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!

Greetings For a Happy and Prosperous 2021!!

Happy Pongal Greetings!!!

Happy Republic Day Greetings!!!!

The New Year 2021 is born with lot of anxieties and challenges with regard to health and normal life of all people, peace, prosperity and progress in all activities of the nation, harmony, peace and goodwill among nations of the world, to mention a few. Let us invoke the Blessings of Gurus and Gods to bestow the blessings and restore the welfare of the World.

As usual January makes us celebrate Pongal, the farmer's festival, the Republic Day that makes us feel proud about our Independent and Democratic India, and January makes us sadly remember the day of Martyrdom of Father of Nation Mahatma Gandhi. It is very unfortunate that the events in the midst of which the New Year is born connects all the three, namely Agriculture, Democracy and the Mahatma and it is certainly the fervent appeal of all 'Good Citizens' of our country for good senses to prevail in all concerned people. All the three areas of our economy namely Agriculture, Manufacturing and Services have recorded sufficient progress since our first Republic Day in 1950, but it is really the Agriculture that excelled during 1979 – '80 itself recording self-sufficiency in our food production. This is no mean achievement as we got Freedom with abundance of poverty and large deficiency of food grains, which, in subsequent years drove us to live on "Ship to mouth" situation of dependence of alms of ship loads of food grains from other countries. It is the farmers who rose to the occasion and extended their might with the "Green and White Revolutions" of the country which is making the country feel secure and proud till date. Mahatma Gandhi used the tool of agitations to fight the Colonial Rulers before independence. We are a vibrant democracy to day and we can feel proud about our record as a long standing democracy, when the whole world thought that, given the kind of diversities in all aspects of languages, religions and so on, India will not survive as a democracy. In democracy, there can only be protests to register the disagreements and remedies through the process of law and the ballots and there is no place for unending protests and dictating terms, as is being resorted to by farmers now, as it can give room for undesirable developments for the citizens at large. Let us hope and pray for things to settle down sooner than later.

January is also the month (January 11th) which marks the death anniversary of another true Gandhian, Sri Lal Bahadur Sastry, who gave us the Slogan of "Jai Jawan! Jai Kisan!!" which is really needed to reverberate across our country to echo our faith in our Agriculture and the Army. We also remember Nethaji Subhash Chandra Bose this month that certainly loved our Mother Land the most and literally gave his life for the cause of freedom for our Nation.

We thank all those members who have helped us by participating in the advertisement appearing for the issue December 2020 – E Power, Gravin Earthing, Mahindra & Mahindra, Mersen, Supreme Power Equipment Pvt. Ltd.

Editor

Thiru. C. MUNUSAMY
15.05.1950 – 24.12.2020

OBITUARY

On behalf of the Tamilnadu Electrical Installation Engineers Association 'A' Grade extends **Heartfelt Condolences** for the demise of Our Member **Thiru. C. Munusamy,** ***Proprietor*****,** ***The Ganga Consultants and Contractors*****,** Chennai – 600 106.

We pray the almighty to rest his Soul in Peace.

ELECTRICAL INSTALLATION ENGINEER

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CONTENTS

KNOW THY POWER NETWORK - 155

Energy conversion from "Start to End"

Part – II

This part / portion mainly deals with Electrical Energy. The readers especially Energy Auditors may be interested in knowing / learning the roles played by various factors / players that cause / bring losses during the flow of electrical energy through the three phases / stages already out lined i.e. during its flow from the "Supplier Side – Metering Point" – to the "End use". The more attention you give to these factors, the better will be the results.

I. Meet the players concerned

a. Before energy conversion. i.e. What is happening in phase – I of energy conservation

During this phase, the electrical energy flow suffers mainly "I^2R losses or line losses". As out-lined in Fig 7 in the last article, the factors that demand attention are treated one by one here. Most of them need no elaboration, since the readers know them very well. These simply exhibit the leakage areas.

I. Power Factor - the ratio of active energy in KW (usable energy) to the gross electrical energy supplied (in KVA) i.e KW / KWA (e.g) $\frac{8\ \text{KW}}{10\ \text{KWA}} = 0.8\ \text{lag.}$ It indicates the quantum of energy that is beneficially utilized. Higher the power factor (lagging) greater will be the beneficial usage of the supply energy. In other words, it simply underlines the "Main requirement" Viz the reactive power should not flow or supplied from supplier's side in large quantities to the Demand / Load side. It should be created / generated locally nearer the loads by the provision of suitable shunt capacitor (fixed / variable) or by any other means. So when low PF exists in the circuit, it indicates the paucity of VAR flow and the need for its generation locally i.e low PF means higher losses. We should ensure that under no circumstances the PF should go below 0.8 lag. Only in arc welding processes, it can be tolerated upto 0.6 lag.

II. Load Factor or Demand Factor – It simply shows how the equipment in service are beneficially used; Low load factor means the equipment installed in the service connection concern are not optimally / beneficially put into use; precisely most of them run below their assigned capacity. By definition

$$\text{Load Factor} = \frac{\text{Actual consumption (in KWH)/day}}{\text{Max demand x 24 Hrs/day}}$$

During my Energy Audit in one of the HT services in Chennai, the contracted demand was found to be around 13 MVA whereas the actual demand was in the order of 2-3 MVA only. It simply shows how the electrical energy is wasted in that service and it needed closer attention. Mainly its demand and consumption patterns required special attention so that its losses due to lower / inadequate running of its equipment are stemmed.

III. Diversity Factor – It simply shows that with the available quantum of power, how all the connected loads in the premises are met with i.e. it simply reflects the effective usage of the electricity supplied to the premises. This condition warrants that it should always be higher; lower diversity factor means inadequate apportionment of the received electrical energy in that location and it leads to higher losses; normally diversity factor below 1.5 is not desirable.

IV. Harmonics – It simply mirrors the presence of other wave forms with higher / lower frequencies in the supply i.e. presence of wave forms of other than fundamental frequency (50 Hz) (higher / lower order fre-wave forms). All these waves superimpose on the fundamental frequency wave that is generated in the generating machines (50 Hz). The unwanted adding up of other

frequency waves leads to the distortion of fundamental fre-waves form. The presence of higher order harmonic waves lead to heating and higher I^2R losses; other notable impacts include resonance phenomenon in that network and mal- functioning of sensitive devices.

The causative factors for harmonics are,

- Presence of switch mode electronic devices in large numbers. Among them, notable are, Television, Computers, Electronic traction equipment, and HVDC converters all power Electronic Devices / Equipment
- Over excited transformers (over fluxing transformers) and motors
- Failed capacitors
- Hot spots, Arcs in OH lines / UG cables; sparks due to over loads and loose jumpers, presence of contaminants on the conductor surfaces
- Corona

V. Imbalance in Voltage – It is a supply side problem and required focused, corrective actions from the supplier only; the receiving end consumers cannot lend his hand nor provide any solutions. However to ward off unwanted losses, servo voltage stabilizers can be employed at the receiving end.

VI. Unbalance in load – It is simply reflected in the neutral current flows. Higher the neutral current flows, greater will be the losses in the neutral. It invariably results in untimely neutral cuts and excess heating. In addition, the rotors of the generating units are impacted by the negative sequences currents caused by such unbalances. Normally neutral current flows should be very low. The remedy demands that proper balancing / sharing of loads in all phases in the power distribution circuits.

VII. Use of Aluminium cables - It requires no detailed discussion since we all know that aluminium is not the apt conductor for transmitting electrical energy. Owing to its very nature, it causes higher losses and other problems like conductor snapping and improper high resistance contacts of supply due to the deposits of Al_2O_3 (white deposit). The only possible corrective measure is to replace the existing aluminium cables with copper cables. We can also install smoke free / heat resistant PVC copper cables (though costly) in the new services.

VIII. Bimetallic Action - When Aluminium and copper OH lines / cables are joined together, without the provision of proper bimetallic connectors, this kind of bimetallic corrosion invariably takes place. The end result will be the total loss / disappearance of copper conductors. i.e. copper part of connection will be eaten by the cheap aluminium conductors with the attendant high energy losses.

IX. Loose connection / Improper crimping of joints and over loading of sockets

This factor also needs no detailed discussion elaboration since all the readers know very well that all the above stated factors will always lead to persistent arcing, higher losses and fire accidents. Some readers might have personally witnessed them.

X. Improper Running – This factor is also known to all readers. When any equipment is run below its capacity, it always lead to poor return of the investments made; in addition it leads to higher losses. Optimal running of the concerned equipment is the correct answer to this sort of problem.

XI. Mishandling or Improper Selection of Equipment – This factor also comes under the category out lined under item 10.

XII. Higher Voltage drop across the connection – *(Refer our Electrical Installation Engineer – Newsletter "July 2015 page 36 – 38)*

It is one of the leading causative factors for higher losses in industrial plants.

Other related factors are,

- Voltage unbalance, over and under voltages
- Undersized conductors
- Low power factor (already explained)
- Leakage to ground
- Poor connections (already out lined)

All these account for 1-4 percent of total plant electrical consumption.

In this connection, it will be of interest to note that inadequate conductor sizing and poor connections account for the 40% of the electrical distribution system losses in the plant, which constitutes nearly "2 percent of plants" annual energy usage. Small size conductor (Inadequate conductor sizing) will result in excessive voltage drop accompanied by increased energy losses and reduced motor torque. In addition, it imposes increased resistance with the consequential heating and additional loading.

This factor is better illustrated in the following case study. This voltage drop information furnished are used to determine energy losses and excess energy consumption. Voltage drop measurement have to be taken across each phase and it is simply the voltage drop across that connection between motor control centre and the motor terminals. This voltage drop should not exceed 2.5-3 percent; if it occurs then install larger than code minimum conductor or limit the loads in each circuit. KWH is calculated taking continuous working for 24 Hrs per day.

No	Line (phase)	Voltage drop measures (volts)	Permissible Voltage drop (Standard)	Excess voltage drop	Current (Amps)	Excess KW	Excess KWH/year
L_1	(Phase R)	8.1	2.5	5.6	199.7	1.12	9.796
L_2	(Phase Y)	5.9	2.5	3.4	205.7	0.7	6.126
L_3	(Phase B)	10.6	2.5	8.1	201.8	1.63	14.318
				Total		3.45	30.240

Assuming Rs.6/Kwh, a saving of Rs. 1,81,443 may be effected per breaker / year (Annual savings)

XIII. In correct maintenance

It needs no special mention, since its importance is well known to all.

XIV. Higher applied voltage

The lighting loads like single phase fluorescent lamps require input voltages in the range of 205-210 volts only for their optimal functioning. Application of voltages in excess of this level leads to unwanted losses, which is approximately at 1% for every 1% increase in the input or applied voltage. In order to achieve the required voltage level for the lighting loads "lighting energy savers" are employed. Kindly note that this measure is applicable only for lighting loads not for other electrical loads like motive power or heating loads.

Now let us move to the next stage / phase of the energy conversion process. It is nothing but the actual energy conversion process. It is the difficult / critical phase faced by the electrical energy flow. It is mainly due to the fact that it is exposed to mechanical parts that are vulnerable to higher losses. So several steps / measures are essentially required to keep these losses in check.

This phase involves the actual energy conversion process Viz. electrical to Hydraulic, Mechanical, Chemical and Heating energy forms. So the main role is played by the connected mechanical equipment like Pumps, Compressors, fans and other energy converting equipment. This is the phase where focused attention is needed to minimize losses that occur during energy conversion. Actually the losses that occur in the electrical part of the drives is comparatively less. That is to say, in a pump connection the contribution of losses by the electrical motor is very much less; the pipe losses and other losses are more. We know motor losses are proportional to its loads. Presently the wide application of super conductivity cables at room temperature to Motors, Variable Speed Drives / Variable Frequency Drives, Squirrel Cage Motors with Torque Adjustments and Energy Efficient Motors restrict these losses. So the major part of the losses that happen in this stage are assigned mechanical part of the drives only. As energy converters, they play a bigger role than other components. Thus far, we have learnt that the second stage of the actual energy conversion process warrants a close attention.

i.e Energy Input – Integrated losses during stages I and II = Actual Energy in the converted form available for further use or end use Applications (i.e. Energy Output)

Slowly we reach the third stage of energy conversion. It mainly focuses on "How the converted energy form is utilized". In a way, it also exhibits the areas / where / wastages take place. (e.g) pipe lines, poor insulation of steam pipes, leakages in compressor pipe connections. It also indicated the possible avenues for the retrieval of the lost / wasted energy (e.g) better utilization of waste heat generated in large motors. This part mainly deals with the possible solutions to avoid losses in the converted energy form before it is actually put into beneficial use.

To summarise, the three major stages / phases in any energy Conservation process are put in a simple way as follows

Electrical energy input ↓ Motor ↓ Mechanical drives ↓ End use ↓

Stage I	Stage II	Stage III
Mainly I^2R losses	Losses due to converting equipment like motors, heaters and connected mechanical drives	Losses in this stage mainly based on how the converted energy form reaches the end use equipment and how it is put into beneficial use
Preliminary stage	i.e Its effectiveness mainly depends on the converters and connected drives	Final Stage
Losses in the energy form before it reaches the converting equipment	How the energy form is converted in the converter	How the converted energy form is utilize

Total losses integration of losses = In all the three stages.

i.e. = (Electrical Input) - (Final output in electrical terms)

Our aim / objective is to reduces these integrated or cumulative losses.

The concluding part comprises of the following

- Key topics that need attention
- Potential areas for energy savings on the supply side

- Focused areas in an industry
- Suggestive measures for energy savings

Topics That Need Attention

- Power Quality of incoming supply
- Power Factor
- Load Factor
- Overloading
- Loose connections

Potential Areas for Energy Saving on the Supply Side

- Phase Balancing
- Reactive Power Optimization
- Effective and Efficient Utilization of Real Power (Active Power)
- Voltage Optimization

Focused areas in an Industry

- Power Delivery System
- Lighting System
- Compressed Air System
- Welding System
- Motive Power System

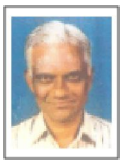
Suggestive Measures for Energy Savings

S. No	Equipment	Control	Energy saving measures	Remarks
1.	Transformer	Breaker / Switch control	1. Single / parallel running – depending on loads 2. Use of energy efficiency star rated transformers 3. Connect fixed capacitors across secondary winding 4. Optimum level of running (70%)	——
2.	Motor	(Load control) Breaker / Air/ Oil medium Switch control (manual) / VFD / Soft stater – ideally running cut off – Delta – star running control – cut out low power factor operation	1. Reduce voltage drop across the connection (use adequate size of copper cables) 2. Application of fibre class fans and flat belts	

3.	Compressor	- Same as motor – + intercoller temperature control + temperature rise control + pressure control + unloading operation cut off	1. Avoid misuse + delivery side leakage of compressed air, avoid long delivery system. 2. Adopt centralized system of compressed air. 3. Avoid running of compressor during low protection period.	Avoid cooling water re-circulation.
4.	Pump	- Same as motor + Flow control device (Van control)	1. Single / parallel operation – depending on water requirement. 2. Replace old impeller with high efficiency impeller.	Avoid water leaks, replace old pump with high efficiency pump
5.	Fans and Blowers	- Same as motor -	1. Change impeller with high efficiency impeller. 2. Adopt required pulleys where ever needed	Avoid excess air conditioning, the end use
6.	Welding set	- Switch or breaker control	1. Provide capacitors across windings	Avoid use of single phase welding set. Instead use three phase welding set.
7.	DG set	- Engine speed and load control	1. Arrange dust free cool inlet water for cooling 2. Avoid low load and low power factor operation	Avoid re-circulation of cooling water.
8.	Lighting System	- Breaker or switch or energy saver, Occupancy sensor, limiter and timer	1. Adopt separate feeder 2. Adopt energy saver for each circuit	Clean the fitting frequently

With this, I conclude this article

(To be continued)



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on Behalf of the
Tamilnadu Electrical Installation
Engineers Association 'A' Grade
extends *Heartfelt Condolences*
for the demise **of Mrs. V. SAMBAVI** (67),
W/o Mr. V. Sankaranarayanan, Author,
Know thy Power Network, NEWSLETTER
on 24.12.2020.
We Pray the almighty to rest her Soul in Peace.

HOW TO SELECT THE CORRECT AUTOMATIC TRANSFER SWITCH

Deciding Factors

There are a number of different factors to consider when selecting an automatic transfer switch for a diesel generator, the most important being size. Part one of this article will discuss the type of load, voltage rating and continuous current rating.

Careful selection of an automatic transfer switch is important to ensure maximum reliability and adequate capability under both normal and emergency situations. However, in the end, the most common influencing factors are price and reliability.

Different Types of Loads

Underwriters Laboratory is the prevailing authority figure when it comes to independent testing of electrical products. Underwriters Laboratory or UL classifies automatic transfer switch loads under guideline UL 1008. The loads listed are Total System Loads, Motor Load, Electric Discharge Lamp Loads, Restrictive Loads, and Incandescent Lamp Loads.

Underwriters Laboratory requires that all transfer switches for diesel generators be clearly marked to specify what type of load it is capable of handling. The "Total System Loads" panel indicates that the switch can be used for a variety of loads described in the previous paragraph. However, when dealing with an incandescent (tungsten-based filament) load the total load should never exceed 30% unless the transfer switch is specifically rated to transfer a higher percentage of power to incandescent lamps.

In general, most transfer switches for used generators are rated to handle Total System Loads. It is always best to check the markings as some Total System Loads are marked "Resistance Only, Tungsten Only etc." The overall project management hassle is greatly reduced for engineers by choosing a Total System Load from the onset of the project.

Voltage Ratings

Automatic transfer switches for used generators are unique in regards to, their electrical distribution system in that they are one of only a few electrical devices that are designed to have two unsynchronized power sources connected to it. For example, this could mean that voltages impressed on one side of the insulation, in the unit, may actually be as high as 960 volts on a 480-volt AC system. A well designed UL transfer switch will provide adequate spacing and insulation to cope with the increased voltage stress.

It is due to this reason of increased stress on the unit that spacing in transfer switches should be less than those shown in Table 22.1 in UL 1008, regardless of the component used as part of the transfer switch.

The voltage ratings for AC systems are typically 120, 208, 240, 480, 600 volts, single or polyphase. Standard frequencies are 50 or 60 hertz. Automatic transfer switches can be used for other voltages and frequencies if required, this also includes DC.

Continuous Current Rating

The standard expectation of an automatic transfer switch in regard to a continuous load is that the switch should be able to hold maximum value for three hours or more. Transfer switches differ widely from other emergency equipment in that they must continuously carry the current to critical loads, either from the normal source of power or emergency source. Whereas, a standby engine generator set usually supplies power only during emergency periods.

Automatic transfer switches for diesel generators are manufactured to meet continuous current ratings of 30-4000 amperes. Typically, the most commonly used ampere ratings include 30, 40, 70, 80, 100, 150, 225, 260, 400, 600, 800, 1000, 1200, 1600, 2000, 3000 and 4000 amperes.

Modern transfer switch technology is capable of carrying 100% of the rated current at an ambient temperature of 40° C. Transfer switches incorporating integral over current protective devices may be limited-to a continuous load current no more than 80% of the switch rating. In modern switches there are control measures in place to make sure no more than 80% of the load is continuous. However, in older units, system failure is a possibility for exceeding 80%.

Project engineers should anticipate future load requirements during the planning process. Not all projects require forethought into future load requirements however it is generally advisable to select a transfer switch with a continuous current rating equal to the total of the anticipated load.

To calculate the continuous rating for a transfer switch one must total the amperes required for all loads. To determine the load current for tungsten (incandescent) lamps and electric heaters one must total the wattage value. Mercury vapour, fluorescent vapour and sodium vapour lamp load currents must be based on the current that each ballast or autotransformer draws, not on the total watts of the lamps. Motor full load currents only determine motor loads and are not an accurate measure for other types of loads. Locked rotor and motor inrush currents do not need to be considered in sizing a transfer switch that is UL listed for the Total System Load. In most cases, there is no need to de-rate a transfer switch for use in ambient temperatures up to 40° C; this includes switches that are installed in the switchboard or in a separate enclosure.

Example Formula for Finding Ampere Rating

The following example involves needing to find the ampere rating for a total system load:

Requested: An automatic transfer switch rated for Total System Loads, for a 208/120 volt, three phase, four wire circuit consisting of the following three phase balance load:

115 kW heating load

I = 115 kW/208V x 3 = 320 amps

64 kW tungsten lighting load

I = 64 kW/208V x 3 = 178 amps

Three 10 HP motors, @ 32 amps each

I = 3 x 32 = 96 amps

Total Load = 320 + 178 + 96 = 594 amps

When reviewing the tungsten load take note that since the load does not exceed 30% of the total load, select a three-pole transfer switch rated at least 600 amperes. Typical diesel generator line currents versus kW ratings can be found in UL 1008. For the previous example a 200-kW generator may be suitable for the application, provided it can handle the inrush currents.

Proper sizing of a transfer switch for a diesel generator requires careful consideration of the load type, voltage at the point of application and continuous load current. In the next article I will continue the discussion with overload and fault current ratings, protective devices ahead of the transfer switch, UL long-time ratings and other special considerations. As always, it is best to consult a professional electrical engineer before embarking on any sort of power generation project.

Referenced: Daugherty, Herbert. 'Automatic Transfer Switches' p. 207-209 On-Site Power Generation 4th Edition. Boca Raton, Florida: Electrical Generating Systems Association, 2006.

Courtesy: https://www.generatorsource.com/Automatic_Transfer_Switch_Selection_For_Diesel_Generators.aspx

3-PHASE DISTRIBUTION TRANSFORMERS 11 OR 433 KV/415-240V (OUTDOOR TYPE) - 2

6. TECHNICAL REQUIREMENTS:

6.1.1 **CORE MATERIAL**

6.1.2.1 The core shall be stack / wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage. *CRGO steel for core shall be purchased only from the approved vendors, list of which is available at*

http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20 kV-CM%20List.pdf

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

or

No-load current above 200kVA and up to 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

6.1.2.5 *Please refer to "**Check-list for Inspection of Prime quality CRGO for Transformers"** attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.*

7 Windings:

(i) Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered/Double Paper covered Aluminum/Electrolytic Copper conductor.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Nomex/Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).

7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.8 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPPING RANGES AND METHODS:

8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.

8.1.2 For ratings above 100 kVA and up to 500 kVA, tappings shall be provided, if required by the purchaser, on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 10% in steps of 2.5%.

8.1.3 For ratings greater than 500 kVA, tapping shall be provided on the higher voltage winding for variation of HV voltage within range of (+) 2.5% to (-) 5.0 % in steps of 2.5%.

8.1.4 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

(To be continued)

Courtesy: www.mstcecommerce.com>RenderFileViewVideo

ABSTRACT OF INDIAN ELECTRICITY RULES

1) Cut-out on consumer's premises:

- The supplier shall provide a suitable cut-out in each conductor of every service-line other than an earthed or earthed neutral conductor or the earthed external conductor of a concentric cable within a consumer's premises, in an accessible position. Such cut-out shall be contained within an adequately enclosed fireproof receptacle.
- Where more than one consumer is supplied through a common service-line, each such consumer shall be provided with an independent cut-out at the point of junction to the common service
- Every electric supply line other than the earth or earthed neutral conductor of any system or the earthed external conductor of a concentric cable shall be protected by a suitable cut-out by its owner
- No cut-out, link or switch other than a linked switch arranged to operate simultaneously on the earthed or earthed neutral conductor and live conductors shall be inserted or remain inserted in any earthed or earthed neutral conductor of a two wire-system or in any earthed or earthed neutral conductor of a multi-wire system or in any conductor connected thereto with the following exceptions:(a) A link for testing purposes, or (b) A switch for use in controlling a generator or transformer.

2) Danger Notices:

- The owner of every medium, high and extra-high voltage installation shall affix permanently in a conspicuous position a danger notice in Hindi or English and the local language of the district, with a sign of skull and Bones on
- Every motor, generator, transformer and other electrical plant and equipment together with apparatus used for controlling or regulating the same;
- All supports of high and extra-high voltage overhead lines which can be easily climb-upon without the aid of ladder or special appliances.

"Bhakti in religion may be a road to the salvation of the soul. But in politics, Bhakti or hero-worship is a sure road to degradation and to eventual dictatorship." – Dr. AMBEDKAR

3) Cables:

- Flexible cables shall not be used for portable or transportable motors, generators, transformer rectifiers, electric drills, electric sprayers, welding sets or any other portable or transportable apparatus unless they are heavily insulated and adequately protected from mechanical injury.
- Where the protection is by means of metallic covering, the covering shall be in metallic connection with the frame of any such apparatus and earth.
- The cables shall be three core type and four-core type for portable and transportable apparatus working on single phase and three phases supply respectively and the wire meant to be used for ground connection shall be easily Identifiable
- Where A.C. and D.C. circuits are installed on the same support they shall be so arranged and protected that they shall not come into contact with each other when live.

4) Safety:

- Two or more gas masks shall be provided conspicuously and installed and maintained at accessible places in every generating station with capacity of 5 MW and above and enclosed sub-station with transformation capacity of 5 MVA and above for use in the event of fire or smoke.
- Provide that where more than one generator with capacity of 5 MW and above is installed in a power station, each generator would be provided with at least two separate gas masks in accessible and conspicuous position.

5) High Voltage Equipments installations

- High Voltage equipments shall have the IR value as stipulated in the relevant Indian Standard.
- At a pressure of 1000 V applied between each live conductor and earth for a period of one minute the insulation resistance of HV installations shall be at least 1 Mega ohm Medium and Low Voltage Installations- At a pressure of 500 V applied between each live conductor and earth for a period of one minute, the insulation resistance of medium and low voltage installations shall be at least 1 Mega ohm

6) Every switchboard shall comply with the following provisions, namely:

- A clear space of not less than 1 meter in width shall be provided in front of the switchboard;
- If there are any attachments or bare connections at the back of the switchboard, the space (if any) behind the switchboard shall be either less than 20 centimeters or more than 75 centimeters in width, measured from the farthest outstanding part of any attachment or conductor;
- If the space behind the switchboard exceeds 75 centimeters in width, there shall be a passage-way from either end of the switchboard clear to a height of 1.8 meters.

7) Declared voltage of supply to consumer:

- In the case of low or medium voltage, by more than 6 per cent, or;
- In the case of high voltage, by more than 6 per cent on the higher side or by more than 9 per cent on the lower side, or;
- In the case of extra-high voltage, by more than 10 per cent on the higher side or by more than 12.5 per cent on the lower side.

8) Declared frequency of supply to consumer

- Except with the written consent of the consumer or with the previous sanction of the State Government a supplier shall not permit the frequency of an alternating current supply to vary from the declared frequency by more than 3 per cent.

Courtesy: Jignesh.Parmar

ABSTRACT OF CPWD INTERNAL ELECTRIFICATION PART – 1 (2)

Conductor Clearance (min) (Cable crossing):

- The horizontal and vertical distance between Power and Communication cable shall not be less than 60cm.

Conductor Clearance (min) (Railway crossing):

- After taking approval of railway authority, Cable under railway track shall be min 1meter from bottom of sleeper under RCC or cast Iron Pipe.
- Cable in parallel to Railway track shall be min 3meter far away from center of nearest Track.

Cable trench

- For single cable: For below 11KV.Min length of Trench shall be 35cm and depth shall be min 75cm (with sand cushioning of 8cm at bottom + Cable + protective covering/Sand cushioning of 17cm above Cable) and without Cushioning Depth shall be 75cm + 25cm.
- For single cable: For above 11KV.Min length of Trench shall be 35cm and depth shall be min 1.2meter (with sand cushioning and protective covering).
- For multi cable in horizontal level: Min distance between two cable shall be 20cm and min distance between cable and edge of trench on both side shall be 15cm
- For multi cable in Vertical level: Min distance between two cable shall be 30cm.(min Sand cushioning at bottom of trench shall be 8cm + Cable + min Sand cushioning of 30cm + Cable + protective covering/ Sand cushioning of 17cm above Cable)
- For LV/MV cable cushioning is not required where there is no possibility of mechanical damages.
- Extra loop of cable at end shall be 3meter for cable termination/Joints.

Cable Route Marker

- Cable Route Marker shall be min 0.5meter away from cable trench at the interval not exceeding 100 meter parallel.
- Plate Type Cable Route Marker shall be made of 100mm x 5mm GI/Aluminum Plate welded/Bolted on 35mm x 35mm x 6mm Iron angle of 60cm Long.
- Cement Concrete (C.C) type marker shall be made in formation of 1:2:4.

Cable Bending Radius

Voltage	1 Core	Unarmored (Multi core)	Armored (Multi core)
11KV	20D	15D	12D
22KV	20D	20D	15D
33KV	20D	25D	20D

Cable Lying in Pipe

- For Single Conductor Shall be min 10cm Diameter and more than Two Cable shall be min 15cm Dia.

Cable in Road Crossing

- In Road Crossing Cable shall be laid min 1 meter below Road in Pipe.

Cable Tray (Perforated)

- Cable Tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members with cross bracing between them 50mm x 5mm welded/Bolted at angle and 1 meter spacing of 2mm thick MS sheet.

Steel Tubular Pole

- 1/6 length of Steel Tubular Pole + 30 cm from base shall be coated with Black Bituminous paint on both internally and externally. The remaining portion of the pole shall be painted with Red oxide.

Cross arm

- LV/MV Line: MS angle iron of size not less than 50mm x 50mm x 6mm (4.5kg/meter)
- 11KV Line: MS angle iron of size not less than 65mm x 65mm x 6mm (5kg/meter)
- LV/MV Line: MS Chanel iron of size not less than 75mm x 40mm x 4.8mm (7.14kg/meter) 11KV Line: MS Chanel iron of size not less than 75mm x 40mm x 4.8mm (7.14kg/meter)
- For LV/MV Line: Min distance shall be 5cm between center of insulation pin and end of cross arm.
- For 11KV Line: Min distance shall be 10cm between center of insulation pin and end of cross arm.

Cross arm Length

Voltage	Nom of Horizontal Con	Length of Cross Arm
LV/MV	2 Conductors	55cm
LV/MV	4 Conductors	115cm
LV/MV	4 Conductors	175cm
11KV	3 Conductors	225cm

Insulators:

- For LV/MV Overhead Line: Pin/Shackle Insulator and For 11KV Line Pin/Disc Insulator
- For Pin Insulator for LV/MV line: Stalk Length 135mm Shank Length 125 mm, min Load 2KN.
- For Pin Insulator for 11KV line: Stalk Length 165mm Shank Length 150 mm, min Load 2KN.

D Clamp

- D clamp shall be made of MS Flat size of 50mm x 6mm, height of 75mm Galvanized and only used for vertical configuration for LV/MV Line only.

Pole Top Clamp

- Pole Top clamp made from Flat iron 50mm x 8mm.

Stay wire Rod

- Stay wire Rod shall not be less than 1.8 m Long and 19mm Dia. Anchor Plate shall not be less than 45mm x 45mm x 7.5mm.

Overhead Conductor (min)

- For LV/MV Line: AAC (All Alu. Conductor) 7/1/2.21mm, ACSR 6/1/1/2.11mm, AAAC (All Alu. Alloy Conductor) 7/2.09mm(20Sqmm)
- For 11KV/33KV Line: AAC (All Alu. Conductor) N/A, ACSR 6/1/1/2.11mm, AAAC (All Alu. Alloy Conductor) 7/2.56mm (30Sqmm)

Binding Wire

- Binding Wire with insulator shall be done with 2.6mm (12SWG) soft aluminum wire.

Earthing in Overhead Line

- Earthing wire shall not be less than 4mm (8SWG) and min 3 earthing Pit per KM shall be required.
- If there is no Continuous wire for earthling in overhead line than each pole should be earthed.

Same Support

- For LV/MV Line on Same Support Vertical distance: Between Phase to Earth shall be min 30cm and Between Phase to Phase min 20cm
- For LV/MV Line on Same Support Horizontal distance: Between Live wire on either side of support shall be 45cm.
- For LV/MV Line on Same Support Horizontal distance: Between Live wire on same side of support shall be 30cm.
- For LV/MV Line on Same Support Horizontal distance: Between central of pin insulator to end of cross Arm shall be 05cm.
- For HV Line in Triangular Configuration for 11KV/33KV Line shall be min 1.5meter.

Overhead Line Struts

The Pit for Struts shall be located not less than 1.8meter from pole side. The depth of Pit shall be at least 1.2meter

Danger board

All Support carrying HV Line shall be fitted with Danger Board (IS: 2551-1982) at height of 3meter.

Anti Climbing Device

For HV Line (IS: 278-1978) having 4Point Barbs 75mm + 12mm apart weight 128 / 125gm / meter shall be wrapped helically with pitch of 75mm around Limb of Pole height of 3.5meter to 5 to 6 meter.

Looping Box

- Looping Bus shall be fabricated from MS Sheet of 1.6mm (16SWG) thickness, Min Size 250mm x 200mm x 100mm for single cable entry and for 250mm x 300mm x 100mm for more than two cable entry

Feeder Pillar

- Feeder Pillar shall be fabricated min 2mm thick MS sheet and hinged type double door at front side. If width of Pillar shall be less than 60cm than single hinged type door shall be permitted.
- Min height of Pedestal of Feeder Pillar shall be not less than 45cm and 1 to 2 meter height from Road Level.
- Each Feeder Pillar shall be earthed with 2 no of Earthing electrode

Substation

- Clear Height of S/S Building shall be min 3.6 meter.

Area of Sub station

Sub Station	Total Transformer Room Area	Total S/S Area (Transformer, HT/LT Panel without D.G)
2 x 500 KVA	36 Sq. meter	130 Sq. meter
3 x 500 KVA	54 Sq. meter	172 Sq. meter
2 x 800 KVA	39 Sq. meter	135 Sq. meter
3 x 800 KVA	58 Sq. meter	181 Sq. meter
2 x 1000 KVA	39 Sq. meter	149 Sq. meter
2 x 1000 KVA	58 Sq. meter	197 Sq. meter

Courtesy: *https://fdocuments.in/document/abstract-of-cpwd-internal-electrification-part.html*

ELECTRICAL Q & A PART – 1 (1)

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

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

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

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

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

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

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

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

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

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

6) What is meant by regenerative braking?

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

"Freedom of mind is the real freedom. A person whose mind is not free though he may not be in chains, is a slave, not a free man. One whose mind is not free, though he may not be in prison, is a prisoner and not a free man. One whose mind is not free though alive, is no better than dead. Freedom of mind is the proof of one's existence." – Dr. AMBEDKAR

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

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

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

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

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

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

10) Mention the methods for starting an induction motor?

- The different methods of starting an induction motor
- DOL: direct online starter
- Star delta starter
- Auto transformer starter
- Resistance starter
- Series reactor starter

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

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

  (A) The resistance of the metal and that of the connection to it.

  (B) The contact resistance of the surrounding earth to the electrode.

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

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

Courtesy: ***Jignesh.Parmar***

"A people and their religion must be judged by social standards based on social ethics. No other standard would have any meaning if religion is held to be necessary good for the well-being of the people." – Dr. AMBEDKAR

REPUBLIC DAY CELEBRATIONS

Each year, 26th January is a day on which every Indian heart fills up with patriotic fervour and immense love for motherland. There are many significant memories as it was this day when the Indian Tricolour was first unfurled in January 1930 at Lahore, by Pt Jawaharlal Nehru and the declaration of an independent Indian National Congress was made.

26th January, 1950 was the day when the Indian republic and its constitution came into force. It was this day in history in 1965 when Hindi was declared as the official language of India.

THANGABASPAN TOBACCO
N ARUMUGAM PILLAI

Indian Express

RUP TOILET SOAP

INDIA PROCLAIMED SOVEREIGN DEMOCRATIC REPUBLIC

Madras Turns Into 'City Of Lights'

FESTIVE ILLUMINATIONS ON REPUBLIC DAY

RAJENDRA PRASAD SWORN IN AS PRESIDENT

Proclamation Read Out By Retiring Governor-General

NEW DELHI, Jan. 26.

The birth of Indian sovereign democratic Republic was proclaimed at 10-18 this morning by the country's last Governor-General Mr. Chakravarti Rajagopalachari at the Durbar Hall at Government House in the capital and the Republic's first President Dr. Rajendra Prasad took the oath of

A Million People Watch

Celebrations Galore

Republic Day is celebrated every year with much enthusiasm all over the country and to mark the importance of this occasion, a grand parade is held in the capital, New Delhi, from Raisina Hill near the Rashtrapati Bhavan (President's House), along the Rajpath, past India Gate and on to the historic Red Fort.

The event begins with the Prime Minister of India laying a wreath at the Amar Jawan Jyoti at India Gate, commemorating all the soldiers who sacrificed their lives for the country. Soon, a 21 gun salute is presented, the President unfurls the National Flag and the National Anthem is played. This marks the beginning of the parade.

The President is accompanied by a notable foreign Head of State - who is the invited Chief Guest at the celebration.

The Parade begins with winners of gallantry awards passing the President in open jeeps. President of India, who is the Commander-in-Chief of the Indian Armed Forces, takes the salute at the grand parade. The Indian Military also showcases its latest acquisitions such as tanks, missiles, radars, etc.

Soon after, awards and medals of bravery are given by the President to the people from the armed forces for their exceptional courage in the field and also to those civilians who have distinguished themselves by their different acts of valour in different situations.

After this, helicopters from the armed forces fly past the parade area showering rose petals on the audience.

The military parade is followed by a colourful cultural parade. India's rich cultural heritage is depicted in the form of tableaus from various states. Each state depicts its unique festivals, historical locations and art. This exhibition of diversity and richness of the culture of India lends a festive air to the occasion.

Tableaus from various government department and ministries of India are also presented displaying their contribution towards the progress of the nation. The most cheered section of the parade is when the children who have won National Bravery Awards ride past the dais on elephants. School-children from all over the country also participate in the parade showcasing folk dances and singing to the tunes of patriotic songs.

The parade also includes displays of skilful motor-cycle rides, by the Armed Forces personnel. The most eagerly awaited part of the parade is the fly past, put on by the Indian Air Force. The fly past marks the conclusion of the parade, when fighter planes of the IAF roar past the dais, symbolically saluting the President.

Live Webcast of the Republic Day Parade is made available every year to millions of surfers who wish to view the parade over the Internet. After the event is over, the exclusive footage is made available as 'video on demand'.

Celebrations, though on a relatively smaller scale, are also held in all state capitals, where the Governor of the state unfurls the Tricolour. Similar celebrations are also held at district headquarters, sub divisions, talukas, and panchayats.

HUMOUR

A Mathematician, an engineer and a physicist were traveling through Scotland when they saw a black sheep through the window of the train.

"Aha", says the engineer, "I see that Scottish sheep are black."

"Hmm", says the physicist, "You mean that some Scottish sheep are black".

"No", says the mathematician, "All we know is that there is at least one sheep in Scotland, and that at least one side of that one sheep is black!"

A computer programmer was crossing a road one day when a frog called out to him and said, "If you kiss me, I'll turn into a beautiful princess." He bent over, picked up the frog and put it in his pocket.

The frog spoke up again and said, "If you kiss me and turn me back into a beautiful princess, I will tell everyone how smart and brave you are and how you are my hero." The man took the frog out of his pocket, smiled at it and returned it to his pocket.

The frog spoke up again and said, "If you kiss me and turn me back into a beautiful princess, I will be your loving companion for an entire week." The man took the frog out of his pocket, smiled at it and returned it to his pocket.

The frog then cried out, "If you kiss me and turn me back into a princess, I'll stay with you for a year and do anything you want." Again the man took the frog out, smiled at it, and put it back into his pocket."

Finally, the frog asked, "What is the matter? I've told you I'm a beautiful princess, that I'll stay with you for a year and do anything you want. Why won't you kiss me?"

The man said, "Look, I'm a computer programmer. I don't have time for a girlfriend, but a talking frog is cool."

A pilot was utterly lost and decided to fly down through the clouds and try to figure out where he was.

When he finally got close to earth he saw miles and miles of fields, all looking exactly the same, except for one that had a man standing in the middle of it staring into the air.

The pilot decided to fly close to the man and ask him for directions. When the pilot came close enough to the man he shouted "Where am I?" the man in the field shouted back: "You are in a plane"

The pilot took another circle and shouted back "You must be an IT consultant"

Man in the field: "Why… Yes I am, how did you know"

Pilot: "While your answer is technically correct it doesn't tell me anything I don't already know"

Man in field: "You must be a business man"

Pilot: "Why… Yes I am, how did you know"

Man in field: "Because you don't know where you are, you don't know where you should go….. and all of a sudden it is all my fault!"

A physicist, an engineer, and a statistician were out game hunting.

The engineer spied a bear in the distance, so they got a little closer.

"Let me take the first shot!" said the engineer, who missed the bear by three metres to the left.

"You're incompetent! Let me try" insisted the physicist, who then proceeded to miss by three metres to the right.

"Ooh, we *got* him!!" said the statistician.

ELECTRICAL MAINTENANCE UNIT
(QUESTION & ANSWERS) - 4

49. What is capacitor? On what factor capacity of a capacitor depends?

    Capacitor or condenser is a device to store electrical energy and to release it into the circuit of which the capacitor forms a part.

    Capacity of a capacitor depends on following factors

    a. Capacity of the capacitor is directly proportional to the area of the plate.

    b. Capacity is inversely proportional to the distance between the plate. That is if the distance is more the capacity decreases or if the distance is less the capacity more.

    c. It depends on the nature of dielectric constant.

50. On what factor voltage rating of the capacitor depend?

    The voltage rating of the capacitor depends on the distance between the plates of the capacitor. If the voltage exceeds, the electrons across the space between the plates can result in permanent damage to the capacitor.

51. What are the types of capacitor?

    a. Paper capacitor.

    b. Rolled plastic cover or polyester type capacitor.

    c. Mica capacitor.

    d. Silver mica capacitor.

    e. Ceramic capacitor.

    f. Electrolytic capacitor.

52. What is the resultant capacitance in series and parallel circuit?

    In series circuit the resultant capacitance $1/C_T = 1/c_1 + 1/c_2 + 1c_n$ farad.

    In parallel circuit the resultant capacitance $C_T = c_1 + c_2 + c_n$ farad.

53. What is the formula to find the capacitance in a circuit?

    C = Q/E farad.

54. What is work?

    Work is said to be done, when the point of application of the force moves. Work done is equal to force * distance. The unit of work is Newton (M.K.S system) and joule (1 Newton Meter).

55. What is power?

    Power is the rate of doing work or power is the work done per second.

    Power = Work / time.

    Unit of electrical power is watt. One mechanical horsepower is equal to 746 watts (British) and 735.5 watts (metric) or 735.5 joules/sec. So 1 kW is equal to 1.34 horsepower (British) and 1.36 horsepower (metric)

56. What is energy?

Energy is the capacity to do the work. The unit of energy is joule or watt-second or watt-hour or kilo watt-hour.

57. Define Joule's law.

The heat generated in conductor (resistance) while the flow of current is directly proportional to the square of the current, the resistance of the conductor and time for which the current flows.

$H = I^2 R t/J$ calories.

Where J is mechanical equivalent of heat is equal to 4.2 Joules.

In electricity $H = 0.24 I^2 R t$ calories.

58. What is electrolysis?

When current passes through an acid or a salt, it de-composes and the two decomposed portions tend to move in opposite direction. This process is called the electrolysis.

Or the process of decomposing a liquid by the passage of electric current (DC) through it is called the electrolysis or electric analysis.

59. What are the Faradays laws of electrolysis?

First law

The mass ions liberated at an electrode are directly proportional to the quantity of electricity (coulomb Q) which has passed through the electrolyte. That is M""Q or

M""I t.

And M = Z I t.

Where Z is electro chemical equivalent

Second law

If the same quantity of electricity passes through several electrolyte the masses of the ions liberated are proportional to their respective chemical equivalent.

60. What is electro plating?

The process of depositing a metal on the surface of another metal by electrolysis is known as electro plating. Usually the plating material will be silver, chromium etc.

61. What are the applications of electrolysis?

a. Electro plating.
b. Purification of copper and extraction of number of metals and number of commercial compounds like sodium, hydrogen, hydroxide, oxygen etc.
c. Electro typing.
d. Determination of DC polarity.
e. Electro refining of metals.

"However good a Constitution may be, if those who are implementing it are not good, it will prove to be bad. However bad a Constitution may be, if those implementing it are good, it will prove to be good."

– Dr. AMBEDKAR

62. State the laws of magnetism.

a. Magnet imparts its magnetic properties to other metals.

b. When a magnet is suspended freely horizontally, it stands at geographical north and south.

c. Every magnet has a north and its associated separable South Pole.

d. If a magnet broken in any number of pieces, each piece will act as a separate magnet having north and south poles.

e. Like poles repulse and unlike poles attracts.

f. The amount of attraction or repulsion is directly proportional to the pole strength and inversely proportional to the square of the distance between them.

This is some times known as inverse square law.

63. What is flux density?

It is the flux passing per unit area in a substance through a plain at a right angle to the flux. The letter 'B' denotes it and it is measured in Weber/cm^2.

$B = Q/a$ Weber/cm^2.

64. What is magneto motive force?

The force, which drives the magnetic flux through a magnetic circuit, is called the magneto motive force.

65. What is permeability?

Permeability of a substance is the conducting power for lines of force of magnetic material as compared with the air.

66. What is reluctivity?

It is the specific reluctance of a magnetic circuit or magnetic material as in the case of resistivity in an electric circuit.

67. What is reluctance?

It is the property of a magnetic material, which opposes the establishment of magnetic flux in it, as in the case resistance in an electric circuit.

68. What is permeance?

It is the reciprocal of reluctance, which helps to develop or establish magnetic flux easily in a magnetic material as in the case of conductivity in an electrical circuit.

69. What are the methods of magnetization?

a. Tough method

b. By means of electric current

c. Induction method

70. How the polarity of the magnet can be determined?

Polarity of the magnet can be determined by 'End rule' and 'Palm rule'.

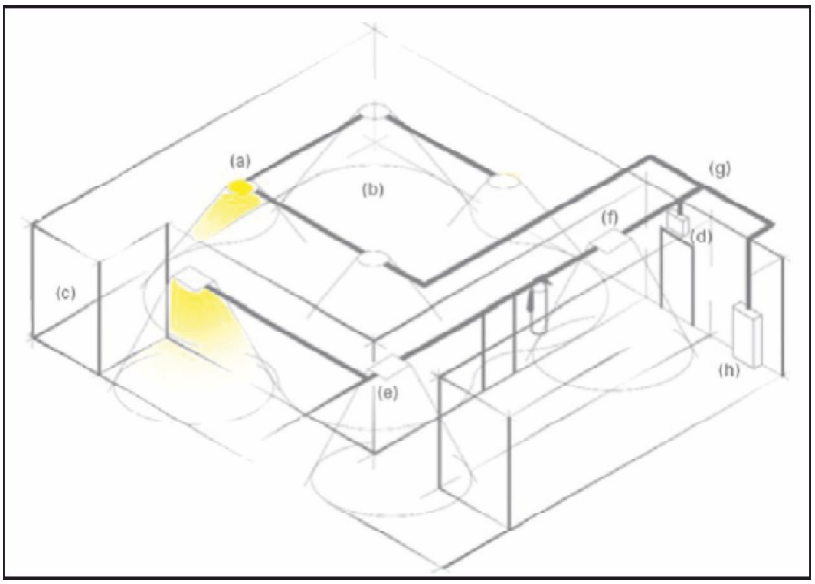
Courtesy: https://www.scribd.com/document/244623258/Question-and-Answers-Electrical-Maintenance-Unit

"Some people think that religion is not essential to society. I do not hold this view. I consider the foundation of religion to be essential to the life and practices of a society." – Dr AMBEDKAR

INSTALL LIGHTING SYSTEM - 5

Escape lighting luminaries should be located near each exit door and emergency exit door and also at points where it is necessary to emphasize the position of potential hazards, for example:

1) near each intersection of corridors
2) near each change of direction (other than on a staircase)
3) near each staircase so that each flight of stairs receives direct light
4) near any other change of floor level which may constitute a hazard
5) outside each final exit and close to it



(a) Emergency Lighting (b) Open Area Lighting (c) Other Areas (eg lifts) (d) Signage

(e) Maintained or Non-Maintained - Duration of Luminaires (1 hr minimum)

(f) Escape Route Lighting - Fire Points (g) Wiring (h) Central System

4.5 List the IEE regulations concerning industrial and commercial lighting circuits.

1. Where conductors or flexible cables enter a luminaire, the conductors should be able to withstand any heat likely to be encountered or sleeved with heat resistant sleeving.
2. A ceiling rose, unless designed for the purpose, should have only one flexible cord.
3. The flexible cord used to make a pendant (the ceiling rose, flex and lamp-holder assembly) should be capable of withstanding any heat that is likely to be present in normal use.
4. Where a flexible cord supports or partly supports a luminaire, the maximum mass supported shall not exceed the values as stated in the Regulations.
5. A ceiling rose shall not be used on a voltage exceeding 250 V.
6. Parts of lamp-holders, installed within 2.5 m of a fixed bath or shower, shall be constructed or shrouded in insulating material.
7. Lighting switches shall be installed, so as to be normally inaccessible to persons using a bath or shower. The regulation does not apply to ceiling switches operated by an insulated cord.
8. For circuits supplying equipment in a room containing a fixed bath or shower that can be touched at the same time as conductive parts, the protective device shall disconnect the circuit within 0.4 second.

9. For circuits on TN or TT systems, where an Edison screw lamp-holder is being used, the outer contact shall be connected to the neutral conductor.
10. Final circuits for discharge lighting (including Fluorescent luminaries) shall be capable of carrying the total steady current.

4.6 List the types of luminaires for.:

(i) Decorative luminaires for indoors and outdoors

(ii) Flood lights

(iii) Road lighting

(iv) Industrial lighting

Decorative luminaires for indoor and outdoor utilizations

(a) Indoor luminaire

- Pendant including incandescent lamp
- Chandelier including incandescent lamps
- Halogen lamp

(b) Outdoor luminaire

- Neon gas lamp
- Sodium vapour lamp
- Mercury vapour lamp

Luminaire for flood lights

- Halogen lamp
- Mercury vapour lamp
- Sodium lamp

Luminaire for road lighting

- Sodium lamp
- Mercury vapour lamp
- Fluorescent lamp

Luminaire for industrial lighting

- Halogen lamp
- Fluorescent lamp
- Incandescent lamp
- Mercury vapour lamp
- Sodium vapour lamp

4.7 State the use of indicating lamps.

Indicating lamps are used in industrial panels to provide information about the status of a process.

Two types of indicating lamps available are as follows:

- Incandescent type
- Neon type

Courtesy: Khemraz Ramduth

LIGHTING FUNDAMENTALS – 2

Uniformity of Illuminance on Tasks

The uniformity of illuminance is a quality issue that addresses how evenly light spreads over a task area. Although a room's average illuminance may be appropriate, two factors may compromise uniformity.

- improper fixture placement based on the luminaire's *spacing criteria* (ratio of maxim recommended fixture spacing distance to mounting height above task height)
- fixtures that are retrofit with reflectors that narrow the light distribution

Non-uniform illuminance causes several problems:

- inadequate light levels in some areas
- visual discomfort when tasks require frequent shifting of view from underlit to overlit areas
- bright spots and patches of light on floors and walls that cause distraction and generate a low quality appearance

Colour Rendition

The ability to see colours properly is another aspect of lighting quality. Light sources vary in their ability to accurately reflect the true colours of people and objects. The colour rendering index (CRI) scale is used to compare the effect of a light source on the colour appearance of its surroundings.

A scale of 0 to 100 defines the CRI. A higher CRI means better colour rendering, or less colour shift. CRIs in the range of 75–100 are considered excellent, while 65-75 are good. The range of 55-65 is fair, and 0-55 is poor. Under higher CRI sources, surface colours appear brighter, improving the aesthetics of the space. Sometimes, higher CRI sources create the illusion of higher illuminance levels.

The CRI values for selected light sources are tabulated with other lamp data in Exhibit 3.

Light Source

- Characteristics of Light Sources
- Incandescent Lamps
- Fluorescent Lamps
- High-Intensity Discharge Lamps

Commercial, industrial and retail facilities use several different light sources. Each lamp type has particular advantages; selecting the appropriate source depends on installation requirements, life-cycle cost, colour qualities, dimming capability and the effect wanted, Three types of lamps are commonly used:

- incandescent
- fluorescent
- high intensity discharge
- mercury vapour
- metal halide
- high pressure sodium
- low pressure sodium

Before describing each of these lamp types, the following sections describe characteristics that are common to all of them.

Characteristics of Light Sources

Electric light sources have three characteristics: efficiency, color temperature, and color rendering index (CRI). Exhibit 4 summarizes these characteristics.

Efficiency

Some lamp types are more efficient in converting energy into visible light than others. The efficacy of a lamp refers to the number of lumens leaving the lamp compared to the number of watts required by the lamp (and ballast). It is expressed in lumens per watt. Sources with higher efficacy require less electrical energy to light a space.

Colour Temperature

Another characteristic of a light source is the colour temperature. This is a measurement of "warmth" or "coolness" provided by the lamp. People usually prefer a warmer source in lower illuminance areas, such as dining areas and living rooms, and a cooler source in higher illuminance areas, such as grocery stores.

Colour temperature refers to the colour of a blackbody radiator at a given absolute temperature, expressed in Kelvins. A blackbody radiator changes colour as its temperature increases (first to red, then to orange, yellow, and finally bluish white at the highest temperature. A ***"warm"*** colour **light source actually has a lower colour temperature**. For example, a coolwhite fluorescent lamp appears bluish in color with a colour temperature of around 4100 K. A warmer fluorescent lamp appears more yellowish with a colour temperature around 3000 K. Refer to Exhibit 5 for colour temperatures of various light sources.

Colour Rendering Index

The CRI is a relative scale (ranging from 0-100). indicating how perceived colours match actual colours. It measures the degree that perceived colours of objects, illuminated by a given light source, conform to the colours of those same objects when they are lighted by a reference standard light source. The higher the colour rendering index, the less colour shift or distortion occurs.

The CRI number does not indicate which colours will shift or by how much~ it is rather an indication of the average shift of eight standard colours. Two different light sources may have identical CRI values, but colours may appear quite different under these two sources.

Incandescent Lamps

Standard Incandescent Lamp

Incandescent lamps are one of the oldest electric lighting technologies available. With efficacies ranging from 6 to 24 lumens per watt, incandescent lamps are the least energy-efficient electric light source and have a relatively short life (750-2500 hours).

Light is produced by passing a current through a tungsten filament, causing it to become hot and glow. With use, the tungsten slowly evaporates, eventually causing the filament to break.

These lamps are available in many shapes and finishes. The two most common types of shapes are the common ***"A-type"*** lamp and the ***reflector-shaped*** lamps.

Tungsten-Halogen Lamps

The tungsten halogen lamp is another type of incandescent lamp. In a halogen lamp, a small quartz capsule contains the filament and a halogen gas. The small capsule size allows the filament to operate at a higher temperature, which produces light at a higher efficacy than standard incandescents. The halogen gas combines with the evaporated tungsten, redepositing it on the filament. This process extends the life of the filament and keeps the bulb wall from blackening and reducing light output.

Because the filament is relatively small, this source is often used where a highly focused beam is desired. Compact halogen lamps are popular in retail applications for display and accent lighting. In addition, tungsten-halogen lamps generally produce a whiter light than other incandescent lamps, are more efficient, last longer, and have improved lamp lumen depreciation.

(To be continued)

Courtesy: U.S. EPA Green Lights

TRANSFORMER BASICS - 2

Transformer Basics Example No 1

A voltage transformer has 1500 turns of wire on its primary coil and 500 turns of wire for its secondary coil. What will be the turns ratio (TR) of the transformer.

$$T.R. = \frac{N_p}{N_s} = \frac{\neq pri.coils}{\neq Sec.Coils} = \frac{1500}{500} = \frac{3}{1} = 3.1$$

This ratio of 3:1 (3-to-1) simply means that there are three primary windings for every one secondary winding. As the ratio moves from a larger number on the left to a smaller number on the right, the primary voltage is therefore stepped down in value as shown.

Transformer Basics Example No 2

If 240 volts rms is applied to the primary winding of the same transformer above, what will be the resulting secondary no load voltage.

$$T.R. = 3:1 \text{ or } \frac{3}{1} = \frac{V_p}{V_s} = \frac{\neq pri.Volts}{\neq Sec.Volts} = \frac{240}{V_s}$$

$$\therefore Sec.Volts.\ V_s = \frac{V_p}{3} = \frac{240}{3} = 80 \text{ volts}$$

Again confirming that the transformer is a "step-down" transformer as the primary voltage is 240 volts and the corresponding secondary voltage is lower at 80 volts.

Then the main purpose of a transformer is to transform voltages at preset ratios and we can see that the primary winding has a set amount or number of windings (coils of wire) on it to suit the input voltage. If the secondary output voltage is to be the same value as the input voltage on the primary winding, then the same number of coil turns must be wound onto the secondary core as there are on the primary core giving an even turns ratio of 1:1 (1-to-1). In other words, one coil turn on the secondary to one coil turn on the primary.

If the output secondary voltage is to be greater or higher than the input voltage, (step-up transformer) then there must be more turns on the secondary giving a turns ratio of 1:N (1-to-N), where N represents the turns ratio number. Likewise, if it is required that the secondary voltage is to be lower or less than the primary, (step-down transformer) then the number of secondary windings must be less giving a turns ratio of N:1 (N-to-1).

Transformer Action

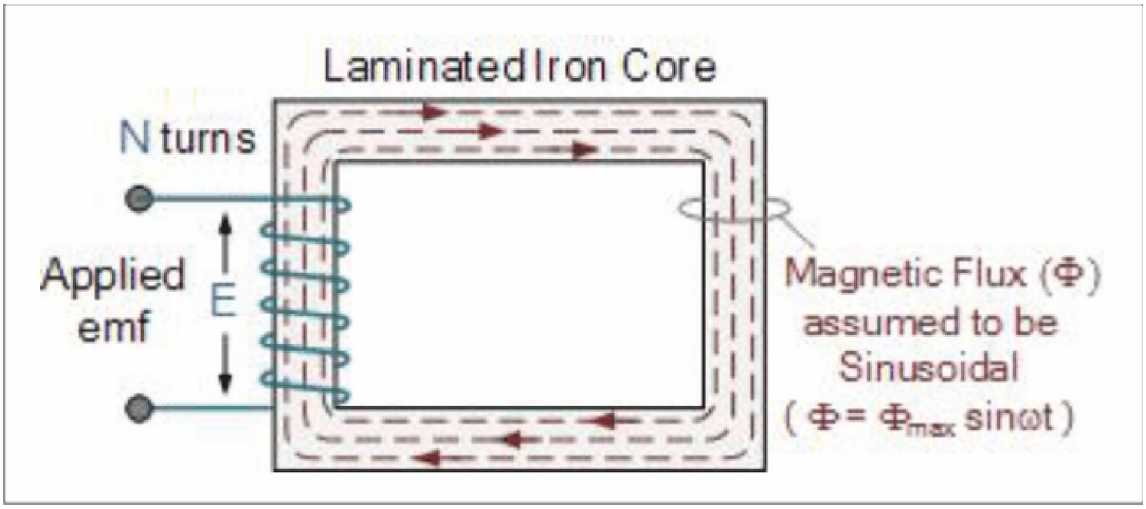
We have seen that the number of coil turns on the secondary winding compared to the primary winding, the turns ratio, affects the amount of voltage available from the secondary coil. But if the two windings are electrically isolated from each other, how is this secondary voltage produced?

We have said previously that a transformer basically consists of two coils wound around a common soft iron core. When an alternating voltage (V_p) is applied to the primary coil, current flows through the coil which in turn sets up a magnetic field around itself, called *mutual inductance*, by this current flow according to *Faraday's Law* of electromagnetic induction. The strength of the magnetic field builds up as the current flow rises from zero to its maximum value which is given as $d\Phi/dt$.

As the magnetic lines of force setup by this electromagnet expand outward from the coil the soft iron core forms a path for and concentrates the magnetic flux. This magnetic flux links the turns of both windings as it increases and decreases in opposite directions under the influence of the AC supply.

However, the strength of the magnetic field induced into the soft iron core depends upon the amount of current and the number of turns in the winding. When current is reduced, the magnetic field strength reduces.

When the magnetic lines of flux flow around the core, they pass through the turns of the secondary winding, causing a voltage to be induced into the secondary coil. The amount of voltage induced will be determined by: N*dΦ/dt (Faraday's Law), where N is the number of coil turns. Also this induced voltage has the same frequency as the primary winding voltage.



Then we can see that the same voltage is induced in each coil turn of both windings because the same magnetic flux links the turns of both the windings together. As a result, the total induced voltage in each winding is directly proportional to the number of turns in that winding. However, the peak amplitude of the output voltage available on the secondary winding will be reduced if the magnetic losses of the core are high.

If we want the primary coil to produce a stronger magnetic field to overcome the cores magnetic losses, we can either send a larger current through the coil or keep the same current flowing, and instead increase the number of coil turns (N_p) of the winding. The product of amperes times turns is called the "ampere-turns", which determines the magnetising force of the coil.

So assuming we have a transformer with a single turn in the primary and only one turn in the secondary. If one volt is applied to the one turn of the primary coil, assuming no losses, enough current must flow and enough magnetic flux generated to induce one volt in the single turn of the secondary. That is, each winding supports the same number of volts per turn.

As the magnetic flux varies sinusoidally, $\Phi = \Phi_{max} \sin\omega t$, then the basic relationship between induced emf, (E) in a coil winding of N turns is given by:

emf = turns x rate of change

$$E = N\frac{d\phi}{dt}$$

$$E = N \times \omega \times \phi_{max} \times \cos(\omega t)$$

$$E_{max} = N\omega\phi_{max}$$

$$E_{rms} = \frac{N\omega}{\sqrt{2}} \times \phi_{max} = \frac{2\pi}{\sqrt{2}} \times f \times N \times \phi_{max}$$

$$\therefore E_{rms} = 4.44\, fN\phi_{max}$$

Where:

- f – is the flux frequency in Hertz, $= \omega/2\pi$
- N – is the number of coil windings.
- Φ – is the amount of flux in webers

This is known as the **Transformer EMF Equation**. For the primary winding emf, N will be the number of primary turns, (N_p) and for the secondary winding emf, N will be the number of secondary turns, (N_S).

Also please note that as transformers require an alternating magnetic flux to operate correctly, transformers cannot therefore be used to transform or supply DC voltages or currents, since the magnetic field must be changing to induce a voltage in the secondary winding. In other words, **transformers DO NOT operate on steady state DC voltages**, only alternating or pulsating voltages.

If a transformers primary winding was connected to a DC supply, the inductive reactance of the winding would be zero as DC has no frequency, so the effective impedance of the winding will therefore be very low and equal only to the resistance of the copper used. Thus the winding will draw a very high current from the DC supply causing it to overheat and eventually burn out, because as we know I = V/R.

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

ELECTRICITY GENERATION - 2

Electrochemistry

Figure 6: Large dams such as Hoover Dam can provide large amounts of hydroelectric power; it has 2.07 GW capability.

Electrochemistry is the direct transformation of **chemical energy** into electricity, as in a **battery**. Electrochemical electricity generation is important in portable and mobile applications. Currently, most electrochemical power comes from batteries. **Primary cells**, such as the common **zinc–carbon batteries**, act as power sources directly, but **secondary cells** (i.e. rechargeable batteries) are used for **storage** systems rather than primary generation systems. Open electrochemical systems, known as **fuel cells**, can be used to

extract power either from natural fuels or from synthesized fuels. **Osmotic power** is a possibility at places where salt and fresh water merge.

Photovoltaic Effect

The **photovoltaic Effect** is the transformation of light into electrical energy, as in **solar cells**. **Photovoltaic panels** convert sunlight directly to DC electricity. **Power inverters** can then convert that to AC electricity if needed. Although sunlight is free and abundant, **solar power** electricity is still usually more expensive to produce than large-scale mechanically generated power due to the cost of the panels. Low-efficiency silicon solar cells have been decreasing in cost and multi junction cells with close to 30% conversion efficiency are now commercially available. Over 40% efficiency has been demonstrated in experimental systems. Until recently, photovoltaics were most commonly used in remote sites where there is no access to a commercial power grid or as a supplemental electricity source for individual homes and businesses. Recent advances in manufacturing efficiency and photovoltaic technology, combined with subsidies driven by environmental concerns, have dramatically accelerated the deployment of solar panels. Installed capacity is growing by 40% per year led by increases in Germany, Japan, United States, China, and India.

Economics

See also: Cost of electricity by source and Electricity pricing

The selection of electricity production modes and their economic viability varies in accordance with demand and region. The economics vary considerably around the world, resulting in **widespread residential selling prices**, e.g. the price in Iceland is 5.54 cents per kWh while in some island nations it is 40 cents per kWh. **Hydroelectric plants**, **nuclear power plants**, **thermal power plants** and **renewable sources** have their own pros and cons, and selection is based upon the local power requirement and the fluctuations in demand. All power grids have varying loads on them but the daily minimum is the base load, often supplied by plants which run continuously. Nuclear, coal, oil, gas and some hydro plants can supply base load. If well construction costs for natural gas are below $10 per MWh, generating electricity from natural gas is cheaper than generating power by burning coal.

Thermal Energy may be economical in areas of high industrial density, as the high demand cannot be met by local renewable sources. The effect of localized pollution is also minimized as industries are usually located away from residential areas. These plants can also withstand variation in load and consumption by adding more units or temporarily decreasing the production of some units.

Nuclear power plants can produce a huge amount of power from a single unit. However, **disasters in Japan** have raised concerns over the safety of nuclear power, and the capital cost of nuclear plants is very high. Hydroelectric power plants are located in areas where the potential energy from falling water can be harnessed for moving turbines and the generation of power. It may not be an economically viable single source of production where the ability to store the flow of water is limited and the load varies too much during the annual production cycle.

Due to advancements in technology, and with mass production, renewable sources other than hydroelectricity (solar power, wind energy, tidal power, etc.) experienced decreases in cost of production, and the energy is now in many cases cost-comparative with fossil fuels. Many governments around the world provide subsidies to offset the higher cost of any new power production, and to make the installation of renewable energy systems economically feasible. However, their use is frequently limited by their **intermittent nature**; sometimes less than demand, sometimes more than transmission constraints allow, in which case their production may be curtailed.

Generating Equipment

Main article: Electric generator

Electric generators were known in simple forms from the discovery of the **magnetic induction** of electric current in the 1830s. In general, some form of prime mover such as an engine or the turbines described above, drives a rotating magnetic field past stationary coils of wire thereby turning mechanical energy into electricity. The only commercial scale electricity production that does not employ a generator is solar PV.

Turbines

Almost all commercial electrical power on Earth is generated with a **turbine**, driven by wind, water, steam or burning gas. The turbine drives a generator, thus transforming its mechanical energy into electrical energy by electromagnetic induction. There are many different methods of developing mechanical energy, including **heat engines**, hydro, wind and tidal power. Most electric generation is driven by **heat engines**. The combustion of **fossil fuels** supplies most of the energy to these engines, with a significant fraction from **nuclear fission** and some from **renewable sources**. The modern **steam turbine** (invented by **Sir Charles Parsons** in 1884) currently generates about 80% of the **electric power** in the world using a variety of heat sources. Turbine types include:

Figure 7: A large generator with the rotor removed

Main article: World energy resources and consumption

"Religion must mainly be a matter of principles only. It cannot be a matter of rules. The moment it degenerates into rules, it ceases to be a religion, as it kills responsibility which is an essence of the true religious act." – Dr. AMBEDKAR

ENERGY INDEPENDENCE AND ENERGY SELF RELIANCE - 5

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 some of the year end observations in the form of a few News Reports are given below for information.

The Covid-19 pandemic is an opportunity for India to pursue clean energy more aggressively

Every industry can be part of the solution — or part of the ongoing problem.

April 20, 2020

While India should prioritise health and economic recovery in the aftermath of the Covid-19 crisis, there will also be an opportunity for clean energy transition as part of coping strategies and support measures, says a report which examines India's energy policies.

Though it is yet uncertain how long the pandemic will last, the report anticipates an increased focus on economic recovery once Covid-19 is under control, which includes addressing concerns of the energy sector. The period post Covid-19 will give the Indian government a chance to reset its energy policies and increase focus on clean energy, notes the report published on April 16. If India considers economic stimulus to support energy producers it should "carefully assess" how different interventions for producers will "undermine or support the clean energy transition," it says.

The report "Mapping India's Energy Subsidy 2020: Fossil fuels, renewables, electric vehicles" (pdf) has been put together by two think tanks working on environmental issues—the International Institute for Sustainable Development (IISD) and the Council on Energy, Environment and Water (CEEW).

It highlighted that though the overall support for fossil fuels has been decreasing, there is still a significant gap between usage of fossil fuels and renewable energy, with the latter left to cover a lot more ground to match up to fossil fuel usage. It also revealed that subsidies for fossil fuels are still over seven times more than subsidies for alternative energy in India. "In financial year 2019, subsidies for oil, gas and coal amounted to Rs83,134 crore ($12.4 billion), compared to Rs11,604 crore for renewables and electric mobility," said the report.

There are three key implications for public resources and energy transition in India in the post-pandemic recovery phase.

While talking about how India's energy subsidies might change in response to the Covid-19 crisis, the report said: "it is hard to predict the full impacts of Covid-19, but it seems likely they will be significant and prolonged," and that "clean energy transition can and should be reflected in coping strategies and support measures."

The report stressed that there are three key implications for public resources and energy transition in India, in the post-pandemic recovery phase—a crash in world oil prices can free up revenue to help tackle the crisis by temporarily eliminating petroleum product subsidies and enabling higher tax rates, increasing demand to support energy producers, as profits fall, demand falters and perceptions of risk rise as well as increasing demand for social protection and effective and efficient public services.

"Investments in these areas can create new options to target energy access subsidies, allowing benefits to be clustered on those most in need," said the report.

"India's major energy subsidies amount to Rs1.74 lakh crore—higher than the initial economic package of Rs1.70 lakh crore that the government announced for tackling Covid-19. The centre needs to reassess this large subsidy outlay and rationalise it across end-consumers," Karthik Ganesan, a research fellow at the CEEW and one of the authors of the report, told Mongabay-India.

The IISD and CEEW report examined how the Indian government has used subsidies to support different types of energy and how India's energy subsidy policies have changed. It focused on the major developments in India's dynamic energy policy environment over the years, public support to the country's desired energy future, subsidies from production to consumption for coal, oil and gas, electricity transmission and distribution, renewable energy and electric vehicles.

Subsidies mix

According to the report, the oil and gas subsidies in India are up by over 65% from about Rs40,762 crore in financial year 2017 to Rs67,679 crore in financial year 2019 but that was largely driven by higher oil prices and growing use of subsidised liquefied petroleum gas (LPG).

Over the past few years, there has been an increase in the number of LPG consumers under the Pradhan Mantri Ujjwala Yojana (PMUY), which provides LPG connections to families below the poverty line.

The report also discussed the slowdown in India's renewable sector stating that renewable energy subsidies are down by 35% but are likely to rise again. "Renewable energy subsidies fell from a high of Rs15,313 crore in financial year 2017 to only Rs9,930 crore in financial year 2019. This reflects falling renewable energy costs but also a slowdown driven by policy decisions such as the solar safeguard duty and price caps in auctions," it said but stressed that they are expected to rise again in financial year 2020 as several new policies have been confirmed since financial year 2019.

This basically means that the recent increases in fossil fuel subsidies and decreases in renewable energy subsidies have not yet altered larger trends. Since financial year 2014, India has shifted significant public resources toward a clean energy transition.

"Other than the subsidies for providing clean cooking options for the poor, any other form of subsidy for the fossil fuel industry would only further the climate catastrophe and health impacts due to various forms of pollution (air, water, and land). Unfortunately, fossil fuels continue to enjoy a larger share of subsidies than clean energy options, this would only further challenge the achievement of our climate goals under the Paris Agreement," said Sunil Dahiya, who is an analyst with the Centre for Research on Energy and Clean Air (CREA).

"On the other hand, the current Covid-19 crisis has shown the world what one crisis could do to health, economy and livelihood. It has also shown us the importance of investing in public health. The best investment that the governments should focus on when they revive the economy is in the clean and renewable energy sector and not to focus on fossil fuel sources which cause the most damage to public health and the climate," said Dahiya.

India's energy sector is full of price distortions and on account of poor targeting of subsidies.

The report also focuses on subsidies provided in the form of underpriced electricity and highlighted that "state-level under-priced electricity is the most costly individual subsidy policy in India estimated at Rs63,778 crore."

"India's energy sector is full of price distortions and on account of poor targeting of subsidies, the rich ultimately end up benefiting disproportionately. For instance, LPG consumption is concentrated more in urban areas than in rural areas, thereby serving the needs of the wealthier section. Similarly, on the electricity front, the focus of the government is only in keeping the wheels greased and not an overhaul to address the inefficiencies in the system," said Ganesan while explaining that the subsidies provided masks losses linked to specific consumer groups.

The report stressed that the support for coal power largely remains unchanged and talks about the associated cost of the coal power. it explained that the net costs of coal are much larger than the revenues if we compare total revenues from coal taxes and total costs from coal-related subsidies, air pollution and greenhouse gas (GHG) emissions.

MONGABAY INDIA/KARTIK CHANDRAMOULI

Subsidies for electricity consumption need to be targeted precisely so that it only benefits the poor and not the rich.

"Even with conservative assumptions, the outcome is a large net cost from coal. Coal subsidies are estimated at Rs15,456 crore in financial year 2019 and may increase significantly from financial year 2020, given non-compliance with deadlines to install air pollution control technology," said the report.

"The non-economic costs of coal—air, soil and water pollution (poor ash management) are significant and over-rides any benefit of using this domestic resource. Unless we address these, the emergence of newer and cleaner options will always be inhibited," said Ganesan.

Moving to EVs

As far as overall trends are concerned, since financial year 2014 (from the time the IISD started mapping all energy subsidies of India), fossil fuel subsidies have fallen by more than half, largely driven by falling world oil prices and policy reforms to diesel and kerosene pricing, while subsidies for renewable energy and electric vehicles (EVs) have increased over three and a half times, largely due to policy efforts to meet capacity targets. "EV subsidies, in particular, have increased over 440 times from a very low baseline in financial year 2014," the report highlighted.

Since financial year 2017, the subsidies for EV have grown over 11 times but the report explained that it is because India has only very recently stepped up its support levels for EVs.

It said though the growth in this sector is expected to continue, policies should be monitored to ensure effective, efficient and equitable support, including for two-wheelers, public transport, waste treatment and battery recycling because "support may still not be sufficient to reach 2030 targets."

Moving away from subsidies

According to the report though India has shown a commitment to shift to clean energy the action is still insufficient to address the scale of sustainability challenges and thus the government of India should increase the shift of public resources from fossil fuels to clean energy.

Before the 2015 Paris Climate Agreement, India had promised to unconditionally reduce the emission intensity of its GDP by 30 to 35% from 2005 level by 2030 and achieve 40% of its installed power capacity from renewables.

The Indian government had also promised 175,000 megawatts (MW) of renewable power, including 100,000 MW from solar power, by 2022. Subsequently, India has been talking about 450,000 MW of renewable power by 2030. As of Feb. 29 this year India's total installed capacity of renewable power is 86,759.19MW and of that 34,405.67MW is from solar power.

The report, meanwhile, stressed that the government should resist demands for new oil and gas subsidies. It also emphasised that to achieve 450,000MW by 2030, the Indian government must develop "quality interstate grid transmission and storage.

Will invest across renewables, solar manufacturing, transmission in 2021: Sumant Sinha, ReNew Power

The other big focus area for the firm will be commissioning of projects which are in the pipeline and nearing completion

December 30, 2020,

New Delhi: Introduction of long-term measures including privatisation of distribution companies to improve the sector's health are absolutely necessary now, Sumant Sinha, chairman and managing director, ReNew Power told *ETEnergyworld.* Edited excerpts:

What are your top policy demands from the government for next year?

Indian renewable energy sector has come a long way since 2014 and a stable policy regime has been a critical component of its success and growth.

Going forward as India looks to mainstream renewables and address the problem of intermittency some of the key tasks would be to expedite the signing of pending power purchase agreements for bids already completed... upgrading the transmission infrastructure as with new capacity addition from renewables, existing infrastructure is nearing full capacity. New transmission infrastructure will ensure upcoming projects do not face any bottlenecks due to constrained transmission capacity. Many more renewable resource rich areas can also be tapped if the transmission infrastructure is augmented in these areas.

Other than this, distribution sector reforms will also play a key role in keeping the sector healthy. The government has already taken some steps towards reforming distribution companies and hopefully next year we will see the process gathering pace.

Further, a clear policy on inter-state transmission system (ISTS) needs to be charted out. Given that ISTS waiver for a renewable energy (RE) project is limited to June 2023, it is important that a roadmap for these innovative future bids is finalised. If the roadmap is not finalised, the government should then consider an extension of ISTS waiver beyond June 2023.

What will be the major highlights in your company?

As the economic recovery continues in 2021, I expect auctions of new projects to gather pace. We are likely to see more hybrid projects and storage-based projects, to be put out for bidding. The other big focus area for our firm will be commissioning of projects which are in the pipeline and nearing completion. I expect our leadership, in innovation and technology, in areas of storage, round-the-clock projects and manufacturing, will continue in 2021.

What are your investment plans for 2021?

We plan to make substantial investments across renewables, solar manufacturing, transmission and other emerging areas in the power sector value chain, next year.

What are your Budget 2021 expectations?

The union government has taken several measures recently which have positively impacted the sector. Introduction of PLI scheme, liquidity infusion in discoms and notifying power as a service has made the sector more robust. This Budget, therefore, presents an opportunity for the government to take a step further on the road of *Aatma nirbharta* and offer clarity on the duty structure for solar manufacturing in India. Clarity on duty structure for manufacturing will boost local manufacturing and kick start the virtuous cycle of development, upstream and downstream.

The government should also look at supporting storage as a short-term measure through concessional duty structure till local manufacturing gathers pace. An increased allocation to MNRE for exploring areas such as offshore, hydrogen and storage will be crucial for India to achieve its ambition of 450 GW of renewable energy by 2030.

What is your assessment of the health of the RE sector at present?

The RE sector has remained relatively insulated by the COVID-19 shock; government policies such as the classifying power as an essential service and 'must-run' status to renewables has helped the sector stay afloat. The recent liquidity infusion by the Central government into the sector, through a special scheme for distribution companies has also brought about much needed relief. However, longer term measures including privatisation of distribution companies to improve the sector's health, are absolutely necessary now. The finances of distribution companies have been badly hit by COVID-19 triggered lockdowns across the country and further

assistance by the central government may be needed to ensure that the sector is able to tide over these challenging times.

Energy demand improvement slows down in Nov: India Ratings

This was due to the early onset of winters impacting demand from the northern region

December 30, 2020

Mumbai: The all-India energy demand increased year-on-year for the third consecutive month in November after declining over March to August although the improvement slowed down to 3.7 per cent to 97.9 billion units, India Ratings and Research (Ind-Ra) said on Wednesday.

This was due to the early onset of winters impacting demand from the northern region. Even though the energy demand has been recovering, the demand over April to November came in 5 per cent year-on-year lower.

Electricity generation (excluding renewables) increased 1.9 per cent to 95.3 billion units in November owing to 4.1 per cent growth in thermal generation, although hydro generation was lower 17 per cent.

OPINION: Global trends in Sustainability and ESG compliance

Technology will continue to assume a significant part in assessing material issues, assessing risks and opportunities, and streamlining Sustainability/ESG data to publish report (ESG Environmental Social and Governance)

December 30, 2020,

New Delhi: As 2020 began, the pandemic amplified gaps in companies' ESG practices, forcing them to rethink their materiality, imparting a powerful lesson on how risks can become reality seemingly overnight. Materiality, as it is imagined and utilized today, is essential in giving a static image of the potential risks but it can't quite capture the rapidly moving outer situations where what isn't material today can become material tomorrow. As

we move out of the restriction posed by the Covid-19 crisis, many companies look to systemize how they will address the risks and opportunities through the concept of dynamic materiality which, talks about how ESG issues change over time and emerging issues shape how key stakeholders make decisions about a company. The methodology when equipped with technology enables companies to conduct stakeholder surveys more effectively and assess, manage, monitor and disclose risks with real-time insights and respond to stakeholder expectations.

The pandemic has stirred organizations to the financial realities of ESG risks (and opportunities). As the pandemic has presented, nothing occurs in separation. Just as investors utilize conventional financial information to assess business performance, they use ESG information to assess the sustainability setting of their ventures. ESG information to evaluate ecological issues like annual emissions, water stress level, or whether an organization has an emissions target. Under the social umbrella, it covers issues like diversity, gender equality, human rights, and labor issues while information on governance tracks matters like ethical practices, corruption, and gender diversity on board. Contingent upon the investment objectives, this information can educate different stages regarding the investment cycle, including resource allocation, security determination, portfolio development, and risk management. The extra layer of data can uncover material risks and openings that are otherwise neglected in investment decisions, assisting in identifying investments that may lead to enhanced risk-adjusted return and reduced downside risk. This year saw a surge in the development of AI, ML tools, and technologies to assess ESG risks and opportunities, which will continue and grow to become a norm in the future.

The pandemic not only reinforced the interest for ESG but also defied those who thought that sustainability targets would take a backseat in a crisis. 2020 saw the addition of China, Brazil, Austria, Switzerland in the list of countries committed to achieving a net zero carbon goal which will give rise to renewable energy and carbon

trading mechanisms. More than 230 companies set a call to action for net-zero emissions, in line with a 1.5°C future target between July 2019 and June 2020. The pandemic saw a major disruption in the most marginalized and vulnerable communities like extreme poverty, unemployment, deprivation of healthcare and vaccination services for children. The CSR community needs to take vigilance and act in response to the community needs while addressing the SDGs.

Delhi's clean power goal has a problem: Idled fossil fuel plants

The effort underscores how India's electricity sector continues to struggle with debt and overcapacity after a massive build-out of plants to power a surge in economic activity that never fully materialized

Bloomberg

December 30, 2020, 13:21 IST

New Delhi: India's capital city is seeking to shed its onerous contracts with fossil fuel power plants to reduce costs and free up funds for clean energy.

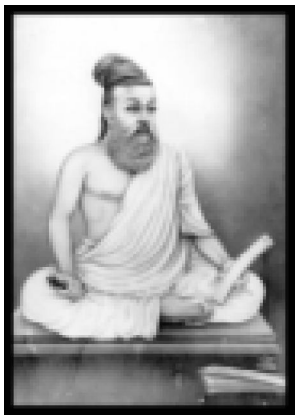
Tata Power Delhi Distribution Ltd., which retails electricity to customers in New Delhi, is in talks with Delhi's provincial government and the federal power ministry to get some of its contracted thermal power re-allocated to other states, Chief Executive Officer Ganesh Srinivasan said in a phone interview. It also plans to oppose any life time-extension plans for ageing plants it has contracted to buy electricity from, he said.

(To be continued)

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

"If I find the constitution being misused, I shall be the first to burn it."
– Dr. AMBEDKAR

TENETS FROM TIRUKKURAL TO SEEK WISDOM OF EXPERIENCE FROM THE WORTHY



It will be a good start for the New Year if we can absorb some of the valuable tenets contained in Tirukkural, as they are applicable for all in various walks and stages in life and at all times. The value is advise of wisdom to solve the problems that have set in and also the possible future ones.

Tiruvalluvar advocates that the close company with such wise ones would keep the foes away too.

"Utranoi Neekki Uraamai Murkakkum
Petriyarp Penik Kolal". Kural 442

உற்றநோய் நீக்கி உறாஅமை முற்காக்கும்
பெற்றியார்ப் பேணிக் கொளல். *குறள் 442*

Behold the men who can cure the evils that have already befallen thee and who can guard thee from future ones. Cultivate thou their friendship with ardour."

"Thakka Rinaththanayth Thanozuga Vallanaich
Cetrar Seyakkidandha Dhil". Kural 446

தக்கா ரினத்தனாய்த் தானொழுக வல்லானைச்
செற்றார் செயக்கிடந்த தில். *குறள் 446*

"Behold the men who can move with the worthy as their intimate; his foes will be powerless against him"

HOME FESTIVALS - 2

மாசி - Masi (February/March)

Above, this is the month of **Mahasivaratri**, *Siva's great night*. In the above painting four stories associated with the festival are told. At lower left a hunter has been cornered in a tree-top by wild beasts, where he must spend the night. To avoid sleep he plucks leaves from the bilva tree, sacred to Lord Siva, and drops them upon a sivalinga below-a traditional for of worship. Many undertake fasts and stay awake the whole night, praying to Lord Siva both at home and in temples (lower right).

The home observance of Karadainombu (upper right) derives from the story of Savitri and her husband, Satyavan. They enter a forest, where he dies. When Lord Yama, the God of Death, comes to take his life, Savithri persuades Yama to let him live. The intent of the observance is that wives not be separated from their husbands.

Another explanation of this festival (upper left) is that on this day Lord Siva tied a thread to parvati's right hand after their marriage as a sign of protection and fidelity.

(To be continued)

Look deep into nature, and then you will understand everything better.
– ALBERT EINSTEIN

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE

S.D. POONGUNDRAN
PRESIDENT

P. SUYAMBU
SECRETARY

M. BALAMURUGAN
TREASURER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நல்வாழ்த்துக்கள்
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