



# ELECTRICAL

INSTALLATION ENGINEER

## NEWS LETTER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)

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# EVENTS

## 1. GEBT 2013 - GUANGZHOU ELECTRICAL BUILDING TECHNOLOGY 2013

### guangzhou electrical building technology

广州国际建筑电气技术展览会

**Event Profile:** The 7th Renewable Energy India 2013 Expo is recognised as Asia's largest event on renewable. The 3 days international expo comprehensively covers Solar, Wind, Bio-mass/fuel, Small Hydro, Geothermal and Energy Efficiency.

**Date :** 9<sup>th</sup> – 12<sup>th</sup> June 2013

**Venue :** China Import and Export Fair Pazhou Complex, No.380, Yuejiang Zhong Road, Guangzhou, Guangdong, China

**Website:** <http://www.biztradeshows.com/gebt/>

## 2. CIPV EXPO - 2013

**Event Profile:** CIPV EXPO, as an integral part of Clean Energy Expo China (CEEC), is the first and only platform for the industry in China which focuses on the Industry's New Technology, Materials, Products and Equipment amongst its comprehensive exhibit scope of all the Solar PV related products spanning the entire range from large-scale PV station construction to BIPV (Building Integrated PV).

**Date :** 3<sup>rd</sup> – 5<sup>th</sup> July 2013

**Venue :** Beijing, China National Convention Center, China

**Website:** <http://www.cipvexpochina.com>



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## 3. SOLARCON INDIA 2013

**Event Profile:** SOLARCON India is organized by SEMI India and is the only event that reinvests its revenues into programs and services that support the growth and expansion of the Solar/PV Industry in India

**Date :** 1<sup>st</sup> - 3<sup>rd</sup> August 2013

**Venue :** KTO Exhibition Complex, Bangalore, India

**Website :** <http://solarconindia.org/>

## 4. 7<sup>TH</sup> RENEWABLE ENERGY INDIA 2013 EXPO



Promoting a Democratic Industry Forum

Renewable Energy India Expo  
12-14 September 2013,  
India Expo Center, Greater Noida (NCR)



**Event Profile:** The 7<sup>th</sup> Renewable Energy India 2013 Expo is recognised as Asia's largest event on renewable. The 3 days international expo comprehensively covers Solar, Wind, Bio-mass/fuel, Small Hydro, Geothermal and Energy Efficiency.

**Date :** 12<sup>th</sup> - 14<sup>th</sup> September 2013

**Venue :** India Expo Center, Greater Noida (NCR)

**Website :** <http://www.renewableenergyindiaexpo.com/>

## 5. LII 2013 – LIGHT INDIA INTERNATIONAL



**Event Profile:** The Light India International 2013 will publicise the developments taking place in the lighting industry and provide excellent marketing opportunities for all the products and services covered by the lighting industry.

**Date :** 13<sup>th</sup> – 16<sup>th</sup> September 2013

**Venue :** Chennai Trade Centre, Nandambakkam, Chennai

**Website :** <http://lii.in/index.aspx>

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indian society  
of lighting engineers

# EDITORIAL

Dear Members, Fellow Professionals, Friends and Well wishers,

The Profession of 'Electrical Installation Engineer' revolves around Technology, Efficiency and Safety. Safety and Reliability are of utmost Concern with equal concern for Technology and Efficiency as they direct us to Better Controls and Conservation.

11<sup>th</sup> of May is marked as "National Technology Day" and let us remember that the Technological Inventions and Improvements have, in fact, been the cause for all our Galloping Developments over the past 150 years, but 'Challenges' continue to remain. One of the important challenges is the "Storage of Electricity" and the solutions available at present are Storage Batteries of Lead Acid and other types with their limitations of capacities and weights and Life etc. Continuous researches are taking place all over the World and even as recently as April '13, some land mark successes have been achieved. Announcement of successful design of low-cost, long-life battery that could enable solar and wind energy to become major suppliers to the electrical grid has come as a step forward. Currently the electrical grid cannot tolerate large and sudden power fluctuations caused by wide swings in sunlight and wind. As solar and wind's combined contributions to an electrical grid approach 20 percent, energy storage systems must be available to smooth out the peaks and valleys of this "intermittent" power — storing excess energy and discharging when input drops. For solar and wind power to be used in a significant way, we need a battery made of economical materials that are easy to scale and still efficient, and it is believed that the new battery may be the best yet designed to regulate the natural fluctuations of these alternative energies. Most promising batteries for intermittent grid storage today called "flow" batteries, are relatively simple to scale their tanks, pumps and pipes to the sizes needed to handle large capacities of energy. The new flow battery developed seems to have a simplified, less expensive design that presents a potentially viable solution for large-scale production.

Another Technology of Energy Storage – "Fuel Cells" - is being continuously addressed mainly for Cost Reduction without sacrificing Efficiency, but the challenges here are Storage of either 'Hydro Carbons or Hydrogen for producing instant Electricity.

As the share of Electrical Energy out of the total Energy usage is going beyond 60%, the needs for Technologies and the needs for security and safety continue to remind us of our increased responsibilities.

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EDITOR

## LETTER TO EDITOR

Sir,  
Thanks for April 2013, issue of 'News Letter' of TNEIEA .  
As usual, it is full of important technical information to all electrical engineers to keep them up to date. Congrats.  
I am sending a cheque for Rs.1000/- by post as my humble contribution to the **ONLY valuable, Technical Journal down here, in whole of South India**. Please accept the same.  
Thanks & Regards,  
P.C. ARAVAMUDHAN,  
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## CONTRIBUTION TO NEWSLETTER

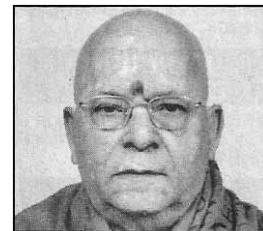
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We request other members also to send their contribution for NEWSLETTER early.  
(Please help us to serve you better).

## OBITUARY

On behalf of the  
**Tamilnadu Electrical Installation Engineers' Association 'A' Grade** extends  
Heartfelt Condolence for the demise of



**Vastu Sasthri Dr. S. Raman**

**DOD: 28/04/2013 Ph: 044 - 24423283**

Padmasri Kalaimamani Vastu Sasthri Sakthi  
Dr. S. Raman, Electrical Engineer, Contractor  
and a Active Ex-Member of our Association.

*We pray the almighty to rest his Soul in Peace.*

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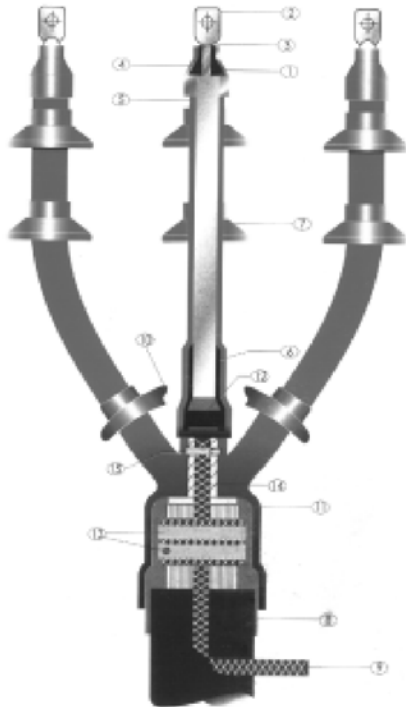
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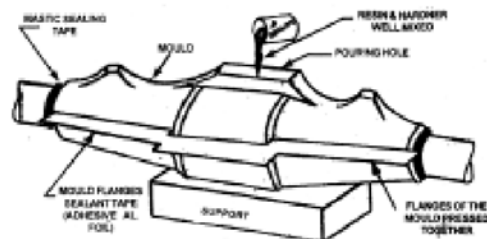
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Let our journey through the “Residual Life Assessment of Power System Equipment” resumes.

**5.5.3** The residual life estimation/assessments are carried out at several levels. To make an illustration, transformer has been selected as the equipment for our study. The Level-I assessment relates to the examination of the collected information on transformers in regard to the quality frequency of the items discussed earlier in “Para 5.5.2”. If the data available is insufficient to make any reasonable assessment, then level-II Investigation may be resorted to. This investigation involves

- the physical and external inspection of the equipment in point and also
- Their internal examination if necessary. The next level of investigation viz. Level-III investigation requires the use of recording thermometers, ammeters and oscillographs to monitor voltage surges. Then we can go for Level-IV Assessment. This step involves the tests like Dissolved gas in oil Analysis, the insulation power factor and dielectric absorption. Similar to the procedures adopted for the Transformers, Procedures/methods as given in the guidelines for Switchgear, Cables, Relay Systems, Batteries and Grounding Systems can be adopted.

### 5.6 CONDITION ASSESSMENT FOR SUB-STATIONS

**5.6.1** As a part of life extension, we are in need of reliable and useful information on the condition of older substation and its associated equipment. Much of these information is readily available in the concerned utilities files and databases. The key sources of information which are useful to assess the condition of substations and their equipment are,

#### ➤ **Loading Condition**

This information can be gleaned from the daily log sheets or load reports showing the loads on the substations and its feeders. From the data thus collected, it can be gauged whether the station in point is “over dutied or over loaded.” Further the present “Fault level” or “Short circuit level” of the station can be obtained from the short circuit and load flow studies conducted by the planning wing of the utility.

If the latest short circuit levels are not readily available it can be easily calculated with the available equipment line and cable details. Further if the instrumentation presently available in the station fails to bring the desired useful information on the loading pattern, additional instrumentation like Max. demand ammeters, hotspot locators may be installed. This step will help to develop a “useful database.” In this connection it is stated that the deployment of SCADA System will be a valuable asset for recording and retrieving the useful information. While reviewing the loading information/pattern, care should be taken to note that the loading occurs only in the standard operating conditions not in the contingency conditions/ emergency conditions like sharing the loads of neighbouring substations, when they are in distress condition for a shorter or longer duration. Further when loading conditions of a substations are considered, it is important to ensure that these stations which are adequate for standard operating conditions are not overdutied in any modified arrangement proposed.

#### ➤ **Maintenance**

Now a days maintenance-free equipment are widely used. In addition, the recording of information for many maintenance programs is computerised. Further condition based maintenance or proactive maintenance is adopted in addition to periodic inspection and routine servicing of major items of equipment. All these help to maintain/ create a large database of information about equipment repair and maintenance records. By using this computerized database, the trends and potential trouble areas can be identified and it will help to pin point the particular items of equipment that are deteriorating/ degrading at a faster rate.

#### ➤ **Equipment Monitors**

Equipment monitors are generally used to measure the parameters that indicate the rate of wear. Two categories of devices are used.

- (i) These devices measure the amount of actual use that a piece of equipment had faced in its service life.
- (ii) The second group of devices help to identify the changes in certain parameters which will in turn indicate the changes in the operating conditions of the equipment.

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Two examples of equipment monitors are given below.

### **I Circuit Breaker**

- (i) One type of circuit breaker monitor gives the cumulative interrupted current and the number of operations carried by the breaker. It measures the actual service undergone by a breaker.
- (ii) This type of monitor makes the signature analysis of the circuit breaker operations. i.e. it can analyze the vibration signatures of a circuit breaker. This monitor can be used to detect changes in vibration that in turn signify changes in the breaker- operation mechanism.

### **II Transformer**

The Transformer monitors provide a more exact measurement of transformer component temperature and a comparison with actual loading conditions. Further the present day continuous dissolved gas analysers provide a vivid and clear picture of the events taking place inside the transformer.

A more exact measurement of the winding temperature or hot spot temperature of a transformer will help to indicate how much design life of a transformer has been used and how much service life presently available (Remaining life) for further use. Thus it will provide an accurate indication of “Transformer Service Age”.

The transformers gas evolution will indicate the incipient faults and the present day gas analysers are used to look for the variations in the gas evolution of a transformer. When these devices are applied to new equipment, they provide many useful information. Among them are

- A lifetime record of equipment operating data
- The development of incipient faults/gradual wear and tear.

However, it is difficult to fit these monitoring devices to older equipment.

Kindly stay tuned for the next article.

*(To be continued...)*

**V. Sankaranarayanan B.E., FIE,**  
**Former Addl. Chief Engineer/TNEB**  
**e-mail: vsn\_4617@rediffmail.com;**  
**Mobile: 9840207703**

## **COPPER RESTRICTS THE GLOBAL SPREAD OF ANTIBIOTIC - RESISTANT INFECTIONS : STUDY**

Professor Bill Keevil, Chair in Environmental Healthcare at the University of Southampton in the UK; renowned for his findings on Antimicrobial Copper, presented a white paper on ‘Design Parameter for Infection Control’ at the National Conference on Safe and Sustainable Hospitals (SASH 2013) organised by Academy of Hospital Administration, India. His presentation focused on new insights into the antimicrobial properties of copper touch surfaces for reducing healthcare-associated infections. The study results were based on laboratory work conducted in the university’s Environmental Healthcare Unit, exploring the extent and implications of copper’s antimicrobial efficacy.

Prof Keevil discussed about his newly-published work showing that copper can prevent horizontal transmission of genes (HGT), which has contributed to the increasing number of antibiotic-resistant infections worldwide. Appearing in the journal mBio, his paper explained that HGT in bacteria is largely responsible for the development of antibiotic resistance, which has led to hard-to-treat healthcare-associated infections. While HGT can take place in the environment, on frequently touched surfaces such as door handles, taps and light switches; copper prevents this process from occurring and rapidly kills bacteria on contact.

Prof Bill Keevil, Chair in Environmental Healthcare at the University of Southampton in the UK said, “We know many human pathogens survive for long periods in the hospital environment and can lead to infection, expensive treatment, blocked beds and death. What we have shown in this work is the potential for strategically-placed antimicrobial copper touch surfaces to not only break the chain of contamination, but also actively reduce the risk of antibiotic resistance developing at the same time. Provided adequate cleaning continues in critical environments, copper can be employed as an important additional tool in the Fight against pathogens.”

Copper is inherently antimicrobial, meaning it will kill bacteria and viruses that settle on its surface, quickly and completely. It shares this efficacy with many commonly-used alloys, such as brasses and bronzes, and they are collectively described as ‘antimicrobial copper’. Prof Keevil has found copper to have broad-spectrum efficacy against organisms threatening public health, including Influenza A, MRSA, C. difficile, E. coli and-most-recently studied-norovirus.

Copper also has a wider role to play in infection control. Prof. Keevil explained, “Copper touch surfaces have promise for preventing antibiotic resistance transfer in public buildings and mass transportation systems, which lead to local and – in the case of jet travel – rapid global dissemination of multidrug-resistant superbugs as soon as they appear. Copper substantially reduces and restricts the spread of these infections, making an important contribution to improved hygiene and, consequently, health.”

*Courtesy: Electrical Monitor, March 2013*

# A NOVEL APPROACH TO HARNESS MAXIMUM POWER FROM SOLAR PV PANEL

*Among alternate sources of electricity, Solar Photo Voltaic (PV) energy is gaining prominence due to its plentiful availability. It is not being opted for in large numbers as grid parity of cost has not been achieved. By harnessing more power per unit installed capacity of the solar panel, the cost can be reduced. One of the methods of realizing this is by Maximum Power Point Tracking (MPPT) wherein a power electronic converter is used to match the load with the PV panel. Widely employed approach for MPPT is to monitor the power generated by the PV panel and keep on adjusting the duty cycle of converter so that this power is always maximum.*

*Present paper proposes a novel method to realize MPPT for standalone solar PV system with resistive (R) load. It is shown that the output power becomes the maximum when the load voltage becomes the maximum. Conversely, varying the duty cycle of the converter such that load voltage is always maximum leads to harnessing maximum power output. This approach can be referred to as Maximum Load Voltage Point Tracking (MLVPT). Only one parameter i.e. load voltage needs to be monitored. It is simpler than monitoring PV panel power as in that case it's necessary to measure both panel voltage and current and then find their product.*

*The proposal of MLVPT for realizing MPPT is substantiated by theoretical explanation. Simulation as well as experimentation are also carried out. The results are found to be in close conformity with the theoretical findings.*

**Keywords:** Maximum power point tracking, Solar photo voltaic system and Maximum load voltage.

## Symbols & Abbreviations

Symbol/ Abbreviation	Significance	Unit	Symbol/ Abbreviation	Significance	Unit
C	Capacitance	F	$P_{pm}$	Panel Side Maximum Power at a particular Radiation	W
D	Switching Duty Cycle of the Converter		R	Resistive Load	$\Omega$
Exp.	Experimental		R'	R Referred to panel Side	$\Omega$
$I_a$	Load Current	A	$R_s$	Series Equivalent Resistance of PV Panel	$\Omega$
$I_a'$	$I_a$ Referred to Panel Side	A	Sim.	Simulation	
$I_m$	Panel Current for Maximum Rated Power	A	$V_a$	Load Voltage	V
$I_p$	Panel Side Current	A	$V_a'$	$V_a$ Referred to Panel Side	V
$I_{ph}$ or $I_{sc}$	Solar Panel Short Circuit Current	A	$V_{cl}$	Voltage across Capacitor $C_1$ in MPPT converter	V
L	Inductance	H	$V_{ds}$	MOSFET Drain to Source Voltage	V
MPPT	Maximum Power Point Tracking		$V_g$	MOSFET Gate Voltage	V
MLVPT	Maximum Load Voltage Point Tracking		$V_{oc}$	Open Circuit Voltage of Panel	V
$P_a$	Load side Power	W	$V_m$	Panel Voltage for Maximum Rated Power	V
$P_m$	Maximum Rated Power of Panel	W	$V_p$	Panel Side Voltage	V
$P_p$	Panel Side Power	W	$W_p$	Peak Watt	W
			y	Transformation Ratio of the Converter { $y=D/(1-D)$ }	

## 1. INTRODUCTION

Among alternate sources of electricity, Solar Photo Voltaic (PV) energy is gaining prominence due to its plentiful availability. It is not being opted for in large numbers [1, 2] as grid parity of cost has not been achieved. The cost can be reduced by harnessing more power per unit installed capacity of the solar panel.

Solar PV panel exhibits [3] typical “Voltage vs. Current” ( $V_p - I_p$ ) (Figure 1) and “Voltage vs.

Power” ( $V_p - P_p$ ) (Figure 2) characteristics as a function of solar radiation. At each radiation, represented proportionally by the panel short circuit current  $I_{ph}$ , there exists a particular operating point at which the output power of the panel becomes the maximum.

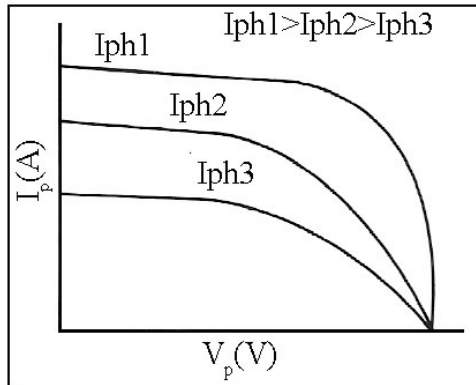


Fig.1: Typical “ $V_p$  VS.  $I_p$ ” For PV Panel

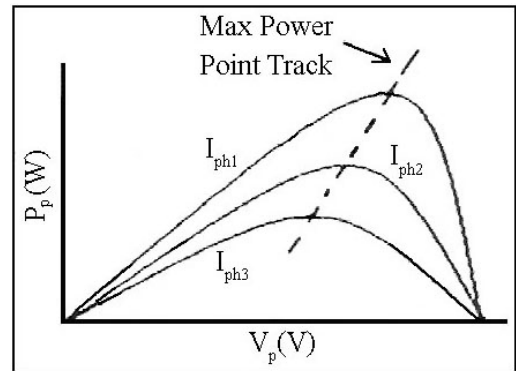


Fig.2: Typical “ $V_p$  VS.  $P_p$ ” For PV Panel

The Process of controlling the operating point of PV panel so that it always corresponds to Maximum Power at the corresponding radiation is referred to as Maximum Power Point Tracking (MPPT). This needs matching between the Load and PV panel and can be accomplished by connecting a power electronic converter with variable switching duty cycle (D) as the interphase between the PV panel and the load [4, 6]. There are different strategies to vary D [5] which can be broadly categorised as:

- a) **Interruptive Type:** This has mainly two approaches. The first one is to maintain  $V_p$  at a value which is a fixed percentage of open circuit voltage ( $V_{oc}$ ). This requires monitoring of  $V_{oc}$ . Another approach is to maintain the panel current ( $I_p$ ) as a fixed percentage of short circuit current ( $I_{sc}$ ). This requires monitoring of  $I_{sc}$ . These two approaches, though simple, require regular delinking (interruption) of panel from the load for measuring  $V_{oc}$  or  $I_{sc}$ , leading to loss of harnessed power.
- b) **Non Interruptive Type:** Here the PV panel power ( $P_p$ ) is monitored continuously. D is varied till  $P_p$  becomes maximum. This method is more accurate and does not require delinking of panel from load. Hence is widely employed. But for computing power ( $P_p = V_p \times I_p$ ), two parameters i.e.,  $V_p$  &  $I_p$  are to be measured and then multiplication operation is to be performed, making the controller comparatively complicated. Hence there is need for a method which is non interruptive as well as simple.

Present paper proposes a simple method to realise MPPT for standalone solar PV system with resistive load and without battery backup. It is shown that the output power becomes maximum when the load voltage becomes maximum. Conversely, varying the duty cycle of the converter such that load voltage is always maximum leads to harnessing maximum power output. This approach can be referred to as Maximum Load Voltage Point Tracking (MLVPT). It is required to monitor only load voltage which is simpler than monitoring PV panel power.

The proposal of MLVPT for realising MPPT is substantiated by theoretical explanation. The Matlab-Simulink (version 7.5) based simulation as well as experimentation are carried out and the results obtained are found to be in close conformity with the theoretical findings thus validating the proposal made.

Section 2 of the paper provides the theoretical background. Section 3 deals with the simulation. Section 4 provides the experimentation details. Section 5 presents observations and discussion followed by conclusion in Section 6.

## 2.0 THEORETICAL BACKGROUND

PV system with PV panel, load resistance R and a converter for MPPT (Figure 3) is considered. Cuk topology is chosen for the converter due to its versatility (possibility of both step down & step up operations) and parallel switch position always giving continuity of connection with the input. The converter acts like a transformer with a transformation ratio  $y = D/(1-D)$  where D is the switching duty cycle of the converter. Let  $R'$ ,  $V_a'$ ,  $I_a'$  be the values of R,  $V_a$  &  $I_a$  respectively referred to panel side (Figure 4).

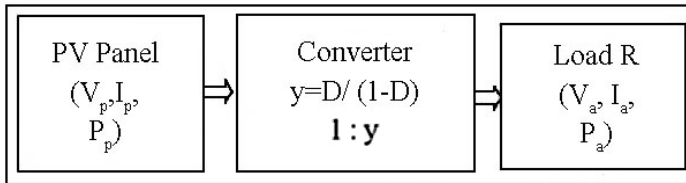


Fig.3: System parameters

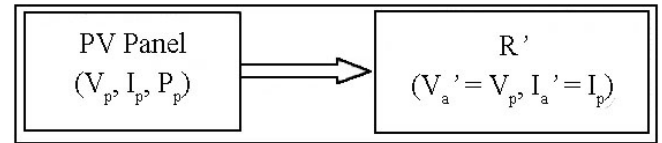


Fig.4: Load Referred to Panel Side

For this system the following equations can be written:

$$y = \frac{D}{(1-D)} \quad (1) \quad R' = \frac{R}{y^2} \quad (2) \quad P_p = V_p I_p \quad (3)$$

$$P_a = V_a I_a \quad (4) \quad V_a = y V'_a = y V_p \quad (5)$$

$$I_a = \frac{I'_a}{y} = \frac{I_p}{y} \quad (6) \quad R' = \frac{V'_a}{I'_a} = \frac{V_p}{I_p} \quad (7)$$

$$\text{Assuming 100\% efficiency for converter, } P_p I_p = P_p = V_a I_a = P_a \quad (8)$$

$$V_a = \sqrt{P_a} \sqrt{R} = \sqrt{P_p} \sqrt{R} \quad (9) \quad V_a \propto \sqrt{P_a} \quad (10)$$

Hence theoretically, equations (9) and (10) indicate that  $V_a$  follows variations of  $P_a$  and  $P_p$ . As per the typical  $V_p$ - $I_p$  characteristics (Figure 2),  $P_p$  rises from zero, reaches maximum and decreases to zero. So does  $P_a$  and  $V_a$ . Thus  $V_a$  becomes maximum when  $P_a$  becomes maximum. Conversely, maximum  $P_a$  corresponds to maximum  $V_a$ .

To establish validity of (10), an actual solar PV panel is taken with the following specifications:

$P_m = 148 \text{ W}$ ,  $V_m = 16.4 \text{ V}$ ,  $I_m = 9 \text{ A}$ , Sun Technics Make.  $V_p$  -  $I_p$  characteristics are obtained experimentally at a radiation corresponding to  $I_{sc} = 5.8 \text{ A}$  (Figure 5). Pure resistance  $R = 2 \Omega$  is considered as load. Using (2),  $R'$  is calculated for different values of  $D$ . By superimposing  $R'$  lines on the  $V_p$ - $I_p$  plot of Figure 5, different operating points ( $V_p$ ,  $I_p$ ) are obtained. With these,  $P_p$ ,  $V_a$  &  $I_a$  are obtained using (3), (4), (5) & (6) and tabulated (Table 1). It is observed from Table 1, that, with change in  $D$ , as load voltage  $V_a$  increases (decreases), load power  $P_a$  and panel power  $P_p$  also accordingly increase (decrease).  $P_a$  becomes maximum when  $V_a$  becomes maximum. This is in accordance with (10).

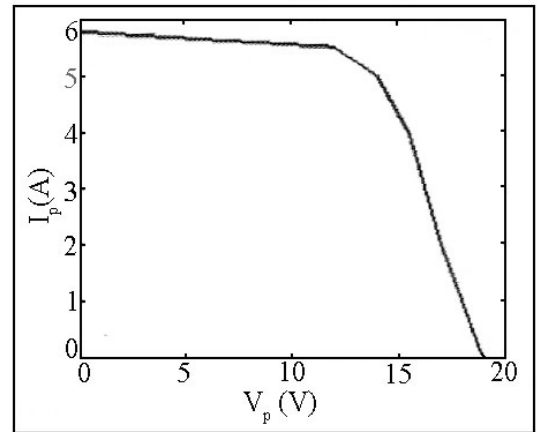


Fig.5: “ $V_p$  VS.  $I_p$ ” (EXP) OF PV PANEL

TABLE 1

VALUES DERIVED FROM PRACTICAL  $V_p$ - $I_p$  CHS FOR SYSTEM WITH MPPT & R LOAD AT  $I_{sc} = 5.8\text{A}$

D	0.30	0.35	0.40	0.45	0.50	0.55
$Y(=D/(1-D))$	0.42	0.53	0.66	0.81	1.0	1.22
$R' (=R/y^2)\Omega$	11.3	7.1	4.5	3.0	2.0	1.34
$V_p \text{ V}$	17.5	16.8	16.0	14.6	10.3	6.5
$I_p \text{ A}$	1.5	2.3	3.5	4.4	5.1	5.2
$P_p (=V_p I_p) \text{ W}$	27.1	38.6	56	64.2	52.5	33.8
$V_a (=y V_p) \text{ V}$	7.35	8.9	10.5	11.8	10.3	7.9
$I_a (=I_p / y) \text{ A}$	3.6	4.3	5.3	5.4	5.1	4.26
$P_a (=V_a I_a) \text{ W}$	26.4	38.2	55.6	63.7	52.5	33.6

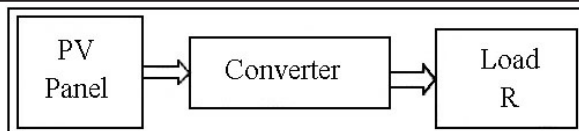


Fig.6: System with MPPT

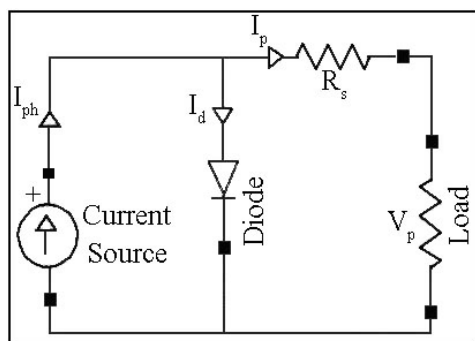
### 3.0 SIMULATION OF THE PV SYSTEM

This section deals with the simulation of Solar PV system with the MPPT converter (Figure 6). Details of different components considered for simulation are given below.

#### PV Panel:

Specifications are the same as given in section 2, PV Panel can be represented by a simple equivalent circuit [7] with a current source having a diode in parallel and resistance  $R_s$  in series. From experiment,  $R_s$  is found to be  $= 2.13 \Omega$ . The simulation module is shown in Figure 7. The current and power are given by the equations (11) & (12).  $I_{ph}$ , being directly proportional to the radiation, is used as a measure of radiation. “ $V_p$ - $I_p$ ” characteristics found from simulation as well as experimental test are in close conformity (Fig.8)

validating the simulation module developed for the PV Panel.



**Fig.7: PV Panel Equivalent**

$$I_p = I_{ph} - I_d \quad (11) \quad P_p = I_p \times V_p \quad (12)$$

### MPPT Converter (Figure 9):

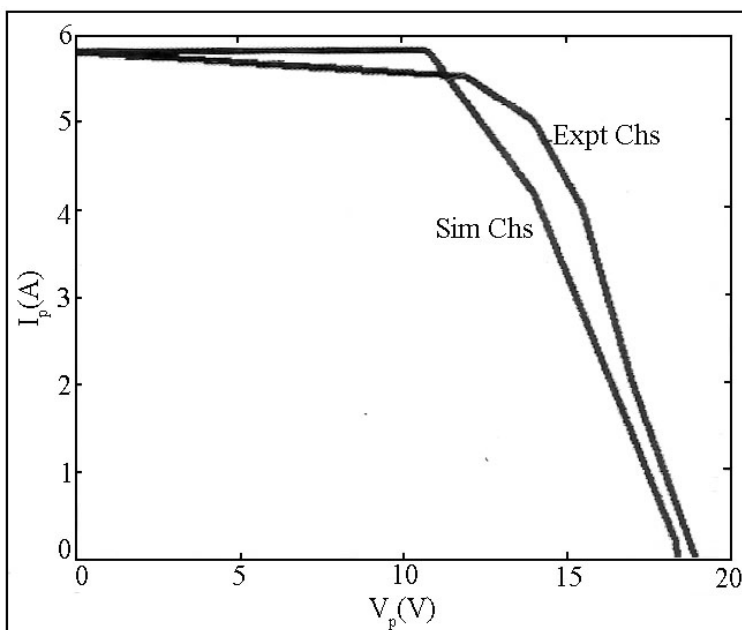
Cuk configuration is employed with MOSFET as switch. It is designed [8] for switching frequency of 20 kHz with the component values:  $L_1=4.2 \times 10^{-3}$  H;  $L_2=7 \times 10^{-3}$  H;  $C_1=1000 \times 10^{-6}$  F;  $C_2=4 \times 10^{-6}$  F. Converter output voltages for an input voltage of 12 V are obtained for different values of D by simulation ( $V_{asim}$ ) as well as theoretical calculation ( $V_{acal}$ ). There is close conformity between both (Fig.10) validating the simulation module developed for the MPPT converter.

The simulation setup for the entire system is shown in Figure 11. Inputs required for this module are radiation level (given in terms of  $I_{ph}$ ) and duty cycle D for converter. The output parameters are:  $I_p$ ,  $V_p$ ,  $I_a$ ,  $V_a$ . The simulation is run for different  $I_{ph}$  and at each radiation for different duty cycles D. The plots of load voltage (Figure 12) and load power (Figure 13) as a function of D are obtained.

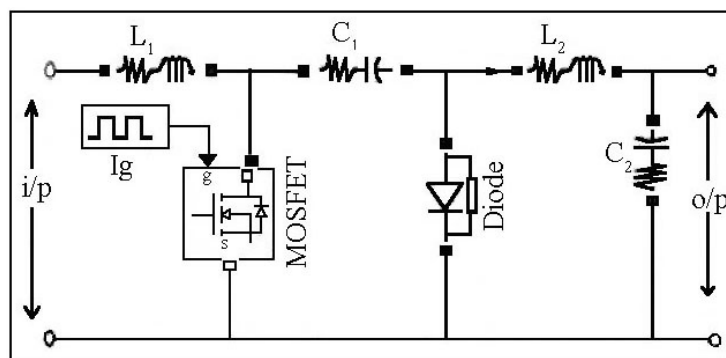
### 4.0 EXPERIMENTAL TESTING

The experimental setup (Figure 14) consists of the PV Panel, MPPT Converter and the resistive load connected as per the block diagram shown in Figure 6. Necessary meters are added for measuring currents and voltages. Load resistance is taken as 10  $\Omega$ . PV Panel and MPPT Converter are taken with specifications mentioned in the earlier sections. First the load is connected directly to panel and the voltage and current readings are taken. Then the load is connected through the MPPT converter.

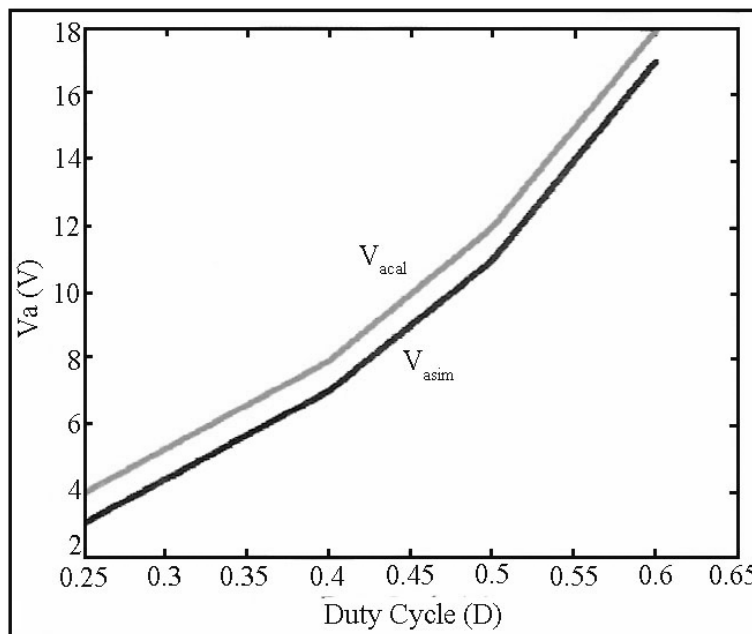
The duty cycle of the MOSFET is varied and different parameters like D,  $V_p$ ,  $I_p$ ,  $V_a$  and  $I_a$  are noted. This procedure is repeated for different radiations i.e. times of the day. The following characteristics are obtained: a) "Load



**Fig.8: " $V_p$  VS. $I_p$ " CHS for PV Panel (Exp. & Sim.)**

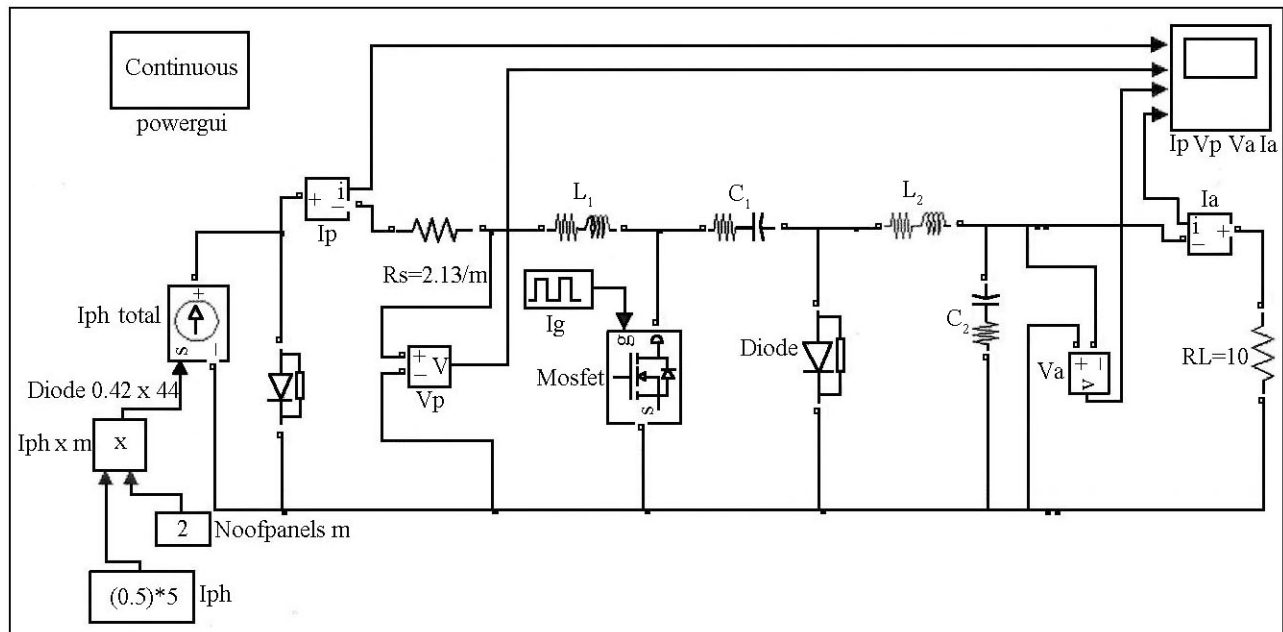


**Fig.9: MPPT Converter**

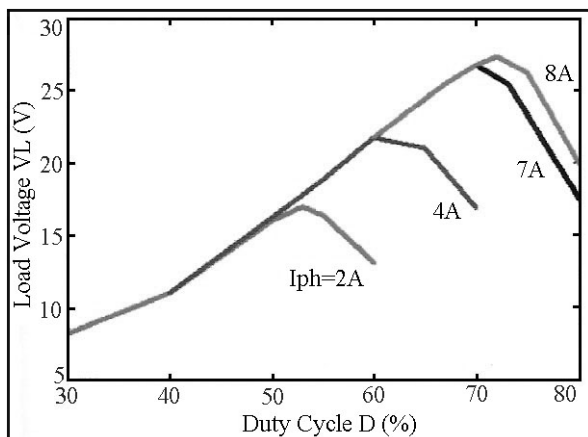


**Fig.10: MPPT Converter: caln & sim results**

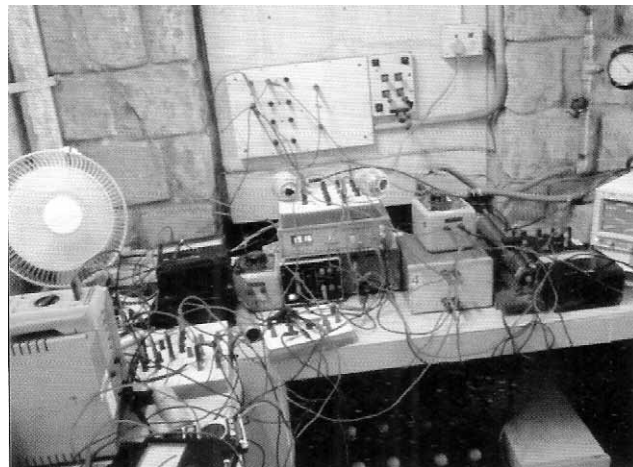
Voltage Vs Duty Cycle” (Figure 15); b) “Load Power Vs Duty Cycle” (Figure 16); c) “Different Powers Vs Time of Day” (Figure 17). The powers shown are: Maximum available panel power ( $P_{pmav}$ ), Maximum Panel Power due to MPPT converter ( $P_{pmcon}$ ), Panel Power ( $P_p$ ) and Load Power ( $P_{adir}$ ) with direct connection. MPPT converter waveforms are shown in Figures 18, 19, 20 & 21 which conform to theoretical patterns [8].



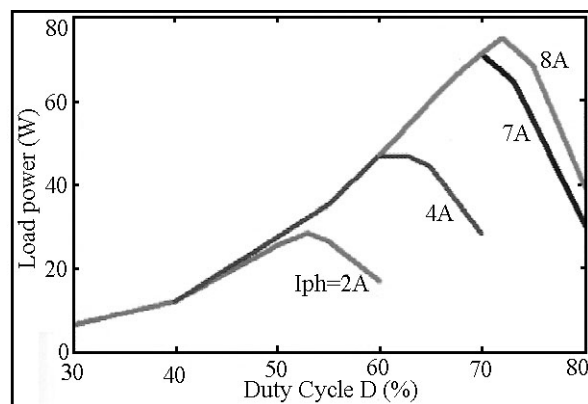
**Fig.11: Simulation Module for system with MPPT Converter**



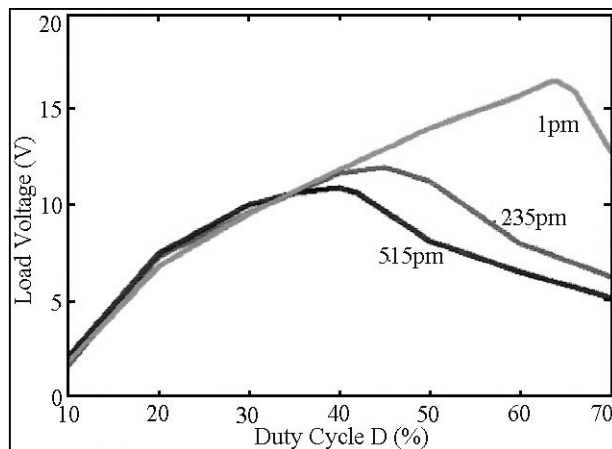
**Fig.12: “Converter Duty Cycle Vs Load Voltage” for System with MPPT Converter**



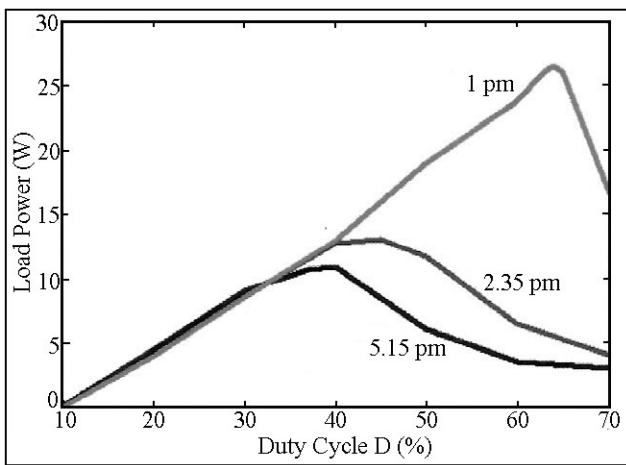
**Fig.14: Experimental Test Set up**



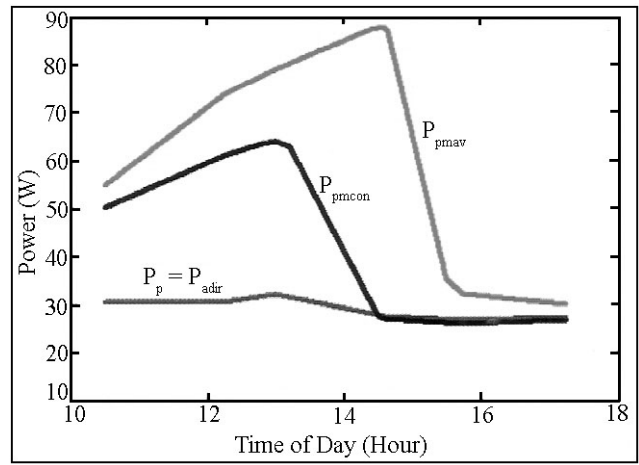
**Fig.13: “Converter Duty Cycle Vs Load Power” for System with MPPT Converter**



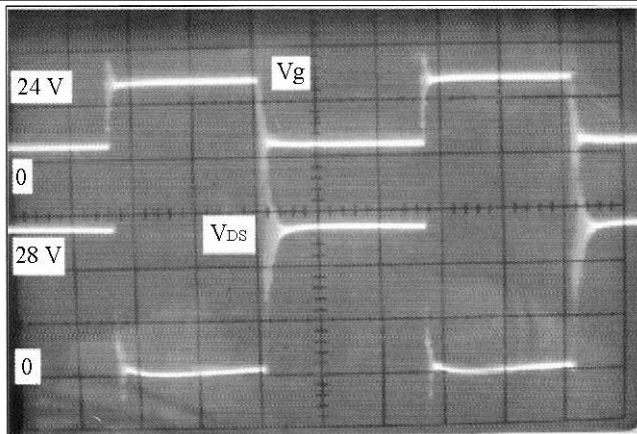
**Fig.15: “Converter Duty Cycle Vs Load Voltage” Expt on System with MPPT converter**



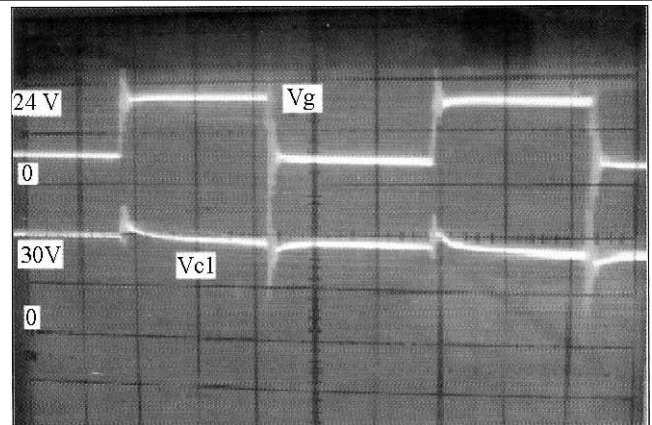
**Fig.16: “Converter Duty Cycle Vs Load Power” Expt on system with MPPT converter**



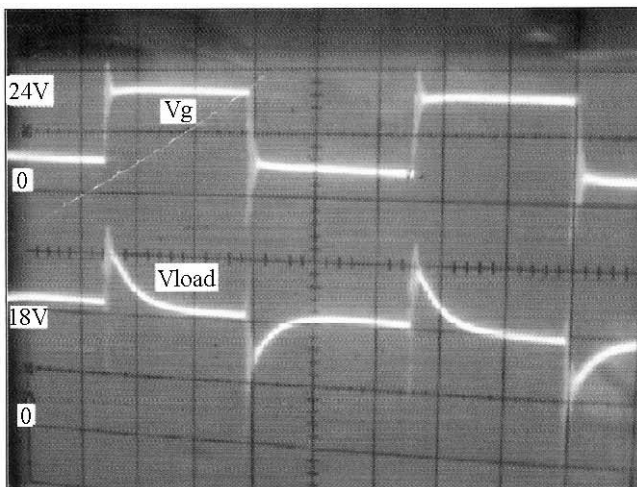
**Fig.17: “Time of Day Vs Different Powers” Expt on system with MPPT converter**



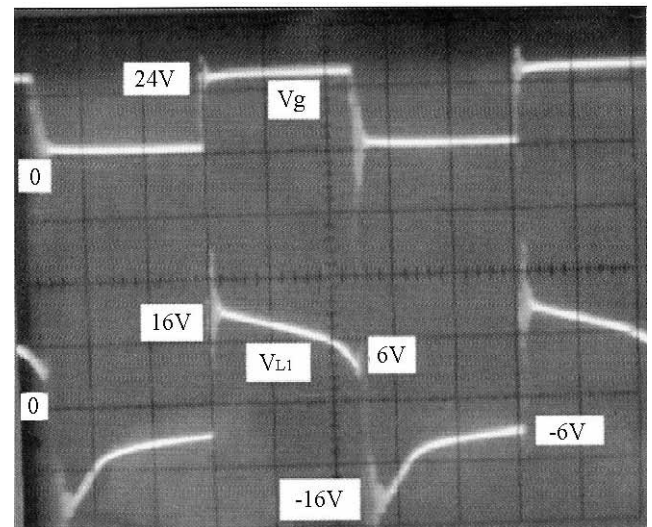
**Fig.18: MPPT converter waveform: “Time Vs Gate Voltage (VG) and MOSFET Voltage (VDS)”**



**Fig.19: MPPT converter waveform: “TIME VS Gate Voltage (VG) and Capacitor (C1) voltage (VC1)”**



**Fig.20: MPPT Converter waveform: “TIME Vs Gate Voltage (VG) and Load Voltage (VA)”**



**Fig.21: MPPT Converter Waveform: “Time Vs Gate Voltage (VG) and inductor (L1) voltage (VL1)”**

## 5.0 OBSERVATIONS AND DISCUSSIONS

Following observations are made from the simulation and experimental results presented in earlier sections:

- From simulation it is observed that the load voltage and power show increase/decrease trend with change in duty cycle (Figures 12&13). Experimental results also indicate this feature (Figures 15&16). Looking at the corresponding value of  $d$ , it is also found that, at a particular radiation, load power becomes maximum when

$V_a$  becomes maximum. These observations are in conformity with the theoretical findings presented in section 2.

- This means for a particular radiation, there exists a specific load voltage at which output power becomes maximum. Hence the load voltage  $V_a$  can be used as a control parameter for varying the duty cycle of the converter in achieving MPPT.
- $V_a$  can be continuously monitored and  $D$  continuously varied so as to realize Maximum  $V_a$  which automatically ensures maximum output power at the corresponding radiation. This approach can be referred to as Maximum Load Voltage.

Point Tracking (MVPT). This is simpler than monitoring PV panel power which means monitoring PV Panel voltage as well as current and then multiplying them to obtain power value.

- The maximum panel power obtained for the system with MPPT converter is more than the panel power obtained for the system without MPPT converter (Figure 17). This feature demonstrates the role of MPPT Converter in harnessing more power from the solar panel.

## 6.0 CONCLUSION

MPPT is opted for harnessing maximum power from the PV panel. Widely employed approach for MPPT is to monitor the PV panel power and keep on adjusting the switching duty cycle of MPPT converter so that tapped power is always maximum.

Present paper has proposed a novel method to realize MPPT for standalone solar PV system.

It is shown that the output power becomes the maximum when the load voltage becomes the maximum. Conversely, varying the duty cycle of the converter such that load voltage is always maximum leads to harnessing maximum power output. This approach can be referred to as Maximum Load Voltage Point Tracking (MLVPT). It is required to monitor only load voltage. It is simpler than monitoring PV panel power as in that case it's necessary to measure both panel voltage and current and then find their product. The proposal is substantiated by theoretical explanation. Simulation as well as experimentation are carried out and the results are found to be in close conformity with the theoretical findings thus validating the proposal made.

*Courtesy: Mrityunjaya Kappali and Uday Kumar R Y  
Journal of CPRI, December 2012*

## JAPAN'S FUKUSHIMA FACES LONG ROAD TO REPAIR



The cleanup after the catastrophic nuclear accident two years ago at the Fukushima nuclear plant in Japan is not going well. Radioactive cooling water is leaking into the ground from at least three vast storage tanks, and the vulnerability of the plant to further accidents was revealed when a rat chewed through an electric cable, cutting off vital cooling. Spent nuclear fuel melted into lumps of unknown size will remain dangerous for hundreds of years, and so far no one has devised a method of retrieving it. Tepco admits only that the leaks are a "crisis" but says it has kept the stricken reactors stable by injecting water continuously. Without the water the spent fuel inside the reactors could overheat, causing another potential radioactive release. But it is the massive amount of

radioactive water that is becoming part of the problem, because it cannot be discharged into the sea without breaching international law and risking contamination of fish stocks. Instead it is pumped into reservoirs that have been inadequately lined, and it is from three of these that the radioactive leaks of thousands of gallons are continuing. Pumping the reservoirs dry to solve the problem will take weeks. The latest plan to avoid this happening involves building a giant concrete arch that will be moved on rails over the stricken reactor to contain any further collapse. The arch is being constructed away from the sarcophagus to avoid the continuing radiation and will be wheeled over it. At 270 meters across, 150 meters long and 100 meters high it is the largest moveable structure in the world. There are hopes that it will be completed in 2015, but even this is seen as only a temporary solution. The cost is estimated at around \$1.5 billion.

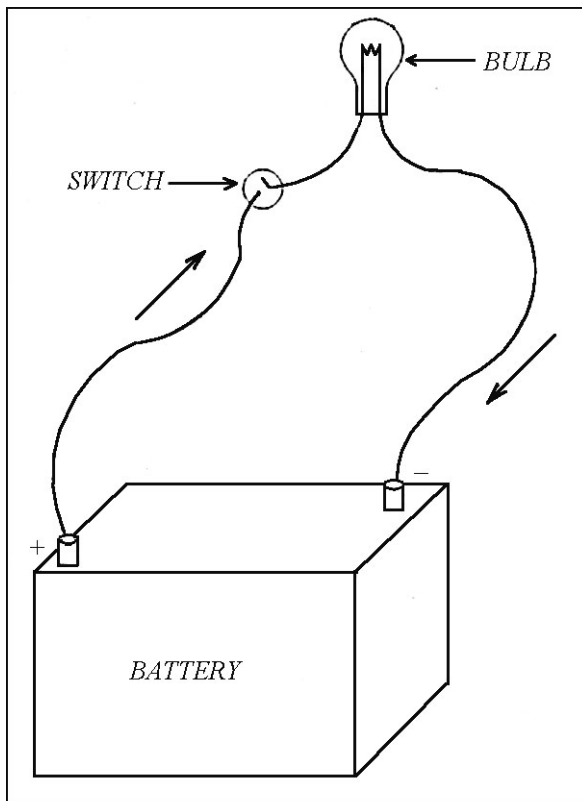
*Paul Brown is a joint editor at Climate News Network. Climate News Network is a news service led by four veteran British environmental reporters and broadcasters.*

# PLAY SAFE WITH ELECTRICITY (1965)

*(This article is mainly written for the average layman. Here an attempt is made to imbibe the principle rather than explaining case histories in the belief that a principle well understood would go a long way in electrical safety in ever different situations).*

Now before going into the details of electrical safety let us first understand what exactly is the mechanism of electrical shock and how it occurs in living beings.

The sensation of shock occurs when a current of electricity passes through the body (human or other living beings). As you are all aware that a flow of electrons constitutes an electric current. Materials that easily allow the flow of electric current are called conductors such as copper, silver, aluminium and in fact all metals. And those that do not allow the flow of electric current are called non-conductors or insulators. Eg. rubber, plastic, dry paper wood etc. An electric current flows when the circuit is complete. A 'bulb' (the correct technical term being incandescent lamp) glows or a motor runs or a person receives shock only when the circuit is complete Fig.1 makes clear what the circuit completion means. When the switch is closed (ON) a current starts from the positive pole of the battery, flows along the wires, through the bulb and back to the battery. As long as this flow takes place the bulb glows. If the switch is open (OFF) the flow of current is interrupted and the bulb stops glowing. Similarly when the bulb is removed from the holder with the switch in the ON position, no current flows. And no current leaks from the holder as some people think. This same thing happens whenever an electrical equipment works. In our electric power supply an electric current starts from the transformer, flows through the wires, through the electrical equipment and back to the transformer.



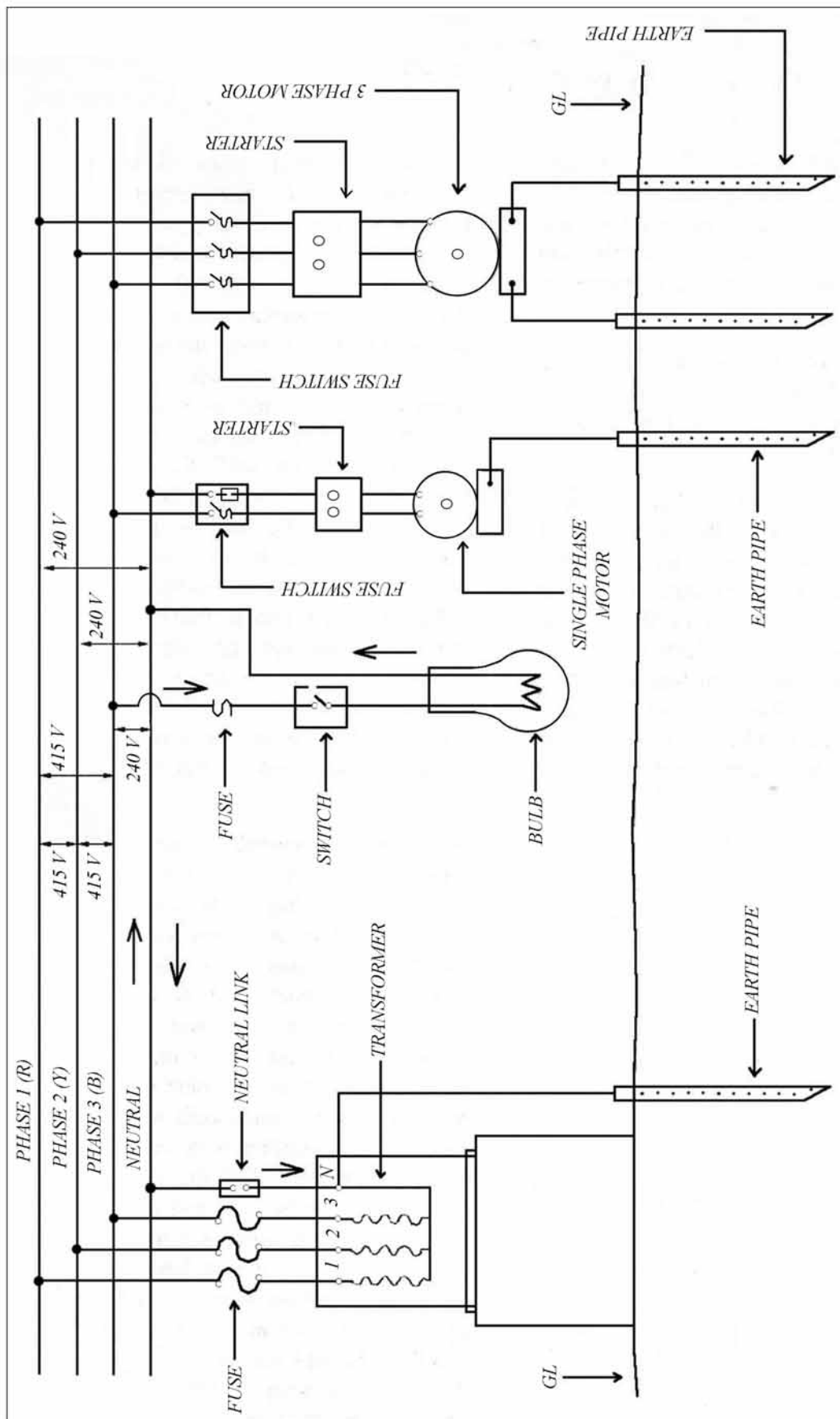
Now let us examine our electric power transformer connections. On the low tension side (i.e. low voltage side connected to motors and bulbs), there are three coils of wire in the transformer connected as shown in Fig2. One end of each coil is connected to an individual terminals 1,2, and 3, called phase 1, Phase 2, and phase 3, or otherwise called red phase yellow phase and blue phase (RYB). The other ends of the three coils are joined together inside the transformer body and brought out as a single terminal called the neutral. For safety reasons, the neutral terminal of the transformer is earthed i.e. a wire is connected from this neutral terminal to a pipe buried in the ground. The voltage between any two phases is 415V and that between any one phase and neutral is 240V and not half of 415V as some people link. All equipment working on 240V (bulbs, small motors etc.) are connected between any one phase and neutral and equipments working on three phases such as large motors are connected to all three phases leaving the neutral.

In Fig.2 a bulb is connected to phase 3 through a switch to neutral (note the switch should always be connected in the phase line only). When the switch is closed (ON) a current flows from the phase terminal 3, through the switch, through the neutral and back into the transformer coils as shown by

the arrows. And this same thing happens when the starter of the motor is switched ON, the circuit is completed and a current flows as indicated by the arrows. We get alternations electric current (AC), which current changes direction 50 times a second. For our study here it is assumed to flow in one direction only.

From the above, the main point to be understood is that a current flows when the circuit is complete i.e. when the switches are ON and provided there is no break in the supply wires. The completion of circuit is something like a person starting from his house in one direction and arriving at his house from the opposite direction after travelling many streets in a round about manner.

When a person's body forms a path for a flow of current he feels the sensation of shock. 50 milli amperes or 50/1,000 of an ampere can be fatal, higher the voltage, the more the current flows and greater is the danger. A flow of current through a person's body paralyzes the nervous systems. Severity of electric shock depends on the path



**Fig.2: Principle of Connection of Single Phase & Three phase equipments**

taken by the electric current in the person's body. Usually it paralyzes breathing and if the path is taken through heart region, there is an instantaneous stoppage of heart. The most common situation in which a person is liable to receive a shock is while standing on the ground or when in contact with a grounded metallic object. And now let us examine how the circuit is completed.

In the Fig. 3 a person standing on the ground with bare feet, comes in contact with phase wire 3 because of the insulation fault in the motor. A current flows from the phase terminal 3 of the transformer, through the wire, through the person's body, through ground (earth is a good conductor of electric current) and back to the neutral terminal of transformer through the buried earth pipe near the transformer. Thus the circuit is complete, a current flows through the person's body and the person receives a shock. But if this person were to be wearing rubber shoes or standing on a dry wood (wet surfaces conduct electric current) current flow is obstructed, no current flows through the person's body and the person receives no shock, provided no other part of his body is in contact with grounded metallic objects. Again if this same person wearing rubber shoes comes in contact with two phase wires each with one hand, he receives a mighty shock of 415V which is fatal.

### **Electrical safety**

So from the above one can conclude the first precaution to prevent electric shock is to insulate all current carrying wires. All defective wires should be replaced. All parts carrying electric current should be enclosed in rigid enclosures.

**Earthing:** To prevent danger of electric shock in the event of insulation getting damaged in electrical equipment, all non-current carrying metal parts of electrical equipment should be earthed and how an earthed electrical equipment prevents danger of shock is explained as follows.

In the Fig. 4, the body of the electric motor is connected to an earth pipe. When a fault occurs at point 'A' (live wire in the motor coming in contact with the body of the motor due to damage of insulation) and since the resistance of the ground to the flow of current is small, a very heavy current flows from the phase 3 through the fault in the path shown, by the arrows. This heavy current blows off the fuse in phase 3, thus cutting off the power and rendering the equipment safe. The main point to be noticed is that a circuit is to be completed. The notion some people have that earth absorbs electric current is false. This same principle applies whether it is a single phase (240V) or three phase (415V) equipment.

But this safety will fail if there are the following defects.

1. If the body of the equipment is not properly earthed with required thickness of earthing wire.

**Loose contact of earthing wire at the body and earth pipe terminals.**

**Remedy:** Use proper thickness of earthing wire. Check earthing terminals for tightness.

2. If there is **no continuity of earth wire from motor to earth pipe.**

**Remedy:** Check for continuity.

3. **Defective earthing of earth pipe:** Even though earth is a good conductor of electricity, at the place where the earth pipe is buried the ground must be moist and conductive. This is achieved by surrounding the pipe with charcoal and common salt. The earth pipe must be driven at least 8 feet into the ground (not 2 or 3 feet 'nam ke vasty' job many people are now doing) surrounded by charcoal and common salt and kept moist.

**Remedy:** Use proper length of earth pipe buried as described above. Measure the earth resistance of earth pipe periodically. The resistance should be less than 2 ohms.

4. **Defective earth pipe connected to the neutral of the transformer.**

**Remedy:** This you cannot do. You have to request Electricity Board people to install a good earth pipe.

5. **The fuse:** If the size of the fuse is large than necessary, it may not blow off when a fault current flows thus not rendering the equipment safe.

**Remedy:** Use correct size of fuse.

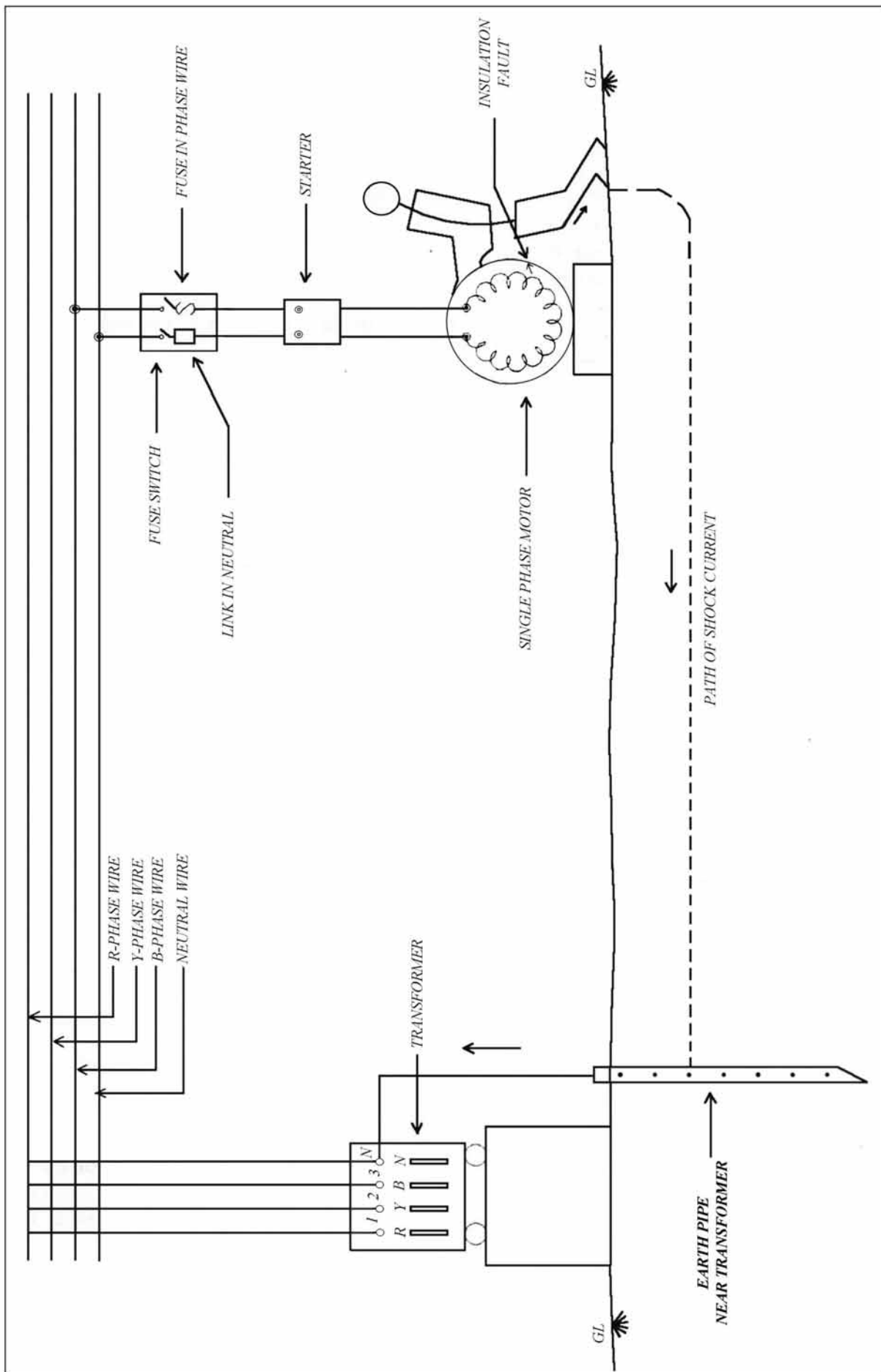
6. If the **lighting and single phase equipment is connected between phase and earth wire**

**Remedy:** Never connect lighting bulbs and single phase i.e. (240V) equipment between, phase and earth wires. Lighting and single phase equipments should be connected between phase and insulated neutral wire brought separately all the way from the transformer neutral terminal.

The above indicates how important earthing is. Never fail to earth properly all the non-current carrying metal parts of electrical equipments.

**Insulation:** Apart from earthing, the next important safety is the maintenance of electrical equipment. All indoor current carrying wires and equipment are surrounded by insulation (covered by materials which do not allow the flow of electric current) This insulation is liable to get damaged in the following ways.

1. Due to abuse.



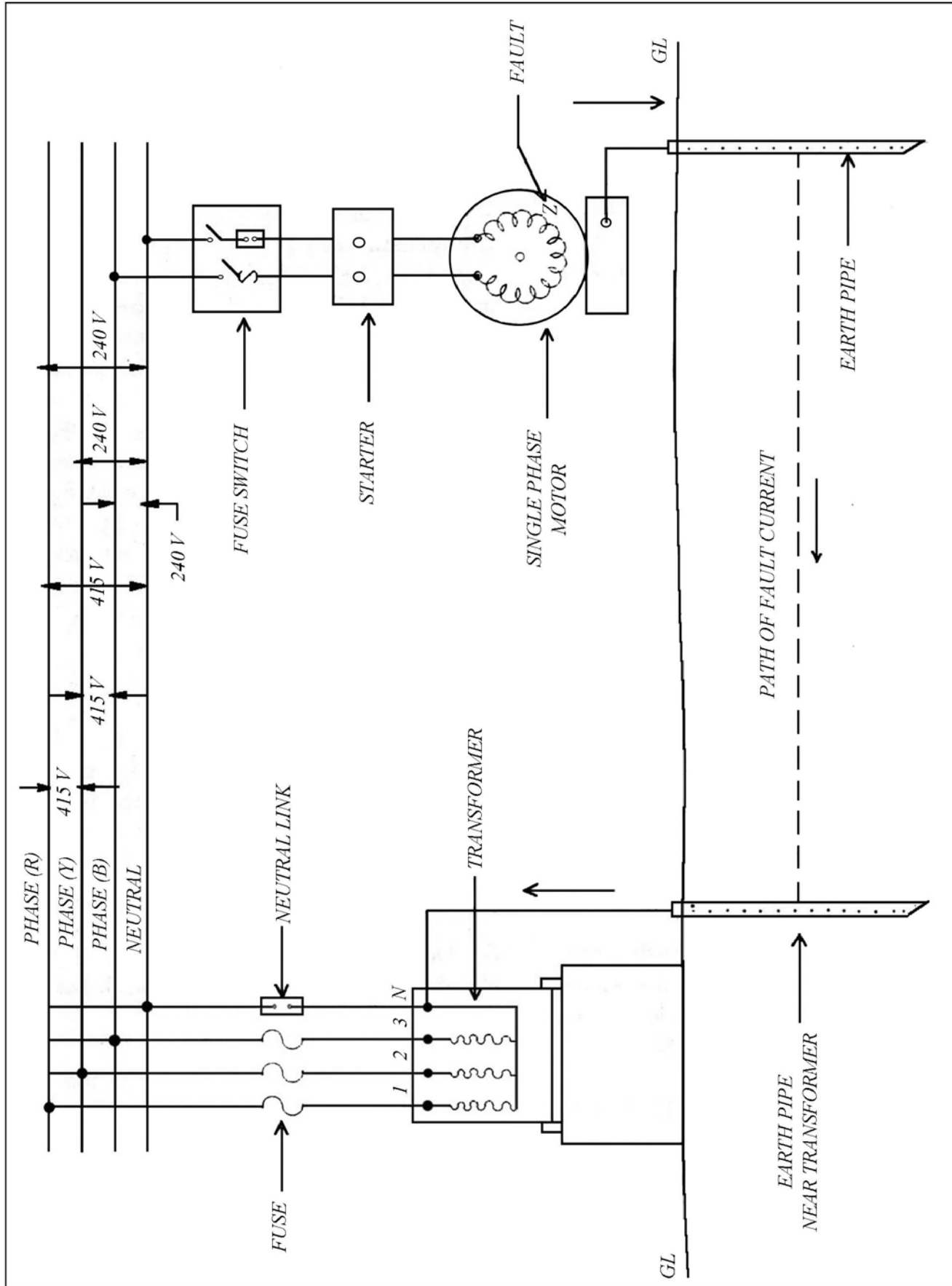


Fig.4: Diagram showing the path of fault current

2. Due to over loading, i.e. if the electrical equipment and wires are made to carry more than their capacity they get heated up beyond the temperature for which they are designed causing damage to the insulation and leading to breakdown and danger.
3. Due to moisture. When the insulation absorbs moisture it is rendered weak leading to breakdown and danger.

**Remedy:** Contra indications for all the above.

The condition of insulation of all electrical equipments can be gauged by an instrument called insulation tester popularly known by the name as 'Megger' which is a trade name given to it by its manufacturer.

Before putting new electrical equipment into operation, the condition of its insulation should be checked by the 'megger' and the insulation should have certain minimum values. One meg ohm or one million ohms. The condition of insulation of all working electrical equipment should be ascertained by the megger periodically and recorded. Should an equipment tend to show fall of values immediate remedial measures should be taken.

**Installation:** All electrical equipment and its connected gear should be of proper rating and designed for the type of work. All wires entering and coming out of conduits should be protected by insulated bushes to prevent cutting of insulation by sharp edges. Cable ends and joints should be properly sealed using right type of cable glands and boxes.

**Rescue from electric shock:** When a person comes in contact with live wires or equipment never rescue him by pulling him with your bare hands. By doing so the rescuing person will also receive a shock which might be fatal. There were instances where half dozen persons died while trying to rescue each other.

First keep you wits and presence of mind. Run to the main switch and switch off the supply.

If you do not know the location of the main switch or if the main switch is far away, take a dry cloth, stick or rope put around the victim and disengage him from the live equipment.

Send for a doctor. Apply artificial respiration if breathing stops.

Follow **First Aid**.

*Courtesy: Electricity Pack for Architects, Project Consultants, Builders by Mr. B. Raja Rao*

## PRODUCT OF THE MONTH

### SOCOMEK MOTORISED CHANGEOVER SWITCHES 40 TO 125 A

**Safe, competitive and user friendly, New Remote Transfer Switching Equipment : ATyS S - ATyS Sd**

ATyS S is a range of 4 pole motorised changeover switches with positive break indication. They enable the on load transfer of two three-phase supplies via remote volt-free contacts, from either an external automatic controller, using pulse logic, or a switch.

They are intended for use in low voltage power systems **where interruption of the load supply is acceptable during transfer.**

#### Advantages

**Extensive power supply range:** The ATyS S is available in four supply versions, each with a broad range (+/-30%). The four versions are:

- 230 VAC single power supply,
- 2 x 230VAC dual power supply,
- 12 VDC power supply and
- 24/48 VDC power supply.

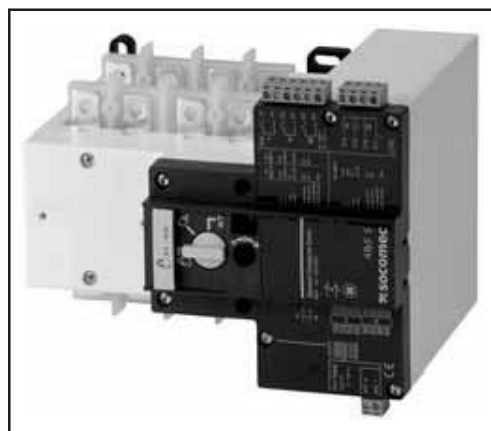
**Safety and reliability:** ATyS S products use stable position technology, ensuring constant pressure on the contacts and preventing premature faults. In addition, they do not require a power supply to maintain position, thus protecting their loads from voltage fluctuations.

**Easy integration:** ATyS S products can be easily installed inside enclosures. Their design, and in particular their compact size, enables integration within most 200 mm deep enclosures.

**Simplified maintenance:** Maintenance can be carried out easily under load, with manual operation still available. The control and motorisation section can be replaced simply by removing 4 screws, with no work required on the installation cabling.

**ATyS Sd: Dual power supply:** In addition to the functions offered by the ATyS S, the ATyS Sd incorporates supply redundancy without the need for additional wiring. This is obtained by integrating a double supply (2 independent supplies) directly within the product.

*Courtesy : <http://www.socomec.co.in/Home.html>*

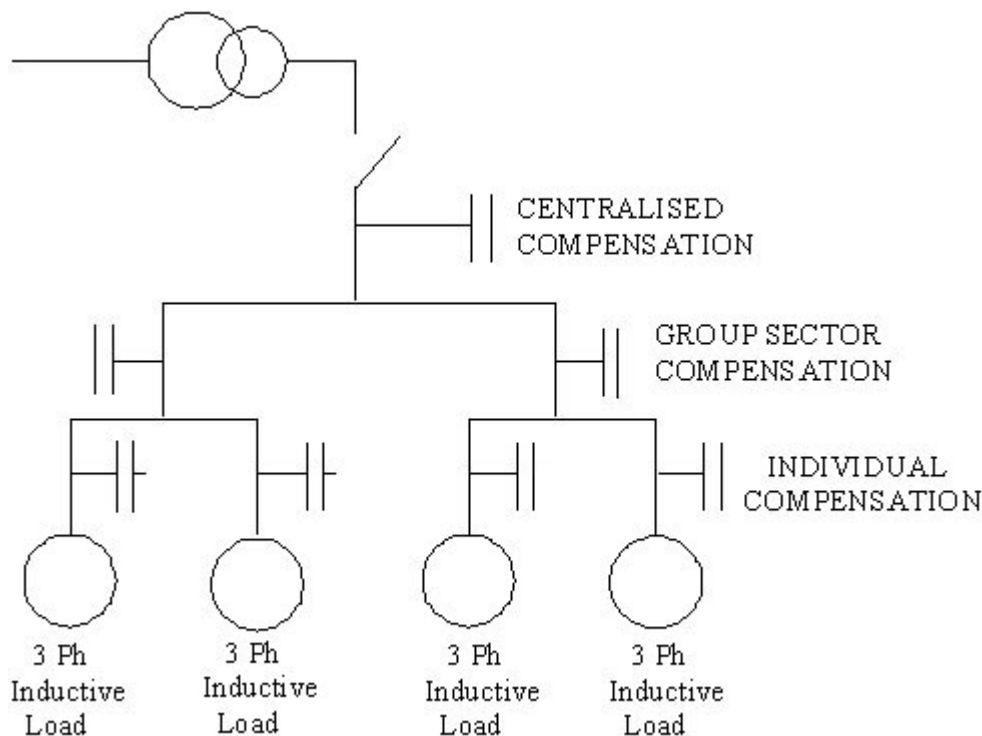


## HELP LINE

**Query:** *What are the parameters to be considered when placing the Capacitors?*

*I. Jagadeesh, Chennai*

**Explanation:** Placement of LV Capacitors in a distribution systems can be broadly classified into 3 types.



### (a) Centralised

#### Principle

- The capacitor bank is connected to the Main MV distribution board for power factor compensation of entire installation. It improves PF close to unity during normal usage of load through EB power.

#### Advantages

- Reduces the tariff penalties for Low PF.
- Reduces the apparent power KVA demand,
- Relieves Reactive energy of Transformer, Less burden on transformer, when used to its full capacity.

#### Limitation:

- Reactive current still flows in all conductors of cables leaving (i.e. downstream of) the Main MV distribution board. For this reason, the sizing of these cables and power losses in them are not improved by the centralised mode of compensation.

#### Application:

- Where a load is continuous and stable, global compensation can be applied
- EB Penalties are at minimum as APFC takes care of the entire system.
- Overall monitoring makes it easy.

### (B) Compensation by sector:

#### Principle:

- Capacitor banks are connected to bus bars of each local distribution Panel.

#### Advantages:

- The size of the cables feeding the local distribution boards may be downsized.
- For a given size of cable, maximum load can be connected.
- Losses in the same cables will be reduced.
- Apart from the above it improves the PF, thereby reducing the burden on the upstream distribution arrangement, Reduces the possibility of PF penalties & improves the system efficiency from the local Distribution level.

#### Limitation:

- Reactive current still flows in all cables downstream of the local distribution Boards.
- Monitoring becomes difficult as there shall be many such individual local distribution networks.
- large changes in downstream loads, may result in under / over compensation.

#### Application:

- Compensation by sector is recommended for large installations

- Where the load/time patterns differ from one part of the installation to another.

### (C) Individual compensation:

#### Principle

- Capacitors are connected directly to the motor terminals.
- Individual compensation should be considered to motors of higher capacity

#### Advantages

- Compensation happens at the source level itself.
- Reduces the burden of all the upstream distribution cables
- Reduces the size of all cables in design stage, as well as the cable losses.

#### Limitation:

- Not recommended for Electronics Drives.
- Monitoring is difficult.



Photo Courtesy: Yuhchang Electric

## TAMILNADU PLANS BIG IN POWER INFRA

In a bid to encourage more households to set up solar power plants, Honorable Chief Minister Jayalalithaa on Thursday announced an investment subsidy of Rs. 20,000 per KW. She said it was part of her government's plan to make solar power generation a mass movement. She also said 11 lakh new electricity connections covering houses, agriculture, commercial and industries would be given in the current year. In the first phase, the solar energy investment subsidy scheme would benefit 10,000 consumers, she said in a suo motu statement in the Assembly.

She said more power could be generated through solar energy and the State government had already announced generation-based incentive along with the 30 per cent subsidy given by the **Ministry of New and Renewable Energy**. As per the announcement, the government is giving Rs. 2 per unit in the first two years, Re. 1 in the next two years and 50 paise for the two years subsequently. Now, the government has decided to give Rs 20,000 as investment subsidy. The Chief Minister said in the past the government purchased less than 10,000 transformers every year to ensure uninterrupted power supply to consumers and now it had been decided to buy 20,000 transformers at a cost of Rs. 500 crore to overcome the shortage.

Moreover, Rs. 850 crore would be spent on creating 15,000 km of high tension and low tension power lines. She said a sub-station with a capacity of 400 KW would be set up to transmit the **wind** power generated in Coimbatore, Udumalpet and Theni. These stations would come up in Thappakundu in Theni district and Anakadavu and Rasipalayam in Coimbatore district. In a bid to encourage more households to set up solar power plants, Chief Minister Jayalalithaa on Thursday announced an investment subsidy of Rs. 20,000 per KW. She said it was part of her government's plan to make solar power generation a mass movement. She also said 11 lakh new electricity connections covering houses, agriculture, commercial and industries would be given in the current year. In the first phase, the solar energy investment subsidy scheme would benefit 10,000 consumers, she said in a suo motu statement in the Assembly.

*Courtesy: Hindu*

## GLOBAL SOLAR PV DEMAND WILL HIT 31 GIGAWATTS IN 2013

Solar photovoltaic (PV) demand will reach 31 gigawatts (GW) during 2013, according to the new NPD Solarbuzz Marketbuzz 2013. This is an increase of two GW, up seven per cent year over year, with China, Japan, and India accounting for 36 per cent of global demand. According to the report, starting from 2013, China will become the largest country market for PV demand. This will elevate China to become the leading driver in the supply and demand segments of the industry. However, a new group of emerging PV markets is poised for strong growth. This group includes Latin America, the Caribbean, the Middle-East, Africa and all countries across the Asia Pacific region (excluding China, India, Japan and Australia). This emerging group accounted for 2% of demand in 2012 but is set to grow rapidly with a CAGR of 50% out to 2017. Emerging markets are projected to create over 25 GW of PV demand, more than 10% of the cumulative total to 2017. Barker stated that 2013 would represent another transition year as the PV industry adjusts to changes to the European markets, and the Chinese end-market compensates for the downturn in demand from Germany. New policies across leading PV markets in the Asia-Pacific region, led by China, Japan, and India will stimulate regional growth over 50 per cent and account for more than 11GW of PV demand this year. Emerging regions such as the Middle East, Africa, Latin America, Southeast Asia, and the Caribbean, are forecast to account for less than 8 per cent of global demand in 2013; however this is expected to double by 2017, driven primarily by South Africa, Saudi Arabia, Thailand, Israel and Mexico.

Read more at: <http://www.renewable-energy-sources.com/2013/04/15/global-solar-pv-demand-will-hit-31-gigawatts-in-2013/>

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## TECHNICAL SEMINAR ON 30.03.2013 - A BRIEF REPORT

Tamil Nadu Electrical Installation Engineers Association 'A' Grade organised a Technical Seminar on Quality of Power & Importance of earthing in improving Safety in Electrical installations.

Chief Electrical Inspector to Govt. gave the inaugural Address.

*In his Address* - A major improvement is seen in the website regarding more user interactive & useful informations for members for their Business improvement. He said FAQ sections shall be very helpful to all to know about Specific Questions such as usage of seven segment DBs etc. This is not only useful to members in Tamil Nadu but it shall be useful to all practicing Engineers across the country. The prime objective of the Electrical Inspectorate office is enforcing rules & regulations regarding safety. But he added, this is not only the responsibility of the Electrical Inspector office but it is also with each & every Contractor, Consultant & Clients.

He suggested the Contractors, submitting the drawing Approvals, to plan well in advance and not to rush in the last minute. This shall reduce the undue pressures on the existing work load faced by the department officers.

Regarding the seminar on harmonics, he insisted it is very pertinent topic as Chennai is facing acute harmonic issues. Areas like Gummidipoondi, Irungattukottai & OMR (Rajiv Gandhi Salai) have distinct type of harmonics issues. This is due to different types of loads prevailing in respective areas. Furnace Load, Welding Load & Computer Load inject harmonics to the SEB distribution system in the above mentioned areas respectively. The issue has to be tackled by having awareness by different stakeholders acting as a team.

He suggested, Contractor's Association has to perform a lead role to bring the manufacturers, Consultants, Contractors & Clients to find ways to mitigate harmonics in the equipment level itself.

**Mr. U. BASKARAN, President** honoured **Mr. S. APPAVOO, CEIG** by presenting a memento on behalf of the Association.

JEF TECHNO SOLUTIONS PVT. LTD. **Managing Director Mr. K. KANESAN** gave a splendid insight about the Earthing Systems & Myths Surrounding the Procedures.

*In his speech* - Of late Chemical compound earthing is becoming popular among the Clients & Contractors. This has superseded the traditional method of earthing using GI Pipe with Salt & Charcoal.

In the Recent Chemical earthing most of the Chemical earthing providers use Bentonite Powder. When the normal moisture content is available the Bentonite powder retains the moisture and have satisfactory level of conduction. In summer and in Dry conditions, Bentonite shrinks away from the earth electrode resulting in higher resistivity. These types of earthing where bentonite powder used for treating the soil around the electrode shall give less resistance during monsoon and wet condition & high resistance in summer/Dry condition. Since the resistivity varies from season to season this is highly unreliable.

For the above reason it is better to have materials like Carbon/Gel etc. instead of Bentonite.

Advantages of Carbon Compounds

- ❖ As per IEEE standards it gives 0.1 ohm/mtr.
- ❖ It complies with International standards.
- ❖ They don't diffuse & leach in the ground.
- ❖ It's truly maintenance free and does not depend on water.

As Electrical Installation Engineers we are working like doctors. We have to guide our clients for selecting the appropriate Earthing System Selection.

*When safety is a factor, call in a Contractor*

Old Conventional Earthing System may not be continued in future as new Earthing Techniques and new materials are available for better earthing.

In normal practice we dig a 3' x 2' pit for conventional Earth pits. But today we can use a 100mm – 150mm dia bore which is sufficient and shall give a better result, since the natural earth is undisturbed near the earth electrode. This improves the conductivity by 40% - 50%.

It's normal to believe going to copper electrode shall lower the resistance. But copper or steel the difference in resistance is negligible. Copper corrodes less compared to steel. Latest techniques uses copper bonded steel rods. Copper Bonded for 250 microns as outer layer on steel rod. This gives sufficient resistance against Corrosion at the same time it saves precious copper.

When Plate electrode is used, it gives 36.27 Ohm / Mtr resistivity and 17mm dia compound based copper bonded earth electrodes gives 34.5 Ohm / Mtr resistivity in the same area. This shows just dumping the precious metal without any useful result.

Regarding interlinking of Earth pits it's a normal practice that only few of the Earthing terminals are interlinked. Other Earthing work as dedicated or stand alone systems. This should be avoided. All earthing systems should be interlinked. When a Lightning strikes a area, for a 1½ km radius ground potential raises. If earthing systems are not interlinked, when lightning strikes potential difference shall be different in different earth electrodes. We all know in Electrical installations the difference in voltage between earthing systems shall cause more damage than the uniform raise. When interlinking between all Earthing systems is done, the raise in potential shall be uniform and shall save sensitive electronic equipments.

Many customers are particular about  $1^2/\text{Electrode}$ . Mostly this is not possible as this resistivity depends upon the natural soil available at the site. We can improve the efficiency of the earth electrode by improving the diameter. Medium adjacent to the electrode plays an important role regarding dissipation of current.

As a normal practice, mostly on Customer's preference, dedicated earth is provided. This stand alone earthing is not interlinked with any other earthing system. This is not recommended. Instead separate earth electrode is provided and interlinked in the ground level to the other earthing system. This is an accepted International practice.

For Highrise buildings to comply EMI requirements every 20mts In the vertical building, all earthing systems are interlinked in respective 20mts level.

Now our National Electric Code insists even bathroom taps (metallic parts) to be earthed to local supplementary equipotential bonding. It is the duty of Engineer to take lot of care and procedures to be followed.

As we are dealing with lot of sensitive electronic equipments, surge protection becomes very important.

The main causes of surges are

1. Lightning
2. Sw.ON & Sw.OFF of TNEB supply
3. Transient Voltage surges.

Most surges last only for 700 Micro sec. All our conventional system requires millisecond response time. So this cannot give solution to surges. We need devices which respond in nano or Pico seconds.

When a Lightning strikes equipotential raises, induces capacitive coupling in cables. Induces Inductive coupling and results in surges in system.

Type 3 surge protection is offered to provide minimum protection. This acts in general and if we don't have Type-2 & Type 1 surge protection downstream, when a damaging surge destroys this Type 3 surge protection, the equipments in the downstream shall be vulnerable during the next surge strike.

Combined protections are the preferred mode of surge protection. Multielement model gives high degree of protection.

*(To be continued)*

## TECHNICAL SEMINAR PHOTOS - 30.03.2013



"A Treatise on Power Quality with a focus on Harmonics" book was released by Mr. S. APPAVOO, Chief Electrical Inspector to Government and the first copy of the book received by Mr. A.K. VENKATASAMY



Revamping Website by Mr. S. APPAVOO, Chief Electrical Inspector to Government



Inaugural Speech by Mr. S. APPAVOO



Honouring Mr. A.K. VENKATASAMY, Managing Director, Shanti Enterprises Electricals Pvt. Ltd., by our Secretary Mr. K. KANNAN



Honouring Mr. L.A. SRINIVASAN, CEIG (Retd.),  
by our Vice President Mr. D. CHANDRAN



Honouring Mr. S. KULASEKARAN, CEIG (Retd.),  
by our Treasurer Mr. P. SUYAMBU



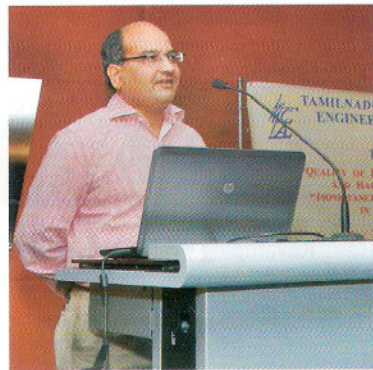
Honouring Mr. M. VEDACHALAM, EI (Retd.),  
by our Vice President Mr. G.S. VENUGOPAAL



Honouring Mr. T. CHUHARA, EI (Retd.),  
by our Vice President Mr. B. PAALANIKUMAR



Presenting Technical Papers by Mr. RAVINDRA NATH SETH, Vice  
President, Electrotherm (India) Ltd.



Presenting Technical Papers by Mr. DHIRAJ BUDHIRAJA, Business  
Head, Electrotherm (India) Ltd.



Honouring Mr. B. RAJA RAO, Electrical Consultant  
by our Member Mr. R. JEYAKUMAR



Presenting Technical Papers by Mr. K. KANESAN, Managing Director,  
Jef Techno Solutions Private Limited

## EARTHING - 4

### ANNEX - A (Clause 1) ADDITIONAL RULES FOR EARTHINGS

#### A-1 ADDITIONAL RULES APPLYING TO THE DIRECT EARTHING SYSTEM

Where a driven or buried electrode is used, the earth resistance shall be as low as possible.

**NOTE** — *The value of earth resistance is under consideration.*

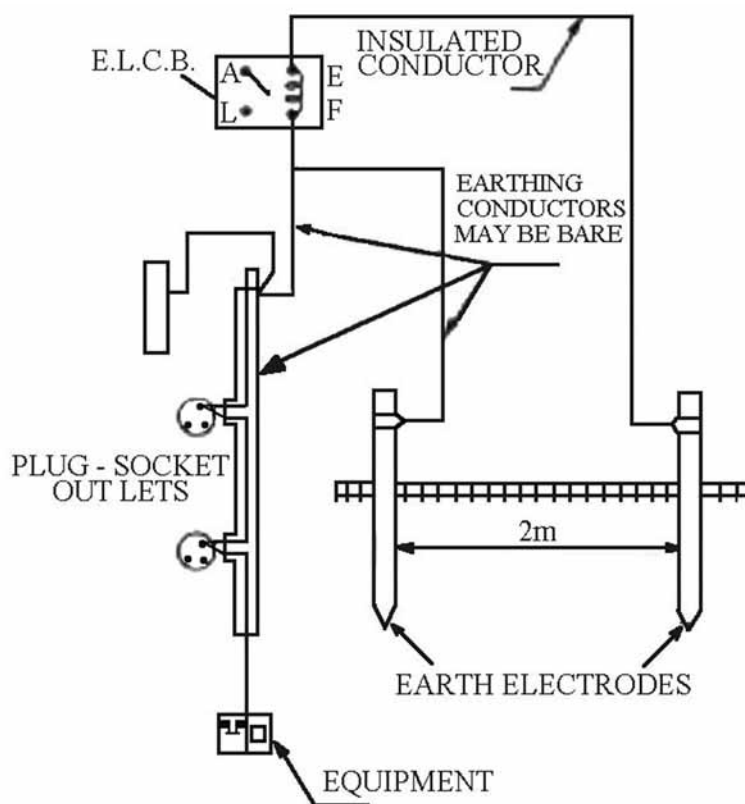
#### A-2 ADDITIONAL RULES APPLYING TO THE MULTIPLE EARTH NEUTRAL SYSTEM

This system shall be used only where the neutral and earth is low enough to preclude the possibility of a dangerous rise of potential in the neutral.

#### A-3 ADDITIONAL RULES APPLYING TO THE EARTH LEAKAGE CIRCUIT-BREAKER SYSTEM

##### A-3.1 Installation of the Earth Leakage Circuit-breaker System (see Fig.9)

All parts required to be earthed shall be connected to an earth electrode through the coil of an earth leakage circuit-breaker which controls the supply to all those parts of the installation which are to be protected; and to a separate earth electrode.



*Fig.9: Connection of Earth leakage circuit breakers Simple Installation*

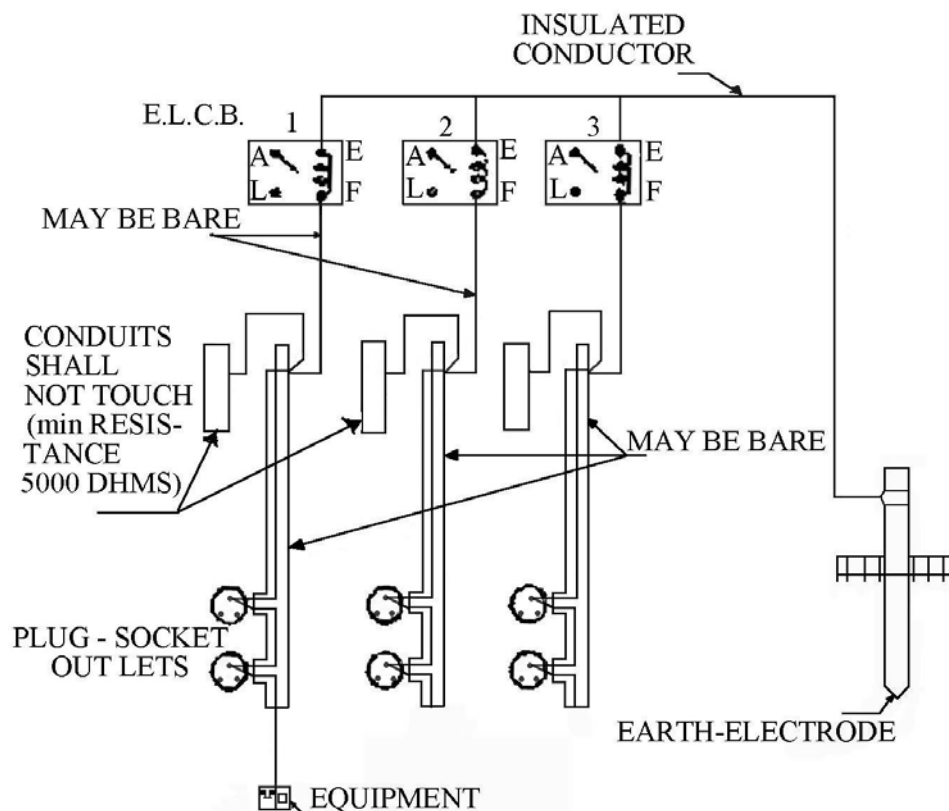
##### A-3.2 Selective Protection

If selective operation of earth leakage circuit-breaker is required, the circuit-breaker, electrodes and earthing conductors shall be installed in one of the following ways:

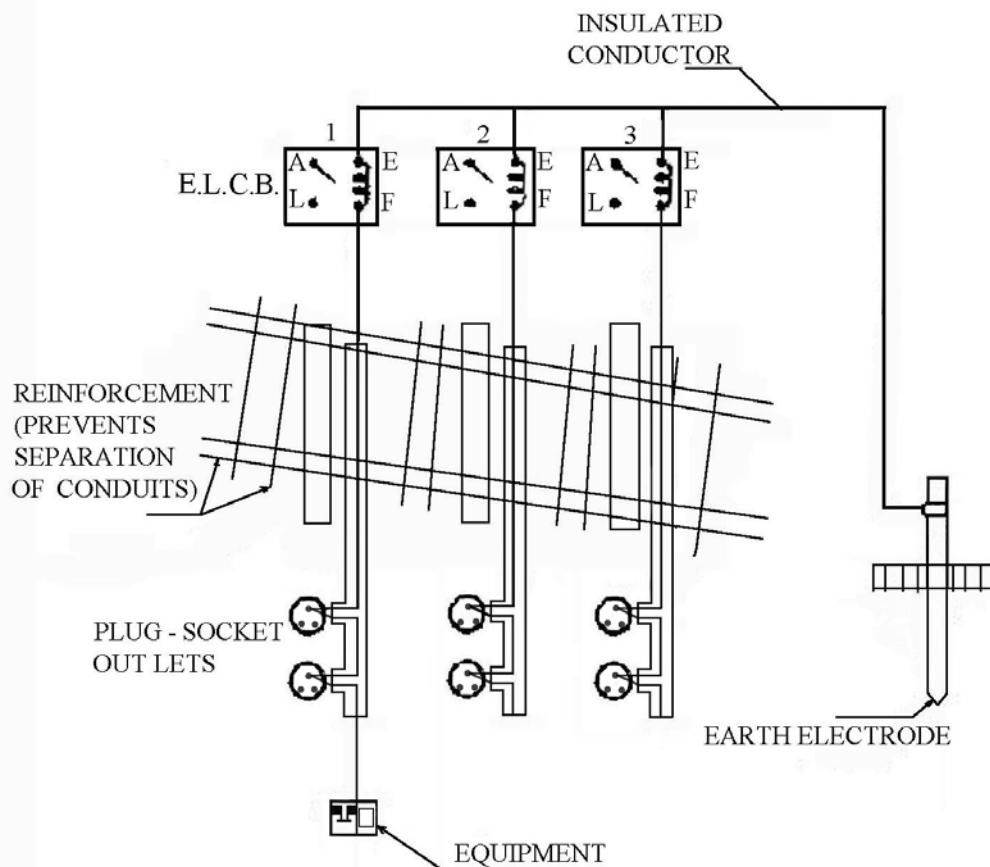
a) *Arrangement Giving Complete Selectivity* – All metal frames, conduits, earthing conductors, etc, which are to be protected as a unit shall be electrically separated from all other such parts and from any other earthed metal. Each part to be protected as a unit shall be connected to an earth electrode through the coil of an earth leakage circuit-breaker, (see Fig.10)

All the separately protected portions of the installations may be connected to one electrode to the earth leakage circuit-breaker.

***Don't use a metal ladder or hard hat when working near Electricity.***



**Fig 10A – Complete Separation of the Exposed Metal of One Installation from that of Other Installation**



**Fig 10B – By Use of a Double-Insulated Wiring System, Where There are no Conduits to be Earthed**

*Fig. 10: Connection of Earth leakage Circuit Breakers for Complete selectivity*

b) *Arrangement Giving Partial Selectivity (complete Selectivity with respect to Faults in Apparatus, but no Selectivity with Respect to faults in Wiring in Conduit) (see Fig.9) - All the conduits and associated fittings shall be bonded together and connected to an earth electrode, all shall also be connected to another earth electrode through an earth leakage circuit-breaker which controls all the active conductors supplying the whole or portions of the installations concerned. Each part to be protected as a unit shall be connected to an earth electrode through the coil of a separate earth leakage circuit-breaker which controls all the active conductors supplying that portion of the installation only. All these portions may be connected to one electrode, but this electrode shall be separated from the electrode to which the conduits are connected.*

## NOTES

1. *A double-insulated wiring system is used, for example, tough rubber-sheathed cables. Any conduit used does not then need to be earthed.*
2. *The earthing conductor is insulated from the conduit*

### ANNEX B (Clause 3.13.2) REPRESENTATIVE VALUES OF SOIL RESISTIVITY IN VARIOUS PARTS OF INDIA

Sl. No.	Locality	Type of soil	Order of Resistivity $\Omega m$	Remarks
(1)	(2)	(3)	(4)	(5)
1.	Kakarapar, Distt.Surat, Gujarat	Clayey black soil	6-23	Underlying bedrock-Deccan trap
2.	Taptee Valley	Alluvium	6-24	do
3.	Narmada Valley	Alluvium	4-11	Underlying bedrock-sand-stone shale and lime-stones, Deccan trap and gneisses
4.	Purna Valley(Deogaon)	Agricultural	3-6	Underlying bedrock-Deccan trap
5.	Dhond, Mumbai	Alluvium	6-40	do
6.	Bijapur Distt, Karnataka	a) Black cotton soil b) Moorm	2-10 10-50	do do
7.	Garimenapenta, Distt. Nellore Andhra Pradesh	Alluvium (highly clayey)	2	Underlying bedrock-gneisses
8.	Kartee	a) Alluvium b) Alluvium	3-5 9-21	Underlying bedrock-sand-stone, trap or gneisses
9.	Delhi a) Najafgarh b) Chhatarpur	a. Alluvium (dry sandy soil) b. Loamy to clayey soil c. Alluvium (sailine) Dry soil	75-170 38-50 1.5-9 36-109	do do do Underlying bedrock-quartzites
10.	Korba, M.P.	a) Moist clay b) Alluvium soil	2-3 10-20	Underlying bedrock-sandstone or shale
11.	Cossipur, Kolkata	Alluvium	25 (approx)	—
12.	Bhagalpur, Bihar	a) Alluvium	9-14	Underlying bedrock-traps, sand-stone or gneisses
13.	Kerala(Trivandrum Distt)	Lateritic clay	2-5	Underlying bedrock-laterite, charnockite or granites
14.	Bharatpur	Sandy loam (saline)	6-14	—
15.	Kalyadi, Mysore	Alluvium	60-150	Underlying bedrock gneisses
16.	Kolar Gold Fields	Sandy surface	45-185	do
17.	Wajrakarur, Andhra Pradesh	Alluvium	50-150	do
18.	Koyana, Satara Distt	lateritic	800-1200 (dry)	Underlying bedrock-sand-laterite or trap
19.	Kutch-Kandla(Amjar Area)	a) Alluvium (clayey) b) Alluvium (sandy)	4-50 60-200	Underlying bedrock-sandstone, shale or tap do
20.	Villupuram, Chennai	Clayey sands	11	Underlying bedrock-granite
21.	Ambaji, Banaskantha, Gujarat	Alluvium	170	Underlying bedrock-granites and gneisses
22.	Ramanathapuram Distt., Chennai	a) Alluvium b) Lateritic soil	2-5 300 (approx)	Underlying bedrock-sandstones and gneisses do

**NOTE-** *The soil resistivities are subject to wide seasonal variation as they depend very much on the moisture content.*

## C-I CASCADING

The utilization of the current limiting capacity of a circuit-breaker at a given point to enable installation of lower-rated circuit-breakers in branch is known as 'cascading' or 'back-up protection'. The main (upstream) circuit-breakers acts as a barrier against short-circuit currents and branch (downstream) circuit-breakers with lower breaking capacities than the prospective short-circuit (at their point of installation) operate under their normal breaking conditions. The limiting circuit-breaker helps the circuit-breaker placed downstream by limiting high short-circuit currents thus enabling use of downstream circuit-breaker with a breaking capacity lower than the short-circuit current calculated at its installation point thus enabling economical selection of circuit-breakers.

Cascading concerns all devices installed downstream of the circuit-breaker, and can be extended to several consecutive devices, even if they are used in different switchboards. The upstream device must have an ultimate breaking capacity greater than or equal to the assumed short-circuit current at the installation point. For downstream circuit-breakers, the ultimate breaking capacity to be considered is the ultimate breaking capacity enhanced by coordination.

The association of the upstream and downstream circuit-breakers allows an increase in performance of the breakers. Thus, the electromagnetic, electrodynamic and thermal effects of short-circuit currents are reduced. Installation of a single limiting circuit-breaker alongwith lower rated circuit-breakers results in considerable economy and simplification of installation work.

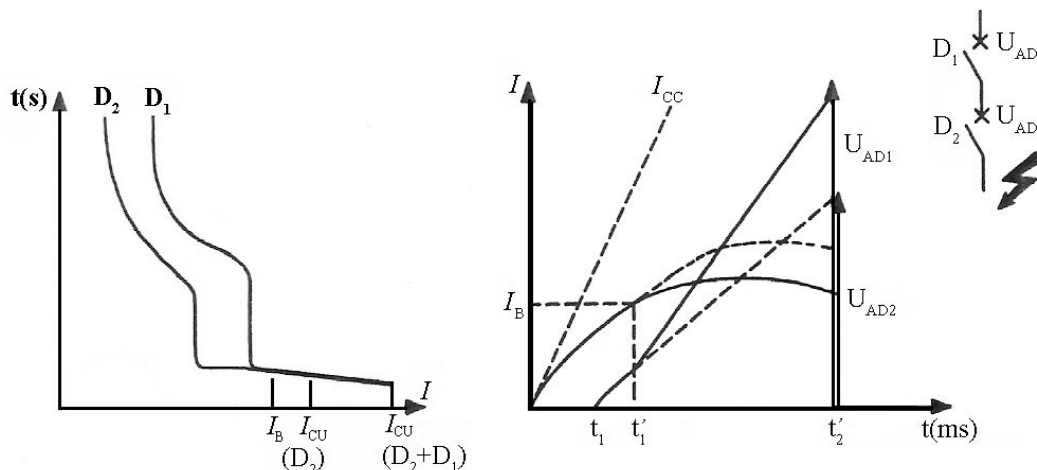


Fig.11: Operation of Circuit-Breakers in Cascade.

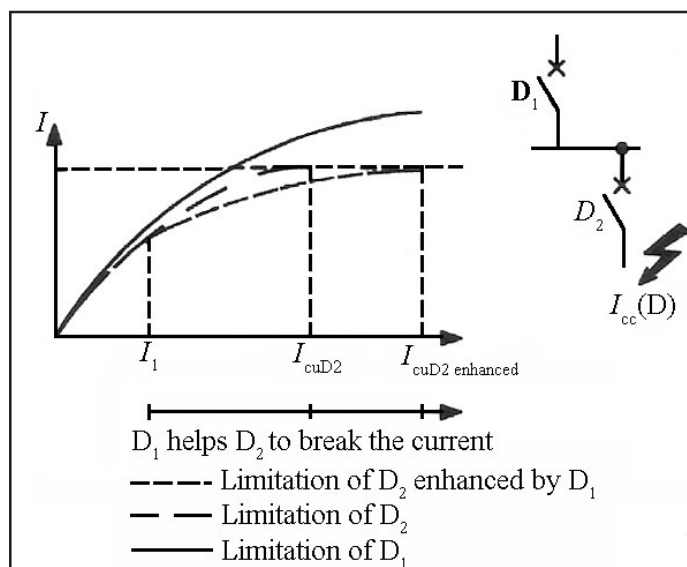


Fig.12: Limitation Curves for Circuit-Breakers

$D_1$  and  $D_2$  are the two circuit-breakers (see Fig. 11). As soon as the two circuit-breakers trip (as from point  $I_B$ ), an arc voltage  $U_{AD1}$  on separation of the contacts of  $D_1$  is added to voltage  $U_{AD2}$  and helps, by additional limitation, circuit-breaker  $D_2$  to open.

The association  $D_1 + D_2$  allows an increase in performance of  $D_2$  as shown in Fig. 12, which depicts, limitation curve of  $D_2$ , enhanced limitation curve of  $D_2$  by  $D_1$ ,  $I_{cu} D_2$  enhanced by  $D_1$ .

Annex A of IS/IEC 60947-2 defines coordination under short-circuit conditions between circuit-breaker and another short-circuit protective device (SCPD) associated in the same circuit and the tests to be performed. Cascading is normally verified by tests for critical points. The tests are performed with an upstream circuit-breaker  $D_2$  with a maximum overcurrent setting and a downstream circuit-breaker  $D_2$  with a minimum setting.

(To be Continued)

Courtesy: National Electrical Code 2011

# ENERGY-EFFECTIVE LIGHTING SYSTEMS

## 1 SCOPE

This part of the code describes the energy conservation measures in any lighting installation and lighting system.

## 2 TERMINOLOGY

The definitions given in Part 1 of this code shall apply.

## 3 ENERGY CONSERVATION MEASURES

**3.1** The incandescent lamp (GLS) is used as a major light source in India. These lamps have an efficacy of 10 to 20 lm/W and a life of 1 000 burning hours. There are varieties of gas discharge lamps with efficacies ranging between 50 and 200 lm/W and having a life between 5 000 and 15 000 burning hours. These gas discharge lamps are: a) Tubular fluorescent lamps; b) Compact fluorescent lamps (CFLs); c) High pressure mercury vapour lamps (HPMV); d) High pressure sodium vapour lamps (HPSV); and e) Metal halide lamps.

CFL lamps are available in lumen packages, so that they can replace GLS lamps of equivalent lumen output. The fluorescent lamps have been made further energy effective with the use of triband phosphors instead of the conventional fluorescent powder. The luminous efficacy of this new family of lamps is 35 percent higher.

There is another area, which can give good energy saving. Every gas discharge lamp needs a ballast. Today, most of these ballasts are the conventional electromagnetic type. All these ballasts, when the lamp is in operation, consume electric power known as ballast loss. With proper design, the ballast loss can be substantially reduced. Use of such low loss ballasts can result in a lot of energy saving.

However, the best solution in this area is to gradually introduce electronic ballasts. These ballasts, not only have very low losses because of electronic components, but increase the luminous efficacy of fluorescent lamps because of high frequency operation. The overall luminous efficacy of an electronic ballast and high frequency fluorescent lamp combination is 25 percent higher than that of a conventional ballast and fluorescent lamp combination.

Even the best lamp and ballast combination may not give the ideal result if used in luminaires which are poorly designed. A lot of light will be wasted in such luminaires. It is imperative today to look into all the aspects of application and select the most optimum solution for all lighting installations. For example, luminaires with mirror optics and widespread light distributions save approximately 25 to 33 percent energy for the same lighting level in offices. Similarly, road lighting luminaires using pot optics and tubular HPSV lamps achieve the same lighting parameters with 30 percent less number of poles and luminaires than the conventionally designed luminaires. The associated energy and material savings are enormous.

**3.2** There are enormous saving opportunities in almost all the sectors of lighting if following steps are taken:

- a) Incandescent lamps replaced with fluorescent lamps, retrofit compact florescent lamps and non-retrofit compact fluorescent lamps;
- b) Conventional fluorescent lamps replaced with T5 fluorescent lamps;
- c) Electronic ballasts installed in place of electromagnetic ballasts;
- d) High pressure sodium vapour lamps and ballasts used instead of high pressure mercury vapour lamps and ballasts; and
- e) Metal halide lamps used in place of high pressure mercury vapour lamps and tungsten halogen lamps.

With proper implementation of energy-effective lighting design and good engineering practices, it is possible to conserve energy.

## 4 METRICS

All lighting equipment requires electric power, measured in Watts (W). As the lighting system operates over time, it consumes energy, which is expressed as kilowatt hours (kWh). One kWh is 1 000 W utilized for one hour. Power and energy are the two major products that the electric utility charges for; the total electrical load of the building in kW and the amount of energy consumed in kWh. Therefore, in any lighting upgrade the goal will be to reduce the amount of power the lighting system requires and, when possible, the hours of operation.

### 4.1 Demand Charge

This is the monthly cost based on the connected electrical load of the building. Actual demand is metered by the utility and the charge is based on the month's demand peak. With this in mind, it not only pays to reduce wattage, but reduce consumption during the day's peak load period, which is typically at midday. The utility may also impose a ratchet clause based on demand, locking in the demand charge at maximum demand for the recent past.

## 4.2 Energy Use Charge

**4.2.1** It is the monthly charge by the kWh for electrical energy consumed by the building's electrical systems. The lighting energy management goals therefore can be clearly stated as: a) Reduce wattage (power) required by the lighting system; and b) Reduce energy (power x time) consumed by the lighting system.

**4.2.2** To measure the energy performance of lighting systems, a variety of metrics can be used:

*Total wattage:* For all lighting equipment (does not include impact of controls);

*Total energy consumed:* For all lighting equipment;

*Watts per square metre:* This metric, called light power density (LPD), is determined by dividing total watts by the total area of the space in square metres. Lighting requirements in the National Building Code (NBC) and Energy Conservation Building Code (ECBC) typically set restrictions on light power density; and *kWh per square metre:* This metric, called the energy utilization index, is determined by dividing the total kWh of energy consumed by the lighting system in a space by the total area of the interior space in square metres. The advantage of using the energy utilization index is that it induces the factor of time, and encourages the use of lighting controls that reduce the amount of time the lighting system operates when it is not needed.

## 4.3 Relevant Formulae

Using local environmental data and system performance data from manufacturers' literature, we can use the formulae below to determine the energy characteristics of an application:

Demand for power (kW) = System input wattage (W) ÷ 1 000;

Energy consumption (kWh) = System input wattage (kW) x hours of operation/year;

Hours of operation/year = Operating hours/day x Operating days/week x Operating weeks/year;

Lighting system efficacy (lumens per watt or LPW) = System lumen output ÷ Input wattage;

Light power density (W/m<sup>2</sup>) = Total system input wattage (W) ÷ Total area (square metres);

Watts (W) = Volts (V) x Current in amperes (A) x Power factor (pf); and

Voltage (V) = Current in amperes (A) x Impedance (Ohms) [This is called Ohm's Law].

## 5 UPGRADE STRATEGIES

**5.1** Several simple strategies can be employed to adopt energy-effective lighting in existing installations, commonly called an 'upgrade' or 'retrofit.' Regardless of strategy, however, every lighting upgrade requires the same thought process, as shown below in a simplified form.

- a) Determine the required maintained light level. As the industry proverb goes, "Light is for people, not buildings." The lighting system's first task is to provide sufficient quantity and quality of light for occupants to perform relevant tasks. In existing installations, this will require a lighting system audit;
- b) Determine the qualitative lighting requirements. Identify all quality issues such as glare, colour, aesthetics, distribution and attendant factors (such as surface reflectances and ceiling heights) that must be given priority during equipment selection and design. In existing installations, this will require a lighting system audit;
- c) Identify equipment options that produce the desired maintained quantity and quality of light and also save energy. Equipment options will include lamps, ballasts, luminaires and advanced controls (occupancy sensors, dimming controls, photocells, lighting management systems, etc);
- d) Identify strategies that support the goal of reducing energy consumption, such as planned lighting maintenance, repainting room surfaces to give them a higher reflectance (if appropriate) and developing a written lighting energy policy; and
- e) Choose the best package of equipment and strategies that will achieve the desired lighting goals while delivering desired economic performance.

## 5.2 Lighting Upgrade Strategies

### 5.2.1 Maintained Light Levels

With this strategy, the same level is maintained as in the existing system after upgradation. This goal can be accomplished by incorporating automatic controls and more efficient lamps and ballasts into the lighting system.

### 5.2.2 Optimized Light Levels

In some applications, lighting audit may reveal considerable opportunities to reduce lighting levels. In a renovation or new construction situation, we can reduce light levels by focusing higher intensities closer to the task. For example, in an open plan office, indirect lighting can be specified to provide lower light levels for ambient illumination, while higher light levels are provided at the task by workstation task lighting.

### 5.2.3 Increased Light Levels

This strategy entails increasing light levels via strategies such as planned lighting maintenance, higher room surface reflectance and higher luminaire efficiency.

Other considerations are:

- a) Incorporate daylighting into the lighting scheme as much as possible; there are many ways that help daylight penetration into the building and distribute the light; glare controls should be provided and daylight harvesting controls can be specified for significant energy savings;
- b) In new construction or renovation projects, the interior designer can affect the overall efficiency of light distribution by providing finishes that give proper ceiling, wall and task reflectance values;
- c) All lighting components must be compatible to operate properly;
- d) All applicable safety requirements and regulations should be strictly adhered to when any work is done on an electrical system;
- e) Consider a planned lighting maintenance programme and opening retrofit opportunities that reduce light output and energy consumption;
- f) Ensure that all retrofits are permanent and understood by the maintenance personnel in a written and communicated lighting policy, so that old components are not reintroduced back into the lighting system later;
- g) Be sure to include provisions for legal compliance in disposing of any lighting waste; and
- h) Ensure compliance with the Energy Conservation Act and other statutory regulations.

## 6 EQUIPMENT SELECTION

The lighting system operates within a larger system, that includes the space itself, with its various values of reflectances for room and task surfaces, and availability of daylighting. When planning a lighting upgrade, equipment that changes any combination of these components can be specified.

## 7 COMPARING SYSTEMS

7.1 To compare the relative efficiencies of lighting systems, the following may be considered:

- a) **Compare efficacies for various light sources and lighting systems:-** Efficacy, expressed in lumens (light output) per watt (electrical input), is often used to compare the relative efficiencies of lamps and lighting systems. It is abbreviated LPW or lm/W. To determine efficacy, divide the lumen output of a lamp or lighting system by its rated input wattage;
- b) **Compare power requirements:-** Determine the light level goals and compare various options that achieve these goals at the lowest wattage possible. From this we can also compare LPD, or watts per square metre; and
- c) **Compare energy usage:-** Determine the light level goals and compare various options that achieve these goals with less energy consumption. This is advantageous as it includes automatic lighting controls, which reduce operating time, not watts. From this we can also compare the energy utilization index, or kWh consumed per square metre.

7.2 Efficacy is a popular metric used to assess the relative efficiencies of lighting systems. It can be used to easily screen a wide range of options, helping to narrow down choices that can be compared. However, efficacy alone does not ensure that more light will be delivered to the task.

A luminaire may be optimized for one type of lamp but may be relatively inefficient with a different lamp type. Both the light output ratio (LOR) and the coefficient of utilization (COU) of the system need to be taken into account.

Comparing energy usage for various systems that achieve the same maintained light level target is useful in that it includes controls, which affect energy consumption over time but not system wattage. With this metric, we can include more specific parameters about the installation, such as its target light level and hours of operation.

LPD is most useful when screening a space for lighting efficiency and to ensure compliance with applicable lighting codes when conducting a building activity that is governed by these codes.

Typical efficacies of common light sources are given in Fig. 1.

### 7.3 Typical Fluorescent Luminaire Upgrades

Lighting system upgrade options for fluorescent lighting systems include: a) T5 and T8 lamp and ballast systems; b) Low loss electromagnetic ballasts and electronic ballasts (full output, dimmable, light-level switching and low wattage); and c) Optics upgrade.

#### 7.4 Typical Incandescent Luminaire Upgrades

Lighting upgrade options for incandescent fixtures include: a) Compact fluorescent lamps; b) Halogen lamps; c) Low wattage metal halide lamps; and d) New luminaires that offer a higher efficiency.

#### 7.5 Typical High Intensity Discharge (HID) Lighting Upgrades

Lighting system upgrade options for HID lighting systems include: a) Switching to metal halide or high pressure sodium vapour from high pressure mercury vapour lamps; b) Dimming ballasts; and c) New luminaires that offer a higher efficiency.

#### 7.6 Typical Control Upgrades

Upgrades for lighting controls include:

- a) Lighting management systems; b) Dimmable fluorescent and HID systems; c) Daylight dimming systems that measure ambient daylight and dim light levels accordingly, producing energy savings; d) Illuminance maintenance dimming systems; e) Electronic time clocks; f) Occupancy sensors; and g) Manual, step-level and panel-level dimming systems.

#### 7.7 Typical Exit Sign Upgrades

Upgrade options for exit sign fixtures include: a) Light emitting diodes (LEDs); b) Electroluminescent panels; c) Light panels; d) FTL cold cathode lamps; and e) New exit signs.

### 8 ECONOMICS

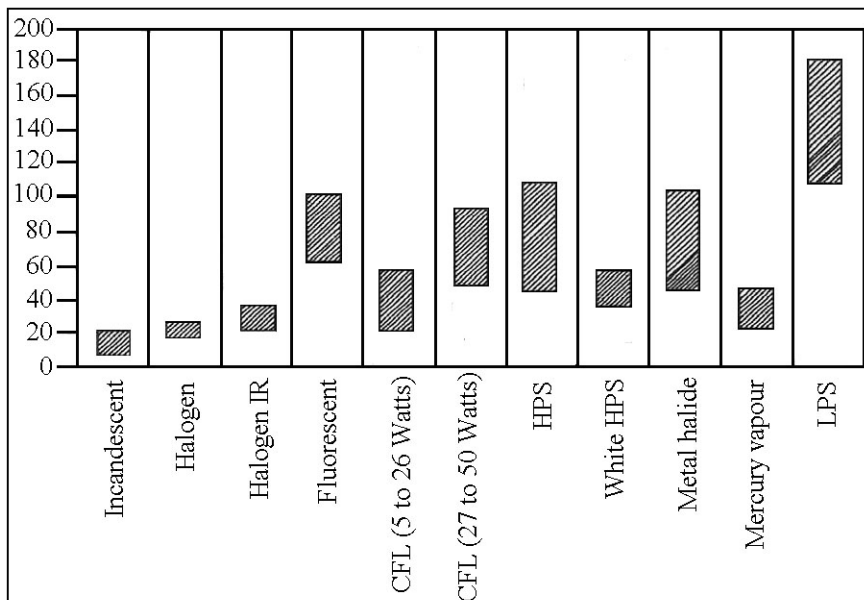
**8.1** When upgrading an existing installation, a capital investment is made that produces energy savings, which deliver a payback and return on the investment. There are several ways of using economics to compare lighting systems. The most popular for screening purposes are simple payback and return on investment.

- a) First, determine the initial cost of the new lighting system, and then compare energy usage to the existing system to determine energy savings. Initial Cost (Rs) = Equipment Cost + (Installation Hours x Labour Rate); and Annual Energy Savings = (A - B) x Energy Rate charged by utility  
where A = [Existing system wattage (kW) x Annual operating hours (h)]; and  
B = [New system wattage (kW) x annual operating hours (h)].
- b) Now determine simple payback, five year cash flow and simple return on investment.  
Simple Payback on an Investment (Years) = Initial Cost (Rs) ÷ Annual Energy Savings (Rs);  
5 Year Cash Flow (Rs) = 5 Years - Payback (Years) x Annual Energy Savings (Rs); and  
Simple Return on Investment (%) = [Annual Energy Cost Savings (Rs) ÷ Net Installation Cost (Rs)] x 100.
- c) Another method of comparing lighting systems is to look at the cost efficacy of the system, expressed as rupees per lumen hour, and the total cost of ownership for the system over its life.

Cost of Light/Lumen Hour = (Initial Cost + Total Operating Cost) / (Total Lumens Delivered x Hours of Operation). Total Operating Cost and Hours of Operation are set for any period of time that the specifier or owner wishes to consider.

Simple Life Cycle Cost = Initial Cost + (Annual Operating Cost x Life of System in Years). Annual Operating Cost is Annual Energy Cost + Annual Maintenance Cost, with the annual maintenance cost assuming all labour costs, replacement components, etc. The life of the system in years must be estimated. The owner can participate in determining this figure, but otherwise one could assume 20 years.

Once simple values are achieved, one can determine which lighting system makes the most economic sense to replace the existing system with. Then one can conduct a full economic analysis, including life cycle costing and return on investment that takes into account many economical factors such as the future value of money.



*Fig.1: Typical Efficacies for Common Light Sources*

*Courtesy: National Lighting Code 2010*

# ICELAND : A 100% RENEWABLES EXAMPLE IN THE MODERN ERA

Iceland's famous for its breathtaking scenery, its geysers, its Blue Lagoon—and for sitting astride the Mid-Atlantic Ridge. Among energy wonks, Iceland is also well known for using its abundant renewable energy, and especially for tapping the volcanic roots of the island in developing its geothermal resources. Iceland today generates 100% of its electricity with renewables: 75% of that from large hydro, and 25% from geothermal. Equally significant, Iceland provides 87% of its demand for hot water and heat with geothermal energy, primarily through an extensive district heating system. Altogether, hydro and geothermal sources meet 81% of Iceland's primary energy requirements for electricity, heat, and transportation. This must be a record in the modern era. Certainly Icelandic politicians think so, because they frequently make reference to it. Yes, Iceland is a very small country. Despite a land area of 100,000 km<sup>2</sup>, only 300,000 people inhabit the island, two-thirds of those in the capital Reykjavik. Yet, Iceland shows what can be done when a nation puts its mind to the task of eliminating fossil fuels. Until the extensive development of the island's hydro and geothermal resources, the country was dependent upon coal and oil for providing transportation, fueling its fishing fleet, and heating its homes. The latter is not something to take lightly in a nation just south of the Arctic Circle. Iceland's older residents can remember a time when coal smoke, not steam from the island's famed fumaroles, shrouded the capital. Iceland is a leader in geothermal development and exports its technical expertise worldwide. The country, along with the Philippines and El Salvador, is among countries with the highest penetration of geothermal energy in electricity generation worldwide. On a per capita basis, Iceland is an order of magnitude ahead of any other nation in installed geothermal generating capacity.



**WORLD GEOTHERMAL PENETRATION 2010**

		<b>2010 Capacity MW</b>	<b>% Consumption</b>	<b>W/Captia</b>
1	Iceland	575	30.0%	1,806
2	Philippines	1,904	27.0%	21
3	El Salvador	204	25.0%	33
4	Costa Rica	166	14.0%	39
5	Kenya	167	11.2%	4
6	New Zealand	628	10.0%	143
7	Nicaragua	88	10.0%	15
8	Indonesia	1,197	3.7%	5
9	Mexico	958	3.0%	9
10	Italy	843	1.6%	14

[http://en.wikipedia.org/wiki/Geothermal\\_electricity](http://en.wikipedia.org/wiki/Geothermal_electricity)

Icelanders use geothermal energy in two ways: for generating electricity, and for heating. They generate electricity in what is, for all practical purposes, conventional thermal power plants. Instead of burning coal in a boiler to create steam, Icelanders use steam directly from the earth. Iceland also heats most of its domestic water, swimming pools, and buildings with geothermal fluids. In older systems, they use the geothermal fluids directly. In more modern applications, they use heat exchangers that transfer the heat of geothermal fluids to fresh water.

*Courtesy : <http://reneweconomy.com.au>*

*Stay healthy, use electrical extension cords wisely*

## TANGEDCO CHOOSES 29 FIRMS TO SET UP SOLAR PLANTS



Going by the schedule, the plants should be in place by January 2014. As many as 29 firms have been chosen by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO) for setting up solar power plants of an aggregate capacity of 226 megawatt (MW). The price at which the Corporation will buy solar power from the proposed plants will, in the beginning, be Rs. 6.48 per unit. The plants will come up in Ramanathapuram, Sivaganga, Tuticorin, Virudhunagar, Karur, Vellore, Tiruvannamalai and Kancheepuram districts. In Andhra Pradesh too, a similar price has been arrived at, says an official. [The Andhra Pradesh government came out with a policy document in September last]. A few days ago, the Corporation, at its meeting of Board of Directors, approved the selection.

Once the TANGEDCO issues Letters of Intent, the developers will have, effectively, nine months to commission their plants. Going by this schedule, the plants should be in place by January 2014. The Corporation has taken up load flow studies for the developers, who are required to tie up on their own for getting land. They are also expected to achieve financial closure with financial institutions. The establishment of the plants will come under the broad ambit of the Solar Energy Policy of the State government which was unveiled in October last. On December 5, the TANGEDCO issued a notice, inviting bids. It had expected proposals for 1,000 MW. In January, the technical bids were opened and 90 bids had been received for 500 MW. Subsequently, price bids were taken up for scrutiny. The sources say the initial price of Rs. 6.48/unit will be in force till March 31, 2014.

From the financial year of 2014-2015, there will be five per cent increase in the price for 10 years, after which there will be no rise for another 10 years, the official adds. As per the policy, high tension consumers including information technology parks and special economic zones and low-tension commercial consumers have to meet three per cent of their energy requirements through solar energy by the end of this year and six per cent from January 2014. As the TANGEDCO is the agency to administer solar power obligations, it has decided to facilitate prospective investors by procuring energy generated from their plants through the long-term power purchase agreements. Besides, the HT and LT commercial establishments can fulfill their obligations by purchasing power from the Corporation at tariff applicable to solar power.

*Courtesy: The Hindu, dt: 09.03.2013*

## CORPORATION ZONAL OFFICES LOOK TO THE SUN FOR POWER



Four out of Chennai Corporation's 15 zonal offices have recently begun to tap solar energy. The civic body recently commissioned six solar power plants, at a cost of Rs. 16 lakh, to light up portions of select zonal offices in the city. While the facility at Basin Bridge zonal office has the capacity to generate 5 kilowatts of power, the zonal offices at Kodambakkam, Nungambakkam and Adyar; street light office at Shenoy Nagar and the corporation's electrical lab and stores in Chintadripet each have one kilowatt capacity plants.

According to sources in the Chennai Corporation, these solar power plants have been installed on a pilot basis. "We have sought guidance relating to specifications and norms from the Tamil Nadu Energy Development Agency so that we can expand to more buildings. Once they let us know, we will begin covering buildings including schools and hospitals," the source said. Recently, in its budget, the civic body had announced that in three years' time, all its 600-odd buildings would also produce solar power. Presently, a portion of these buildings draw their power from the solar panels atop their roof. "For instance 20 tubelights and 4 ceilings fans have been connected to a one kilowatt plant that will generate 5 units. We have both connections — the grid and solar plant — and switch over when necessary. In about three years the power from the plants would be free," said a source.

However, the Corporation has not opted for hybrid plants that also have wind turbines. "We visited a few companies and saw working models. But, we were not satisfied and the companies themselves said such turbines could be installed only in coastal areas in south Tamil Nadu," a source explained. The solar power plants are also part of the civic body's efforts to become more environment-friendly.

*Courtesy: The Hindu, dt: 24.3.2013*

*A bad wire can cause a fire*



# TAMILNADU ELECTRICAL INSTALLATION ENGINEERS ASSOCIATION 'A' GRADE

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4	(1) Installation of Captive generator (2) Electricity H.V. & M.V. Installation Proposals (3) Precautionary Measures to be taken in Design & Installation of building services including Electrical Services (4) The Indian Standard Specification	90
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## OTHER PUBLICATIONS

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2	National Lighting Code 2010 (NLC 2010)	3,370
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## DIESEL ON DEMAND — E.COLI BACTERIA ENGINEERED TO PRODUCE PURE DIESEL FUEL

Diesel on demand — researchers at the University of Exeter have developed a method of producing pure diesel with E.coli bacteria. The new diesel is nearly identical to the conventional form, and apparently does not need to be blended with petroleum products as other biodiesels typically do. The multinational oil and gas company Royal Dutch Shell, commonly known as Shell, contributed to the research.

There are significant commercialization challenges that face the new technology, but it's still an interesting development. The new **diesel** is created through the use of specialized E. coli bacteria, which turn the sugars supplied to them into fats to build their cell membranes (as all E.coli do). But with carefully chosen changes to the bacteria, it becomes possible to create the synthetic fuel. E.coli is already widely used in the pharmaceutical industry in a similar capacity. One of the significant advantages of this new diesel, and why oil companies are so interested in it, is that it is completely compatible with current infrastructure. All of the engines, pipelines, and tankers that are currently in use can simply continue being used. No changes necessary. Professor John Love from Biosciences at the **University of Exeter** said: "Producing a commercial biofuel that can be used without needing to modify vehicles has been the goal of this project from the outset. Replacing conventional diesel with a carbon neutral biofuel in commercial volumes would be a tremendous step towards meeting our target of an 80% reduction in greenhouse gas emissions by 2050. Global demand for energy is rising and a fuel that is independent of both global oil price fluctuations and political instability is an increasingly attractive prospect."

Rob Lee from Shell Projects & Technology said: "We are proud of the work being done by Exeter in using advanced biotechnologies to create the specific hydrocarbon molecules that we know will continue to be in high demand in the future. While the technology still faces several hurdles to commercialisation, by exploring this new method of creating biofuel, along with other intelligent technologies, we hope they could help us to meet the challenges of limiting the rise in carbon dioxide emissions while responding to the growing global requirement for transport fuel." While it's easy to see why the technology is appealing to those in the industry, it remains a very open question whether it will ever be widely used. Or whether it even should be. Whether "carbon neutral" or not, there are significant downsides to any form of diesel, that simply aren't there with **renewable energy** and **electric vehicles**. Among the most significant and obvious downsides is air pollution — why use biodiesel when it's possible to switch over to forms of transportation that release no air pollution at all?

## RAJ BHAVAN PLUGS INTO THE SUN IN ANDHRA PRADESH

Raj Bhavan, the official residence of the Governor, has become a role model by switching over to non-conventional energy to meet most of its energy requirements. Thanks to the proactive role played by Governor E.S.L. Narasimhan, the sprawling 21-acre premises is now harnessing solar energy to meet over 70 per cent of its requirements. The regular lights, televisions and other electronic gadgets run on solar power, while heavy load-drawing appliances like air-conditioners are dependent on conventional energy. The main house, administrative block (Sudharma), security block and other buildings, barring heritage structures like Durbar Hall, are powered by solar energy. The Raj Bhavan here is the third in the country after Jammu & Kashmir and Gujarat to switch over to alternative mode of power supply. According to Governor's principal secretary N. Ramesh Kumar, the daily energy consumption of the premises is around 250 units of which solar power contributes over 150 units, depending on the availability of the light. The total installed generation capacity, including inverter, batteries and other paraphernalia, is 200 units (41.05 KWp) and this involved an investment of Rs. 96 lakh.

Efforts are under way to replace streetlights on the Raj Bhavan premises with induction lights and solar lights, the officials said. The solar lighting programme was sanctioned under the Special Area Demonstration Project of the Union New and Renewable Energy Ministry in 2011 with NREDCAP (Non-conventional Energy Development Corporation of Andhra Pradesh Limited) designated the nodal agency for the project.

*Courtesy: The Hindu, dt: 19/4/2013*

## FUTURE BUILDINGS TO WEAR SOLAR GLASSES!!!

Turning regular glass into an electricity-generating medium is rather simple. The company simply adds a layer of clear, solid-state solar cells no thicker than three microns. This results in glass that turns about 12% of the **solar energy** that hits it into electricity. Oxford researchers have developed a photovoltaic (PV) technology that has the potential to deliver low cost, efficient solar cells that can be readily incorporated into glass building facades. Results just released in the journal Science promise to provide the lowest cost-performance photovoltaic solution on the market. The technology makes use of a simple manufacturing process with inexpensive and abundant raw materials. Prototypes of these new Meso-Superstructured Solar Cells (MSSC) demonstrated in the journal have already achieved an impressive 10.9% efficiency. Oxford researchers have developed a photovoltaic (PV) technology that has the potential to deliver low cost, efficient solar cells that can be readily incorporated into glass building facades.

The technology has been exclusively licensed by Isis Innovation Ltd., the Technology Transfer company of the University of Oxford, to Oxford Photovoltaics Ltd (Oxford PV) who were spun out by Isis in December 2010. Oxford PV has since gained experience in developing solid state dye sensitized solar cells for the Building Integrated PVs (BIPV) industry. According to a 2010 Nanomarkets LC report, revenues for BIPVs are estimated to rise to US\$6.4 billion by 2016. CEO Kevin Arthur said: "Our experience with this hybrid technology gives us the perfect vantage point to quickly develop our exciting new MSSCs into commercial products. This new class of solar cells will deliver a massively scaleable product firstly for BIPV market and, as energy conversion performance improves further, for other high volume PV applications. Ultimately we envisage this technology competing directly with grid delivered electricity."

*Courtesy : Oxford PV News*

# CHIEF MINISTER ANNOUNCES INVESTMENT SUBSIDY FOR SOLAR POWER PLANTS

In a bid to encourage more households to set up solar power plants, Chief Minister Jayalalithaa on Thursday announced an investment subsidy of Rs.20,000 per KW. She said it was part of her government's plan to make solar power generation a mass movement.

She also said 11 lakh new electricity connections covering houses, agriculture, commercial and industries would be given in the current year. In the first phase, the solar energy investment subsidy scheme would benefit 10,000 consumers, she said in a *suo motu* statement in the Assembly.

She said more power could be generated through solar energy and the State government had already announced generation-based incentive along with the 30 per cent subsidy given by the Ministry of New and Renewable Energy. As per the announcement, the government is giving Rs.2 per unit in the first two years, Re.1 in the next two years and 50 paise for the two years subsequently. Now, the government has decided to give Rs 20,000 as investment subsidy.

The Chief Minister said in the past the government purchased less than 10,000 transformers every year to ensure uninterrupted power supply to consumers and now it had been decided to by 20,000 transformers at a cost of Rs.500 crore to overcome the shortage.

Moreover, Rs.850 crore would be spent on creating 15,000 km of high tension and low tension power lines.

She said a sub-station with a capacity of 400 KW would be set up to transmit the wind power generated in Coimbatore, Udumalpet and Theni. These stations would come up in Thappakundu in Theni district and Anakadavu and Rasipalayam in Coimbatore district.

*Courtesy: The Hindu, dt: 26/04/2013*

## CENTRE FOR INCENTIVISING USE OF CLEAN ENERGY, SAYS MONTEK

The government was all for creating a viable and competitive domestic production base and incentivise use of clean energy in the country, Deputy Chairman of the Planning Commission Montek Singh Ahluwalia said at the fourth Clean Energy Ministerial here on Wednesday.

Efforts were on to encourage domestic production and usage. "We are interested in incentivising the use of clean energy. We are also interested in creating a viable and competitive domestic production base," he said.

The big push for use of clean energy would come from wind, solar and biomass and the Union government would have to take the difficult decision by incorporating them into the integrated energy policy. "China has invested 10 times more than us in clean energy. We have to increase the percentage of clean energy and need to integrate all forms of clean energy."

### For a better world

The focus on a clean energy policy should not be on resolving issues on a short-term basis but to make the globe a better place to live say from 20 years from now. "Many countries were putting forward their experiences and we are studying them and after that we will put forward our experience also."

On the shale gas policy, he said its potential and implications were needed to be examined. "We don't have a plan for that as yet, but that would not stop us from putting in place regulatory framework for shale gas."

Referring to price pooling for coal, he said the government and power producers did not have much of a choice as various sectors faced coal shortage. "You can either pool prices or allocate [domestic fuel] in certain quantities and then import coal at a higher price and then pass on the additional cost in the tariff."

*Courtesy: The Hindu, dt: 18/4/2013*

## POWER YOUR MIND - WHO IS GREAT?

He is not great  
Who is proud of his wealth  
But he is great  
Who says it is God's wealth.



He is not great  
Who is proud of his strength  
But he is great  
Who protects weak, innocent.

He is not great  
Who says 'I am the owner'  
But he is great  
Who says, 'I am a trustee.'

He is not great  
Who is proud of his knowledge  
But he is great  
Who feels that he is ignorant.

God is the doer  
And you are His instrument  
Know this truth  
And discard false sentiment.

*Courtesy: Swami Srikantananda*

## Rs.20,000-cr. POWER PROJECTS UNVEILED

Chief Minister Jayalalithaa on Thursday unveiled a slew of power and infrastructure projects, including a Rs.7,000-crore underground power station with a capacity of 2,000 MW at Sillahalla in the Nilgiris district.

Making a *suo motu* statement in the Assembly, she said objective of unveiling these projects, totally worth around Rs.20,000 crore, was to restore TamilNadu to its position as a power-surplus State.

Ms. Jayalalithaa said the Sillahalla project would be implemented in two phases and it would take eight to ten years for completion.

Sillahalla is a tributary of the river Kundah, and in the first phase a dam with a height of 98 metres and a capacity of 2.25 thousand million cubic feet of water will be constructed. Then it will be linked with Avalanche-Emerald reservoirs through a 2,750-metre tunnel.

In the second phase, a power station will be set up, taking advantage of the 1,500-metre height difference between the proposed Sillhalla plant and the Pillur dam.

The Chief Minister said that after generating electricity, the water would reach Pillur dam through a tailrace tunnel.

An approach tunnel would be created for the water to reach the underground power station.

Stressing the need for creating infrastructure to distribute the power generated through new projects, Ms. Jayalalithaa said a plan had been conceived at a cost of Rs.5,000 crore. The Japan Bank for International Cooperation would release a loan amount of Rs.3,572 crore and the project would help in streamlining the power distribution in Chennai.

Besides, five new sub-stations with a capacity of 400 KW, corridors would be set up with financial assistance of Rs. 2,750 crore from the Japan Bank for International Cooperation. The sub-stations would come up in Guindy, Koratur, Manali and Ottiyambakkam in Chennai and Karamadai in Coimbatore.

Similarly, 14 sub-stations with a capacity of 230 KW would be set up in Alandur, the third main road in Ambattur, Chennai Central, Raja Annamalaipuram and TNEB headquarters in Chennai and Tirupur and Karuvalur in Tirupur district, Kinnimangalam in Madurai, Kumbakonam in Thanjavur, Poyyur in Ariyalur, Purisai in Tiruvannamalai, Chavvashpuram in Virudhunagar, Shenbagaputhur in Erode and Kancheepuram.

The total cost for creating these sub-stations is Rs.822 crore.

Ms.Jayalalithaa said the Power Grid Corporation of India was setting up a sub-station with a capacity of 765 KW in Thiruvalem in Vellore for the purpose transmission of power among Southern States. Tamilnadu will set up a 400 KW sub-station at a cost of Rs.1000 crore to get more electricity from other States.

She said this year alone 10 sub-stations with a capacity of 400 KW, 16 sub-stations with a capacity of 230 KW, 19 sub-stations with a capacity of 110 KW and 11 sub-stations with a capacity 33 KW would be set up.

To overcome the power crisis, the government has decided to procure power through case-1 bidding. In the first phase, 1000 MW electricity will be procured since October for 15 years.

*Courtesy: The Hindu, dt: 26/04/2013*

## INTERNATIONAL ENERGY STORAGE ALLIANCE LAUNCHED

International storage alliance will spearhead the development of new technologies. The International PV Equipment Association (IPVEA) and solar research group EuPD have jointly formed a new industry body to represent the emerging solar storage sector. The International Battery and Energy Storage Alliance (IBESA) is aimed at bringing together companies from the fields of solar energy, energy storage and smart grid technology to cooperate on the development of new renewable energy storage systems. Markus Hoehner, chief executive of EuPD, said: "A strong, industry-wide alliance of global players like the IBESA is crucial in order to unify the fragmented electrical energy storage and smart grid markets, as well as to prepare and position them sustainably for the future." Bryan Ekus, managing director of IPVEA, added: "Our goal is to promote photovoltaics and the electrical energy storage market and provide real benefits for our member companies." The development of cost-effective storage technologies is seen as vital for the ongoing roll-out of renewable energy, particularly solar. Recent assessments put the market for solar storage at US\$19 billion, as other countries follow the lead being shown by Germany in adopting storage technologies. Germany has already formed a national energy storage trade body and from next month will be offering a subsidy for PV storage systems. *Courtesy: www.pv-tech.org*

## SOLAR POWER PROJECT AT DEOGARH

**Deogarh (Jharkhand), April 30 (ANI):** President Pranab Mukherjee inaugurated a 14 megawatt solar power project and laid foundation stones for the Pilgrim Queue Complex and Deoghar- Basukinath 44 kilo metre solar street light project at Deoghar in Jharkhand on Tuesday. Speaking on the occasion, Mukherjee said he is hopeful of these initiatives contributing to the overall growth of Deoghar and helping in setting high standards for pilgrimage management. He also commended the government authorities and local MPs for having taken the initiative to establish the high technology solar lighting project. (ANI)

# ENERGY STORY

## ENERGY EFFICIENCY – THE FIFTH FUEL – PART 2

Before presenting the details of Energy Efficiency improvements, technologies and potentials in various Energy usage areas such as Electricity, Machines, Fuel and Thermal areas etc, we take pleasure presenting below extracts from a recent article on the subject dealing with the dimensions of Measurements, Communication and Controls.

How energy efficiency is evolving into “intelligent efficiency”

The last two major economic revolutions were caused by the convergence of two factors: communications and energy. In the 1800s, the convergence of printing technology and steam power created the first form of mass communications – bringing with it sweeping changes in literacy and education. In the 1900s, the convergence of radio and television with electricity and the oil-powered combustion engine created the modern consumer-based society we know today.

We are now on the verge of a third revolution, argues one economist. This one will be abetted by the convergence of the internet and distributed energy, creating new ways to do business, communicate, and build wealth. This is called a “new economic paradigm for the 21st century.” This new paradigm is already reshaping the way we think about energy efficiency.

All around us, embedded in every commercial building, manufacturing facility and corporate campus, is a vast, untapped energy resource: efficiency. In the past, that resource was hidden, ignored or misunderstood by the companies sitting on the potential, and recognized only by a small group of energy professionals.

But with dramatic advances in web-based monitoring, real-time data analytics and utilities using peak pricing, that hidden resource is now becoming something tangible – an asset that companies can measure, manage, procure and sell. This isn’t the stale, conservation-based energy efficiency we often think about.

“In the past, energy efficiency was seen as a discrete improvement in devices,” says an economist who specializes in energy efficiency. “But information technology is taking it to the next level, where we are thinking dynamically, holistically, and system-wide.”

This emerging approach to energy efficiency is information-driven. It is granular. And it is empowering consumers and businesses to turn energy from a cost into an asset. We call this new paradigm “intelligent efficiency.”

That term, which was originally used for an Energy-Efficient Economy in a 2012 report, accurately conveys the information technology shift underway in the efficiency sector.

The IT revolution has already dramatically improved the quality of information that is available about how products are delivered and consumed. Companies can granularly track their shipping fleets as they move across the country; runners can use sensors and web-based programs to monitor every step and heartbeat throughout their training; and online services allow travelers to track the price of airfare in real time.

Remarkably, these web-based information management tools are only now coming to the built environment in a big way. But with integration increasing and new tools evolving, they are starting to change the game for energy efficiency.

Although adoption has been slow compared to other sectors, many of these same technologies and applications are driving informational awareness about energy in the built environment. Cheaper sensors are enabling granular monitoring of every piece of equipment in a facility; web-based monitoring platforms are making energy consumption engaging and actionable; and analytic capabilities are allowing companies to find and predict hidden trends amidst the reams of data in their facilities and in the energy markets.

This intelligence is turning energy efficiency from a static, reactive process into a dynamic, proactive strategy.

Interview of more than 30 analysts and companies in the building controls, equipment, energy management, software and utility sectors about the state of the efficiency market showed that every person we spoke to pointed to this emerging intelligence as one of the most important drivers of energy efficiency.

“We are hitting an inflection point,” said one of the experts. “The interchange of information is creating a new paradigm for the energy efficiency market.”

The conversations with a wide range of energy efficiency professionals, helped to identify the five key ways, intelligent efficiency is shaping the market in the commercial and industrial (C&I) sector:

- The decreased cost of real-time monitoring and verification is improving project performance, helping build trust among customers and creating new opportunities for projects;

*Electrical Safety is NO ACCIDENT*

- Virtual energy assessments are bringing more building data to the market, leveraging new lead opportunities for energy service professionals;
- Web-based energy monitoring tools are linking the energy efficiency and energy management markets, making efficiency a far more dynamic offering;
- Big data analytics are creating new ways to find trends amidst the “noise” of information, allowing companies to be predictive and proactive in efficiency;
- Open access to information is strengthening the relationship between utilities and their customers, helping improve choices about efficiency and setting the foundation for the smart grid.



***Fig.1: How intelligent Efficiency Creates Value for Customers***

At its core, energy efficiency is still about the nuts and bolts of changing equipment and improving the physical components of a facility. Information is not a panacea and is not a substitute for the physical integration of new systems. But it is becoming the glue binding the holistic, system-wide approach that is starting to define the intelligent efficiency business.

“It is rapidly becoming much cheaper to measure efficiency and analyze that data alongside lots of other information so companies can actually take action,” says an expert. “These information technologies are transforming the efficiency business. They are incredibly powerful.”

Driven by the convergence of instantaneous communication and distributed energy resources, the world is entering new phase of economic growth. The evolution of intelligent efficiency parallels that larger shift that is now underway.

*^ (To be continued)*

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

***Prepare and prevent, don't repair and repent.***

# THIRU. V. KALYANASUNDARAM



**Thiruvavarur Viruttachala Kalyanasundaram** (1883–September 17, 1953), better known by his Tamil initials **Thiru Vi Ka** (“Mr. V.K.”), was a Tamil scholar, essayist and activist. He is esteemed for the strong humanism of his essays, the analytical depth of his commentaries on classical Tamil literature and philosophy, and the clear, fluid style of his prose. His works, along with those of V. O. Chidambaram Pillai, Maraimalai Adigal, and Arumuga Navalar are considered to have defined the style of modern Tamil prose.

## History of Thiru . V .Ka

Thiru Vi. Ka was born in the village of Thullam in Chengalpet district, near Chennai in the southern Indian state of Tamil Nadu in 26.8.1883 in a Mudaliar community. He attended the Wesley College High School, and also studied Tamil under Maraimalai Adigal against N. Kathiravel Pillai of Jaffna. He worked briefly as a teacher, and in 1917 became an editorial assistant on *Desabaktan*, a nationalist Tamil daily. Thiru Vi. Ka. was soon involved in various aspects of the independence movement. During this period, he became a strong campaigner for worker rights. In 1918, he became active in the trade union movement as an associate of BP Wadia, and organised the first trade unions in the south of India.

## Contribution to Literature

In 1920, Thiru. Vi. Ka. started a new Tamil weekly magazine, titled *Navasakthi*. *Navasakthi* would be the vehicle for his thoughts for much of the rest of his life. Thiru Vi. Ka. sought to make his magazine a beacon to the Tamil people. His writings reflected his political and philosophical views. He published one of the first Tamil interpretations of the thought of Mahatma Gandhi, which is still regarded as an important milestone in Gandhian studies. He wrote a number of works on the religious and spiritual thought of Ramalinga Swamigal, an influential Tamil Saivite philosopher-saint of the 19th century. He wrote commentaries on a number of works of classical Tamil literature, which appeared as serials in *Navasakthi*.

Over the course of his writing career, Thiru Vi. Ka. published over fifty books. These include *Manitha Vazhkkaiyum Gandhiyadigalum*, a study of the implications of Gandhi’s thought for human conduct. His *Pennin perumai allatu valkai tunai nalam* was one of the most read books of that period. Also very influential, albeit at a more critical level, is his study of the concept of Beauty in Hinduism, published as *Murugan alladhu azaku* (Lord Murugan or Beauty). His writings reflect the internationalism characteristic of Indian intellectuals of that period, a strong pride in Indian and Tamil culture, coupled with a strong belief in the unity and universal kinship of all human thought. In his writings, Thiru Vi. Ka. developed a prose style which built on the inner rhythms of the Tamil language and produced a rhythmic, flowing text. The field of Tamil prose was still relatively new, and the style he developed was extremely influential. His works are today seen as having given a new energy to the Tamil language and regarded as part of the foundations on which the modern Tamil prose style has been built.

## Politics

Through this period, Thiru Vi. Ka. continued to remain active in politics and the Indian independence struggle. He was considered to be one of the three pillars of the Indian National Congress in Tamil Nadu, even becoming the President of the Tamil Nadu Congress Committee in 1926. He spent much time touring Tamil Nadu, making speeches on the need for independence. He remained active well into his sixties, and did not retire from politics until Indian independence in 1947.

## Death

Thiru Vi. Ka. died on September 19, 1953 at the age of 71.

## Stamp

On October 21, 2005, the Indian government commemorated his life by releasing a stamp in his honor.



*Wear the Right Protective Equipment for the Job.*

# SECRETS OF FOOD COMBINING

The observance of rules of food combining is neither faddish nor eccentric. It is a simple, scientifically-based system of selecting foods, from among different types, which are compatible. This facilitates easy and efficient digestion and ensures after-meal comfort. Digestion is not merely chemical or physical process, but also a physiological one. When food enters the body, it undergoes several changes before it is broken down into its constituent parts and assimilated. But no food can be assimilated by the system and used by various organs unless it has first been digested and then absorbed in the digestive system known as alimentary canal, while the residue, unfit for absorption is eliminated from the system.

The chemical part of digestion is accomplished by a series of juices and their enzymes. The juices alternate between alkalies and acids, and their character is determined by the requirement of the enzymes they contain. These enzymes remain active in suitable media of well defined acid-alkaline ranges and are destroyed in unsuitable media.

For instance, the salivary amylase (ptyalin) or starch-splitting enzyme of the mouth is active only in an alkaline media and is destroyed by a mild acid. The gastric enzyme, pepsin, which initiates protein digestion, is active only in the acid medium and is destroyed by alkalies.

A noteworthy feature of the digestive secretions is that the body suits its fluid and enzymes to the character of the food eaten. There are, however, severe limitations in this process. It is possible to suit the juices to a particular food, however, complex it may be, but not to a variety of foods taken together. It is the combining of many varieties and incompatible foods at a meal that causes 90 per cent of digestive disorders.

There is a marked tendency to gastro-intestinal fermentation with certain combinations of foods. There is no fermentation and digestion will be much more satisfactory when the foods comprising a meal are of the same type. This generally means eating similar foods at one time in order to accomplish the most complete digestion.

The most important rule for combining foods is to avoid mixing protein and carbohydrate concentrated foods. Although every food contains some protein, those regarded as protein concentrated foods demand the longest digestive time. They are held in the stomach for some hours until the gastric juices has performed its task. This may vary from two-and-a-half to six hours, depending upon the complexity of the protein in the food. If a protein food is mixed with starch-concentrated or sugar-concentrated foods, it will usually result in fermentation. This may lead to indigestion and gas in the stomach.

Animal-food proteins, such as meats, fish and cheese, require very high concentration of hydrochloric acid. Their gastric digestion will be greatly inhibited by carbohydrate fermentation in the stomach. This will produce more gas

and increased discomfort. Eating meat, potatoes, bread and sweets should, therefore, be especially avoided.

Protein foods are best digested when eaten with fresh vegetable salad. Primary protein foods such as nuts, seeds and soyabeans also combine very well with acid fruits like oranges, pineapples, grapefruit and lemons, and fairly well with sub-acid fruits, like grapes, pears, apples, berries, apricots and peaches. These vegetables and fruits are rich natural sources of vitamin C which aids protein digestion.

The second important rule for food combining is to avoid mixing proteins and fats at the same meal. Fat in foods inhibits the secretion of gastric juice through the small wall. Thus when fat-concentrated foods are taken with protein foods, gastric catabolism will decrease by the degree of liquid concentration in the stomach. Fat will remain undigested in the stomach until gastric juices complete their work on the complex protein molecule.

Although all primary protein foods contain high concentration of fat, such lipids will be held in suspension, awaiting catabolism in the intestine, without impeding gastric action. Free fats like oil, butter, and milk tend to coat the gastric mucoa, thereby inhibiting its effort to secrete gastric juice. Fat surrounding fried foods is also regarded as free fat and it interferes with gastric catabolism.

Another important rule for food combining is to avoid mixing carbohydrates and acid fruits in the same meal. The starch-splitting enzyme ptyalin in the saliva plays an important role as the food is chewed. It converts the complex starch molecules into simpler sugars. Ptyalin requires a neutral or slightly alkaline medium for proper functioning and this is the normal condition of the saliva in the mouth. However, when acid foods are taken, the action of ptyalin is halted. It is, therefore, necessary to avoid acid fruits in the same meal as sweet fruits or starches. Thus tomatoes should not be eaten with starches especially potatoes or bread.

Refined sugar products are also acidic, both in the mouth and in the bloodstream. The acidifying of the saliva by sucrose is one of the main causes of tooth decay. It can also cause severe damage to the digestion.

Food combining is designed to facilitate easier digestion. The chart in Table I, represents diagrammatically food combining rules in an easy-to-follow method. Accompanying this chart are the lists of food in their correct classification.

In a nutshell, starches, fats, green vegetables and sugars may be eaten together as they require either an alkaline or neutral medium for their digestion. Similarly, proteins, green vegetables and acid fruits may be eaten together as they require an acid or neutral medium for their

*Loose Wires Cause Fires*

digestion. But starches and proteins, fats and proteins and starches and acid fruits should not be eaten together as a general rule, if the best results are required from the ingestion of the food eaten. This in brief is the whole basis for successful food combination.

An important point to remember about meals is that the smaller the number of courses they consist of, the better it will be. They should approximate to a one-course meal as much as possible. Simple meals in every way are more conducive to health, than more elaborate ones, no matter how well they may be combined.

A meal consisting of proteins, carbohydrates and fats may remain in the stomach for six to seven hours before the stomach is emptied. If carbohydrates are eaten without proteins, they remain in the stomach for a relatively short period. A fruit meal remains in the stomach for even shorter time. It is advisable to eat these different foods at different meals - a fruit meal, a starch meal and a protein meal. The ideal practice is a fruit meal for breakfast, a starch meal with salad and non-starchy vegetables for lunch, and a protein meal with a salad and non-starchy vegetables for dinner.

**Table I - Food Combining Chart**

Food Groups	Proteins	Fats	Starches	Vegetables	Sweet Fruits	Sub-acid Fruits	Acid Fruits
<b>Proteins</b>	Good	Poor	Poor	Good	Poor	Fair	Good
<b>Fats</b>	Poor	Good	Fair	Good	Fair	Fair	Fair
<b>Starches</b>	Poor	—	Good	Good	Fair	Fair	Poor
<b>Vegetables</b>	Good	Good	Good	Good	Poor	Poor	Poor
<b>Sweet Fruits</b>	Poor	—	Fair	Poor	Good	Good	Poor
<b>Sub-acid Fruits</b>	Fair	—	Fair	Poor	Good	Good	Good
<b>Acid Fruits</b>	Good	—	Poor	Poor	Poor	Good	Good

**Proteins:** Nuts, seeds, soyabeans, cheese, eggs, poultry\* meat\*, fish\*, yogurt.

**Fats:** Oils, olive, butter, margarine.

**Starches:** Whole cereals, peas, beans, lentils.

**Vegetables:** Leafy green vegetables, sprouted seeds, cabbage, cauliflower, broccoli, green peas, celery, tomatoes, onions.

**Sweet Fruits:** Bananas, fits, custard apples, all-dried fruits, dates.

**Sub-acid-fruits:** Grapes, pears, apples, peaches, apricots, plums, guavas, raspberries.

**Acid fruits:** Grapefruit, lemons, oranges, limes, pineapple, strawberries.

\* Not recommended for good nutrition.

*Courtesy: A Complete Handbook of Nature Cure*

## WHAT IS THE DIFFERENCE?

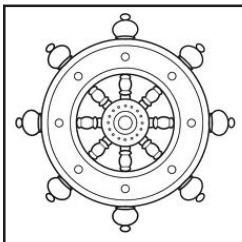
### Between LENDING and FINANCING

Lets deal with lending first. A bank or even your neighbour can lend you money. You may or may not have to put up collateral to secure the loan. Say you borrow \$100 from your mate and promise to repay the \$100 in 2 weeks time. He may ask you to give him something of similar value that he can “hold” until you repay him, this is collateral. He is not interested in why you want the \$100. He just wants his money back in 2 weeks or he will sell your collateral and recover his \$100 loan to you.

In financing, you buy a specific item usually with a specific interst rate over usually a specific time frame. The best example here may be a car or house or similar asset. If you default (miss payments) before the end of the payment period, the person / bank that financed your specific asset can (within reason) take away the specific asset that you financed and sell it to recover his / their debt.

So in a nutshell, financing (often called asset based financing) is the funding for a specific item and lending is generally non specific i.e. simply a loan.

*The Safe Way is the Best Way*



## DHARMA - 1

**What is Dharma?** Vedas- The Sole and Ultimate Authority- The Changing Dharma- Dharma In Other Religions- Benefits of the Practice of Dharma -Kinds

of Dharma- Fundamentals of Dharma- Non-violence (Ahimsa)- Truth, Purity, Self-control- Varnasrama Dharma (The Four Castes) Brahmana, Kshatriya, Vaisya, Sudra- The Four Asramas (Student, house-holder, recluse, renunciate) Brahmacharyasrama, Grihasthasrama, Vanaprasthasrama, Sannyasthasrama -Yuga Dharma- In Satya-Yuga, there was a different set of Dharmas or laws; in Treta-Yuga they changed into another form; in Dvapara Yuga, the Dharmas were different from the Dharmas of other Yugas- From the Bhagavad Gita Some verses with reference to Dharma

### Hindu Dharma

By Swami Shivananda The Divine Life Society, Rishikesh

Silent adorations to the Lord, the Embodiment of Dharma, the Controller and Protector of Dharma and the fountain-head of Dharma. What is Dharma? What is Dharma? Dharma is so called, because it holds: Dharma alone holds the people, etc. The word Dharma is derived from the root DHR- to hold- and its etymological meaning is 'that which holds' this world, or the people of the world, or the whole creation from the microcosm to the macrocosm. It is the eternal Divine Law of the Lord. The entire creation is held together and sustained by the All-powerful Law of God. Practice of Dharma, therefore, means recognition of this Law and abidance by it. That which brings well-being to man is Dharma. Dharma supports this world. The people are upheld by Dharma. That which accrues preservation of beings is Dharma. Dharma leads to eternal happiness and immortality. That which is Dharma is verily the Truth. Therefore, whosoever speaks the truth is said to speak Dharma, and whosoever speaks Dharma is said to speak the truth. One and the same thing becomes both. Dharma includes all external deeds, as well as thoughts and other mental practices which tend to elevate the character of a man. Dharma comes from the Divine and leads you to the Divine. Definition of Dharma No language is perfect. There is no proper equivalent word in English for the Sanskrit term Dharma. It is very difficult to define Dharma. Dharma is generally defined as 'righteousness' or 'duty'. Dharma is the principle of righteousness. It is the principle of holiness. It is also the principle of unity. Bhishma says in his instructions to Yudhishtira that whatever creates conflict is Adharma, and whatever puts an end to conflict

and brings about unity and harmony is Dharma. Anything that helps to unite all and develop pure divine love and universal brotherhood, is Dharma. Anything that creates discord, split and disharmony and foments hatred, is Adharma.

Dharma is the cementer and sustainer of social life. The rules of Dharma have been laid down for regulating the worldly affairs of men. Dharma brings as its consequence happiness, both in this world and in the next. Dharma is the means of preserving one's self. If you transgress it, it will kill you. If you protect it, it will protect you. It is your soul companion after death. It is the sole refuge of humanity.

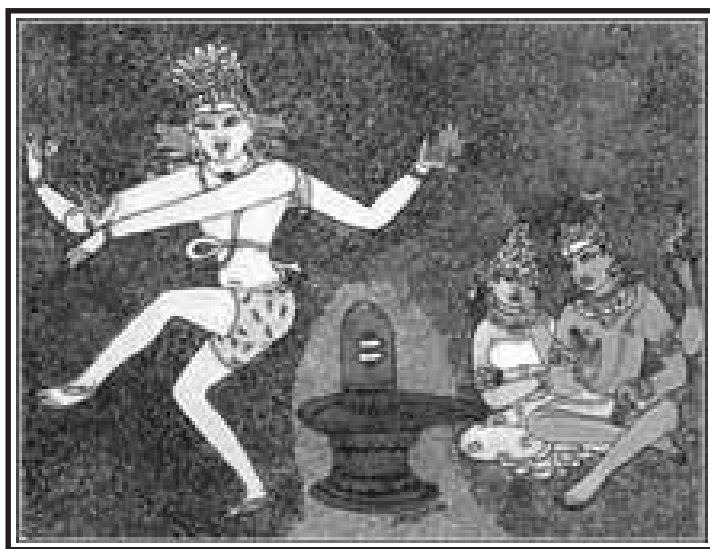
That which elevates one is Dharma. This is another definition. Dharma is that which leads you to the path of perfection and glory. Dharma is that which helps you to have direct communion with the Lord. Dharma is that which makes you divine. Dharma is the ascending stairway unto God. Self-realisation is the highest Dharma. Dharma is the heart of Hindu ethics. God is the centre of Dharma. Dharma means Achara or the regulation of daily life. Achara is the supreme Dharma. It is the basis of Tapas or austerity. It leads to wealth, beauty, longevity and continuity of lineage. Evil conduct and immorality will lead to ill-fame, sorrow, disease and premature death. Dharma has its root in morality the controller of Dharma is God Himself.

Maharshi Jaimini defines Dharma as that which is enjoined by the Vedas and is not ultimately productive of suffering.

Rishi Kanada, founder of the Vaisesika system of philosophy, has given the best definition of Dharma, in his Vaisesika Sutras: "That which leads to the attainment of Abhyudaya (prosperity in this world) and Nihisreyasa (total cessation of pain and attainment of eternal bliss hereafter) is Dharma". *(To be continued)*

## HOME FESTIVALS

Ani (June/July)



This is the one month of the year when there are no home festivals – coinciding not uncoincidentally with an intense month of agricultural effort. However, during Ani, major temple festivals are held for Lord Siva as Nataraja, King of Dance (above left), and for Siva and Parvati. *(To be continued)*

# HUMOUR

## SOME JOBS ARE JUST NO PUN

My first job was working in an Orange Juice factory, but I got canned. I couldn't concentrate. After that, I tried to be a Tailor, but I wasn't suited for it – mainly because it was a sew-sew job.

Next, I tried working in a Muffler Factory, but that was too exhausting.

Then, I tried to be a Chef - figured it would add a little spice to my life, but I just didn't have the thyme.

I studied a long time to become a Doctor, but I didn't have any patience.

Next, was a job in a Shoe Factory. I tried but I couldn't fit in. I became depressed and soulful.

Then there was the Professional Fisherman job. But I discovered that I couldn't live on my net income.

I managed to get a job working for a Pool Maintenance Company, but the work was just too draining. So then I got a job in a Workout Center, but they said I wasn't fit for the job. After many years of trying to find steady work, I finally got a job as an Historian - until I realized there was no future in it.

## Oh! There can be ANSWERS like these

- Q1. In which battle did Napoleon die?  
\*\* his last battle\*
- Q2. Where was the Declaration of Independence signed?  
\*\* at the bottom of the page\*
- Q3. River Ravi flows in which state?  
\*\* liquid\*
- Q4. What is the main reason for divorce?  
\*\* marriage\*
- Q5. What is the main reason for failure?  
\*\* exams\*
- Q6. What can you never eat for breakfast?  
\*\* Lunch & dinner\*
- Q7. What looks like half an apple?  
\*\*The other half\*
- Q8. If you throw a red stone into the blue sea what it will become?  
\*\* It will simply become wet\*
- Q9. How can a man go eight days without sleeping?  
\*\*No problem, he sleeps at night.\*
- Q10. How can you lift an elephant with one hand?  
\*\*You will never find an elephant that has only one hand.\*
- Q11. If you had three apples and four oranges in one hand and four apples and three oranges in other hand, what would you have?  
\*\*Very large hands\*

## DIFFERENT PERSPECTIVE

Confucius say: "man who run behind car get exhausted"... "man who run in front of car get tired"

## OLD IS GOLD

A young man at this construction site was bragging that he could outdo anyone based on his strength. He especially made fun of one of the older workman. After several minutes, the older worker had enough.

"Why don't you put your money where your mouth is?" he said. "I'll bet a week's wages that I can haul something in a wheelbarrow over to the other building that you won't be able to wheel back."

"You're on, old man," the young man replied. "Let's see what you've got."

The old man reached out and grabbed the wheelbarrow by the handles. Then nodding to the young man, he said with a smile, "All right. Get in."

1) Perfect Prayer....." B. M. W. "

Bless My Work;  
Bring My Wisdom;  
Burn My Worries.

2) GOD is ONE only...

MANDIR - 6 letters; GEETA - 5 letters;  
MASJID - 6 letters; KURAN - 5 letters;  
CHURCH - 6 letters; BIBLE - 5 letters.

They Preach that Every thing is ONE, all in ONE only, i.e.  $6 - 5 = 1$ .

3) Alphabets are the same, the only difference is their Placement.

CHEATING..... TEACHING.....

..... thus, who CHEAT You, always TEACH You for not getting Cheated !

WORDS..... SWORD.....

..... both have Similar effect !

.... I am sending LATE,

.... but I have no TALE to cover !

Courtesy: M. Sri Rama Prasad



When Man chooses a Mission his life get altogether a new meaning. But when a mission chooses the best suitable Man to carry out its work, that Man himself becomes the Mission.

**Salutations to the Man  
who can never die,  
SWAMI VIVEKANANDA  
on his 150<sup>th</sup> Birthday!**

# TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL'



There was a discussion recently about the very basics of Management or Business Management. It was discussed that the 2 concepts of "Attractiveness" and "Competitiveness" convey the very essence of Business and Management.

Attractiveness in essence, presents the attractiveness of the 'Opportunity' with potentials of attractive earnings, with all its dimensions of challenges and demands. Competitiveness in essence, is the analysis of the capabilities of the Organization with all its strengths and weaknesses and its ability to 'Offer' a competitive Solution in the light of competition. The Business venture can be expected to succeed if the 'Attractiveness' and 'Competitiveness' dimensions are well taken care, before taking a decision.

Tiruvalluvar sums up the above concepts in a Kural as follows, where in the Competitiveness dimension, he also includes the support we can command from our associates at the time of need as necessary.

*Vinaivaliyum Thanvaliyum Maatran valiyum  
Thunaivaliyum Thookkichcheyal Kural 471*

*tṭi d tṭAk; j d; tṭAk; khwṭhd; tṭAk;  
Ji z tṭAk; J)ffr; nray; Fws; 471*

"The decision to act must be based on the Demands of the Act, our own strength, the strength of the opponents (competition) and the support we can command from associates."

## SWAMI VIVEKANANDA'S MESSAGE ON SEPTEMBER 11, 1893



"Sisters and Brothers of America. [At this moment came the three minute standing ovation from the audience of 7,000] It fills my heart with joy unspeakable to rise in response to the warm and cordial welcome which you have given us. I thank you in name of the most ancient order of monks in the world; I thank you in the name of the mother of religions; and I thank you in the name of millions and millions of Hindu people of all classes and sects.

"My thanks also to some of the speakers on this platform who,

referring to the delegates from the Orient, have told you that these men from far-off nations may well claim the honor of bearing to different lands the idea of toleration.

"I am proud to belong to a religion which has taught the world both tolerance and universal acceptance. We believe not only in universal toleration but we accept all religions as true. I am proud to belong to a nation which has sheltered the persecuted and the refugees of all religions and all nations of the earth. I am proud to tell you that we have gathered in our bosom the purest remnant of the Israelites who came to Southern India and took refuge with us in very year in which their holy temple was shattered to pieces by Roman tyranny. I am proud to belong to the religion which has sheltered and is still fostering the remnant of the grand Zoroastrian nation.

"I will quote to you brethren a few lines from a hymn which I remember to have repeated from my earliest childhood, which is every day repeated by millions of human beings: 'As the different streams having their sources in different places all mingle their water in the sea, so, O Lord, the different paths which men take through different tendencies, various though they appear, crooked or straight, all lead to Thee.'

"The present convention, which is one of the most august assemblies ever held, is in itself a vindication, a declaration to the world of the wonderful doctrine preached in the Gita: 'Whosoever comes to me, though whatsoever form, I reach him; all men are struggling through paths which in the end lead to me.'

"Sectarianism, bigotry, and its horrible descendant, fanaticism, have long possessed this beautiful Earth. They have filled the earth with violence, drenched it often and often with human blood, destroyed civilization, and sent whole nations to despair. Had it not been for these horrible demons, human society would be far more advanced than it is now.

"But their time is come; and I fervently hope that the bell that tolled this morning in honor of this convention may be the death-knell of all fanaticism, of all persecutions with the sword or with the pen, and of all uncharitable feelings between persons wending their way to the same goal."

*Anything in life that is perceived as Kashtam Kashtam will only appear to be even more difficult.  
Do the same thing, perceiving it as Ishtam Ishtam, the most complex of tasks can be done with effortless ease.*

## MASSIVE SOLAR POWER PLANT OPENS IN ABU DHABI



One of the world's oil capitals opens the world's largest single concentrated solar power plant. One of the world's largest solar power plants opened in the oil-rich city of Abu Dhabi. The 100-megawatt plant, called Shams 1, is a first step in a plan to make seven percent of Abu Dhabi's energy resources renewable, Sultan Ahmed Al Jaber, head of the Abu Dhabi Future Energy Company, said during a news conference. Abu Dhabi is part of the United Arab Emirates, which are famed for their oil wealth. The emirates rank 13th in the world for per capita GDP, a standing driven mostly by their oil exports. The new plant includes a huge field of parabolic mirrors located in the desert about 74 miles (120 kilometers) south of Abu Dhabi. Shams 1 will serve 20,000 homes and cost an estimated \$600 million to build, the BBC reported. Similar Shams 2 and Shams 3 plants are in the works, Clean Technica reported.

Shams 1 is a concentrated solar energy plant, which means its technology is a little different from the flat, black photovoltaic panels you might have seen on people's roofs. Shams 1's uses mirrors to concentrate the sun's energy to heat a fluid, which produces steam to turn turbines to make electricity.

Shams 1 isn't a perfectly efficient solution,

however. The plant's process still requires some natural gas to "superheat" the fluid, Clean Technica reported. It also requires uses some energy in the form of brusher trucks that clean the mirrors of sand. Even in the middle of the desert, it's impossible to make a solar power station totally efficient. Although there are certainly other solar plants in the world Shams 1's size or larger, the Abu Dhabi plant holds the title of the largest single concentrated solar energy plant. Other concentrated solar plants are connected with thermal power plants, IEEE Spectrum reported. There are also larger concentrated solar energy projects that are near completion, but aren't yet plugged into their local grids. Covering an area of 2.5 km<sup>2</sup> or 285 football fields Shams 1 incorporates the latest in parabolic trough technology and features more than 258,000 mirrors mounted on 768 tracking parabolic trough collectors. By concentrating heat from direct sunlight onto oil-filled pipes, Shams 1 produces steam, which drives a turbine and generates electricity. The project uses a booster heater to heat steam as it enters the turbine, dramatically boosting the cycle's efficiency. Shams 1 also features a dry-cooling system that significantly reduces water consumption a critical advantage in the arid desert.

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