TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE

NEWSLETTER

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

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EDITORIAL

In today's world, the phrase "everyone is unique" has become more relevant than ever. With a vast array of cultures, beliefs, and ideas, every individual possesses their own distinctive qualities and strengths. Yet, amidst this seemingly positive notion, there is a growing concern that the current generation is lacking essential decision-making skills. This deficiency is often attributed to the pervasive habit of comparing oneself to others when making important life choices. It is crucial to acknowledge that individuals should not rely on comparisons to determine their path and should instead tap into their own unique qualities.

The rapid advancement of technology and the influence of social media have contributed to a comparison culture that permeates modern society. Constantly bombarded with carefully curated images of success and happiness, individuals feel compelled to measure themselves against others. This incessant need to conform and achieve societal standards has repercussions, particularly when it comes to decision making. In the quest for acceptance and validation, many relinquish the power to make choices and instead follow the path set by others, whether it aligns with their own desires or not.

The consequence of this lack of decision-making skills is a generation that struggles to assert their individuality and make choices that truly resonate with them. Critical thinking and independent decision-making are vital skills that enable personal growth and pave the way for self-discovery. Decisions made based on comparison are often inadequate, as they do not consider one's own unique circumstances, passions, and aspirations. It is essential to break free from this detrimental habit and recognize the inherent value of one's distinct qualities.

Embracing individuality and originality is key to escaping the pitfalls of comparison and making sound decisions. Each person has a distinct set of talents, experiences, and perspectives that shape their identity. By tapping into these unique qualities, individuals can navigate their own path in life, free from the constraints of societal expectations. Understanding and celebrating one's own strengths and weaknesses fosters a sense of self-assurance and empowerment, enabling individuals to make decisions based on their genuine desires and goals.

To overcome the dearth of decision-making skills, society must encourage young individuals to develop their sense of self and embrace their uniqueness. This can be achieved through education systems that promote critical thinking, problem-solving, and self-reflection. Encouraging individuals to explore their own interests, passions, and talents will allow them to make decisions that align with their authentic selves.

In conclusion, it is imperative for individuals to recognize and value their uniqueness when making decisions. While society often encourages comparison, this path impedes personal growth and diminishes the importance of individuality. By embracing our own distinct qualities and breaking free from the shackles of comparison, individuals can make decisions that are true to themselves, leading to a more fulfilling and authentic life journey.

We thank all those members who have helped us by participating in the advertisement appearing for the issue August 2023 – Gravin Earthing & Lightning Protection System (P) Ltd., 3SI Eco Power LLP, Rachana Cables, E Focus Instruments India (P) Ltd., Sri Bhoomidurga Marketing (P) Ltd., Power Cable Corporation (Cable Network Solution), Galaxy Earthing Electrodes (P) Ltd., E Power Engineering, Global EPC India Private Limited, Ashlok Safe Earthing Electrode Ltd., Hinox Industrial Supplierz, Power Cable Corporation Screened Separable Connection, RBB Electricals, MV Power Consultants & Engineers (P) Ltd., Pentagon Switchgear (P) Ltd., Sakthi Transformers, Jai Electricals, Sastinadha EPC Solutions India Pvt Ltd., Sinewaves Solutions India Pvt Ltd., Value Engineers, Supreme Power Equipment (P) Ltd.

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KNOW THY POWER NETWORK - 173

(Human Life in the universe - changes presently experienced and expected in future especially in Power Sector – A Recap / Review)

It is time now to revisit the journey made in the power systems during the last a few decades.

In continuation of my last article, this brief deals with the changes experienced / witnessed by the humanity during the last a few decades, especially in the power network and its connected equipment. **In other words, it is the journey made by the power network in line with the "Basic feature of Nature" i.e. change is the constant of "Nature".**

You will agree with me without any hesitation, when I say it is always better to know / understand the "Reality" around us – what is going on technically around us and also know where do we stand now.

In earlier years, we led a simple and calm life; our lives were in the arc of a narrow spot light. The circumference of our movement never went beyond our physical needs. (It never exceeded / crossed a few kilo meters). Contrast this with today's position – Our horizons got expanded and we are in a bigger integral world where

- Knowledge can be stored and processed in no time
- Knowledge can be passed on to one person to another very quickly
- Any distance can be covered in a short period / time

All these were made possible due to the fast advent of transportation, information, computer and communication technologies. Unexpectedly, this caused a tectonic shift in our life and environment. They moved from "Very Simple" to "Complex". Presently, all our movements and activities are tracked. We lost our freedom.

We are now at the mercy of our smart devices, phones, apps and smart electrical equipment and devices – no exception. We become a product of so many interactions and surveillances; external world knows who we are and what we want / what we do.

I. With this brief, let us see the happening in the power sector and how it traverses from the past to the present.

Past	Present
➢ Manual operations	➢ Smart operations brought by sensors and smart devices
➢ Manual monitoring and all operations were performed in the network manually	➢ SCADA and Automation
➢ Protection and Metering (ElectroMagnet meters) and Relays	➢ Smart Meters; computer based numerical relays
➢ OCBs, OMCBs, ABCBs,Vacuum CBs, SF6 Gas	➢ Smart CBs, (Existing VCBs and SF6 Gas are controlled by smart means)
➢ AIS (Air Insulated Substation)	➢ GIS (Gas Insulated Substation)
➢ Normal grid	➢ Smart Grid, Super Grid, Micro Grid
➢ Nuclear and Fossil fuel based power stations ➢ Wide application of petroleum, mineral oil based products	➢ A mixture of non-renewable and renewable power stations ➢ Wide use of synthetic liquids, polymers and plastics
➢ Non-existence of Drones and Robots	➢ Wide application of Drones and Robots and Automation
➢ Normal world with simple Electrical and Electronics devices and means	➢ Digital world (Digitilization)
➢ Isolated operation of regional electrical Grids eg. SREB NREB EREB	➢ Integrated grid operation (1) electricity grid for the entire nation – now electric power can flow from anywhere in the country to any point. (e.g.) Northern part of country can now feed to Southern most part of India

The prevailing working environment in the power sector that includes industries also demands the aligning / joining of Humans and Machines and not their drifting. This is the need of the future also i.e they need to work together seamlessly or go hand in hand. Let us see how this collaborative functioning of humans and machines can be achieved. Such smart collaboration between humans and machines can bring the transformation of industries and reshape our work culture. i.e. how we work, make decisions and solve problems

II. Man – Machine Collaboration

Areas where Human and Machines can contribute their mite immensely are,

S.No.	Humans	Machines
1	Can utilize their creativity, experience and emotional intelligence to the decision making process	Can process vast data quickly and accurately
2	With the fast analysis of data as contributed by the machines, the required data algorithms and collaborative intelligence can be evolved rapidly and the problems on hand can be solved easily and cost effectively	Can augment human cognitive capabilities by automating repetitive tasks, analyzing data at scale and providing real time insights. This frees human and help them to focus on the much needed critical thinking and emotional intelligence sectors.

III. Key ways that make collaborative intelligence as possible are

(i) Cognitive augmentation

Similar to "Health Care" segment, where computers assist doctors by analyzing medical record and suggest treatment options, machines can execute various of problem – solving methods (solutions) in power sector and industrial sectors also. By this, they allow engineers to make more informed decisions.

(ii) Data Drives Decisions

By combining the analytical capabilities of machines with the intentions and experience of humans, the data driven decisions that are both informed and contextual can be made. In the power sector it is the best method of selecting cost effective generation - Mix daily / weekly with better out comes i.e. it can be effectively adopted in load dispatch centres of all state Electricity Boards and utilities while selecting the material inputs (feed stocks) in industries this method can adopted.

(iii) Enhanced Personalisation

Machine Learning algorithms can analyze vast amounts of data about individual preferences, behavior and patterns and provide highly "Personalised Recommendations". It will bring more benefits when it is applied in power utilities and industries in the areas like,

- Selection of new equipment
- Replacement of old equipment and devices with new equipment and devices
- Failure analysis of costly equipment manufacturing process.

Here, the role of humans is first to provide the necessary context and interpretation which are essential in such personalized dealing.

IV. Automation and Robots

You allknow that robots can perform effectively and efficiently in any work site environment, especially hazardous, toxic and other risky areas and also do repetitive tasks with greater precision.Collaborative robots (cobots) are also preferred and made to work alongside human workers in difficult power sectors.

Among them are, live line Maintenance and Repairs, Erection of EHV lines, Works in the Radio-active areas of nuclear power stations, Erection and Maintenance of lines and equipment's is highly contaminated areas and,on - site repairs of generators and transformers.

V. Adoption of Machine Learning and Artificial Intelligence Techniques

The application of "Collaboration Intelligence" with its critical components like Artificial Intelligence and Machine Learning is essentially required in power sector for the analysis of grid separation, (Major Black-outs) and long term planning. Annual maintenance of nuclear and thermal power stations, checks on the adequacy of existing protection co-ordination and insulation co-ordination. The specialty about Artificial Intelligence, while performing the analysis of the vast amounts of data, its algorithms can easily learn from human inputs and interactions and continuously improve their performance i.e. it simply adopts and evolves and changes its working on the basis of human feed backs leading to more accurate and personalized out comes. For example, in the consumer service sector of State Electricity Boards, which lags far behind the expected level at present, much improvements can be achieved. AI "Powered Chat bots" can provide better responses and improve customer satisfaction by its learning from human interactions.

VI. Profitable Partnership

Presently we are having an efficient machine-to-machine interaction. It can be enhanced further by including humans also i.e. by having human brain – computer – Interface technology. Then the expected possible situation would be like the one indicated below

- A factory worker interacts with Robots / machines intensively, without displays and switches
- A machine functioning remotely in met-averse in a factory by having seamless contacts with humans

All these would lead to,

- Improved efficiency and minimum errors with the consequential more profitable and productive manufacturing process in the plants. This holds good for various operations in power utilities also.

Further physical – virtual – human interfaces / interactions can be accelerated by having innovations around,

- AR / VR Devices
- Meta-versa and
- BC 1

All these would transform the industrial eco system exponentially. New levels of efficiency, innovations and value creations can be easily unlocked. The all-important "Human – Verification Layers", which are imperative to ensure the conclusions drawn from the in feed data, are translated into the right outputs. In respect of BC1 better device control, efficiency, greater accessibility can be achieved, in addition to the reduced safety concerns, better trust and environmental awareness brought by it.

No doubt, you can simply envisage a future with

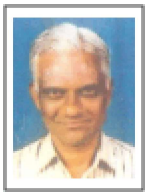
- A true Human – Machine integrated factory environments just like an integrated machine assisted surgery in hospitals
- Presence of robots as Personal Assistants, Provision of Assistants to factory officials and workers. It is like the provision of personal attendants to the patients especially to the differently abled patients in hospitals.
- Robots that carry out numerous difficult tasks in hazardous industrial environments effectively and efficiently.

With this, I think that we have reached the end of our discussion on the prevailing environment around us and also the that can be expected in future.

With this, I sign off.

Ref: (1) Humans and Machines are "joining Forces" – An article published in TOI dt. 21.07.2023

(To be continued)



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ELECTRICAL MAINTENANCE UNIT
(QUESTION & ANSWERS) – 19

Electrical equipment fundamental

1. Why indoor switchyard is provided in MAPS?

   The salt contamination in the switchyard is avoided by providing indoor switchyard in MAPS. Because the plant is just 300 metres away from the seashore and the atmosphere is saline. This salt will get deposited on the insulators and on the conductors used in the switchyard. Due to this deposition insulator may fail to unnecessary trip the system and conductor used must be copper for better performance instead of low cost aluminum. So to avoid unnecessary trip and to have low cost of installation and spare parts of aluminium indoor switchyard is used.

2. What do ABCB and ACB mean?

   ABCB – Air Blast Circuit Breaker.

   ACB – Air Circuit Breaker.

3. What do you mean by frequency?

   The number of cycles per second is called the frequency.

4. State the voltage and current relation in star and delta connection.

   In star connection line current is equal to the phase current and line voltage is $\sqrt{3}$ times that of phase voltage.

   In delta connection line voltage is equal to the phase voltage and line current is $\sqrt{3}$ times that of phase current.

5. In DC motor what is the relation between speed and field flux?

   Speed of a DC motor is inversely proportional to the field flux.

6. What is the difference between self-excited and separately excited DC generator?

   Self-excited generator: In a self-excited generator the field winding is excited by an external DC source like a battery etc.

   Separately excited generator: In a separately excited generator the field poles have some residual magnetism. When the armature is rotated a small emf is induced in it. This is fed to the field winding and if the current direction is such that it adds the residual magnetic flux to the field winding and the field strength is increased. The more emf in the armature, which is again fed to the field winding and goes on till the generator builds up voltage.

Power and control cables.

1. Define conductor.

   Conductor: A material of low resistance used to transmit electrical energy. Example wires, cables, bus bars etc.

2. Define unprotected insulated wire.

   Unprotected insulated wire: Unprotected insulated wire is which the insulation of the wire is not covered by a protective sheathing to prevent it from mechanical damage.

3. Define cable.

   Cable: One or more insulated conductor enclosed in a protective mechanical sheathing of either GI wire or GI strip or aluminium to protect the insulation from mechanical damage.

4. Define insulated wire.

   Insulated wire: A conductor or multi-stranded conductor which has an insulating material on it is called a insulated wire.

5. Explain briefly about armouring for an under grounded cable.

   Armouring is required to protect the cores from mechanical damage.

6. Explain briefly about grounding of cable trays.

   Cable trays are grounded because to avoid any shocks to personnel in case of leakage. A grounding wire runs at the side of tray through a parallel groove clamp throughout the length of the cable tray. If trays are one above another we can loop up the grounding wire to the tray below. This saves extra ground wire.

7. What are the differences between the power and control cable?

   Power cable: It is used for supplying current to load. It is of larger current carrying capacity available in single core, 2 cores, 3 cores, 3½ cores, and 4 cores. Single core is available upto 1000 mm^2. Usually power cables are of aluminium. These cables are graded for higher voltages and possess more cross section area.

   Control cable: Control cables are used for control purposes for logics, indication or annunciation etc. These are of lower current carrying capacity and voltage grading is also less. These are of less cross sectional area are available in pairs of 2,5,10,25,50 etc.

8. What is the purpose of using corrosion inhibiting compound?

   It is used for aluminium conductors while crimping to a lug or ferrule. It prevents corrosion of aluminium conductor due to oxidation and due to saline atmosphere.

9. Why aluminium armouring for single core 1000 mm^2 is used?

   Aluminium armouring for single core 1000 mm^2 is used so that heating will not take place due to the flux around the conductor, as the aluminium is a non-magnetic material.

10. What is resistance of copper compare to the aluminium?

    Copper is less resistive than aluminium.

11. What is applied over the steel tape armour of PILC cable as serving?

    Bituminous covered jute.

12. What is used as insulation for PILC cable?

    Impregnated paper.

13. A small quantity of impurity reduces how much of conductivity of copper?

    35% of conductivity will be reduced due to a small impurity in the conductor.

14. Why cast aluminium tri-foil clamp is used in single core cables laying?

    When three conductors are clamped together the fluxes around the conductors are get cancelled

15. What are the parts of a cable gland?
    a. Check nut.
    b. Nipple.
    c. Metal washer.
    d. Neoprene rubber.
    e. Compression nut.
16. What are the advantages of PVC insulated cable?
    a. Plumbing is not required. Joints can be made easily.
    b. As PVC is light the injury caused to it while laying is less.
    c. It is corrosion resistant.
    d. It has high fire retarding property.
    e. It does not break down even if moisture enters.

Basic electronics

1. How many types of logic gates are there?
    a. OR gate.
    b. AND gate.
    c. NAND gate.
    d. NOR gate.
    e. Inverter gate.
    f. Exclusive OR gate.
    g. Equivalent gate.

Mechanical equipment fundamentals

1. Why feed valves are used?

   Feed valves are used to prevent back flow.

2. What are the functions of a heat exchanger?

   The function of heat exchanger is to transfer heat efficiently and economically between two fluids. Heat is transferred from the fluid, which has higher temperature to the fluid, which has lower temperature. The modes of heat transfer are,

   a. Conduction – Heat transfer in solids by momentum of molecules.
   b. Convection – Heat transfer in liquids by movement of molecules.
   c. Radiation – Heat transfer by energy waves.

   There are three types of flow in heat exchangers

   a. Parallel flow.
   b. Counter flow.
   c. Transverse flow.

Nuclear Power is our gateway to a Prosperous Future
– DR APJ ABDUL KAALAM

3. Why baffle plates are used in heat exchanger?

Baffle plates are used in heat exchanger so that the maximum heat can be transferred and to avoid tube sagging.

4. How pumps are classified?

A. Centrifugal pumps	–	a. Single volute
		b. Double volute
		c. Diffuser type
		d. Mixed flow
		e. Axial flow
		f. Turbine or regenerative type
B. Rotating pumps		a. Screw type
		b. Gear type
		c. Vane type
C. Reciprocating pumps		a. Piston
		b. Plunger
		c. Bucket

5. What you mean by cavitation and NPSH?

Cavitation: Bubbles form in the liquids whenever there is pressure reduction inside the pump. These bubbles collapse when they approach high-pressure areas damaging pump internals. This is called the cavitation.

NPSH: Net Positive Suction Heat. It is the head available at the eye of the impeller corrected to vapour pressure.

6. Name the functions of the valve?

a. ON and OFF service.
b. Throttling or regulating liquid flow.
c. Avoid back flow.
d. Regulating pressure.
e. Relieving pressure.

7. What are the advantages of butterfly valve?

a. Less holdup.
b. No support needed.
c. Any actuator can be used.
d. Quick opening and closing.
e. Less space required.
f. Used for low-pressure low temperature and large pipelines.

(To be continued)

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

HARMONICS IN POWER SYSTEM & MITIGATION - 2

Effect of Harmonics – Over Load of Equipment's

Generator

Generators supplying power to non-linear load must be de-rated due to additional losses caused by harmonic current. The level of de-rating of generator is approximately 10% where the over load. is made up of 30% non-linear load. Hence it is necessary to oversize the generator in order to supply the same active power.

Uninterrupted Power Supply (UPS)

Normally UPS is sized taking into account exclusively the RMS current which is not correct. The computer system has a high CREST FACTOR in current. The UPS may not capable of supplying the necessary peak current and hence over loaded. It is necessary to size the UPS based on the crest factor current of connected load.

Transformer

The effective rating of transformer will reduce based on the percentage of non-linear load. The given below is the effective % of transformer rating based on the connected % of non-linear load.

% of Non-linear load	Effective KVA % of transformer
0	100
20	80
40	60
60	50
80	45
100	45

Asynchronous Machines

Deration of asynchronous machines are based on Harmonic Voltage Factor (HVF).

HVF is the ratio of square root of Fundamental Voltage to Square of all harmonic voltages. This should be equal to or less than 2%. In practical asynchronous machines must be supplied with a voltage having THD not exceeding 10%.

Capacitors

The RMS current flowing through the capacitor should not exceed 1.3 times of rated current due to voltage THD.

Neutral Conductor

Due to 3rd harmonic in the system neutral conductor will be loaded since the 3rd harmonic current is Zero sequence current added up in the neutral. Hence neutral conductor size should be selected based on the percentage of 3rd harmonic current in the system as follows

3rd harmonic Current %	Neutral Conductor Size
Below 15%	Smaller than phase conductor
15% to 33%	Equal to phase conductor

Reduction Factor of Harmonic Current in 4 & 5 Core Cable as Per IEC 60364-5-52

% Content of 3rd harmonic	Size based on Ph current	Size based on neutral current
0 -15	1.0	——-
15 -33	0.86	———-
33-45	—-	0.86
>45	—-	1.0*

* If the neutral current is more than 135% of the phase current the cable size should be selected on the basis of neutral current then the 3Ph conductor will not be loaded fully. The reduction in heat generated by the phase conductor off sets the heat generated by the neutral conductor to the extent that is not necessaryto apply any reduction factor to the current carrying capacity of three loaded conductors.

Power Loss Due to Harmonics

Losses in Conduction

When the current drawn by the load contains harmonics the RMS (Irms) is greater than the fundamental current(Ifun)

Irms = Ifun x root of 1+ THDi^2

The harmonic current causes an increase of Joule losses in all conductors in which they flow and additional temperature rise. The percentage of loss is based on the percentage of current THD

Losses in Asynchronous Machines

The harmonic voltage supplied to the asynchronous machines causes the flow of current in the rotor with frequencies higher than fundamental frequency and creates additional losses. The voltage distortion of 10% will cause additional power loss of 6%

Losses in Transformer

Harmonic current flows in transformer causes additional copper loss due to Joule effect & additional iron loss due to eddy current.

Harmonic Voltage supplied to transformer causes additional iron loss due to Hysteresis. Generally, the loss in winding will increase as the square of THDi & loss in the core will increase linearly with THDv

Losses in Capacitor

The harmonic voltage supplied to capacitor cause flow of current proportional to the frequency of harmonics since the impedance of capacitor is inversely proportional to the frequency and this creates additional loss.

Power Factor Problem Due to Harmonics

Shunt capacitors are provided in the system for the improvement of power factor

In the case linear load True power factor = Displacement PF = KW/KVA

In the case of non-linear load which generates harmonics another element is involved that is distortion power factor.

We should remember that there are nations which meet more than 30 to 60% of the Power Requirements through the Nuclear Power System – DR APJ ABDUL KAALAM

Here True PF = Displacement PF x Distortion PF due to harmonics

Distortion PF = 1/root 1+ THDi ^2

Even Displacement PF is unity True PF will not be unity due to poor distortion power factor

Hence True PF can be improved by improving the Distortion PF. Mere by providing bare capacitor distortion power factor will not improve.

Distortion PF can be improved by providing suitable harmonic filter

Resonance

When we add capacitor in the inductive circuit for power factor improvement the capacitor and inductor is forming LC tank circuit.

The reactance of inductor is 2x3.14 x f x l and reactance of capacitor is ½ x3.14 x f xC

Hence the reactance of inductor is directly proportional to frequency and reactance of capacitor is inversely proportional to frequency.

In the existence of harmonics in the system at any one of the harmonic frequency the inductive reactance and the capacitive reactance may equal. That is the energy stored in both inductor and capacitor will be equal or the net energy stored in the circuit is Zero. This frequency is called **Resonant Frequency.**

The type of resonance is Series Resonance & Parallel Resonance. A series resonance will also have a parallel resonance due to circuit topology. Let us assume

Xt = Reactance of facility transformer

Xc = Reactance of capacitor installed

Xs = Source reactance

Series resonant point = root of Xc/Xt

Parallel resonant point = root of Xc / Xt + Xs

Parallel resonant point is always lower than the series resonant point in the power system

Series resonance creates low impedance path which draws maximum current into the system

Parallel resonance creates large impedance which even in the presence of small current can create large harmonic voltage drop and hence cause voltage stress related damages.

The resonance frequency can be calculated as follows

Resonant Frequency Fr = 50 x root of Tr KVA x 100/cap kvar x % imp of TR

Resonant Frequency Fr = 1/ 2x3.14 x root LC

(To be continued)

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We need freedom from fossil fuel and undertake a mission in Solar, Nuclear and Bio-fuel. We need to set up 100 per cent Energy independence." – DR APJ ABDUL KAALAM

UPDATED CENTRAL ELECTRICITY AUTHORITY (MEASURES RELATING TO SAFETY AND ELECTRIC SUPPLY) REGULATIONS, 2023

CHAPTER I - PRELIMINARY

1. Short title and Commencement

(1) These regulations may be called the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

(2) These regulations shall come into force on the date of publication in the Official Gazette.

(3) Scope and extent of application. – These regulations shall be applicable to electrical installation including electrical plant and electric line and the person engaged in the generation or transmission or distribution or trading or supply or use of electricity.

2. Definitions

(1) In these regulations, unless the context otherwise requires,

(a) "Act" means the Electricity Act, 2003 (36 of 2003);

(b) "accessible" means within physical reach without the use of any appliance or special effort;

(c) "aerial bunched cable" means polyethylene or cross linked polyethylene insulated cable having three or four cores with aluminium conductors twisted over a central bare or insulated aluminium alloy or steel messenger wire;

(d) "apparatus" means electrical apparatus and includes all machines, fittings, accessories and appliances in which conductors are used;

(e) "bare" means not covered with insulating materials;

(f) "bonding conductor" means the inter connecting conductors for the purpose of equipotential bonding with the main earth;

(g) "cable" means a length of insulated single conductor, solid or stranded, or two or more such conductors each provided with its own insulation, which are laid up together;

(h) "chartered electrical safety engineer" means a person authorised by the Appropriate Government as referred in regulation 6;

(i) "circuit" means an arrangement of conductor or conductors for conveying electricity and forming a system or a branch of a system and protected at the origin;

(j) "circuit breaker" means a mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified duration and breaking currents under specified abnormal circuit condition;

(k) "concentric cable" means a composite cable comprising an inner conductor which is insulated and one or more outer conductors which are insulated from one another and are disposed over the insulation of, and more or less around, the inner conductor;

(l) "conductor" means any wire, cable, bar, tube, rail or plate used for conducting electricity;

(m) "conduit" means rigid or flexible metallic tubing or mechanically strong and fire resisting non-metallic tubing into which a cable or cables may be drawn for the purpose of affording it for mechanical protection;

(n) "connected load" means the sum of the ratings in kilowatt or kilovolt-ampere of the apparatus connected to the installation of the consumer which may be connected simultaneously to the source;

(o) "contact potential" means electric potential difference across the junction of two different objects in the absence of electric current;

(p) "covered with insulating material" means adequately covered with insulating material of such quality and thickness as to prevent danger;

(q) "cut out" means any device for automatically interrupting the flow of electricity through the conductor when the current increases above a pre-determined value, and shall also include fusible cut-out;

(r) "danger" means risk to health or life or any part of body from electric shock, burn or other injuries to person, or property, or from fire or explosion, attendant upon the generation, transmission, transformation, conversion, distribution or use of electricity;

(s) "dead" means at or about earth potential and disconnected from any live system and is used only with reference to current carrying parts when these parts are not live;

(t) "designated person" means a person whose name appears in the record maintained under sub-regulation (2) of regulation 3 by the supplier or consumer, or the owner, agent or manager of all electrical installations including mine, or the agent of any company operating in an oil-field or the owner of a drilled well in an oilfield or a contractor;

(u) "earthing" means connection of the exposed conductive and extraneous parts of an installation to the main earthing terminal of that installation or connection of neutral of transformer or generator or equipment to general mass of earth or earth bonded bar of that installation;

(v) "earthing arrangement or earthing system" means all the electric connections and devices involved in the earthing of a system, an installation or equipment;

(w) "electric vehicle" means any vehicle propelled, partly or wholly, by an electric motor drawing current from a rechargeable storage battery, or other portable energy storage devices or other self-generating electric source;

(x) "electric vehicle supply equipment" means an element in electric vehicle charging infrastructure that supplies electric energy for recharging the battery of electric vehicles;

(y) "enclosed substation" means any premises or enclosure or part thereof, being large enough to enable the entry of a person after the apparatus therein is in position, containing apparatus for transforming or converting electricity to or from a voltage at or exceeding six hundred fifty volt (other than transforming or converting solely for the operation of switch gear or instruments) with or without any other apparatus for switching, controlling or otherwise regulating the electricity, and includes the apparatus therein;

(z) "enclosed switching station" means any premises or enclosure or part thereof, being large enough to enable the entry of a person, after the apparatus therein is in position, containing apparatus for switching,controlling or otherwise regulating electricity at or exceeding six hundred fifty volt but not for transforming or converting electricity (other than for transforming or converting solely for the operation of switchgear or instruments) and includes the apparatus therein;

(za) "equipotential bonding" means an electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential;

(zb) "exposed conductive part" means a conductive part which can readily be touched and which is not normally live, but which may become live under fault conditions;

(zc) "extraneous conductive part" means a conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth;

(zd) "flameproof enclosure" means an enclosure in which the parts which can ignite an explosive atmosphere are placed and which can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the spread of explosion to the explosive atmosphere surrounding the enclosure;

(ze) "flexible cable" means a cable consisting of one or more cores each formed of a group of wires, the diameter and the physical properties of the wires and insulating material are to allow flexibility;

(zf) "guarded" means covered, shielded, fenced or otherwise protected by means of suitable casings, barrier, rails or metal screens to remove the possibility of dangerous contact or approach by persons or objects to a point of danger;

(zg) "hand-held portable apparatus" means an apparatus designed to be capable of being held in the hands and moved while connected to a supply of electricity;

(zh) "high voltage direct current" means direct current voltage one hundred kilovolt and above used for transmission of power;

(zi) "inspector of mines" means an inspector appointed under the mines Act, 1952 (35 of 1952);

(zj) "installation" means any composite electrical unit used for the purpose of generating, transforming, transmitting, converting, distributing or utilizing electricity;

(zk) "Installation Manager" has the same meaning as defined in the Oil Mines Regulations, 2017;

(zl) "intrinsically safe circuit" means any circuit in which any spark or any thermal effect produced in the conditions specified in the relevant standards, which include normal operation and specified fault conditions and not capable of causing ignition of a given explosive gas atmosphere;

(zm) "intrinsically safe apparatus" means an electrical apparatus in which all the circuits are intrinsically safe circuits;

(zn) "lightning arrester" means a device which has the property of diverting to earth any electrical surge of excessively high amplitude applied to its terminals and is capable of interrupting follow on current, if present, and restoring itself thereafter to its original operating conditions;

(zo) "linked switch" means a switch with all the poles mechanically linked to operate simultaneously;

(zp) "live" means electrically charged;

(zq) "load despatcher" means the personnel engaged in operation of Load Despatch Centre;

(zr) "metallic covering" means mechanically strong metal covering surrounding one or more conductors;

(zs) "mine" shall have the same meaning as defined in clause (j) sub-section (1) of section 2 of the Mines Act, 1952 (35 of 1952);

(zt) "neutral conductor" means that conductor of a multi-wire system, the voltage of which is normally intermediate between the voltages of the other conductors of the system and shall also include return wire of a single phase system;

(zu) "notified voltage" means a voltage notified by the Appropriate Government under intimation to the Authority for the purpose of specifying the voltage level up to which self-certification is to be carried out under regulation 32 and regulation 45;

(zv) "occupier" means the owner or person in occupation of the premises where electricity is used or proposed to be used;

(zw) "open sparking" means sparking which owing to the lack of adequate provisions for preventing the ignition of inflammable gas external to the apparatus would ignite such inflammable gas;

(zx) "owner or agent or manager of a mine" have the same meanings as are assigned to them in the Mines Act, 1952 (35 of 1952);

(zy) "portable apparatus" means an apparatus which is so designed as to be capable of being moved while in operation;

(zz) "portable hand lamp" means a portable light-fitting provided with suitable handle, guard and flexible cord connected to a plug;

Courtesy: https://cea.nic.in/

"Learning gives creativity, creativity leads to thinking, thinking provides knowledge and knowledge makes you great."

– Dr APJ ABDUL KALAM

Point On Wave Switching (POW)

These capacitor banks, while reducing the flow of reactive power and improving voltage regulation in the system, constitute a source of transient's every time they are switched. Controlled closing of shunt capacitor banks (POW) is used to minimise the power system and its components by operating each CB pole at the most favourable time instant. A number of P O W control relays are available for this application.

Wye-connected grounded-neutral, shunt capacitor banks are energised when the voltage is equal to zero on each phase. All phases are closed within 120 electrical degrees.

Breaker Pole	A	B	C
Phase	L1 or R phase	L 2 or Y phase	L3 or B phase
Operating Instant	0°	120°	60°

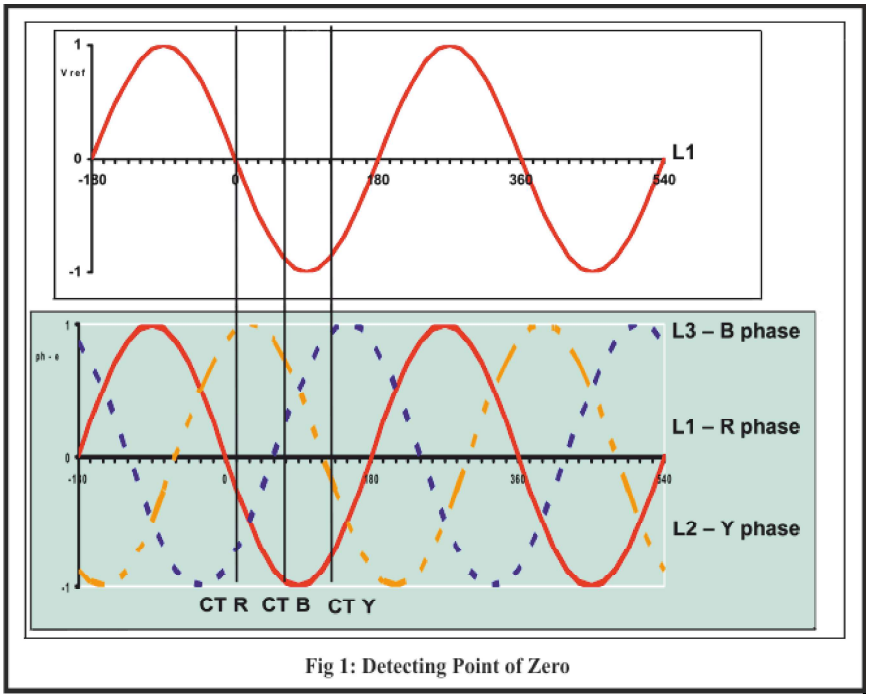


Fig 1: Detecting Point of Zero

Back to back switching refers to the conditions where a shunt capacitor bank is energised in the presence of one or more capacitor banks already connected to the system in proximity to the first.

6.8.6 The Capacitor Unit and Bank Configuration

The capacitor unit is the building block of a shunt capacitor bank. The capacitor unit is made up of individual capacitor elements, arranged in parallel/series connected groups within a steel enclosure. Each capacitor unit is provided with a discharge resistor that reduces the unit residual voltage to 50V in 5 minutes. Capacitor units are available in variable voltages and sizes.

Capacitors are intended to be operated at or below their rated voltage and frequency as they are very sensitive to these values; the reactive power generated by a capacitor is proportional to both voltage and frequency ($kVAr = 2\pi \int v^2$).

a) **Bank Configuration**

The use of fuses for protecting the capacitor units and its location (inside the capacitor unit on each element or outside the unit) is an important subject in the design of capacitor banks. They also affect the failure mode of the capacitor unit and influence the design of the bank protection.

b) Externally Fused Capacitor Unit/Bank

An individual fuse, externally mounted between the capacitor unit and the capacitor bank fuse bus, typically protects each capacitor unit.

A failure of a capacitor element welds the foils together and short circuits the other capacitor elements connected in parallel in the same group. The remaining capacitor elements in the unit remain in service with a higher voltage across them than before the failure and an increased capacitor unit current. If a second element fails, the process repeats itself resulting in an even higher voltage for the remaining elements. Successive failures within the same unit will make the fuse to operate, disconnecting the capacitor unit and indicating the failed one.

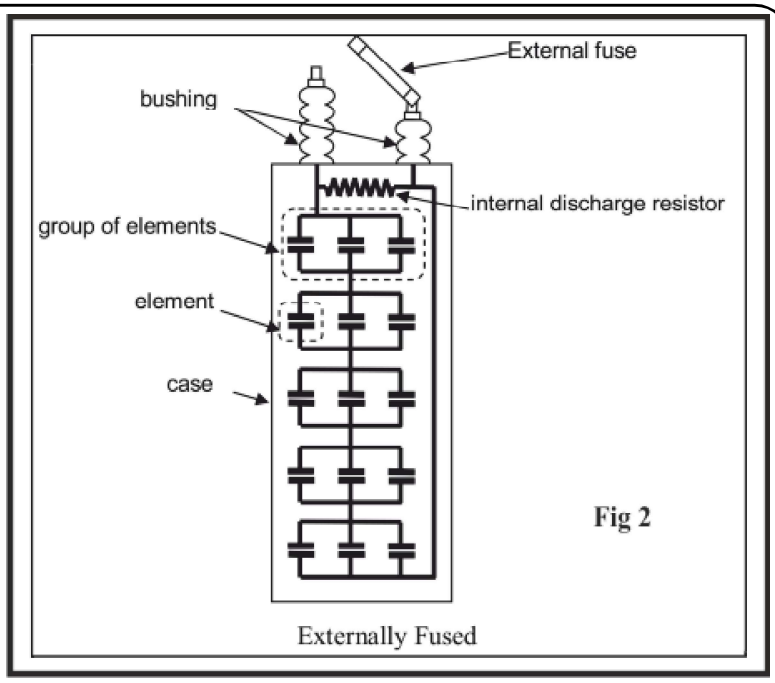


Fig 2

Externally fused Shunt Capacitor Banks are configured using one or more series groups of parallel-connected capacitor units per phase. The available unbalance signal level decreases as the number of series groups of capacitors is increased or as the number of capacitor units in parallel per series group is increased. However, the kiloVAr rating of the individual capacitor unit may need to be smaller because a minimum of parallel units are required to allow the bank to remain in service with one fuse or unit out.

c) Internally Fused Capacitor Unit / Bank

Each capacitor element is fused inside the capacitor unit. The fuse is a simple piece of wire enough to limit the current and encapsulated in a wrapper able to withstand the heat produced by the arc. Upon a capacitor element failure, the fuse removes the affected element only. The other elements, connected in parallel in the same group, remain in service but with a slightly higher voltage across them. In general, banks employing internally fuses capacitor units are configured with few capacitor units in parallel and more series groups of units than are used in banks employing externally fused capacitor units. The capacitor units are normally large because a complete unit is not expected to fail.

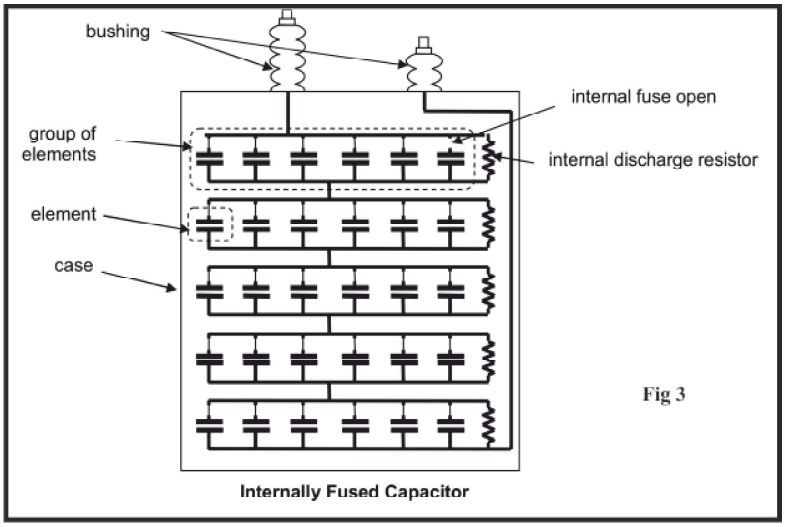


Fig 3

d) Fuse-less Shunt Capacitor Banks

The capacitor units for fuse-less capacitor banks are identical to those for externally fused described above. To form a bank, capacitor units are connected in series strings between phase and neutral.

The protection is based on the capacitor elements (within the unit) failing in a shorted mode, short-circuiting the group. When the capacitor element fails it welds and the capacitor unit remains in service. The voltage across the failed capacitor element is then shared among all the remaining capacitor element groups in the series. For example, if there are 7 capacitor units in series and each unit has 10 element groups in series then there are a

total of 70 element groups in series. If one capacitor element fails, the element is shortened and the voltage on the remaining elements is 70/69 or about a 1.5% increase in the voltage. The capacitor bank continues in service; however successive failures of elements will lead to the removal of the bank.

Manufacturer's experience is that for modern capacitor units all element failures result in strong gas-free welded short circuits on the elements.

The key advantages of fuse less capacitors compared to internally fused capacitors may be considered to be:

- No internal fuse losses resulting in heating and loss of life
- No internal fuses to fail
- Improved protection sensitivity since the loss of an element is more detectable
- Simpler internal construction of the units since there is no need for fuses to be wired into the circuit Simpler external construction of the bank since there is no need for fuses to be wired into the circuit Less likelihood of cascade failures of elements due to overvoltage
- Lower losses due to the absence of fuses

6.8.7 Shunt Reactors

Shunt reactors are used for controlling system voltages. Shunt reactors are either in permanent service or switched daily. Shunt reactors are most electrically stressed equipment in the transmission network system. Some shunt reactors were installed to support system restoration strategies, in particular the need to re-energise the network under a black start condition, following a system shut down. The reactor rating should be chosen to limit the magnitude of the steady state voltage step change during routine switching operation.

There are two kinds of shunt reactors, they are air insulated air core dry type reactors and oil insulated type reactors. Oil insulated reactors can be used at all voltage levels, but the use of air core dry type reactors are limited to MV range.

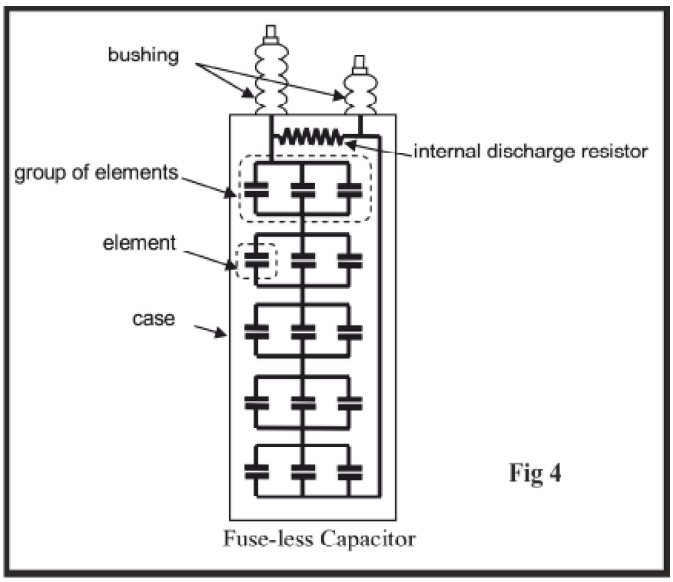


Fig 4
Fuse-less Capacitor


Fig 5. Internally Fused Capacitor Units Damages

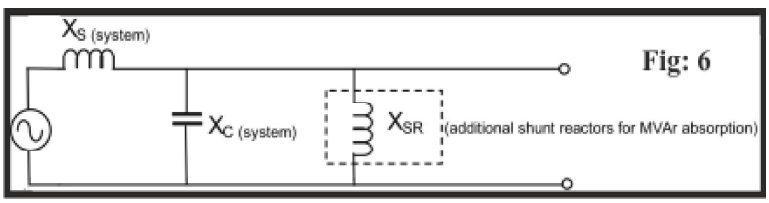


Fig: 6

Air Cored Air Insulated Reactors

Due to magnetic field effect air core reactors need a lot of free fenced space round them. Special attention has to be considered to the location of metallic parts and loops in the vicinity of the air core reactors. The figure below shows using thyristor for switching MV shunt reactor

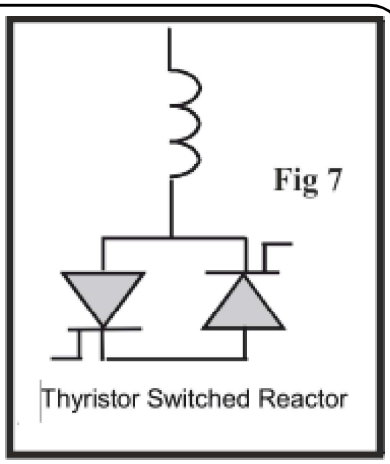


Fig 7

Oil Filled Shunt Reactors

The main use of shunt reactors is for controlling busbar voltage levels associated with cable under Light load condition. Shunt reactors are used directly on the 400kV (200MVAr), 275kV (100MVAr) and 132kV (60MVAr) busbar systems. Normally 33kV and 13Kv shunt reactors ((60MVAr) are connected to the system via tertiary (delta) winding of the system transformer.

6.8.8 Series Reactors

For example in the design of a new system, available switchgear ratings at the higher or lower voltages may be inadequate and it may be uneconomic to install higher voltage equipment to meet the inherent fault levels of the networks. Fault level limitation must therefore be employed to reduce fault currents to within an acceptable level. Alternatively, due to the expansion of an existing system the new fault levels may exceed the capacity of installed circuit breakers. Hence a decision must be made whether to employ fault level limitation or to up-rate the switchgear.

An obvious extension to the choice of major electrical plant impedances to contain fault levels is the incorporation of additional impedances in the form of series current-limiting reactors into a network. However since reactors are by way of extension, they are associated with similar disadvantages and may tend to aggravate problems already existing in a network. Instances actually exist where reactors have been purchased and installed in the system and it has not been possible to retain them in circuit because of the aggravation of a voltage regulation problem or a machine stability problem. Other disadvantages often associated with current limiting reactors are problems with reactive power demand, power ordering difficulties and loss of system flexibility.

An important consideration when using series reactors is that increasing system reactance this will increase X/R ratios of the system increase the DC time constants. This can have full of implications for circuit breaker duty even with reduced short circuit current levels. The MVA rating of the series reactors is to be co-ordinated with the thermal rating of the adjacent network equipment including switchgear.

Series current-limiting reactors are most often employed where the normal load transfer is low and the required degree of fault level reduction is not great so that a reactor with a small percent impedance on rating is sufficient. The use of small reactors as busbar couplers, for example, has in many cases provided a satisfactory solution to a fault level problem.

AREVA have designed, installed and commissioned series reactors for National Grid 400kV power systems at Kingsnorth, Grain substation and EDFE 132kV power systems at Bankside substation.

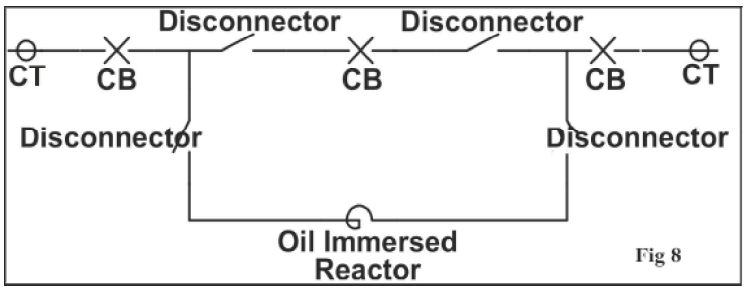


Fig 8

When the series reactor wants to be energised, first the line CB should be closed, second the bypass CB to be closed the third outgoing line CB to be closed and then the bypass CB to be Opened to energise the series reactor. However POW switching relays can be used on CBs for particularly for opening.

(To be Continued)

Courtesy: V. Ayadurai Bsc, C.Eng, FIEE
Engineering Expert

ZERO-EMISSION POWER GENERATION TECHNOLOGY DEVELOPED IN IIT DELHI

A view of Hydrogen Fuelled Spark-ignition Engine Generator for Electrical Power Generation… IIT Delhi and KOEL have jointly filed a patent application for the technology

Diesel-fuelled internal combustion engine generator for electrical power generation mainly emits Carbon Monoxide (CO), Hydrocarbon (HC), Smoke, Particulate Matter (PM), Oxides of Nitrogen (NOx) and Carbon Dioxide (CO_2) emissions resulting in a contribution to air pollution.

To tackle this, in 2021, researchers at the Engines and Unconventional Fuels Laboratory, IIT Delhi developed a new technology and built "Hydrogen fuelled Spark-Ignition Engine Generator" in collaboration with Kirloskar Oil Engines Limited (KOEL), and the Indian Oil R&D Centre for the utilization of hydrogen in internal combustion engines for zero-emission with higher thermal efficiency. A dedicated lubricating oil for the engine was also developed by the IOCL.

The technology will be useful to the industries (chloro-Alkali, Ammonia, etc.), those are producing hydrogen as tangible or main products, to generate electrical power to meet their inhouse-power requirement in the industry.

The developed hydrogen engine can also be used in decentralized power generation for industries, buildings, etc. Thus, the green power with hydrogen can be generated using the multi-cylinder spark-ignition engine generator with the developed technology for strengthening the sustainable energy and environment.

Courtesy: Electrical India

Wind energy is one of the sustainable forms of energy currently available. It harmesses the power of naturally moving air to spin wind turbines, which in turn generate electricity. Not only is this great because it provides a regenerative form of energy but it also does so without green house gas emissions.

TAKING CARE OF YOUR ELECTRIC 2W DURING MONSOON

With monsoons fast advancing across various parts of India, water-clogged roads become an unavoidable reality. It is a good time to understand water safety ratings, especially from the perspective of Electric 2 Wheelers. ***GurusharanDhillon, Director of eMobility at Customised Energy Solutions,*** *shares the guidelines for taking care of electric two-wheelers during the monsoon season.*

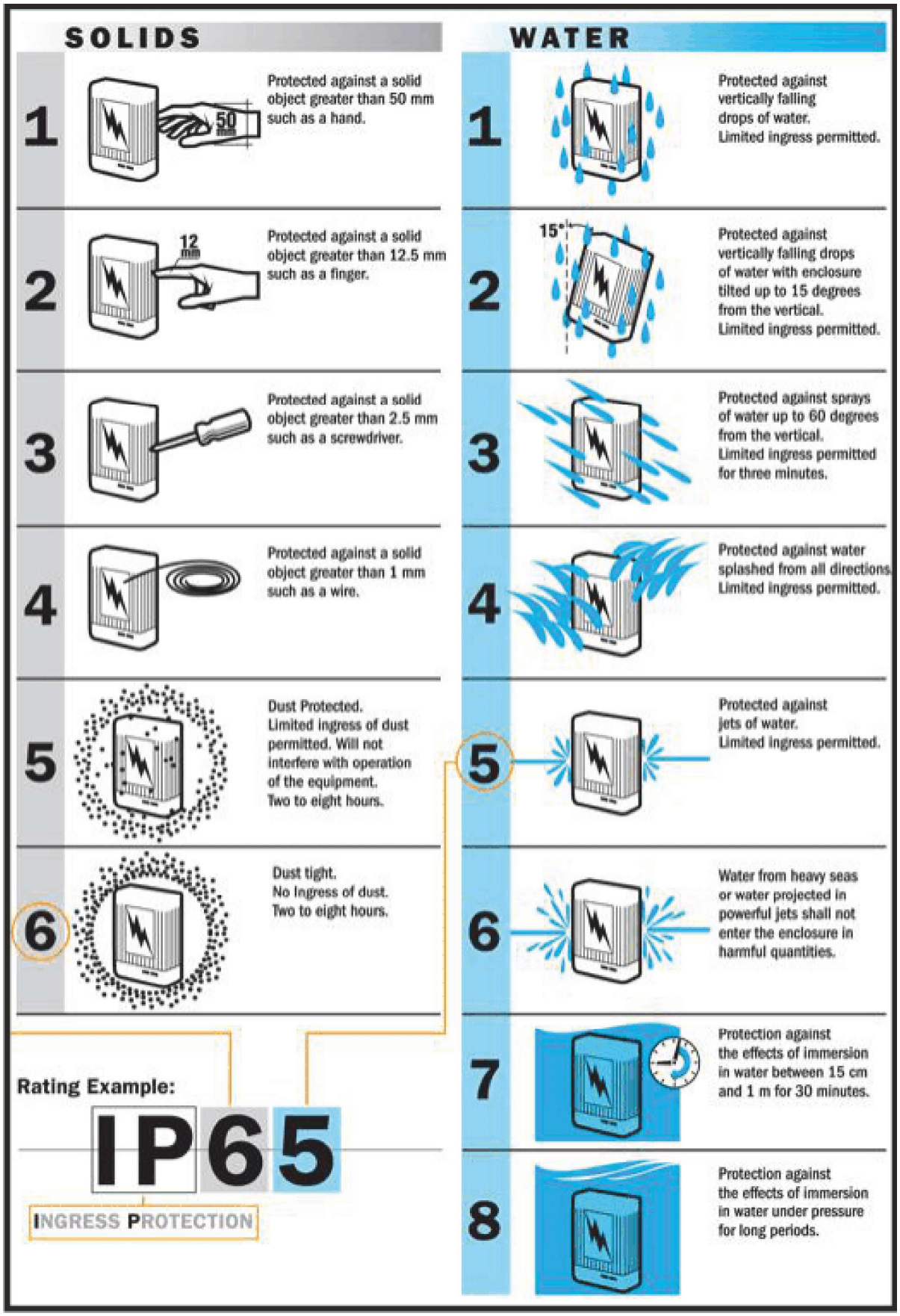
The **mounting position of an electric scooter's motor** can either be Hulb mounted or Mid Drive. In case the motor is mounted on the hub of the wheel, it is placed approximately 150 – 160mm over the ground. The mounting position for a Mid Drive Motor may be slightly higher and can range from 200mm to 210mm, depending on the vehicle. We also need to bear in mind that because of the higher wheel diameter Electric Motor Cycles are at an advantage as compared to electric scooters due to higher ground clearance.

Water ingress into the Electric motor housing of the Motor can severely impact the entire electrical system of the vehicle, causing short circuits and permanently damaging the motor, windings and control unit, along with corrosion on the Bearings. Water ingress can also be a concern for the Battery pack, especially if the mounting location is on the floor board of the Electric scooter. Additionally, due consideration needs to be taken for other aspects like the information Display unit, sensors, controllers and other sensitive components.

During the Vehicle development stage, OEMs expose vehicles to highly demanding testing conditions to challenge product capabilities in all environments like extreme temperature, vibration, water wading, impact and all possible road conditions and terrains. **With that reassurance in mind, let us quickly look at what does Ingress Protection Code mean, how it is measured and what level of Ingress Protection (IP) rating can help assure for our Electric 2 Wheelers.**

Ingress Protection Code is defined by International Electrotechnical Commission (IEC) under applicable international standard IEC 60529, which classifies the degree of protection against dust and water

The detailed IP rating table is as below:



1M = 1000mm Information Source: International Electrotechnical Commission

Additional detail on testing methods specifically for IP 65, 66 and 67 are as below

Rating	Description	Detail	Test Method
IP65	Protection against low-pressure water jets from any direction	Water projected from a nozzle (S† 6.3mm) from any direction	Duration: 3 minutes Volume of Water: 12.5 L/min Pressure: S 4.4PSI at distance of 3m
IP66	Protection against high-pressure water jets of heavy seas	Water projected as powerful jets (S 12.5mm nozzle)	Duration: 3 minutes Volume of Water: 100 L/min Pressure: S†15PSI at distance of 3m
IP67	Protection against temporary immersion in water up to 1 meter for 30 minutes	Immersion in water under defined conditions of pressure and time (up to 1m of submersion)	Duration: 30 minutes Immersion at depth of at least 1m measured at bottom of device, and at least 15cm measured at top of device

Critical electrical components of an Electric 2W comply with IP65 and above ratings (Battery Pack, IPX7 is now mandatory as per AIS – 156 regulation). This information on ingress protection and stringent development and testing protocols for Electric 2W's is reassuring and helps alleviate many concerns related to the use of Electric 2W in rain.

Answers to some important questions regarding your Electric 2 Wheeler during monsoon are as below:

Parking:

It is recommended to park your Electric 2W in a flat, covered and dry location during rains however, if this is not possible, kindly cover your electric scooter with a good quality water-resistant cover to help safeguard your vehicle.

Charging:

Due consideration has been made on both the vehicle as well the charger side to support all-weather operations. On-board sensors establish a connection between the charger and vehicle after the system validated safety, after which the flow of current starts. Charging is normally suspended as soon as the system detects any concern.

While it is safe to charge your vehicle in the rain after making sure that the charging gun and charging socket are dry, it is advisable to do so only as an exception in case of any exigency rather than as normal practice.

Driving:

Driving any 2W in heavy rains is not recommended from a safety perspective. However, Electric scooters are safe to use in light rain or drizzle conditions without any concern. If you are caught in unexpected heavy rain, it is advisable to find shelter for yourself and your vehicle from rain as soon as possible.

Water Logging:

Electric 2W are elaborately tested for water wading capabilities. If your normal route entails having to go through a water-logged area, it is safe to do so; however, after reaching your destination, please park your vehicle in a flat, covered and dry location to allow water to drain out.

The information shared above is advisory in nature, and it is recommended to always consult OEM Owner's manual or their Contact centre for any specific queries and further clarifications. Wishing you safe riding in all seasons.

Courtesy: EV Corner

ESTIMATING ELECTRICAL POWER REQUIREMENTS FOR FIRE FIGHTING PUMPSETS IN RESIDENTIAL BUILDINGS - PART - 2

THE BRIEF – WHAT ELECTRICAL ENGINEERS CAN DO TO ENSURE SAFETY AND SECURITY OF RESIDENTIAL BUILDINGS

1. In the fire safety and security system of the residential buildings, the electrical engineers play a major role.
   - The fire fighting pumpsets are powered and controlled by the Electrical Engineers.
   - The fire alarm systems are powered and controlled by the Electrical Engineers.
   - The Security Systems are powered and controlled by the Electrical Engineers.
2. The connected and demand load of these systems need to be properly understood and planned.
3. The location at which the power needs to be provided needs to be understood.
4. The reliability of the power supply needs to be understood.
5. Unauthorized use or disruption of the power supply needs to be avoided – it should be ensured that unauthorized personnel should not be able to operate or switch-off the systems.
6. The voltage drop in the systems needs to be understood etc.

We saw in the last part of the article the limitations faced by the Electrical Engineers in coming to a proper judgement.

We also saw in the last part of the article that with the fire fighting pumpsets being important equipment to utilize power, the various types of applications for the fire fighting pumpsets - for example they may used to feed water for hydrant system, sprinkler system, water curtain system, water mist system etc.

We reviewed the requirements of National Building Code – the code applicable all over our Bharat. This tabular column of NBC 2016 has three important sections –

- Type of building occupancy for residential building.
- Type of installation required for the occupancies – first aid hose reel, wet riser, down comer, yard hydrant and automatic sprinkler system.

FAST FORWARD

The Table -7 in the National Building Code is very elaborate please, we had gleaned out type of building occupancy for the residential buildings and the types of installation for the various occupancies.

We will now see three additional detailing of the NBC Table – 7 below:

- Minimum water quantity required in litres
- Minimum pump capacity in litres. (We can see in this tabular column that only the capacity of the pumpset is indicated, but the head required for the pumpset is not indicated. In our next issue we will see the rule of the thumb to work out the head of the pump and hence the kW required of the pump. This way, our esteemed electrical engineers can question the architect / fire contractor if the power requirement indicated is very different!).
- Applicable notes of Table -7.

As the detail in the NBC Table -7 is very elaborate, we had to present the concise information in two issues of the journal please.

We request our esteemed readers to read the details of the earlier journal and this journal together for getting complete information.

Sr. no.	Type of building occupancy	Water Supply in litres	
		Underground static Water storage tank Combined for Wet Raiser, Yard Hydrant and Sprinklers per set of Pumps	Terrace tank over Resetive Tower Terrace
1	2	8	9
	RESIDENTIAL BUILDING (A)		
a)	Lodging and Rooming (A-1) (see Note 3)		
1)	Less than 15 M in height		
	i) Up to 15 rooms	NR	5 000 (see Note 5)
	ii) More than 15 and up to 30 height rooms.	NR	5 000 (5 000) (see Note 6)
	iii) More than 30 rooms	NR	10 000 (5 000) (see Note 6)
b)	One or Two Family Private Dwellings (A-2) (see Note 3)	NR	NR
c)	Dormitories (A-3) and Apartment Houses (A-4)		
1)	Less than 15 M in height	NR	5 000 (5 000) (see Note 6)
2)	15 m and above but not exceeding 35m in height	NR	25 000
3)	above 35m but not exceeding 45m in height	75 000	5 000
4)	above 45m in height but not exceeding 60m in height	150 000	10 000
5)	above 60m in height	200 000	10 000

1 These shall include any building in which sleeping accommodation is provided for normal residential purpose with or without cooking or dining or both facilities, except any building classified under Group C.

Subdivision A-1 Lodging and rooming houses- These shall include any building or Group of buildings under the same management, in which separate sleeping basis, with or without dining facilities but without cooking facilities for individuals is provided. This includes inns, club, motels and guest houses.

Subdivision A-4 Apartment houses - These shall include any building or structure in which living quarters are provided for three or more families, living independently of each other and with independednt cooking facilities, for example, apartment houses, mansions and Chawls.

3 Buildings above 15m in height are not to be permitted for occupancies A-1 and A-2

4 Required to be installed in basement if area of basement exceeds 200 m sq.

5 Required to be provided if basement area exceeds 200 m sq.

6 Additional value given in parenthesis shall be added if basement area exceeds 200 m sq.

7 Required to be provided for buildings with more than two storeys (Ground+ One).

8 Required to be provided for buildings with height above 15m and above

9 Sprinklers shall be fed water from both underground static water storage tank and terrace tank.

10 Provide required number of sets of pumps each consisting of one electric and one diesel pump (stand by) of capacity 2 280 litre/min and one electric pump of capacity 180 litre/min (see also Notes 22 and 23)

11 Provide required number of sets of pumps each consisting of one electric and one diesel pump (stand by) of capacity 2 280 litre/min and one electric pump of capacity 180 litre/min (see Fig. 12) (see also Notes 22 and 23)

12 Provide required number of sets of pumps each consisting of one electric and one diesel pump (stand by) of capacity 2 850 litre/min and one electric pump of capacity 180 litre/min (see Fig. 12) (see also Notes 22 and 23)

13 Lower levels in high rise buildings 60 m or above in height are likely to experience high pressure and therefore, it is recommended to consider multi-outlet pumps (creating pressures zones) of variable frequency drive pump or any other equipment arrangement.

		Pump capacity in lpm	
Sr. no.	**Type of building occupancy**	**Pump near underground static storage water tank (Fire Pump with minimum pressure of 3.5 Kg/cm² at Remotest Location)**	**At the terrace tank level with minimum pressure of 3.5 kg/cm²**
1	**2**	**10**	**11**
	RESIDENTIAL BUILDING (A)		
a)	Lodging and Rooming (A-1) (see Note 3)		
1)	Less than 15 M in height		
	i) Up to 15 rooms	NR	NR
	ii) More than 15 and up to 30 height rooms.	NR	450 (450) (see Note 6)
	iii) More than 30 rooms	NR	450 (450) (see Note 6)
b)	One or Two Family Private Dwellings (A-2) (see Note 3)	NR	NR
c)	Dormitories (A-3) and Apartment Houses (A-4)		
1)	Less than 15 M in height	NR	450 (450) (see Note 6)
2)	15 m and above but not exceeding 35m in height	NR	900
3)	above 35m but not exceeding 45m in height	(see Note 10)	NR
4)	above 45m in height but not exceeding 60m in height	(see Note 11)	NR
5)	above 60m in height	(see Note 12 & Note 13)	NR

Furthering Note:

In the next issue of the journal, we will complete the major requirement of estimating power of the fire pumpsets.

Fires in residential buildings are increasing and Electrical engineers hold the key to understanding the safety systems and providing suitable electrical systems to protect Life and Property Safety. All the best to our readers.

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STATIC ELECTRICITY CAN KEEP DESERT SOLAR PANELS FREE OF DUST

Dust drastically lowers the output of solar panels, but applying an electric field to the panels can make dust particles repel each other and disperse

Static electricity could remove dust from desert solar panels, saving around 45 billion litres of water every year.

Some of the largest solar farms in the world are in deserts, such as Mohammed bin Rashid Al Maktoum Solar Park in the United Arab Emirates and Desert Sunlight Solar Farm in California. These environments tend to be very dusty, with particles quickly accumulating on solar panels. One month's dust build-up can cut a solar panel's output by around 40 per cent.

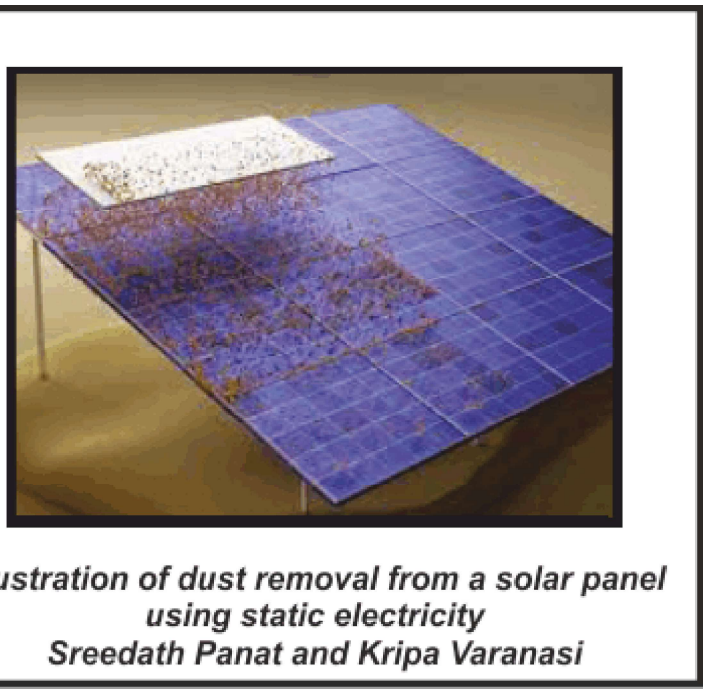

Illustration of dust removal from a solar panel using static electricity
Sreedath Panat and Kripa Varanasi

One of the most common ways of removing this dust is to spray large amounts of distilled water onto the solar panels. With an estimated 45 billion litres of water being used every year just to clean solar panels, the process is costly and unsustainable, says **Kripa Varanasi** at the Massachusetts Institute of Technology.

"That amount could provide water for over a million people [every year]," he says.

To help solve this issue, Varanasi and his colleagues created a water-free way of cleaning solar panels via static electricity in the laboratory.

Dust doesn't ordinarily conduct electricity. This changes, however, when **moisture in the air** attaches onto the surface of a dust particle – a process known as adsorption. The thin glass sheets that cover solar panels also aren't conductors. To change this, Varanasi's team added a 5-nanometre layer of transparent zinc oxide and aluminium to a solar panel's surface.

A metallic plate was then hovered above the dust-covered panel, and an electric field of around 12 kilovolts was applied between the plate and the panel. This caused both layers to become electrodes, conductors that make contact with a non-metallic part of a circuit.

The **solar panel** and dust then became positively charged, while the metallic plate became negatively charged. As the plate swept above the panel, dust particles started to repel each other, causing them to disperse.

At around 30 per cent relative humidity, the dust particles adsorbed enough moisture to be completely removed from the solar panel in the laboratory, restoring 95 per cent of its lost power output. Even the driest deserts have a relative humidity of about 30 per cent, says Varanasi.

Courtesy: Chen Ly

Solar Power is going to be absolutely essential to meeting growing Energy demands while starving off Climate change.

– RAMEZ NAAM

RECENT INVENTIONS IN THE ELECTRICAL ENGINEERING INDUSTRY

1. Medical - Notable recent innovations in Medical Electronic Engineering have come in robotics and augmented and virtual reality.

Robotics - One of the most significant new inventions in medical electronic engineering involves robotic surgery. In minimally invasive procedures, robotic tools are useful because they offer precision, flexibility and extreme control. The result is that surgeons can use automated capabilities to perform surgeries that would otherwise be needlessly complex or impossible altogether. Robotic surgical technology is not likely to replace human surgeons — instead, it will assist and enhance their work.

Virtual and Augmented Reality - The development of virtual and augmented reality (VR/AR) is one of the most influential trends in electrical engineering. In medicine, VR/AR is helpful for providing convalescent patients with an immersive way to participate in rehabilitation exercises. VR/AR is also invaluable in training tools for medical students — students can engage with augmented or virtual scenarios to become familiar with new procedures or see 3D representations of difficult-to-visualize human anatomy.

2. Consumer - Many recent innovations in Consumer Electrical Engineering have to do with wearable devices and electric vehicle capabilities.

Wearable Devices - In wearable consumer devices, wireless technology has been making exciting advances. Smart watches and similar wearable devices help users monitor their health and athletic performance. Wireless technology — often Bluetooth Low Energy — means these devices can be smaller and more convenient to use because they run on smaller, longer-lasting batteries.

Innovations in wearable devices also have lifesaving potential in industrial applications. Some wearable devices can vibrate to notify engineers if they get too close to high-voltage equipment, and they can provide valuable data without requiring a smartphone for access. Wearable devices also increasingly have the technology to facilitate authentication — if someone approaches sensitive equipment without the right wearable device, the machine will not grant access. These innovations dramatically increase electrical engineers' work place safety.

Electric Vehicles - Electric vehicles have steadily been gaining in popularity, and they are almost certainly the vehicles of the future because of their energy efficiency and reduced carbon emissions. Tesla, for instance, recently rose to **$100 billion** in market valuation — it is the first publicly traded carmaker in the United States to do so — and shows no sign of slowing down anytime soon.

Industry experts predict that by the year 2030, the number of electric vehicles on the road in the United States will have **ballooned to 18.7 million**, up from only about 1 million at the end of 2018. Heavy investments in electric vehicle technology mean consumers have seen — and can anticipate — the emergence of various innovative improvements, including more powerful, longer-lasting batteries; enhanced charging technology; genuinely functional autonomous driving; and solar-powered vehicles. There's even the possibility of electric airplanes.

Wireless Charging - One area of technology that holds particular promise for expanding the electric vehicle market is wireless charging. Wireless charging has some current applications for personal devices like laptops, smartphones and earbuds, and it will likely eventually become standard for electric vehicles as well. An electric car owner will be able to park on a charging spot without the hassle of plugging in the car. Wireless charging docks will also be smaller, so they'll likely become easier and more cost-effective to build.

3. Industrial - In the industrial field, a few different innovative technologies are emerging as game-changers. Here is some of the latest technology in electrical engineering for industry:

Augmented Reality - Advances in augmented reality are taking place substantially for industrial use — **65% of VR/AR companies** report that they are working on **industrial applications**, while only 37% are working on consumer products. VR is useful in industrial facilities because it allows companies to simulate dangerous industrial scenarios without putting their employees through the actual risks. AR is useful because it super imposes data on a real visual to give engineers and technicians real-time information about the industrial systems they're working with and helps them take more informed approaches to repairs and maintenance.

Smart Grid - More and more commercial and industrial consumers can generate their own power and even sell their surplus. This development has changed electrical delivery infrastructure, in part with the advent of smart grids.

Smart grids contain smart devices throughout their infrastructure, including in homes, offices and industrial facilities. These smart devices collect and supply data that allows industrial facilities to analyze trends and make more informed, efficient and cost-effective choices about their electricity use. The devices can predict surges in usage and prepare for the higher demand, and they detect outages at once and notify the personnel who can rectify them.

Perhaps most importantly, the smart grid allows for communication between the power company, distributors and end-users and helps boost efficiency and lower costs by facilitating a quick resolution of any issues.

Graphene Super-capacitors - Super-capacitors store energy and have higher capacitance values and lower voltage limits than traditional capacitors and can function somewhat like rechargeable batteries. Graphene super-capacitors are super-capacitors that use **graphene in place of activated carbon** in their electrodes.

A super-capacitor, which can often store almost as much energy as a lithium-ion battery, offers the advantages of increased energy storage. Super-capacitors allow for the power density of capacitors — they can deliver a lot of energy in quick bursts — while also providing high energy storage capabilities and charging incredibly rapidly. Graphene helps enhance super-capacitors because it is exceptionally conductive, so graphene super-capacitors are ideal for high-frequency applications, whereas traditional super-capacitors are not. Graphene allows for structuring and scaling down, so it has applications in computer processing units (CPUs) and integrated circuits where standard capacitor materials do not.

Graphene super-capacitors may also be able to combine with carbon nanotubes to help connect the geometrically unique graphene structures into a comprehensive network. This combination might reduce costs and boost capacitance and performance.

The IoT (Internet of Things) - Many disciplines of electrical engineering are affected by the Internet of Things. IoT is linked with a variety of electrical engineering fields, including smart grids, smart lighting, and visible light communication (VLC), among others; an electrical engineer must be familiar with IoT.

Smart inverters, advanced meeting infrastructure (AMI), remote control operation of energy-consuming equipment, and SCADA are examples of IoT applications in electrical energy, in addition to typical grid benefits like monitoring, distribution, and automation.

Better Drones - When people think of drones, the first thing that springs to mind is movies or other forms of entertainment. But drones aren't just for that.

Drones have several uses outside of the entertainment business. According to a recent survey, engineering and construction sites are the most common places where drones are used, and this industry is continuously developing. Drones could boost security by up to 55 percent.

Drones are used by electrical engineers to investigate potentially dangerous conditions without putting themselves in danger. With its cameras, infrared, and other sensors, it saves the lives of electrical engineers and provides a clear picture of the hazard. Drones also aid in the recording, examination, and analysis of the job site, providing reliable data and increasing production.

Artificial Intelligence - Artificial intelligence (AI) can help make electrical engineers' jobs much easier in an industrial setting. They allow for several significant improvements in engineering work, including:

- Constructing AI and machine learning platforms for more complex and capable equipment.
- Crafting complicated algorithms for data analysis.
- Developing new codes or enhancing current code.
- Processing images.

AI image processing, in particular, opens substantial new doors in engineering for industrial applications. Image processing with AI is easier because AI allows for more sophisticated algorithms — they can perform tasks like detecting structural irregularities in equipment and sending feedback to alert facility managers to the necessity of repairs, thereby promoting safety in the workplace.

LEARN ELECTRICAL SAFETY OBSOLUTE BEGINNERS - 1

Electrical Safety - Power System

The power system consists of a three-stage network – generation, distribution, and transmission. The power system is responsible for the production of electricity with the help of energy such as coal and diesel. All the devices connected to the system such as a motor, circuit breaker, transformer, etc., fall under the umbrella of a power system.

Components of a Power System

There are six main components of a power system. Let us see what the components are –

The Power Plant - The place where power is generated and set for transmitted with the help of a transformer.

Transformer - Transmit electrical energy from one circuit to another.

Transmission Line - The power passes through the transmission line towards the substations.

Substation - Power is transferred to the distribution line through a medium.

Distribution Line - It comprises of low and medium level power lines that connect to the distribution transformer.

Distribution Transformer - From the distribution line, the electricity is distributed to consumers as per an appropriate value.

Causes of Hazards - Electrical hazards are recorded in thousands of number per year, which includes more than 30 fatality cases. Therefore, it is essential to stay away from electrical hazards.

Several factors lead to electricity hazards. The factors are described below in brief –

Faulty wiring - Exposure to loose, frayed and naked wires possess a severe health risk. It is the responsibility of the worker to report cases for damage or faulty cable to the authority as soon as possible. The best way to avoid risk is to inform everyone about it and never try to deal if one is not legally authorized.

Improper usage of equipment - Practicing a safety approach for using electrical equipment is imperative. If a worker is not permitted and trained to use a particular electrical device, then he/she should avoid using it. Sometimes live equipment can seem dead and can cause a severe fatality. A worker should also avoid using electrical tools when on a suspended platform unless he/she is entitled to it.

Overused outlets - All electrical outlets have thresholds. After usage, an outlet starts to fray and poses a risk. When overused, an outlet begins to overheat or generates less power than usual. If a worker experiences an overheating or sparks from an outlet, then he/she must inform the authority rather than dealing with it him/herself.

Exposure to liquid - Water and all other liquids are a good conductor of electricity. Therefore, all workers should always try to keep their electrical equipment away from any liquid. Also, while using electric equipment, all workers must pat their hands dry to avoid any shock or burn.

Need for safety - Electrical hazards are something that should be taken seriously in a workplace. Every organization has to conduct an electrical safety programme for all their workers. Apart from informing them about the hazards, the workers should also take a safety workshop.

Many workers in a workplace do not pay much heed towards electricity hazards. Some think that electrical related incidents are a part of life and some even believe that accidents can never happen to them. What makes it worse is that, some workers think that health risk is a part of their job and it cannot be avoided. Such type of careless attitude among employees results in more work-related injuries. To bring effective changes in worker's perspective, a safety program is of paramount importance.

Courtesy: Tutorials Point

HOME FESTIVALS - 10

Aippasi (October/November)

Skanda shasti is the first festival of this month(right), commemorating the victory of Lord Murugan over the demon Sura, of the higher, spiritual self over the lower nature. **Dipavali is the major event of Aippasi**, celebrated everywhere Hindus live and by Buddhists and Jains, too. In one story of its origins, Vamana, the dwarf avatar of Lord Vishnu, requests the amount of land from King Bali that he can cover in three steps. Granted the request, Vamana covers with his first step all of the Earth, with the second all of the sky, and then asks the king where to take the third step. The king offers his own head (lower left), and in commemoration of the king's humility, the day was established. In another story, Lord Vishnu (center) kills the demon Naragasvaran with His discus. The various observances (lower right) of Dipavali include an oil bath, gifts of new clothes, fireworks (sufficiently indulged in Chennai to rattle dishes off the kitchen shelves), oil lamps for display and abundant pots of delicious food. The early morning bath is always considered to be in the Ganga itself, so one greeting of the day is, "Did you have the Ganga bath?"

HOME FESTIVALS - 11

Karttikai (November/December)

Krittika Dipa (right) is a joyous festival held on the Kritttika nakshatra (when the moon is in Pleiades constellation). Also called Sivalaya Dipa, it is celebrated most famously at Tiruvannamalai (upper left in the painting), on top of Arunachala Hill, home of saint Ramana Maharishi. A bonfire is lit on top that can be seen for miles around. Karthigai Purnima, the full- moon day, honours Lord Murugan. In one traditional story, six sparks from Siva's third eye became six babies (lower left), later gathered into one six-headed Arumugam (centre) by Parvati. Celebrations include lighting hundreds of oil lamps especially the standing lamp (right) of the home. On this day in Orissa, devotees make banana leaf boats and float them in the river with oil lamps.

(To be continued)

Courtesy: What is Hinduism?

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