 sq. centimeters and even more. A thin p type silicon wafer is taken through phosphorus diffusion process and by screen-printing technology electrodes are made. The P-N junction of the solar cell gives rise to diode characteristics. Hence a solar cell is a PN junction device on which front and back electrical contacts are screen-printed. A sketch of typical psuedo-square solar cell is shown in Fig.2 (a) & (b). The side, which has negative polarity, is taken as front side and that which has positive polarity is taken as backside. The front or Negative side is exposed to sunlight for conduction to take place. Two Tinned copper strips work as terminal leads for interconnection to other cells. For collection of charge from the cell and conduction to terminal leads on negative side, Silver Oxide lines are screen printed horizontally and these are joined to terminal leads at close spacing (refer Fig 2 a). These lines cover only 5% of the total area of the cell, so that these do not pose any hindrance to the exposure of Sunrays. The back or Positive side is not exposed to sunlight; hence Aluminium is coated on whole surface for better conductivity (refer Fig 2 b). Aluminium is coated instead of Silver Oxide as latter is expensive hence not economical. The operation of solar cells involves these major processes:

i. Absorption of sunlight into semiconductor materials

ii. Generation of charge carriers.

iii. Separation of +ve & -ve charges to different regions of the cell to produce e.m.f.

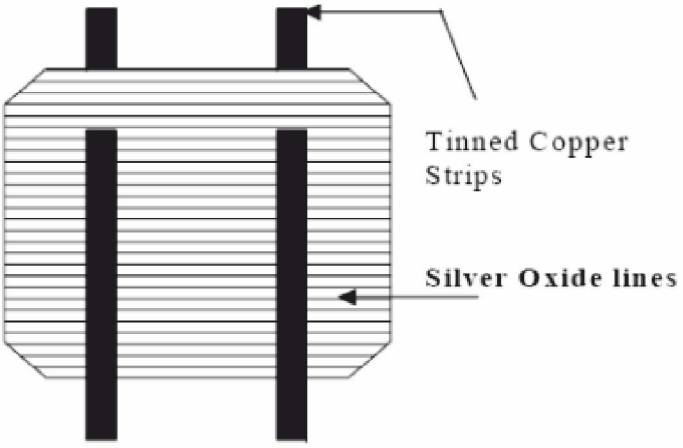


Fig 1.2 (a) Sketch showing front view of typical pseudo square solar cell

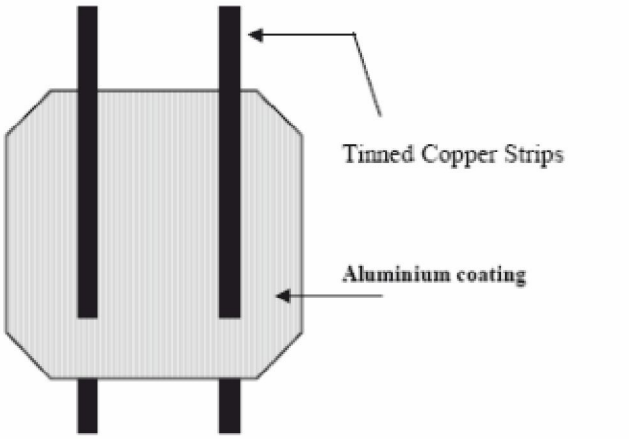


Fig 1.2 (b) Sketch showing rear view of typical pseudo square solar cell

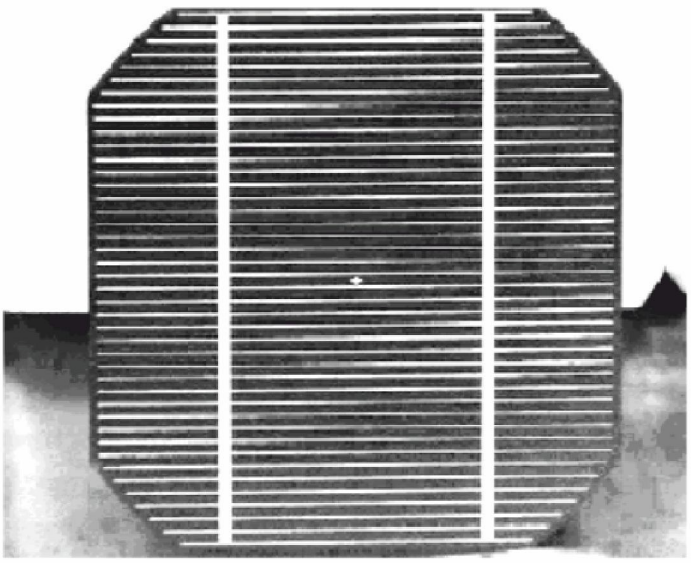


Fig. 1.2 (c): Solar Cell: Actual view

1.8 Solar Photo Voltaic (SPV) Module

The power generated by a single cell is small and therefore several cells are interconnected in series/parallel combination to get the required voltage and current. When a number of solar cells are connected in series to get a specific voltage the unit so formed is called as Solar Module. Charging batteries is the primary use of SPV module. Therefore normally 36 cells are joined in series to form a standard module, which is capable of charging 12 volts battery. A terminal box is provided on the backside of the module for external connections. A Bypass diode is connected across +ve and –ve in the terminal box. Cathode of the diode will be at +ve terminal and Anode will be at –ve terminal of the module. This diode protects the module cells from overheating due to shadowing of the module or any cell breakage generally the rating of bypass diode is 1.52 times of the maximum current of module. The Repetitive Reverse Peak Voltage Vrrm of the diode should be double the string open voltage. For Indian Railways Solar Photovoltaic Module is manufactured as per RDSO Specification No. IRS:S 84/92 with latest amendment. A typical solar module is shown in Fig 1.3.

1.9 Solar Panel

A Solar panel consists of a number of solar modules, which are connected in series and parallel configuration to provide specific voltage and current to charge a battery. A diode is connected on the +ve terminal of such string in forward bias.

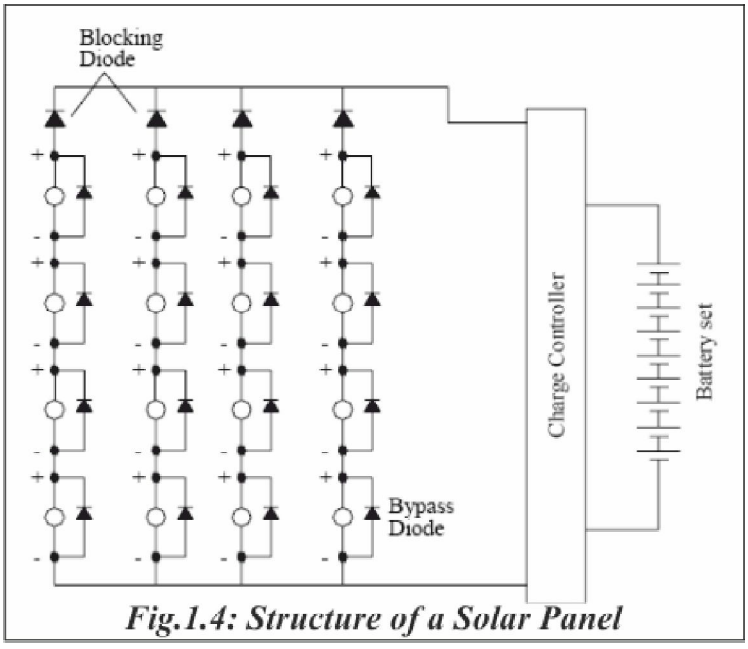


Fig.1.4: Structure of a Solar Panel

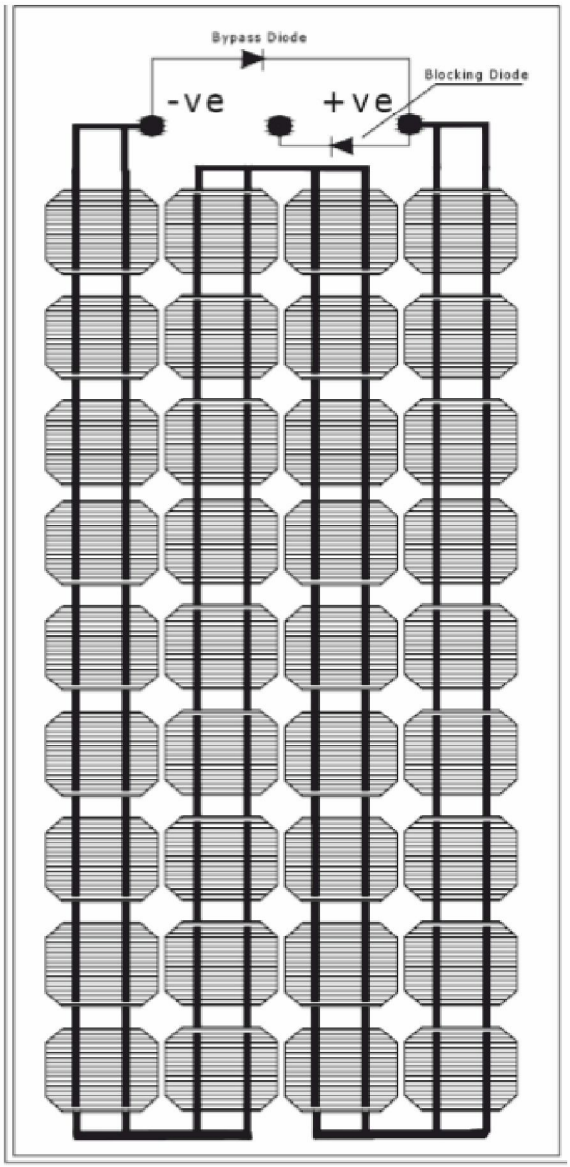


Fig.1.3: Solar Module

This is called Blocking diode. This diode is provided so that in daytime current can flow from module to battery, but at night or in cloudy day current should not flow back from battery to module or from one string to another string Drawing shown in Fig 4 below illustrates a Solar panel.

1.10 Main Components of Solar Photo Voltaic System

The solar power system consists of the following components:

i. Solar array
ii. Battery Bank
iii. Solar Charge Controller

iv. Field Junction Box

v. Solar Module Mounting Structure

vi. Earthing kit

vii. Cables

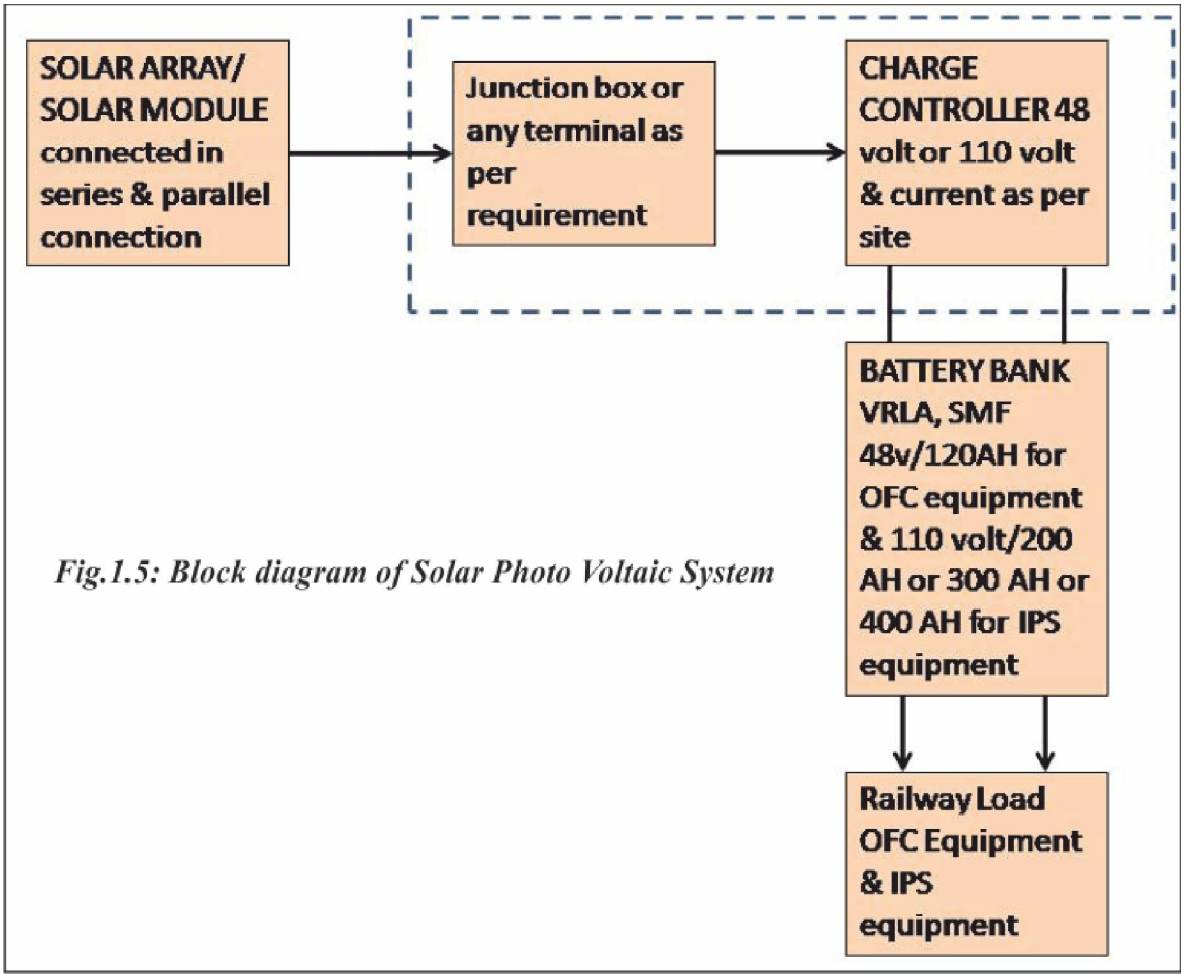


Fig.1.5: Block diagram of Solar Photo Voltaic System

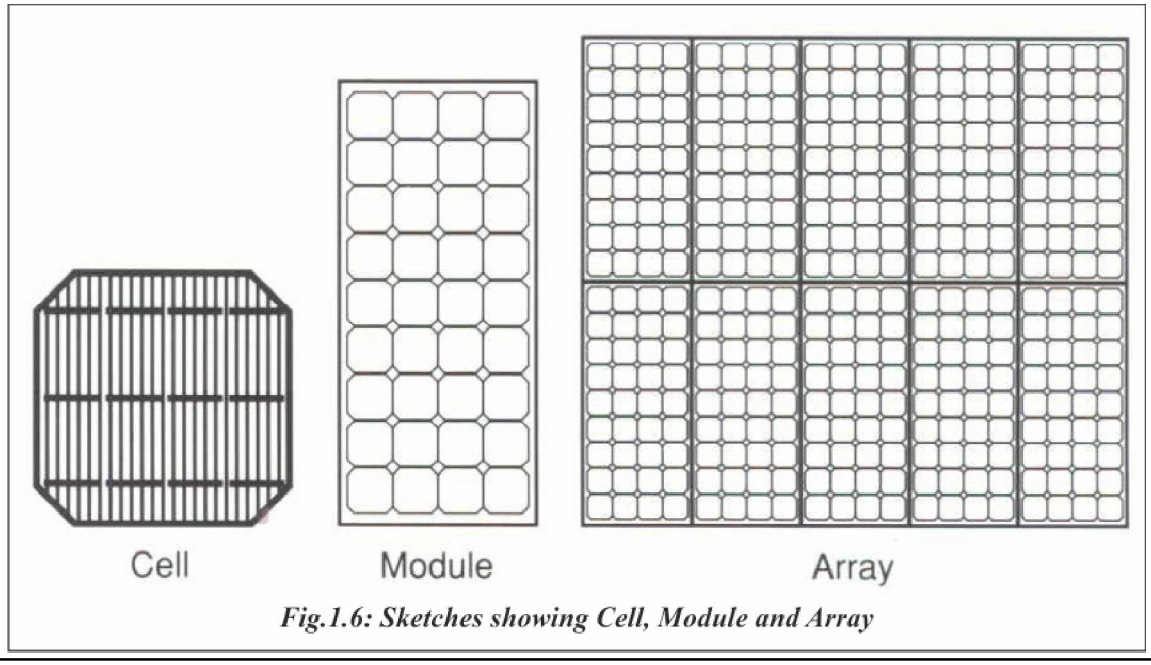


Fig.1.6: Sketches showing Cell, Module and Array

1.10.1 Solar Array

Solar array consists of series/parallel combination of modules, which are mounted on the metallic structure in sunny and shadow free area at a fixed angle as recommended by designer. All the modules will face the South in Northern hemisphere. Cables from the array area will come to the control and battery room through junction boxes from panels of modules.

1.10.2 Battery Bank

The Sun is not always available and it is not regular. However, loads are to be fed any time of the day. Therefore power should be stored in a battery bank. Low maintenance Lead acid battery as per IRS: S 88/2004 or latest of specified capacity will be provided. The capacity of this battery bank is given in Ampere - Hour (AH) and bus bar voltage. The bus-bar voltage is decided by the voltage requirement of the load.

1.10.3 Solar Charge Controller

Charge controller is the interface between Array and battery bank. It protects the battery from overcharging and moderate charging at finishing end of charge of battery bank. Therefore it enhances the life of the battery bank. It also indicates the charging status of batteries like battery undercharged, overcharged or deep discharged through LEDs indications. Some switches and MCBs are also provided for manual or accidental cut-off of charging. In some charge controllers load terminals are also provided through a low battery charge cut-off device so that it can protect the battery bank from deep discharge. Solar Charge Controller units for Indian Railways are manufactured as per RDSO Specification No. RDSO/SPN/187/ 2004. The front view of a typical CEL make Charge Controller is shown in Fig.1.7.

Fig.1.7: Front view of a Charge Controller

The technology adopted nowadays for manufacturing solar charge controller is MOSFET/IGBT technology. With this technology the idle current of the controller is less than 50 mA depending upon the rating of the charge controller and its current. First the controller is connected to battery bank and then it is connected to Solar Array/Solar module for sensing the voltage from the module. When the system is put into operation, the SPV modules start charging the battery bank. Care should be taken that in no case the battery connections are removed from the controller terminals when the system is in operation, otherwise SPV voltage may damage the Charge controller, since the Solar voltage is always higher than the battery voltage.

LED indications of Charge Controller

Sr. No.	LED Colour	Indication
1.	GREEN	Boost Charging (SPV1 & SPV2)
2.	YELLOW	Float Charging (SPV)
3.	RED	Battery LOW
4.	RED	Battery REVERSE with Alarm
5.	RED	PV REVERSE with Alarm

1.10.4 Field Junction Box (FJB)

FJB is the interface between Solar panels and the Charge Controller. All the incoming/outgoing cables/wires from Solar panel to Charge Controller are terminated at FJB.

Fig.1.8: A typical FJB

1.10.5 Solar Module Mounting Structure

This is made up of galvanized iron frames and angles. In this structure flexibility is provided to change the module-mounting angle seasonally. This structure is grouted by small civil work and modules are mounted subsequently. Also, this mounting structure should be earthed suitably at several places if voltage of the array is more than 50 Volts.

1.10.6 Earthing kit

Earthing kit is provided to earth the mounting structure. Provision of earthing shall be done as follows:

The installation shall have proper earth terminals and shall be properly earthed.

Zonal Railways shall provide earthing arrangement as per IS:S 3043 and directions issued by RDSO for Lighting and Surge protection for signaling equipment vide letter No. STS/ E/SPD dated 22.06.2004. The earth resistance shall not be more than 2 ohm. Earth provided shall preferably be maintenance free using earth resistance improvement material.

1.10.7 Cables

We require different types of cables to connect module to module, modules to charge controller, charge controller to battery, or connect battery to load as required. The cable size used for interconnection of SPV module, Charge Controller and battery shall be minimum 2 X 2.5 sq. mm Cu. Cable. As far as some hardware is concerned the screws and bolts/nuts are of Chrome plated, stainless steel and brass so that rusting should not be take place.

1.10.8 Operation

Operation of the Solar power source is very simple. Once the system is installed, CHG. ON (Green) LED will glow during daytime and will indicate that the power is available for charging Battery Bank from SPV panel. Connect the equipment to be operated on solar power to the SPV Charge Control Unit at terminals marked 'LOAD' position.

1.11 Types of Solar Panels

Solar panels are classified on the basis of the following points :

1) Crystalline Silicon (Mono/Poly/Amorphous)
2) Different Size or Area of cells
3) Type of cells & nos. (Rectangular/Circular/Square/ Pseudo-square/Semi-circular etc)
4) Power (High/Mid/Low range)

(To be continued)

IS 3043 / 5039 - ABSTRACT OF IS: 3043 CODE FOR EARTHING PRACTICE

- All medium voltage equipment shall be earthed by two separate and distinct connections with earth In the case of high.
- And extra high voltage the neutral points shall be earthed by not Less than two separate and distinct connections with earth, each having its own electrode at the generating station or substation and may be earthed at any other point provided no interference is caused by such earthing.
- If necessary, the neutral may be earthed through suitable impedance.
- In cases where direct earthing may prove harmful rather than provide safety (for example, high frequency and main. frequency coreless induction furnaces). Relaxation may be obtained from the competent authority.
- As far as possible, all earth connections shall be visible for inspection.
- No cut-out, link or switch other than a linked switch arranged to operate simultaneously on the earthed or earthed neutral conductor and the live conductors shall be inserted on any supply System.
- This however does not include the case of a switch for use in controlling a generator or a transformer or a link for test purposes.
- Grounding is not likely to reduce the total magnitude of over-voltage produced by lighting or switching surges. It can, however, distribute the voltage between phases and reduce the possibility of excessive voltage stress on the phase-to-ground insulation of a particular phase.
- Plate electrodes shall be of the size at least 60cm x 60cm, Plates are generally of cut iron not less than 12mm thick and preferably ribbed. The earth connection should be joined to the plate at not less than two separate points. Plate electrodes, when made of GI or steel, shall be not less than 63mm in thickness.
- Plate electrodes of Cu shall be not less than 3.15mm in thickness.
- Plate electrodes shall be buried touch that soil. Top edge is at a depth not less than 15m from the surface of the ground. However, the depth at which plates are set should be such as to ensure that the surrounding soil is always damp.
- Pipes may be of cast iron of not less than 100mm diameter, 2.5 to 3m long and 13mm thick. Such pipes cannot be driven satisfactorily and may, therefore, be more expensive to install than plates for the same effective Area.
- Water pipes shall not be used as consumer earth electrodes.
- Under fault conditions, the earth electrode is raised to a potential with respect to the general mass of the earth that can be calculated from the prospective fault current and the earth resistance of the electrode. The results in the existence of voltage. In the soil around the electrode, that may be injurious to telephone and pilot cables, whose cores are substantially at earth potential, owing to the voltage to which the sheaths of such cables are raised.
- The voltage gradient at the surface of the ground may also constitute a danger to life, especially where cattle are concerned. The former risk arises mainly in connection with large electrode systems as at power stations and substation.
- Earth electrodes, other than the used for the earthing of the fence itself, should not be installed.
- In proximity to a metal fence to avoid the possibility of the fence becoming live and thus. Dangerous at points remote from the substation.
- The materials used for making connections have to be compatible with the earth rod and the copper earthing conductor so that galvanic corrosion is minimized. In all cases, the connections have to be mechanically strong.

- The cross-sectional area of every protective conductor which does not form part of the supply cable or cable enclosure shall be in any case, not less than
    a) **2.5 mm²,** if mechanical protection is provided and
    b) **4 mm²,** if mechanical protection is not provided.
- Joints of protective conductors shall be accessible for inspection and testing except compound-filled or encapsulated joints.
- No switching device is inserted in the protective conductor, but joints which can be disconnected for test purposes by use of a tool may be provided.
- An auxiliary earth electrode shall be provided electrically independent of all other earthed metal, for example, constructional metalwork, pipers, or metal-sheathed cables. This requirement considered to be fulfilled if the auxiliary earth electrode is installed at a specified distance from all other earthed metal (value of distance under consideration).
- The earthing conductor leading to the auxiliary earth electrode shall be isolated to avoid contact with the protective conductor or any of the parts connected thereto or extraneous conductive parts which are, or may be, in contact with them.
- In TN systems, for cables in fixed installations having a cross sectional area not less than 10mm^2 for copper and 16mm^2 for aluminum, a single conductor may serve both as protective conductor and neutral conductor, provided that the part of the installation concerned is not protected by a residual current-operated device.
- However, the minimum cross sectional area of a PEN conductor may be 4 mm^2, provided that the cable is of a concentric type conforming to Indian Standards and that duplicate continuity connections exist at all joints and terminations in the run of the concentric conductors.
- When the source of energy is privately owned, there should be no metallic connection with the General public supply unless there has been consultation with the electricity authority concerned.
- It should be emphasized that an installation together with its source of energy may not consist entirely of one particular type of system. In such cases, each part of that installation may be required to be treated separately without detriment to other parts of the same installation.
- RCD's Having Minimum Operating Currents Greater Than 30 mA – These devices are intended to give indirect shock risk protection.
- The neutral points of each separate electricity system which has to be earthed at the power station or substation.
- GI/Copper Plate Size: 500mm x 500mm x 10mm.
- Wood coal powder and salt are in same quantity.
- Size of GI Strip: 300mm x 10mm
- Size of GI Pipe: 2.5" Diameter.
- Minimum 1Ω Resistance should be available at a distance of 15mt.
- IR value of Earth resistance is less than 10Ω.
- Earthing resistance of earthing rod is changed from 0.3Ω to 0…8Ω between summer to winter.
- Distance between two earthing pit is 2 x Length of earthing electrode.
- If ground resistance is less than plate earthing (if hard rock) than Pipe earthing shall be used.
- Resistance between two earthing pit is negligible.
- Earthing of lighting protection should not mix with power system earthing.

- Lighting protection earhing should be 10 time stronger than normal earthing (use copper bus strip instead of wire)
- Jointing of earthing strip shall be overlap of min 50mm and for earthing wire overlapping shall be min 40mm

Plate / Pipe Earthing:

Plate Earthing Electrode

- for copper shall be 600 x 600 x 3.1mm and
- For Hot dip GI shall be 600 x 600 x 6.3mm.

Pipe Earthing Electrode

- Earthing electrode shall consist of a GI pipe (class B of approved make), not less than 40 mm dia. and 3 meters long. CL pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia. drilled at 75mm interval up to 2.5 meters length from bottom. The electrode shall be buried vertically in the ground as far as practicable below permanent moisture level, but in any case not less than 3 meters below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode.

Size of Excavation:

- Size of 1 meter diameter and 3 meter length shall be excavated after depth of 3 meter the size of excavation shall be 900 x 300 x 900mm depth.
- Plate / Pipe Electrode shall be in vertical position.
- GI/PVC pipe for Watering shall be used of 40mm Diameter, length of 3 meter (contain hole of 12mm Diameter in Zigzag manner starting from 15cm away from bottom to 2 meter height).
- At bottom 150mm layer of Salt and charcoal power shall be installed than Plate shall be installed.
- Alternate layer of 150mm of Salt and charcoal power shall be used up to 2.5 meter.
- Min 120kg of charcoal power and 120kg of salt shall be used for each earthing pit.
- The plate \pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.

IS: 5039 Distribution Pillars (<1kV AC & 1.2KV DC)

- Distribution pillars are used by a number of distributing agencies to interconnect, terminate, control, protect and sectionalize distribution feeders.
- They are generally located on public footpaths abutting the building line or along the kerb line of footpaths.
- The distribution pillars covered by this standard are intended to incorporate HRC type fuses/links only and of current rating not exceeding 630 amperes.
- This standard covers distribution pillars for voltages not exceeding 1000 V ac or 1200 V dc, the current rating in each outgoing or incoming circuit not exceeding 630 A, for use on ac or dc systems, in outdoor conditions.

Rating of Individual Circuits:

- The rated current of the outgoing or incoming circuits shall be as follows: 160, 200, 250, 400 and 630 amperes.
- NOTE 1 — These ratings correspond to those of fuse-bases.
- NOTE 2 — All the incoming circuits of the same distribution pillar shall have the same current rating and similarly all the outgoing circuits of the same distribution pillar shall have the same current rating. Unless otherwise specified the sum of the rated current of the incoming circuits shall be fixed at the 2/3 of the sum of the current ratings of outgoing circuits, rounded up to the nearest higher value of the preferred current.

Rated Diversity Factor:

- The rated diversity factor of the distribution pillar having several incoming and outgoing circuits is the ratio of the maximum sum at any one time, of the assumed circuits of all the circuits involved, to the sum of the rated currents of all the circuits of the distribution pillar.

NUMBER OF FUSE-WAYS	DIVERSITY FACTOR
2 and 3	0.9
4 and 5	0.8
6 to 9 inclusive	0.7
10 and above	0.6

Enclosure:

- It shall be in all respect suitable for outdoor installations. It shall be made from a suitable material to withstand rough usage and weather. If fabricated out of MS sheets the thickness of the sheet shall be at least 3.15 mm in accordance with IS: 1730-1989.

Doors:

- Distribution pillars shall have a set of double hinged doors at the front. Similar doors shall be provided at the back also; if specified.
- The doors shall be so fitted as to provide the interior with maximum protection from atmospheric conditions. The hinges shall be of such construction that the doors can be swung open by not less than 150°.
- In addition the hinged design shall permit doors being completely removed when necessary. The base horizontal member shall be completely removable to facilitate cable jointing

Canopy:

- The top of the pillar shall be fitted with a sloping canopy design of which shall be such that rain water shall not accumulate on the top.

Aprons:

- If required, an apron (two if there are doors at the rear also) shall be provided below the door level of the pillar.
- They shall be easily removable. The apron shall be made from a suitable material to withstand rough usage. If made from sheet steel, the thickness of the sheet shall be at least 3.15 mm.

Pillar Lighting:

- A bayonet lamp holder complying with IS: 1258-1987, with a tumbler switch, competing with IS: 3854-1988†, a three pin plug and socket complying with IS: 1293-1988 with necessary fuses and wiring shall be provided inside the pillar.
- Unless otherwise agreed between the manufacturers and user, on TPN fuse boards, terminals for the neutral conductor shall allow the connection of aluminum conductors having a current carrying capacity:
- (a) equal to half the current carrying capacity of the phase conductor with a minimum of 25 mm^2, if the size of the phase conductor exceeds 25 mm^2; and
- (b) equal to the full current carrying capacity of the phase conductor if the size of the latter is less than or equal to 25 mm^2.

Bus-bar

- Suitable barriers shall be provided between bus-bars.

Earthing

- The metal casing of the distribution pillar shall be provided with two separate earthing terminals and the framework shall be metallically connected with the casing.

ENERGY, ELECTRICAL ENERGY AND RENEWABLE ENERGY – 27

Sustainable Growth, Sustainable Electrical Energy and Renewable Energy

Solar Energy – Focus on Solar PV & Solar Thermal and Electricity.

Review of "Waste to Energy" concept.

Waste to Energy is a very important concept which should be kept in mind in searching for all kinds of sources of energy for producing Electricity or fuel. This is today very largely applied in the area of Bio Energy and the definition and details below will illustrate the point. In the Solar Energy part, which is later dealt as a part of this series, we are going to see that the same concept of Waste to Energy is very relevant, at least in Indian context.

Definition

Waste to Energy (WTE), is a term that is used to describe various technologies that convert non-recyclable waste into usable forms of energy including heat, fuels and electricity. WTE can occur through a number of processes such as incineration, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery.

The term WTE is commonly used in specific reference to incineration which burns completely combusted waste at ultra-high temperatures allowing for energy recovery. Modern incineration or combustion facilities use pollution control equipment to prevent the release of emissions into the environment. Currently combustion is one of the WTE technology that is economically viable and operationally feasible at commercial scale.

Another example of WTE is anaerobic digestion (AD), an old but effective technology that biologically converts organic material of all kinds including wastes from animals and poultry and foods and agro processing, into compost as well as biogas for energy. AD systems have large potential and can range from low to high tech, therefore they can service communities of all income levels. Government of India has already commenced large scale programs of "Bio CNG" with the basic process of AD with purification processes and so on. Another process, called pyrolysis, can thermo-chemically convert waste products into clean liquid fuels.

One important point to note is that in all Bio Energy processes, biomass is reduced, Energy is separated and ashes or the residues are left behind for further analysis and use as manure or otherwise as per merit.

In AD of animal or poultry wastes, for example, the digested remains have the full manure components of Phosphorus, Potassium and other minerals making it fit for use as manure. The same is the case in case of combustion of biomass, where the ashes contain all the chemicals and the minerals originally contained in the biomass making it fit for use as fertilizers. There are cases, particularly in the UK,that combustion of poultry wastes is found highly economical, because the ashes fetch lucrative revenue more than the value of energy generated.

Finally, landfill gas recovery refers to the process of capturing the gases emitted from municipal landfills and converting it for energy. The most common form of collection occurs by drilling horizontal or vertical wells into the landfill and uses blowers and vacuums to collect the gas for treatment.

Context

Currently, the world generates 1.3 billion tonnes of Municipal Solid Waste (MSW) annually. By 2025 the world could generate 2.2 billion tonnes of MSW per year. Such a prediction forces us to consider and develop alternatives for addressing our future waste management (WM) challenges. A part of the solution will be WTE technologies which will help facilitate sustainable WM programs by diverting waste from landfills for energy production.

Unfortunately, WTE practices are underutilized and therefore the majority of the world still uses landfills as their primary disposal method. Landfills are an unsustainable use of land and pose environmental concerns including water and air quality issues.

The most significant challenge to WTE technology adoption is the awareness that all kinds of wastes can be used as a source of clean and reliable energy.

100 Cub Meters of waste reduced to 10 Cub Meters and 13,0000 kwh generated.

Solar Energy and the concept of Waste to Energy:

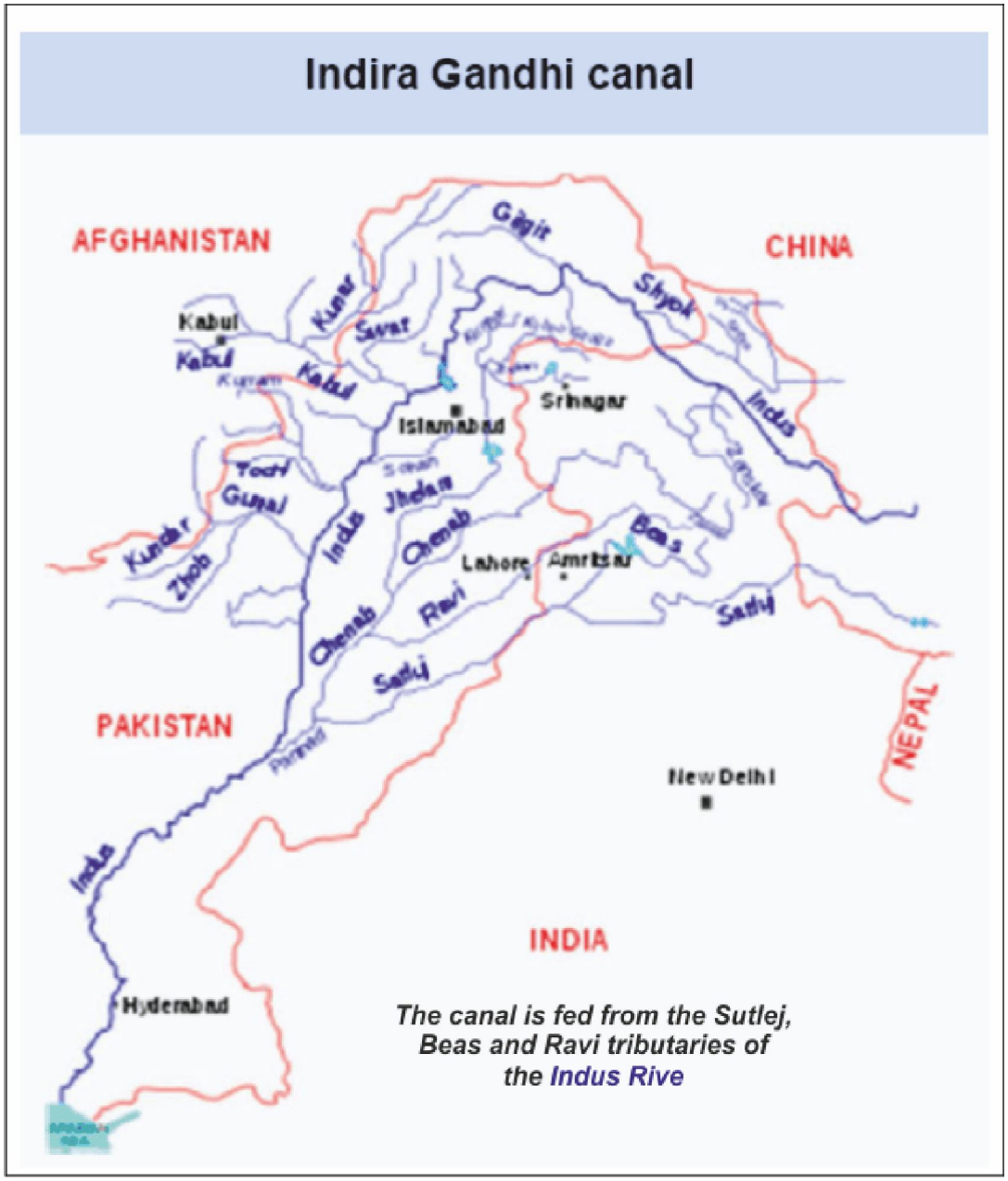
Solar Energy is an important source, providing both light and heat, both of which can be used to generate Electricity directly. Photo voltaic (PV) systems are one of the very popular systems in use all over India and Electricity can be directly generated (both Grid and Non Grid connected) by installation of Solar Panels either on lands acquired for this purpose or on Roof Tops of Buildings and Factories. As can be seen from the details discussed below, wasted sunlight is what is falling on roof tops and sunlight falling on the land anywhere, in Indian context particularly, can help growth of crops and vegetation, subject to availability of water. In Solar Energy, therefore, Waste to Energy concept will apply to "Roof Tops" and very rightly our Government have come out with lot of initiatives for Roof Top Solar Energy Projects and support. It is estimated that if Solar Energy is used to help grow crops and vegetation or biomass of any kind, multiple times (17 times) of Solar Energy gets stored, which can be processed to get gas, oil and electrical energy.

Solar Energy uses have great potential in India as we are one of the few blessed countries of the world with bright sun light for most of the days in a year with daytime of almost 12 hours in almost all parts of India. One of the main utility of SUNLIGHT is to help growth of crops and vegetation and most of India is involved in agriculture with probably the exception of Thar Deserts in Rajasthan. Even in many parts of the country, where the lands are barren with min or no agriculture due to vagaries of monsoon, cultivation has been established with arrangements of irrigation either through lift irrigation or canal irrigation projects and provisions.

One interesting and valuable example is that, even in Thar deserts of Rajasthan, agriculture could be established with the help of Indira Gandhi Canal Project.

The **Indira Gandhi Canal** (Originally: **Rajasthan Canal**) is the longest canal of India. It starts from the Harike Barrage at Harike, a few kilometers below the confluence of the Satluj and Beas rivers in the Indian state of Punjab and terminates in irrigation facilities in the Thar Desert in the north west of Rajasthan state. Previously known as the Rajasthan Canal, it was renamed the Indira Gandhi Canal on 2 November 1984 following the assassination of Prime Minister Indira Gandhi.

The canal consists of the Rajasthan feeder canal with the first 167 kilometres (104 mi) in Punjab and Haryana state and a further 37 kilometres (23 mi) in Rajasthan followed by the 445 kilometres (277 mi) of the Rajasthan main canal, which is entirely within Rajasthan. The canal enters Haryana from Punjab near Lohgarh village then runs through the western part of the Sirsa district before entering Rajasthan near Kharakhera village in the Tibbi tehsil of the Hanumangarh district. The canal traverses seven districts of Rajasthan: Barmer, Bikaner, Churu, Hanumangarh, Jaisalmer, Jodhpur, and Sriganganagar.



The point is that in Indian context, Soil and Sunlight are available in all parts of India and with only the arrangement for availability of water for agriculture cultivation can flourish. Lift irrigation and agricultural pumping sets have

played a vital role in this regard as numbers have gone up from a few lakhs to few crores in the past 50 years. The long term plans of 'Interlinking of Rivers' too are measures towards increase of agriculture in this country. It is therefore sensible to focus completely on Roof Top Solar and here again the potentials are very substantial.

Roof Top Solar Power

A Roof Top Installation

100Kw Peak Installation at Chinnasamy Stadium, Bangaluru

150Kw peak installation at Faridabad Metro Station

The 2MW Rooftop project in Tirupur, Tamil Nadu was the LARGEST rooftop project in South India for the LARGEST power loom producer in India

IIT Roorke 1800Kw Peak

(To be continued)

S. Mahadevan, B.E., F.I.E., M.B.A., Consultant, Energy and Energy Efficiency, Mobile: 98401 55209

தமிழ்நாடு அரசு

மக்கள் நல்வாழ்வு மற்றும் குடும்பநலத்துறை

இந்திய மருத்துவம் மற்றும் ஹோமியோபதி ஆணையரகம்

நிலவேம்பு குடிநீர்

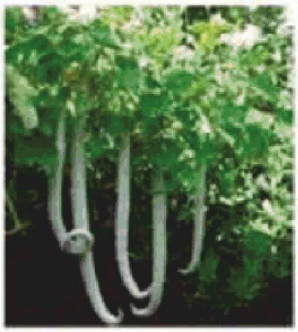
இவற்றில் சேரும் மருந்துகள்

நிலவேம்பு

வெட்டிவேர்

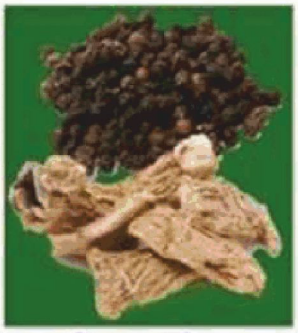
விலாமிச்சம்வேர்

சந்தனம்

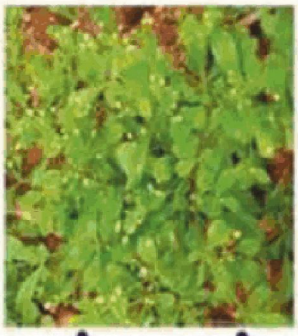


பேய்ப்புடல்

கோரைக்கிழங்கு



சுக்கு,மிளகு



பற்பாடகம்

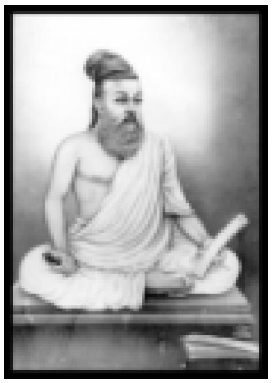
குடிநீர் அளவு

5 வயது முதல் 12 வயது வரை உள்ள குழந்தைகளுக்கு 10 மி.லி. தினமும் 2 வேளை அருந்தவும்.

பெரியவர்களுக்கு 50மி.லி. தினமும் 2 வேளை அருந்தவும்.

எல்லா வகை காய்ச்சலும் குணமாகும்

TIRUKKURAL AND FAIR AND ETHICAL MANAGEMENT - 11



Going further with respect to basic characteristics for men in Management to practice Ethical Management, as advocated by Tiruvalluvar, they should be able to deal with all kinds of people apart from being fair and courteous.

It is essential for men of knowledge and wisdom and training to possess the ability to keep the discussions on, even with people of different points of view, with justice and fairness and ensure smooth functioning and harmony all around.

There was a recent occasion of Management debate about keeping the negotiations on in spite of different points of view by different parties on the negotiation table, when an important point was brought out that there must be basic respect for every point of view, even though there may not be agreement or acceptance.

Thiruvalluvar goes to the extent to declare that for those who can't keep the discussions on, there will only be darkness in spite of brightness all round.

Nagalvallar Allarkku Maayiru Gnaalam
Pagalumpaar Pattandru Irul ***Kural 999***

நகல்வல்லர் அல்லார்க்கு மாயிரு ஞாலம்
பகலும்பாற் பட்டன்று இருள் குறள் ***999***

"It is important to be able to create a good atmosphere and conduct discussions as otherwise even a bright world will be engulfed with darkness"

Nanpatraar Aagi Nayamila Seyvarkkum
Panpatraar Aathal Kadai ***Kural 998***

நண்பாற்றார் ஆகி நயமில செய்வார்க்கும்
பண்பாற்றார் ஆதல் கடை. குறள் ***998***

"It is important to exercise fairness and courtesy even with people who exhibit unfriendliness and unfair activities"

HOME FESTIVALS - 1

தை - Thai (Mid-January/Mid-February)

At left the Sun god, Surya, is being worshipped with the outdoor cooking of a large pot of rice from the recent harvest. The overflowing of the dish is called **"pongalo-pongal"**, and thus this festival is known as **Thai Pongal**. Other crops, like sugarcane, bananas and turmeric, are also offered. *Kolams* (hand-made rice flour patterns) are drawn in the form of the chariot, with the Sun and Moon in the centre. On this day cows and other animals are decorated and fed special foods, and their owners prostrate to them. Crows and other birds are offered food on leaves of turmeric. Sisters pray for the welfare of brothers, and elders bless the children. **Thai Pongal is celebrated by the poorest farmers and the wealthiest householders.**

(To be continued)

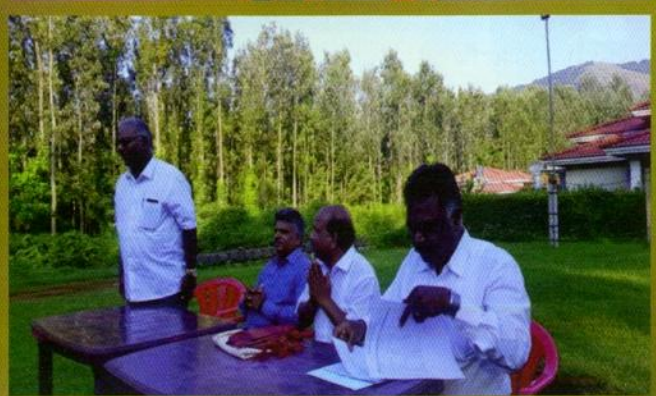
EXECUTIVE MEETING ON 13.11.2019
HELD AT ASSOCIATION OFFICE, CHENNAI

TECHNICAL SEMINAR ON13.11.2019

at RADISSON BLU HOTEL


TAMILNADU ELECTRICAL INSTALLATION
ENGINEERS' ASSOCIATION 'A' GRADE
"TECHNICAL SEMINAR"
Chief Guest
P. Thangamani
TAMILNADU ELECTRICAL INSTALLATION
ENGINEERS' ASSOCIATION 'A' GRADE
TECHNICAL SEMINAR"
Thiru O.S. Manian
TAMILNADU ELECTRICAL INSTALLATION
ENGINEERS' ASSOCIATION 'A' GRADE
"TECHNICAL SEMINAR"
Thiru O.S. Manian
"TECHNICAL SE
Chief Guest
TAMILNADU ELECTRICAL INSTALLATION
ENGINEERS' ASSOCIATION 'A' GRADE
ECHNICAL SEMINAR"

EXECUTIVE MEETING ON 12.10.2019
HELD AT YERCAUD



Printed and Published by 'Tamilnadu Electrical Installation Engineers' Association "A" Grade, Chennai -14. Editor : G. Venkatesh Advisor : S. Mahadevan