ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

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

Dear Members, Fellow Professionals and Friends

Seasons Greetings to One and All!

The month of January with lot of celebrations of cultural and National importance has just come to an end with enough of positives and negatives. It is heartening to get the vaccination in action all over the country and it equally gives a feeling of relief to see the Covid 19 in fast decline in Tamilnadu as well in the whole of the country, partly due to the actions of Government and the people, but mostly due to the inherent high immunity levels in our people. The most unfortunate events are the farmers' agitation and the ugly happenings on the Republic Day, due to infiltration of anti-social and anti-national elements. This is just unpardonable, that day really being the pride of our freedom and democracy. The whole world admires and envies our democracy as it is approaching a century soon, as our country has the highest of population and high diversity any country cannot think of. It is really not a puzzle for any Indian as we all know that the diversity is one of our natural evolutions over a few thousand years, but we always had a common basic culture across the country of Bharat intact.

February is always a month of the Budget. In the light of the economic slowdown due to the Pandemic and other associated problems, and the challenges to ensure growth in all sectors, employments and overall prosperity, it will be a tough job for the Government to address all the aspirations. Successful progress can only be ensured with all our whole hearted co-operation and support. There are good indications of positive all round growth and recent IMF Report also indicates that India will have 11.5% growth in the year 2021 – 22. We can all look forward to good times ahead for businesses.

February 28th is celebrated every year as National Science Day in India. The theme of Science Day for the year 2021 is "Future of STI: Impacts on Education, Skills and Work".

Science, Technology and Innovation are all knowledge based and as popularly believed, this is the age of knowledge workers and the impact of STI is already there in large measure in all activities and work. Historically, we have had a very long tradition of science and technology, be it mathematics or astronomy or metallurgy or textiles manufacture or medical sciences or irrigation and agricultural science or machines or ship building and navigation and so on, but over a period of hundreds of years of invasions and foreign rules, we have been forced to abandon many things and have been made to believe as if we were barbaric. There are lots of efforts since the time of our independence to revive our glorious past and the knowledge supported by clear evidences. We have had a long history of sea travel and international trade long before Vaskodagama found sea route to India. In the same context, there are also serious efforts to rewrite our history with glorious periods of Cholas, Vijayanagar Empire and many more dynasties of Orissa, Bengal Kerala and so on, which have all been left out by the history writers. Let us cherish and revive our old glory as we have had a flourishing history of thousands of years of great civilization and prosperity.

We thank all those members who have helped us by participating in the advertisement appearing for the issue January 2021 – Arrow Marketing, E Power Engineering, Gravin Earthing & Lightning Protection System (P) Ltd., Mersen, Pentagon Switchgear (P) Ltd., Supreme Power Equipment (P) Ltd.

Editor

ELECTRICAL INSTALLATION ENGINEER

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In a lifetime devoted to her patients, she lived in a single room within the Adyar Cancer Institute premises, so that she would be available round the clock

Tributes from PM, V-P

DR. SHANTA

Tributes poured as the day of her passing away progressed, with patients, colleagues, and political leaders talking of how she had touched their lives and improved the field of oncology. All of them were clear that Dr. Shanta occupied a unique space that will now be a void with her passing.

Among those who paid tributes to her were Prime Minister Narendra Modi, Vice-President Venkaiah Naidu and Union Health Minister Harsh Vardhan, apart from State leaders, and healthcare professionals from across the country.

Dr. Shanta was active until her hospitalisation, colleagues said, even though she had been feeling under the weather for a couple of days. Arvind Krishnamurthy, professor and head, Surgical Oncology, Cancer Institute, said Dr. Shanta never wanted to leave the Institute for treatment outside and was not for invasive ventilation.

"She was quite active till the very last day considering her age and frailty. She preferred medical management. She did not want any final rituals to be performed, and wished that her ashes should be sprinkled all over the Institute... She continued to be in control till the very end," he added.

Right through the pandemic, Dr. Shanta continued to be concerned about the new challenges to health care brought on by the lockdown and expressed them eloquently in communication she sent to The Hindu. It deeply troubled her that many sick people could not be treated during the peak of the lockdown, and she was looking for multiple safe options to open up services again.

Affairs relating to the Institute — funding, infrastructure upgradation, helping more people with cancer, awareness generation activities — occupied her time wholly. She lived in a single room within the Cancer Institute premises, so that she would be available for patients round the clock.

It was in April 1955 that Dr. Shanta joined the Cancer Institute as its resident medical officer. She completed her MBBS in 1949 and M.D. in Obstetrics and Gynaecology in 1955. While she

was selected to the post of assistant surgeon at the Women and Children's Hospital, Madras by the Madras Public Service Commission, she joined the Cancer Institute, which was established in 1954 by the Women's Indian Association Cancer Relief Fund under the leadership of another medical pioneer, Dr. Muthulakshmi Reddy.

Over six decades

In her medical career spanning over 60 years, she focussed on organising care of cancer patients, study of the disease, its prevention and control, creation of specialists and scientists in different aspects of oncologic sciences. She played a key role along with Dr. Krishnamurthi in the development of the Institute from a cottage hospital of 12 beds to a comprehensive cancer centre, according to the Institute.

Dr. Shanta came from a family of eminent scientists, including two Nobel laureates in Physics — C.V. Raman and S. Chandrasekhar. She was responsible for the recognition and practice of medical oncology as a specialty and the creation of a separate medical oncology division at the Institute. The first super specialty course in surgical and medical oncology in India was introduced at the institute in 1984.

Dr. Shanta was on the World Health Organisation Advisory Committee on Cancer till March 2005. She was also convenor of the State Advisory Board on Cancer, and has been member of many ICMR committees.

Dr. Shanta was the recipient of Padma Shri in 1986, Padma Bhushan in 2006 and Padma Vibhushan in 2016. She was conferred the Ramon Magsaysay Award for Public Service in 2005. She has received many national and international awards.

Service on her mind

Doctors of the institute recalled her journey with Dr. Muthulakshmi Reddy and Dr. Krishnamurthi, and her efforts in building the institute brick by brick. She always emphasised on the ethos of the Institute as providing service for all and care for the needy. She often stressed on the need to pursue research and recalled Dr. Krishnamurthi's passion for research and his driving mantra: "Today's Research, Tomorrow's Treatment".

In one of the communications to The Hindu, she said, "The Cancer Institute has survived crises and come through stronger. Through all the difficult times, we never lost sight of our vision of top quality service to all, particularly the economically weaker sections".

Dr. Shanta has also pointed out that the challenge in cancer today was early detection and prevention.

"We have screening centres in Villupuram, Tiruvannamalai, Gummidipoondi and Pudukottai because we want to dispel the fear of cancer in people by enabling them to understand that if you come early, cancer can be cured," she said during an interview. Dr. Shanta did not lose any opportunity to reiterate the need for tobacco control and government support to implement the regulations.

On December 28, 2020, she participated in the launch of Tamil Nadu Cancer Registry Project Report 2020, a collaborative study by Cancer Institute and Department of Health and Family Welfare, Government of Tamil Nadu.

Science without religion is lame, religion without science is blind.
– ALBERT EINSTEIN

KNOW THY POWER NETWORK - 156

Embracing Electrical Safety

1. Need

A "Dancer" cannot be separated from her/his "Dance"; so also an "Actor" from her/his "Actions". Likewise, Electrical Energy cannot be used without the basic "Safety Measures". We can never think of "Electrical Energy" without "Safety"; yet at most of the times we consider it as "Our Master"/ "Companion" and not as our "Servant". It is the "root cause" of all the problems experienced while utilizing electrical energy. The curiosity on the part of young children may also be treated as one more reason. Moreover, the wrong conception/opinion we construe about our electrical installations can also be added to these factors. We erroneously think that our premises are "free" from defects and it is fully guarded against the threats accompanied with electricity. In reality, it is not so; it is only an "illusion". Our premises have many short comings / inadequancies, which we never thought of. Actually, we are at the **"mercy of electricity".**

Main reason for this situation is that we never have a clear true picture of the possible threats that come with electrical energy and the required protective measures to counter them. So there exists an urgent need for proper awareness of the problems on hand and the effective measures to solve them / before we go for electrical energy, a carrier / transporting agent of all kinds of energy forms for our needs.

Kindly note that "Truth" has a unique way of making to presence felt. So when we have an incorrect / false view of the healthiness of our electrical installations, the reality reveals itself by way of "electrical shocks / electrocutions, electrical fires and equipment failures at unexpected junctures. Such a situation is mainly brought by our lack of awareness, under estimation of the dangers of electricity, inadequate knowledge, ignorance and over confidence. "Our escapism mindset", while facing the challenges thrown by electricity may be adduced as the prime reason. On accepting this fact, we need to correct it so that we can move freely on the "Right Safety Track".

1. Threats that accompany electricity

Now you may be interested in learning the threats that come along with electrical energy and the required corrective measures.

Under no circumstances, we should not remain unprepared for these threats; otherwise we will cut a sorry figure with undesirable losses of lives and equipment / devices.

Threats and Remedies

S. No	Possible Threats	Remedial Measures
1	Over Voltage Surges (i) Lightning (a) Direct lightning stroke (b) Indirect lightning stroke (ii) Switching surge (iii) Temporary Power Frequency over voltages caused by (a) U-G LT cable Dig-in faults (b) Ferroresonance (c) Loss of neutral (d) Over fluxing in the related transformers and other causes.	 Lightning masts or spikes, ground wires Surge Protection Devices like Zinc oxide surge arresters surge suppressors and other devices. Surge Arresters and other Surge Protection Devices. Normally it is difficult to provide protection for it. The equipment has to be designed for it. However over voltage circuit breaker and Moulded case circuit breaker with over voltage trip features offer maximum protection against it.

2	Over currents (overloads) and short circuit currents	Miniature circuit breaker MCCBs, HRC fuses and rewirable fuses.
3	Earth leakages (Leaking neutral, poor earth connections and arcing earth)	Earth leakage circuit breaker, low resistance earth connection in good operating condition.
4	Higher neutral currents (due to unbalance in the loads/supply) that create unwanted losses and over heating.	Indicating devices like maximum demand ammeters and ammeters in the neutral circuits are used.
5	Harmonics that create excess heat and undesirable higher I^2R losses	Active and passive harmonic filters. Before installing these devices, predominant harmonics at the site in point need to be measured.
6	Unwanted losses in the single phase lighting circuit containing fluorescent lamps due to higher input voltages i.e. more than 210 volts	Lighting Energy savers.

2. New Panels

The threats posed by electrical energy land us in an "Unknown Territory". We know that any unknown sector is limitless and has many dimensions. To travel in this region, we should give up our present mind set of accepting tolerable safety out comes and go for new panels. So there is a need for the erection of the panels incorporating the suggested protective features since the existing panels in most of the services you not have fully effective protective features and hence they cannot "Square Up" with the said threats. To meet this "Safety first" condition it may be considered as the essential need of the hour. The general arrangements of the panel are shown in Fig1 and 2. Just for the sake of "Safety First", it is preferable to adopt this panel with all the recommended features. This panel generally meets safety needs and helps to save electrical energy also. It is sincerely felt that it will meet the approval of the aghast readers chiefly formed by electrical engineers and panel manufactures and suppliers.

Refer Fig 1 - Page No. 9

Refer Fig 2 - Page No. 10

At this juncture, it will be of interest to view the recent electrical accidents in Chennai areas. Electric shocks can cause muscle spasm, weakness, shallow breathing, severe burns, unconsciousness and death. Besides power lines, these shocks can be brought by electrical appliances like iron boxes, heaters, faulty electrical equipment like motors, fans and power cords and it can be fatal most times. The arc of recent accidents in domestic services in Chennai city and its suburbs reveals,

(i) A 13 year old boy was electrocuted, when he curiously touched a live wire dangling from the switchboard in his house at Paalikaranai.

(ii) A 53 year old woman of Red Hills got electric shock, while she was grinding dosa batter in her house.

(iii) Another woman of 56 years old was electrocuted when she was ironing clothes in her house at Anna Nagar.

(iv) A small boy suffered electrocution at "Choolai Medu" when he accidently touched table fan wire with his wet hands.

All these accidents would have been averted had ELCBs (Earth Leakage Circuit Breakers) been installed in their house services. It stressed the need for the suggested protective panel in all LT services.

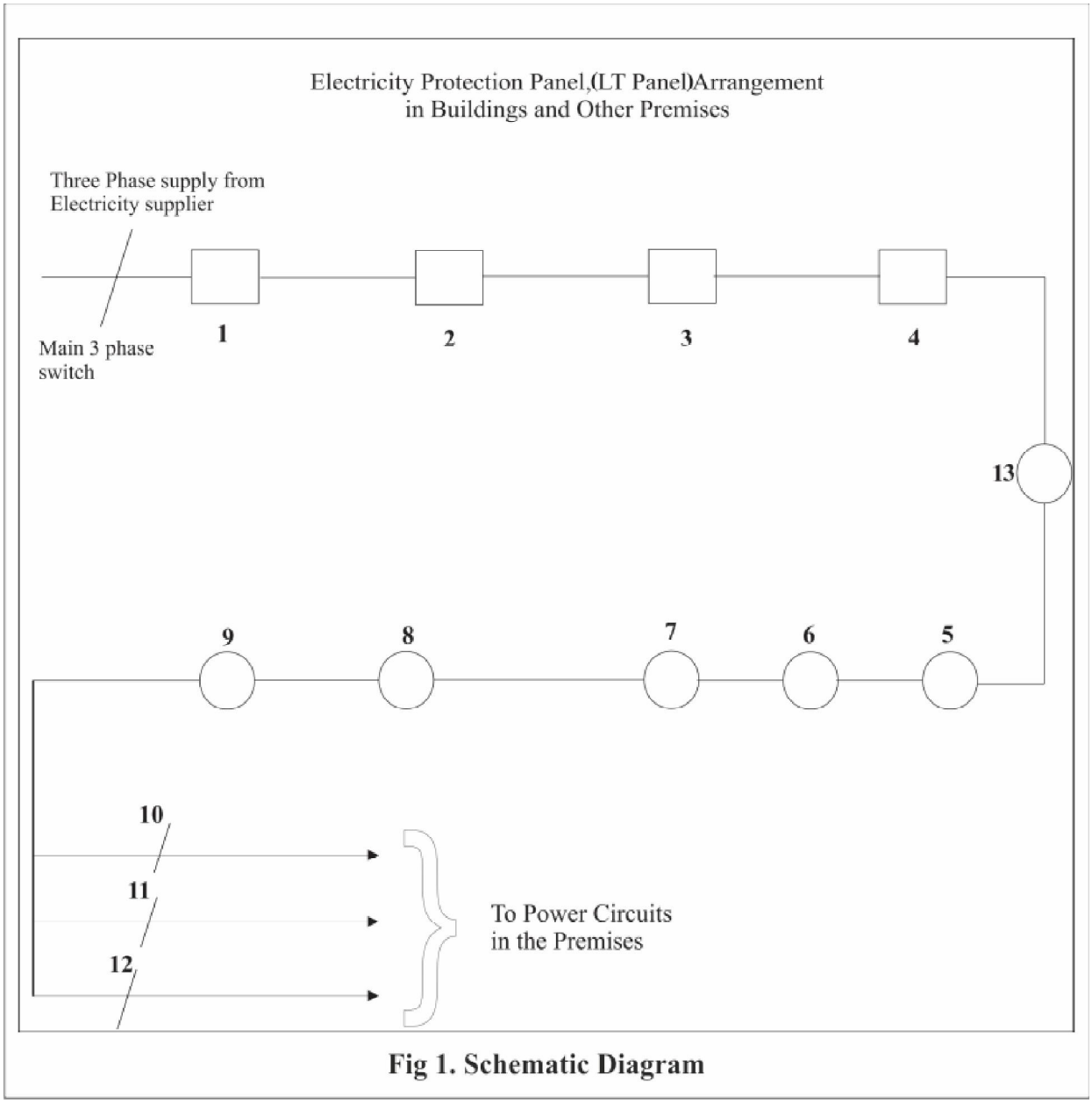


Fig 1. Schematic Diagram

Legend:

1. Short Circuit Protective Devices, / OL CB (MCB, MCCB)
2. Earth Leakage CB
3. Over Voltage CB / MCCB with over voltage trip feature
4. Surge Protective devices, lightning masts ground wires
5. Ammeter Neutral Circuit
6. Harmonic Filter
7. Power Factor Meter
8. Voltmeter
9. Electronic energy (WHr) meter
10. 10-12 CB or Switch
13. Lighting Energy Saver

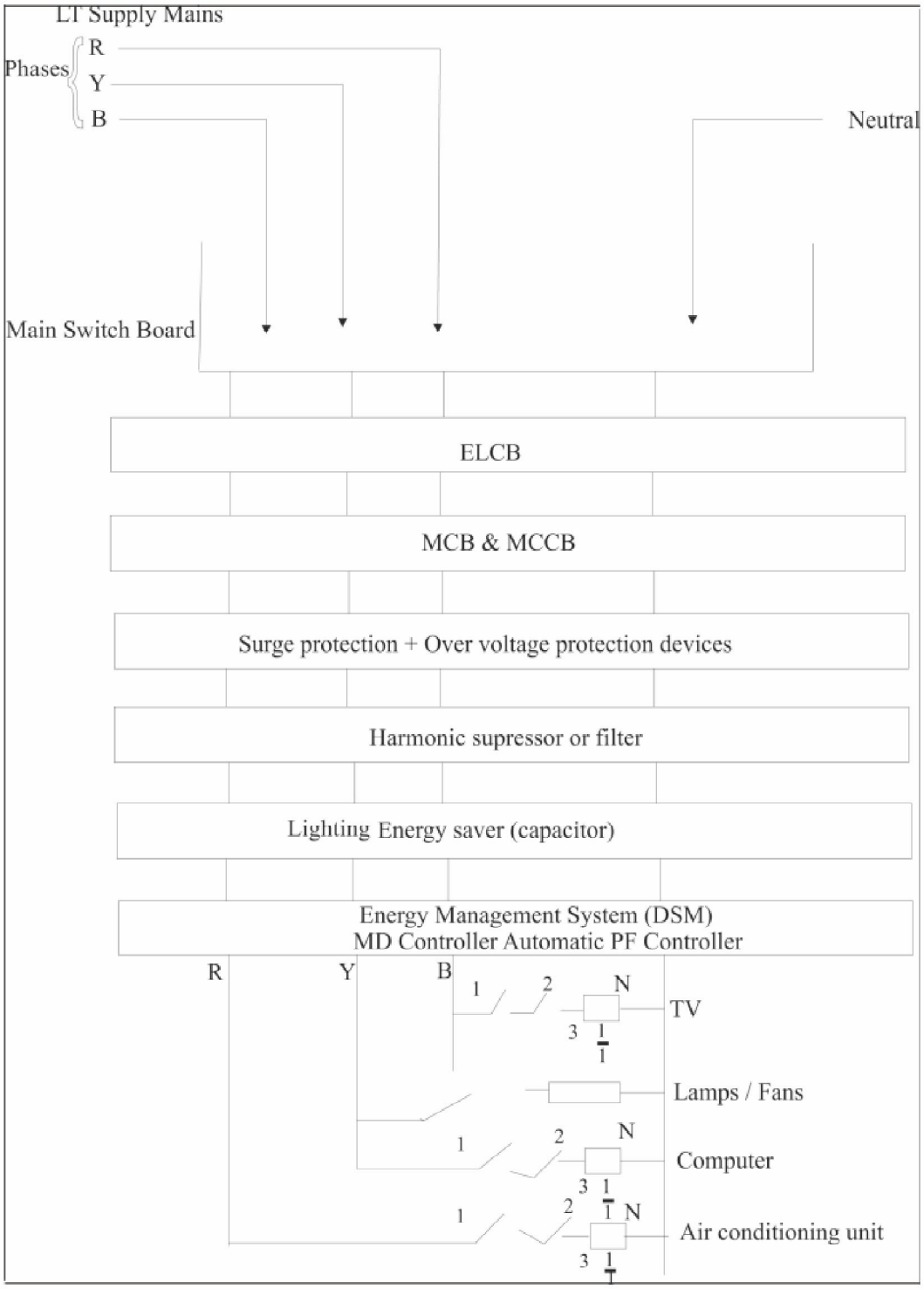
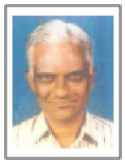


Fig 2. Electricity Circuit Protection Arrangement (Schematic)

Legend: 1. Switch, 2. Control / Limiter, 3. Remote Switch or Hand Operated Remote Switch

Let me sign off here.

(To be continued)



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NATIONAL SCIENCE DAY

National Science Day is celebrated all over India with great enthusiasm on 28th of February every year in order to commemorate the invention of the Raman Effect in India by the Indian physicist, Sir Chandrasekhara Venkata Raman on the same day in the year 1928. For his great success in the field of science in India, Chandrasekhara Venkata Raman was awarded and honoured with the Nobel Prize in the Physics in the year 1930.

National Science Day 2021

National Science Day 2021 in India will be celebrated on 28th of February, on Sunday.

Objectives of Celebrating National Science Day

- National Science Day is being celebrated every year to widely spread a message about the significance of scientific applications in the daily life of the people.
- To display the all the activities, efforts and achievements in the field of science for human welfare.
- To discuss all the issues and implement new technologies for the development of the science.
- To give an opportunity to the scientific minded citizens in the country.
- To encourage the people as well as popularize the Science and Technology.

C V RAMAN

How National Science Day is Celebrated

National science day is celebrated as one of the main science festivals in India every year during which students of the schools and colleges demonstrates various science projects as well as national and state science institutions demonstrates their latest researches. The celebration also includes public speech, radio-TV talk shows, exhibitions of science movie, science exhibition based on themes and concepts, watching night sky, live projects and researches demonstration, debates, quiz competitions, lectures, science models exhibitions and many more activities.

It is celebrated every year with immense passion at the Giant Metrewave Radio Telescope (also called GMRT) at Khodad which is a worldwide famous telescope getting operated at low radio frequencies by the NCRA (National Centre for Radio Astrophysics) established by the TIFR (Tata Institute of Fundamental Research).

Variety of activities is organized by the NCRA and GMRT at the ceremony of national science day celebration in order to recognize their leading research activities in the field of radio astronomy and astrophysics. Variety of programmes is also held for the common public and student community to popularize the science and technology in the country.

Theme for the National Science Day (NSD) 2021 is "Future of STI: Impacts on Education, Skills and Work" STI – Science Technology and Innovation

Schemes for Communication and Popularization of Science & Technology

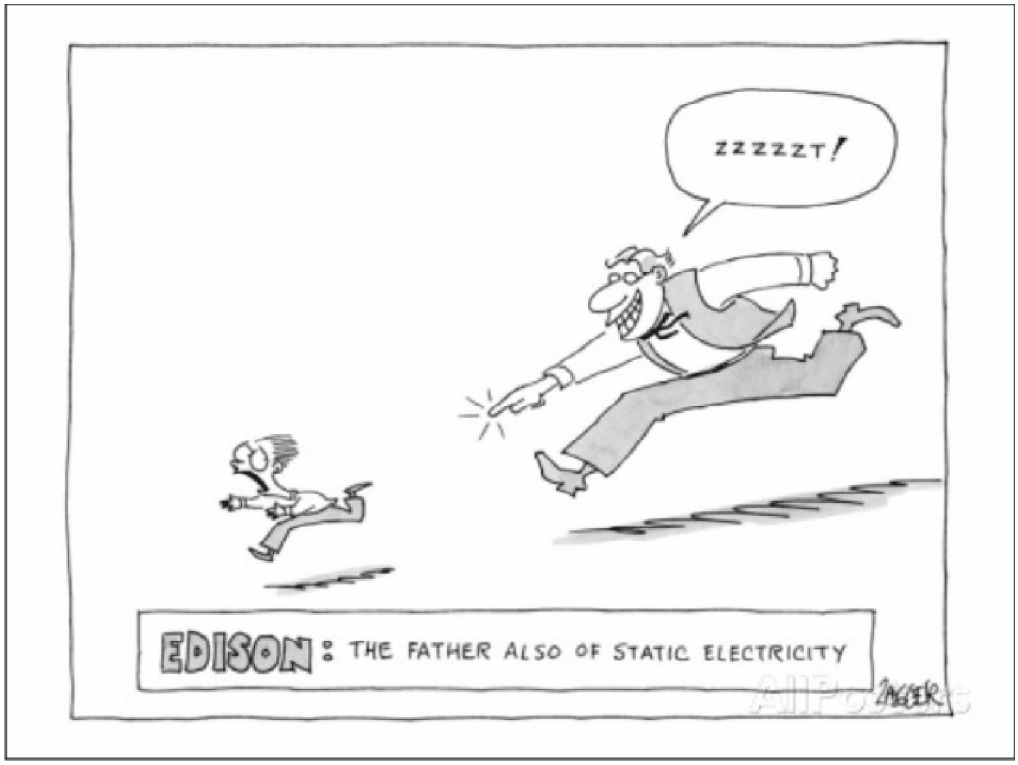
The National Council for Science and Technology Communication (NCSTC) is mandated to communicate Science and Technology to masses, stimulate scientific and technological temper and coordinate and orchestrate such efforts throughout the country. The programmes of NCSTC aims at building capacity for informed decision making in the community and promote scientific thinking. It is devoted towards societal upliftment through the dissemination of scientific knowledge in an informed manner and builds programmes with the help of different media which percolate down to every nook and corner of the society.

The NCSTC focuses on outreach activities, training in Science and Technology communication, development, production & dissemination of S & T software, incentive programmes, and field based Sci-Com projects, research in S&T communication, international co-operation, motivating students and teachers, environment awareness and programmes with a special component exclusively for women.

Some of its important successful initiatives, over the years include the campaigns over the Year of Scientific Awareness, Year of Physics, Year of Astronomy, Year of Mathematics, observation of the National Science Day and National Mathematics Day, the National Children's Science Congress, National Teacher's Science Congress, and Science Express etc.

A multi- pronged effort has been developed by the NCSTC including:

- Communicating science using folk media;
- Use of mass & digital media for science communication and popularization;
- Use of Social media in science and Technology Popularization



Section IV

Maintenance & Troubleshooting

4.1 Maintenance

Solar panels require virtually no maintenance. However the associated equipments such as batteries and charge controller are to be maintained. Once a fortnight the surface of the panels should be wiped clean with wet rag to remove dust, fallen leaves, bird dropping etc. Only water to be used and no other cleaning agent.

With Solar Panel Secondary battery maintenance becomes minimum. Still general periodical maintenance of battery should be carried out in usual manner and as per maintenance manual.

For efficient working of SPV system certain precautions are to be observed as given below.

4.1.1 Precautions and Preventive Steps

Please ensure that:

a) SPV Modules are connected in parallel and SPV Panel output voltage is less than 25 Volts under normal sunshine condition (for 12 V System/Module)

b) All connections are properly made tight and neat using the crimped Red (for +ve) and Black (for –ve) wires supplied by the manufacturer in order to avoid reverse connection.

c) The rating of the fuse in the charge controller is not changed.

d) The SPV Panel is installed facing SOUTH and with the correct 'Angle of tilt'.

e) There is no shadow on any part of the SPV Panel at any time of the day, to get maximum power.

f) SPV Modules are protected against any act of vandalism and accidental strike or hit by heavy objects, like stone, hammer etc. If the SPV Panel is installed on ground, it must be fenced properly to protect it from cattle and to prevent from any damage/theft. Fencing should be made in such a way that no shadow should fall on SPV Panel at any time of the day.

g) Battery Bank is placed on a rack or platform insulated from ground and located in a well-ventilated room and also sufficient clearance is there over the battery.

h) FIRST the Battery Bank, then SPV Panel and then Load is connected to SPV Charge Control Unit and for disconnection reverse sequence is adopted.

i) Battery terminals are never shorted even momentarily as shorting will result in HEAVY SPARK AND FIRE. (To avoid the same connect the cable at Charge Controller end 'First' and then Battery end.)

j) Never connect the Load directly to the SPV Panel as SPV Panel may give higher/lower voltage than required by the Load Equipment and hence the equipment may be DAMAGED permanently.

k) Blocking diode is provided at the array output for protection against reverse polarity.

l) Make sure that the Solar PV module gets direct sunlight throughout the day where you install it.

m) The Green indicator on Charge controller is only an indication for charging. It will glow even at small amount of charging. So to ensure efficient charging, the availability of direct sunlight over the Solar PV module for the maximum hours of the day should be ensured.

n) It is NOT HEAT BUT LIGHT that produces energy. So let direct sunlight to fall on the module surface without shades.

4.2 Troubleshooting

The SPV Power Source is reliable Source of Electrical energy. However, there may be rare instances, when the SPV Power Source is not able to drive the connected equipment.

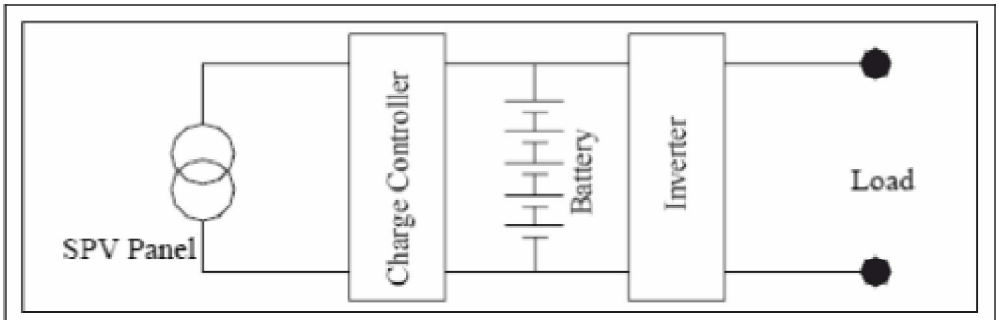


Fig. 4.1: SPV Power Source

The diagnosis of the problem in such situations starts with the battery. Check the voltage of the battery bank. If the voltage of the battery bank is correct as indicated in Charge controller, there may be problem in the inverter or switch between load and inverter i.e. either inverter is tripped or switch/load MCB is tripped or load fuse is blown off. If none of the above fault is observed then check the specific gravity of the electrolyte in the secondary cells of the battery. There may be two cases:

a) If the specific gravity is above the level 1.2 (Hydrometer reading 1200) value or as specified in the maintenance manual, it implies that the battery is in order and the problem would be either with the Charge Controller or Load. Disconnect the load (S & T Equipment) from Charge Controller and connect it directly to Battery Bank. If the equipment operates, the defect may be with the Charge Controller. Disconnect the Charge Controller and check as per troubleshooting instructions given in the manual supplied with it or inform the manufacturer/supplier.

b) If the specific gravity of the electrolyte is below the specified level and BATT/LOW (Red)) LED is glowing, the problem may be with any of the following:

   i. Load: This may be drawing more current from the battery than required. In such case, battery is bound to get discharged, even if SPV Panel is functioning properly. This would result in frequent tripping of the load. To avoid this, get the load equipment checked and replace any defective components.

   ii. SPV Panel: The SPV Panel may not be producing required power for which the Power Source has been designed. In that case, check the SPV Panel as given below:

   - Check for any loose connection/breakage of wire in SPV module interconnections.
   - If there is no such loose connection, clean the SPV Modules with soft cloth. Whenever there is bright sunshine, measure the voltage and current of each module after disconnecting the wire. Open circuit voltage of each module should be around 21 volts and short circuit current should be as per table given under Para 6 depending upon the wattage of the module, at 100 mW/Sq.cm AM 1.5 Solar radiation.
   - If any of the SPV modules gives low voltage/current output during bright sunlight (Sun intensity 90 mW/Sq. cm) inform the manufacturer/Supplier with module serial number along with the measurement taken, for necessary investigations.

   iii. Failure of blocking diode: Blocking diode fails in short circuit and open circuit mode. If it is failed in short circuit mode, voltage across its terminal will be zero in place of 0.7 V while charging current flows through it. When it fails in open circuit mode, the current will not flow

through the diode. The diode may be checked as per standard method of checking of diode by removing from the circuit.

Apart from these some possible complaints and troubleshooting methods for Solar modules are listed in Table C below:

Table C

S. No.	Symptom	Possible Failure	Probable cause	Action
1.	No output	Cable	Conductor break	Replace cable
			Corrosion	
			Loose connection	
			Improper connection	Verify the wire connections are tight, corrosion free and of correct polarity.
		Connector	Defective connector	Replace connector
			Loose connection	
			Pin loose	
			Corrosion	
			Improper fixing	Fix the connector properly
		Junction box	Mechanical problem	Return to factory for Servicing
			Connection problem	Connect properly
		Charge controller	Electronic failure	Replace charge controller
		None of the above	Internal problem	Return to factory, if within warranty
2.	Output voltage OK, but no output current	Cell/interconnections	Internal damage	Return to factory, if Within warranty
3.	No charging indication on the Charge controller	Solar module	Shading	Remove the shades or change the location of the module and ensure maximum sunlight to fall on the module.
			Direct accumulation	Clear the particles on the module
		Module cable	Breakage	Replace cable
			Corrosion	
			Dry solder	
			Loose connection	
		Module	Broken module	Replace module
		Charge controller	Electronic failure	Replace Charge controller

4.	Output voltage for less duration	Solar module	Shading	Remove the shades or change the location of the module and ensure maximum sunlight to fall on the module.
			Dirt accumulation	Clear the particles on the module
			Improper installation	Place the module in such a way thatdirect sunlight falls on the module formore hours.
		Module cable	Breakage	Replace cable
			Corrosion	
			Loose connection	
			Dry solder	
		Charge controller	Electronic failure	Replace Charge controller
			Corrosion	
		Battery	Insufficient charging	Charge the battery to full charge condition and check the output duration.
			Low capacity	Replace battery
			Acid leakage	
			Terminal broken	
5.	Always low battery condition	Solar module	Shading	Remove the shades or change the location of the module and ensure maximum sunlight to fall on the module.
			Dirt accumulation	Clear the particles on the module
		Battery	Insufficient charging	Charge the battery to full charge condition and check the output duration.
		Solar Module	Improper installation	Place the module in such a way that direct sunlight falls on the module for more hours
		Module cable	Loose connection	Replace cable
			Improper fixing	Fix the cable properly and ensure that the connections are tight with correctpolarity.
		Charge Controller	Electronic failure	Replace the Charge controller
			Corrosion	
6.	Front Glass broken	Breakage	Mishandling/ transportation	Unserviceable, Replace

7.	No voltage Across blocking diode	Diode failed in short Circuit mode	Random failure	Replace the diode
8.	Voltage high Across blocking diode	Diode failed in open Circuit mode	Random failure	Replace the diode

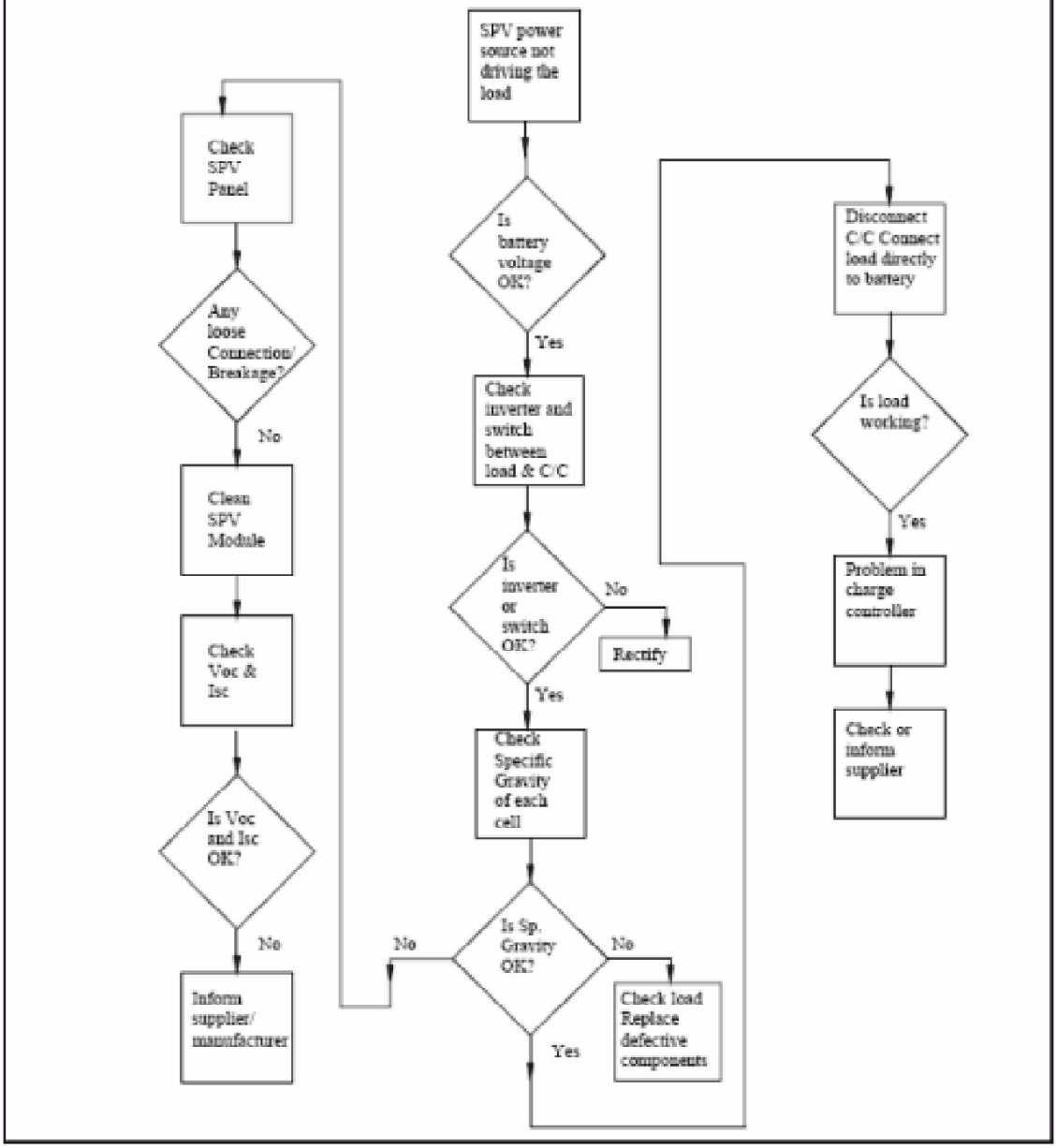


Fig. 4.2: Troubleshooting flowchart for SPV Panel

Courtesy: CAMTECH Gwalior

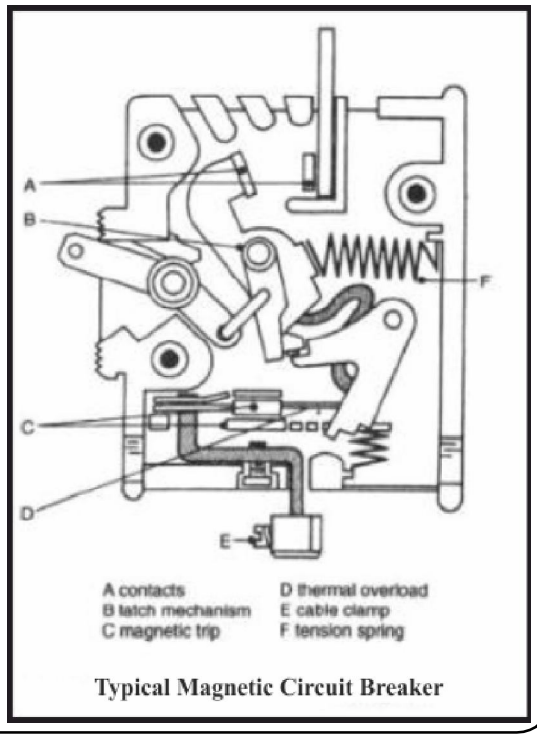
Men love to wonder, and that is the seed of science.
– RALPH WALDO EMERSON

HOW TO CHOOSE A CIRCUIT BREAKER

There are a few different criteria to consider when selecting a circuit breaker including voltage, frequency, interrupting capacity, continuous current rating, unusual operating conditions and product testing. This article will give a step by step overview on selecting an appropriate circuit breaker for your specific application.

Voltage Rating

The overall voltage rating is calculated by the highest voltage that can be applied across all end ports, the distribution type and how the circuit breaker is directly integrated into the system. It is important to select a circuit breaker with enough voltage capacity to meet the end application.



Typical Magnetic Circuit Breaker

Frequency

Circuit breakers up to 600 amps can be applied to frequencies of 50-120 Hz. Higher than 120 Hz frequencies will end up with the breaker having to derate. During higher frequency projects, the eddy currents and iron losses causes greater heating within the thermal trip components thus requiring the breaker to be derated or specifically calibrated. The total quantity of deration depends on the ampere rating, frame size as well as the current frequency. A general rule of thumb is the higher the ampere rating in a specific frame size the greater the derating needed.

All higher rated breakers over 600 amps contain a transformer-heated bimetal and are suitable for 60 Hz AC maximum. For 50 Hz AC minimum applications special

calibration is generally available. Solid state trip breakers are pre-calibrated for 50 Hz or 60 Hz applications. If doing a diesel generator project the frequency will either be 50 Hz or 60 Hz. It is best to check ahead of time with an electrical contractor to make sure calibration measures are in place before moving forward with a 50 Hz project.

Maximum Interrupting Capacity

The interrupting rating is generally accepted as the highest amount of fault current the breaker can interrupt without causing system failure to itself. Determining the maximum amount of fault current supplied by a system can be calculated at any given time. The one infallible rule that must be followed when applying the correct circuit breaker is that the interrupting capacity of the breaker must be equal or greater than the amount of fault current that can be delivered at the point in the system where the breaker is applied. Failure to apply the correct amount of interrupting capacity will result in damage to the breaker.

Continuous Current Rating

In regards to continuous current rating, molded case circuit breakers are rated in amperes at a specific ambient temperature. This ampere rating is the continuous current the breaker will carry in the ambient temperature where it was calibrated. A general rule of thumb for circuit breaker manufactures is to calibrate their standard breakers at 104° F.

Ampere rating for any standard application depends solely on the type of load and duty cycle. Ampere rating is governed by the **National Electrical Code** (NEC) and is the primary source for information about load cycles in the electrical contracting industry. For example lighting and feeder circuits usually require a circuit breaker rated in accordance with the conductor current carrying capacity. To find various standard breaker current ratings for different size conductors and the permissible loads consult NEC table 210.24.

A Typical Operating Conditions

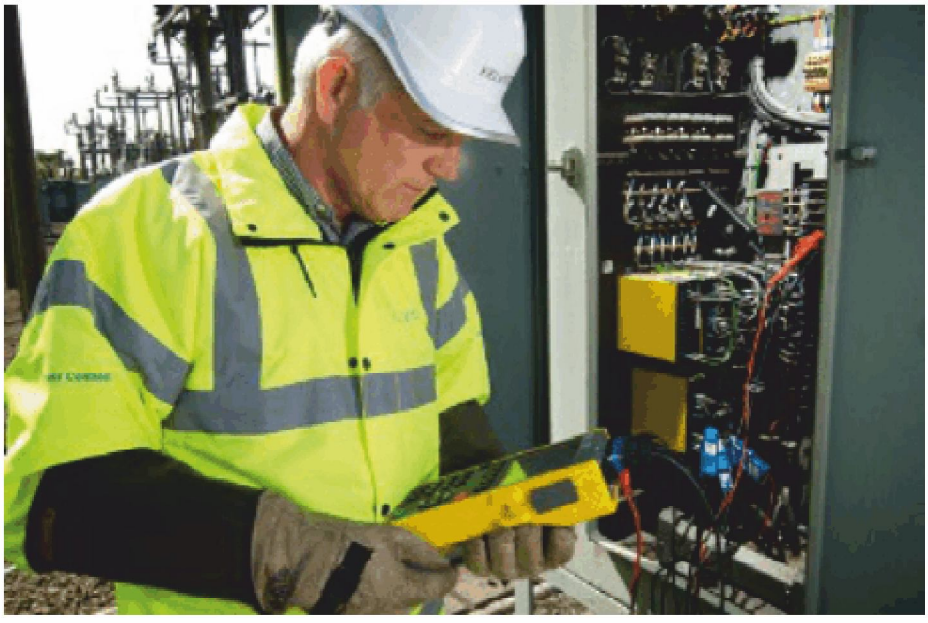
When selecting a circuit breaker it is crucial to have in mind the end user location. Each breaker is different and some are better suited for more unforgiving environments. Below are a few scenarios to keep in mind when determining what circuit breaker to use:

- *High Ambient Temperature:* If standard thermal magnetic breakers are applied in temperatures exceeding 104° F, the breaker must be derated or recalibrated to the environment. For many years, all breakers were calibrated for 77° F which meant that all breakers above this temperature had to be derated. Realistically, most enclosures were around 104° F; a common special breaker was used for these types of situations. In the mid-1960s industry standards were changed to make all standard breakers be calibrated with 104° F temperature in mind.
- *Corrosion and Moisture:* In environments where moisture is constant a special moisture treatment is recommended for breakers. This treatment helps resist mold and/or fungus that can corrode the unit. In atmospheres where high humidity is prevalent the best solution is the usage of space heaters in the enclosure. If possible, breakers should be removed from corrosive areas. If this is not practical, specifically manufactured breakers that are resistant to corrosion are available.
- *High Shock Probability:* If a circuit breaker is going to be installed in an area where there is a high probability of mechanical shock a special anti-shock device should be installed. Anti-shock devices consist of an inertia counterweight over the center pole that holds the trip bar latched under normal shock conditions. This weight should be installed so that it does not prevent thermal or **magnetic trip units** from functioning on overload or short circuit scenarios. The United States Navy is the largest end user of high shock resistant breakers which are required on all combat vessels.
- *Altitude:* In areas where the altitude is over 6,000 feet, circuit breakers must be derated for current carrying ability, voltage and interrupting capacity. At altitude, the thinner air does not conduct heat away from the current carrying components as well as denser air found in lower altitudes. In addition to

overheating, the thinner air also prevents the building a dielectric charge fast enough to withstand the same voltage levels that occur at normal atmospheric pressure. Altitude issues can also derate most **used generators** and other power generation equipment. It is best to speak with a power generation professional before purchasing.

- *Resting Position:* For the most part, breakers can be mounted in any position, horizontally or vertically, without affecting the tripping mechanisms or interrupting capacity. In areas of high wind it is imperative to have the breaker in an enclosure (most units comes enclosed) on a surface that sways a bit with the wind. When a circuit breaker is attached to an inflexible surface there is a possibility of disrupting the circuit when exposed to high winds.

Maintenance and Testing



When selecting a circuit breaker the user must decide to either buy a unit that is UL Tested (Underwriters Laboratories) or not. For overall quality assurance it is recommended that customer purchase circuit breakers

that have been UL Tested. Be aware that non UL Tested products do not guarantee correct calibration of the breaker. All low voltage molded case circuit breakers which are UL listed are tested in accordance with UL Standard 489 which is divided up into two categories: factory testing and field testing.

- *UL Factory Testing:* All UL standard molded case circuit breakers undergo extensive product and calibration testing based upon UL Standard 489. UL certified breakers contain factory sealed calibrated systems. The unbroken seal guarantees that the breaker is correctly calibrated and has not been subject to tampering, alteration and that the product will perform accordingly to UL specifications. If the seal is broken the UL guarantee is void as well as any warranties.
- *Field Testing:* It is quite normal for data obtained in the field to vary from published information. Many users become confused to whether field data is flawed or published information is out of sync with their particular model. The difference in data is that test conditions in the factory vary considerably than in the field. Factory tests are designed to produce consistent results. Temperature, altitude, a climate controlled environment and using test equipment designed specifically for the product being tested all effect the outcome. **NEMA publication AB4-1996** is an outstanding guide to infield testing. The guide gives the user a better variant of what are normal results for infield testing. Some breakers come with their own testing instructions. Where no instructions are present use a reliable circuit breaker service company.
- *Maintenance:* For the most part, molded case breakers have an exceptional track record of reliability mostly due to the fact that the units are enclosed. The enclosure minimizes exposure to dirt, moisture, mold, dust, other containments and tampering. Part of proper maintenance is making sure that all terminal connections and trip units be tightened to the proper torque value as set by the manufacturer. Overtime these connections will loosen and need to be retightened. Breakers also need to be cleaned regularly. Improperly cleaned conductors, the wrong conductors used for the terminal and loose terminations are all conditions that can cause excessive heating and weakening of the breaker. Breakers that are manually operated require only that their contacts are clean and that the linkages operate freely. For circuit breakers that are not used on a regular basis an intermittent startup of the breaker is required to refresh the systems.

As always, it is best to consult a certified electrician to determine exactly what type of circuit breaker is right for your generator application. The factors influencing the safe and proper operation of a power generator and a circuit breaker vary from site-to-site and only a licensed professional can specify the right equipment.

Referenced: Matulic, Darko. 'Circuit Breakers' p. 171-173 On-Site Power Generation 4th Edition. Boca Raton, Florida: Electrical Generating Systems Association, 2006

GREAT EXPECTATIONS FOR LEDS: DOE PREDICTS LIGHTING PRODUCT PENETRATION

The installed stock of LED products will reach 5 billion units, or 60% of all installed lighting, by 2025, according to the U.S. Department of Energy (DOE). By 2035, most projected energy savings will come from nonresidential building sectors, with the greatest value and savings provided by increased controllability and networked control capabilities.

Published in December 2019, DOE's biannual report, "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications," models adoption of LED lamps and luminaires in the general lighting market and estimates energy savings from 2017 to 2035. Residential, commercial, industrial and outdoor stationary building sectors are evaluated. This article will focus on DOE's near-future forecast, looking out to 2025, and specifically examining LED penetration and connected LED penetration.

LED lighting has either matched or surpassed all conventional lighting technologies in terms of energy efficiency, longevity, versatility and color quality, and with a declining cost, making it competitive in a majority of applications.

This has resulted in an estimated penetration of more than 70% of new lighting systems, which is slowly but steadily transforming the installed base of lighting in the United States. Advancements in connectivity enables additional control capabilities and energy cost savings.

Across all sectors, lighting installations were forecast to grow about 1.3% per year from 7.6 billion lamp systems in 2017. LED penetration was estimated at 19% in 2017, forecast to increase to 35% in 2020 and 60% by 2025. In other words, in five years, a majority of lamp systems installed in the United States is expected to be LED. Residential will lead in total number—already representing 72% of LED installations in 2017—but the commercial and outdoor sectors will lead in LED penetration, and the commercial, industrial and outdoor sectors will generate a disproportionate share of energy savings due to high-output lamps and long operating hours.

Residential—In 2017, the residential sector represented an estimated 80% of the national installed lighting stock, with 6 billion lamp systems installed, of which 17% (1 billion) were LED. This was forecast to increase to 33% (2 billion lamp systems) in 2020 and 56% (3.8 billion) by 2025.

Commercial—In 2017, the commercial sector represented 16% of all lighting installations, with 1.2 billion lamp systems installed, of which 26% (322 million) were LED. DOE forecast adoption to increase to 44% of installed lighting (558 million lamp systems) in 2020 and 72% (964 million) by 2025. While connected lighting is forecast to enjoy extraordinarily rapid growth—a compound annual growth rate of 47%—adoption is expected to achieve a 7% adoption in the LED installed base.

Industrial—In 2017, the industrial sector had an estimated 82 million lamp systems installed, of which 12% (10 million) were LED, the lowest penetration among any building sector. Adoption is forecast to increase to 29% (25 million lamp systems) in 2020 and 63% (56 million) by 2025. As with the commercial sector, connected lighting in the industrial sector is forecast to grow to a 7% adoption in the LED installed base.

Outdoor—In 2017, the outdoor sector had an estimated 214 million lamp systems installed, of which 35% (75 million) were LED. This sector has the fastest adoption rate. DOE forecast adoption to increase to 66% (146 million) in 2020 and 93% (218 million) by 2025, of which 9% will be connected.

Lighting controls—Dimmers, daylight-responsive controls, occupancy sensors, timers, energy-management and connected lighting systems were estimated to control a minority of lighting installations in 2017. Specifically, 34% of commercial, 14% of residential, 7% of industrial and 87% of outdoor (largely due to a large incidence of photocells and time-switches) lighting was controlled. The most prevalent controls in the commercial sector were energy-management systems (16%) and occupancy sensors (6%), while the most prevalent in the residential sector was dimmers (11%). Connected lighting was estimated at less than 1% across all sectors, though DOE expected penetration of connected luminaires to grow rapidly to 3–21% in 2020 and 7–31% in 2025, with this range split between the current market trajectory and a trajectory if certain DOE program goals are met that addresses adoption hurdles.

Some manufacturers declare the LED revolution over, while others say a new phase is beginning, as LEDs become increasingly controllable, connected and pack features such as color tuning. Meanwhile, despite rapid adoption, the market continues to show ample opportunities for electrical contractors to upgrade traditional lighting.

Courtesy: By Craig DiLouie, Published in September 2020

TRANSFORMER BASICS - 3

Transformer Basics Example No 3

A single phase transformer has 480 turns on the primary winding and 90 turns on the secondary winding. The maximum value of the magnetic flux density is 1.1T when 2200 volts, 50Hz is applied to the transformer primary winding. Calculate:

a. The maximum flux in the core.

$$E_{rms} = \frac{N\omega}{\sqrt{2}}\,\Phi_{max}$$

$$\Phi_{max} = \frac{E_{rms}}{N\omega} \times \sqrt{2} = \frac{2200}{480 \times 2\pi \times 50} \times \sqrt{2}$$

$$\therefore \Phi_{max} = 0.0206 \text{ Wb or } 20.6\text{m Wb}$$

b. The cross-sectional area of the core.

$$\Phi_{max} = \beta \times A$$

$$\therefore A = \frac{\Phi_{max}}{\beta} = \frac{0.0206}{1.1} = 0.0187 \text{ m}^2$$

c. The secondary induced emf.

$$\text{T. R.} = \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\therefore V_s = \frac{V_p \times N_s}{V_p} = \frac{2200 \times 90}{480} = 412.5 \text{ Volts}$$

Electrical Power in a Transformer

Another one of the transformer basics parameters is its power rating. The power rating of a transformer is obtained by simply multiplying the current by the voltage to obtain a rating in **Volt-amperes**, (VA). Small single phase transformers may be rated in volt-amperes only, but much larger power transformers are rated in units of **Kilo volt-amperes**, (kVA) where 1 kilo volt-ampere is equal to 1,000 volt-amperes, and units of **Mega volt-amperes**, (MVA) where 1 mega volt-ampere is equal to 1 million volt-amperes.

In an ideal transformer (ignoring any losses), the power available in the secondary winding will be the same as the power in the primary winding, they are constant wattage devices and do not change the power only the voltage to current ratio. Thus, in an ideal transformer the **Power Ratio** is equal to one (unity) as the voltage, V multiplied by the current, I will remain constant.

That is the electric power at one voltage/current level on the primary is "transformed" into electric power, at the same frequency, to the same voltage/current level on the secondary side. Although the transformer can step-up (or step-down) voltage, it cannot step-up power. Thus, when a transformer steps-up a voltage, it steps-down the current and vice-versa, so that the output power is always at the same value as the input power. Then we can say that primary power equals secondary power, ($P_P = P_S$).

Power in a Transformer

$$\text{Power}_{\text{Primary}} = \text{Power}_{\text{Secondary}}$$

$$P_{(PRIM)} = P_{(SEC)} = V_p I_p \cos\theta_p = V_s I_s \cos\theta_s$$

Where: Φ_P is the primary phase angle and Φ_S is the secondary phase angle.

Note that since power loss is proportional to the square of the current being transmitted, that is: I^2R, increasing the voltage, let's say doubling (×2) the voltage would decrease the current by the same amount, (÷2) while delivering the same amount of power to the load and therefore reducing losses by factor of 4. If the voltage was increased by a factor of 10, the current would decrease by the same factor reducing overall losses by factor of 100.

Transformer Basics – Efficiency

A transformer does not require any moving parts to transfer energy. This means that there are no friction or windage losses associated with other electrical machines. However, transformers do suffer from other types of losses called "copper losses" and "iron losses" but generally these are quite small.

Copper losses, also known as I^2R loss is the electrical power which is lost in heat as a result of circulating the currents around the transformers copper windings, hence the name. Copper losses represents the greatest loss in the operation of a transformer. The actual watts of power lost can be determined (in each winding) by squaring the amperes and multiplying by the resistance in ohms of the winding (I^2R).

Iron losses, also known as hysteresis is the lagging of the magnetic molecules within the core, in response to the alternating magnetic flux. This lagging (or out-of-phase) condition is due to the fact that it requires power to reverse magnetic molecules; they do not reverse until the flux has attained sufficient force to reverse them.

Their reversal results in friction, and friction produces heat in the core which is a form of power loss. Hysteresis within the transformer can be reduced by making the core from special steel alloys.

The intensity of power loss in a transformer determines its efficiency. The efficiency of a transformer is reflected in power (wattage) loss between the primary (input) and secondary (output) windings. Then the resulting efficiency of a transformer is equal to the ratio of the power output of the secondary winding, P_S to the power input of the primary winding, P_P and is therefore high.

An ideal transformer is 100% efficient because it delivers all the energy it receives. Real transformers on the other hand are not 100% efficient and at full load, the efficiency of a transformer is between 94% to 96% which is quiet good. For a transformer operating with a constant voltage and frequency with a very high capacity, the efficiency may be as high as 98%. The efficiency, η of a transformer is given as:

Transformer Efficiency

$$\text{Efficiency}, \eta = \frac{\text{Output Power}}{\text{Input Power}} \text{ x } 100\%$$

$$= \frac{\text{Output Power} - \text{Losses}}{\text{Input Power}} \text{ x } 100\%$$

$$= 1 - \frac{\text{Losses}}{\text{Input Power}} \text{ x } 100\%$$

Where: Input, Output and Losses are all expressed in units of power.

Generally when dealing with transformers, the primary watts are called "volt-amps", **VA** to differentiate them from the secondary watts. Then the efficiency equation above can be modified to:

$$\text{Efficiency, } \eta = \frac{\text{Secondary Watts (Output)}}{\text{Primary VA } (Input))}$$

It is sometimes easier to remember the relationship between the transformers input, output and efficiency by using pictures. Here the three quantities of VA, W and η have been superimposed into a triangle giving power in watts at the top with volt-amps and efficiency at the bottom. This arrangement represents the actual position of each quantity in the efficiency formulas.

Transformer Efficiency Triangle

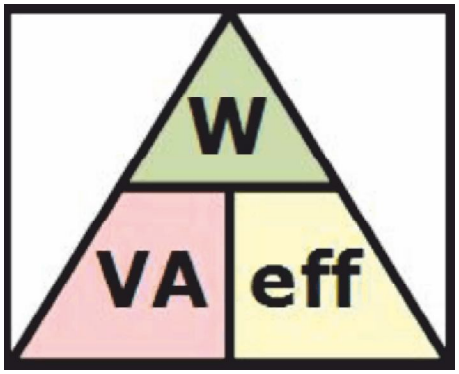


Fig.5

and transposing the above triangle quantities gives us the following combinations of the same equation:

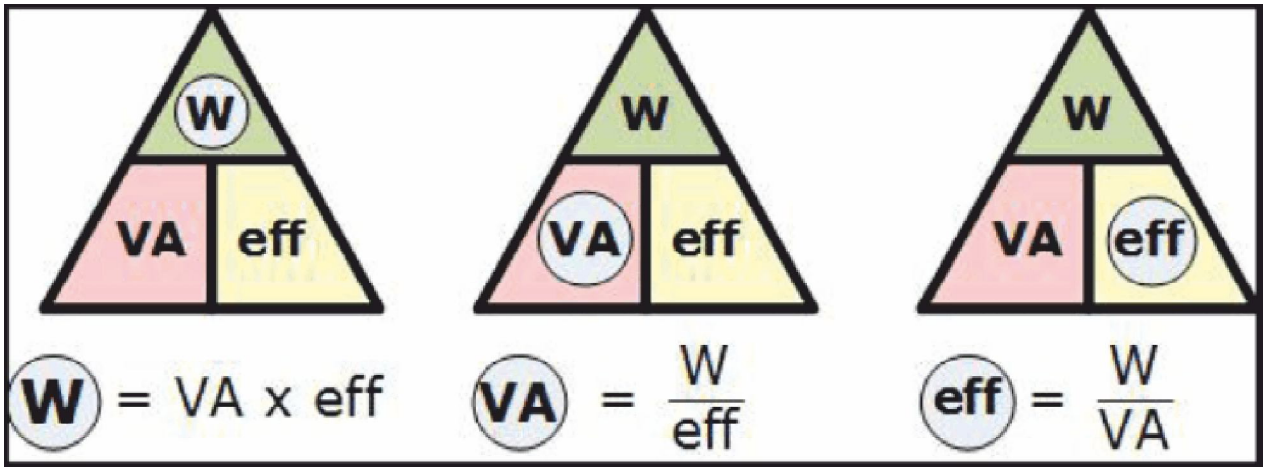


Fig. 6

Then, to find Watts (output) = VA x eff., or to find VA (input) = W/eff., or to find Efficiency, eff. = W/VA, etc.

Transformer Basics Summary

Then to summarise this transformer basics tutorial. A **Transformer** changes the voltage level (or current level) on its input winding to another value on its output winding using a magnetic field. A transformer consists of two electrically isolated coils and operates on Faraday's principal of "mutual induction", in which an EMF is induced in the transformers secondary coil by the magnetic flux generated by the voltages and currents flowing in the primary coil winding.

Science is a best invention of a universe. – Unknown

Both the primary and secondary coil windings are wrapped around a common soft iron core made of individual laminations to reduce eddy current and power losses. The primary winding of the transformer is connected to the AC power source which must be sinusoidal in nature, while the secondary winding supplies electrical power to the load. Having said that, a transformer could be used in reverse with the supply connected to the secondary winding provided the voltage and current ratings are observed.

We can represent the transformer in block diagram form as follows:

Basic Representation of the Transformer

The ratio of the transformers primary and secondary windings with respect to each other produces either a step-up voltage transformer or a step-down voltage transformer with the ratio between the number of primary turns to the number of secondary turns being called the "turns ratio" or "transformer ratio".

Fig.7

The ratio of the transformers primary and secondary windings with respect to each other produces either a step-up voltage transformer or a step-down voltage transformer with the ratio between the number of primary turns to the number of secondary turns being called the "turns ratio" or "transformer ratio".

If this ratio is less than unity, $n < 1$ then N_S is greater than N_P and the transformer is classed as a step-up transformer. If this ratio is greater than unity, $n > 1$, that is N_P is greater than N_S, the transformer is classed as a step-down transformer. Note that single phase step-down transformer can also be used as a step-up transformer simply by reversing its connections and making the low voltage winding its primary, and vice versa as long as the transformer is operated within its original VA design rating.

If the turns ratio is equal to unity, that is $n = 1$, then both the primary and secondary have the same number of coil turns so therefore the voltages and currents will be the same for both the primary and secondary windings.

This type of 1:1 transformer is classed as an isolation transformer as both the primary and secondary windings of the transformer have the same number of volts per turn. The efficiency of a transformer is the ratio of the power it delivers to the load to the power it absorbs from the supply. In an ideal transformer there are no losses so no loss of power then $P_{IN} = P_{OUT}$.

In the next tutorial to do with **Transformer Basics**, we will look at the physical *Construction of a Transformer* and see the different magnetic core types and laminations used to support the primary and secondary windings.

Courtesy: https://www.electronics-tutorials.ws/transformer/transformer-basics.html

The good thing about science is that it's true whether or not you believe in it.

– NEIL DEGRASSE TYSON

ELECTRICITY GENERATION - 3

Steam

Figure 8

Large dams such as **Three Gorges Dam** in China can provide large amounts of hydroelectric power; it has a 22.5 **GW** capability.

- Water is boiled by **coal** burned in a **thermal power plant**, about 41% of all electricity is generated this way.
- **Nuclear fission** heat created in a **nuclear reactor** creates steam. Less than 15% of electricity is generated this way.
- Renewables. The steam is generated by **Biomass**, **Solar thermal energy** where **solar parabolic troughs** and **solar power towers** concentrate sunlight to heat a heat transfer fluid, which is then used to produce steam, or **Geothermal power.**

➢ Natural gas: turbines are driven directly by gases produced by combustion. **Combined cycle** are driven by both steam and natural gas. They generate power by burning natural gas in a **gas turbine** and use residual heat to generate steam. At least 20% of the world's electricity is generated by natural gas.

➢ Water Energy is captured by a **water turbine** from the movement of water - from falling water, the rise and fall of tides or **ocean thermal currents**. Currently, hydroelectric plants provide approximately 16% of the world's electricity.

➢ The **windmill** was a very early **wind turbine**. In a **solar updraft tower** wind is artificially produced. Before 2010 less than 2% of the world's electricity was produced from wind.

Although turbines are most common in commercial power generation, smaller generators can be powered by **gasoline** or **diesel engines**. These may used for backup generation or as a prime source of power within isolated villages.

Production

Total worldwide gross production of electricity in 2016 was 25,082TWh. Sources of electricity were coal and peat 38.3%, natural gas 23.1%, hydroelectric 16.6%, nuclear power 10.4%, oil 3.7%, solar/wind/geothermal/tidal/other 5.6%, biomass and waste 2.3%.

Source of Electricity (World total year 2008)

-	Coal	Oil	Natural Gas	Nuclear	Renewables	other	Total
Average electric power (TWh/year)	8,263	1,111	4,301	2,731	3,288	568	20,261
Average electric power (GW)	942.6	126.7	490.7	311.6	375.1	64.8	2311.4
Proportion	41%	5%	21%	13%	16%	3%	100%

data source IEA/OECD

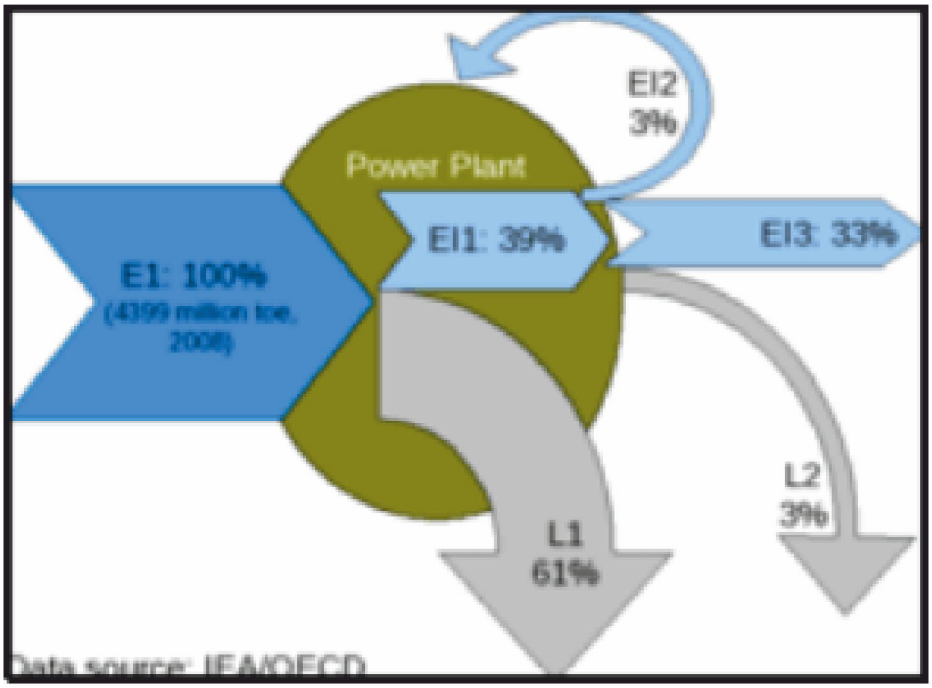


Figure 9: Energy Flow of Power Plant

Total energy consumed at all power plants for the generation of electricity was 4,398,768 ktoe (kilo **ton of oil equivalent**) which was 36% of the total for primary energy sources (TPES) of 2008.

Electricity output (gross) was 1,735,579 ktoe (20,185 TWh), efficiency was 39%, and the balance of 61% was generated heat. A small part (145,141 ktoe, which was 3% of the input total) of the heat was utilized at co-generation heat and power plants. The in-house consumption of electricity and power transmission losses were 289,681 ktoe. The amount supplied to the final consumer was 1,445,285 ktoe (16,430 TWh) which was 33% of the total energy consumed at power plants and heat and power **co-generation** (CHP) plants.

Historical results of production of electricity

Note that the vertical axes of these two charts in the next page are not to the same scale.

The United States has long been the largest producer and consumer of electricity, with a global share in 2005 of at least 25%, followed by **China**, Japan, Russia, and India. As of Jan-2010, total electricity generation for the two largest generators was as follows: USA: 3,992 billion kWh (3,992 TWh); China: 3,715 billion kWh (3,715 TWh).

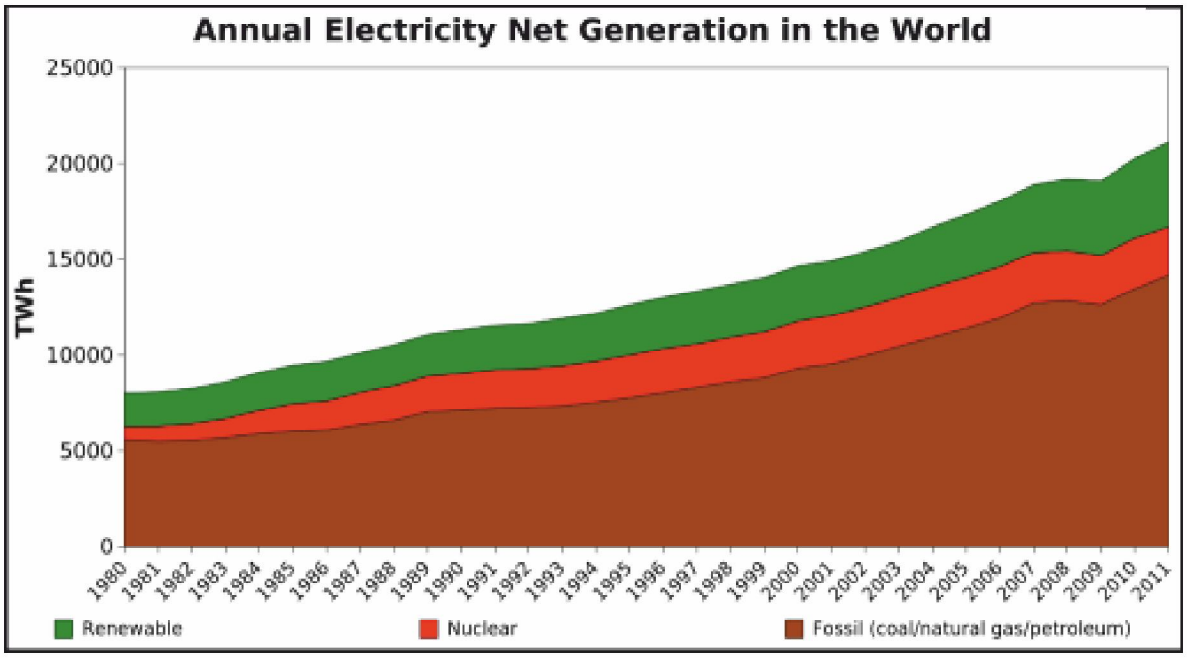


Figure 10

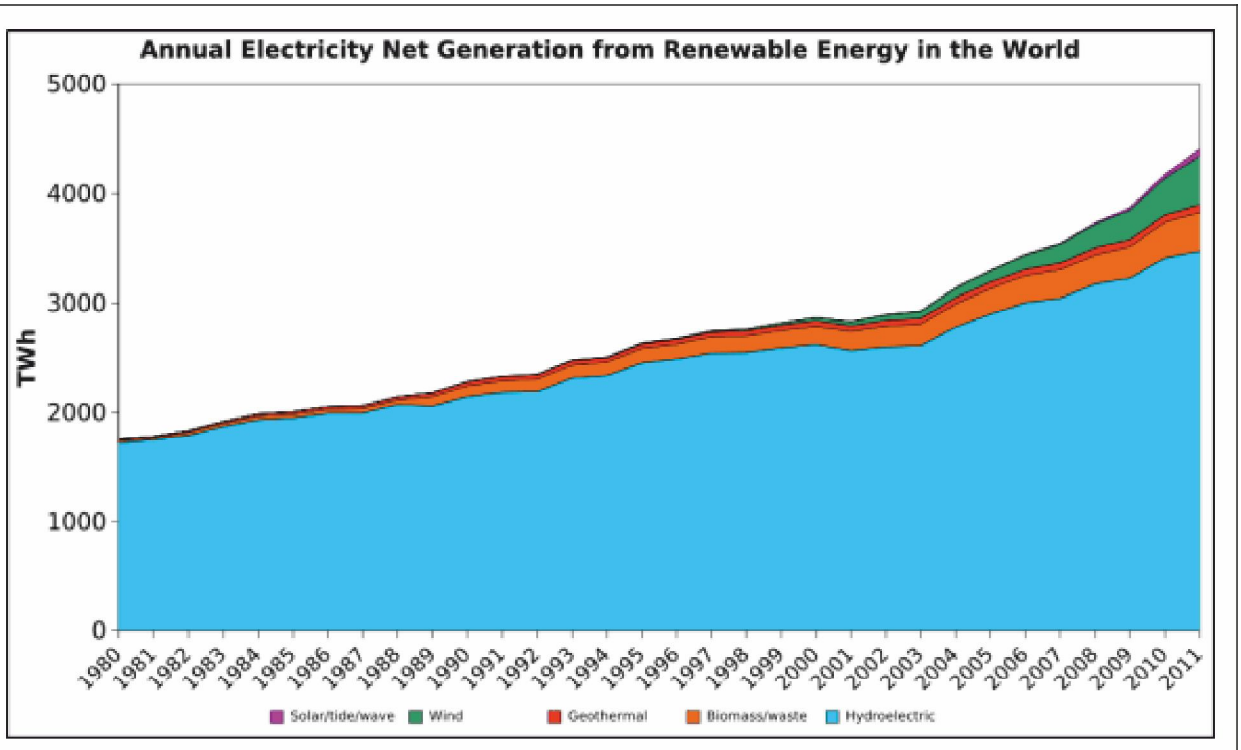


Figure 11

Production by country

Main article: ***World energy resources and consumption***

See also: ***Electricity consumption***

3-PHASE DISTRIBUTION TRANSFORMERS 11 OR 433 KV/415-240V (OUTDOOR TYPE) – 3

9 OIL:

9.1 The insulating oil shall comply with the requirements of IS 335. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 35 $X10^{12}$ ohm-cm at 27°C when tested as per IS 6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10 INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	75	28
3	33	170	70

11 LOSSES:

11.1 The transformer of HV voltage up to 11kV, the total losses (no-load + load losses at 75ºC) at 50% of rated load and total losses at 100% of rated load shall not exceed the maximum total loss values given in Table-3 upto 200kVA & Table-6 for ratings above 200kVA of IS 1180 (Part-1):2014.

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75ºC for 11/0.433 kV transformers can be chosen by the utility as per **Table-3 upto 200kVA** and **Table-6 for ratings above 200kVA** as per **Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014** for all kVA ratings of distribution transformers.

11.3 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

12 TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

The percentage impedance of transformers at 75ºC for different ratings upto 200 kVA shall be as per Table 3 and for ratings beyond 200 kVA shall be as per Table 6 of IS 1180 (Part-1):2014.

Science is a beautiful gift to humanity; we should not distort it.
– A. P. J. ABDUL KALAM

14 **Temperature rise**: The temperature rise over ambient shall not exceed the limits given below:

14.1 Top oil temperature rise measured by thermometer : 35ºC

14.2 Winding temperature rise measured by resistance method : 40ºC

14.3 The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15 PENALTY FOR NON PERFORMANCE:

15.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

17.1 TANK:

- Transformer tank construction shall conform in all respect to clause 15 of IS 1180 (Part-1):2014.
- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- All joints of tank and fittings shall be oil tight and no bulging should occur during service.
- Inside of tank shall be painted with varnish/hot oil resistant paint.
- The top cover of the tank shall be slightly sloping to drain rain water.
- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

i) PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular/octagonal/round/ elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers upto and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and

Nature composes a number of her loveliest poems for the magnifier and also the telescope. – Unknown

including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below:

(All figures are in mm)

Horizontal length of flat plate	Permanent deflection
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

17.2.4 The tank shall further be capable of withstanding a pressure of 0.8kg/sq.cm and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

17.2.5 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.3 CORRUGATED TANK:

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

17.3.4 Tanks with corrugations shall be tested for leakage test at a pressure of 0.25kg/ sq. cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation, the dimensions of which should be more than the length and width of the transformer tank with corrugations.

(To be continued)

Courtesy: www.mstcecommerce.com>RenderFileViewVideo

Science is nothing but perception. – PLATO

ABSTRACT OF INDIAN ELECTRICITY RULES - 2

9) Meters, maximum demand indicators and other apparatus on consumer's premises

- Any meter or maximum demand indicator or other apparatus placed upon a consumer's premises in accordance with section 26 shall be of appropriate capacity and shall be deemed to be correct if its limits of error are within the limits specified in the relevant Indian Standard Specification and where no such specification exists, the limits of error do not exceed 3 per cent above or below absolute accuracy at all loads in excess of one tenth of full load and up to full load Connection with earth Neutral conductor of a phase, 4 wire system and the middle conductor of a 2 phase, 3-wire system shall be earthed by not less than two separate and distinct connections with a minimum of two different earth electrodes of such large number as may be necessary to bring the earth resistance to a satisfactory value both at the generating station and at the sub-station. The earth electrodes so provided, may be interconnected to reduce earth resistance. It may also be earthed at one or more points along the distribution system or service line in addition to any connection with earth which may be at the consumer's premises.
- In the case of a system comprising electric supply lines having concentric cables, the external conductor of such cables shall be earthed by two separate and distinct connections with earth.
- The connection with earth may include a link by means of which the connection may be temporarily interrupted for the purpose of testing or for locating a fault.
- All metal castings or metallic coverings containing or protecting any electric supply-line or apparatus shall be connected with earth and shall be so joined and connected across all junction boxes and other openings as to make good mechanical and electrical connection throughout their whole length.

10) Use of energy at high and extra-high voltage

Voltage	Ground clearance	Sectional clearance
11KV	2.75 Meter	2.6 Meter
33KV	3.7 Meter	2.8 Meter
66KV	4.0 Meter	3.0 Meter
132KV	4.6 Meter	3.5 Meter
220KV	5.5 Meter	4.3 Meter
400KV	8.0 Meter	6.5 Meter

11) Transformer:

- Where transformer or transformers are used, suitable provision shall be made, either by connecting with earth a point of the circuit at the lower voltage or otherwise, to guard against danger by reason of the said circuit becoming Accidentally charged above its normal voltage by leakage from or contact with the circuit at the higher voltage.
- A sub-station or a switch station with apparatus having more than 2000 litres of oil shall not be located in the basement where proper oil draining arrangement cannot be provided.
- Where a sub-station or a switch station with apparatus having more than 2000 litres of oil is installed, whether indoor or out-doors, the following measures shall be taken, namely:
- The baffle walls [4 of 4 hour fire rating] shall be provided between the apparatus in the following cases:
- (1) Single phase banks in the switch-yards of generating stations and substations;
- (2) On the consumer premises;
- (3) Where adequate clearance between the units is not available.
- Provisions shall be made for suitable oil soak pit and where use of more than 9000 litres of oil in any one oil tank, receptacle or chamber is involved, provision shall be made for the draining away or

removal of any oil which may leak or escape from the tanks receptacles or chambers containing the same.

- The transformer shall be protected by an automatic high velocity water spray system or by carbon dioxide or BCF (Bromo chlorodi feuromethane) or BTM (Bromo tri fluromethane) fixed installation system; and
- Oil filled transformers installed indoors shall not be on any floor above the ground or below the first basement.
- Isolators and the corresponding earthing switches shall be interlocked so that no earthing switch can be closed unless and until the corresponding isolator is in open position.
- When two or more transformers are operated in parallel, the system shall be so arranged as to trip the secondary breaker of a transformer in case the primary breaker of that transformer trips.
- Where two or more generators operate in parallel and neutral switching is adopted, inter-lock shall be provided to ensure that generator breaker cannot be closed unless one of the neutrals is connected to the earthing system.
- Gas pressure type protection to given alarm and tripping shall be provided on all transformers of ratings 1000 KVA and above.
- Transformers of capacity 10 MVA and above shall be protected against incipient faults by differential protection; and all generators with rating of 100 KVA and above shall be protected against earth fault/leakage. All generators of rating 1000 KVA and above shall be protected against faults within the generator winding using restricted earth fault protection or differential protection or by both.

1) Connection with earth:

- In case of the delta connected system the neutral point shall be obtained by the insertion of a grounding transformer and current limiting resistance or impedance wherever considered necessary at the commencement of such a system.
- Where the earthing lead and earth connection are used only in connection with earthing guards erected under high or extra-high voltage overhead lines where they cross a telecommunication line or a railway line, and where such lines are equipped with earth leakage relays of a type and setting approved by the Inspector, the resistance shall not exceed 25 ohms.

2) Clearance above ground of the lowest conductor

- No conductor of an overhead line, including service lines, erected across a street shall at any part thereof be at a height of less than:
- For low and medium voltage lines 5.8 meters
- For high voltage lines 6.1 metres
- No conductor of an overhead line, including service lines, erected along any street shall at any part thereof be at a height less than:
- For low and medium voltage lines 5.5 metres
- For high voltage lines 5.8 metres
- No conductor of in overhead line including service lines, erected elsewhere than along or across any street shall be at a height less than:
- For low, medium and high voltages lines = 4.6 meters.
- For low, medium and high voltage = 4.0 meters.
- For high voltage lines above 11,000 volts = 5.2 meters.
- For extra-high voltage lines the clearance above ground shall not be less than 5.2 metres plus 0.3 meter for every 33,000 volts or part thereof by which the voltage of the line exceeds 33,000 volts.

Courtesy: Jignesh.Parmar

ENERGY INDEPENDENCE AND ENERGY SELF RELIANCE - 6

Sustainable Growth, Sustainable Energy and Renewable Energy

The whole of 'Pandemic year' 2020 has affected the energy scenario in India as well as globally, both positively and negatively, and in continuation of some of the details and views presented earlier, the following interesting and positive plans as conveyed in news items are presented for information.

2021: India to garner Rs 1.75 lakh crore investment for renewable energy Sector — The move aims to address a key issue faced by renewable energy projects in the country

Around 50 GW of renewable energy capacity is under construction

India will be more innovative in its approach to garner additional investments worth Rs 1.75 lakh crore for having 35 GW of renewable power generation capacity next year to meet the ambitious target of 175 GW of clean energy capacity by 2022. At present, the country has a total installed renewable energy capacity of 90 GW. This includes 39 GW of wind and 37 GW of solar generation capacity. Around 50 GW of renewable energy capacity is under construction and there is also a strong pipeline of 30 GW for new bids. "There is a fund requirement of Rs 1.75 lakh crore to achieve the balance capacity of 35 GW (under bidding/ to be bid out/ auctioned) to achieve an overall target of 175 GW," Director General of Solar Power Developers Association Shekhar Dutt said. He also said that implementation of renewable projects and innovation in tendering them to attract investors would play a key role in 2021. According to him India needs to design innovative tenders with the inclusion of wind, solar and energy storage to ensure that renewable can replace fossil fuels to a great extent. This year has been challenging for the renewable energy sector but the industry has been able to withstand the crisis caused by the pandemic with support of the government. Moreover, confidence of investors

It is strange that only extraordinary men make the discoveries, which later appear so easy and simple. – GEORG C. LICHTENBERG

in the sector has soared further as was evident from solar power tariff breaching the psychological barrier of Rs 2 per unit. Solar power tariff dropped to an all-time low of Rs 1.99 per unit in an auction of projects of 500 MW capacity by Gujarat Urja Vikas Nigam Ltd (GUVNL) in December. Prior to that, the tariff had declined to a record low of Rs 2 per unit in an auction for 1,070 MW projects conducted by the Solar Energy Corporation of India (SECI) in November. In July last year, solar power tariffs fell to a low of Rs 2.36 per unit in an auction of 2 GW capacities by the SECI. Now, in order the the maintain the momentum, the government will have to be more proactive and innovative to attract investors into the sector. India had set an ambitious target of having 175 GW of renewable energy capacity by 2022. This includes 100 GW from solar, 60 GW from wind, 10 GW from biomass and 5 GW from small hydro power. Talking about the challenge of bringing required investment next year to achieve the 175 GW target, Union Power and New & Renewable Energy Minister R K Singh said, "We are going to come out with more innovative bids (in 2021)." He told PTI that earlier efforts of the government helped to position India as the most favourite destination for investment, especially in the clean energy sector and it is evident from USD 64 billion investment in renewables.

The minister also cited some examples of round the clock, hybrid and manufacturing linked auctions for clean energy in the country.

As per the government estimates, the demand for domestically manufactured solar cells and modules is likely to be around 36 GW over next three years. In November, Prime Minister Narendra Modi said there are huge renewable energy deployment plans for the next decade. "These are likely to generate business prospects of the order of around 1.5 lakh crore rupees or USD 20 billion per year. This is a big opportunity to invest in India," Modi had said. With the impact of Covid-19 on a gradual decline and higher visibility of vaccine availability, 2021 promises to be an exciting year for the renewable sector.

As per industry estimates, the cumulative capacity of 20 GW clean energy is scheduled to be commissioned, which shows increased opportunities for equipment suppliers.

Dutt said that agencies implementing renewable energy projects are facing challenges with respect to signing Power Sales Agreements (PSA) for around 16 GW with power distribution companies (discoms) and electricity procurers. Such a situation shows that the implementation of the ambitious target of 175 GW will be possible only when there are assured buyers for clean energy across the country. Otherwise, it will not be viable to set up huge generation capacities.

Meanwhile, there is a continued focus on ''Aatmanirbhar Bharat'' initiative to boost local PV (Photo Voltaic) manufacturing as well as ensure quality and competitiveness against imported PV cells. This is being done by way of providing support through the government''s PLI (Performance Linked Incentive) scheme. However, Dutt said that till the time domestic manufacturing capacity of requisite quality is not enough to meet demand, restrictive measures must be avoided.

According to industry players, the current focus is on developing large-scale ultra mega solar power projects but there are challenges such as land acquisition, sub-optimal utilisation of power evacuation infrastructure and higher transmission losses and charges.

"India is endowed with abundant sunshine across the country with a variation of 15-20 per cent. Hence, small to medium scale projects (50-100 MW) can be developed at load centres in 700+ districts located across the country, which will result in lower transmission losses, better utilisation of transmission assets, equitable job creation and development etc," Dutt said. Structural reforms for discoms are being looked at to ensure timely

Science, like life, feeds on its own decay. New facts burst old rules; then newly divined conceptions bind old and new together into a reconciling law. – WILLIAM JAMES

payment to power producers. Amendments to Electricity Act, 2003 and Tariff Policy, which has provisions to address the issues, are awaited by the industry.

Imaan Javan, Director of Operations at Suntuity REI (Suntuity REI is a leading solar energy solutions provider), said that "with sufficient government policies, support and schemes in place and educating people on the advantages of clean and sustainable energy, I believe that we can definitely achieve our renewable energy target of 175 GW by 2022".

"Though we have already seen various measures from the government like Safeguard Duty, ''One Sun One World One Grid'' initiative, anti-dumping duty, Vocal for Local and Make in India, more strict imposition of these policies will help India be at par with her global counterparts and penetrate into the world market," Javan said.

The renewable energy industry also expects higher coordination between central transmission utility and agencies implementing renewable energy projects to ensure seamless development of transmission evacuation infrastructure.

About increasing the share of renewables in the country''s energy mix, the minister said that India already has 38 per cent installed electricity generation capacity (140 GW) coming from clean energy and that the 40 per cent target will be surpassed in 2021.

India has set an ultimate target of having 450 GW of clean energy by 2030.

IEA has predicted that India will be the largest contributor to the renewables upswing in 2021 and one of the key forces behind the record global expansion.

Renewable power is growing robustly around the world this year, contrasting with the sharp declines triggered by the COVID-19 crisis in many other parts of the energy sector such as oil, gas and coal, according to the latest report from the International Energy Agency (IEA). The agency's flagship '*Renewables 2020'* report forecasts that driven by China and the United States, new additions of renewable energy capacity worldwide will increase to a record level of almost 200 gigawatts this year. This rise – representing almost ***90 percent*** of the total expansion in overall power capacity globally – is led by wind, hydropower and solar PV. Wind and solar additions are set to jump by 30 percent in both the United States and China as developers rush to take advantage of expiring incentives. However, there is more positive news, the report has predicted that even stronger growth is yet to come. India and the European Union will be the driving forces behind a record expansion of global renewable capacity additions of nearly 10 percent next year – the ***fastest growth since 2015***. This, it claims, is the result of the commissioning of delayed projects where construction and supply chains were disrupted by the pandemic and growth in markets where the pre-COVID project pipeline was robust. ***India is expected to be the largest contributor to the renewables upswing in 2021***, with the country's annual additions doubling from 2020.

"Renewable power is defying the difficulties caused by the pandemic, showing robust growth while other fuels struggle," said Dr. Fatih Birol, the IEA Executive Director. "The resilience and positive prospects of the sector are clearly reflected by continued strong appetite from investors – and the future looks even brighter with new capacity additions on course to set fresh records this year and next."

Over the first 10 months of 2020, China, India and the European Union have driven auctioned renewable power capacity worldwide 15 percent higher than in the same period last year – a new record that shows expectations of strong demand for renewables over the medium and long term. At the same time, shares of

Science is the great antidote to the poison of enthusiasm and superstition.
– ADAM SMITH

publicly listed renewable equipment manufacturers and project developers have been outperforming most major stock market indices and the overall energy sector. By October, shares of solar companies worldwide had more than doubled in value from December 2019.

However, policymakers still need to take steps to support the strong momentum behind renewables. In the IEA report's main forecast, the expiry of incentives in key markets and the resulting uncertainties lead to a small decline in renewables capacity additions in 2022. But if countries address these policy uncertainties in time, the report estimates that global solar PV and wind additions could each increase by a further 25 percent in 2022. Critical factors influencing the pace of deployment will be policy decisions in key markets like China and effective support for rooftop solar PV, which has been impacted by the crisis as households and businesses reprioritised investments. Under favourable policy conditions, solar PV annual additions could reach a record level of 150 gigawatts (GW) by 2022 – an increase of almost 40 percent in just three years. India Renewables 202

"Renewables are resilient to the COVID crisis but not to policy uncertainties," said Dr. Birol. "Governments can tackle these issues to help bring about a sustainable recovery and accelerate clean energy transitions. In the United States, for instance, if the proposed clean electricity policies of the next US administration are implemented, they could lead to a much more rapid deployment of solar PV and wind, contributing to a faster decarbonisation of the power sector."

The report then goes on to add that renewables outside the electricity sector are suffering from the impacts of the COVID crisis. Biofuels used in transport are set to experience their first annual decline in two decades, driven by the wider plunge in transport fuel demand this year as well as lower fossil fuel prices reducing the economic attractiveness of biofuels. The demand for bioenergy in the industry is also falling as a result of the wider drop in economic activity. The net result of these declines and the growth of renewable power is an expected overall increase of 1 percent in global renewable energy demand in 2020.

Renewable fuels for transport and industry are an area in particular need of potential policy support, as the sector has been severely hit by the demand shock caused by the crisis. More can and should be done, to support deployment and innovation in bioenergy to supply sustainable fuels for those sectors.

The report's outlook for the next five years sees cost reductions and sustained policy support continuing to drive strong growth in renewable power technologies. Total wind and solar PV capacity is on course to surpass natural gas in 2023 and coal in 2024. Driven by rapid cost declines, annual offshore wind additions are set to surge, accounting for one-fifth of the total wind market in 2025. The growing capacity will take the amount of renewable electricity produced globally to new heights.

"In 2025, renewables are set to become the largest source of electricity generation worldwide, ending coal's five decades as the top power provider," said Dr. Birol. "By that time, renewables are expected to supply one-third of the world's electricity – and their total capacity will be twice the size of the entire power capacity of China today."

(To be continued)

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We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology.

– Sir C.V.RAMAN

ELECTRICAL MAINTENANCE UNIT (QUESTION & ANSWERS) - 5

71. What are the advantages of electro magnetism?
    a. Electro magnets can be magnetised very easily by sending DC through it.
    b. Changing the direction of the current through the coil can change the polarity of the poles.
    c. The strength of the magnet can be controlled by the electric current.
    d. Electro magnets can be made in any shape depending upon the need.
    e. The magnetic strength remains constant as long as the current is constant.
72. State 'Cork screw rule' and 'Right hand thumb rule'.

    Cork screw rule

    Direction of magnetic lines of force around a straight current carrying conductor can be determined by these rules.

    'Cork screw rule' says that, the direction of magnetic lines of force around a straight current carrying conductor is the same as that in which the cork screw must be rotated to cause to an advance in the direction of the current in conductor.

    Right hand thumb rule

    Grasp the conductor with right hand in such a way that the extended thumb must be in the direction of current in the conductor. Then the folded fingers or encircling fingers must be in the direction of magnetic lines of force around the conductor.
73. Who discovered electro magnetism?

    'Orsted' a denish scientist discovered that whenever an electric current passes through a conductor, a magnetic field will be produced around that conductor in concentric circle. In addition to that heat will be produced in that conductor.
74. State the faraday's laws of electro magnetic induction.

    In 1831 Faraday discovered the production of electric current in electric conductor by converting magnetism. Faraday has mentioned two laws known as faraday's laws of electro magnetic induction.

    First law

    Whenever a conductor causes to cut the magnetic lines of force an emf will be induced in that conductor.

    Second law

    The quantity of electricity or the value of the emf produced in that conductor is directly proportional to the rate of change of flux linked with that conductor.
75. How we can find the direction of induced emf?

    The direction of induced emf can be find out by the 'Fleming's right hand rule', and 'lenz's law'

    Fleming's right hand rule

    Fleming's right hand rule states that, if one extends the thumb, fore finger and middle finger of the right hand at right angle to each other in such a way that the thumb point in direction of motion of the conductor, the fore finger in the direction of flux (from north to south pole), then the middle finger is indicate the direction of the induced emf in the conductor.

    Lenz's law

    The lenz's law states that, electro magnetically induced current always flows in such a way or direction that the action of magnetic field set up by induced current tends to opposes the root cause which produces it.

76. What is eddy current?

Eddy currents are those which are produced or induced in the mass of metal whenever the metal are moved in magnetic field of the magnetic field is moved across the mass metal so as to link it. The direction of this eddy current is always in opposite direction to the cause to produce them as per lenz's law.

Eddy current can be calculated by following equation

$We = k B_{max}^2 f^2 t^2 v$ watt.

Where, k – Constant

B_{max} – Maximum flux density

f – frequency of magnetic reversal

t – thickness of each lamination

v – volume if the armature core or mass metal.

Development of eddy current is made use in energy meters to provide controlling torque and also in form of automatic starters in moving coil measuring instruments.

77. What is magnetic Hysteresis?

Lagging of magnetization or induction flux density 'B' behind the magnetising force 'H' is known as magnetic hysteresis.

78. What are the types of induced electro motive force?

a. Dynamically induced emf.

b. Statically induced emf.

Statically induced emf can be further divided into two groups.

a. Mutually induced emf.

b. Self induced emf.

79. What are the use of mutual induction and self-induction?

Use of mutual induction

a. Transformers are works on this principle.

b. An inductance furnace makes use of it.

c. Used in ignition coils of motor car, motor cycles, scooters etc.

Use of self-induction

a. In regulators to give reduced voltage to the fans.

b. In fluorescence tube light to give high voltage at the time of starting and to give law voltage at it's normal working time.

c. Used in welding plant rectifiers to keep arc stationary by smoothing choke.

80. What are the different methods used to measure the resistance?

The different methods developed to measure the resistances are as follows.

a. Wheat stone bridge.

b. Slide wire bridge.

c. Post office box.

d. Ohm meter.

e. AVO meter or multi meter.

f. Bridge megger.

g. Megger.

81. What is generator? What are the essential parts of the generator?

Generator is a machine, which converts mechanical energy into electrical energy.

A generator works on under the principle of faraday's laws of electro magnetic induction.

It's essential parts are conductor, magnetic field and the movement of either the conductor or the magnetic field so as to create a rate of change of flux linkage with the conductor by the action of applied mechanical energy.

82. What is the equation used to find out frequency of number of cycles of induced emf?

$f = NP/120$

83. What are the types of generators?

There are two types of generator.

a. Permanent magnet generator.

b. Electro magnet generator.

In electro magnet generator there are two types.

a. Self excited generator.

b. Separately excited generator.

84. What are main types of DC generator?

Mainly there are three types.

a. Series generator or series wound generator.

b. Shunt generator or shunt wound generator.

c. Compound generator.

There are different types of compound generator.

a. Short shunt commulative compound generator.

b. Short shunt differential compound generator.

c. Long shunt commulative compound generator.

d. Long shunt differential compound generator.

Depending upon the terminal voltage characteristics there are three types of compound generator.

a. Under compound generator.

b. Flat or level compound generator.

c. Over compound generator.

85. What is the emf equation for generator?

$emf = P * \phi * Z * N / A * 60$

Where,

ϕ = Flux per pole in Weber.

Z = Total number of armature conductors.

P = Number of poles.

A = Number of parallel paths in armature.

N = Speed in rpm.

emf = emf generated in one parallel path and it is the emf generated of that generator.

For a wave wound generator there are only two (2) parallel paths in the armature. In such cases A = 2 and in lap wave wound armature parallel paths is equal to the number of poles in the armature winding.

Courtesy: https://www.scribd.com/document/244623258/Question-and-Answers-Electrical-Mainten

ELECTRICAL Q & A PART – 1 (2)

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

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

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

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

15) What is meant by knee point voltage?

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

16) What is reverse power relay?

- Reverse Power flow relay are used in generating stations' protection.
- A generating station is supposed to feed power to the grid and in case generating units are off, there is no generation in the plant then plant may take power from grid. To stop the flow of power from grid to generator we use reverse power relay.

17) What will happen if DC supply is given on the primary of a transformer?

- Mainly transformer has high inductance and low resistance. In case of DC supply there is no inductance, only resistance will act in the electrical circuit. So high electrical current will flow through primary side of the transformer. So for this reason coil and insulation will burn out When AC current flow to primary winding it induced alternating flux which also link to secondary winding so secondary current flow in secondary winding according to primary current. Secondary current also induced emf (Back emf) in secondary winding which oppose induced emf of primary winding and thus control primary current also.
- If DC current apply to Primary winding than alternating flux is not produced so no secondary emf induced in secondary winding so primary current may goes high and burn transformer winding.

18) Different between megger and contact resistance meter?

- Megger used to measure cable resistance, conductor continuity, phase identification whereas contact resistance meter used to measure low resistance like relays, contactors.

19) When we connect the capacitor bank in series?

- We connect capacitor bank in series to improve the voltage profile at the load end in transmission line there is considerable voltage drop along the transmission line due to impedance of the line. so in order to bring the voltage at the load terminals within its limits i.e (+ or – %6) of the rated terminal voltage the capacitor bank is used in series.

20) What is Diversity factor in electrical installations?

- Diversity factor is the ratio of the sum of the individual maximum demands of the various subdivisions of a system, or part of a system, to the maximum demand of the whole system, or part of the system, under consideration. Diversity factor is usually more than one.

21) Why humming sound occurred in HT transmission line?

- This sound is coming due to ionization (breakdown of air into charged particles) of air around transmission conductor. This effect is called as Corona effect, and it is considered as power loss.

22) Why frequency is 50Hz only & why should we maintain the frequency constant?

- We can have the frequency at any frequency we like, but then we must also make our own motors, transformers or any other equipment we want to use.
- We maintain the frequency at 50 Hz or 60Hz because the world maintains a standard at 50 /60Hz and the equipment's are made to operate at these frequency.

23) If we give 2334 A, 540V on Primary side of 1.125 MVA step up transformer, then what will be the Secondary Current, If Secondary Voltage=11 KV?

- As we know the Voltage & current relation for transformer-V1/V2 = I2/I1

  We Know, VI = 540 V; V2 = 11KV or 11000 V; I1= 2334 Amps.

  By putting these value on Relation-

  540/11000 = I2/2334

  So, I2 = 114.5 Amps

24) What are the points to be considered for MCB (miniature circuit breaker selection)?

- I (L) x 1.25 = I (MAX) maximum current. MCB specification is done on maximum current flow in circuit.

25) How can we start-up the 40w tube light with 230v AC/DC without using any choke / Coil?

- It is possible by means of Electronic choke. Otherwise it's not possible to ionize the particles in tube. Light, with normal voltage.

26) What is "pu" in electrical engineering?

- "Pu" stands for per unit and this will be used in power system single line diagram there it is like a huge electrical circuit with no of components (generators, transformers, loads) with different ratings (in MVA and KV). To bring all the ratings into common platform we use "pu" concept in which, in general largest MVA and KV ratings of the component is considered as base values, then all other component ratings will get back into this basis. Those values are called as "pu" values. (p.u = actual value/base value).

27) Why link is provided in neutral of an ac circuit and fuse in phase of ac circuit?

- Link is provided at a Neutral common point in the circuit from which various connections are taken for the individual control circuit and so it is given in a link form to withstand high Amps.
- But in the case of Fuse in the Phase of AC circuit it is designed such that the fuse rating is calculated for the particular circuit (i.e load) only. So if any malfunction happens the fuse connected in the particular control circuit alone will blow off.
- If Fuse is provided in Neutral and if it is blowout and at the same time Supply is on than due to open or break Neutral Voltage is increase and equipment may be damage.

Science has made us gods even before we are worthy of being men.

– Jean Rostand

28) If 200w, 100 w and 60 w lamps connected in series with 230V AC, which lamp glow brighter? Each lamp voltage rating is 230V.

- Each bulb when independently working will have currents (W/V = I)
- For 200 Watt Bulb current (I200) = 200/230 = 0.8696 A
- For 100 Watt Bulb current (I100) = 100/230 = 0.4348 A
- For 60 Watt Bulb current (I60) = 60/230 = 0.2609 A
- Resistance of each bulb filament is (V/I = R)
- For 200 Watt Bulb R200 = 230/0.8696 = 264.5 ohms
- For 100 Watt Bulb R100 = 230/0.4348 = 528.98 ohms and
- For 60 Watt Bulb R60 = 230/0.2609 = 881.6 ohms respectively
- Now, when in series, current flowing in all bulbs will be same. The energy released will be I^2R
- Thus, light output will be highest where resistance is highest. Thus, **60 watt bulb will be brightest.**
- The 60W lamp as it has highest resistance & minimum current requirement.
- Highest voltage drop across it X I [which is common for all lamps] = s highest power.
- **Note to remember:**
- Lowest power-lamp has highest element resistance.
- And highest resistance will drop highest voltage drop across it in a Series circuit
- And highest resistance in a parallel circuit will pass minimum current through it. So minimum power dissipated across it as min current X equal Voltage across = s min power dissipation

29) How to check Capacitor with use of Multi meter.

- Most troubles with Capacitors either open or short.
- An ohmmeter (multi meter) is good enough. A shorted Capacitor will clearly show very low resistance. A open Capacitor will not show any movement on ohmmeter.
- A good capacitor will show low resistance initially, and resistance gradually increases. This shows that Capacitor is not bad. By shorting the two ends of Capacitor (charged by ohmmeter) momentarily can give a weak spark. To know the value and other parameters, you need better instruments

30) What is the difference between Electronic regulator and ordinary rheostat regulator for fans?

- The difference between the electronic and ordinary regulator is that in electronic regulator power losses are less because as we decrease the speed the electronic regulator give the power needed for that particular speed .But in case of ordinary rheostat type regulator the power wastage is same for every speed and no power is saved. In electronic regulator triac is employed for speed control. By varying the firing angle speed is controlled but in rheostat control resistance is decreased by steps to achieve speed control.

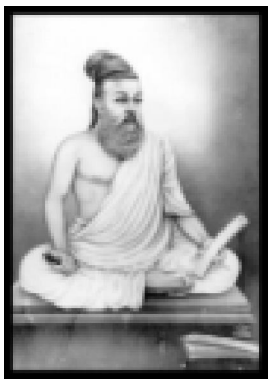
(To be continued)

Courtesy: ***Jignesh.Parmar***

Science is organized knowledge.

– Herbert Spencer

TENETS FROM TIRUKKURAL FOR GOOD GOVERNANCE AND GOOD LEADER



The current situation of our country with ambitions of growth and all round prosperity and its 'Heads' at current times facing challenges and serious problems of both internal and external in nature, along with the Pandemic affecting us and the world and the total economy, brought to mind 2 apt Kurals of Tiruvalluvar.

In spite of threats across borders, and various challenges and opposition within the country, the governance at present seems to be going ahead with dynamic decisions, plans and actions for over 6 years now with fairly good all round success. This is also reflected in growth of popularity and democratic victories. However, as we are a live democracy, there are sharp and bitter criticisms by all opponents and opposition, but the leader has to be focused to the essentials of the governance, without minding the bitter words of the opposition. These aspects are brought out in the following Kurals:

"Sevikaippach Sorpporukkum Panpudai Vendan Kavikaikkeezh Thangum Ulagu" Kural 389

செவிகைப்பச் சொற்பொறுக்கும் பண்புடை வேந்தன்
கவிகைக்கீழ்த் தங்கும் உலகு *குறள் 389*

"Behold the Prince (leader) who hath the virtue to bear with words that are bitter to the ear; his subjects will never leave the shadow of his umbrella"

"Kodaiali, Sengol, Kudiombal Naangum Udaiyanam Vendarkku Oli" Kural 390

கொடையளி செங்கோல் குடியோம்பல் நான்கும்
உடையானாம் வேந்தர்க் கொளி *குறள் 390*

"Behold the Prince (Leader) who is liberal and gracious and just, and who tendeth his people with care; he is a light among kings"

HOME FESTIVALS - 3

பங்குனி - Panguni (March/April)

This month brings the popular nine-day festival of Ram Navami, celebrating the birthday of Lord Rama, an incarnation of Lord Vishnu. When the full moon rises, Vishnu in the form of Satyanarayana is worshiped before a decorated kumbha pot with a branch of mango leaves placed in its mouth and a coconut on top. Rice is spread on banana leaves and the sacred vessel is completed with a tray of fruits, flowers an betel leaves and nuts. This month is also known for Sita's marriage to Rama. King Janaka, Dasaratha and priests surround the sacred fire, as Sita garlands Rama in Janaka's royal palace.

(To be continued)

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